ENVIRONMENTAL IMPACT STATEMENT

The Sea Lion Field
Northern Development Area, Phase 1 & 2

July 2025



Environmental Impact Statement: The Sea Lion Field Northern Development Area, Phase 1 & 2

Navitas Petroleum Development and Production Limited.

Project	Area	Discipline	Doc Type	Doc. Number	Sheet
SLN	REG	ENV	RPT	00001	00

Acknowledgements

Thanks are extended to the Falkland Islands Government, particularly to the following personnel: Andrea Clausen, James Wilson, Chris Moorey, Nomali Port, Steuart Barlow, Francis J Hart, Dani Baigorri, Robert King, Hayden Eldridge, Rebecca Piontek, Debbie Barlow, Maeve Daly-Llamosa, Roddy Cordeiro, Zac Stephenson, James Greenland. Thanks are also extended to: Laura Yon (Stanley Services), Craig Paice (Atlink Limited) and SAERI staff who provided additional data used in the assessment.

Thanks go to the Joint Nature Conservation Committee and Falklands Conservation allowing access to the Seabirds at-Sea Team survey dataset in previous Sea Lion EIAs. These data are presented again here but no re-analyses were conducted for this current EIS submission. The original project was sponsored by Falklands Conservation with funding coming from Falkland Islands Government and FOSA (Falklands Offshore Sharing Agreement) in the first year.

This document has been prepared by SAERI (Falklands) Ltd. SAERI is the South Atlantic Environmental Research Institute.

TABLE OF CONTENTS

1 NON-TECHNICAL SUMMARY 26
1.1 Introduction 28
1.2 The Sea Lion Field 29
1.3 EIA Context 31
1.4 Consideration of alternatives 33
1.5 The Sea Lion Field Northern Area Phase 1 & 2 - Development description 35
1.6 Scoping consultation 39
1.7 Environmental and social baseline description 40
1.8 Environmental and social impact and risk assessment 46
1.9 Environmental Monitoring and Management 70
1.10 Overall conclusion 74
1.11 Formal stakeholder consultation 75
2 INTRODUCTION 76
2.1 Introduction 77
2.2 Overview of the Sea Lion Field Development 78
2.3 EIA process overview 85
2.4 Scope of the EIA 85
2.5 Purpose and structure of this Environmental Impact Statement 86
3 EIA CONTEXT 90
3.1 Regulatory overview and legislation 92
3.2 Navitas Operating Management System 103
4 CONSIDERATION OF ALTERNATIVES 117
4.1 Introduction 118
4.2 Project development process 118
4.3 Historical consideration of alternatives 118
4.4 Development optimisation by Navitas 127
4.5 Mitigations not used 130
5 SEA LION FIELD, PHASE 1 & 2 DEVELOPMENT DESCRIPTION 132
5.1 Introduction 136
5.2 Project overview 136
5.3 Sea Lion reservoir characteristics 145
5.4 Phase 1 & 2 Drilling operations 145
5.5 Construction: Installation of drilling, production and export facilities 163
5.6 FPSO Hook-up and commissioning 172
5.7 Simultaneous Operations (SIMOPS): drilling and production 172
5.8 Production facilities 173
5.9 Steady state production 191
5.10 Oil export process and facilities 193
5.11 Logistics and infrastructure 196
5.12 Decommissioning 222

5.13 Development resilience to the effects of climate change 224
5.14 Phase 1 & 2 base-case mitigation technologies 225
5.15 Estimated quantities of residues and emissions resulting from the project 228
6 SCOPING AND STATUTORY CONSULTATIONS 230
6.1 Introduction 231
6.2 Historical scoping and statutory consultations 236
6.3 Navitas informal scoping consultation 2023 242
6.4 Summary of all informal scoping consultation outcomes 242
6.5 Navitas statutory 42-day public consultation 247
7 ENVIRONMENTAL AND SOCIAL BASELINE 248
7.1 Introduction 256
7.2 Data Sources 259
7.3 Physical Environment 267
7.4 Biological Environment 307
7.5 Conservation Designations for sites, species and habitats 484
7.6 Coastal Sensitivity to Oil Spills 499
7.7 Social Environment 506
7.8 Summary of Key Environmental and Social Sensitivities 550
8 ENVIRONMENTAL IMPACT AND RISK ASSESSMENT METHODOLOGY 554
8.1 Introduction 555
8.2 Overview of the environmental impact and risk assessment process 555
8.3 Aspect, impact and risk identification 556
8.4 Environmental baseline and receptor identification 558
8.5 Impact assessment methodology for planned events 558
8.6 Risk assessment methodology for unplanned and accidental events 568
8.7 Impact and risk mitigation 571
8.8 Residual assessments 572
8.9 Cumulative impact assessment and impact interactions 573
8.10 Confidence in the assessment 575
8.11 Offsetting of impacts 576
9 ENVIRONMENTAL IMPACT AND RISK IDENTIFICATION AND SCREENING 581
9.1 ENVIID workshop 582
9.2 ENVIID outcomes - preliminary impact assessment and screening 586
10 ENVIRONMENTAL IMPACT AND RISK ASSESSMENT 612
10.1 Artificial light 613
10.2 Onshore disturbance to wildlife from helicopter use 646
10.3 Disturbance to seabed 659
10.4 Underwater noise - Offshore 682
10.5 Underwater noise inshore 721
10.6 Discharge of drilling fluid and cuttings 740
10.7 Operational Discharges 773

10.8 Thermal discharges 817
10.9 Atmospheric emissions 829
10.10 Waste Generation and Management 888
10.11 Collision / entanglement between cetaceans, vessels and moorings 920
10.12 Introduction of marine non-native species 939
10.13 Introduction of terrestrial non-native species 964
11 SOCIAL IMPACT AND RISK ASSESSMENT 975
11.1 Other Users of the Sea - Offshore 976
11.2 Other users of the sea – Inshore 994
11.3 Competition for resources – Accommodation 1016
11.4 Competition for resources – Freshwater 1028
11.5 Competition for resources – Electricity 1047
11.6 Competition for resources – Air links 1059
11.7 Competition for resources – Road networks 1065
11.8 Disturbance to human population - Light 1085
11.9 Disturbance to human population – Helicopters and Noise 1096
12 ACCIDENTAL AND CHRONIC OIL POLLUTION IMPACT AND RISK ASSESSMENT 1120
12.1 Accidental and chronic oil pollution offshore 1121
12.2 Inshore fuel oil spill 1234
12.3 At-shore and onshore fuel oil and chemical spills 1266
13 CUMULATIVE IMPACTS AND IMPACT INTERACTIONS 1284
13.1 Introduction 1285
13.2 Cumulative impacts 1285
13.3 Indication of impact interactions 1286
14 SUMMARY OF EIS FINDINGS 1289
14.1 Introduction 1289
15 OUTLINE ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN 1312
15.1 Introduction 1313
15.2 EMMP Workshop 1313
15.3 EMMP Scope 1314
15.4 Legislative and corporate monitoring 1318
15.5 Governance 1327
15.6 Baseline data and survey work 1327
15.7 Research and studies 1337
16 FINAL REVIEW AND CONCLUSION 1341
16.1 Introduction 1342
16.2 Significant impacts and risks of planned activities and unplanned events 1342
16.3 Significant risks associated with accidental events 1343
16.4 Overall conclusion 1344
17 POST-SUBMISSION CONSULTATION OUTCOMES 1345
18 ABBREVIATIONS 1739

19 GLOSSARY 1746
20 REFERENCES 1751
APPENDIX 1 INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE (IUCN) THREAT CATEGORIES 1808
APPENDIX 2 COMPLIANCE EVALUATION AGAINST SCHEDULE 4 1813
APPENDIX 3 STATUTORY CONSULTATION REPRESENTATIONS AND RESPONSES 1828
APPENDIX 4 INVENTORY OF BASELINE DATA COLLECTION 2034

TABLE OF FIGURES

Figure 1-1: North Falklands Basin Licence Block Locations 31
Figure 1-2: Showing the FPSO and the Phase 1 & 2 Development Field layout 36
Figure 1-3: Project activities and the identification of environmental aspects and the receptors, upon which they may impact 49
Figure 1-4: Illustration of the impact assessment for planned events and the risk assessment for unplanned and accidental events 50
Figure 1-5: Illustrating the difference between the initial and residual impact and risk assessment outcomes. 53
Figure 2-1: Sea Lion Field and Licence Block Locations 80
Figure 2-2: The Sea Lion Field Northern Development Area Phase 1 & 2 field configuration (illustrative only) 82
Figure 3-3: Navitas Health Safety and Security Policy 104
Figure 3-4: Navitas Environment & Biodiversity Policy 105
Figure 3-5: Showing the inter-connectivity of the Operating Management System's expectations 106
Figure 3-6: Well construction project delivery lifecycle 109
Figure 4-1: Types of offshore exploration and production facilities. 122
Figure 5-1: The Sea Lion Field Northern Development Area Phase 1 & 2 field configuration (illustrative only) 141
Figure 5-2: The Sea Lion Northern Development Area Phase 1 & 2 plan of development layout 142
Figure 5-3: Photograph of a typical anchored semi-submersible drilling rig (the Ocean Valiant) 147
Figure 5-4: Typical Thermomechanical cuttings cleaner used to treat NADF coated drill cuttings 156
Figure 5-5: Indicative positioning of LTVs in Berkeley Sound during the installation period. 164
Figure 5-6: An illustration of the Sea Lion FPSO 171
Figure 5-7: FPSO schematic showing the disconnectable turret and offloading tanker 172
Figure 5-8: P50 Production forecast for the Sea Lion Field Northern Area Phase 1 & 2 Development. 176
Figure 5-9: Block flow diagram of the FPSO separation and stabilisation processing facilities 187
Figure 5-10: Photograph of the existing Temporary Dock Facility with a PSV alongside 197
Figure 5-11: Forecast estimates of freshwater demand for Phase 1 & 2 drilling requirements 218
Figure 7-1: Phase 1 & 2 Development drill centre and Licence Block Locations 257
Figure 7-2: The location of Berkeley Sound within the Falkland Islands archipelago 258
Figure 7-3: The location of settlements and place names mentioned in the text within Berkeley Sound 259
Figure 7-4: Summary of environmental survey locations on the Falklands Continental Shelf 261
Figure 7-5: Environmental survey locations in the North Falkland Basin and vicinity of the Phase 1 & 2 Development drill centre 262
Figure 7-6: Environmental survey information in the vicinity of the Phase 1 & 2 Development drill centre 263
Figure 7-7: Atmospheric structure 269
Figure 7-8: Atmospheric composition 270
Figure 7-9: The average of mean hourly wind speeds at 10m above ground (dark gray line), with 25th to 75th and 10th to 90th percentile bands 272
Figure 7-10: The percentage of hours in which the mean wind direction is from each of the four cardinal wind directions, excluding hours in which the mean wind speed is less than 0.4 m/s 272
Figure 7-11: The daily average high (red line) and low (blue line) temperature, with 25th to 75th and 10th to 90th percentile bands 273
Figure 7-12: The average rainfall (solid line) accumulated over the course of a sliding 31-day period centered on the day in question, with 25th to 75th and 10th to 90th percentile bands 273

Figure 7-13: Main Patagonian Shelf oceanographic features overlain on Sea Surface Temperature map, March 2008 276
Figure 7-14: Seabed topography in the Sea Lion Field and surrounding area 279
Figure 7-15: Locations of bathymetry and environmental sampling sites within the Inner Sound, the western extent of Berkeley Sound 280
Figure 7-16: Locations of bathymetry and environmental sampling sites within the Outer Sound, the eastern extent of Berkeley Sound, showing the proposed anchorages for LTVs and exclusion zones 281
Figure 7-17: Ocean currents field obtained from the hydrodynamic modelling 283
Figure 7-18: Snapshot of TUFLOW FV 2km currents grid 284
Figure 7-19: Snapshot of TUFLOW FV 500m currents grid 285
Figure 7-20: Distribution of surface currents at Sea Lion 285
Figure 7-21: Distribution of seabed currents at Sea Lion 286
Figure 7-22: Snapshot of combined WRF and CFSR wind field grids 287
Figure 7-23: Snapshot of wind field produced by the WRF model 288
Figure 7-24: Distribution of winds at Sea Lion 289
Figure 7-25: Bathymetry data used in the modelling 290
Figure 7-26: Mean particle size (mm) recorded at each of the 46 sites sampled 296
Figure 7-27: The position of the 46 stations sampled within Berkeley Sound within the Folk triangle 296
Figure 7-28: Percentage of sand recorded at each of the 46 sites sampled 297
Figure 7-29: Percentage of fines recorded at each of the 46 sites sampled 297
Figure 7-30: Percentage of gravel recorded at each of the 46 sites sampled 298
Figure 7-31: Total Organic Carbon (TOC) recorded at each of the 46 sites sampled 299
Figure 7-32: Total Hydrocarbon Concentrations (THC) recorded at each of the 46 sites sampled 300
Figure 7-33: Total saturate alkanes recorded at each of the 46 sites sampled 301
Figure 7-34: Total Polycyclic Aromatic Hydrocarbons (PAH; 2-6 Ring) recorded at sites sampled 302
Figure 7-35: Example of Chlorophyll-a concentrations in the south-west Atlantic 308
Figure 7-36: Kelp coverage around the East Falkland coastline 314
Figure 7-37: Map showing the distribution of giant kelp (*Macrocystis pyrifera*) in Berkeley Sound 314
Figure 7-38: Number of VME indicator taxa predicted to be present in the Sea Lion field, licence area, and production area 318
Figure 7-39: Distribution of SMSG dive survey sites across the Falklands archipelago 323
Figure 7-40: Satellite image of Berkeley Sound showing the extent of the three separate images 325
Figure 7-41: Shallow marine and intertidal habitat map for Berkeley Sound 329
Figure 7-42: Sites and substrate classes recorded at Magellan Cove 331
Figure 7-43: Inter-tidal and shallow marine habitats mapped at Magellan Cove 332
Figure 7-44: Habitats mapped within the inner Berkeley Sound 333
Figure 7-45: Habitats mapped in the outer Berkeley Sound, showing the proposed LTV anchorage and exclusion zones 334
Figure 7-46: Example of progress in colonisation and growth of organisms on settlement plate over time (TDF site, May 2016 – Jan 2017) 341
Figure 7-47: Map delineating habitat zones within Falkland Islands waters. Rectangle illustrates the area of rough ground and corals 345
Figure 7-48: Combined data, from both satellite (PTT) and GPS tags, spanning over 20 years and for ten species – includes data collected during DPLUS139 366
Figure 7-49: Panel A = locations of the 21 tracked breeding colonies (blue dots) and untracked colonies (green dots). Panel B = important areas identified by overlap of 50 % utilisation distributions, derived from the tracking data presented in Table 7.16 370

Figure 7-50: Penguin telemetry data, by species and where available, season or breeding stage. The pink dot represents the drill centre....371
Figure 7-51: Flying seabird telemetry data, by species and where available, breeding stage. The pink dot represents the drill centre....372
Figure 7-52: Pinniped telemetry data, by species and where available, sex and season. The pink dot represents the drill centre....373
Figure 7-53: An overview of the GAP data....374
Figure 7-54: Black-browed albatross predicted habitat use (predicted presence) for birds breeding on the Falklands from the available biotelemetry and biologging data (A = chick rearing, B = incubation)....376
Figure 7-55: Sooty shearwater predicted habitat use (predicted presence) for birds breeding on Kidney Island from the available biotelemetry and biologging data. Adapted from Baylis, *et al.* (2019). The pink dot represents the drill centre....378
Figure 7-56: Magellanic penguin, predicted habitat use (predicted presence) for birds breeding on the Falklands from the available biotelemetry and biologging data....380
Figure 7-57: Rockhopper penguins, predicted habitat use (predicted presence) for birds breeding on the Falklands from the available biotelemetry and biologging data (A = Chick rearing, B = Incubation)....382
Figure 7-58: King penguin, predicted habitat use (predicted presence) for birds breeding at Volunteer Point from the available biotelemetry and biologging data....384
Figure 7-59: The locations of 25 gentoo penguins tracked during the winter and early summer from five locations. Utilisation distributions show areas where penguins spent most (>50 %) of their time....385
Figure 7-60: Distribution of coastal bird survey effort achieved in each season....393
Figure 7-61: The distribution of all bird records in each season....394
Figure 7-62: Total survey effort achieved during JNCC surveys in coastal waters near Berkeley Sound, each point represents a 10-minute observation period (or approximately three km of survey track)....396
Figure 7-63: Locations of penguin colonies within Berkeley Sound....398
Figure 7-64: Distribution of rockhopper penguins recorded during coastal bird surveys....401
Figure 7-65: Distribution of rock shags recorded in each season....402
Figure 7-66: The distribution of all imperial shag recorded in each season....403
Figure 7-67: The distribution of all Falkland steamer duck records in each season....404
Figure 7-68: The distribution of all Magellanic penguin records in the vicinity of Berkeley Sound....405
Figure 7-69: The distribution of all black-browed albatross records in the vicinity of Berkeley Sound....407
Figure 7-70: The distribution of sooty shearwater records in the vicinity of Berkeley Sound (held on the SAST database)....409
Figure 7-71: The Stanley Harbour coastline showing the coastal bird survey transects....418
Figure 7-72: Annual estimates of seabird bycatch in the Falkland Islands trawl fishery....422
Figure 7-73: Seabird Vulnerability Maps for summer months; December (left), January (centre) and February (right) (the red star indicates the location of the Sea Lion Development)....426
Figure 7-74: Seabird Vulnerability Maps for autumn months; March (left), April (centre) and May (right) (the red star indicates the location of the Sea Lion Development)....427
Figure 7-75: Seabird Vulnerability Maps for winter months; June (left), July (centre) and August (right) (the red star indicates the location of the Sea Lion Development)....428
Figure 7-76: Seabird Vulnerability Maps for spring months; September (left), October (centre) and November (right) (the red star indicates the location of the Sea Lion Development)....429

Figure 7-77: Total survey effort achieved during JNCC surveys between February 1998 and January 2001 433
Figure 7-78: Relative incidence of marine mammal sightings, by species, adjusted for monthly survey effort. Note that this is based on percentages of sightings for each month 433
Figure 7-79: Fin whale call detections 435
Figure 7-80: Killer whale call detections 435
Figure 7-81: Pilot whale call detections 436
Figure 7-82: Southern right whale call detections 436
Figure 7-83: Sperm whale call detections 437
Figure 7-84: Unidentified odontocete (toothed whale) call detections 437
Figure 7-85: Peale's dolphin distribution recorded during JNCC surveys, all months 443
Figure 7-86: Hourglass dolphin distribution recorded during JNCC surveys, all months 444
Figure 7-87: South American sea lion, predicted habitat use (predicted presence) for sea lions breeding on the Falklands from the available biotelemetry and biologging data 445
Figure 7-88: South American fur seal, predicted habitat use for breeding on the Falklands from the available biotelemetry and biologging data. A = winter and B = spring 446
Figure 7-89: Southern elephant seal, predicted habitat use for breeding on the Falklands from the available biotelemetry and biologging data. 447
Figure 7-90: The distribution of southern right whale records during the winter 2017 survey 454
Figure 7-91: Distribution of anecdotal large cetacean records around the Falkland Islands 456
Figure 7-92: The spatial distribution of cetacean sightings recorded during boat-based surveys in Berkeley Sound (A) sei whale; (B) other baleen whales; (C) Peale's dolphin and (D) Commerson's dolphin 459
Figure 7-93: Predictive models for sei whales, depicting the probability of occurrence and density – both highlighting the potential importance of nearshore waters to sei whales. Upper panel is modelled using a MaxEnt model (Maximum Entropy). Lower panel is the combined Generalised Additive Model (GAM) and a MaxEnt model. Note the difference in scale (relative density and probability) between the upper and lower panel 460
Figure 7-94: Recent cetacean survey efforts by SAERI and Falklands Conservation between 2016-2018 have rarely ventured beyond 5 km from the Falkland Islands coastline. Also shown are proposed Marine Manage Areas 461
Figure 7-95: Sei whale hotspots derived from 350 opportunistic observations collated between 2010 and 2015. Also shown is the Sei whale KBA 462
Figure 7-96: Map of the inshore waters of the Falkland Islands showing the positions of aerial survey transects 463
Figure 7-97: Locations of Commerson's (red triangles) and Peale's dolphin (blue squares) recorded during aerial surveys from March to May 2017 463
Figure 7-98: Locations of baleen whales sighted from March to May 2017 464
Figure 7-99: Survey effort and dolphin sightings between 21st November and 22nd December 2016, in the three focal areas; A, Port William and Berkeley Sound; B, Choiseul Sound and Bertha's Beach; C. Port Howard and many Branch Harbour 465
Figure 7-100: The location and number of tissue samples collected from Commerson's and Peale's dolphins for genetic analysis 466
Figure 7-101: The distribution of all cetacean records in the waters adjacent to Berkeley Sound from SAST JNCC data 468
Figure 7-102: Commerson's dolphin distribution recorded during JNCC surveys, all months 472
Figure 7-103: Sea Lion and fur seal colonies in Berkeley Sound 474
Figure 7-104: Terrestrial habitat mapping: Magellan Cove 480
Figure 7-105: Terrestrial habitat map for Berkeley Sound 481

Figure 7-106: Terrain model data coloured to show low-lying land liable to marine inundation.....483
Figure 7-107: The Falkland Islands Conservation Zones showing permanent and seasonal no-take zones 487
Figure 7-108: Falkland Islands National Nature Reserves and Important Plant Areas.....491
Figure 7-109: The location of currently proposed Marine Managed Areas (MMAs). MMAs include proposed Sustainable Multi-use Zones (SMZ) and National Marine Nature Reserves. Also shown are the non-statutory marine Key Biodiversity Areas (KBA). 492
Figure 7-110: Current Important Bird Areas (IBAs) and Ramsar Sites (Bertha's Beach and Sea Lion Island) around the Falkland Islands.....494
Figure 7-111: ESI North Falklands Coastline. Coastal sensitivity categorised by Environmental Sensitivity Index habitat types 1-10 501
Figure 7-112: North Falklands Coastline. Environmental Sensitivity Mapping (ESI) categorised as Low (ESI 1-3), Moderate (ESI 4-7) and High (ESI 8-10) vulnerability to offshore oil spill 502
Figure 7-113: ESI Berkeley Sound. Coastal sensitivity categorised by Environmental Sensitivity Index habitat types 1-10 505
Figure 7-114: Prominent geographic features, major settlements and roads within the Falkland Islands.....508
Figure 7-115: Farms with land bordering Berkeley Sound 509
Figure 7-116: Fisheries squares and licences in the Sea Lion Field area 514
Figure 7-117: *Loligo* catch statistics from 2022.....515
Figure 7-118: Positions of vessels within Berkeley Sound, May 2014 to May 2015 517
Figure 7-119: Vessel traffic in Berkeley Sound 2014-2022.....517
Figure 7-120: FIPASS.....519
Figure 7-121: Road map of the Falkland Islands, indicating road class 525
Figure 7-122: The Stanley filtration and water supply system with the limiting capacity of each stage 531
Figure 7-123: Total number of cruise ship visitors per season, from 1995/96 to 2022/2023.....537
Figure 7-124: Location of noise monitoring points in Stanley.....538
Figure 7-125: Frequency profile for Liberty Lodge sound level measurement 541
Figure 7-126: Time sequence of noise measurements at Liberty Lodge (1-minute intervals) 541
Figure 7-127: Sound pressure levels recorded at Long Island Farm on 21st - 22nd February 2017 ...545
Figure 7-128: Known shipwrecks within the Falklands Continental Shelf.....547
Figure 7-129: The location of wreck sites within Berkeley Sound.....548
Figure 7-130: Photograph of large man-made object found on the floor of Berkeley Sound.....549
Figure 8-1: Overview of EIA process.....557
Figure 8-2: Illustrating cumulative impacts and impact interaction on an environmental receptor ..574
Figure 10-1: Photographs of representative offshore lighting arrangements 618
Figure 10-2: Navigational lighting requirements for a vessel over 50 m in length.....621
Figure 10-3: Example of an educational poster for the management of birds on deck.....637
Figure 10-4: Jigging vessel fishing at-sea in Falkland Islands waters.....641
Figure 10-5: The distribution of anthropogenic light in the south-west Atlantic, 2007 641
Figure 10-6: The distribution of anthropogenic light in the region of Berkeley Sound, 2007 642
Figure 10.7: The distribution of sensitive wildlife receptors and settlements in relation to the most direct helicopter flightpaths.....654
Figure 10-8: Example of marine growth on seabed boulder in the Isobel Deep area of the NFB.....666
Figure 10-9: Layout of long-term FPSO anchors.....670
Figure 10-10: Sinusoidal wave showing changes in pressure over time, illustrating measurement parameters for Peak pressure (PK) and Root Mean Squared (rms) pressure 688

Figure 10-11: Audiograms covering a range of fish and marine mammal hearing groups and humans (underwater) 691
Figure 10-12: Vessel frequency spectrums used in noise modelling for Scenarios 1, 2 and 3 703
Figure 10-13: Maximum rms SPL received by fish in Scenario 3 706
Figure 10-14: Predicted cumulative SEL received by VHF cetaceans during Scenario 1 over 24 hours; marine mammals are assumed to remain stationary..... 708
Figure 10-15: Predicted cumulative SEL received by VHF cetaceans during Scenario 3 over 24 hours; marine mammals are assumed to remain stationary..... 708
Figure 10-16: Predicted unweighted rms SPL received by marine mammals during Scenario 1. 711
Figure 10-17: Predicted unweighted rms SPL received by marine mammals during Scenario 2. 712
Figure 10-18: Predicted unweighted rms SPL received by marine mammals during Scenario 3. 712
Figure 10-19: Vessel frequency spectrums used in noise modelling for Scenario 1 and 2..... 726
Figure 10-20: Predicted cumulative SEL received by LF cetaceans during Scenario 1 over 24 hours. 728
Figure 10-21: Predicted unweighted rms SPL received by marine mammals during Scenario 1. 731
Figure 10-22: Predicted unweighted rms SPL received by marine mammals during Scenario 2. 732
Figure 10-23: Vessel frequency spectrums used in noise modelling for Scenario 3 736
Figure 10-24: Predicted unweighted rms SPL received by marine mammals during Scenario 3. 736
Figure 10-25: Modelled production, WI and GI DCs..... 754
Figure 10-26: Modelled drill cuttings deposition at well locations at end of drilling. Note: the colour legend applies to both figures..... 759
Figure 10-27: NA-P-01 drill centre modelled drill cuttings deposition thickness profiles 760
Figure 10-28: Contribution to risk to the 2.5 km^2 of affected at the end of drilling..... 761
Figure 10-29: Total environmental risk to the sediment at the NA-P-01 DC at end of drilling and 20 years after drilling 762
Figure 10-30: Predicted instantaneous risk to the water column 764
Figure 10-31: The locations of existing (abandoned) wells within 2.5 km of the Drill Centre..... 769
Figure 10-32: Maximum EIF (yellow equals 1 - 5 % risk) at any point over the model duration showing the composite risk during early and late Field Life..... 805
Figure 10-33: Instantaneous EIF for early and late Field Life cases at time of maximum EIF (yellow equals 1 - 5 % risk)..... 806
Figure 10-34: Daily EIFs over model duration 807
Figure 10-35: Contribution of the main components to the EIF value (late life case) 808
Figure 10-36: The mean number of fishing vessels operating within Falkland Islands waters on a weekly basis throughout 2023 814
Figure 10-37: Graphs of maximum temperature difference from ambient seawater for both PW and CW discharges in early and late Field Life 824
Figure 10-38: Plots of temperature differences (°C) from ambient seawater for both PW and CW discharges in early and late Field Life..... 825
Figure 10-39: Total UKCS emissions 851
Figure 10-40: Showing the decline in production over field life for the P10 – P90 production profiles. 860
Figure 10-41: Showing the 'worst-case' and 'currently expected' emission profiles over field life. ... 867
Figure 10-42. Indicating the worst-case carbon intensity, per annum, for the lower production rate (P90, 242.3 MMstb)..... 874
Figure 10-43. Indicating the worst-case carbon intensity, per annum, for the medium (and expected) production rate (P50, 310.5 MMstb). 874
Figure 10-44. Indicating the worst-case carbon intensity, per annum, for the upper production rate (P10, 336.7 MMstb)..... 875
Figure 10-45: Waste Hierarchy..... 891

Figure 10-46: Phase 1 & 2 Development wastes managed onshore split by activity generating the waste 908
Figure 10-47: Phase 1 & 2 Development wastes managed onshore split by endpoint 908
Figure 10-48: Example of an educational poster for placement around the MODU and FPSO 912
Figure 10-49: Images of lethal and sub-lethal injuries to baleen whales following vessel collisions ..924
Figure 10-50: Probability of a lethal injury resulting from a vessel strike to a large whale as a function of vessel speed 928
Figure 10-51: Proportion (out of one (1)) of collisions that were successfully avoided as a proportion of the total that would have occurred if no avoidance action was taken 928
Figure 10-52: Distribution of vessel activity between June 2014 and June 2015 929
Figure 10-53. Example of educational poster on whale strikes 934
Figure 10-54: Biofouling on a settlement plate used to monitor for non-native species; note the presence of the invasive vase tunicate (*Ciona intestinalis*), transparent balloon like organisms 947
Figure 10-55: Regions on a ship that may remain fouled following mechanical cleaning 947
Figure 10-56: Parchment worms (*Chaetopterus variopedatus*) smothering native species 950
Figure 10-57: Distribution map of the parchment tubeworm 950
Figure 11-1: Offshore exclusion zones associated with the Sea Lion Development 980
Figure 11-2: Overview of AIS shipping data for the Sea Lion Location (2022-23) 986
Figure 11-3: Averaged shipping routes and vessel shipping density within 15 nautical miles of the Sea Lion FPSO (see Table 11.4 for detail on the shipping type associated with each route number) 987
Figure 11-4: Indicative locations of LTVs and associated exclusion zones (three potential locations shown, maximum two LTVs anchored at any one time) 999
Figure 11-5: Monthly vessel traffic in Berkeley Sound 2014 - 2022 1004
Figure 11-6: The extent of the exclusion zones associated with the anticipated LTV site in relation to the position of all vessels (from AIS) between May 2014 and May 2015 (a particularly busy year) 1008
Figure 11-7: Average daily water consumption (m^3/day) in Stanley by year from 1995 to 2023 1034
Figure 11-8: Key elements of road transport required 1071
Figure 11-9: Location of noise monitoring points in Stanley. Note: 'This Survey' refers to the 2016 survey carried out by POEPL 1102
Figure 11-10: The distribution of sensitive wildlife receptors and settlements in relation to the most direct helicopter flightpaths. Note: the arrows heading out to sea ultimately converge at the Sea Lion Field 220 km offshore. 1106
Figure 11-11: Received noise levels at a height of 1.5 m above ground from vessels operating around the proposed LTV Anchorage 1111
Figure 12-1: Examples of testing images from tests on seaweed, shoreline and feathers 1136
Figure 12-2: Behaviour and fate of oil in the marine environment 1137
Figure 12-3: Behaviour of oil over time during the modelled blow-out 1157
Figure 12-4: Probability of surface contamination above threshold of 1 g/m^2 for worst-case well blow-out scenario 1159
Figure 12-5: Minimum arrival times of Sea Lion crude above 1 g/m^2 on the surface 1159
Figure 12-6: Maximum time surface is exposed to Sea Lion crude above 1 g/m^2 1160
Figure 12-7: Probability of Surface Oiling at Differing Oil Densities for Subsea Blow-out (stochastic). Note: No results are reported for 1,000 g/m^2 1161
Figure 12-8: Surface results (deterministic) for worst-case well blow-out 1162
Figure 12-9: Probability of water column concentrations of >25 ppb in a worst-case blow-out 1163
Figure 12-10: Water column maximum exposure time >25 ppb 1164

Figure 12-11: Cumulative water column concentrations from a worst-case blow-out....1165
Figure 12-12: Probability of shoreline oiling for the model runs where oil does reach the shore, for a worst-case blow-out....1166
Figure 12-13: Minimum arrival times for shoreline oiling for a worst-case blow-out....1167
Figure 12-14: Concentration of oiling on the shoreline for a worst-case blow-out (deterministic)..1167
Figure 12-15: Forecast of oil arriving onshore in a worst-case blow-out scenario 1168
Figure 12-16: Mass of oil recovered by modelled response units....1170
Figure 12-17: Predicted overall behaviour of Sea Lion crude oil after FPSO inventory loss 1171
Figure 12-18: Probability of surface contamination above threshold of 1 g/m^2 following FPSO inventory loss 1172
Figure 12-19: Minimum arrival times of Sea Lion crude above 1 g/m^2 on the surface following FPSO inventory loss 1173
Figure 12-20: Maximum time surface is exposed to Sea Lion crude above 1 g/m^2 following FPSO inventory loss 1173
Figure 12-21: Probability of Surface Oiling at Differing Oil Densities following FPSO inventory loss1174
Figure 12-22: Surface results (deterministic) for FPSO inventory loss (at 30 days) 1175
Figure 12-23: Probability of water column contamination above threshold of 25 ppb (stochastic) for FPSO inventory loss 1177
Figure 12-24: Maximum time water column is exposed above threshold of 25 ppb (stochastic) for FPSO inventory loss 1177
Figure 12-25: Cumulative water column concentrations from an FPSO inventory loss....1178
Figure 12-26: Probability of shoreline oiling for an FPSO inventory loss 1179
Figure 12-27: Minimum arrival times for shoreline oiling for an FPSO inventory loss....1180
Figure 12-28: Concentration of oiling on the shoreline for an FPSO inventory loss (deterministic).1180
Figure 12-29: Time evolution of oil on shoreline for FPSO inventory loss (deterministic)....1181
Figure 12-30: Comparison of shoreline oiling with and without oil spill response 1182
Figure 12-31: Mass of oil recovered offshore by modelled response units 1183
Figure 12-32: Predicted overall behaviour of Sea Lion crude oil after a crude transfer spill 1184
Figure 12-33: Surface results (stochastic) for crude transfer spill....1186
Figure 12-34: Total impacted surface area above threshold of 1 g/m^2 for single deterministic model run of crude oil transfer spill scenario....1187
Figure 12-35: Predicted overall behaviour of MGO after full inventory loss 1188
Figure 12-36: Surface results (stochastic) for MGO inventory loss 1189
Figure 12-37: Total impacted surface area above threshold of 0.3 µm for a single deterministic model run of the MGO inventory loss scenario 1190
Figure 12-38: Water column results (deterministic) for MGO inventory loss....1191
Figure 12-39: Predicted overall behaviour of MGO after a bunkering spill....1192
Figure 12-40: Surface results (stochastic) for MGO bunkering spills 1194
Figure 12-41: Total impacted surface area above threshold of 0.3 µm for the single deterministic model run of the worst-case MGO bunkering spill 1195
Figure 12-42: Number of oil spills and quantity of oil spilled in UKCS (2012 – 2022) 1211
Figure 12-43: UKCS Fraction of releases by oil type, 2022 1211
Figure 12-44: Proposed local shoreline classification 1A, reference location as the north coast of Kidney Island 1244
Figure 12-45: Probability of surface contamination and shoreline oiling – Scenario 1....1248
Figure 12-46: Probability of surface contamination and shoreline oiling – Scenario 2....1249
Figure 17-1: response from Byron Holdings Ltd. to Falklands Conservation....1738

TABLE OF TABLES

Table 1.1. Summary of the options considered for the Development basis of design....34
Table 1.2: Summary of the mitigations built-in to the Phase 1 & 2 Development basis of design 38
Table 1.3: Summary of key environmental sensitivities in the Phase 1 & 2 Development area 42
Table 1.4: Summary of key environmental sensitivities in Berkeley Sound 43
Table 1.5: Summary of key social sensitivities in the Phase 1 & 2 Development area....46
Table 1.6: A summary of the impacts and risks initially identified as being of Moderate significance or above and which were reduced following commitment to reasonably practical project-specific mitigations....54
Table 1.7: A summary of the residual impacts and risks that, while considered to be ALARP, remain significant 55
Table 1.8: Summary of the worst-case residual impacts / risks to each receptor for all The Sea Lion Northern Area Development, Phase 1 & 2 activities, and an indication of whether they were raised as a concern by stakeholders during informal scoping consultations 66
Table 1.9: Definitions of significance categories 69
Table 1.10: Summary of environmental monitoring and management commitments 72
Table 2.1: Impact and risk assessment chapter structure....87
Table 2.2: Summary of the assessment chapters and project activities are included within each....89
Table 3.1: Summary of PONs relevant to the Phase 1 & 2 Development 103
Table 3.2: Summary of Navitas OMS Elements 107
Table 4.1: Summary of the challenges associated with production and export of oil from the Sea Lion Field 119
Table 4.2: Comparison of the offshore production options identified during the 'Appraise' phase ..121
Table 4.3: Concept screening differentiators 123
Table 4.4: Six key areas that require management to successfully complete direct offtake 125
Table 4.5: Strengths and weaknesses of oil export *via* direct offtake in the Falkland Islands 127
Table 5.1: Overview of the activities associated with the four stages of the proposed Sea Lion Phase 1 & 2 Development 139
Table 5.2: Duration of Stages within the Sea Lion Field Northern Area Phase 1 & 2 Development ...143
Table 5.3: Indicative Sea Lion Field Northern Area Phase 1 & 2 Development timeline....144
Table 5.4: Sea Lion reservoir properties....145
Table 5.5: Sea Lion drill centre co-ordinates by Development phase 145
Table 5.6: Indicative drilling by MODU at the Sea Lion Field development 146
Table 5.7: Phase 1 & 2 Development well profiles....152
Table 5.8: Typical mud requirements and cuttings volume per well for Sea Lion wells 154
Table 5.9: Typical cement requirements per well 158
Table 5.10: Quantities of oil and gas produced during the contingent flow-back / tests of three oil wells to the MODU 161
Table 5.11: Quantities of oil and gas produced during the contingent flow-back / test of the GI (or contingent GI well) to the MODU....161
Table 5.12: SPS and SURF requirements for Sea Lion Phase 1 & 2 Development....167
Table 5.13: Co-ordinates of Production facilities 171
Table 5.14: Facility design rates 175
Table 5.15. Combustion equipment on the FPSO 176
Table 5.16. Power generation equipment on the FPSO 178
Table 5.17: Production chemical functional groups and hull chemical tank storage volumes 180
Table 5.18: Technical flow assurance strategy for continuous operation and interventions in the Sea Lion Development 182

Table 5.19: Stabilised oil specification 188
Table 5.20: Injection water treatment specifications 190
Table 5.21: Production and utility chemicals required during steady state production 192
Table 5.22: Potential supply base requirements for the Sea Lion Field Northern Area Phase 1 & 2 Development 199
Table 5.23: Indicative Tier 2 oil spill equipment / action for the Development Stages 203
Table 5.24: Summary of the worst-case vessel activity anticipated during the Phase 1 & 2 Development 208
Table 5.25: Sea Lion Development transportation of personnel and SARs 212
Table 5.26: Estimated maximum accommodation requirement for personnel required during the Phase 1 & 2 Development 216
Table 5.27: Estimated freshwater use by the Phase 1 & 2 Development 220
Table 5.28: Power demand of Phase 1 & 2 Development infrastructures 221
Table 5.29: Summary of the technologies and measures which are built-in to the Sea Lion Field Northern Area Phase 1 & 2 Development basis of design in order to reduce outputs 226
Table 5.30: Estimated quantities of residues and emissions resulting from Stages 1, 2 and 3 of the project 228
Table 6.1: Comparison between previous and the current Sea Lion O&G Development proposals 232
Table 6.2: Statutory stakeholders and Interested Parties consulted during scoping 233
Table 6.3: Summary of informal scoping consultation outcomes from 2014, 2015, 2016 and 2023 consultations 244
Table 7.1: Summary of Falkland Islands drilling and environmental survey activities 259
Table 7.2: Summary of heavy and trace metal concentrations in Berkeley Sound 304
Table 7.3: Summary of the offshore and inshore physical environment 304
Table 7.4: Conspicuous algae species found within Falkland Islands Waters 312
Table 7.5: Habitat descriptions for the Falkland Islands shallow marine environment found in Berkeley Sound 326
Table 7.6: The area and percentage cover of habitat types mapped in Berkeley Sound 328
Table 7.7: Look-up table linking fieldwork derived inter-tidal habitat classes and classes discernable in the remote sensing imagery 330
Table 7.8: Provides a summary of the offshore and inshore benthic environments 343
Table 7.9: Summary of seasonal abundance of fish species in the six FOCZ/FOCZ habitat zones, indicating abundance on the Northern Slope habitat zone 347
Table 7.10: Summary of offshore fish and invertebrate species around the Falkland Islands 352
Table 7.11: Summary of inshore fish and invertebrate species around the Falkland Islands 357
Table 7.12: Relative seasonal abundance of seabird species recorded in the vicinity of the Sea Lion Field during JNCC surveys 361
Table 7.13: Number of seabird sightings during the PL001 and NFB Surveys 363
Table 7.14: Summary of deployments from a recent multi-colony tracking project 365
Table 7.15: Colony location abbreviations used in the Table 7.16 and Figure 7-49 369
Table 7.16: Data derived from tags other than GLS tags, includes six seabird and three pinniped species 369
Table 7.17: Summary of offshore bird abundance, distribution, life-cycle and behavioural characteristics 386
Table 7.18: Summary of the number of individuals of each bird species recorded by season 394
Table 7.19: Relative seasonal abundance of seabirds recorded in the waters adjacent to and within Berkeley Sound during JNCC surveys 397
Table 7.20: The size of seabird colonies within Berkeley Sound 399
Table 7.21: Summary of king penguin foraging trips from Volunteer Point 406

Table 7.22: Sooty shearwater behaviour derived from geolocator tags 409
Table 7.23: Summary of inshore bird abundance, distribution, life-cycle and behavioural characteristics 412
Table 7.24: A summary of the results of the Stanley Harbour coastal bird survey 421
Table 7.25: Seabird mortalities based on Fisheries Statistics Bulletin methodology 421
Table 7.26: ACAP species that have been recorded within the waters of the Falkland Islands 423
Table 7.27: Summary of the number of AMAR detections in vicinity of Sea Lion Field from July 2012 to July 2013 438
Table 7.28: Summary of cetaceans in the NFB and Sea Lion Field 449
Table 7.29: Descriptions of visits and sightings categories 455
Table 7.30: Summary of cetacean sightings made during the Dolphins of the Kelp aerial survey 464
Table 7.31: Cetacean observations in waters adjacent to Berkeley Sound 468
Table 7.32: Summary of marine mammals found inshore around the Falkland Islands 475
Table 7.33: The area and percentage composition of terrestrial habitat types within 200 m of the Berkeley Sound shore 482
Table 7.34: National Nature Reserves in the Falkland Islands and Berkeley Sound in particular 489
Table 7.35: Confirmed Important Bird Areas for breeding sites in the Falkland Islands and Berkeley Sound in particular 493
Table 7.36: Kidney Island Group IBA criteria 495
Table 7.37: Volunteer Point IBA criteria 496
Table 7.38: Species and habitats of conservation concern and their action plan status 499
Table 7.39: Environmental Sensitivity Index definitions 500
Table 7.40: Location of population, excluding MPC 507
Table 7.41: Annual fishing catch by target species in the FICZ / FOCZ 511
Table 7.42: Total annual catch and effort in grid square XFAK 2013 – 2022 512
Table 7.43: Summary of size (length) of vessels using Berkeley Sound (May 2014 to May 2015) 516
Table 7.44: Vessels entering Stanley Harbour (during 2014, 2018, 2022 and 2023) 519
Table 7.45: Vessel visits to FIPASS (during 2014, 2018, 2022 and 2023) 521
Table 7.46: Road classification 525
Table 7.47: Summary of flights to and from the Falkland Islands 526
Table 7.48: The number and proportion of Stanley households owned outright, owned under mortgage, rented or provided rent free 528
Table 7.49: Electrical power use (kWh = one unit in domestic usage) over a ten year period (each period covering July - June) 534
Table 7.50: Summary of the measured noise data 539
Table 7.51: Measurement conditions for baseline sound measurement 540
Table 7.52: Summary of baseline sound levels at Liberty Lodge 540
Table 7.53: Summary of baseline sound levels collected in February 2017 543
Table 7.54: Measurement conditions for baseline sound measurement 544
Table 7.55: Summary of baseline sound levels at Berkeley Sound 544
Table 7.56: Recorded wrecks within 100 miles of the Phase 1 & 2 Development 546
Table 7.57: Summary of key environmental sensitivities in the Phase 1 & 2 Development area 551
Table 7.58: Summary of key environmental sensitivities in Berkeley Sound 552
Table 7.59: Summary of key social sensitivities in the Sea Lion Phase 1 & 2 Development area 553
Table 8.1: Project-specific guidelines for the sensitivity of environmental receptors 561
Table 8.2: Project-specific guidelines for the severity of effect 565
Table 8.3: Environmental impact significance of effect matrix 567
Table 8.4: Definition and implication of impact significance categories 568

Table 8.5: Project-specific guidelines for assessing the likelihood of an unplanned / accidental event occurring....570
Table 8.6: Environmental Risk Assessment matrix....570
Table 8.7: Definition and implication of risk significance categories....571
Table 8.8: Project-specific definition of the degree of confidence in the impact assessment....575
Table 8.9: Significant environmental impacts / risks and direct offsetting[1] options considered....578
Table 9.1: Summary of the outcomes of the *offshore* ENVIID and the preliminary assessment, which was used to determine the environmental and social aspects, impacts and risks that required further investigation in the EIA....587
Table 9.2: Summary of the outcomes of the *inshore* ENVIID and the preliminary assessment, which was used to determine those environmental and social aspects, impacts and risks that required further investigation in the EIA....600
Table 9.3: Summary of the outcomes of the onshore, at-shore and logistics ENVIID, which describes all the activities required to support the offshore and inshore activities associated with the project and the aspects, impacts and risks that required further investigation in the EIA....605
Table 10.1: Number, source and duration of lights during the Phase 1 & 2 Development....619
Table 10.2: Examples of the power required by different light sources on gas production platform L5, located in Danish waters in the North Sea....621
Table 10.3. Summary of vulnerability scores for seabirds, shorebirds and terrestrial birds....627
Table 10.4: An example of relative species abundance within approximately 15 nautical miles of the Sea Lion Field and Berkeley Sound....628
Table 10.5: Bird-strikes reported during the 2015 Exploration Drilling Campaign....629
Table 10.6: The design and auditing procedures associated with lighting on project vessels....635
Table 10.7: Other sources of artificial light in the NFB and Berkeley Sound....640
Table 10.8: Summary of the impacts and risks associated with artificial light offshore and inshore arising from the Phase 1 & 2 Sea Lion Development....644
Table 10.9: Number of helicopter flights during the Phase 1 & 2 Development....650
Table 10.10: Sound level from helicopter and flight activity experienced at ground level....652
Table 10.11: Temporal distribution of colonies and / or haul outs on and around the northern coast of East Falkland....653
Table 10.12: Summary of the assessment of impacts to wildlife associated with helicopter disturbance during the Phase 1 & 2 Sea Lion Development....658
Table 10.13: Summary of terminal marine growth estimates in the UK versus Sea Lion....667
Table 10.14: Dimensions and footprints of the FPSO and MODU anchor layouts....671
Table 10.15: Estimated dimensions of subsea equipment and temporary deposits....673
Table 10.16: Estimated dimensions of inshore LTV anchoring....676
Table 10.17: Summary of the impact and risk assessment for the placement and removal of objects on the seabed....681
Table 10.18: Definitions of terms found in the text....688
Table 10.19: Categorisation of fish hearing groups....694
Table 10.20: Criteria for noise induced disturbance and injury in fish (shipping and continuous sounds)....695
Table 10.21: Marine mammal hearing groups....698
Table 10.22: The nature of potential impacts of sound upon marine mammals....699
Table 10.23: Marine mammal TTS and PTS injury criteria for non-impulsive sounds, as adopted in this assessment....700
Table 10.24: Modelled offshore scenarios....702
Table 10.25: Summary of source levels used in modelling....704

Table 10.26: Predicted maximum distances from the offshore activities (all scenarios) where the rms SPL thresholds for injury to fish are exceeded 705
Table 10.27: Predicted areas where the cumulative 24-hour SEL may cause TTS onset to marine mammals that remain stationary. 707
Table 10.28: Summary of source levels used in the fleeing marine mammal calculations 709
Table 10.29: Predicted initial starting distances from the vessel location where the adopted weighted cumulative SEL thresholds for non-impulsive noise are exceeded for marine mammals swimming away from the vessel location at 1.5 m/s 709
Table 10.30: Predicted area where the adopted unweighted rms SPL thresholds for disturbance to marine mammals is exceeded 713
Table 10.31: Summary of the impact assessment for underwater noise offshore 720
Table 10.32: Modelled inshore scenarios 725
Table 10.33: Summary of source levels used in the modelling 726
Table 10.34: Predicted maximum distances where rms SPL thresholds for injury to fish are exceeded for Scenario 1 and Scenario 2 727
Table 10.35: Predicted initial starting distances from the vessel location where the adopted weighted cumulative SEL thresholds for non-impulsive noise are exceeded for marine mammals swimming away from the vessel location at 1.5 m/s 729
Table 10.36: Assessment of disturbance to fish 729
Table 10.37: Predicted area where the adopted unweighted rms SPL thresholds for disturbance to marine mammals is exceeded 732
Table 10.38: Summary of source levels used in the Scenario 3 modelling 735
Table 10.39: Summary of the impacts from vessel noise during inshore operations 739
Table 10.40: Metal concentrations of MI-High[1] drilling fluid and Sea Lion sediment 747
Table 10.41: Summary of drilling fluid and cuttings totals 755
Table 10.42: Environmental risk to the sediments around the drill centres 757
Table 10.43: Modelling uncertainties 770
Table 10.44: Summary of the impact assessment for discharge of drill cuttings during the Phase 1 & 2 Development 772
Table 10.45: Discharge composition, behaviour and fate 783
Table 10.46: List of analogous chemicals likely to be used during steady state production 785
Table 10.47: Estimation of the Sea Lion PW composition based on an analogous low salinity PW from the North Sea 788
Table 10.48: Estimated volumes of discharge 798
Table 10.49: Estimated grey and black water volumes generated by vessels during the Phase 1 & 2 Development 799
Table 10.50: Estimated hypersaline discharge volumes during the Phase 1 & 2 Development 799
Table 10.51: Flow rates and volumes of PW and oil production 801
Table 10.52: PW discharge parameters used in DREAM 802
Table 10.53: Explanation of the PEC, PNEC and the EIF and how these are calculated and used by DREAM 802
Table 10.54: Time averaged and annualised EIFs for early and late Field Life 807
Table 10.55: Modelling uncertainties 815
Table 10.56: Summary of the impact assessment for operational discharges during the Phase 1 & 2 Development 816
Table 10.57: Discharge parameter inputs to DREAM 822
Table 10.58: Summary of the impact assessment for thermal discharges during the Phase 1 & 2 Development 828
Table 10.59: Key consumers of electricity generated by the DLE turbines 837

Table 10.60: Summary of the Direct and Indirect greenhouse gases, the GWP, emission source and impact as a pollutant 842
Table 10.61: Summary of historical Falkland Islands' emissions of direct Kyoto GHGs 847
Table 10.62: Summary of historical Falkland Islands' emissions of Kyoto GHGs by IPCC sector 847
Table 10.63: Summary of historical total UK emissions (including the UKOTs and Crown Dependencies) of direct Kyoto GHGs 848
Table 10.64: Summary of historical total UK emissions (including UKOTs and Crown Dependencies) of direct Kyoto GHGs by IPCC sector 849
Table 10.65: Total UK Emissions of indirect GHGs for 1990 to 2021 850
Table 10.66: Carbon intensity of UKCS installations, 2023 ($kgCO_2e$/boe) 851
Table 10.67: Carbon Budgets and actual and projected UK CO_2e emissions and targets 852
Table 10.68: Current daily global oil demand (as of December 2023 as reported by IEA) and two future global oil demand scenarios. 854
Table 10.69. Indicating the expected Development activity and the worst-case assumptions used for the emissions impact assessment 855
Table 10.70: Consumption rates for each planned source of combustion emissions 860
Table 10.71: Emissions factors 862
Table 10.72: Estimation of worst-case atmospheric emissions[1] per Phase 1 & 2 Development Stage (using AR5 GWPs w/o cc feedback) 864
Table 10.73: Summary of worst-case total atmospheric emissions for the whole Phase 1 & 2 Development (32.6 years) (using AR5 GWPs w/o cc feedback) 866
Table 10.74: Showing the percentage contribution of each activity category to the worst-case Phase 1 & 2 emissions 866
Table 10.75: Estimated emissions during emergency and unplanned events (per event) 868
Table 10.76: Summary of emissions from combustion of sold product 869
Table 10.77: Phase 1 & 2 average annual emissions in the context of Falkland Islands' and UK emissions data 872
Table 10.78. Summary of the Sea Lion carbon intensity estimates and the NSTA benchmarks 875
Table 10.79: Comparison between the Phase 1 & 2 direct GHG emissions and the projected future UK direct GHG emissions 876
Table 10.80. Showing a comparison of estimated emissions from combustion of sold product between Sea Lion, current global oil demand (as at December 2023 as reported by IEA) and two future demand scenarios 878
Table 10.81: Estimated total atmospheric emissions resulting from O&G operations in the NFB during Field Life 885
Table 10.82: Summary of the impact assessment for emissions during the Phase 1 & 2 Development 887
Table 10.83: Summary of waste streams generated by the Phase 1 & 2 Development, showing where they are assessed within this EIS 891
Table 10.84: Waste management options assessment indicating the methods that were considered both viable and in line with Navitas' objectives 905
Table 10.85: Forecast of hazardous and non-hazardous waste quantities that require onshore treatment, broken down by activity at different stages of the project 909
Table 10.86: Disposal options for Sea Lion waste streams 909
Table 10.87: Summary of wastes produced during the Phase 1 & 2 Development Stages 1 to 3 in comparison to total UK waste, total UK C&I waste and total UK waste to landfill 911
Table 10.88: Comparison of the fate of O&G industry wastes 911
Table 10.89: Summary of the impact assessment for waste management during the Phase 1 & 2 Development 919

Table 10.90: Summary of the vessels to be used during each stage of the Phase 1 & 2 Development 922
Table 10.91: Summarising the effect of cetacean behaviour and distribution on the likelihood of collision 925
Table 10.92: Summary of vessel use during the Phase 1 & 2 component of the Sea Lion Development 930
Table 10.93: Summary of the risk assessment for collision with marine mammals during the Phase 1 & 2 Development 937
Table 10.94: The process of non-native species introduction and invasion 948
Table 10.95: Factors that may influence species introduction and / or invasion from Phase 1 & 2 vessels 953
Table 10.96: Summary of the residual risk assessment for the introduction of invasive marine species during the Phase 1 & 2 Development 963
Table 10.97: Summary of the risk assessment for the introduction of invasive terrestrial species during the Phase 1 & 2 Development 974
Table 11.1: Summary of potential impacts and risks to other users of the sea 977
Table 11.2: Summary of the type, purpose and behaviour of offshore Phase 1 & 2 vessels used to inform the impact and risk assessment 982
Table 11.3: Ship Routes Passing within 15 nautical miles of the Sea Lion Field 986
Table 11.4: Details of the analogous vessels used in the modelling 987
Table 11.5: Summary of the assumptions and results of the COLLRISK collision frequency model 988
Table 11.6: Impact energy and predicted consequences 989
Table 11.7: Vessel, MODU and FPSO collision frequencies (per year) at different impact energies 989
Table 11.8: Summary of the impact and risk assessment for other users of the sea at the Sea Lion Field 993
Table 11.9: Summary of potential impacts and risks to other users of the sea 996
Table 11.10: Exclusion zones applying to Phase 1 & 2 Development LTVs in Berkeley Sound 998
Table 11.11: Summary of the type, purpose and behaviour of inshore Phase 1 & 2 vessels used to inform the impact and risk assessment 1000
Table 11.12: Estimate of the monthly number of refuelling visits to FIPASS 1001
Table 11.13: Number of vessels entering Stanley Harbour during 2014, 2018, 2022 and 2023 1001
Table 11.14: The number of vessel visits to Berkeley Sound recorded from 2010 to 2022 1003
Table 11.15: Annual *Illex* catch 1004
Table 11.16: Anecdotal data on incidents involving vessels in Stanley Harbour and Port William 1005
Table 11.17: Anecdotal data on incidents involving vessels in Berkeley Sound 1005
Table 11.18: The influence of exclusion zones on vessel 'density' on a monthly basis, data from 2014 1008
Table 11.19: Summary of the impact and risk assessment on other users of the sea inshore 1014
Table 11.20: Estimated maximum accommodation requirement for personnel required to support the Sea Lion Phase 1 & 2 Development 1021
Table 11.21: Summary of the impact assessment for accommodation resource competition 1027
Table 11.22: Mitigations built-in to the Phase 1 & 2 Development basis of design 1035
Table 11.23: Estimated shore water used by the Sea Lion Development by activity centre 1039
Table 11.24: Summary of the impact assessment for water use resource competition during the Sea Lion Phase 1 & 2 Development 1046
Table 11.25: Summary of exploration use and forecast Phase 1 & 2 energy use 1051
Table 11.26: Contribution of exploration infrastructures to power demand 1053
Table 11.27: Current Stanley power demand with forecast O&G development demands versus current baseline capacity 1053

Table 11.28: Summary of the impact assessment of energy use on the competition for resources 1058
Table 11.29: Air-link seat capacity requirements during the three stages of the Sea Lion Phase 1 & 2 Development 1062
Table 11.30: Summary of the impact assessment on the competition for air-link resources 1064
Table 11.31: Highways Asset Management Plan Road Classification 1071
Table 11.32: Vehicle passes recorded by vehicle loggers 1072
Table 11.33: Vehicle categories logged 1073
Table 11.34: MPC Road known historical road use 1073
Table 11.35: Vehicle transit requirements based upon air-link capacity requirements during the three stages of the Phase 1 & 2 Development 1077
Table 11.36: Transportation requirements during the Phase 1 & 2 Development 1078
Table 11.37: Base-case mitigations which will serve to minimise impacts from road use 1080
Table 11.38: Summary of the impact assessment for use of road network during the Sea Lion Phase 1 & 2 Development 1084
Table 11.39: Sources of light disturbance from operations in Stanley and Berkeley Sound during the three stages of the Development 1087
Table 11.40: Proposed area of yard space required for the Phase 1 & 2 Development in comparison to 2015 exploration drilling campaign yard space 1089
Table 11.41: Source and duration of lights in Berkeley Sound during the Phase 1 & 2 Development 1090
Table 11.42: Summary of the of the social impact assessment for light disturbance during the Sea Lion Phase 1 & 2 Development 1095
Table 11.43: Sources of noise disturbance from helicopter operations, operations in Stanley and operations in Berkeley Sound during the three stages of the Development 1099
Table 11.44: WHO guideline thresholds for noise in specific environments 1101
Table 11.45: Number of helicopter flights during the Phase 1 & 2 Development 1104
Table 11.46: Sound level from helicopter activity experienced at ground level 1104
Table 11.47: Source and duration of noise at the TDF and in the supply base during the Phase 1 & 2 Development as compared to the 2015 exploration campaign 1107
Table 11.48: Example noise sources[1] from the supply base and TDF and the calculated received sound at nearest residences 1109
Table 11.49: Number, source and duration of noise in Berkeley Sound during the Phase 1 & 2 Development 1110
Table 11.50: Main source assumptions used for modelling 1110
Table 11.51: Berkeley Sound noise modelling results in comparison to WHO recommended levels 1112
Table 11.52: Summary of the of the social impact assessment for noise disturbance during the Sea Lion Phase 1 & 2 Development 1118
Table 12.1: Summary of results of CEDRE Sea Lion crude oil tests 1131
Table 12.2: Fate of oil in the marine environment 1138
Table 12.3: Parameters included in the oil dispersion modelling for the oil and diesel spill scenarios 1152
Table 12.4: Oil density thresholds used in the Sea Lion development oil spill modelling study 1154
Table 12.5: Summary of oil spill response effectiveness for worst-case shoreline oil 1169
Table 12.6: Summary of oil spill response effectiveness for worst-case shoreline oil 1182
Table 12.7: Industry-standard mitigation measures relevant to each of the oil spill risk scenarios . 1197
Table 12.8: Blow-out frequencies for offshore operations of North Sea Standard 1201
Table 12.9: Risk assessment of a subsea well blow-out 1202
Table 12.10: Risk assessment for loss of FPSO crude oil inventory 1208

Table 12.11: Risk assessment associated with crude oil transfer spills 1212
Table 12.12: Risk assessment of MODU MGO spill 1215
Table 12.13: Risk assessment of MGO bunkering spill 1219
Table 12.14: Initial and residual (same) worst-case risks for each oil release scenario 1222
Table 12.15: Oil spill uncertainties 1224
Table 12.16: Confidence assessments 1224
Table 12.17: Summary of the risk assessment for all oil spill scenarios 1226
Table 12.18: Potential maximum hydrocarbon inventories 1237
Table 12.19: Summary of Typical Fuel Physical and Environmental Properties 1239
Table 12.20: Case studies on the impact of oil spills on kelp communities 1241
Table 12.21: General features of shorelines that influence their potential susceptibility to oil spill impacts, as classified on the ESI scale 1243
Table 12.22: Summary of the release parameters and assumptions used in the model run for each scenario 1245
Table 12.23: Summary of the impact assessment for a 10 tonne MGO spill at the LTV Mooring location, with base-case mitigation in place 1253
Table 12.24: Summary of the impact assessment for a 1,200 tonne MGO spill at the LTV Mooring location, with base-case mitigation in place 1258
Table 12.25: Summary of the worst-case initial and residual (same) risk assessments for both MGO release scenarios 1261
Table 12.26: Anecdotal data on incidents that could lead to oil leaks involving vessels in Berkeley Sound 1262
Table 12.27: Summary of the risk assessment for all oil spill scenarios 1264
Table 12.28: Summary of the credible worst-case spill quantities for each at-shore scenario 1273
Table 12.29: Summary of the risk assessment of leaks and spills at the TDF, FIPASS and the onshore supply base 1282
Table 13.1. Impact significance level colours (after Table 8.4) 1286
Table 13.2: The number of ways receptors[1] could be impacted, indicating the worst-case significance of the impact 1287
Table 14.1: Overall summary of EIA findings 1290
Table 15.1: Example: collisions between cetaceans and an inshore vessels 1315
Table 15.2: Screened impacts and risks from the assessment that require EMMP action 1316
Table 15.3: Navitas' environmental performance data reporting 1319
Table 15.4: Legislative and corporate environmental monitoring requirements 1321
Table 15.5: Legislative and corporate social monitoring requirements 1326
Table 15.6: Project timeline 1327
Table 15.7: Overview of proposed EMMP survey activities throughout Sea Lion Field life 1329
Table 17.1: Representations made during the public consultation 1346
Table 17.2: Requests for information made under section 66 of the Offshore Minerals Ordinance 1620

1 NON-TECHNICAL SUMMARY

Table of Contents

1.1 Introduction 28
1.1.1 Historical context 28
1.1.2 Purpose of the EIA 28
1.2 The Sea Lion Field 29
1.3 EIA Context 31
1.3.1 Regulatory overview 32
1.3.2 Navitas Operating Management System 33
1.4 Consideration of alternatives 33
1.5 The Sea Lion Field Phase 1 & 2 - Development description 35
1.5.1 Activities associated with the Development 35
1.5.1.1 Drilling and installation of subsea infrastructure 35
1.5.1.2 Hook up and commissioning of the FPSO vessel and First-Oil 36
1.5.1.3 Simultaneous operations (SIMOPS) 36
1.5.1.4 Production 36
1.5.1.5 Oil export 37
1.5.1.6 Logistical support 37
1.5.1.7 Decommissioning 37
1.5.2 Base-case mitigations 37
1.6 Scoping consultation 39
1.7 Environmental and social baseline description 40
1.7.1 Key environmental sensitivities 40
1.7.1.1 Data gaps 44
1.7.1.1.1 The Gap Analyses Programme 44
1.7.1.1.2 Key data gaps relevant to the Sea Lion EIA 44
1.7.1.1.3 Management of data gaps within the Sea Lion EIA 45
1.7.2 Key social sensitivities 45
1.8 Environmental and social impact and risk assessment 46
1.8.1 Environmental and social aspects, impacts and risks 46
1.8.2 Impact and risk assessment methodology 50
1.8.3 Offsetting 50
1.8.3.1 Review of offsetting options 51
1.8.4 Key findings of the EIA 52
1.8.4.1 Overview of EIA findings - initial and residual assessments 52
1.8.4.2 Significant residual impacts and risks 54
1.8.4.2.1 Artificial lights offshore and inshore 55
1.8.4.2.2 Underwater noise offshore 56
1.8.4.2.3 Discharge of drill cuttings 57
1.8.4.2.4 Atmospheric emissions (climatic factors) 57
1.8.4.2.5 Waste management 58
1.8.4.2.6 Risk of injury to cetaceans 58

1.8.4.2.6.1 Injury *via* collisions in-transit and inshore 58
1.8.4.2.6.2 Risk of entanglement with subsea infrastructure 59
1.8.4.2.7 Risk of introducing marine invasive species 59
1.8.4.2.8 Risk associated with non-native terrestrial species arriving on freight 60
1.8.4.2.9 Competition for freshwater resources 60
1.8.4.2.10 Competition for electricity 61
1.8.4.2.11 Competition for use of road network 61
1.8.4.2.12 Disturbance to the human population from light 62
1.8.4.3 Significant residual risks associated with accidental events 62
1.8.4.3.1 Accidental releases of crude oil or MGO to sea offshore 62
1.8.4.3.2 Accidental releases of MGO to sea inshore 63
1.8.4.3.3 Day-to-day small leaks and spills at-shore 64
1.8.5 EIA outcomes summary 65
1.9 Environmental Monitoring and Management 70
1.9.1 Environmental Monitoring and Management Plan 70
1.9.2 EMMP Workshop 71
1.9.3 Preliminary EMMP 71
1.10 Overall conclusion 74
1.11 Formal stakeholder consultation 75
1.11.1 Representations by stakeholders 75
1.11.2 Responses by Navitas 75

1.1 Introduction

Navitas Petroleum Development and Production Ltd. (hereafter referred to as Navitas) is proposing to develop the Sea Lion Field Northern Development Area in the North Falkland Basin (NFB) with a view to the long-term production and export of oil. A phased development process is proposed.

Navitas will conduct all operations in compliance with its Health, Safety and Security Policy (HS&S) and its Environment and Biodiversity (E&B) Policy (see EIS Section 3.2.1), which requires that Navitas does all that is reasonably practicable to prevent major accidents and minimise environmental impacts.

In line with Falkland Islands legislation and its Operating Management System (OMS), Navitas has conducted a full Environmental Impact Assessment (EIA) of The Sea Lion Field Northern Area Development, Phase 1 & 2 (hereafter referred to as the 'Phase 1 & 2 Development').

The EIA was carried out in line with:

- Falkland Islands Government (FIG) Hydrocarbons Environmental Impact Assessment Guidance Note (FIG, 2016e).

The detailed outcomes of the EIA process are reported in the Environmental Impact Statement (EIS) and the key outcomes are summarised in this Non-Technical Summary (NTS). Following submission to FIG a copy of the full EIS is available on request from the Navitas office in Stanley (sealion.enviro@navitaspet.com).

1.1.1 Historical context

The NFB licences were previously held by Premier Oil Exploration and Production Limited (POEPL) working with their Joint Venture partner Rockhopper Exploration. Exploration drilling campaigns were carried out by Rockhopper in 2010 - 11 and by POEPL in 2015-16. Plans for the development of the Sea Lion project, with a view to production, commenced in 2012. An EIS for POEPL's plan for the Sea Lion Development was submitted and formally accepted by FIG in 2020 (Premier, 2020). However, in 2020 the parent company of POEPL (Premier Oil) and Chrysaor merged to form Harbour Energy Plc. Harbour Energy Plc. then sold POEPL to Navitas Petroleum in September 2022. At this time, POEPL was renamed Navitas Petroleum Development and Production Limited (hereafter referred to as Navitas).

All intellectual property previously owned by POEPL in relation to the Sea Lion Project is now owned by Navitas. As a result, Navitas has access to all preparatory processes and documentation developed under POEPL, all reports and surveys commissioned in support of the Sea Lion Development, as well as all 'lessons learned' throughout the process.

Since Navitas acquired the NFB licences, the proposed Sea Lion Development has further evolved and has been optimised in terms of:

- A reduction in number of wells and subsea infrastructure,
- The design of the wells uses 'Open Hole Gravel Pack' (OHGP) completions in the production wells, which are installed where the well meets the hydrocarbon reservoir, and which do not require conventional explosive perforation guns,
- The proposed daily production figures and hence the size and efficiency of the Floating Production, Storage and Offload (FPSO) vessel such that the forecast atmospheric emissions per barrel are reduced, and
- A longer proposed Field Life with increased recoverable resources.

As a result of these changes, it is necessary to conduct another EIA and submit a revised EIS to FIG.

1.1.2 Purpose of the EIA

The main purpose of the EIA is to answer the following six questions:

1. What is the context within which the proposed Development is being carried out?
    a. What do the '**Regulations**' and the '**Navitas OMS**' require?
2. What does the Phase 1 & 2 Development involve?
    a. What activities are involved in the proposed Development? In other words, what is the '**Phase 1 & 2 Development Description**'?
    b. Are any mitigation measures built-in to the basis of design to minimise interactions with the environment and the human population? In other words, what are the '**Base-Case Mitigations**'?
3. What do the stakeholders think about the proposed Development?
    a. What do the Falkland Islands Government (FIG) and its expected consultees think? What do the Falkland Islands public think? The answers to these questions were invited during '**Scoping and Previous Statutory Consultations**'.
4. What are the existing environmental and social attributes and sensitivities in the area?
    a. What is known about the local environment and the local human population? For example, what species of marine mammals or seabirds are found in the area? When are they there? What are they doing there? How important is the population that could be impacted upon? Do they have international or local protected status? This is called the '**Environmental and Social Baseline**'.
5. What are the environmental and social impacts and risks associated with the project activities?
    a. How might the Development interact with the environment and / or the human population? In other words, what are the associated '**Environmental and Social Aspects**'?
    b. How are the impacts and risks assessed? In other words, what is the '**Impact and Risk Assessment Methodology**'?
    c. What impacts and risks are associated with the planned activities and accidental or unplanned events? Are the potential impacts and risks significant? What are the '**Key Findings of the EIA**'?
6. What is Navitas doing to reduce the potential impacts and risks?
    a. What if an impact or risk is considered to be significant despite compliance with legislation, the use of industry-standard practice and the 'base-case' mitigation measures? Will additional actions be taken to remove, minimise or monitor the impact or risk?
    b. All mitigations and monitoring commitments will be summarised in the '**Project-Specific Environmental Monitoring and Management Plan (EMMP)**' which will remain 'live' (be continually reviewed and updated) for the life of the field.

Numerous steps are involved in conducting an EIA and in answering the questions above. This NTS briefly outlines the planned Development and describes the key outcomes of the EIA.

1.2 The Sea Lion Field

The Sea Lion Field is an oil field. Oil and gas are trapped in underground sandstone rocks approximately 2.5 km below the seabed, in water depths of approximately 450 m. It is likely that there is a gas accumulation (or 'gas cap') overlying some of the oil. The existence of the gas cap will be determined

during the Development drilling operations. The field is located approximately 220 km to the north of the Falkland Islands in Block 14 / 10 and is 480 km from Argentina, the closest point on the South American coastline (Figure 1-1). Navitas propose the development of the Sea Lion Field in accordance with the Production Licence areas PL032 and PL004b granted by the Falkland Islands Government (Figure 1-1).

The Sea Lion Field is the first potentially commercially viable hydrocarbon discovery in the NFB and was discovered by Rockhopper Exploration plc in 2010. With regard to oil production, a Field Life of 30 years has been projected and it is estimated that the Phase 1 & 2 Development can recover approximately 310.5 million stock tank barrels (MMstb) of oil in this time.

The crude oil discovered in the Sea Lion Field has a high wax content such that it needs to be kept at an elevated temperature throughout the production and export process to ensure that it can flow.

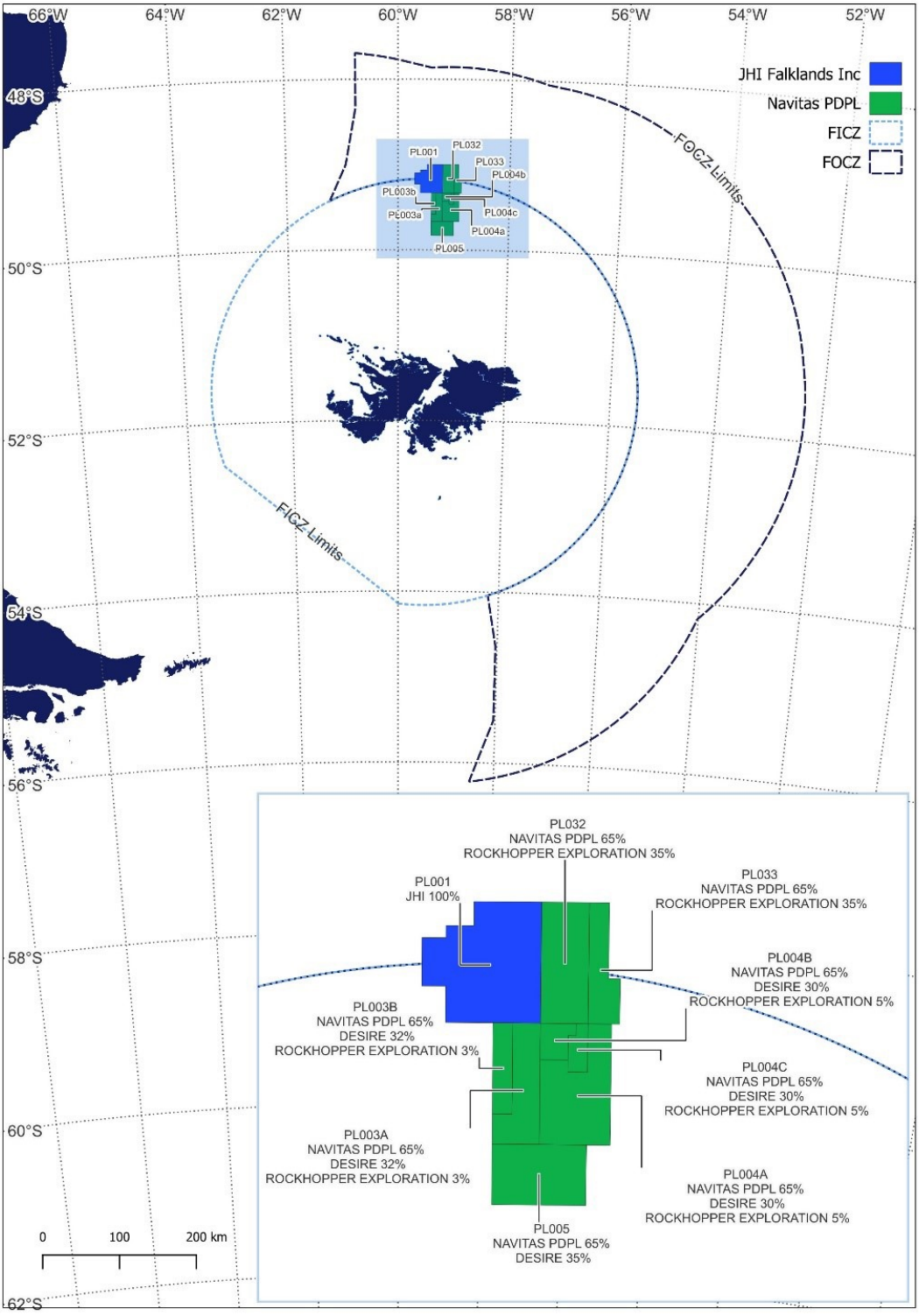


Figure 1-1: North Falklands Basin Licence Block Locations

1.3 EIA Context

To answer 'Question 1' above, the following information summarises FIG's regulatory requirements, and those of the Navitas OMS, both of which define the context within which the EIA has been carried out. Full details on both are provided in Chapter 3 of the EIS.

1.3.1 Regulatory overview

The Falkland Islands is one of 14 UK Overseas Territories (UKOT) as defined under the British Overseas Territories Act 2002.

The Environmental Charter is a joint agreement between FIG and the UK Government that was signed in 2001. The Charter lists ten guiding principles and 11 commitments therein. All commitments are intended to ensure effective environmental management within the Islands.

Falkland Islands environmental legislation that applies to Oil and Gas (O&G) activities is largely based upon the regulatory requirements for the United Kingdom Continental Shelf (UKCS).

Legal compliance and the preparation of all required consents will be based on current FIG legislation (where it exists) with reference to UK legislation and guidance. In the event that FIG legislation is enacted in the future, reference to UK legislation will not be required.

Existing Falkland Islands legislation relevant to the O&G industry is as follows:

- Offshore Minerals Ordinance 1994 (1997 and 2011 Amendments).
- Offshore Petroleum (Licensing) Regulations 1995.
- The Offshore Petroleum (Licensing) Regulations 2000 (as amended).
- Petroleum Survey Licences (Model Clauses) Regulations 1992.
- Maritime (Amendment) Ordinance 2019.
- Maritime (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 2019.
- Deposits in the Sea (Exemptions) Order 1995.
- Marine Mammals Ordinance 1992.
- Maritime Ordinance 2017.
- Maritime (Amendment) Ordinance 2019.
- Conservation of Wildlife and Nature Ordinance 1999.
- Fisheries (Conservation and Management) Ordinance 2005.
- Endangered Species Protection Ordinance 2015.
- Planning Ordinance 1991.
- Planning (Environmental Impact Assessment) Regulations 2015.
- Falklands Interim Port And Storage System (FIPASS) Ordinance 1989.
- Harbours and Ports Ordinance 2017.
- Maritime (Registration of Ships) Regulations 2019.
- Merchant Shipping (Confirmation of Legislation) (Falkland Islands) Order 2018.
- Offshore Installations (Prevention of Fire, Explosion and Emergency Response) Order 2008
- Offshore Installations (Safety Case) Order 2008.
- Falkland Islands Environmental Trust Ordinance 2021.
- Maritime (Port State Control) Regulations 2021.

Specific guidance on the Falkland Islands EIA process and the development of the EIS is provided in:

- FIG Hydrocarbons Environmental Impact Assessment Guidance Note (FIG, 2016e).

1.3.2 Navitas Operating Management System

As in all of its O&G activities, Navitas will, as a minimum, adhere to its own corporate Health, Safety and Security (HS&S) Policy and Environment and Biodiversity (E&B) Policy *via* the processes set out in the OMS. The application of the OMS framework throughout the lifecycle of the Phase 1 & 2 Development will ensure environmental management is considered at every stage.

With regard to managing environmental impacts, the OMS provides a framework for operational controls to prevent and reduce impacts and risks by:

- Preventing, minimising or remediating an impact,
- Preventing, or reducing the likelihood of unplanned events, and
- Minimising the severity of effects in the event of an incident.

Operational controls include a hierarchy of Elimination, Substitution, Engineering and Administrative Controls. Elimination and substitution controls are built-in to the project basis of design such that the project will always endeavour to minimise impacts and risks. During the EIA process, where impacts or risks are deemed significant despite the base-case mitigations and industry-standard safeguards, it is necessary to determine what additional, project-specific, controls may be required. All additional project-specific controls intended to prevent or mitigate impacts and risks will be utilised where they are deemed to be 'reasonably practicable'.

The OMS provides for incident management and monitoring, emergency response and safety and environmentally critical equipment with regular measurement and reporting against plans and objectives.

The OMS will apply through all subsequent Phases of the Development. Full details on the Navitas OMS are provided in Section 3.2 of the EIS.

1.4 Consideration of alternatives

The basis of design for the production of the Sea Lion field has been under development since 2011. Between 2012 and 2020, the relevant licences were owned by POEPL with their Joint Venture partner Rockhopper Exploration (Section 2.1.1 of the EIS). An EIS for POEPL's proposal for the Sea Lion Development was submitted and formally accepted in 2020 (Premier, 2020). However, in 2020 the parent company of POEPL (Premier Oil) and Chrysaor merged to form Harbour Energy Plc. Harbour Energy Plc. then sold POEPL to Navitas Petroleum in September 2022. At this time, POEPL was renamed Navitas Petroleum Development and Production Limited (hereafter referred to as Navitas). Navitas now operates the licences and has further optimised the proposed basis of design

Detail on the history of the project development and option selection is provided in Chapter 4. However, in summary, numerous options were considered by POEPL and the majority of the options selected were carried over into the Navitas basis of design although some key activities have been optimised by Navitas (Table 1.1).

Table 1.1. Providing a basic summary of the options considered for the Development basis of design.

Development option	Selected by POEPL					Selected by Navitas	Optimised by Navitas
	2014/15	2016	2018	2020	2023		
Drilling and Production							
Semi-submersible	Rejected	No change	No change	No change	No change	Rejected	N/A
TLP with FSO and Electric Submersible Pumps (ESPs) for dry wells and gas lift to subsea wells.	Considered	Rejected	No change	No change	No change	Rejected	N/A
TLP with FSO and subsea wells with Hydraulic submersible pumps (HSPs)	Considered	Rejected	No change	No change	No change	Rejected	N/A
FPSO with subsea wells and artificial lift from downhole HSPs	Considered	Rejected	No change	No change	No change	Rejected	N/A
FPSO with subsea wells and gas lift	Considered	**Selected**	No change	No change	No change	**Selected**	Yes. Fewer wells and smaller FPSO.
Well completion design	Cement and perforation	No change	No change	No change	No change	Rejected	Yes. Open Hole Gravel Pack.
Oil export							
Offload from the FPSO directly to the export vessel for transport to market	Considered	Rejected	No change	**Selected**	No change	**Selected**	Unchanged
Offload from the FPSO to an Offshore Loading Shuttle Tanker (OLST) and Transfer to a CTT elsewhere							
At an offshore / nearshore location	Considered	Rejected	No change	No change	No change	Rejected	N/A
At a sheltered location in another country	Considered	Rejected	No change	No change	No change	Rejected	N/A
At a sheltered location in the Falkland Islands	Considered	**Selected**	No change	Rejected	No change	Rejected	N/A

1.5 The Sea Lion Field Northern Area Phase 1 & 2 - Development description

To answer 'Question 2' above, the following sections provide a summary of:

- The activities that will be required during the proposed Phase 1 & 2 Development to enable the production of oil from the Sea Lion Field, and
- The base-case mitigations that are built-in to the basis of design.

The full Phase 1 & 2 Development Description is provided in Chapter 5 of the EIS.

1.5.1 Activities associated with the Development

1.5.1.1 Drilling and installation of subsea infrastructure

The proposed Phase 1 & 2 Development is expected to consist of 23 completed wells comprising 16 Oil Production (OP) wells, six Water Injection (WI) wells and a remote Gas Injection (GI) well, drilled by a Mobile Offshore Drilling Unit (MODU) over six drill centres. If the remote GI well has insufficient gas flow, an additional remote GI well will be drilled, although only one of these will be completed. Further, based on historical data from drilling in the Sea Lion Field, there is a contingency for two potential redrills in the event of technical problems. Therefore, while there may be up to 26 penetrations, only 23 wells will actually be completed and operated. The MODU will be anchored to the seabed and surrounded by a 500 m exclusion zone, supported by up to two support vessels and an Emergency Response and Rescue Vessel (ERRV).

An FPSO vessel (Figure 1-2 below) will be used to produce the fluids from the wells. The FPSO will be anchored to the seabed, within a 1,275 m radius exclusion zone. The OP and WI well drill centres will all be within a 2 - 5.5 km radius around the FPSO and the remote GI well location is approximately 8 km from the FPSO.

After First-Oil there will follow two periods of Simultaneous Operations (SIMOPS) as the FPSO commences with production from the first tranche of wells while the MODU continues to drill the remaining wells and installation of subsea equipment takes place.

Wells are normally 'cleaned up' once completed to remove unwanted solids and liquids. With the use of Open Hole Gravel Pack (OHGP) completions, it is anticipated that the wells will be cleaned up by flowing them directly to the FPSO prior to being brought on for production. However, a contingency is retained to flow four wells (3 x OP and 1 x GI well) back to the MODU should it be considered necessary. Flow-back / testing of these wells will require flaring off of the product from the MODU, for approximately one day per well.

To support the Development, ten subsea manifolds and an array of subsea pipelines, 'umbilicals', 'risers' and associated supports (e.g., sandbags, clump weights etc.) will be installed to connect the wells at the seabed with the FPSO at the surface.

While drilling of the wells is underway, installation of the subsea production facilities will be undertaken by dedicated installation vessels.

It is anticipated that four Large Transport Vessels (LTVs) will be used to support the construction and installation operations, with a maximum of two vessels anchored in Berkeley Sound at any one time, for a combined total period of *c.* 13 months. These LTVs will act as 'floating storage barges' from which equipment will be collected and taken out to the Sea Lion Field for installation.

It is anticipated that drilling will start approximately 17- 20 months after project sanction. Up to nine wells will be drilled pre-First-Oil (including the contingency GI well if needed, noting that only one GI well will be operated) and the remaining 15 wells will be drilled during SIMOPS. When drilling starts, only the MODU, its support vessels and the installation vessels will be in the Field.

1.5.1.2 Hook up and commissioning of the FPSO vessel and First-Oil

Oil production and processing will be carried out from the FPSO ship-shaped vessel which will be anchored to the seabed *via* a turret and surrounded by a 1,275 m radius exclusion zone, which is effectively 500 m beyond the installation extremities (including the hose and tanker during crude oil offload). The term 'Hook Up and Commissioning' (HUC) refers to the process by which the FPSO is connected to the subsea wells, *via* the manifolds and the pipelines, umbilicals and risers through the turret mooring buoy (Figure 1-2).

During the commissioning process, the gas injection system will also be commissioned which will involve flaring gas from the GI well for 30 days.

It is expected that 'First-Oil' will occur approximately 33 months after project sanction.

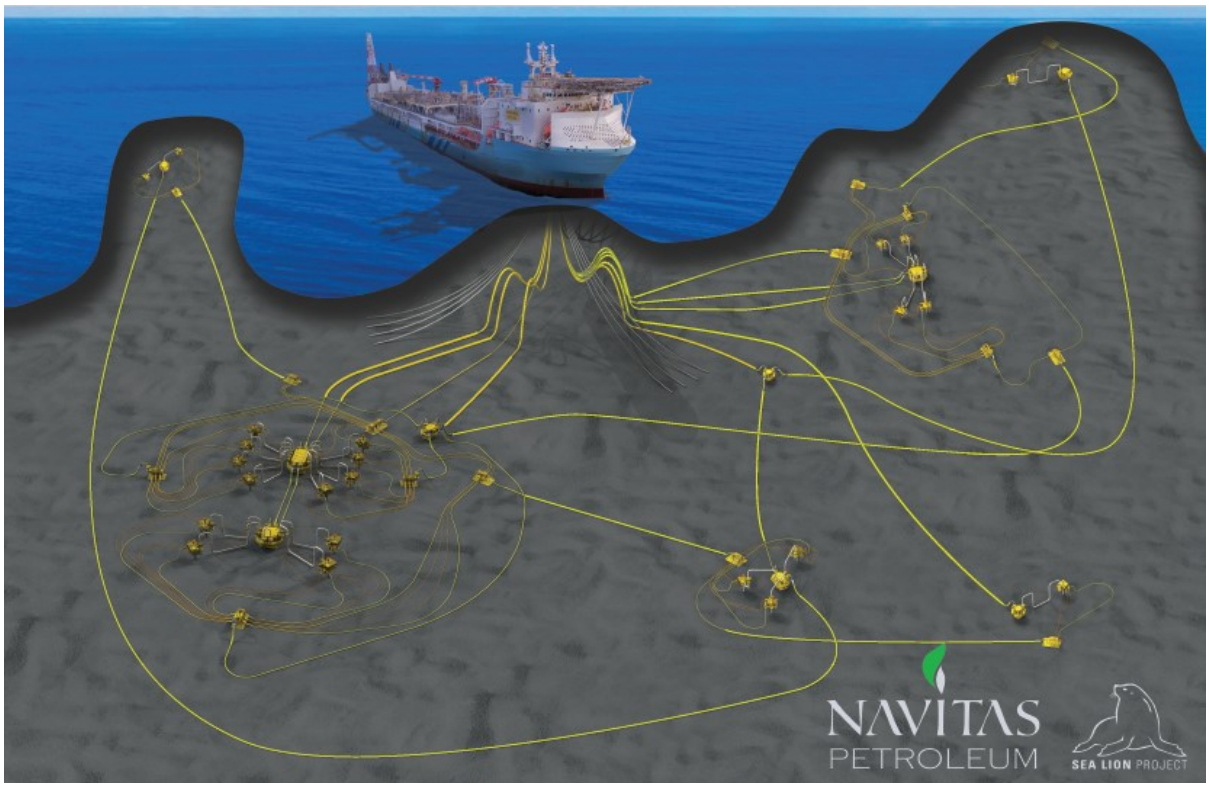


Figure 1-2: Showing the FPSO and the Phase 1 & 2 Development Field layout

1.5.1.3 Simultaneous operations (SIMOPS)

After 'First-Oil' there will follow a period of SIMOPS with the MODU continuing to drill the remaining wells while the FPSO produces from the wells which have already been drilled. During SIMOPS, both the MODU and the FPSO will be supported by two support vessels and an ERRV.

Once all the wells have been drilled, the MODU will leave the Sea Lion Field and only the FPSO and its support vessels will remain.

1.5.1.4 Production

The OP wells will produce reservoir fluids to the FPSO. The total produced fluids will consist of:

- Crude oil (the desired product),
- Associated hydrocarbon gas (arising from the gas cap in the reservoir, (if present) and gas dissolved in the oil which is liberated as the oil flows to surface i.e., the gas that is 'associated' with the oil production), and

- Water (a by-product of the oil production which is referred to as 'produced water').

These three products will be separated and treated on the FPSO:

- The oil will be stabilised (i.e., made ready for export) and transferred to storage tanks within the FPSO hull for subsequent offloading and export (Section 5.10),
- The associated gas from the production wells will be used:
  - As fuel to heat and power the FPSO, and
  - For 'gas lift' in the oil production wells, which reduces the density of the oil enabling it to flow at higher production rates.

Note: During normal operations any excess associated gas will be re-injected back into the reservoir *via* the remote GI well. In the event of a deficit in associated gas, the required gas volumes will be supplemented with gas brought back up from the designated GI well.

Note: The produced water will be cleaned to remove dispersed oil and any solids (e.g., sand, if present). During normal operations, produced water will be re-injected *via* the WI wells (in combination with treated seawater) to maintain pressure in the reservoir, thereby optimising oil recovery.

1.5.1.5 Oil export

The crude oil will be directly offloaded from the FPSO to the purchasers' Conventional Trading Tankers (CTT) at the Sea Lion location and from there will be exported to market. To ensure that the offloading operating conditions are maintained within strict limits, direct offtake will require an Offshore Support Vessel (OSV, i.e., a pull-back tug) to attend the CTT offshore, in addition to the presence of the ERRV, which is always on standby.

1.5.1.6 Logistical support

The logistics and infrastructure support required by the Sea Lion Phase 1 & 2 project includes:

- Port facilities and onshore supply base: including the Temporary Dock Facility (TDF) already established in Stanley Harbour together with onshore laydown yards, storage bases and offices in the Gordon Lines area of east Stanley,
- Use of vessels: for the movement of materials and equipment, installation of the infrastructure and support,
- Personnel transportation facilities: including fixed-wing flights, helicopters and land transportation, and
- Use of resources: e.g., accommodation, freshwater, electricity, fuel, roads and waste management / disposal facilities.

1.5.1.7 Decommissioning

At the end of Field Life, expected to be 30 years after commencement of production, the FPSO and all associated subsea infrastructure and pipelines, will be decommissioned and removed from the NFB in accordance with regulatory requirements in place at that time. Decommissioning will be subject to a separate EIA, submitted at a time to be agreed with FIG (most commonly a few years prior to the cessation of production).

1.5.2 Base-case mitigations

FIG legislation, Navitas' corporate standards and industry-standard practices will be followed to reduce the potential impacts associated with the above planned activities, and to minimise the likelihood and / or consequences of unplanned events or accidents. The legislation and industry-standard practices relevant to each activity are detailed in the impact and risk assessment chapters of the EIS (Chapters 10, 11 and 12).

It is important to note that, where possible, a number of best-practice mitigations are built-in to the design of the facilities. These serve to minimise the impacts of the Development by reducing the outputs or activities that might lead to impacts in the first place (e.g., technologies to reduce the amount of gaseous emissions). These are referred to as the base-case mitigations and are summarised in Table 1.2.

Table 1.2: Summary of the mitigations built-in to the Phase 1 & 2 Development basis of design

Project activity	Mitigations built-in to the Phase 1 & 2 basis of design
General	• All materials, fittings and system contents contained in the FPSO hull will be non-toxic, non-smoke emitting, fire retardant or 'low flame spread'.
Drilling and production	**The following will reduce the amount of atmospheric emissions:** • The main fuel supply for the FPSO will be produced gas, use of which will be facilitated by the availability of three Dual Fuel GTG Turbines, • Use of waste heat recovery to reduce the need for active heat generation and therefore to reduce fuel consumption / CO_2 emissions, • No planned flaring during ongoing well testing throughout Field Life, • No routine flaring during normal production (notwithstanding the flare pilot light), • Use of a Flare Recovery Package during normal operations, • No venting from the FPSO during normal production, • Follow international standards for piping, valves etc. and best practises for integrity management e.g., UK Step Change Hydrocarbon Toolkit, • Use of Vapour Recovery Package (VRP) during normal operations, • Use of a vapour balancing system to pass blanket gases from the FPSO cargo tanks to the CTT cargo tanks, when available, during transfer of oil, • The use of passive heat retention systems wherever possible to maintain working temperatures and flow assurance, thereby preventing energy expenditure, and its associated emissions, on active heating systems, • Use of Open Hole Gravel Pack (OHGP) completions which minimise downhole debris and reduce the requirement for well clean-up to the MODU, and thus the likelihood of associated flaring. The base-case is for the wells to be flowed straight back to the FPSO (**Note:** there is a contingency flow / test four wells to the MODU if considered necessary which would require flaring), • Use of F-Gases with the lowest Global Warming Potential, • Back-up inert gas generator for use as gas blanket in the event that the VRP malfunctions to prevent venting of hydrocarbon gas, and • Use of Marine Gas Oil (MGO) instead of Intermediate Fuel Oil (i.e., a lighter fuel) when operating inshore. **The following will reduce the volumes of drilling discharges:** • Use of seawater sweeps, bentonite and WBM for tophole drilling, and • Batch drilling to optimise drilling mud use. **The following will reduce the volumes of, or negate the need for, discharges of oil and chemicals to sea:** • Produced Water Reinjection (PWRI) as a base-case to alleviate the need to discharge produced water to sea during normal production operations, • Subsea and topside technical flow assurance measures, e.g., insulation and heating, will minimise the use of flow assurance chemicals, • Diversion of produced water to slops / off-spec tanks for retreatment in the event that PWRI is down and produced water is out-with discharge specifications, and • Oil in ballast tank detection on the FPSO. **The following will reduce the volume of oily waste returned to shore:**

Project activity	Mitigations built-in to the Phase 1 & 2 basis of design
	• Use of a Thermomechanical Cuttings Cleaner (TCC) during drilling which will clean-up drill cuttings on the rig so they may be discharged to sea, reducing the amount of oily waste sent to shore for treatment. **The following will reduce the volume of waste being returned to the UK for disposal:** • Use of FIG municipal waste facilities. **The following will reduce the competition for resources:** • Use of buffer storage water tanks at the TDF, the mud plant and potentially the at-shore bulk supply base to ensure management of peak water use requirements.
Oil spill prevention measures	**Note:** many industry-standard preventative mitigation measures must be built-in to the basis of design. Therefore, there are very few 'extra' base-case mitigation options available and the standard requirements are summarised below: **Preventative measures built-in to the FPSO include:** • Cargo and fuel tanks of the vessel will be double skinned, • Bunding of all liquid containing equipment and chemicals, • Open deck drains to catch and collect spills to a dedicated slops tank, • High level tank filling alarm and emergency shutdown of the process, • FPSO offloading hose quick-break connectors to prevent spills on unplanned disconnection, and • Automatic Identification Systems and Marine Procedures to prevent collisions. **Preventative measures built-in to the well design include:** • Development of the appropriate, and peer reviewed, well design, • Use of appropriately weighted drilling muds, • The use of appropriate mud additives to ensure over-balanced drilling, and • Use of Blow-Out Preventers and production X-mas trees. **Preventative measures built-in to the CTT nomination and selection include:** • Cargo tanks, and potentially the fuel tanks, of the vessel will be double-skinned, • Vetting and auditing prior to acceptance of the nominated vessel, • Transfer of Falkland Islands' authorised Berthing Master / Pilot and assistant to CTT to manage the offshore direct offtake operation, • Cargo tank hi level and hi-hi level alarms to prevent overfilling, • Bunding of all liquid containing equipment and chemicals, and • Open deck drains to catch and collect spills to a dedicated slops tank.

1.6 Scoping consultation

To answer 'Question 3' above, the following section describes the scoping consultation processes which were carried out to identify any concerns that the stakeholders (including the Falkland Islands public and consultees) had regarding the Phase 1 & 2 Development. The consultations were carried out in line with the FIG EIA Guidance (2016e) and were intended to:

- Inform the stakeholders about the proposed Development,
- Identify stakeholder concerns, and
- Ensure that the EIA adequately addresses stakeholder concerns.

As advised by the FIG EIA Guidance (2016e), the stakeholders consulted by Navitas included:

- Falkland Islands Government (FIG),
- Conservation groups,
- Naturalists,
- Special interest groups,
- Other users of the sea, and

- The general public.

Scoping consultations for the (then) Phase 1 Development proposed by POEPL were carried out between 2014 and 2016, prior to formal submission/s of the EIS and the statutory consultations that followed in 2018 and 2020. Further scoping consultations were carried out by Navitas in 2023 to present detail on, and elicit response to, the optimised development basis of design (presented in this EIS). Details on the pre-submission scoping consultations and their outcomes, are provided in Chapter 6 of the EIS.

During scoping consultations, numerous questions were asked, and issues raised by the stakeholders. All representations were taken into account during the EIA process and are recorded in the EIS. The key issues that were identified as areas of concern over the course of the scoping consultations (2014 – 2023) were:

- Control of vessels and general management in Berkeley Sound,
- Oil spill mitigations and clean-up:
  - The impact of this particular type of crude on the marine environment.
- Onshore infrastructure,
- Environmental offsetting,
- Decommissioning,
- Jobs, employment and numbers of people, and
- Standards and governance.

1.7 Environmental and social baseline description

To answer 'Question 4' above, the following sections aim to summarise the current environmental and social baseline information. It is necessary to describe the baseline in sufficient detail to:

- Understand what is currently present i.e., the 'baseline'. For example, what benthic (seabed) communities, fish, birds, marine mammals are in the area? What is the current condition of the seabed? What resources are available in the Falkland Islands for the local human population, and who else uses the offshore and inshore locations?
- Understand the sensitivity of the receptors. For example, what are the population sizes of the species present? What are they doing there? Are they vulnerable, are they protected, are they commercially important or of value for other users? Are stakeholders concerned?
- Determine whether there are data gaps and if, or how, these could affect confidence in the impact and risk assessments, and
- Provide a reference point of comparison for future monitoring that will be carried out by Navitas to determine whether or not the Phase 1 & 2 Development has had any discernible environmental or social impacts, and to validate the results of the EIA.

1.7.1 Key environmental sensitivities

Understanding the attributes of the NFB, the Sea Lion Field and Berkeley Sound area was informed by:

- Extensive literature reviews,
- Historical environmental surveys conducted in the area by various parties since the mid-1990's, and
- Further surveys carried out by Rockhopper and POEPL between 2012 and 2019.

Note: The survey reports can be requested from sealion.enviro@navitaspet.com.

The Patagonian Shelf, on which the Falkland Islands archipelago is located, is one of the most biologically productive areas in the South Atlantic. Two marine ecosystems, the sub-Antarctic ecosystem and the southern temperate ecosystem, are separated by a transition zone, which runs through the Falkland Islands. Further, the area is dominated by two different oceanic currents.

The resulting mixing of water masses produces areas of high biological productivity, including one on the edge of the Continental Shelf to the south of the Sea Lion Field. This productivity supports a high biomass of plankton in the NFB, which forms the basis of marine ecosystem food chains, upon which many species of larger animals such as fish, seabirds and marine mammals depend.

The inshore area of Berkeley Sound is important given its regular use by the fishing and tourism industries, as well as by wildlife. The Sound is used by a variety of protected marine mammals and protected birds. Moreover, the entrance to Berkeley Sound is flanked by two National Nature Reserves (Volunteer Point and Cow Bay, and the Kidney Island Group), which are also classified as Important Bird Areas (IBAs).

Potentially sensitive habitats identified within Berkeley Sound that are equivalent to those of conservation significance in the UK, as defined by the Offshore Marine Conservation of Habitats Regulations (which implement the EC Habitats Directive), include biogenic reefs (reefs created by living organisms), geogenic reefs (created by geological processes) and kelp forests.

The key biological sensitivities of the Falkland Islands offshore environment and Berkeley Sound are summarised in Table 1.3 and Table 1.4, respectively. In order to provide an overview of the environmental sensitivities, the tables indicate the relative importance of each month, regardless of the particular species, fishery or site that is driving the sensitivity.

Table 1.3: Summary of key environmental sensitivities in the Sea Lion Phase 1 & 2 Development area

Environmental baseline and sensitivity at Sea Lion											
Low[1]				Medium[1]				High[1]			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Plankton: Plankton comprises of small to microscopic plants (phytoplankton) and animals (zooplankton) that drift in the surface layers of the sea. Phytoplankton require sunlight, like all other plants, to survive, and zooplankton graze upon the phytoplankton or prey on other zooplankton. The oceanic fronts around the Falkland Islands result in nutrient rich waters which create an area of very high phytoplankton productivity immediately to the north of the Islands (and approx. 60 km to the south of the Sea Lion Field). This phytoplankton productivity is seasonal and in turn supports complex communities of zooplankton, which then support complex pelagic (in the water column) and demersal (near the seabed) ecosystems.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marine flora: Not applicable to offshore location.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Benthic fauna: Benthic fauna are those animals which live on, or below, the seabed. Overall, benthic fauna around the Sea Lion area is very uniform, with polychaetes (i.e., marine worms) and crustaceans (e.g., crabs) being the two most abundant groups present, followed by molluscs (e.g., clams).											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fish and shellfish: The convergence of the temperate and sub-Antarctic regions in the Falkland Islands archipelago results in the presence of species belonging to both. The six sub-Antarctic, and seven temperate, fish and squid species found in abundance in Falkland Islands' waters primarily utilise the NFB as feeding grounds, migrating in and out of the area as food availability changes and to follow seasonal spawning migrations. Other species feed in the area as juveniles and move to deeper waters as they mature and become adults. This results in seasonal changes in the fish assemblages across the ecosystem.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Seabirds: Over 70 % of the global population of black-browed albatross breed on the Falkland Islands with a significant proportion of the global populations of gentoo and rockhopper penguins doing the same. The waters surrounding the Falklands also support numerous species that breed elsewhere. Of the species recorded in the Sea Lion area, the Atlantic petrel, grey-headed albatross, and northern royal albatross are all listed as 'Endangered' on the IUCN Red List, and the southern rockhopper penguin, white-chinned petrel, southern royal albatross and the wandering albatross are listed as 'Vulnerable'.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marine mammals: Confirmed records indicate that 25 species of cetacean (whales, dolphins and porpoises) occur within Falkland Islands waters and three species of pinniped (seals) breed on the Islands. Many of the cetacean species are rare and inconspicuous and some are only known from stranded animals. Of these 25 cetacean species, two species are listed as 'Endangered' on the IUCN Red List, namely the sei whale and the less common blue whale, two species, the fin and sperm whales, are listed as 'Vulnerable' and the southern right whale is listed as being of regional conservation concern.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Conservation sites: There are no designated marine protected areas in Falkland Islands waters. The Falkland Islands Government (FIG) has identified several areas as proposed Marine Managed Areas, for which a public consultation was held in 2022[2]. Policy work is ongoing (as of 2024) but it is anticipated the proposed Marine Managed Areas will be designated. Non-statutory Key Biodiversity Areas (KBAs) have also been identified for sei whales and seabirds around the Falkland Islands. On land, a number of Important Bird Areas (IBAs) have been designated. Additionally, a network of National Nature Reserves (NNR) and Important Plant Areas (IPAs) protect many of the most important seabird breeding sites and areas supporting native flora respectively.											

[1] Note that the terms Low, Medium and High in this context provide a guide only as to the general sensitivity / abundance as it is relevant to each receptor. Specific sensitivities of each receptor to each environmental impact are explored in full within the EIS.

[2] Consultation report and scientific evidence to support Marine Managed Areas is available *via* FIG website https://www.falklands.gov.fk/policy/environment/marine-managed-areas-consultation-report.

Table 1.4: Summary of key environmental sensitivities in Berkeley Sound

Environmental baseline and sensitivity in Berkeley Sound											
Low[1]				Medium[1]				High[1]			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Plankton: Plankton comprises small to microscopic plants (phytoplankton) and animals (zooplankton) that drift in the surface layers of the sea. The most conspicuous component of the inshore zooplankton community is lobster krill, which is an important prey species for higher predators (such as penguins and whales).											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marine flora: Marine plants are the major primary producers in the marine environment. The most common species of seaweed within the Falklands are the giant kelp and the tree kelp, which are found around the entire Falklands coastline. Kelp is a habitat forming species and is a very important part of the inshore ecology.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Benthic Fauna: Benthic fauna are those animals which live on, or below, the seabed. Berkeley Sound supports a wide range of benthic habitats (including biogenic and geogenic reefs), each supporting a characteristic range of species. Although none of the species found is rare or protected under any Falkland Islands legislation. Work is ongoing to identify important marine areas, and as such work develops, new designations can be incorporated in the ongoing management of the project *via* the EMMP and the 5-yearly review of the EIS.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fish and shellfish: The most conspicuous species found inshore off the east coast is loligo squid, which play a key role in the inshore ecology as predator and prey. In addition, loligo support the second largest fishery in the Falklands. Loligo are known to migrate inshore to spawn, although the key spawning sites remain unknown. Periods of 'high sensitivity' reflect the spawning periods of the two loligo cohorts. There are several species of shellfish found within Berkeley Sound that are commercially exploited elsewhere but not currently in the Falklands.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Seabirds: Berkeley Sound encompasses significant breeding populations (>1 % of the national population) of gentoo and rockhopper penguins and a far higher proportion of the national populations of king penguins, sooty shearwaters and white-chinned petrels. In addition to king and gentoo penguins, there are large resident populations of imperial and rock shags and Falkland steamer ducks, which are present year-round. Of the species breeding in Berkeley Sound the white-chinned petrel and southern rockhopper penguin are listed as 'Vulnerable' on the IUCN Red List.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marine mammals: Berkeley Sound supports small breeding populations of South American sea lions (Diamond Cove), South American fur seals (Volunteer Rocks) and is likely to have breeding populations of Commerson's and Peale's dolphins. Conspicuous seasonal visitors include sei whales, which are most numerous in the late summer and autumn. Several other species of large whale have been recorded within Berkeley Sound including southern right and Antarctic minke whales. An influx of southern right whales was first *recorded* during the winter of 2017 and seems to have sustained since.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Conservation sites: The entrance to Berkeley Sound is flanked by two National Nature Reserves (Volunteer Point and Cow Bay, and the Kidney Island Group), which are also classed as Important Bird Areas, and a proposed Marine Management Area has also been proposed. Further, the importance of sei and southern right whales in Berkeley Sound and surrounds has resulted in a Key Biodiversity Area and two Important Marine Mammal Areas to be adopted.											

[1] Note that the terms Low, Medium and High in this context provide a guide only as to the general sensitivity / abundance as it is relevant to each receptor. Specific sensitivities of each receptor to each environmental impact are explored in full within the EIS.

1.7.1.1 Data gaps

1.7.1.1.1 The Gap Analyses Programme

The Falkland Islands Offshore Hydrocarbons Environmental Forum (FIOHEF) was established in 2011 to facilitate discussion of environmental issues relating to current and future hydrocarbon activities in the Falkland Islands. FIOHEF established a subcommittee, the Gap Analyses Group, to examine the data gaps that needed to be filled in order to better inform and monitor the potential environmental impacts from offshore hydrocarbon activities in the Falkland Islands.

Data gaps of most relevance to the Development were identified and prioritised according to the urgency with which it was perceived that the data was required:

- Offshore benthic ecosystems with regard to collation of data, infaunal sampling, sedimentology and chemistry,
- Oceanography in relation to oil spill modelling with regard to hydrographic dynamics, temporal and water column dynamics,
- Seabirds with regard to priority species and temporal movements, and
- Marine mammals (seals, dolphins and whales) with regard to populations and breeding activity, spatial and temporal distributions.

This programme is now complete.

1.7.1.1.2 Key data gaps relevant to the Sea Lion EIA

The GAP project is complete and it is considered necessary to acknowledge the outstanding and project-specific data gaps that have been identified during the Sea Lion EIA process. Note that most of the below were out of the scope of the GAP project.

The remaining key data gaps of relevance to the Sea Lion EIA, and associated actions, are:

- General
  - Predicting the likelihood of introducing invasive species:
    - Settlement plates will be positioned in Berkeley Sound prior to and during the construction phase of the project. Settlement plates will also be positioned at the Temporary Dock Facility / Stanley Harbour for sampling throughout the duration of the project. In the event that a new marine invasive species is discovered, a pathway analysis will be conducted to attempt to determine where / how the species had been brought into the Islands. Marine invasive species will be confirmed using genetic barcoding.
  - Auditory sensitivity of penguins and marine mammals:
    - The specific experimental measurement of the auditory sensitivity of penguins and marine mammals is outwith Navitas' responsibility. However, Navitas is committed to the measurement of underwater noise levels *via* hydrophones as a monitoring exercise.
  - Quantifying the impact of bird strikes:
    - Navitas is committed to collecting data on bird-strike on all its vessels. Navitas will also investigate the use of alternative spectrum lighting on the FPSO and vessels operating in the field.
  - Impact of long-term noise and actual noise outputs from the operations:
    - Navitas is committed to the measurement of underwater noise levels *via* hydrophones as a monitoring exercise.

- Impact of Sea Lion crude on pinniped fur:
  - Investigation of Sea Lion crude impacts on seal fur will be conducted prior to drilling commencing.

- Offshore environment (NFB and Sea Lion Field):
  - Inter-annual distribution and abundance of marine mammals in the NFB,
  - Seabird distribution and abundance,
  - Seasonal abundance of fish and squid in the deeper areas of the Northern Slope (NS), and
  - Benthic habitats and fauna at the Sea Lion drill centre and flowline locations specifically.
- Inshore environment (Berkeley Sound):
  - Location(s) of Loligo (*Doryteuthis gahi*) spawning grounds (this work has been progressed through the GAP project and other projects, but the delineation of the spawning grounds remains a gap in knowledge. Survey data shows that Loligo do lay their egg clusters on hard surfaced down to approximately 80 m), and
  - Inter-annual distribution and abundance of marine mammals.
  - Given the limited operations in Berkeley Sound, the distribution and abundance of Loligo inshore *and* the Inter-annual distribution and abundance of marine mammals will not be specifically investigated by Navitas.

1.7.1.1.3 Management of data gaps within the Sea Lion EIA

Data gaps identified during the EIA process are specified in the respective impact and risk assessment chapters in the EIS (Chapters 10, 11 and 12). While a precautionary approach was taken during all the impact and risk assessments, it is important to note that the identification of data gaps was pivotal in determining the level of confidence in the assessment, as is described in the EIA Methodology (Chapter 8 of the EIS).

Where data gaps had the potential to undermine assessments of the 'Sensitivity of Receptor' or the potential 'Severity of Effect' associated with an activity, the confidence in the assessment was indicated to be either 'Probable' or 'Uncertain' (as opposed to 'Certain'). In turn, the level of confidence in the assessment was used to inform the monitoring requirements for each potential impact / risk (see again the EIA Methodology in Chapter 8 of the EIS).

To enable identification and agreement on reasonably practicable monitoring options, a workshop to consider the contents of an Environmental Monitoring and Management Plan (EMMP) to accompany the Sea Lion oil field Environmental Impact Statement (EIS) was held in Stanley, Falkland Islands on 23-25 April 2019. It was attended by 25 interested stakeholders, comprising FIG, POEPL, industry bodies and NGOs. Consideration was given to eleven environmental impacts from the Sea Lion development where there was potentially a need for further certainty as to the actual impact. The Summary EMMP tables, which have been reviewed and updated by Navitas, are provided below (Section 1.9; Chapter 15 in the full EIS). International researchers will continue to be engaged in the EMMP process through workshops and collaborative peer review so the work has international standing and transparency.

1.7.2 Key social sensitivities

As of the 2021 census, the permanent population of the Islands stands at 3,142 (2,818 excluding residents at the Mount Pleasant Complex (MPC)). The majority of the population resides in the capital, Stanley, which is the main town on the Islands and is situated on East Falkland. The key social sensitivities of the Falkland Islands are summarised in Table 1.5.

Table 1.5: Summary of key social sensitivities in the Sea Lion Phase 1 & 2 Development area

Social baseline and sensitivity											
Low[1]				Medium[1]				High[1]			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Commercial fisheries: The four most important fisheries within the Falklands Economic Exclusion Zone (EEZ) are the jig fishery for Argentine shortfin squid, Loligo squid and the trawl fishery for hake and Patagonian rock cod, which accounted for 49.5 %, 25.1 %, 12.9 % and 5.2 % of the 2013-2022 catches by weight respectively[2]. There is also a fleet of trawlers that operate over the Falklands continental shelf that target a range of finfish species. Currently, the only other fishery in the Falklands EEZ is the longline fishery for Patagonian toothfish, which operates in deeper waters (> 600 m).											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tangible property and resources: There is a range of onshore infrastructure on the Falkland Islands that will be utilised during the Phase 1 & 2 Development, which could lead to competition for resources with other users of these facilities. The main areas of potential impact include the use of: port facilities, supply routes, airports and airlinks, the road network, accommodation, freshwater and electricity supply. During the austral summer period, accommodation, flight availability and freshwater may all be less available.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tourism: The majority of tourists visiting the Falkland Islands arrive on cruise ships. Many cruise ships visit locations in the west of the Islands to see wildlife and most vessels visit Stanley. Within Stanley, there are a number of businesses and individuals that support tourist excursions to locations within driving distance of the city. Many of these sites are important for the wildlife that they support; however, they are also important recreational sites for residents.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marine archaeology: The UK Hydrographic Office Wreck site database indicates that there are 177 wrecks recorded within Falkland Islands waters, with records dating from the 1800's to present day. There are six recorded wrecks within 100 nautical miles of the proposed drilling sites; the closest of these wrecks is located approximately 50 nautical miles from the nearest well site. Two wrecks were identified within the Berkeley Sound survey area: the trawler Ocean 8 to the north-west, and the Blakeney to the south-east.											

[1] Note that the terms Low, Medium and High in this context provide a guide only as to the general sensitivity as it is relevant to each receptor. Specific sensitivities of each receptor to each social impact are explored in full within the EIS.

[2] Although rock cod has not been targeted in recent years and is not a commercial species any more, it is still abundant and important to ecosystem function.

1.8 Environmental and social impact and risk assessment

To answer 'Question 5' above, the following section provides:

- A description of how the activities associated with the proposed Phase 1 & 2 Development may interact with the environment e.g., the environmental and social aspects, impacts and risks,
- A brief summary of the EIA methodology,
- Key findings of the EIA including:
  - An overview of the overall EIA findings with regard to the initial and residual assessments, and
  - Narratives on the residual impacts (planned activities) and risks (unplanned / accidental activities) which remain of '**Moderate**' significance or above.
- A summary of all residual impacts and risks from all activities.

1.8.1 Environmental and social aspects, impacts and risks

All of the activities that will be carried out in the proposed Development have the potential to interact with the environment and the human population. The ways in which the Development activities may

interact, and the potential impacts and risks associated with these interactions, were identified during an ENVironmental Impact IDentification (ENVIID) workshop (see Chapter 9 of the EIS).

In summary, the ways in which the planned Phase 1 & 2 activities and unplanned / accidental activities may interact with the environment and the human population are as follows:

- Environmental aspects:
  - Artificial light,
  - Disturbance to wildlife from use of helicopters,
  - Disturbance to the seabed / placement and removal of objects on the seabed,
  - Underwater noise offshore,
  - Underwater noise inshore,
  - Drill cuttings and mud discharges to sea,
  - Operational discharges to sea,
  - Thermal discharges,
  - Atmospheric emissions,
  - Waste,
  - Collisions / entanglements with cetaceans,
  - Introduction marine non-native species, and / or
  - Introduction of terrestrial non-native species.
- Social aspects:
  - Disturbance to other users of the sea offshore,
  - Disturbance to other users of the sea inshore,
  - Competition for resources:
    - Accommodation,
    - Freshwater,
    - Electricity,
    - Air-links, and
    - Use of roads network.
  - Disturbance to the human population through:
    - Light, and
    - Helicopters and noise.
- Accidental events offshore, inshore and at-shore:
  - Loss of control leading to oil / chemical spill,
  - Small spills contributing to chronic oil pollution, and / or
  - Fuel spill either from bunkering operations or from an accidental event.

Each activity carried out during the Development may lead to one or more of the aspects above and one or more associated impact or risk. For example, the use of vessels will result in the presence of artificial light, underwater noise, discharges to sea, the creation of waste, impacts to other users of the sea and atmospheric emissions whilst also carrying the risk of collisions / entanglement with cetaceans, and the introduction of marine invasives and oil / MGO (diesel) spills. Therefore, the project activities, their associated environmental aspects and the environmental receptors on which they may impact upon, as identified in the ENVIID workshop, are presented in Figure 1-3. Details on the ENVIID process and indication of which impacts have been scoped out are provided in Chapter 9 of the EIS.

Note: under the FIG EIA Guidance Notes (FIG, 2016e) and in consultation with FIG (November, 2015) socio-economic impacts, such as tax revenues, wages, land values, were considered to fall outwith the scope of an EIA (see full EIS Section 6.2.2.1.1).

Identification of Environmental Aspects

Project activities	Environmental Aspects														
	Artificial light offshore	Helicopter disturbance onshore	Seabed disturbance offshore	Underwater noise	Drill cuttings and mud discharge	Operational discharges	Thermal discharges	Atmospheric emissions	Waste	Cetacean collision / entanglement	Marine species introduction	Terrestrial species introduction	Increased vessel presence	Competition for resources	Oil spill
Drilling operations	✓	✓	✓	✓	✓	✓		✓	✓				✓	✓	✓
Subsea works[1]	✓	✓	✓	✓		✓		✓	✓	✓			✓	✓	✓
FPSO HUC[2]	✓	✓				✓		✓	✓				✓	✓	✓
SIMOPS[3]	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓
Production	✓	✓		✓		✓	✓	✓	✓				✓	✓	✓
Oil export	✓	✓		✓				✓		✓	✓		✓		✓
Fixed-wing flights								✓				✓		✓	
Helicopter use	✓	✓						✓						✓	
Vessel use (all operations)	✓			✓		✓		✓	✓	✓	✓	✓	✓	✓	✓
Decommisioning[4]															

[1] Installation of subsea infrastructure
[2] Hook-up and Commissioning
[3] Simultaneous drilling and production operations
[4] Subject of a separate EIA

Identification of Environmental Impacts

Environmental aspects	Environmental receptors which may be impacted upon during planned activities and unplanned and accidental events:																		
	Physical				Biological								Social						
	Seabed (and soil)	Water quality	Air quality	Global atmosphere	Marine flora	Plankton	Benthos	Fish / squid	Seabirds	Marine mammals	Designated sites	Biosecurity / biodiversity	Landscape / seascape	Human population	Other users of the sea	Tangible property / resources	Archaeology	Stakeholder concern?
Artificial light (including flaring)						✓		✓	✓	✓				✓				✓
Helicopter use				✓					✓	✓				✓		✓		✓
Seabed disturbance	✓	✓					✓	✓			✓				✓			
Underwater noise						✓	✓	✓	✓	✓								✓
Drill cuttings and mud	✓	✓			✓	✓	✓	✓										✓
Operational discharges	✓	✓			✓	✓	✓	✓	✓	✓								✓
Thermal discharges	✓	✓			✓	✓	✓	✓	✓	✓								✓
Atmospheric emissions	✓	✓		✓														✓
Waste							✓	✓	✓	✓	✓	✓	✓	✓		✓		✓
Cetacean collision / entanglement										✓								
Marine invasive species					✓	✓	✓	✓	✓	✓	✓	✓		✓				✓
Terrestrial invasive species											✓	✓	✓	✓		✓		✓
Increased vessel presence		✓		✓					✓	✓		✓	✓	✓	✓	✓		✓
Competition for onshore resource[1]			✓											✓	✓	✓		✓
Human disturbance													✓	✓				
Oil spill	✓	✓			✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓

Figure 1-3: Project activities and the identification of environmental aspects and the receptors, upon which they may impact. Please note that the impacts of each aspect may be covered in different chapters (see EIS Table 2.2). Note that this figure shows only those impacts that were scoped in for further assessment ('F) in the ENVIID outcomes tables (Chapter 9)

1.8.2 Impact and risk assessment methodology

To understand the impact and risk assessment process and the summary results presented below, it is necessary to appreciate that:

- Impacts to the environmental and human population may result from planned activities, and
- Each activity carries the risk of impacts occurring during unplanned and / or accidental events.

As shown in Figure 1-4, the impact is assessed by considering the 'Sensitivity of the Receptor' and the 'Severity of Effect' on that receptor. This then leads to an overall 'Impact significance Rating' ranging from '**Very Low**' to '**High**'.

Impacts of unplanned or accidental events are assessed in the same way while the significance of the risk associated with these events takes account of the 'Likelihood' of the event occurring. Taking account of both the Impact Significance and the 'Likelihood of Occurrence' the 'Significance of Risk' is then rated, again ranging from '**Very Low**' to '**High**'.

*Significance of the **impact***	=	*The **sensitivity** of the receptor to the environmental aspect*	x	*The **severity** of the effect on the receptor*		
*Significance of the **risk***	=	*(----------Impact----------) The **sensitivity** of the receptor to the environmental aspect*	x	*The **severity** of the effect on the receptor*	x	*The **likelihood** that an unplanned or accidental event will occur*

Figure 1-4: Illustration of the impact assessment for planned events and the risk assessment for unplanned and accidental events

When carrying out the EIA, the impact and risk assessments are each conducted twice:

- The first assessment takes account of the legal requirements and industry-standard practices as well as the mitigations which are built into the base-case (see Section 1.5.2 above). The latter are included as these are already in place and are often included to minimise outputs e.g., emissions, discharges etc. This assessment describes the significance of the initial impact or risk (i.e., '**Very Low**' to '**High**').
- The second assessment takes account of any additional project-specific mitigations which are considered reasonably practical to further reduce the initial impacts and risks which were considered to be significant (i.e., '**Moderate**' or above). Project-specific mitigations are those which are used in addition to any mitigations required by legislation either in the Falklands or the UK and / or are currently considered to be standard industry practice in the Falklands. This second assessment describes the significance of the residual impacts and risks.

All residual impacts and risks will be reduced to a level that is 'As Low As is Reasonably Practicable' (ALARP) throughout the EIA process and throughout the life of the Development.

The mitigation measures and commitments are listed in the Environmental Monitoring and Management Plan (EMMP) described in Section 1.9.1 below.

1.8.3 Offsetting

Section 64C of the Offshore Minerals Ordinance states that EISs must contain a description of measures proposed to "*eliminate or reduce significant adverse effects…remedy those effects and offset them*." Appendix 2 to the FIG Hydrocarbons Environmental Impact Assessment Guidance Note (FIG, 2016e) provides offsetting guidance. ExCo paper 124/16 (FIG, 2016d) details FIG's recommendations for further developing offsetting guidance and suggested the establishment of an Environmental Fund.

ExCo paper 124/16 (FIG, 2016d) states that hydrocarbon development should seek meaningful offsetting of any impacts that cannot be avoided or mitigated, specifically in relation to greenhouse gas emissions and biodiversity. The options for offsetting these impacts include:

- Direct offsetting, i.e., the operator develops local projects to offset, like-for-like, the impacts arising from the Development that cannot be avoided or mitigated,
- Indirect offsetting, i.e., implementing measures that do not directly compensate for the impacts / risks identified, but may provide opportunities to achieve environmental benefits and improve the environment in the longer-term, or
- An environmental fund whereby the operator contributes to a fund with a governance panel to direct, manage and oversee various offsetting projects.

The Operator is required to demonstrate how offsetting measures have been considered which may further reduce significant adverse residual impacts identified in the EIS.

Navitas has ambitions for significant future local offsetting programmes, however these need to be informed by feasibility along with empirical data. Navitas will commit to a Carbon and Biodiversity offsetting Fund that will lay the foundations to inform scaling for island-wide restoration to achieve carbon and biodiversity benefits. Therefore, the Environmental Carbon and Biodiversity offsetting Fund is a precursor to inform any offsetting initiatives.

The section below details the offsetting options considered by Navitas and the reasons for the approach being proposed.

1.8.3.1 Review of offsetting options

Following elimination and / or reduction of all the impacts and risks identified for the Sea Lion Field, Navitas conclude that only tangible significant impacts /risks (impacts / risks assessed as ‘Moderate’ or above), may be offset.

Navitas has reviewed its significant residual impacts / risks (Section 1.8.4.2), and explored practicable, effective and locally beneficial direct offsetting measures in relation to these.

Direct or ‘like-for-like’ offsetting means compensating for impacts / risks to the environment at one site through activities that specifically address the nature of the impact in the local area. For example, this might include re-forestation of a nearby area where trees have been cleared for a construction site. For each residual impacts / risks assessed as ‘Moderate’ or above, Navitas has looked for practicable, local, environmentally beneficial and effective opportunities to directly offset them (see Section 8.11 of the full EIS). However, for each of the significant residual impacts / risks, Navitas has not at this time identified direct ‘like-for-like’ offsetting that is feasible, effective or reasonably practicable. The reasons for this are:

- It has not been possible to sufficiently quantify the impact / risk, and / or
- Navitas has not been able to conceive of a suitable project to achieve like-for-like offsetting,
- Navitas has conceived of but has not yet been able to determine feasibility, empirically define or formulate direct offsetting projects.

In addition, Navitas concludes it is not possible to plan to offset accidental events; that is where the impact may or may not happen, such as an oil spill. There is the risk of a spill occurring, but it is not possible to state if, when and what the impact of that spill might be, thus the impact is assessed in terms of the likelihood of it occurring. The impact itself is very difficult to quantify, and any efforts to remediate an impact that has arisen as the result of a risk, e.g., an oil spill, is considered ‘remediation’ as opposed to offsetting.

While potential offset initiatives have been identified in relation to atmospheric emissions, it has not been possible at this time for Navitas to determine the feasibility of these projects to confirm and quantify the benefit to the local environment, and that they are practicable for Navitas to implement. As such, while Navitas is committed to offsetting where practicable and to securing a positive environmental legacy, Navitas will not commence direct, like-for-like, offsetting for the residual significant impacts / risks from the Sea Lion Development until such time that identified initiatives have been further developed and proved, and it has been demonstrated that they are practicable and achievable within the Falkland Islands environment[1].

Where, following feasibility studies, direct offsetting activities or opportunities are not available, Navitas is also committed to exploring indirect offsetting opportunities onshore and offshore in the Falklands. Indirect offsetting refers to implementing measures that do not directly compensate for the impacts / risks identified above but may provide opportunities to achieve environmental benefits and improve the environment of the Falklands in the longer-term. These may include habitat restoration projects, pest and invasive species eradiation / control and conservation, biodiversity educational initiatives and the research required to inform them.

FIG's offsetting guidance requires proposed offsetting projects to be; described in detail (including costs and timelines), to be realistic, practicable and effective, be as quantitative as possible, additional to current projects / schemes or funding sources, and to provide a level of redundancy. Navitas cannot make *ad hoc* commitments to indirect offsetting projects that are not fully understood, and at this stage it has not been practicable to develop potential indirect offsetting projects to the level of maturity required by the EIA guidance. Given this, as a first step Navitas is working in close collaboration with FIG to initially identify schemes, undertake research as necessary and develop local indirect offsetting initiatives for future funding support.

Navitas will undertake operator-led direct and indirect offsetting in the Falkland Islands including carbon and biodiversity offsetting that includes Falklands-specific habitat restoration projects. To enable this Navitas will make contributions to a fund which will initially be used to commission research and feasibility studies that lead to pilot offsetting schemes that can be expanded to enable large scale in-Falklands habitat restoration (e.g., carbon sequestration) and biodiversity offsetting. Navitas will provide further funding to the viable projects identified. Navitas will monitor opportunities to fund / undertake direct and indirect offsetting throughout Field Life. There will be regular monitoring and reporting on performance of offsetting initiatives.

1.8.4 Key findings of the EIA

1.8.4.1 Overview of EIA findings - initial and residual assessments

A total of 134 impacts and risks were assessed.

During the initial assessment:

- 66.4 % of the impacts and risks assessed were considered to be **Very Low** or **Low**. While no additional, project-specific, mitigations were considered necessary for these impacts and risks, all will be subject to ongoing reviews to ensure that they remain ALARP,
- 27.6 % of the impacts and risks were considered to be of **Moderate** significance,
- 3.7 % were **Upper Moderate**,
- 1.5 % were **High**, and

[1] Since the public consultation, Navitas has agreed with FIG that it will make payments to a fund which will support local offsetting projects.

- 0.7 % were considered **Beneficial**.

Where initial impacts and risks were Moderate or above, project-specific mitigations were identified and those that were considered to be 'reasonably practicable' were factored into the residual assessment to reduce all the impacts / risks to ALARP. This resulted in an overall reduction in the number of 'High' impacts and risks (Figure 1-5).

Based on the residual assessment:

- The number of **Very Low** and **Low** impacts / risks increased to 67.9 %,
- The number of **Moderate** impact / risks remained at 27.6 % because two Upper Moderates were reduced to Moderate,
- The number of **Upper Moderate** impacts / risks remained at 3.7 % because two High risks were reduced to Upper Moderate,
- The number of **High** impacts / risks was reduced to 0 %, and
- The number of **Beneficial** impacts remained at 0.7 %.

A summary of the impacts and risks that were **Moderate** or above during the initial assessment and were reduced in the residual assessment due to the project-specific mitigation commitments is provided in Table 1.6.

The impacts and risks, which remained significant despite the use of industry-standard mitigations and the commitment to reasonably practical project-specific mitigations, are described in more detail below and summarised in Table 1.7.

A summary table showing all the residual impacts and risks to all the receptors is provided in Table 1.8 (in Section 1.8.5) below[2].

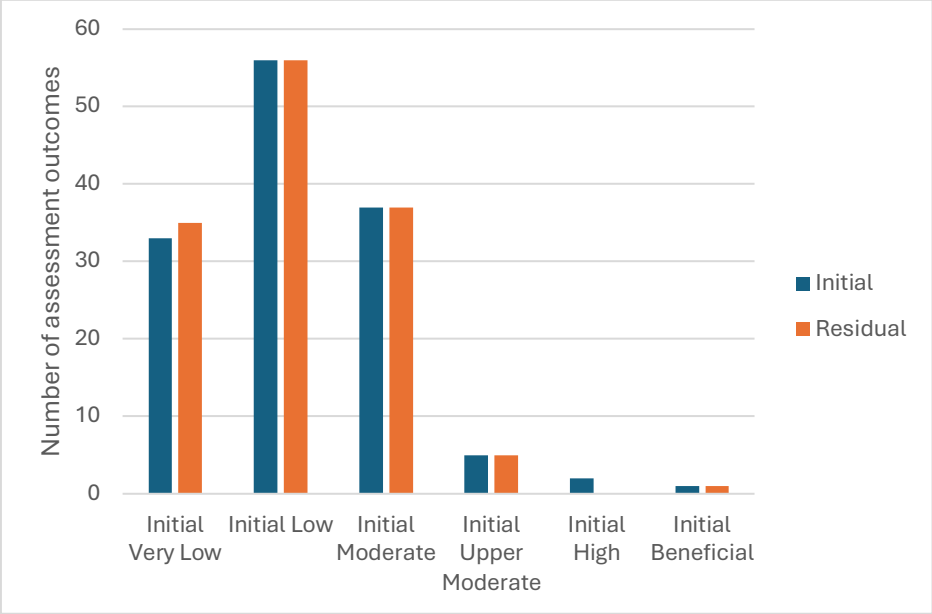


Figure 1-5: Illustrating the difference between the initial and residual impact and risk assessment outcomes

[2] Please note that Figure 1-3 above summarises the outcomes of the ENVIID while Table 1.8 below presents the worst-case outcomes of the assessment chapters. While individual receptors may be highlighted within Figure 1-3, for some activities, the impact assessment may, to avoid repetition, refer to biodiversity as a whole to assess the broad and primary impact rather than to itemise each individual receptor.

Table 1.6: A summary of the impacts and risks that were initially identified as being of Moderate significance or above and which were reduced following commitment to reasonably practical project-specific mitigations

Impact / risk	Initial assessment[1]	Key project-specific mitigation summary	Residual assessment[2]	Section
Collision between cetaceans and vessels inshore.	**Upper Moderate**	Reduction of vessel speed to maximum eight knots.	**Moderate**	**Section 10.11**
Risk of marine invasive species from biofouling on LTVs.	**Upper Moderate**	Hull inspection of LTVs and potential hull cleaning if necessary.	**Moderate**	**Section 10.12**
Use of freshwater resources during Stages 1 and 2 (a & b)	**High**	Ensuring reliability of water supply, offtake limits, pre-filling of MODU and vessels and re-stocking from incoming vessels. Use of seawater where possible.	**Upper Moderate**	**Section 11.4**
Competition with domestic energy needs	**High**	Sustainable and energy efficient design, Off-peak power utilisation, and standby diesel fueled electricity generators.	**Upper Moderate**	**Section 11.5**
Disturbance to the human population from operations noise at the TDF and supply base	**Moderate**	Activity restrictions and minimising noise at night	**Very Low**	**Section 11.9**
Disturbance to the human population from the Large Transport Vessel (LTV) and Offshore Construction Vessel (OCV) operations noise in Berkeley Sound	**Moderate**	Activity restrictions and minimising noise at night	**Very Low**	

[1] Taking account of regulatory requirements, industry-standard practices and base-case mitigations.
[2] Taking account of reasonably practicable project-specific mitigations.

1.8.4.2 Significant residual impacts and risks

The significant residual impacts and risks are summarised in Table 1.7. The sections below summarise only the residual impacts and risks that remained significant following project-specific mitigation. Note that the full EIS describes the initial and residual assessment outcomes for all the environmental and social aspects (Chapters 10, 11 and 12).

Significant residual impacts and risks are those that have been reduced to ALARP but are still considered to be '**Moderate**' or '**Upper Moderate**', primarily because of:

- The limited options for effective and reasonably practicable project-specific mitigations, and / or
- The use of a precautionary approach during the assessment when faced with data gaps, which leads to higher levels of uncertainty.

In each summary below, only the highest impact or risk is presented. For example, where underwater noise may affect diving seabirds and marine mammals, only the impact to marine mammals is described in the sections below as this was assessed as the greatest potential impact.

Table 1.7: A summary of the residual impacts and risks that, while considered to be ALARP, remain significant

Impact / risk	Residual assessment[1]	Section
Impacts and risks associated with planned activities		
Risk of large-scale bird-strikes due to artificial light offshore.	**Moderate**	Section 10.1
Risk of small-scale bird-strikes due to artificial light offshore.	**Moderate**	
Risk of large-scale bird-strikes due to artificial light inshore.	**Moderate**	
Behavioural disturbance to marine mammals from underwater noise offshore.	**Moderate**	Section 10.4
Impacts of drill cuttings discharge on benthos including burial of benthic fauna, modification of habitat, toxicity and oxygen depletion.	**Moderate**	Section 10.6
Impacts from Phase 1 & 2 atmospheric emissions on global warming.	**Moderate**	Section 10.9
Impacts from Phase 1 & 2 atmospheric emissions on ocean acidification	**Moderate**	
Indirect impact from atmospheric emissions associated with the combustion of sold product.	**Upper Moderate**	Section 10.9
Use of regulated landfill for waste disposal (while following the waste hierarchy as far as possible)	**Moderate**	Section 10.10
Risk of collision between cetaceans and vessels *en route* between the field and Stanley	**Moderate**	Section 10.11
Risk of collision between cetaceans and vessels in Berkeley Sound	**Moderate**	
Risk of introducing marine invasive species in Sea Lion in-field vessels	**Moderate**	Section 10.12
Risk of introducing marine invasive species in by *ad hoc* freighters	**Moderate**	
Risk of introducing marine invasive species to Berkeley Sound *via* LTVs	**Moderate**	
Risk of introducing marine invasive species in-field by CTTs	**Moderate**	
Risk associated with non-native terrestrial species arriving on air freight	**Upper Moderate**	Section 10.13
Competition for freshwater resources – water use for MODU drilling and vessel top-up and for onshore yards and accommodation (Stages 1 and 2)	**Upper Moderate**	Section 11.4
Competition for freshwater resources – water use for offshore vessel top-up and onshore yards and accommodation (Stage 3)	**Upper Moderate**	
Competition with domestic electricity needs	**Upper Moderate**	Section 11.5
Competition for use of road network	**Moderate**	Section 11.7
Disturbance to the human population from light at supply bases and TDF	**Moderate**	Section 11.8
Disturbance to the human population from light in Berkeley Sound	**Moderate**	
Risks associated with accidental events		
Accidental releases of Sea Lion oil to sea offshore	**Moderate**	Section 12.1
Accidental releases of inshore Marine Gas Oil (MGO) to sea offshore	**Moderate**	
Accidental release of MGO inshore	**Moderate**	Section 12.2
Day-to-day small leaks and spills at-shore	**Moderate**	Section 12.3

[1] Taking account of regulatory requirements, base-case mitigations, industry-standard mitigation *and* reasonably practicable project-specific mitigations.

1.8.4.2.1 Artificial lights offshore and inshore

Throughout the Phase 1 & 2 Development, installations and vessels will add to the existing levels of artificial light both offshore and inshore, and this was raised as a concern by stakeholders during consultations in 2014, 2015 and 2016 (see EIS Chapter 6). Further, while flaring is not expected to occur during normal operations, a pilot light will be permanently lit, and flaring may be necessary during planned or unplanned equipment outages. Flaring during well tests and well clean-up may also be

required for all production wells and is retained within the Development Description (Chapter 5) as a contingency.

During the hours of darkness, artificial light will attract plankton, fish and squid and potentially marine mammals, but the impact upon seabirds is considered to be of greatest concern. Lights will attract and / or disorientate seabirds (small petrels) and there is the potential for these birds to collide with the lights or vessel superstructures. This phenomenon is known as 'bird-strike'.

Bird-strikes may result in mortality through direct collision. Birds may suffer injuries or hypothermia, should feathers become contaminated with residues on the deck of a vessel. The occurrence of seabird collisions will depend upon a combination of factors including the species and abundance of birds in the area at the time, and local weather conditions. Small nocturnally active petrels are most susceptible during periods of poor visibility.

Taking account of the sensitivity of bird species which may be susceptible, the potential severity of effect of multiple bird-strikes, the fact that some artificial lighting on vessels and installations cannot be reduced or altered without compromising safety, and also adopting a precautionary approach, the residual risk of bird-strikes is considered to be '**Moderate**' (see EIS Section 10.1).

1.8.4.2.2 Underwater noise offshore

Underwater noise will be generated by the use of vessels throughout the Phase 1 & 2 Development and will be continuous throughout the life of the project. Noise pollution and its effects on sensitive receptors was raised as a concern by stakeholders during consultations in 2014 and 2015 (see EIS Chapter 6). While underwater vessel noise has the potential to impact upon plankton, invertebrates, fish and diving birds, it is most likely to have a consequential impact upon fish, seabirds and marine mammals, through disturbance and / or changes in behaviour. In other areas with greater marine actives, impacts on other parts of the ecosystem can also be expected with ramifications for acoustically sensitive marine organisms and the functioning of marine ecosystems.

When assessing the impact of sound on any animal, it is necessary to compare the sounds being made with the thresholds above which the animal may exhibit behavioural reactions to disturbance or experience hearing loss / injury. It is also necessary to consider how close the animal needs to be to the source of the noise for it to experience the sound at levels above the disturbance and injury thresholds.

Modelling was carried out to assess the impact of different sound sources on the different receptors e.g., fish and marine mammals[3], at different distances. Based on the modelling results and available information, the worst-case impact of underwater noise is that of a spread of near-stationary sources of vessel noise at the Phase 1 & 2 Development site (e.g., from the dynamically positioned tug tending the CTT, or the CTT accelerating / decelerating on approach or exit) and its potential long-term effect on marine mammals.

Given the conservation status of the whale species that may be affected, data gaps in marine mammal distribution in the NFB, lack of knowledge of the long-term impact of continuous noise and difficulties in effectively mitigating this impact, the precautionary approach dictates that the residual impact rating remains '**Moderate**' (see EIS Section 10.4).

[3] Note that there are no recorded injury or behavioural disturbance thresholds for plankton, invertebrates or seabirds against which to compare modelling outputs such that impacts to these receptors are not considered within the chapter. However, research has shown that some species of squid are similar to fish in their ability to detect sound (Mooney *et al.,* 2010; OSPAR, 2009b) and a qualitative assessment of the impacts to squid is carried out.

1.8.4.2.3 Discharge of drill cuttings

Drilling of the Development wells will result in the discharge of drilling muds and rock cuttings in the proximity of the well. Water-based Mud (WBM) and cuttings will be discharged directly to seabed whilst drilling the top sections of the wells. Cleaned Non-Aqueous Drill Fluid (NADF) cuttings will be discharged from the bottom sections of each well. Prior to discharge, NADF (see Section 10.6.4.1.3.1) cuttings will be returned to the MODU where they will be cleaned by a Thermo-mechanical Cuttings Cleaner (TCC). The cuttings will be cleaned to ensure there is <0.5 % oil (by weight on dry cuttings) remaining, following which the cuttings will be discharged to sea.

Whilst the discharge of cuttings may impact water quality, plankton, fish and squid, the greatest impact will be to the benthic community in the area. These impacts can arise from smothering, changes to habitat, reduction in oxygen availability and the toxic effects of residues associated with the cuttings.

Modelling was carried out to determine the extent of the impacts of the cuttings in the vicinity of the wells. Although there are no known species of conservation importance in the area, the specific location of the Sea Lion Development has not yet been surveyed such that there are minor data gaps and thus a precautionary approach was taken. Using the precautionary approach, and due to the extent and duration of the impacts, the residual impact to benthic fauna is considered to be '**Moderate**' (see EIS Section 10.6).

1.8.4.2.4 Atmospheric emissions (climatic factors)

Nearly all activities associated with the Phase 1 & 2 Development will result in atmospheric emissions and this was raised as a concern by stakeholders during consultations in 2015 and 2016 (see EIS Chapter 6). Emissions will result from power generation on the MODU and FPSO, the flare pilot light on the FPSO and the use of all vessels, fixed-wing flights and helicopters. There is also a contingency to flow / test four wells to the MODU if this is considered necessary and the potential for non-routine flaring as a result of process upset or emergency shutdowns throughout Field Life.

Atmospheric emissions include gases which lead to global warming and ocean acidification, the best known of which is Carbon Dioxide (CO_2).

A number of emissions reduction measures are built-in to the Phase 1 & 2 project, as shown Table 1.2 above. Moreover, in line with its HS&S and E&B Policies (see Section 3.2.1), and in recognition of Net Zero, Navitas will endeavour to minimise emissions, where possible, through operational control measures, monitoring and reporting and periodic reviews to determine whether or not the emissions remain ALARP. Worst-case emissions estimates based upon the Phase 1 & 2 Development (P10 – P90) indicate a carbon intensity of 21.8 - 30.3 kg CO_2 equivalent per barrel of oil produced. When the worst-case emissions are compared to the NSTA data (i.e., by removing emissions associated with personnel transportation, drilling and vessel use), the carbon intensity estimates range from 17.2 - 23.8 kgCO_2e/boe and the 'currently expected' emissions range from 13.1 - 18.2 kgCO_2e/boe.

The estimated worst-case percentage contribution of Sea Lion emissions is minimal when compared to the 2021 UK emissions (0.06 %) and amounts to 53 % of the Falklands Islands 2021 emissions (noting that the Falkland Islands dataset is currently incomplete as it does not include emissions from aviation, shipping or previous offshore O&G activity and includes only small-scale fishing within the IPPC 'transport' sector). While the new development has been designed with efficiency in mind, owing to the sensitivity of the global environment as a receptor, the residual impacts of the contribution of atmospheric emissions to both global warming and ocean acidification are considered to be '**Moderate**' (see EIS Section 10.9).

Emissions associated with the combustion of sold product are beyond the ability of Navitas to influence. Nonetheless, these were estimated for the P10, P50 and P90 production cases under the

worst-case assumption that 100 % of the sold product will be combusted. These emissions were compared over Field Life to two future projection scenarios for global demand and to the currently known global demand. Comparison with the global daily emissions of the two future projections indicated that the daily contribution of Sea Lion (at the P10 production case, 336.7 MMstb over Field Life) to global emissions ranged from 0.014 – 0.087 % and when compared to the current known demand, was 0.031 % (assuming all globally produced oil is similarly combusted). In absolute terms this is still a significant contribution and to take a precautionary approach, the impact was considered to be '**Upper Moderate**' (see EIS Section 10.9).

1.8.4.2.5 Waste management

Waste by-products will result from nearly every activity carried out during the Phase 1 & 2 Development and waste management was raised as a concern by stakeholders during consultations in 2015 and 2016 (see EIS Section 10.10). Waste from the Development will include domestic and marine wastes, solid wastes, produced water, drainage water, ballast water, domestic wastewater, food, sewage discharges and drill cuttings. Some of these wastes are hazardous, some are non-hazardous and some may be legally discharged to sea provided they undergo proper treatment. Produced water, drainage water, ballast water and drill cuttings are all described in separate chapters. With the exception of drill cuttings (see above) the associated impacts were '**Low**' such that they are not detailed in this NTS beyond their inclusion in Table 1.8 below.

Of greater significance, is the generation of solid operational wastes, all of which will be returned to shore for disposal at the FIG waste management facility or, in the event that the planned municipal facility is not yet available, for incineration at the supply base or deposition to landfill in the UK. To ensure the responsible management of waste, and compliance with Navitas' Duty of Care obligations, Navitas will develop and implement a project-specific Waste Management Plan (WMP) prior to the start of operations.

Navitas is committed to using the planned FIG Waste Management Facility to treat and dispose of all incinerable project wastes that have no re-use or recycling outlet locally. In the event that the FIG Waste Management Facility is unavailable, Navitas will discuss other options with FIG, such as the possibility to install a temporary incinerator at the supply base for the burning of suitable waste streams with resultant ash from the incineration process returned to the UK for disposal.

Navitas will not make use of the Eliza Cove or Mary Hill Quarry sites and will export wastes, if necessary, in compliance with all applicable international and national waste shipment regulations. Throughout the Development the 'Waste Hierarchy' will be utilised and annual waste targets will be set, to maximise waste reduction and recovery.

Waste facilities in the Falkland Islands are currently very limited. Plans approved by FIG should deliver a new municipal integrated waste facility that is capable of receiving the waste from the Sea Lion Phase 1 & 2 Development. Although it is not Navitas' preferred option for the disposal of wastes, should the municipal facilities not be ready when the project starts, some waste will need to be sent to landfill in the UK. Landfill is an unsustainable practice and therefore, although the quantities of waste are comparatively small, landfill space in the UK remains limited such that the worst-case residual impact of waste generation is considered to be '**Moderate**' (see EIS Section 10.10).

1.8.4.2.6 Risk of injury to cetaceans

1.8.4.2.6.1 Injury via collisions in-transit and inshore

There is a risk of vessel collision with cetaceans and this was raised as a concern by stakeholders in the 2016 scoping consultations (see EIS Chapter 6). Concerns about vessel collisions with marine animals is increasing worldwide. However, most publications focus on larger whales. While Schoeman *et al.*

(2020) found that smaller animals are also affected and recommend the establishment of a species-specific necropsy protocol and a database for smaller species, there is a paucity of documented evidence / data on vessel collisions and smaller cetaceans generally. In the Falklands Islands, recent collisions have been reported with sei whales and a Commerson's dolphin (Falklands Conservation, 2020). However, there is little detail on the circumstances. Anecdotally the collision with the dolphin was with a fast-moving launch. According to van Waerebeek *et al.* (2007), most collisions between small cetacean and vessels tend to occur in enclosed inshore, estuarine or freshwater environments where there is a high-density of smaller fast-moving vessels. Navitas will use large ocean-going vessels in Berkeley Sound and in the Sea Lion Field and for this reason, collisions with small cetaceans are not considered further. The impact assessment focuses on the potential for collisions with the larger cetaceans only.

Offshore vessels will transit from the Sea Lion Field into Stanley on a regular basis and though they are some of the smaller vessels used in the project, they will be operational year-round and so there is a possibility they will overlap with large whales, e.g., sei whales (IUCN 'Endangered') and southern right whales.

Some of the inshore vessels involved in the construction phase (e.g., the LTVs) will be considerably larger than vessels employed in the offshore aspect of the project. These vessels are required to transit to, and anchor in, Berkeley Sound where there is a seasonally high likelihood of encountering sei and southern right whales.

In line with the industry-standard guidelines, all vessels coming into Stanley, *via* Port William, will be limited to 10 knots on entering the proposed Marine Management Area (pMMA). However, in line with project-specific mitigations, vessels entering Berkeley Sound will reduce their speed further to eight knots. These relatively slow vessel speeds will reduce the likelihood of collisions and the energy behind any impacts, thus reducing the potential for lethal injury.

While the use of industry-standard guidelines, reduced vessel speeds and the use of Marine Mammal Observers will all lessen the likelihood and impact of collisions, the sensitivity of the large whale species that may be affected (e.g., sei whales), the limited maneuverability of very large whales (e.g., right whales), the unpredictable nature of cetacean behaviour in general and data gaps in the knowledge of whale distribution mean that while the risk has been reduced to ALARP, the residual risk remains '**Moderate**' for both offshore and inshore vessels (see EIS Section 10.11).

1.8.4.2.6.2 Risk of entanglement with subsea infrastructure

A review of the literature indicated that the majority of incidents of entanglement of cetaceans with man-made subsea structures involve fixed and static fishing gears. These usually have a considerable amount of slack in the lines and are generally of a small gauge. This slack enables the lines to wrap around whale body parts, which ultimately leads to entanglement and often drowning.

The anchor chains and cables associated with the MODU / FPSO, other large vessels and subsea risers would be high gauge and taut under most circumstances and would not have enough slack to allow cetaceans to become entangled. In the absence of records for entanglements with this type of gear, coupled with the lack of evidence for entanglement with high gauge moorings in the literature, this risk is not assessed further within this EIS.

1.8.4.2.7 Risk of introducing marine invasive species

The arrival of vessels into Falkland Islands waters from elsewhere in the world may lead to the introduction of non-native marine species and biosecurity was raised as a concern by stakeholders during consultations in 2014, 2015 and 2016 (see EIS Chapter 6). The introduction of non-native species can result from discharged ballast waters or from biofouling present in the 'nooks and crannies' of a

ship's hull. In the event that non-native species are introduced, there is then the potential that they may become established and spread. If this occurs, they are referred to as 'invasive species' and can dramatically alter the local ecosystem and / or outcompete native species altogether, negatively impacting the local biodiversity. Once established, marine invasive species are virtually impossible to eradicate.

The likelihood of such a species being introduced, and then becoming invasive, depends upon numerous factors e.g., whether the species comes from a similar climate and ecosystem, whether the ship passed through different climates *en route* (e.g., the Tropics) and whether or not the vessel is repeatedly 'new' to the Falkland Islands.

Industry-standard and project-specific mitigation measures regarding ballast water management and antifouling of vessels (which will be detailed in the Biosecurity Management Plan) go a long way to reducing the likelihood of species introduction, which may or may not then become invasive. However, the greatest risk comes from third-party vessels such as the purchaser's CTT over which Navitas does not have full control over and above contractor vetting and selection processes. On balance, given that species invasion can be difficult to detect in the short-term and can have severe effects on biodiversity which are almost impossible to reverse, the worst-case residual risk of marine species invasion is considered to be '**Moderate**' (see EIS Section 10.12).

1.8.4.2.8 Risk associated with non-native terrestrial species arriving on freight

Bringing freight into the Islands to support Navitas' operations carries the risk of introducing non-native, potentially invasive species in the cargo. As with marine invasives, if invasive species were introduced during the Phase 1 & 2 Development the impact on the ecology of the Islands through parasites, disease, competitors or predators may not be immediately evident but may have long-term implications. Initially the impact may not be felt locally, however, once established invasive species may spread 'naturally' or with anthropogenic assistance to other parts of the Falklands archipelago. If found, potentially invasive species can be removed but they can be very difficult to detect and then eradicate.

Vessels and charter flights will be arriving in Stanley and Mount Pleasant throughout the life of the Development and a large amount of cargo will be taken onshore. The transportation of invasive species to the Falklands has happened in recent years, and the introduction of invasive species has occurred in the O&G industry elsewhere in the world, such that the risk is considered possible during the Phase 1 & 2 Development. A Biosecurity Management Plan will be implemented during the Phase 1 & 2 Development to help prevent non-native and potentially invasive species being introduced. However, due to the potential impacts of invasive species and the fact that invasives have been introduced in the past, the risk of non-native species introduction is considered '**Upper Moderate**' (see EIS Section 10.13).

1.8.4.2.9 Competition for freshwater resources

Onshore infrastructure associated with the Development (e.g., the onshore supply base and the TDF) will require connection to the existing Stanley water utilities. In addition, the onshore water supply will be required to support a proportion of water use by offshore assets including vessels, the MODU's drilling requirements for muds, cements, brines and domestic use.

The FIG owned Stanley water filtration plant is the single water supplier and has a fixed capacity which is limited by the existing utility infrastructure[4]. Water is therefore considered a limited resource. Any

[4] Navitas is aware that FIG plans to increase water supply and treatment capacity. If these improvements are realised the impact of water use by the Development will be significantly lower. However, these planned improvements are not currently factored into the impact assessment in order to assume the worst-case.

use of water by the Development activities or assets which is above the current baseline Stanley usage has the potential to lead to competition with the local users in Stanley.

Competition for water resources will be particularly high during the drilling stages of the Phase 1 & 2 Development and in the event that demands during these stages exceed supply, impacts upon volume will be immediately apparent to consumers and businesses. The Stanley water supply is already near capacity and, to accommodate the Development, the existing system may need to operate at a temporary deficit for short durations if no changes are made to the current FIG system.

Throughout the project, the water supply to Stanley will always be prioritised over that provided to the TDF such that the impacts of any water shortage will be felt by the Phase 1 & 2 Development rather than the Stanley users. Nonetheless, the overall significance of the impact of water competition on the human population is '**Upper Moderate**' (see EIS Section 11.4).

All additional project-specific mitigation measures, including providing a freshwater buffer tank at the TDF and planning and logistics to reduce water use during the drilling phases, will be discussed further with FIG.

1.8.4.2.10 Competition for electricity

Onshore and at-shore infrastructure in support of the Phase 1 & 2 Development will require connection to the existing electrical power grid of Stanley. FIG is the single energy utility supplier and has a fixed power capacity from a finite number of generators at the Stanley power station and wind turbines located a few miles out of town.

Electricity is an essential utility upon which almost all daily activity depends in an increasingly electronic age. Stanley's current baseline capacity is such that it may be unable to sustain peak demand spikes in the short-term and therefore must be considered a finite resource. The use of electricity by Navitas therefore has the potential to be unsustainable in the immediate term. Overall demand from Stanley plus the Phase 1 & 2 Development has the potential to exceed the available capacity in the system. While Navitas will have back-up generators available at the onshore base, Navitas will liaise closely with FIG to ensure that energy supply and demand are in balance. These discussions will include those based on FIG's planned future development of power capacity.

Nevertheless, while development of a new FIG power station may alter the impact assessment by altering the baseline capacity against which usage is compared, these changes are currently outwith Navitas' control and cannot be used as a mitigation within this assessment. Therefore, the impact of competition for electrical energy on the human population of the Falkland Islands is considered to be '**Upper Moderate**' (see EIS Section 11.5).

1.8.4.2.11 Competition for use of road network

All stages of the Sea Lion Phase 1 & 2 Development will require the use of the existing road network for the movement of personnel to, from and within Stanley, for the haulage of equipment, and transport of supplies and waste between a range of different locations. Whilst road capacity and use cannot be accurately quantified, increased utilisation may be detrimental to the road surfaces and may also result in increased necessity for remedial repairs. Further, additional traffic, congestion and vehicles seeking parking may also create a nuisance to the local population and the issue of road use was raised as a concern during scoping consultations (see EIS Chapter 6).

An increase in traffic of up to 17 % in Stage 1 and Stage 2 (a & b), and 11 % in Stage 3 (up to 30 years) is predicted, which could result in some degree of congestion at peak times and lessen parking availability which may cause inconvenience to other road users.

A Traffic Management Plan (TMP) will be put in place for operations, as was done for the exploration campaigns, to minimise the impacts from operational road use in this area. The TMP will highlight operating hours, signage, allowable routes, warning devices, clothing and pedestrian precautions for Navitas staff and contractors. However, owing to the sensitivity of the receptor and the extent and duration of traffic increases, the residual significance of the impact of road use on the human population is still considered to be '**Moderate**' (see EIS Section 11.7).

1.8.4.2.12 Disturbance to the human population from light

Throughout the Phase 1 & 2 Development the onshore supply base and port facilities in Stanley, as well as the vessels in Berkeley Sound, will create artificial light. All of these sources have the potential to create light pollution and a nuisance to local residents. It was noted during previous scoping consultations that light from the TDF, vessels and yard is noticeable to Stanley residents (see EIS Chapter 6).

To ensure a safe operation, minimum levels of lighting are required on the TDF and at the supply base as well as in Berkeley Sound on the LTV storage vessels. In compliance with safety legislation, the light levels may not be reduced below that minimum. However, mitigation measures are proposed to ensure all lights are facing inwards and to reduce light pollution both by directionally blocking lights and turning them off when not required.

Nonetheless, due to the sensitivity of the receptor (the residents of Stanley and Berkeley Sound), the longevity of the potential disturbance in Stanley and the fact that proposed mitigation measures have not proven to be fully effective during previous campaigns, the residual impact of light pollution and nuisance to the human population is considered to be '**Moderate**' (see EIS Section 11.8).

1.8.4.3 Significant residual risks associated with accidental events

1.8.4.3.1 Accidental releases of crude oil or MGO to sea offshore

All offshore O&G operations carry the risk of oil spills and this was raised as a concern by stakeholders during consultations in 2014, 2015 and 2016 (see EIS Chapter 6). The impacts of any given spill depend upon the type of the oil, the size and source of the spill, the prevailing winds and currents, water depth, proximity to the shoreline or to concentrations of receptors offshore, and numerous other factors. Depending upon these factors, the spill may impact upon biological, social and environmental receptors.

Lessons learned from oil spill events around the world have led to stringent industry-standard practices that are required to minimise both the likelihood of occurrence of an oil spill and the consequences of such an event should it occur. Many of these preventative industry-standard practices are built into the design of the facilities (Section 1.5.2 above) and were therefore taken into account during the initial risk assessment.

With regard to the wells, industry-standard oil spill prevention measures range from the way the wells are designed to the use of blow-out preventers and operational control procedures that ensure that good oilfield practice is followed in all activities that could carry the risk of a large or small spill. Further, the well designs will be peer reviewed by an independent well examiner and the UK Health and Safety Executive (HSEx) to ensure that the risk of an uncontrolled release is minimised.

With regard to the FPSO, the industry-standard preventative requirements built-in to the design range from double-skinned and double-bottomed cargo and fuel tanks to the use of Automated Information Systems (AIS) and marine procedures intended to prevent collisions (Section 1.5.2 above). The FPSO is detachable should there be a risk from iceberg movement.

A range of different offshore oil spill scenarios were modelled to determine the behaviour of spills that could occur if the above preventative mitigation measures fail. The modelled scenarios included spills of reservoir oil from a well blow-out, loss of the FPSO cargo tank inventory, and spills of MGO during bunkering operations. The results of these models were used to inform the impact assessments with regard to the 'Severity of Effect' of a spill.

The measures intended to minimise the consequences of an oil spill are based upon the outcomes of the spill models, as well as industry-standard practice. An Oil Pollution Emergency Plan (OPEP) that covers the offshore operations will be submitted to FIG before operations commence and will detail the organisational responsibilities, immediate and long-term actions, reporting requirements and resources available to ensure the effective and timely management of any spills. The Sea Lion OPEP will be compatible with the FIG National Oil Spill Contingency Plan (NOSCP). Resources available, and described within the OPEP, will range from equipment held on-site by Navitas to international resources which can be brought in to track and monitor spill trajectories and / or equipment that will be deployed to stem the release of oil if necessary.

Mitigation measures to prevent the occurrence of spills and to minimise the consequences are designed based on the outcomes of the modelled oil spill scenarios, the full details of which are provided in Section 12.1 of the EIS.

Taking account of the predicted fate of Sea Lion crude and MGO in the event of a release (as indicated by the models), the worst-case potential impacts of an oil spill would be to fish, seabirds, marine mammals, fisheries and the human population (in terms of potential impact upon tourism through public perception of a spill, even if none were to reach the shore). The sensitivity of each of these receptors to an oil spill was assessed during the EIA and ranged from '**High**' to '**Very High**' (see EIS Section 12.1).

The impact of spills (i.e., the 'Sensitivity of Receptors' x 'Severity of Effect') on all the potential receptors was assessed for each spill scenario. The large volume crude spills (e.g., well blow-out, crude inventory loss) and spills that create a 'sheen' on the water (e.g., fuel spills) resulted in impacts of '**Upper Moderate**' and '**High**' significance to the more sensitive receptors.

As described in Section 1.8.2, the risk assessment process applies the likelihood of a spill occurring to the impacts associated with the spill. In the case of offshore spills, the 'Likelihood of Occurrence' was estimated based on statistical information on the frequency of incidents as well as specific Collision Risk Assessments for the Sea Lion Field activities. Based on these statistics, the likelihood of offshore spills ranges from '**Very Unlikely**' (e.g., for full loss of the FPSO crude inventory) to '**Possible**' (e.g., for a spill during transfer of crude from the FPSO to the CTT). Therefore, the assessment results in a worst-case residual risk of '**Moderate**' (see EIS Section 12.1).

1.8.4.3.2 Accidental releases of MGO to sea inshore

The risk of oil spill in Berkeley Sound was raised by stakeholders during consultations in 2014, 2015 and 2016 (see EIS Chapter 6). The potential sources of inshore spill include the arrival and manoeuvring of the LTVs prior to anchoring, intermittent visits from Offshore Construction Vessels (OCVs), and the presence of non-Navitas third-party vessels. Therefore, the events that may result in an MGO spill in Berkeley Sound include fuel bunkering incidents and potential vessel collisions.

With regard to mitigation, industry-standard collision prevention measures, AIS and marine procedures will be used (Section 1.5.2 above). Also, Navitas will 'vet' all vessels prior to their use for project activities.

The LTVs will be vetted and audited to assess:

- Verification of compliance with all relevant MARPOL Annex requirements and other IMO requirements,
- Verification of compliance with mandatory shipping requirements e.g., The Oil Companies International Marine Forum Ship Inspection Report Programme (SIRE), International Association of Classification Societies (IACS) etc.,
- Verification of the Shipboard Oil Pollution Emergency Plan (SOPEP), and
- Specific checks to ensure the vessel's equipment is suitable for the operation with regard to risk management and insurance requirements.

Two inshore oil spill scenarios were modelled to determine the behaviour of spills that could occur if the above preventative mitigation measures fail. The modelled scenarios were spills of MGO from bunkering incidents and vessel collisions. The results of the modelling were used to inform the impact assessment with regard to the 'Severity of Effect' of a spill.

An OPEP that covers the inshore operations will be submitted to FIG before operations commence.

Mitigation measures to prevent the occurrence of spills and to minimise the consequences are designed based on the outcomes of the modelled oil spill scenarios and full details are provided in Section 12.2 of the EIS.

Taking account of the predicted fate of MGO in the event of a release in the Sound (as indicated by the models), the worst-case potential impacts of spills are to fish and squid, fisheries, seabirds, marine mammals, coastal ecology and the human population (in terms of potential impact upon tourism). The sensitivity of each receptor within Berkeley Sound was assessed during the EIA and ranged from '**High**' to '**Very High**'.

The impact (i.e., the 'Sensitivity of Receptor' x 'Severity of Effect') on all the potential receptors in and around Berkeley Sound was assessed for both spill scenarios. The larger volume spill resulted in residual impacts of '**High**' and '**Upper Moderate**' significance to the more sensitive receptors.

Estimation of the 'Likelihood of Occurrence' of inshore spills was based on statistical information on the frequency of incidents. The assessment of the worst-case residual risk was '**Moderate**' for a spill of MGO (see EIS Section 12.2).

1.8.4.3.3 Day-to-day small leaks and spills at-shore

Small scale spills and leaks may occur through the presence and / or the day-to-day use of equipment onshore and at-shore (e.g., cranes, generators, vehicles etc.). Specifically, spills and leaks that may result from the presence and / or use of equipment include losses of chemicals or fuel oil (MGO). Any unintentional at-shore release which reaches the water, however small, will contribute to chronic pollution of the marine environment. Stanley Harbour supports a population of flightless Falkland steamer ducks, and is utilised by Commerson's and Peale's dolphins and South American sea lions. Although the number of animals present is not significant in terms of the Falklands populations, all of these are included in the list of priority conservation species and therefore the sensitivity of receptors is considered to be '**High**'.

While any such leaks are likely to be contained on the superstructure of the TDF where they will rapidly evaporate and are amenable to clean-up, some may reach the water. The scale of such leaks / spills is unlikely to warrant the deployment of a full oil spill response, although localised spill kits would be utilised to reduce the severity of any effect. While there is some uncertainty regarding the potential impacts of some of the fluids used during operations on the TDF, the environmental impact of any small leak or spill will be localised, short-term and fully reversible once activity ceases and, on balance, the severity of effect is considered to be '**Minor**'.

During the 2015 exploration campaign, two small incidents occurred which lead to leaks which did not reach the water. These events may occur less than once per year but could occur more than once over 10 years in the event that operational controls failed; therefore, the likelihood of small-scale spills or leaks occurring and contaminating the environment is '**Possible**'.

Therefore, the residual risk associated with day-to-day small spills is assessed as '**Moderate (9)**'.

1.8.5 EIA outcomes summary

Table 1.8 shows the significance of the worst-case residual impacts and risks associated with all activities on all receptors. The overall significance of impacts associated with each activity is based upon the greatest impact / risk. In other words, if an oil spill is identified as having a greater impact on seabirds than on the benthos, then the impact to seabirds dictates the overall significance of oil spills. Definitions of each significance category are provided in Table 1.9.

Table 1.8 also indicates which of the aspects were initially raised as a concern by stakeholders during the scoping consultations (EIS Chapter 6) to enable easier review by stakeholders of the EIA outcomes for their particular area of concern.

Table 1.8: Summary of the worst-case residual impacts / risks to each receptor for all The Sea Lion Northern Area Development, Phase 1 & 2 activities, and an indication of whether they were raised as a concern by stakeholders during informal scoping consultations[1]

Activity	Residual Environmental Impact / Risk[2]																	Worst-case Residual Impact / Risk	Raised by stakeholder during scoping
	Physical						Biological						Social						
	Seabed (and soil)	Water quality	Regional air quality	Global atmosphere	Marine flora	Plankton	Benthos / habitats	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Biosecurity / biodiversity	Land / seascape	Human population	Other sea users	Tangible property / resources	Archaeological		
Residual environmental impacts and risks associated with planned activities and unplanned events																			
Artificial light and the risk of bird-strikes inshore and offshore										n/a									✓
Disturbance to wildlife from helicopter use																			✓
Disturbance to seabed																			-
Seabed disturbance - risk of dropped objects																			-
Underwater noise offshore																			✓
Underwater noise inshore																			✓
Discharge of drilling mud and cuttings																			✓
Operational discharges																			✓
Operational discharges – risk of PWRI malfunction																			✓
Thermal discharges																			✓
Atmospheric emissions (climatic factors)																			✓
Atmospheric emissions from combustion of sold product																			-
Atmospheric emissions – risk of blowdown / venting / release of F-Gas																			✓

Activity	Residual Environmental Impact / Risk[2]																	Worst-case Residual Impact / Risk	Raised by stakeholder during scoping
	Physical						Biological						Social						
	Seabed (and soil)	Water quality	Regional air quality	Global atmosphere	Marine flora	Plankton	Benthos / habitats	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Biosecurity / biodiversity	Land / seascape	Human population	Other sea users	Tangible property / resources	Archaeological		
Waste generation																			✓
Waste - risk of loss of waste / improper segregation																			✓
Risk of large cetacean collision inshore and offshore																			✓
Risk of small cetacean collision inshore and offshore										n/a								n/a	-
Risk of cetacean entanglement										n/a								n/a	-
Risk of introducing marine invasive species																			✓
Risk of introducing terrestrial invasive species																			✓
Residual social impacts and risks associated with planned activities and unplanned events																			
Presence of FPSO / MODU and vessels offshore and impact on other users																			✓
Collision between vessels and FPSO / MODU																			✓
Presence of vessels inshore and impact on other users																			✓
Collision between vessels inshore																			✓
Competition for resources – accommodation																			✓
Competition for resources – freshwater																			✓
Competition for resources – electricity																			✓

Activity	Residual Environmental Impact / Risk[2]																	Worst-case Residual Impact / Risk	Raised by stakeholder during scoping
	Physical						Biological						Social						
	Seabed (and soil)	Water quality	Regional air quality	Global atmosphere	Marine flora	Plankton	Benthos / habitats	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Biosecurity / biodiversity	Land / seascape	Human population	Other sea users	Tangible property / resources	Archaeological		
Competition for resources – air links																			✓
Competition for resources - Use of road network																			✓
Disturbance to the human population – light																			✓
Disturbance to the human population – noise																			✓
Residual risks associated with accidental events																			
Oil spill - offshore																			✓
Fuel Oil spill - inshore (MGO)																			✓
At-shore spill of liquid fuel or chemicals																			✓
Spill of chemical at onshore supply base																			✓

Very Low | **Low** | **Moderate** | **Upper Moderate** | **High** | **Beneficial**

[1] Assessment of the Impact Significance is detailed in this EIS. Initial views of key stakeholders were sought during the scoping consultation process (Chapter 6) and thereafter, the EIS was updated wherever applicable in response to comments / information received from the previous public consultation. Comments received through the formal communication and consultation process are detailed in Chapter 0.

[2] Please note that this table summarises the worst-case impact / risk assessment outcomes. While some impacts may have been identified as requiring further assessment ('F') in the ENVIID outcome tables (Chapter 9), the further assessment carried out may have concluded that there would be no impact. This is indicated where necessary in the individual assessment chapters (Chapters 10, 11 & 12). Further, while individual receptors may be highlighted within Figure 1-3 above, for some activities the actual impact assessment may refer to biodiversity as a whole in order to assess the broad and primary impact rather than to itemise each individual receptor, thereby avoiding excessive repetition.

Table 1.9: Definitions of significance categories

Significance Level		Impact / Risk Definition
Unacceptable	High	Action required to eliminate impact or risk *via* project design or to reduce it to an acceptable level *via* additional mitigation measures and controls which aim to minimise consequence where feasible, effective and reasonably practicable. If impact cannot be reduced, the project cannot proceed.
ALARP Region (Impact tolerable if demonstrably ALARP)	Upper Moderate	Impacts assessed as "Upper moderate" may not be tolerable. Action is required to eliminate or reduce impact *via* project design and / or additional mitigation measures and controls, which aim to minimise consequence where feasible, effective and reasonably practicable. Impacts remaining within this category are considered to be within the upper reaches of tolerability and are placed here owing to the combination of a precautionary approach based upon data gaps and / or a lack of further reasonable mitigation options. Where the impact is ALARP and remains within this category, regular reviews (at a minimum of annually) will be held to determine whether the impact can be further reduced based upon the availability of new data and / or new technology. If the impact cannot be further reduced, consideration may also be given to offsetting of the impact (see Section 1.8.3).
	Moderate	Impacts assessed as "Moderate" require action to identify opportunities for improvement *via* project design, additional mitigation measures and controls which aim to minimise consequence where feasible, effective and reasonably practicable. Where the impact is ALARP and remains within this category, it will be subject to regular ALARP reviews as described above.
	Low	Impacts assessed as "Low" are with the levels of existing natural environmental variability. No project-specific mitigations will be implemented over and above industry-standard measures and controls unless it is stated as a requirement in conditions to approval or Falkland Islands Legislation and / or approved policy. Nonetheless, impacts shall be regularly reviewed to ensure that suitable controls remain in place and shall be subject to continuous improvement where opportunities exist.
Broadly acceptable	Very Low	Impact barely detectable. No additional actions required beyond industry-standard measures and controls. Nonetheless, impacts shall be periodically reviewed to ensure that suitable controls remain in place and shall be subject to continuous improvement where opportunities exist.
	Beneficial	Has a positive effect.

1.9 Environmental Monitoring and Management

To answer 'Question 6' above, the following sections describe what Navitas propose with regard to mitigating, monitoring and managing the potentially significant impacts and risks associated with the Phase 1 & 2 Development throughout its lifecycle.

In support of the EIS submission, Navitas has, to date, developed:

- A Waste Management Procedure,
- Preliminary offshore, inshore and onshore Oil Pollution Emergency Plans, and
- A preliminary Environmental Monitoring and Management Plan (Chapter 15).

These documents will be used to develop more detailed project-specific management plans in the event of approval and sanction of the project, and before operations commence.

The following project-specific management plans will be in place by the time operations commence and are under development:

- EMMP (see Section 1.9.1 below),
- Bird Strike Management Plan (BSMP),
- Waste Management Plan (WMP),
- Harbour Management Plan (HMP),
- Biosecurity Management Plan (BMP),
- Traffic Management Plan (TMP),
- Oil Pollution Emergency Plan (OPEP),
- Wildlife Response Plan (WRP), and
- Iceberg Management Plan (IMP).

1.9.1 Environmental Monitoring and Management Plan

Various commitments have been made by Navitas which aim to reduce the residual environmental impacts and risks. These commitments are detailed in the impact and risk assessment chapters of the EIS (Chapters 10, 11 and 12), and will be recorded in the overarching EMMP.

These commitments are in addition to the mitigation measures built-in to the design of the facilities (Section 1.5.2 above) and the industry-standard and legislative requirements (detailed within the EIS) all of which are considered to be a 'given'.

The specific purpose of the EMMP is to detail the actions / plans required to:

- Measure and monitor the impacts (primarily the 'Severity of Effect') of the Development, thus ground-truthing the EIA,
- Check the efficacy of the project-specific mitigations in place,
- Apply adaptive management options to further reduce impacts, and
- Fill spatial / temporal data gaps, where needed, to increase the level of confidence in the impact / risk assessment outcomes.

Should the monitoring of impacts indicate that the significance of the impacts and risks predicted in the EIS are not appropriate, and / or that mitigation is not effective, a revised mitigation measure and / or monitoring regime will be required.

1.9.2 EMMP Workshop

A workshop to consider the contents of an Environmental Monitoring and Management Plan (EMMP) was held in Stanley, Falkland Islands on 23-25 April 2019. It was attended by 25 interested stakeholders, comprising FIG, POEPL, industry bodies and NGOs.

The keys aims of the EMMP workshop were to agree:

- Priorities for monitoring,
- Planned surveys, monitoring and data collection,
- Regularity of surveys, monitoring and data collection,
- Methods for surveys, monitoring and data collection,
- Reporting of data,
- Intervention thresholds and the associated adaptive management options, and
- Governance (who will oversee the work).

At the Workshop, consideration was given to environmental and social impacts from the Sea Lion Development where there was potentially a need for further certainty as to the actual impact.

The Summary EMMP tables are provided in Section 1.9.3 and Chapter 15 in the full EIS.

In the event that the Development is approved and sanctioned, the EMMP will be transferred into a live document, which will provide details on:

- Specific roles and responsibilities,
- Timelines, deadlines and 'frequency of execution' for actions identified, and
- Progress and completion for use throughout the life of the field.

1.9.3 Preliminary EMMP

While the EMMP is ultimately a live document throughout the life of the Development, Table 1.10 provides a summary of the commitments made by Navitas which have been identified during the EIA process. As described above, a full copy of the EMMP will be made available prior to commencement of the project, upon request from Navitas (sealion.enviro@navitaspet.com).

Information arising from the EMMP commitments will be reported to the EMMP group[5] *via* agreed reporting protocols. Where necessary, amendments will be discussed and the EMMP actions updated accordingly.

[5] As agreed in the EMMP workshop held in 2019. This group will be supported by an advisory forum including both non-technical stakeholders and relevant individuals with expertise in the subjects being monitored and managed.

Table 1.10: Summary of environmental monitoring and management commitments

Environmental Aspect	Key monitoring and management commitments
Environmental impacts and risks associated with planned activities and unplanned events	
Physical presence - artificial light	• Investigate use of alternative spectrum ('green') lighting, • Investigate pilot-free flare design using an automated ignition system, • Seabird and Marine Mammal Observers (SMMOs) regularly on board project vessels, and • Development and implementation of the Bird-Strike Management Plan (BSMP).
Physical presence - helicopter use	• Monitor regularity of complaints received.
Physical presence - Disturbance to seabed	• Visual (ROV) pre-drill survey before drilling. • Seabed surveys of benthos and sediment chemistry throughout the Development.
Underwater noise	• Measurement of underwater noise during construction, • Ground truthing of noise levels once into production, • Investigate low noise thrusters and propellers on any Navitas operated vessels, and • SMMOs on board specific vessels and during certain activities.
Discharge of drilling mud / fluid and cuttings	• Seabed surveys of benthos and sediment chemistry throughout the Development, • Visual (ROV) pre-drill surveying, • Post-drilling cuttings pile analysis, and • Use and discharge of muds will be monitored on board throughout drilling.
Operational discharges	• Monitoring of all chemical discharges, • Oil in produced water (not normally discharged) concentrations included in environmental Key Performance Indicators (KPIs), • Risk Based Approach to ascertain the composition of produced water, • DREAM modelling of produced water once sampled and composition known, and • Produced water re-injection uptime included in environmental KPIs.
Waste generation	• Work collaboratively with FIG on the potential for development of improved waste facilities in the Falkland Islands, • Compliance with the specific requirements of the Phase 1 & 2 Waste Management Plan, • Education of offshore and onshore personnel e.g., inclusion in all personnel inductions, • Education of all personnel on the consequences for wildlife and landscape that can result from loss of waste to sea and inclusion of this in all FPSO and MODU inductions, • Use of educational posters about the potential consequence of loss of waste, • Potential for litter pick-up drives / incentives for local beauty spots and protected sites, and

Environmental Aspect	Key monitoring and management commitments
	• Periodic reviews on whether or not impacts of waste remains ALARP.
Atmospheric emissions	• Recording and monitoring of all emissions and fuel use, and • Uptime of gas re-injection included in environmental KPIs.
Marine mammal collision	• SMMOs regularly on board project vessels, and • Education and awareness for mariners. All collisions will be reported to FIG and the IWC via: www.iwc.int\ship-strikes or shipstrikes@iwc.int.
Introduction of non-native marine species	• Specific inclusion of each vessel's ballast water management system, exchange plan, record book and biofouling management plan (BFMP) and logbook in selection and pre-mobilisation HSE audits, • Ballast water sampling programme for OCV / PSVs entering the Falklands nearshore environment, • Implementation of the Biosecurity Management Plan (BMP), • Non-native species monitoring programme, and • Settlement plates and pathways analysis in the event of any incursions.
Introduction of non-native terrestrial species	• Implementation of the Biosecurity Management Plan (BMP).
Social impacts and risks associated with planned activities and unplanned events	
Competition for resources	• Monitoring of accommodation use and socio-economic impact on the rental market, • Use of onshore water supply will be monitored at all infrastructure locations, • Energy use will be monitored onshore and at the TDF, • Any incidental usage of existing air-links will be recorded, and • Off peak power utilisation.
Disturbance to the human population	• Monitor regularity of complaints received from local residents, • Noise and light monitoring during operations to validate predictions and inform ongoing practices, • Baseline levels of noise, and light to be better established, • Routine sampling and quality tests will be undertaken on all fuel supplies as part of procurement processes and audits, and • AIS based survey of shipping traffic at the Sea Lion location.
Risks associated with accidental events	
Oil spills	• Further research into the effect of Sea Lion crude on pinniped fur, • Regular oil spill response equipment exercises to be conducted, • Efficacy tests of oil spill response equipment, • Maintain continuous and live hydrodynamic model, once into production compare modelled rates with actual flowrates, and • Survey effort to improve knowledge of species distributions of seabirds and marine mammals *via* SMMOs on project vessels.

1.10 Overall conclusion

The use of vessels, fossil fuels and onshore resources (e.g., water and electricity) is necessary to carry out any O&G operation and the generation of some waste, which cannot be re-used, recycled or converted to energy is unavoidable. Similarly, the use of third-party vessels from elsewhere in the world will always carry some risk of non-native species introduction and all oil production and export operations carry the risk of oil spill events. It is, therefore, not possible to carry out O&G operations without some degree of environmental and / or social risk and impact.

In summary following the EIA process, and the adoption of ALARP mitigations, thirteen residual impacts and risks have been assessed as significant:

- Impacts - Planned activities:
  - Artificial light offshore and inshore - **Moderate**,
  - Underwater vessel noise offshore - **Moderate**,
  - Drill cuttings discharges – **Moderate**,
  - Atmospheric emissions (climatic factors) - **Moderate**,
  - Waste management (contingent export to UK with unrecoverable waste going to UK landfill) – **Moderate**,
  - Collisions with cetaceans inshore and offshore – **Moderate**,
  - Introduction of marine invasive species - **Moderate**,
  - Introduction of terrestrial invasive species – **Upper Moderate**,
  - Competition for freshwater resources – **Upper Moderate**,
  - Competition for energy resources – **Upper Moderate**,
  - Competition for use of roads – **Moderate**, and
  - Disturbance to the human population from light – **Moderate**.
- Indirect impacts beyond Navitas' ability to influence:
  - Atmospheric emissions associated with the combustion of sold product – Upper Moderate.
- Risks - Unplanned / accidental events:
  - Oil spill offshore, inshore and at-shore - Moderate.

Navitas believe that:

- All impacts and risks associated with The Sea Lion Field Northern Area Development, Phase 1 & 2 have been identified and robustly assessed,
- Impacts and risks which are ALARP and are considered to be of low significance are sufficiently controlled, and
- Impacts and risks that are currently ALARP but remain significant will be further reduced wherever practicable throughout the life of the Development.

Navitas will continue to do all that is reasonably practicable with regard to monitoring and management to minimise environmental impacts / risks during the Phase 1 & 2 Development.

All impact and risk assessments will be periodically reviewed to ensure that the controls remain in place and that activities leading to potentially significant impacts and risks are subject to continuous improvement where opportunities exist.

1.11 Formal stakeholder consultation

1.11.1 Representations by stakeholders

Following review by FIG DMR, and confirmation by the Executive Council that the EIS complied with the Schedule 4 of the FIG Offshore Minerals Ordinance, the EIS was formally submitted and underwent formal consultation in July - August 2024.

1.11.2 Responses by Navitas

Following the 42-day consultation, all material representations were provided to Navitas by DMR and recorded within this EIS (Chapter 0). This chapter also contains Navitas' responses and, where necessary, indicates what changes have been made to this post-consultation EIA / EIS in response to the representations made.

2 INTRODUCTION

Table of Contents

2.1 Introduction 77
2.1.1 Historical context 77
2.2 Overview of the Sea Lion Field Development 78
2.2.1 The Falkland Islands 78
2.2.2 The Sea Lion Field 78
2.2.3 The Sea Lion Field, Phase 1 & 2 - Development overview 81
2.2.3.1 Drilling (Stages 1, 2a & 2b) 81
2.2.3.2 Installation (Stages 1, 2a & 2b) 81
2.2.3.3 Production (Stages 2a, 2b and 3) 82
2.2.3.4 Simultaneous Operations (SIMOPS) (Stages 2a & 2b) 83
2.2.3.5 Oil export 83
2.2.3.6 Logistical Support 84
2.2.3.7 Decommissioning 84
2.2.4 Areas of uncertainty 84
2.2.5 Subsequent phases of development 84
2.3 EIA process overview 85
2.4 Scope of the EIA 85
2.5 Purpose and structure of this Environmental Impact Statement 86
2.5.1 Structure of the EIS impact and risk assessment chapters 87

2.1 Introduction

Navitas Petroleum Development and Production Ltd (Navitas) is proposing to develop the Sea Lion field ('Sea Lion') with a view to the long-term, responsible and sustainable production of hydrocarbons. Therefore, it is necessary to conduct an Environmental Impact Assessment (EIA) and to present the outcomes in an Environmental Impact Statement (EIS).

The EIA and the development of this EIS were carried out in compliance with the:

- Falkland Islands Government (FIG) Directorate of Policy, Economy and Corporate Services (Formally the FIG Environmental Planning Department (EPD)) Hydrocarbons Environmental Impact Assessment Guidance Note (FIG, 2016e), and
- Navitas Operating Management System (SEL-REG-OPM-PLN-00001-00).

The purpose of this introduction is to:

- Provide an overview of the historical context in which this EIS has been developed,
- Provide a brief overview of:
  - The Sea Lion Northern Development Area, Phase 1 & 2 Field Development,
  - The current areas of uncertainty within The Sea Lion Northern Development Area, Phase 1 & 2, and
  - The potential to further develop the basin in the future.
- Describe the purpose of the EIA and structure of this EIS.

2.1.1 Historical context

The North Falklands Basin (NFB) licences were previously held by Premier Oil Exploration and Production Limited (POEPL) working with their Joint Venture partner Rockhopper Exploration. Exploration drilling campaigns were carried out by Rockhopper in 2010-11 and by Premier in 2015-16. Plans for the development of the Sea Lion project, with a view to production, commenced in 2012. An EIS for POEPL's plan for the Sea Lion Development was submitted and formally accepted in 2020 (Premier, 2020). However, in 2020 the parent company of POEPL (Premier Oil) and Chrysaor merged to form Harbour Energy Plc. Harbour Energy Plc. then sold POEPL to Navitas Petroleum in September 2022. At this time, POEPL was renamed Navitas Petroleum Development and Production Limited (hereafter referred to as Navitas). All intellectual property previously owned by POEPL in relation to the Sea Lion Project is now owned by Navitas. As a result, Navitas has access to all preparatory processes and documentation developed under POEPL, all reports and surveys commissioned in support of the Sea Lion Development, as well as all 'lessons learned' throughout the process.

This is of particular importance in the context of:

- The Consideration of Alternatives (Chapter 4) which describes the evolution of the Development, the consideration of all technical options available and ultimately the rationale for the rejection of some options and the selection of others,
- The Scoping Consultation process (Chapter 6) which describes the various consultations carried out as the Development evolved over time,
- The Environmental Impact Identification (ENVIID) process (Chapter 9) which describes the outcome of numerous multidisciplinary ENVIID workshops, and
- Reference to POEPL commissioned surveys and reports.

Since Navitas acquired the NFB licences, the proposed Sea Lion Development has further evolved and has been optimised in terms of:

- The number and layout of the wells,
- The use of Open Hole Gravel Pack (OHGP) completions in the production wells (which do not require explosive perforation guns),
- The proposed daily production figures and hence the size and efficiency of the Floating Production, Storage and Offload (FPSO) vessel such that the forecast atmospheric emissions per barrel are reduced, and
- An extension to the proposed Field Life.

As a result, it is necessary to conduct another EIA and submit a revised EIS to FIG.

In order to avoid confusion regarding reference to work carried out under POEPL's operatorship, and that carried out since by Navitas, which now has ownership of all previous data, the relevant chapters will be managed as follows:

- The Consideration of Alternatives (Chapter 4):
  - An overview of the historical option selection process, as carried out under POEPL, is provided in order to retain understanding of the overall context. Detail on additional variations within the options, as considered by Navitas, is also provided.
- The Scoping Consultation process (Chapter 6):
  - Detail on all previous scoping consultations carried out under POEPL have been retained within the chapter as many of the representations made by the public and other stakeholders (and the relevant outcomes of these discussions) are still relevant to the current project. In order to avoid confusion to the readership (who may have attended the previous scoping sessions), the description of the earlier scoping consultations will remain the same and be referred to as historical consultations carried out under POEPL operatorship. An additional section has been included to describe the scoping process carried out by Navitas in December 2023.
- Reference to POEPL commissioned surveys and reports:
  - Where a given report, survey or review was carried out prior to Navitas' acquisition of POEPL, it is important to recognise that the information is still held within the Company and Navitas now owns the intellectual property rights. To ensure legal validity, sentences will state that 'POEPL (now Navitas) commissioned xyz etc.' but reference to the associated reports will remain as, for example, 'Premier 2016a'. Where necessary, details are provided in a footnote.

2.2 Overview of the Sea Lion Field Development

2.2.1 The Falkland Islands

The Falkland Islands are a UK Overseas Territory located on the edge of the Patagonian Shelf in the South Atlantic Ocean, approximately 480 km from the South American mainland. The Islands have a total land area of 12,173 km^2 (East Falkland approximately 6,700 km^2, West Falkland approximately 5,300 km^2, plus over 700 smaller islands) and a permanent population of approximately 3,000.

2.2.2 The Sea Lion Field

The Sea Lion Field, as determined by FIG in 2024, lies in water depths of approximately 450 m and is located in Block 14/10 in hydrocarbon license areas PL032, PL033, PL003, PL004 and PL005, approximately 220 km north of the Falkland Islands (Figure 2-1). It is the first commercially viable hydrocarbon discovery in the NFB and was discovered by Rockhopper Exploration PLC (Rockhopper) in 2010.

In October 2012, Premier Oil plc farmed in for 60 % of Rockhopper's licence interests in the Falkland Islands which included the Sea Lion Development and incorporated Premier Oil Exploration and Production Limited (POEPL). POEPL successfully submitted an EIS which was accepted in 2020 (Section 2.1.1 above). However, prior to consideration of field development approval, production consent and commencement of the Development, Navitas acquired POEPL in 2022. As such, Navitas is now Operator of licences PL032, PL033 and PL004 (a, b and c) in which the Greater Sea Lion Field is located.

Navitas' aim is to produce Oil and Gas (O&G) from the Sea Lion Field in a phased development and this EIS describes the EIA for the Sea Lion Northern Development Area Phases 1 & 2 (hereafter referred to as the Phase 1 & 2 Development throughout the document).

The Phase 1 & 2 Development is described in more detail in the Field Development Plan (SLN-GEN-PMA-PLN-00001-10).

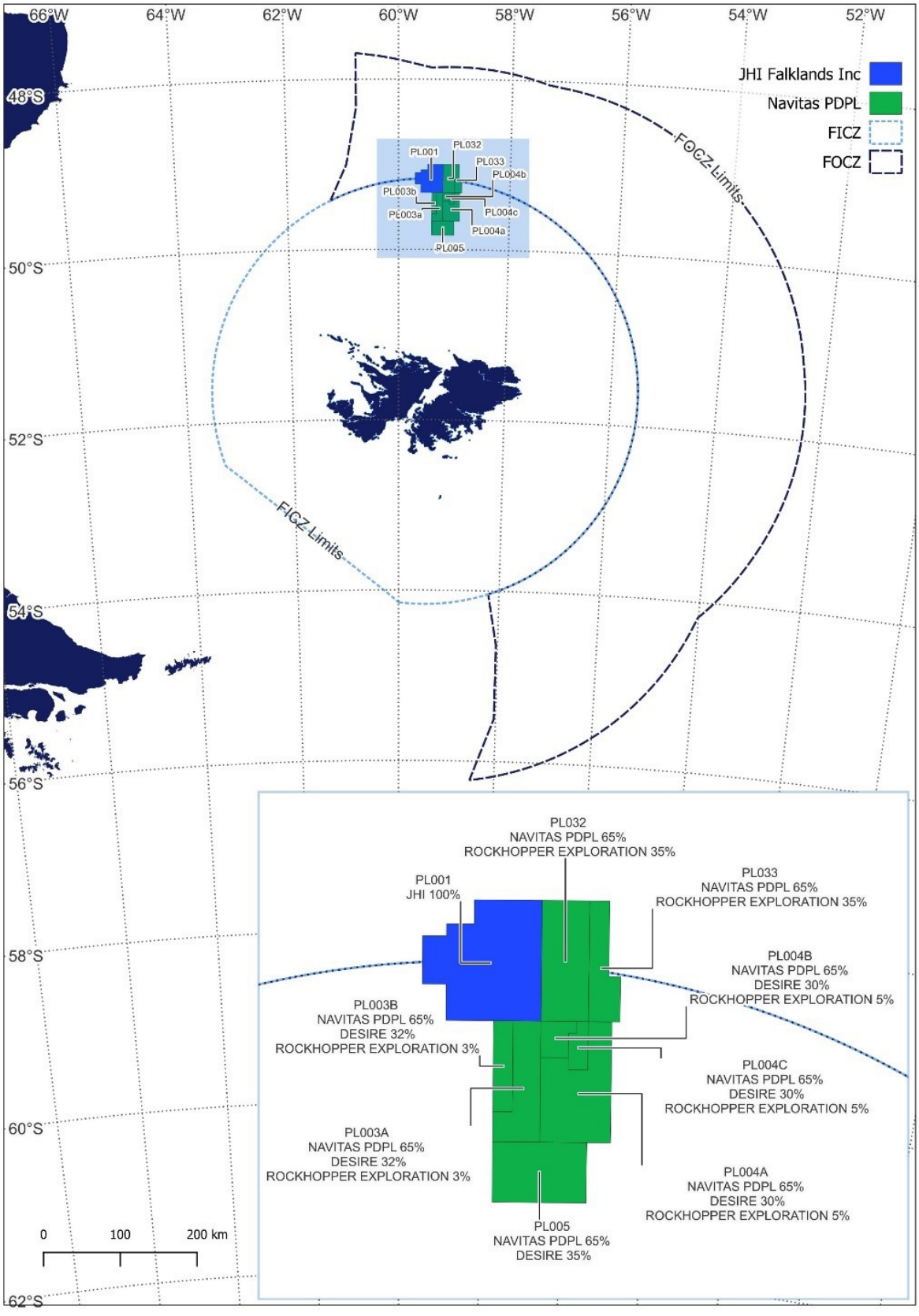


Figure 2-1: Sea Lion Field and Licence Block Locations

2.2.3 The Sea Lion Field Phase 1 & 2 - Development overview

The proposed Phase 1 & 2 Development is located in licence blocks PL032 and PL004. A Field Life of 30 years has been projected and it is estimated that approximately 310.5 million standard barrels (MMstb) of oil can be recovered during Phases 1 & 2.

2.2.3.1 Drilling (Stages 1, 2a & 2b)

The proposed drilling of these wells will occur as follows:

- Stage 1 – drilling of the first batch of the Phase 1 wells (eight wells (potentially nine if it is necessary to drill the contingency GI well)) up to First-Oil,
- Stage 2a – drilling of the second batch of the Phase 1 wells (three wells) while the FPSO simultaneously produces from the first batch (the first period of Simultaneous Operations (SIMOPS) (Section 2.2.3.4)),
- (Interim Stage 3 – steady state production with no drilling),
- Stage 2 b – drilling of the Phase 2 wells (12 wells) with ongoing production (the second stage of SIMOPS), and
- Stage 3 continued steady state production for Field Life (no drilling).

If approved by the Falkland Islands Government (FIG), the Phase 1 & 2 Development will comprise of up to 23 operational subsea wells. The Development is expected to consist of 16 Oil Production (OP) wells, six Water Injection (WI) wells and a single remote Gas Injection (GI) well. These 23 wells will be drilled across six Drill Centres to the north, east and south of the FPSO. There is a contingency to drill an additional GI well should the primary GI location prove unsuitable, and also for two redrills such that while there will only be 23 operational wells, the project may include up to 26 penetrations. To assume the environmental worst-case, this EIS assesses the impact of drilling the maximum number (26) of wells.

The single remote West Flank GI well is the first well in the drilling programme. This well will confirm the presence or absence of a gas cap in the SL20 reservoir and therefore establish whether or not the location is suited for gas disposal. Should this well confirm that the gas cap is absent or significantly smaller than expected, the GI well will be drilled at a contingent location, targeting the known gas cap in the Casper reservoir north of the PL032 / PL004 licence boundary.

All wells will be drilled using a Mobile Offshore Drilling Unit (MODU) located within a 500 m exclusion zone. The drilling operation will be supported by two Anchor Handling Supply Vessels (AHTS), as supply vessels) and an Emergency Response and Rescue Vessel (ERRV). The vessels will also have surveillance and response equipment onboard for monitoring and responding to oil spills should they occur.

The wells will be completed using an Open Hole Gravel Pack (OHGP) which will minimise debris within the wellbore. Therefore, the base-case is to flow the wells back to the FPSO, rather than clean them-up to the MODU beforehand. However, there is a contingency for three of the OP wells and the GI well to be flowed back, tested, to the MODU, which means four wells could be flared offshore for short periods of *c.* 1 day each. It is anticipated that drilling will start approximately 20 months after project sanction.

2.2.3.2 Installation (Stages 1, 2a & 2b)

Whilst drilling is ongoing, installation of subsea facilities will be undertaken by installation vessels, prior to the arrival and 'Hook-Up and Commissioning' (HUC) of the FPSO vessel.

During the installation phase, up to four Large Transport Vessels (LTVs) will be used as floating storage vessels to support the subsea installation operations. The LTVs will be anchored in Berkeley Sound and

each LTV will require its own individual 500 m exclusion zone. At any one time, there will be a maximum of two LTVs present in Berkeley Sound for short periods up to a total of 13 months. Navitas will work with the Falkland Islands Maritime Authority (FIMA) to identify optimum locations within Berkeley Sound that will cause the least disruption to other users during periods of high marine traffic in the Sound.

The FPSO will be anchored to the seabed at the Sea Lion location and will be surrounded by a 1,275 m exclusion zone, which is effectively 500 m beyond the installation extremities (including the hose and tanker during crude oil offload). The FPSO will be located approximately 2 km from the main Production Drill Centre (DC), 3.5km from the Water Injection DC, 5.3 km from the Gas Injection DC, 3.5 km from the Southern Production DC, 2.7 km from the East Water Injection DC and approximately 4.5 km from the Southern Water Injection DC. The contingent Gas Injection well is approximately 7.9 km from FPSO.

The DC's will comprise a number of subsea manifolds (for example, water injection or production) depending upon location (Section 5.5.3). An array of subsea pipelines and risers will be installed to connect the wells at the seabed to the FPSO. An illustrative layout of the installation is provided in Figure 2-2.

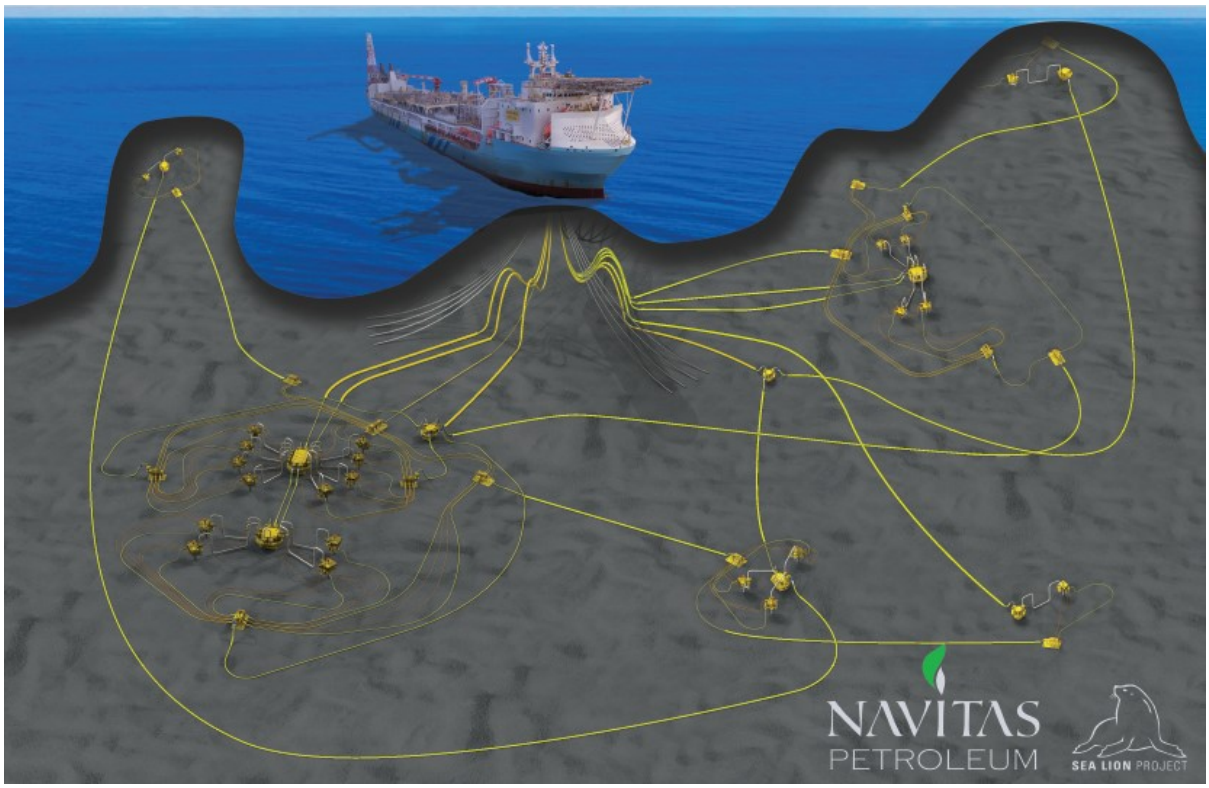


Figure 2-2: The Sea Lion Field Northern Development Area Phase 1 & 2 field configuration (illustrative only)

2.2.3.3 Production (Stages 2a, 2b and 3)

Following HUC of the FPSO, hydrocarbons will be introduced onto the vessel. HUC refers to the process by which the FPSO is connected to the subsea wells, *via* the manifolds and the pipelines, umbilicals and risers. During the commissioning process, the gas injection system will also need to be commissioned. This will potentially involve flaring produced gas for up to 30 days.

Once operational, the production wells will produce reservoir fluids to the FPSO. Oil production and processing carried out onboard the FPSO will stabilise the oil prior to its export. The produced fluids will consist of oil, water and gas which will be separated and treated on the FPSO. Once stabilised the oil will be transferred to storage tanks within the hull structure for subsequent offloading and export to market. Gas will be used for fuel, heat and power on the FPSO and for 'gas lift' in the oil production wells to enhance oil flow by reducing the density of the fluids in the well, thereby enabling a higher production rate from the reservoir. During normal operations, any excess gas will be re-injected into the GI well. Produced water will be cleaned and, during normal operations, will be re-injected *via* the WI wells, in combination with seawater (which has been treated with, for example, biocides and oxygen scavengers to ensure it doesn't foul the system), again to enhance / optimise oil recovery.

It is anticipated that 'First-Oil' will occur approximately 33 months after sanction.

2.2.3.4 Simultaneous Operations (SIMOPS) (Stages 2a & 2b)

Periods when both the MODU and the FPSO are operational in-field is referred to as Simultaneous Operations (SIMOPS). SIMOPS will occur over two periods of time.

After First-Oil, the MODU continues to drill the remaining Phase 1 wells (in Stage 2a) as the FPSO begins production. After this there will follow a period of steady state production (Stage 3) while performance is evaluated. Following this, the second period of SIMOPS will occur in Stage 2b when the Phase 2 wells are drilled. Once all the wells have been drilled, the MODU will leave, and in steady state production, only the FPSO, and its support vessels, will remain.

2.2.3.5 Oil export

The project oil export route involves the direct offtake of oil from the FPSO to a purchaser's Conventional Trading Tanker (CTT) at the Sea Lion location and from there the crude will be exported to market. The direct offtake process will be supported by an Offshore Support Vessel (OSV, i.e., a pull-back tug), in addition to the presence of the ERRV, which is always on standby.

Oil offtakes at peak production rates are expected approximately every 7-10 days. As the rate of oil production reduces over time, it is expected that the oil export operation will occur less frequently and/or smaller parcel offtakes will occur over time.

The direct offtake operation of crude to the CTT is described below.

- The CTT will arrive in Falkland Islands' waters and, dependent on metocean conditions / final risk assessments / approvals, a berthing crew will be transferred to the CTT either by pilot's boarding ladder or helicopter, at a safe distance from the FPSO,
- The CTT will rendezvous with the hold back tug (OSV), which will connect to the stern of the CTT,
- The Multi-Role Support Vessel (MRSV), (acting as an Emergency Response and Rescue Vessel (ERRV)) will be on standby duty in-field throughout the operation,
- The OSV will apply light power to control the heading of the CTT through approach,
- The CTT and connected OSV will approach the stern of the FPSO and connect to the FPSO by a taught hawser. The hose will be unreeled from the FPSO and transferred to the CTT where it will make a connection at the midship manifold and the transfer will begin,
- The OSV will remain attached during connection to the FPSO as well as during pumping, disconnect and departure,
- Once the transfer is complete, the CTT and OSV will disconnect from the FPSO and move away,

- At a safe distance, the OSV will detach and the berthing crew will disembark, and
- The CTT will proceed to deliver the crude to market without entering inshore waters.

2.2.3.6 Logistical Support

The drilling, installation, production and oil export operations will all be supported by an onshore supply base, liquid mud plant, and a Temporary Dock Facility (TDF) located to the east of Stanley. The offshore crew will fly to the Islands on fixed wing charter flights and will be transported from Mount Pleasant to Stanley by road and helicoptered to the Sea Lion Field.

2.2.3.7 Decommissioning

At the end of Field Life, expected to be 30 years after First-Oil, the FPSO and all associated subsea infrastructure and pipelines, will be decommissioned and removed from the NFB in accordance with requirements at that time. Decommissioning will be subject to a separate EIA, submitted at a time to be agreed with FIG (most commonly a few years prior to the cessation of production).

2.2.4 Areas of uncertainty

At the time of conducting the EIA, the following areas have not yet been fully defined:

- Final selection of the MODU to be used,
- Final selection of offshore drilling chemicals,
- The detailed drilling schedule,
- The source/s of equipment and materials e.g., Europe, Asia etc.,
- The specific vessels to be used for transportation, installation and support,
- Final selection of offshore production and utility chemicals,
- The frequency of dedicated charter flights throughout the Field Life,
- The frequency and source of *ad hoc* freighter vessels,
- Fine details on the accommodation arrangements on the Islands,
- Precise infrastructure requirements for power, water and roads, and
- Final selection of oil spill response equipment.

These project details will be finalised following project sanction and contract award. Where project details are subject to change, the 'worst-case' options have been assumed for the purposes of the EIA. Where the different options may impose different impacts and / or risks, either both options, or the worst-case, were assessed.

Therefore, as per the Hydrocarbons EIA Guidance Note (FIG, 2016e), this EIS includes a 'wider range / level of activity to accommodate areas of uncertainty'.

Importantly however, further changes may also occur before commissioning of the field. If post-sanction changes occur, discussions will be held with FIG to determine the most appropriate way to manage and assess the change.

2.2.5 Subsequent phases of development

The potential for subsequent phases of development to produce the remainder of the reserves in Licence Blocks PL032 and PL004 is currently under evaluation. The outcome of this evaluation will depend upon learnings from the Phase 1 & 2 Development, knowledge gained from the 2015 exploration campaign and the forecast for global oil demand and associated prices.

Subsequent phases are, as yet, undefined and are not within the scope of this EIA which assesses the proposal to develop the Sea Lion Field Northern Development Area, Phase 1 & 2 only.

2.3 EIA process overview

Numerous preparatory and data gathering steps are involved in conducting an EIA. These steps aim to:

- Understand the context within which the EIA is being carried out by:
  - Identifying the legal and regulatory context within which the proposed project is to occur (Section 3.1), and
  - Understanding Navitas' Operating Management System (SEL-REG-OPM-PLN-00001-00) which supports the proposed Development (Section 3.2).
- Ensure consideration has been given to alternative approaches to the proposed Development (Chapter 4),
- Understand the proposed Development and all the activities that may interact with the environment (Chapter 5),
- Identify any concerns that stakeholders may have regarding the proposed Development (Chapter 6),
- Understand the environment in which the proposed Development is to occur in order to identify key environmental and social sensitivities (Chapter 7),
- Develop a methodology for assessing the environmental and social impacts of planned activities and the risks associated with unplanned and accidental events (Chapter 8),
- Conduct an ENVironmental Impact IDentification (ENVIID) workshop to specifically identity the impacts and risks associated with the project activities that warrant further investigation, and those that can be 'scoped out' following preliminary assessment (Chapter 9),
- Assess the significance of all environmental and social impacts and risks that were not scoped out, taking account of the base-case (built-in) mitigations as well as the industry-standard, legal and Navitas OMS requirements (Chapters 10, 11 and 12),
- Identify the need for additional project-specific mitigation measures that may be reasonably practicable to reduce any *significant* impacts or risks to 'As Low As is Reasonably Practicable' (ALARP) (Chapters 10 and 11),
- Assess the significance of the residual impacts and risks which take account of the project-specific mitigation (Chapters 10 and 11),
- Identify the level of confidence in the assessments above to inform monitoring and measuring requirements (Chapters 10 and 11),
- Develop a project-specific Environmental Monitoring and Management Plan (EMMP) (Chapter 15) to list all the commitments made by Navitas to reduce impacts and risks, which have been agreed in a workshop and will be reviewed by key stakeholders, and
- Address any concerns raised by stakeholders during the post-submission statutory consultation process (Chapter 0).

2.4 Scope of the EIA

The environmental and societal impacts and risks assessed within this EIS are those associated with:

- Development drilling,
- Transportation and installation of all production facilities,
- Hook-up and commissioning of all production facilities,
- Production of O&G,
- Offloading of crude from the FPSO *via* direct offtake to the CTT,

- The presence of LTVs in Berkeley Sound,
- Associated supporting logistics and the use of onshore facilities e.g., the onshore supply base, and the 'at-shore' facilities e.g., the TDF and other port facilities, and
- Combustion of sold product.

The above are assessed to determine the impacts and risks associated with normal and planned operations as well as unplanned and emergency situations.

Following consultation with FIG (Chapter 6), and in line with FIG EIA Guidance (FIG, 2016e), areas that fall outwith the scope of this EIS include:

- Construction (as opposed to use) of the short-term and long-term onshore supply base and any upgrades that may be required to the TDF:
  - These will be covered by planning applications and separate EIAs as necessary.
- Decommissioning of the short-term onshore infrastructure associated with development drilling,
- Socio-economic impacts of the Development (e.g., revenue, employment etc.):
  - An independent socio-economic assessment of O&G development in the Falkland Islands was previously commissioned by Rockhopper Exploration (Plexus Energy, 2012).
  - FIG commissioned a Socio-Economic Impact Assessment (SIA) to identify potential impacts and any mitigation measures required to minimise any negative impacts that could be associated with O&G development (Regeneris, 2013).
  - An additional separate SIA, building on, and updating, the previous work undertaken for FIG and Rockhopper by Regeneris (2013 & 2015) and Plexus Energy (2012), was completed by POEPL (Maplecroft, 2019).
  - Navitas has commissioned an update to this SIA which will be completed in Q1 2025.
- Offshore decommissioning impacts:
  - These will be covered in a decommissioning-specific EIA prior to the Cessation of Production (CoP) and in support of the decommissioning programme (as agreed in discussion with FIG, and / or in accordance with extant FIG regulation in force at the time, or the approach taken in the UK with regard to developments on the UK continental Shelf (UKCS) and the BEIS (now DESNZ) Decommissioning Guidelines (BEIS, 2018)).

2.5 Purpose and structure of this Environmental Impact Statement

The EIA must be carried out in compliance with the requirements of the:

- Offshore Minerals Ordinance 1994 (and all amendments).

The EIS summarises the outcomes of the EIA and enables informed decisions to be made on whether or not the proposed Development may proceed based on the acceptability, tolerability or otherwise, of the impacts and risks.

Specifically, the EIS informs:

- The Navitas project development and design process; and
- The FIG review process.

Should the FIG Department of Mineral Resources (DMR) indicate to FIG Executive Council (ExCo) that a valid EIS has been submitted which is compliant with Schedule 4 of the Minerals Ordinance, a 42-day consultation period will follow. This will comprise formal consultation with FIG, its expected consultees

and the general public. Prior to any decision being made by FIG, Navitas will respond to comments received from the 42-day consultation by updating the EIS and/or submitting additional information, if required.

2.5.1 Structure of the EIS impact and risk assessment chapters

Within this EIS, each impact and risk assessment chapter (Chapters 10, 11 and 12) follows a consistent structure as summarised in Table 2.1.

Note that many of the Phase 1 & 2 Development activities, e.g., the use of vessels, may have numerous impacts or associated risks and thus need to be described in more than one chapter. Table 2.2 provides an overview of which activities are included in each assessment chapter.

Table 2.1: Impact and risk assessment chapter structure

Impact / risk chapter sub-headers	Description of content
Introduction	This section describes the purpose of the chapter and gives a brief account of the subject-specific legislation and associated compliance requirements.
Sources of impact and / or risk	This section lists Phase 1 & 2 Development activities that may result in the impact and / or risk and provides further detail where necessary and / or reference to the relevant section within the Development Description (Chapter 5).
Potential receptors	This section lists the environmental and social receptors that may be affected by the impact or risk (e.g., water quality, seabirds, human population etc.). Reference is made to the relevant section in the Environmental and Social Baseline (Chapter 7) for detail on the receptors, and a very brief summary of why these are considered to be receptors of the impact and / or risk in question is provided.
Characterising and quantifying the impacts and / or risks	This section provides the specific data necessary to inform the impact and / or risk assessment. Data is drawn from: subject-specific literature reviews to understand the nature of the impact; the Environmental and Social Baseline (Chapter 7) to understand what may be impacted and how sensitive it may be; and the Development Description (Chapter 5) to quantify the relevant project outputs (e.g., emissions, seabed footprint), thus informing the potential severity of the effect. The content within this section varies and is structured as appropriate to the specific impact / risk. **Note:** the estimation of the Phase 1 & 2 Development outputs (e.g., the amount of CO_2 emitted, the area of footprint on the seabed etc.,) takes account of the mitigations which are built-in to the project basis of design which are described in the Development Description (Section 5.14).
Industry-standard mitigation	This section lists the industry-standard mitigation measures that are factored into the initial impact and / or risk assessment and any requirements within the Navitas OMS.
Impact and / or risk assessment	This section draws on all the information above to assess the significance of the impacts and / or risks using the 'Sensitivity of Receptor', 'Severity of Effect' and 'Likelihood of Occurrence' (where applicable) guidelines provided in the EIA Methodology (Chapter 8). This initial assessment takes account of the industry-standard mitigation and a precautionary approach is taken. **Note:** this section aims to provide a concise assessment and refers back to previous sections within the chapter to support the statements made and the rationale behind the evaluation of impact / risk significance.
Project-specific mitigation	This section describes project-specific mitigation measures that may be deployed where necessary, and reasonably practicable, to reduce significant impacts and risks to ALARP.

Impact / risk chapter sub-headers	Description of content
Residual impacts and / or risks	This section describes the residual significance of the impact and / or risk following re-assessment with any project-specific mitigation measures taken into account.
Cumulative impacts	This section assesses the Phase 1 & 2 Development impacts in combination with inputs from other sources as per the EIA Methodology (Chapter 8).
Confidence	This section indicates the level of confidence in the overall assessment, taking account of any data gaps etc.
Offsetting	Where impacts are significant, this section refers back to Section 8.11 and the overarching section on the Carbon and Biodiversity Offsetting Fund.
Findings summary	This section summarises the complete impact and / or risk assessment chapter in a standardised table format.

Table 2.2: Summary of the assessment chapters and which project activities are included within each

Assessment chapters			Drilling operations	Installation	FPSO HUC	SIMOPS	Production	Offloading from FPSO to CTT	LTVs in Berkeley Sound	Use of the onshore supply base and TDF	Fixed-wing flights	Helicopter use	General vessel use	Onshore activity	Decom-missioning
Environmental	10.1	Artificial light	✓	✓	✓	✓	✓	✓	✓				✓		n/a
	10.2	Disturbance to wildlife from helicopter use										✓			n/a
	10.3	Seabed disturbance	✓	✓		✓	✓		✓						n/a
	10.4	Underwater noise offshore	✓	✓		✓	✓	✓				✓	✓		n/a
	10.5	Underwater noise inshore							✓			✓	✓		n/a
	10.6	Drill muds and cuttings discharge	✓			✓									n/a
	10.7	Operational discharges	✓	✓	✓	✓	✓						✓		n/a
	10.8	Thermal discharges (e.g., from cooling systems)				✓	✓								n/a
	10.9	Atmospheric emissions	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	n/a
	10.10	Waste	✓	✓	✓	✓	✓		✓	✓			✓	✓	n/a
	10.11	Cetacean collisions / entanglement	✓	✓	✓	✓	✓	✓	✓	✓			✓		n/a
	10.12	Introduction of marine invasives (e.g., from ballast water)	✓	✓				✓	✓	✓			✓		n/a
	10.13	Introduction of terrestrial invasives									✓		✓	✓	n/a
Social	11.1	Disturbance to other users of the sea offshore	✓	✓	✓	✓	✓	✓					✓		n/a
	11.2	Disturbance to other users of the sea inshore							✓	✓			✓		n/a
	11.3	Competition for accommodation	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	n/a
	11.4	Competition for freshwater	✓	✓	✓	✓	✓		✓	✓			✓	✓	n/a
	11.5	Competition for electricity								✓				✓	n/a
	11.6	Competition for air links	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		n/a
	11.7	Competition for roads	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	n/a
	11.8	Disturbance to the human population from light							✓	✓			✓	✓	n/a
	11.9	Disturbance to the human population from noise							✓	✓		✓	✓	✓	n/a
Acci-dental	12.1	Oil spill and chronic pollution offshore	✓	✓	✓	✓	✓	✓					✓		n/a
	12.2	Fuel oil spill inshore							✓				✓		n/a
	12.3	Oil spill and chronic pollution at-shore								✓			✓	✓	n/a

3 EIA CONTEXT

Table of Contents

3.1 Regulatory overview and legislation 92
3.1.1 Falkland Islands territorial status 92
3.1.2 Falkland Islands governance 92
3.1.3 Governing bodies for O&G activities in the Falkland Islands 92
3.1.4 The Environmental Charter 93
3.1.5 Falkland Islands Environmental Strategy 2021-2040 93
3.1.6 Falklands Islands policies and codes of practice 93
3.1.6.1 Offshore environmental policy review (2016) 93
3.1.6.2 Hydrocarbons Development Policy Statement 2013 94
3.1.6.3 Local Content Code of Practice for Procurement by O&G Companies and their Subcontractors Operating in the Falkland Islands 94
3.1.7 Legislation relevant to O&G development in the Falkland Islands 95
3.1.7.1 International treaties and legislation relevant to the Falkland Islands 95
3.1.7.2 UK legislation 96
3.1.7.3 Falkland Islands national legislation 98
3.1.7.3.1 Offshore Minerals Ordinance 1994 (as amended) (The Ordinance) 98
3.1.7.3.2 Offshore Petroleum (Licensing) Regulations 1995 and 2000 (as amended in 2004, 2005 and 2009) 99
3.1.7.3.3 Petroleum Survey Licences (Model Clauses) Regulations 1992 100
3.1.7.3.4 Maritime Ordinance 2017 (and 2019 amendment) 100
3.1.7.3.5 Maritime (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 2019 100
3.1.7.3.6 Deposits in the Sea (Exemptions) Order 1995 100
3.1.7.3.7 Marine Mammals Ordinance 1992 100
3.1.7.3.8 Conservation of Wildlife and Nature Ordinance 1999 101
3.1.7.3.9 Fisheries (Conservation and Management) Ordinance 2005 101
3.1.7.3.10 Endangered Species Protection Ordinance 2015 101
3.1.7.3.11 Planning Ordinance 1991 101
3.1.7.3.12 Planning (Environmental Impact Assessment) Regulations 2015 101
3.1.7.3.13 Falklands Interim Port And Storage Solution (FIPASS) Ordinance 1989 101
3.1.7.3.14 Harbours and Ports Ordinance 2017 102
3.1.7.3.15 Maritime (Registration of Ships) Regulations 2019 102
3.1.7.3.16 Offshore Installations (Safety Case) Order 2008 102
3.1.7.3.17 Falkland Islands Environmental Trust Ordinance 2021 102
3.1.7.3.18 Maritime (Port State Control) Regulations 2021 102
3.1.7.4 Petroleum Operations Notices (PONs) 102
3.2 Navitas Operating Management System 103
3.2.1 Corporate HS&S and E&B policies 103
3.2.1.1 The Navitas OMS Elements 106
3.2.2 Project planning and review 108
3.2.3 Environmental baseline data gathering 109
3.2.4 Impact and risk identification and assessment 109

3.2.5 Legal compliance 110
3.2.6 Operational control 110
3.2.7 Safety and Environmentally Critical Elements register 111
3.2.8 Emergency response 111
3.2.9 Incident management 111
3.2.10 Monitoring and measuring 111
3.2.11 HSE Plans and environmental objectives and targets 112
3.2.12 Environmental performance 112
3.2.13 Audit and review 112
3.2.14 Contracting strategy 113
3.2.15 Contractor management 113
3.2.16 Management of Change 114
3.2.17 Stakeholder management 114
3.2.18 Project-specific environmental management 114
3.2.18.1 Sea Lion Field Northern Development Area management plans 114
3.2.18.2 Environmental Monitoring and Management Plan 116

3.1 Regulatory overview and legislation

This section provides a brief overview of the system of governance within the Falkland Islands and current legislation that governs Oil and Gas (O&G) activities in the Islands. The information presented is based upon a review carried out by Genesis (2013), updated in 2023 by SFL.

3.1.1 Falkland Islands territorial status

The Falkland Islands is one of 14 United Kingdom Overseas Territories (UKOT), which are managed under the British Overseas Territories Act 2002.

3.1.2 Falkland Islands governance

The Islands are self-governed although supreme authority is vested in His Majesty the King who is represented in the Falkland Islands by Her Excellency the Governor. Defence and foreign affairs remain the responsibility of the British Government.

The Constitution of the Falkland Islands, the present version having been in place since 2008, lays out the rights and freedoms of the individual as well as setting out the ways in which the Falklands are governed and how its laws are made.

The Falkland Islands' system of government follows the Westminster Model and is divided into:

- Elected Members of the Legislative Assembly (MLA) and associated Legislative and Executive Councils:
  - Eight MLAs are elected as independents by the Falkland Islands' Community to serve a four-year term.
- *Ex officio* members from the Falkland Islands Government (FIG), British Forces and the Governor:
  - The Governor is appointed by the Foreign, Commonwealth and Development Office (FCDO).

Legislative Assembly meetings are held in public (FIG, 2023a) and are chaired by a Speaker chosen from the community by Assembly Members. The meetings are attended by the MLAs and two *ex officio* members, namely the Chief Executive and the Financial Secretary. The Attorney General and the Commander of the British Forces South Atlantic Islands (CBFSAI) are also entitled to attend.

The Legislative Assembly is empowered to pass legislation for the peace, order and good governance of the Falkland Islands, subject to the approval of His Majesty the King and acting through his Secretary of State for Foreign Affairs.

Each year, the MLAs elect three of their number to the policy-making body of the Government known as the Executive Council (ExCo) which is chaired by the Governor. Membership includes the same *ex officio* members who sit on the Legislative Assembly. In addition, the Attorney General and CBFSAI may attend and speak on any matter although only the three elected MLAs are able to vote on ExCo (FIG, 2023a).

3.1.3 Governing bodies for O&G activities in the Falkland Islands

The Falkland Islands offshore hydrocarbons industry is regulated by the FIG's Department of Mineral Resources (DMR). The Department obtains specialist advice from a number of UK Government organisations, such as: the Health & Safety Executive (HSE), the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED), and the British Geological Survey (BGS). However, the DMR has limited executive approval powers and makes recommendations for approval to ExCo. Ultimate approval for a number of Mineral Resources-related matters, such as the granting of licences and changes of licence ownership, is retained by the UK Secretary of State for the FCDO.

The Planning and Building Committee is the authority responsible for statutory planning determinations within the Falklands. Any aspects of a hydrocarbon development occurring within the 12 nm limit or onshore will fall under statutory planning regulations.

Ultimate power in mineral regulatory matters lies with the Governor. The Governor consults with the ExCo, which in turn is advised by the DMR, the Policy Unit[6] and Planning and Building Services[7]. The DMR is responsible for leading on the assessment of the EIS and ultimately makes a recommendation to ExCo as to whether the EIS meets the requirements of the Offshore Minerals Ordinance 1994 (as amended) (Section 3.1.7.3.1).

3.1.4 The Environmental Charter

The Environmental Charter is a joint agreement between FIG and the UK Government and was signed in 2001 (FIG, 2023b). The Charter lists ten guiding principles and the UK and Falkland Islands Governments have each made eleven commitments therein, all intended to ensure environmental management within the Islands.

One of the UK commitments within the Environmental Charter is to 'assist the Falkland Islands in reviewing and updating legislation'. Environmental legislation that applies to O&G activities within the Falkland Islands is based on that for the United Kingdom Continental Shelf (UKCS). However, given that the O&G industry within the Falklands is in its infancy, guiding legislation specific to the Falklands is currently limited. FIG are undertaking a review to ensure the development of appropriate offshore environmental legislation (Section 3.1.6.1). While this process is underway however, and in the absence of specific Falklands legislation, the preparation of required consents shall be based on UK guidance.

3.1.5 Falkland Islands Environmental Strategy 2021-2040

The Falkland Islands Environmental Strategy was published in 2021 to address a broad range of environmental issues and is to be used as a vision to guide priorities, policy creation and work for the Falkland Islands in the long-term. The process included across-government consultation as well as public engagement. With specific reference to the O&G industry, the strategy aims to:

- Conduct the extraction of non-renewable resources, including hydrocarbon development, in a way that values and conserves our unique biodiversity and ecology, supported by effective regulation, and
- Promote and encourage investment in the Falkland Islands Environment Trust and support projects funded by that Trust (see Section 3.1.7.3.17) (FIG, 2021a).

3.1.6 Falklands Islands policies and codes of practice

3.1.6.1 Offshore environmental policy review (2016)

As part of its 'oil readiness planning', the FIG has reviewed its current legislative structure in respect of environmental regulation of offshore hydrocarbon activities and several crucial gaps have been identified. Consequently, a consultation was held on proposed offshore environmental legislation. This proposed legislation should provide the Falkland Islands with a modern regulatory regime, granting regulatory powers that are appropriate to the Falkland Islands' constitutional obligations. Further, the proposed legislation will ensure that environmental impacts and risks are appropriately regulated given the logistical and operational challenges inherent in operating in the South Atlantic. Therefore,

[6] Now known as the Policy Department which sits within the new Directorate of Policy, Economy and Corporate Services (as at 2023).
[7] Now part of the Department of Development and Commercial Services.

it is likely that offshore environmental legislation will be updated prior to the commencement of in-field work on the Phase 1 & 2 Development.

3.1.6.2 Hydrocarbons Development Policy Statement 2013

In order to plan for the future development of the hydrocarbons industry in the Falklands, a Policy Statement was prepared to provide clarity on the purpose of hydrocarbon development and how the implications of developments will be managed. In 2013, the Falkland Islands Hydrocarbon Development Policy Statement (158/13) was released with the following recommendations:

- Hydrocarbons in Falkland Islands waters belong to the people of the Falkland Islands and their exploitation must be to the benefit of the people of the Falkland Islands, both those of today and future generations,
- The FIG will maintain constant supervision and control over all hydrocarbon activities within the Falkland Islands Designated Area,
- Petroleum discoveries must be efficiently managed and exploited to maximise economic recovery and to ensure the development of a long-term industry presence that will benefit the Islands for decades to come,
- Development of the hydrocarbons industry must ensure the protection and conservation of the Falkland Islands environment and biodiversity,
- Development of the hydrocarbons industry must take into consideration existing commercial activity and promote the development of local business capacity,
- The exploitation of finite natural resources will be used to develop lasting benefits to society across the whole of the Falkland Islands,
- Transparency and accountability must be present throughout the hydrocarbon development process from all parties involved, and
- The Falkland Islands will only consider onshore hydrocarbon facilities if they are considered to be in the best interests of the Falkland Islands, and can be proven to satisfy all of the above policy goals.

3.1.6.3 Local Content Code of Practice for Procurement by O&G Companies and their Subcontractors Operating in the Falkland Islands

The Local Content Code of Practice was developed by FIG in 2014 (FIG, 2018b) and sets out a series of principles, strategies and practices aimed at ensuring that local people and companies benefit, to the fullest extent possible, from opportunities generated by O&G exploration and production.

The Code applies to contracts and employment opportunities relating to onshore and offshore, field-related and non-field related projects. However, it should be noted that compliance with the Code is voluntary.

Specifically, this voluntary Code of Practice seeks to:

- Increase the stake of the Falkland Islands' people in the developing O&G industry in a sustainable manner,
- Ensure capacity development and employment of Falkland Islands' people,
- Ensure the use of Falkland Islands' goods and services,
- Ensure the transfer of technology and know-how to secure the localisation of knowledge and ownership, and

- Encourage the integration of the O&G sector with the other sectors of the Falkland Islands' economy to effectively support national growth and development through joint projects / facilities, joint ventures and partnerships.

In line with the Hydrocarbon Policy Statement described above, the Code seeks to create a legacy of long-term benefit and growth to the Islands economy and helps to retain as much local 'value' as possible.

3.1.7 Legislation relevant to O&G development in the Falkland Islands

Detail on activity-specific legislation and the associated compliance requirements is included in each impact / risk assessment chapter (Chapters 10, 11 and 12). Nonetheless, an overview of the relevant international treaties and UK regulations followed by detail on the relevant Falkland Islands national legislation is provided below.

3.1.7.1 International treaties and legislation relevant to the Falkland Islands

A 'treaty' is an agreement under international law which is entered into by sovereign states and international organisations and may also be known as an 'international agreement', 'protocol', 'covenant' or 'convention'.

Treaties can be loosely compared to contracts which provide a means for willing parties to assume obligations among themselves. Any party that fails to live up to its obligations can be held liable under international law.

The UKOTs have no legal treaty-making capacity (EAC, 2014) and ultimately, the UK concludes treaties on the UKOTs' behalf. Indeed, the UK may apply treaties to UKOTs without any consultation and the application of the treaty falls wholly within the responsibility of the UK Government (EAC, 2014). Therefore, the UK remains responsible if a UKOT violates a treaty obligation.

Additionally, in the event that the UK does not extend the treaty agreement to a UKOT, the UKOT may request to be party to the treaty and ratification may be extended under Article 29 of the 1969 Vienna Convention on the Law of Treaties. Ratification is a subsequent and separate process after a treaty is signed. To this end, the chapter on 'Rights' in the 2009 Constitution for the Falkland Islands has been brought up-to-date to bring it in line with international agreements (FIG, 2023c).

International treaties, conventions and agreements relevant to O&G in the Falkland Islands are:

- International Convention for the Prevention of Pollution from Ships (MARPOL) 1973 (as amended by the Protocols of 1978 and 1997 and kept updated by the Marine Environment Protection Committee (MEPC)).
- United Nations Convention on the Law of the Sea 1982, specifically the 'protection and preservation of the marine environment'.
- International Convention for the Safety of Life at Sea (1974, as amended).
- International Regulations for Preventing Collisions at Sea (1972).
- International Convention on Maritime Search and Rescue (1979)[8].
- Kyoto Protocol to the United Nations Framework Convention on Climate Change (Doha amendment, 2020).
- Paris Climate Agreement, United Nations Framework Convention on Climate Change.
- The Climate Change Act 2008 (2050 Target Amendment) Order 2019.

[8] Note that ratification of this Convention has not yet been extended to the Falkland Islands.

- The Global Methane Pledge adopted at the 26th UN Climate Change Conference of the Parties.
- The World Bank Zero Routine Flaring by 2030 initiative.
- Montreal Protocol 1987 on Substances that Deplete the Ozone Layer.
- The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal[9].
- The London Convention on the Prevention of Marine Pollution by Dumping of Wastes and other Matter 1972.
- International Maritime Organisation (IMO) – International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004[10].
- IMO International Convention on the Control of Harmful Anti-fouling Systems on Ships (2001) International[10].
- Convention on Biological Diversity 1993.
- Agreement on the Conservation of Albatrosses and Petrels (ACAP) 2004.
- International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC Convention).
- The International Convention on Civil Liability for Oil Pollution Damage – CLC Convention.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).
- Bonn Agreement Oil Appearance Code 2009.
- Ramsar Convention on Wetlands 1971.
- Convention on Migratory Species (CMS) (also known as the Bonn Convention) 1979.
- International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (1996, as amended).

3.1.7.2 UK legislation

It is understood that UK legislation may not be directly transferable to the Falkland Islands and each item of UK legislation that Navitas propose to follow / take cognisance of will be discussed in detail with FIG. This will ensure that it is appropriately and considerately transposed to ensure relevant elements of the legislative requirements are followed, and those that are not appropriate or relevant, are not included. Where the Falklands enact any legislation that supersedes the commitments made by Navitas, the Falkland Islands' legislation will take precedence.

UK legislation that may be of relevance to the Phase 1 & 2 Development is as follows:

- The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020.
- The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended).
- The Offshore Chemicals Regulations 2002 (as amended).

[9] Note that the Falkland Islands are not party to the Basel Convention but a bilateral agreement is in place.

[10] Note that ratification of these IMO Conventions has not yet been extended to the Falkland Islands by the UK. However, with regard to ballast water, all vessels which are flagged to a signatory state are required to hold certification confirming compliance with performance standard D-2 and to hold onboard an approved Ballast Water Management Plans. Further, as indicated in Section 10.12 on the risk of introducing marine invasive species, Navitas commit, as part of the industry-standard mitigation, to ensuring all vessels associated with the Development are compliant with the Conventions on ballast water and bio-fouling.

- The REACH Enforcement Regulations 2008.
- Control of Mercury (Enforcement) Regulations 2017.
- Climate Change Act 2008.
- Offshore Combustion Installations (Prevention and Control of Pollution) Regulations 2013 (as amended).
- Offshore Combustion Installations (Pollution Prevention and Control) (Amendment) Regulations 2018.
- The Energy Act 2008.
- The Environmental Protection Act 1990.
- The Ozone Depleting Substances (ODS) Regulations 2015.
- The Fluorinated Greenhouse Gases Regulations 2015.
- The Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001 (as amended).
- Conservation of Offshore Marine Habitats and Species Regulations 2017 (and the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019).
- The Offshore Installations (Emergency Pollution Control) Regulations 2002.
- Dangerous Substances in Harbour Areas Regulations 1987.
- Transfrontier Shipment of Waste (amendment) Regulations 2007 (as amended). Transfrontier waste shipment controls are expected to follow UK norms which are set out in:
  - Retained Waste Shipments Regulation EC No 1013/2006 as amended by The International Waste Shipments (Amendment) (EU Exit) Regulations 2019, and
  - The International Waste Shipments (Amendment of Regulation (EC) No 1013/2006) Regulations 2020.
- The Waste (England and Wales) Regulations 2011 (as amended), and The Waste (Scotland) Regulations 2012.
- The Controlled Waste (England and Wales) Regulations 2012 (as amended) and The Controlled Waste Regulations 1992 (as amended).
- The Special Waste Regulations 1996 (as amended).
- The Merchant Shipping (Standards for Training, Certification, and Watchkeeping) Regulations 2022.
- The Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998 (as amended).
- The Merchant Shipping (Prevention of Pollution by Garbage from Ships) Regulations 2020.
- The Merchant Shipping (Prevention of Pollution by Sewage from Ships) Regulations 2020.
- The Merchant Shipping (Prevention of Air Pollution from Ships) (Amendment) Regulations 2023.
- The Merchant Shipping (Prevention of Oil Pollution) Regulations 2019.
- Environmental Damage (Prevention and Remediation) (England) (Amendment) Regulations 2019.
- The Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015.
- Environmental Damage (Prevention and Remediation) Regulations 2015.
- Control of Major Accident Hazards Regulations 2015.

3.1.7.3 Falkland Islands national legislation

Falkland Islands legislation relevant to O&G developments is as follows:

- Offshore Minerals Ordinance 1994 (1997 and 2011 Amendments).
- Offshore Petroleum (Licensing) Regulations 1995.
- Offshore Petroleum (Licensing) Regulations 2000 (2004, 2005 and 2009 Amendments).
- Petroleum Survey Licences (Model Clauses) Regulations 1992.
- Maritime Ordinance 2017.
- Maritime (Amendment) Ordinance 2019.
- Maritime (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 2019.
- Deposits in the Sea (Exemptions) Order 1995.
- Marine Mammals Ordinance 1992.
- Conservation of Wildlife and Nature Ordinance 1999.
- Fisheries (Conservation and Management) Ordinance 2005.
- Endangered Species Protection Ordinance 2015.
- Planning Ordinance 1991.
- Planning (Environmental Impact Assessment) Regulations 2015.
- Falklands Interim Port And Storage Solution Ordinance 1989.
- Harbours and Ports Ordinance 2017.
- Maritime (Registration of Ships) Regulations 2019.
- Offshore Installations (Safety Case) Order 2008.
- Falkland Islands Environmental Trust Ordinance 2021.
- Maritime (Port State Control) Regulations 2021.

A brief summary of each of the above is provided below.

3.1.7.3.1 Offshore Minerals Ordinance 1994 (as amended) (The Ordinance)

The Offshore Minerals Ordinance (OMO) 1994 (as amended in 1997 and 2011), known as 'The Ordinance, relates to the granting and renewal of production consents for O&G field developments, the drilling of wells and the construction and installation of production facilities and pipelines in the Falkland Islands Designated Area (200 nm from shore).

The Ordinance requires that any operator who wishes to carry out O&G related activities in the Falkland Islands must first conduct an EIA of the activity and then present the conclusions in an EIS. To inform this process, the specific regulations and requirements are clarified within the 'FIG EPD Hydrocarbons Environmental Impact Assessment Guidance Note 2016' (FIG, 2016e).

Schedule 4 of The Ordinance provides further detail on the expected content of the EIS. Detail on how the Phase 1 & 2 EIS (this EIS) meets the Schedule 4 requirements is provided in Appendix 2.

On formal submission of the EIS to DMR and following review by FIG to ensure it meets the Schedule 4 requirements (Appendix 2), the Governor (in Executive Council) will indicate that the EIS is ready to go to formal public consultation (42 days). Operators are required to notify the public of the EIS

submission by advertising its submission in the local press. The Non-Technical Summary (Chapter 1) and the entire EIS must be made available to the public upon request.

Once comments from the consultation have been addressed and included to the satisfaction of DMR (Chapter 0), the EIS shall be further considered at Executive Council where a decision on acceptance will be reached. The EIS is further considered, alongside the Field Development Plan, as part of the application for petroleum consent. Consent may be given or refused, or the consent may be subject to conditions that require modification to the proposed activity to reduce, remedy or offset impacts / risks to the environment. The decision will be published with detail on the review of the EIS.

Consent to begin any activity will not be given until the Governor (in Executive Council) is satisfied with the information provided and that there will be no unacceptable impact on the environment.

FIG is in the process of amending the existing OMO to remove the references to safety and the environment and will develop a new Safety and Environment Ordinance to cover these areas, the OMO will then be updated to cover other licensing areas as required. The OMO will provide for the licensing regime (including model clauses, oil field determination and decommissioning) and the Safety and Environment Ordinance (OMSEO, title TBC) will cover safety and environmental aspects. This will demonstrate separation of functions between licensing and safety regulation. FIG also intends to repeal the Offshore Installations (Safety Case) Order 2008 and replace it with Major Hazard Regulations in order to align with the requirements of the UK Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015.

The proposed OMSEO seeks to modernise the environmental regulatory system governing offshore hydrocarbons by introducing a goal-setting regime. This will include an environmental assurance plan that will be integrated with the existing EIA regime. Performance will be measured against quantifiable standards based on environmental impacts and risks, with associated regular reporting, audit and review procedures. Statutory requirements for Oil Pollution and Emergency Plans (OPEPs) and the introduction of emergency intervention powers and the 'Polluter Pays' principle will also be introduced to align with, or exceed, UK best practice. At the time of writing this process is still ongoing within FIG.

3.1.7.3.2 Offshore Petroleum (Licensing) Regulations 1995 and 2000 (as amended in 2004, 2005 and 2009)

The Offshore Petroleum (Licensing) Regulations 1995 govern licences awarded through a competitive bidding process ('Competitive Round Licences') and stipulate the licensing requirements for O&G exploration and production as well as fees, royalties and working obligations of the licence holder.

They further provide a detailed description on the licensing application process, the required forms, model clauses, fees, and other requirements, such as maintenance, record keeping and reporting.

The Offshore Petroleum (Licensing) Regulations 2000 govern licences awarded through an open process of application for production licences ('Open Door Licences'). These Regulations also stipulate the licensing requirements for O&G exploration and production as well as fees, royalties and working obligations of the licence holder.

3.1.7.3.3 Petroleum Survey Licences (Model Clauses) Regulations 1992

The Petroleum Survey Licenses (Model Clauses) Regulations 1992 describe the framework governing offshore exploration activities including field observations, geological and geophysical investigations, the use of remote sensing techniques and seabed sampling.

These regulations were made under the Falkland Islands (Continental Shelf) Proclamation 1991 and were enforced by the Offshore Minerals Ordinance 1994.

3.1.7.3.4 Maritime Ordinance 2017 (and 2019 amendment)

The Maritime Ordinance covers the registration of ships as well as prevention of pollution from ships and liability for oil pollution in the case of tankers and other ships. It also includes detail on insurance against liability for pollution.

3.1.7.3.5 Maritime (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 2019

The Maritime (OPPRCC) Regulations relate to oil pollution emergency plans for ships, reporting of pollution events and the duties of ship owners. The regulations also cover the oil pollution emergency plans for harbours, ports and oil handling facilities and how the Governor (in Executive Council) are to respond to reports of pollution. Lastly, the regulations give the power to inspect premises, such as offshore installations, to verify their oil spill preparedness and details the offenses against the regulations.

3.1.7.3.6 Deposits in the Sea (Exemptions) Order 1995

The Deposits in the Sea (Exemptions) Order 1995 exempts 25 specified operations from the licensing requirements.

Deposits of sewage, domestic garbage, wastewater generated from tank cleaning, ballast water and cooling water originating on the vessel are all exempt from licensing requirements. Further, deposits of any substance during firefighting, normal navigation or maintenance, and salvage operations do not require a licence.

Deposition of chemicals, drill cuttings and / or drilling mud are also exempt under this order but are subject to regulation through FIG Petroleum Offshore Notification (PON) 10 (Section 3.1.7.4).

3.1.7.3.7 Marine Mammals Ordinance 1992

The Marine Mammals Ordinance 1992 prohibits:

- The intentional harming, taking or killing of any marine mammal (including whales, porpoises, dolphins, otters, seals, sea lions and elephant seals),
- The use of explosives in such a manner that may cause harm to any marine mammal on land or in inland waters, territorial seas or any fishery waters of the Falkland Islands, and
- The import or export of any marine mammal, or any part of a marine mammal, living or dead, without a licence.

Within this legislation, Falkland Islands' waters correspond to the boundaries of the Falklands Outer Conservation Zone (FOCZ).

3.1.7.3.8 Conservation of Wildlife and Nature Ordinance 1999

This Ordinance repeals the Wild Animals and Birds Protection Ordinance 1964, the Nature Reserves Ordinance 1964 and the Fisheries Ordinance (1986).

Under this Ordinance it is prohibited to deliberately kill, injure, capture, replace, or disturb any protected wild animal, bird or plant without a licence. It also makes provision for the designation of National Nature Reserves (NNRs) on the seabed, on land or on private estates by agreement, with associated regulations for their preservation. Specifically, the Ordinance Schedules list protected bird, animal and plant species which may not be killed at any time but also detail the species that may be killed out with the timing of their closed seasons.

3.1.7.3.9 Fisheries (Conservation and Management) Ordinance 2005

The Fisheries (Conservation and Management) Ordinance 2005 extends the influence of the Conservation of Wildlife and Nature Ordinance 1999 (see above) beyond territorial waters (i.e., >12 nm from shore) to cover the Falklands Interim Conservation Zone (FICZ) and the FOCZ. However, the primary role of the Ordinance is to protect fisheries resources in order to:

- Meet the reasonably foreseeable needs of future generations, and
- Avoid, remedy, or mitigate any adverse effects of fishing on the marine environment so far as is reasonably practicable to do so.

The Ordinance has the following environmental and information principles:

- Associated or dependent species shall be maintained at, or above, a level that ensures their long-term viability,
- Biological diversity of the marine environment shall be maintained,
- Habitats of particular significance for fisheries management shall be protected,
- Decisions shall be based on the best available information,
- Decision-makers shall consider any uncertainty in the information available in any case, and
- Decision-makers shall be cautious when information is uncertain, unreliable, or inadequate.

3.1.7.3.10 Endangered Species Protection Ordinance 2015

The Endangered Species Ordinance 2015 upholds the Convention on the International Trade of Endangered Species (CITES) and controls the import and export of species listed under Appendix I, II and III of CITES.

3.1.7.3.11 Planning Ordinance 1991

The Planning Ordinance 1991 provides the regulatory framework for developments in the Falklands that have the potential to cause a significant impact to the environment or local communities.

3.1.7.3.12 Planning (Environmental Impact Assessment) Regulations 2015

These regulations empower the Planning Officer in the FIG to require applicants to submit an EIS alongside applications for planning permission.

3.1.7.3.13 Falklands Interim Port And Storage Solution (FIPASS) Ordinance 1989

The FIPASS Ordinance 1989 enables the management of FIPASS by the Harbour Master (also acting as the Marine Officer) and FIPASS Manager.

3.1.7.3.14 Harbours and Ports Ordinance 2017

The regulations applying to Falklands Islands harbour and ports was reviewed and updated in 2017. The Harbours and Ports Ordinance 2017 establishes the maritime authority in the Falkland Islands, designates harbours and ports and permissible activity therein.

3.1.7.3.15 Maritime (Registration of Ships) Regulations 2019

The regulations provide for the registration of merchant ships, fishing vessels and small ships.

3.1.7.3.16 Offshore Installations (Safety Case) Order 2008

The Offshore Installations (Safety Case) Order enacts the UK equivalent Safety Case Regulations 2005. Although mainly focused on safety of offshore installations, this order is included here as it covers the prevention of major accident hazards, which can include preventing loss of containment. This order also covers notification of well operations, documentation and verification schemes, which can also apply to environmentally critical equipment.

3.1.7.3.17 Falkland Islands Environmental Trust Ordinance 2021

This Ordinance, which is still to be enacted, establishes the Falkland Islands Environment Trust, responsible for managing payments received from contributors; to provide for applications for funding by persons engaging in an activity that promotes environmental management, and conservation and enhancement of the environment for the benefit of the Falkland Islands; and to provide for connected matters. As an O&G operator, Navitas may be required to contribute to the Environment Trust.

3.1.7.3.18 Maritime (Port State Control) Regulations 2021

The Maritime (Port State Control) Regulations allow the Falklands Maritime Authority to inspect vessels, including confirming the validity of their certificates and assessing the overall condition of the ship.

3.1.7.4 Petroleum Operations Notices (PONs)

The FIG provides numerous Petroleum Operations Notices (PONs) to provide guidance and *pro formas* for reporting. The PONs relevant to the Phase 1 & 2 Development are listed in Table 3.1.

Table 3.1: Summary of PONs relevant to the Phase 1 & 2 Development

PON	Purpose
PON 1	Record keeping and sampling requirements for surveys and wells.
PON 2	Reporting procedure detailing the need for progress meetings, monthly progress reports and daily drilling reports.
PON 3	Notification of Geophysical Surveys
PON 4	Application for the Consent to Drill Exploration, Appraisal, and Development Wells and the Consent to Locate.
PON 5	Application to Abandon or Temporarily Abandon a Well.
PON 6	Application to Complete and/or Workover a Well.
PON 7	Well numbering system.
PON 8	Detailing the: FIG reporting requirements in the event of an accidental oil / chemical release or a visible sheen, and The use of dispersants, and surveying and tracking requirements.
PON 9	Reporting of Injuries, Disease and Dangerous Occurrences (RIDDOR).
PON 10	Application to Use and Discharge Non-Aqueous Drilling Fluids (NADF) and Associated Cuttings.
PON 11	For reporting of the loss or dumping of materials at sea from offshore oil and gas installations.

3.2 Navitas Operating Management System

This section describes the Navitas Operating Management System (OMS) which includes all elements relating to health, safety, security and the environment. This section will demonstrate how the OMS applies to the environmental management of the Sea Lion Field Northern Development Area, Phase 1 & 2 (hereafter referred to as the 'Phase 1 & 2 Development').

3.2.1 Corporate HS&S and E&B policies

Navitas is committed to ensuring that all activities within the life-cycle of a project / operation are carried out in compliance with the relevant international and national legislation, and within the guidance of the Company's OMS to ensure sound health, safety, security, environmental and biodiversity management.

Navitas will conduct the activities associated with the Phase 1 & 2 Development in a manner that is consistent with its Corporate Health Safety and Security (HS&S) (Figure 3-3) and Environment and Biodiversity (E&B) Policies (Figure 3-4).

NAVITAS PETROLEUM

Health, Safety & Security (HSS) Policy

Navitas is committed to protecting the health, safety and security of everyone involved in its activities. Navitas puts the protection of people first and aspires to high standards of practice through a process of continual improvement and the adoption of international codes, standards and procedures. To meet this commitment Navitas has implemented an operational management system (OMS) which strives to:

- Promote, enhance and sustain a strong Health and Safety culture
- Comply with applicable health, safety and security laws and regulations
- Identify, evaluate and manage hazards and risks involved in operational activities to "as low as reasonably practicable" (ALARP)
- Ensure that a high priority is placed on the prevention and control of "major accident hazards" (MAH)
- Regularly monitor and assess the security status and the associated risks of the places where Navitas does business
- Implement controls to ensure that safeguarding of personnel and property is carried out consistently with relevant human rights principles and in a manner that avoids or minimizes risks to the local community
- Provide health, safety and security training to employees and actively promote awareness of health, safety and security issues
- Ensure that those responsible for security are aware of relevant human rights issues
- Ensure that contractors are aware of and comply with Navitas policies and procedures and, where / when necessary, work with contractors to raise their standards to meet Navitas's requirements
- Leverage and influence business partners and stakeholders to promote high standards of health, safety and security
- Ensure that accidents, incidents, near misses and non-compliances with procedures are reported and investigated, and lessons are learned and shared
- Set "key performance indicator" (KPI) objectives and targets for improving health, safety and security performance and monitor and report openly on performance.
- Monitor and evaluate performance, and conduct periodic audits on Navitas's own operations and Contractors' work
- Ensure that a high priority is placed on crisis and emergency response preparedness, contingency and business continuity planning; ensuring that financial and technical capabilities and professional competencies are maintained and any response to an emergency incident can be managed
- Work openly with regulators and industry bodies and promote best practice in protecting health, safety and security
- Consult with, and respond to the concerns of stakeholders on Navitas's health, safety and security performance

Responsibility for compliance with Navitas's HSS Policy is company-wide. It is the responsibility of each individual to be aware of the risks to personal health, safety and security and to take measures commensurate with the environment they are living, working and travelling in.

Figure 3-3: Navitas Health Safety and Security Policy

NAVITAS PETROLEUM

Environment and Biodiversity (EB) Policy

Navitas is committed to protecting the health and sustainability of the environments in which it operates. Navitas aspires to high standards of practice through a process of continual improvement and the adoption of international codes, standards and procedures. To meet this commitment Navitas has implemented an operational management system (OMS) and has focused environmental social governance (ESG) goals which strives to:

- Comply with applicable environmental laws and regulations
- Adopt a precautionary approach to avoid and, where this is not feasible, reduce negative impacts to the environment and biodiversity to "as low as reasonably practicable" (ALARP)
- Conduct environmental impact identification (ENVIID) and risk assessments in the planning stage and put in place site specific Environmental Monitoring and Management Plans (EMMPs) in place prior to commencing operations
- Engage with local of affected stakeholders to utilize their knowledge of the local environment to assist in protecting and conserving biodiversity
- Encourage the development and sharing of environmental knowledge and technologies and seek out the best available techniques to reduce the impact of Navitas operations
- Promote efficiency in the use of energy and water with the aim of conserving natural resources and reducing atmospheric emissions (greenhouse gases [GHG]) thus helping to mitigate the effects of climate change
- Set "key performance indicator" (KPI) objectives and targets for improving environmental and biodiversity performance and monitor and report openly on performance.
- Monitor and evaluate performance, and conduct periodic audits on Navitas's own operations and Contractors' work
- Provide environmental and biodiversity training to employees and actively promote awareness of environmental and biodiversity issues
- Ensure that contractors are aware and comply with Navitas's environmental policy and procedures and, where necessary work with contractors to raise their standards to meet the Navitas's requirements
- Ensure that environmental accidents, incidents , near misses and non-compliances with procedures are reported in a timely manner and investigated with lessons learned and shared
- Prevent pollution and ensure that an appropriate response capability is in place and regularly tested so that environmental incidents can be responded to in a timely and effective manner should they occur
- Work with regulatory and industry bodies in the formulation or improvement of laws, policies, regulations and good practices aimed at protecting the environment and biodiversity
- Consult with, and respond to the concerns of stakeholders on Navitas's environmental and biodiversity performance

Responsibility for compliance with Navitas's EB Policy is company-wide.

Figure 3-4: Navitas Environment & Biodiversity Policy

3.2.1.1 The Navitas OMS Elements

The objectives of the OMS are to:

- Deliver operations which are compliant with the company, industry and regulatory standards,
- Drive operations to meet the company's strategic objectives:

  'No one gets injured, process safety incidents are eliminated and harm to the environment is minimised'

- Ensure a fit for purpose business approach to deliver safe, reliable and cost-effective operations,
- Reinforce values of the company,
- Provide assurance that risks are being managed in a consistent approach and mitigated through routine verification, and
- Secure continuous business improvement.

Figure 3-5 illustrates the inter-connectivity of the Operating Management System's expectations by managing risk and delivering assurance.

There are 14 key elements which sit within the system. Each of the 14 elements provides a set of compulsory expectations, which are summarised in Table 3.2 and described fully in:

- Operating Management System (SEL-REG-OPM-PLN-00001-00)

A series of standards, procedures and guidelines define how each of the 14 elements should be implemented in order to manage HS&S and E&B impacts and risks during the execution of work activities. Where work is to be conducted by third parties, bridging documents are developed to describe the interface between the two companies' management systems prior to the start of activities to ensure that the 14 elements are sufficiently met.

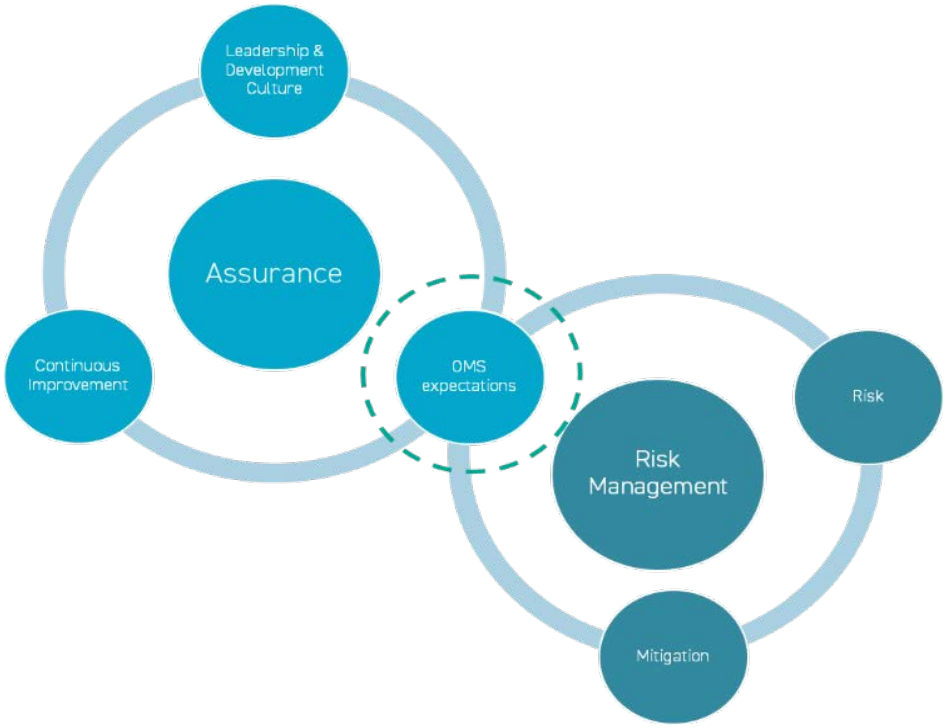


Figure 3-5: Showing the inter-connectivity of the Operating Management System's expectations

Table 3.2: Summary of Navitas OMS Elements

OMS Element		Description
1	Leadership Expectations	Deliver clear and positive safety leadership, visible leadership, commitment, and accountability. Communicate expectations and provide perspective. Set performance targets and provide the structure and resources to support them for all areas of responsibility. Understand high consequence risks, identify safeguards to manage risks and ensure safeguards are working.
2	Health, Safety, Security & Environment	Continually improve Health, Safety and Environmental performance and reduce impacts from our operations whilst protecting people and assets. Ensure work is always controlled. Promote a healthy workforce and mitigate significant workplace health risks. Effective incident investigation, reporting and follow-up in use to achieve performance goals. Emergency response, business continuity and crisis management planning in place to ensure company responds proportionately and effectively to emergencies and reduces impacts and disruptions
3	Performance Management	Business objectives are achieved through a robust long-term planning and scheduling process. Work activities are understood with appropriate resources provided to enable objectives to be met, thus delivering a sustainable and predictable business outcome. Continuous improvement and learnings are routinely incorporated into all aspects of the business and lessons learned are incorporated into future activities. An assurance process in place to ensure that decisions and actions are in line with the group's best interests and that the safeguards expected in the OMS are in place and functioning and meet internal and external requirements. Assurance priorities are established based on risk management assessments and the organisation stops repeated failures and focuses on taking advantage of improvements.
4	Organisation & Capabilities Expectations	People are our most valuable asset, and we develop and enrich our teams of competent professionals to fulfil challenging roles with specific responsibilities defined. The requirements for each role and individual are unique and are considered as such with clear expectations. Our personnel are selected appropriately, trained and their skills and competencies regularly reviewed. Personnel are allocated to a role based on their ability to deliver the requirements and demands of that position.
5	Operations Management	Facilities are operated strictly according to legislation and within established parameters for recognised industry best practice. Facilities are operated within the current design envelope to ensure safe, secure, healthy, and environmentally sound performance.
6	Production Management	Maintain a clear understanding of the entire production value chain from reservoir to export pump, rigorously defining potential, chokes, LMPP, loss management and forecasting. Production is delivered against the IAP and production targets using a clear process to maximise production in a cost-effective manner with a systematic process for managing and optimising the entire value chain from reservoir to export pump. This process includes defining the limit, planning activities, setting targets and forecasting, execution of planned activities, managing losses and seeking opportunities to improve.
7	Maintenance & Inspection management	Facilities are maintained and inspected in accordance with legislation and to prevent injury to people, damage to the environment and to achieve competitive advantage over the lifecycle. Effective maintenance and inspection management delivers the levels of reliability and availability expected to meet business objectives.
8	Management of Change	Change in our organisation is managed to minimise HSE (Health, Safety, Environment) hazards and operational risks. Facilities are designed and constructed to prevent injury, illness, and incidents and to operate reliably and

OMS Element		Description
		efficiently and in an environmentally sound manner. Temporary and permanent changes to our organisation, personnel, systems, procedures, equipment, products, materials, or substances are evaluated and managed to ensure that health, safety, security, and environmental risks arising from these changes remain at an acceptably low level.
9	Management of Contractors & Logistics Management	Third-party contractors are assessed and selected on their ability to perform in a manner that is consistent and compatible with our HSE, process safety, operational, and business requirements. We award contracts that clearly set out the expectations and requirements on each party. The measures applied to control the work are proportionate to the associated risk and based on our ability to manage, influence, or react to the risk. We proactively monitor performance and delivery of, and compliance with, the contract terms. Logistics provide safe, timely and reliable transportation of personnel, materials, and equipment
10	Operational Risk Management	The workforce at all levels of our organisation understands and manages operating risk to prevent accidents and harm to people, to reduce damage to the environment and to achieve competitive performance. Comprehensive risk assessments are used to reduce environmental, Health, safety and security risks and mitigate or eliminate consequences.
11	Responsibility to Stakeholders	Maintain our license to operate through stakeholder confidence in our ability to meet expectations. Communicate and promote a solid understanding of risk awareness, risk management and performance. Key stakeholder groups are identified, and their concerns are addressed to maintain a good relationship and achieve business objectives. Work plans designed to align, involve and empower the whole workforce in the identification and management of hazards.
12	Information Management	Knowledge management process delivers a shared understanding of information required to operate facilities safely and supports the communication of information, knowledge transfer, updating and version control of key documents, maintenance of records and demonstration of compliance.
13	Projects Management	Projects Management are committed to ensure that facilities are designed and delivered strictly according to legislation and within established parameters for recognised industry best practice. Subsea and Topsides facilities design from an integrity and operating envelope is delivered to ensure safe, secure, healthy, and environmentally sound performance.
14	Drilling and Completions Management	Drilling Leadership are committed to deliver safe, reliable, and cost-effective solutions that maximize oil and gas recovery and minimize environmental impact. Commitment to being visible and proactive in our leadership with a clear commitment to continuous improvement, while working to a HSE Management System that shall be established prior to Rig Operations commencing

3.2.2 Project planning and review

The lifecycle of all project planning and review phases within the Phase 1 & 2 Development (from drilling and construction to development and production) are covered within the 14 elements of the OMS.

An example of this is the well engineering project delivery process. This is structured and designed to provide assurance to senior management and joint venture partners with Navitas' operations to ensure / assure that the project team has completed all the necessary work associated with each phase of the project development. To achieve this, Navitas has a 'gated' process for progressing a project through six distinct phases (Figure 3-6).

When following the process, it is necessary for the project team to provide key deliverables before progressing through each 'gate' and on to the next phase of the project. A 'gate-keeper' is assigned

within the project development assurance process to ensure that all deliverables are identified and met.

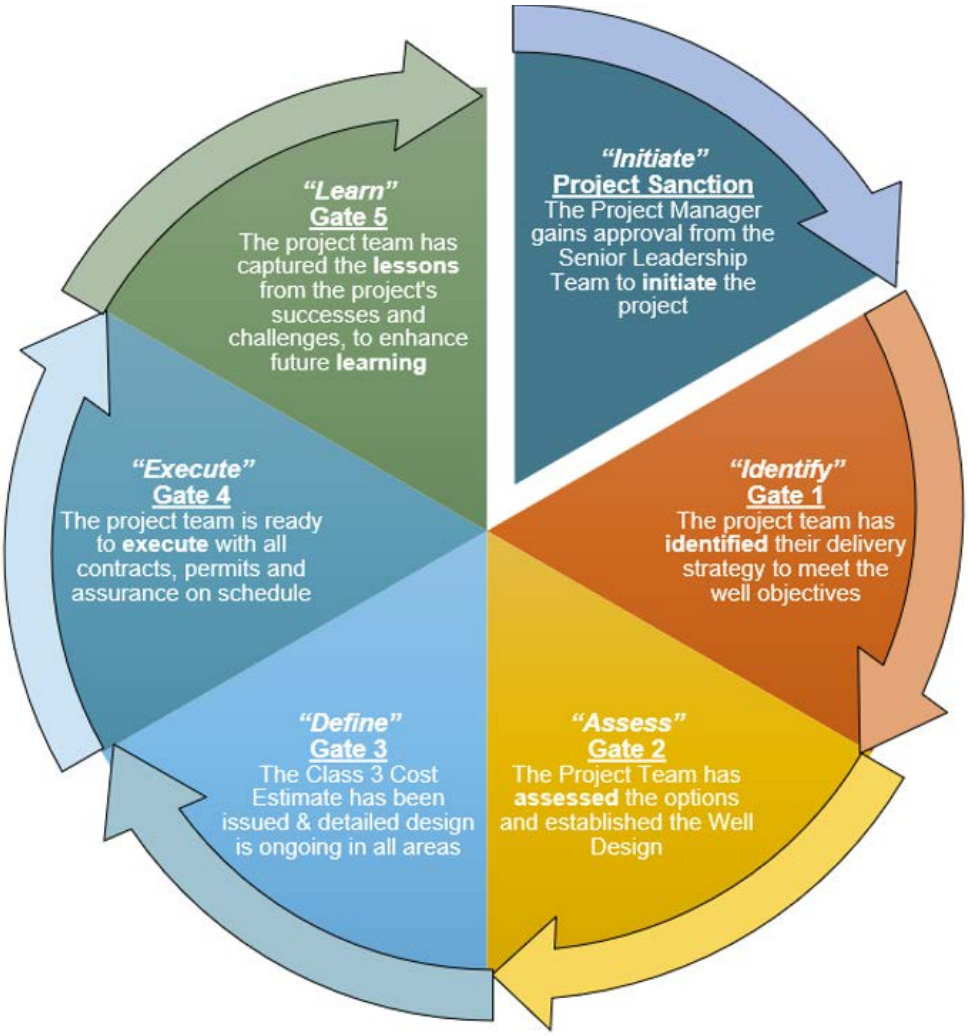


Figure 3-6: Well construction project delivery lifecycle

3.2.3 Environmental baseline data gathering

Element 2 within the OMS is concerned with HS&S and E&B (Table 3.2). The objective of environmental baseline data gathering is to ensure that the existing environmental conditions in areas where Navitas plan to operate are adequately characterised and understood. This informs the Environmental Impact Assessment (EIA) process and enables the identification of trends or changes when conducting monitoring throughout the project lifecycle.

3.2.4 Impact and risk identification and assessment

In line with Element 2 (Table 3.2), the environmental and social aspects, impacts and risks associated with a Development must be identified and assessed. Once the Development activities have been understood, an ENVironmental Impact IDentification (ENVIID) workshop is held to determine the ways the activities will interact with the environment (i.e., noise, emissions, discharges etc.) and what the impacts and risks might be. This can be illustrated by Navitas' ENVIID for the Sea Lion Field Northern Development Area, Phase 1 & 2 as described in Chapter 9.

The impact and risk assessment process and the assessment of mitigation measures ensures that the impacts and risks are reduced to 'As Low As is Reasonably Practicable' (ALARP).

3.2.5 Legal compliance

In line with all OMS Elements (Table 3.2 above), legislative and regulatory compliance shall be adhered to and best practice shall be strived for. These shall be identified at Gate 1 ('Identify Phase') (Figure 3-6) and a Permits, Licences, Approvals, Notifications and Consents (PLANC) register shall be established. This will be updated and verified at all the subsequent Gates.

The PLANC register will define what is required for field development, who is accountable and responsible and when action is required. Therefore, the PLANC register will be used to inform all stages of the Development.

Where no FIG regulation exists for a given activity, or where it awaits enactment, in consultation with FIG, Navitas shall adhere to agreed UK and international standards (Section 3.1.7.2). In accordance with the FIG DMR Guidance Notes on Operations Notices, the FIG PONs will be used / applied for as appropriate (Section 3.1.7.4).

3.2.6 Operational control

OMS Element 10 ('Operational Risk Management') (Table 3.2 above), details that operational control is required in order to ensure that all activities within Navitas' control[11] are carried out in a safe and effective manner. With regard to health, safety and environmental issues, operational controls also serve to prevent and reduce impacts and risks by:

- Preventing an impact from occurring,
- Minimising the impact,
- Remediating the impact,
- Preventing, or reducing the likelihood of, an unplanned event from occurring, and / or
- Minimising the severity of effect in the event of an incident.

Operational controls include:

- Elimination controls e.g., electing not to commence with a specific operation / activity,
- Substitution controls e.g., electing to carry out the activity in a different way, place or time,
- Engineering controls e.g., use of Best Available Technology (BAT) or deployment of additional or alternative equipment, and / or
- Administrative controls e.g., use of standard operating procedures and / or development of project-specific operating procedures / plans where necessary.

Elimination and substitution controls are built-in to the project basis of design such that the project will always endeavour to minimise impacts and risks. During the EIA process, where impacts or risks

[11] Please note that while Navitas OMS Elements 5 (Operations Management) and 6 (Production Management) are relevant to offtake operations between the FPSO and the Conventional Trading Tanker (CTT), the CTT itself is not under Navitas' direct control, and the field operator will not have title or liability for the crude transferred once it is discharged from the offloading flange on the FPSO. Once the Boarding Party, which will include Navitas Mooring Masters, are onboard the CTT, and with the hold back Tug connected, there will be liability across both parties. Navitas' Mooring Master will pilot the CTT entry into the FPSO exclusion zone, during berthing operations, offloading operations, hold back operations and until disconnected with the Boarding Party disembarked from the CTT, there will be some shared responsibilities. Navitas will have in place Terminal Regulations which will govern CTT Operations and within this it will clarify responsibilities through the entire operation. In the event of an incident involving the CTT, the liability would sit with the crude offtaker / tanker owner and would be covered by the tanker P & I Club Cover, and insurance under CLC 1992. Further detail on the Navitas Assurance Process for purchasers' tankers is provided in Section 5.10.

are deemed significant despite the base-case mitigations and industry-standard safeguards, it is necessary to determine what additional, project-specific, controls may be required. All additional project-specific controls intended to prevent or mitigate impacts and risks will be utilised where they are deemed to be 'reasonably practicable'.

The process for identifying the need for project-specific controls and mitigation options is described further under the EIA methodology (Chapter 8).

3.2.7 Safety and Environmentally Critical Elements register

In line with the Element 2 of the OMS (Table 3.2 above), Safety and Environmentally Critical Equipment (SECE) must be identified and performance standards developed that describe and define the equipment's requirements in terms of functionality, availability, reliability, survivability and its interdependence on other systems. The SECE Register will be regularly reviewed and verified prior to commencement of the onshore fabrications / construction stage.

3.2.8 Emergency response

Emergency Response Plans (ERPs) are covered within Element 2 of the OMS (Table 3.2 above). These will be in place for all operations and will be developed for all potential emergency scenarios. Oil Pollution Emergency Plans (OPEP) shall be developed to cover all stages of the Phase 1 & 2 Development and will be reviewed and approved by FIG prior to commencement of the operations.

3.2.9 Incident management

In line with Element 2 of the OMS (Table 3.2), any HS&S and E&B accidents, incidents, near misses and non-compliance will be recorded and investigated in accordance with Navitas' HSS and E&B policies (Figure 3-3 and Figure 3-4). All incidents will be reported in internal performance reports as well as to the statutory authorities in keeping with the required FIG reporting protocols.

3.2.10 Monitoring and measuring

Monitoring and measuring is a fundamental requirement of this EIS. They are noted both in the Navitas HS&S and E&B policies (Figure 3-3 and Figure 3-4) and throughout the OMS. Environmental Monitoring and Measuring will be used throughout the Phase 1 & 2 Development in line with the requirements identified throughout the EIA process, and will be used to:

- Provide assurance of compliance with regulatory requirements standards and FIG policies,
- Determine progress in achieving the objective and targets outlined in the HS&S and E&B Plans,
- Provide an early indication should any of the operational controls fail to achieve acceptable standards,
- Enable Navitas to take remedial action if unexpected problems or unacceptable impacts arise,
- Monitor the performance of the project and the efficacy of project-specific mitigation measures (IEMA, 2008),
- Evaluate any actual environmental impacts,
- Verify the environmental impact predicted in the EIA studies; and
- Provide auditable data.
- Priorities for monitoring will include:
    - Environmental aspects for which significant residual impacts were predicted,
    - Environmental aspects for which successful mitigation is essential to avoid significant impacts, and

- Impacts for which there is a high degree of uncertainty (i.e., a low confidence score) in the impact predictions or in the likely success of the proposed mitigations.

Aspect-specific monitoring and measuring requirements are described in each impact and risk assessment chapter (Chapters 10, 11 and 12) and are listed, with defined responsibilities for implementation, in the outline Environmental Monitoring and Management Plan (Chapter 15).

3.2.11 HSE Plans and environmental objectives and targets

In line with Element 2 of the OMS (Table 3.2 above), Navitas shall develop environmental objectives and targets to ensure continual improvement in environmental management throughout all stages of the Phase 1 & 2 Development.

The objectives and targets, and the programmes by which they are met, will be incorporated into the relevant Phase 1 & 2 Development HSE plans, which will include detail on the responsible person and a means of tracking progress.

The HSE Plan will be drafted at each project's 'Gate 1' (Identify Phase) and will be reviewed and updated each gate thereafter.

3.2.12 Environmental performance

Once the Phase 1 & 2 Development operations commence, data on the Key Performance Indictors (KPIs) (e.g., greenhouse gas emissions, waste volumes, oil in water concentrations etc.) will be gathered on a monthly basis and reported as required. Performance monitoring will be carried out *via*:

- Participation in daily calls during the Development to discuss the project / operations status, any issues that have arisen and proposed solutions (where necessary),
- Receipt of daily, weekly and monthly reports to track HSE performance and provide detail on how any issues were closed out,
- Receipt of daily reports including, where relevant, chemical use,
- Monitoring of all waste streams to ensure waste is properly handled, and
- Presence of an HSE representative on board the Mobile Offshore Drilling Unit (MODU) / FPSO and on shore to ensure effective environmental management.

3.2.13 Audit and review

In accordance with Element 3 the OMS, ('Performance Management') (Table 3.2 above), and the FIG EIA Guidance Note (FIG, 2016e), Navitas will carry out periodic audits to ensure that the Phase 1 & 2 Development is being carried out in compliance with:

- Regulatory requirements,
- Contractual obligations, and
- Commitments in the EMMP and other management plans.

Processes and tools, as detailed within the Navitas OMS, will be used to assign, schedule and track all corrective or preventive actions.

Environmental audits / reviews that will be required prior to, and during, the Phase 1 & 2 Development operations and will include, but not be limited to:

- Internal audits / reviews:
  - Senior Management review,
  - Peer review,
  - Stage gate reviews at the start of each project development phase in line with:

- Operational Controls Reviews,
- Internal reviews to ensure impacts and risks continue to be ALARP, and
- Internal OMS audits.

- Contractor, Joint venture Management System Audits:
  - Pre-Award HSE audits / reviews for selected Tier 1 contractors,
  - Pre-mobilisation HSE audits or readiness reviews for assets such as the MODU, FPSO, helicopters and Offshore Support Vessels (OSVs),
  - On site monitoring and inspection,
  - Supply base HSE audit, and
  - Contractor self-monitoring / inspection / auditing.

3.2.14 Contracting strategy

In line with Element 9 of the OMS ('Management of Contractors & Logistics Management') the service sector requirements of the Phase 1 & 2 Development will be quantified, sourced and contracted in line with the Project Execution Plan (PEP).

The PEP lays out the system of local consultation and capacity evaluation that will be followed within the tender and contracting process.

The strategy complies with the:

- Policy and Procedure for Contracts and Procurement,
- Local Content Policy,
- Hydrocarbons Development Policy Statement 2013 (Section 3.1.6.2), and
- Voluntary Falkland Islands Local Content Code of Practice (Section 3.1.6.3).

The Falkland Islands are at the end of an extended supply chain, and tender evaluation will assess the security of that supply chain, the geographical location of supply and the capacity to supply.

The long-term nature of the Phase 1 & 2 Development encourages market investment and expansion (over and above that achieved during temporary short-term exploration and appraisal campaigns) and contract durations will be assessed and set in order to best achieve capital investment and innovative solutions to service provision.

The contracting strategy will normally incorporate an initial pre-qualification process for local requirements (using the Expression of Interest facility within the Penguin News) and for large, tier 1 contractors providing high value or critical service delivery contracts. This will comprise the first screening in evaluating the capacity and long-term security of supply delivered by the tenderer, prior to full evaluation in the tender bid process.

During this process, tenderers will be asked to provide detail of their proposed incorporation of sustainable design features in their tender submissions. Environmental considerations and sustainable design will form part of the contract evaluation criteria.

It is thus assumed that economic market forces of supply / demand will respond to Phase 1 & 2 Development service needs whether that be through local or external contractors and that the tender process is robust in evaluating market response to ensure local supply is not impacted.

3.2.15 Contractor management

Again in line with Element 9 of the OMS (Table 3.2 above), Navitas will evaluate contractors based on their ability and qualification to appropriately manage HSE risks arising from their work. Bridging documents between the Company and Contractor management systems will be defined and

documented to ensure effective mobilisation, ongoing HSE surveillance and close out of contracted work.

HSE impacts and risks associated with contracts will be identified, assessed and competently managed.

3.2.16 Management of Change

In line with Element 8 in the OMS ('Management of Change') (Table 3.2 above), it is important for the Phase 1 & 2 Development to be able to accommodate changes and respond to a need for further environmental and social impact and risk assessment if it arises throughout the different project stages.

The need for further impact and risk assessment may arise for the following reasons:

- If changes to the project design become necessary at the post-design stage, and / or
- A new environmental sensitivity is identified as a consequence of changing environmental conditions and / or evolving trends that are identified *via* monitoring or additional surveys.

The Offshore Minerals Ordinance (Amendment) 2011 states that environmental impacts that are substantially different, or significantly greater, than those already presented in an EIS will trigger an additional EIS. However, if it can be demonstrated that the impacts are not substantially different then the Governor can waive the need to produce a new EIS.

As explained in the EIS Introduction (Section 2.2.4), there are still specific details that can only be confirmed upon completion of contractual negotiations for the execute / operational stage. This is normal when preparing an EIS for a large project. The approach taken has been to use experience from similar projects to propose conservative analogies to ensure that this EIS assesses the worst credible case so that it should encapsulate all eventualities, preventing the need for an additional EIA/S.

However, if significant post-design changes do occur, the impacts will be reviewed and assessed as part of the gated project delivery process and discussions will be held with FIG to determine the most appropriate way to manage the EIS and EMMP.

3.2.17 Stakeholder management

In line with Element 11 of the OMS ('Responsibility to Stakeholders') (Table 3.2 above), key stakeholders in the Phase 1 & 2 Development have been identified (see Chapter 6 and Table 6.2) and a plan developed to enable identification and recording of stakeholder concerns throughout the lifecycle of the field

The results of the informal pre-submission scoping consultations, (which were carried out to inform this and the previous EIA processes), and a record of the statutory consultations carried out following submission of previous iterations of Sea Lion EIS's are recorded in Chapter 6. Representations from the formal post-submission stakeholder 42-day consultation period, and Navitas' responses to these, will be provided in Chapter 0.

3.2.18 Project-specific environmental management

3.2.18.1 Sea Lion Field Northern Development Area management plans

Management plans are designed to identify and communicate environmental management requirements and commitments to all key personnel and to ensure the implementation of controls.

Management plans will be required in compliance with:

- The terms and conditions of the Drilling and Production Licenses,
- The FIG EIA Guidance Notes 2015 (FIG, 2016e),

- The FIG Guidance Note on Approvals Required for Offshore Operations in the Falkland Islands (02/13) (FIG, 2013b), and
- The outcomes of the EIA (that are reported in this EIS).

Project-specific management plans that will be in place for the Phase 1 & 2 Development include (but will not be limited to):

- Environmental Monitoring and Management Plan (EMMP) (Chapter 15 below),
- Preliminary Oil Spill Emergency Plans, which inform development of the operational Oil Pollution Emergency Plan(s) (OPEPs). The OPEP's will:
  - Provide detail on the actions to be taken in the event of an unplanned release of hydrocarbon and must align with the Falklands National Oil Spill Contingency Plan (NOSCP). Specifically, the OPEP will:
    - Assess the potential consequences of an oil spill from drilling or production operations,
    - Define the roles and responsibilities of all emergency response parties,
    - Detail the action plan in the event of a spill,
    - Detail the available oil spill response resources available,
    - Outline and reference the proposed response procedures, and
    - Detail the regulatory spill reporting requirements (e.g., FIG PON 8).
  - Oil spill response planning is based on oil spill trajectory modelling and findings from the EIA. The OPEP must incorporate any learnings and best practice throughout the industry and it must include an assessment of the worst-case oil spill scenario for each operational area along with a detailed analysis of the availability and mobilisation timetable for oil spill response.
- Wildlife Response Plan (WRP):
  - Detailing the oiled wildlife response strategy to be implemented in the event of an unplanned release of hydrocarbons. Navitas will work with wildlife response providers and FIG to ensure the plan defines relevant details including:
    - Initial response requirements,
    - Management / coordination structures, and
    - Appropriate local responder organisation / involvement.
- Waste Management Plan (WMP):
  - The project-specific WMP will be developed in line with Navitas' Waste Management Procedure and will be tailored to each operation in line with the current Islands' infrastructure and in line with relevant FIG / UK legislation. The WMP ensures that:
    - The hierarchy of waste management is applied,
    - Waste is minimised, handled, stored and transported appropriately,
    - Waste is reported on correctly, and
    - The risks of cross-contamination at source and loss of containment are minimised.
- Iceberg Management Plan (IMP):
  - Describes all response actions required in the event of iceberg presence.
- Biosecurity Management Plan (BMP):

  - Provides a framework for the processes intended to reduce the likelihood of introducing terrestrial or marine non-native species, which may then become invasive to the ecosystem of the Falkland Islands.
- Bird Strike Management Plan (BSMP):
  - Detailing measures to ensure the monitoring, recording and reporting of bird-strikes as a result of artificial light as well as detail on how to manage / handle birds in the event of strikes.
- Harbour Management Plan (HMP):
  - Informed by a project-specific navigational risk assessment, the HMP includes:
    - Pre-notification protocols associated with the entry of vessels into Stanley Harbour,
    - Pre-defined passage routes within Stanley Harbour,
    - Procedures associated with vessel collision, and
    - Emergency response.

3.2.18.2 Environmental Monitoring and Management Plan

The EMMP captures all commitments relevant to environmental monitoring and management and will list these in one place alongside detail on the responsible person and the frequency of the requirement to enable tracking of actions throughout the life of the Phase 1 & 2 Development. Specifically, the EMMP will list:

- Legislative and corporate monitoring requirements,
- Baseline data and survey work proposed,
- Environmental research and studies relating to uncertainties in the EIS,
- Conditions associated with drilling and production license approvals, and
- Any actions falling out of the stakeholder consultation process.

It is anticipated that initially the EMMP will be overseen by a group of key stakeholders who will discuss and steer the issues and actions.

Throughout the Phase 1 & 2 Development lifecycle, information arising from the EMMP process will be reported to the EMMP Steering Group on a regular basis, relevant actions discussed and the programme of work updated as necessary. Meetings of the Steering Group will be open to FIG and invited statutory stakeholders with outputs reported publicly.

The basis of the EMMP, which is specifically informed by this assessment, is provided in Chapter 15 and will be translated into a live commitments and compliance register for use during the ‘Execute’ phase (Section 3.2.2).

4 CONSIDERATION OF ALTERNATIVES

Table of Contents

4.1 Introduction 118
4.2 Project development process 118
4.3 Historical consideration of alternatives 118
4.3.1 Identification of key challenges 118
4.3.2 Identification and consideration of options 120
4.3.2.1 Production 120
4.3.2.1.1 Option identification and consideration 120
4.3.2.1.2 Option selection 122
4.3.2.2 Oil export 123
4.3.2.2.1 Option identification and consideration 123
4.3.2.2.2 Option selection 127
4.4 Development optimisation by Navitas 127
4.4.1 Well count and phased drilling schedule 128
4.4.2 FPSO 128
4.4.2.1 Sourcing the FPSO 128
4.4.2.2 Optimal vessel size 128
4.4.3 The well completion design 129
4.4.4 Field life 129
4.4.5 Selected basis of design 129
4.5 Mitigations not used 130
4.5.1 Drill Cuttings disposal 130
4.5.2 Drilling mud 130
4.5.3 Hydrotest water 130
4.5.4 Atmospheric emissions 130
4.5.5 Waste 130
4.5.6 Marine invasives 130
4.5.7 Disturbance to other users of the sea 131
4.5.8 Resource competition – Water 131
4.5.9 Resource competition – Electricity 131
4.5.10 Oil spill offshore 131

4.1 Introduction

The basis of design for the production of the Sea Lion field has been under development since 2011. Between 2012 and 2020, the relevant licences were owned by Premier Oil Exploration and Production Limited (here after referred to as POEPL) with their Joint Venture partner Rockhopper Exploration (Section 2.1.1). An EIS for POEPL's proposal for the Sea Lion Development was submitted and formally accepted in 2020 (Premier, 2020). However, in 2020 the parent company of POEPL (Premier Oil) and Chrysaor merged to form Harbour Energy Plc. Harbour Energy Plc. then sold POEPL to Navitas Petroleum in September 2022. At this time, POEPL was renamed Navitas Petroleum Development and Production Limited (hereafter referred to as Navitas). Navitas now operates the licences and has further optimised the proposed basis of design.

All intellectual property previously owned by POEPL in relation to the Sea Lion Project is now owned by Navitas and for the sake of context and completeness, the following chapter describes the historical review of alternatives carried out by POEPL (now Navitas) as well as the most recent consideration of alternatives carried out by Navitas since 2022.

4.2 Project development process

During its development, the Sea Lion basis of design must go through the following concept phases:

- Appraise (evaluation of project feasibility, identification of options),
- Select (detailed evaluation of options),
- Define (definition of selected option and Front End Engineering Design (FEED)),
- Execute (detailed engineering and construction), and
- Operate (start-up and ongoing operation).

When evaluating the options during the 'Appraise' and 'Select' project phases, balanced consideration of the following is required:

- Health and safety,
- Environment,
- Technical feasibility,
- Financial, and
- Strategic implications.

During the Appraise and Select phases, assessment of the proposed options is carried out by multi-disciplinary teams, including environmental and technical specialists, as well as stakeholder liaison personnel. Further, a number of technical and environmental supporting studies are undertaken to inform the EIA and final concept selection.

4.3 Historical consideration of alternatives

Between 2012 and 2020, numerous options for producing the Sea Lion Field were considered by POEPL (now Navitas), all of which required an appreciation of the potential challenges inherent within the project. The following sections provide an overview of the identification of key challenges, and consideration of alternative development strategies as carried out under POEPL. Of note, some options were ruled out on technical grounds rather than environmental grounds, however, where environmental criteria were considered key to the selection process, this is indicated in the narrative below.

4.3.1 Identification of key challenges

The identification of challenges inherent in the development of the Sea Lion Field, was informed by assessment of the:

- Potential obstacles to production of the field, and
- Concepts available to overcome the challenges.

Further, it is necessary to consider the above as they apply specifically to the processes of:

- Oil production - which refers to the process of producing the Oil and Gas (O&G) resources from the subsurface reservoirs to the processing installation in order to ready them for use on the installation, or export to market, and
- Oil export - which requires the offload of the product (the oil) from the producing installation and delivery to market in quantities which are cost efficient.

Screening studies commenced in 2011. The identified challenges are outlined in Table 4.1 below and indicated that the options for the Development were limited.

Table 4.1: Summary of the challenges associated with production and export of oil from the Sea Lion Field

Challenges		Consequences and potential solutions	
		Production	Oil Export
Reservoir fluid properties:	High pour point i.e., produced fluid temperatures need to be above 25°C in order to flow. The separated oil (the product) needs to be kept higher than 36°C. High wax appearance temperature (i.e., the oil will become less viscous at < 66°C) such that the live fluid will have potential gelling issues.	Water injection (required to maintain reservoir pressures and oil sweep) will need to be heated, Artificial gas lift will be required for oil wells to increase flow rate as it is produced from the reservoir, Subsea and topside temperatures will need to kept above 60°C in normal operating conditions to minimise the wax deposition / gelling issues, and Temperatures will need to be maintained during turndowns / start-up operations.	The crude will require relatively complex, high upgrading (cracking) refineries to enhance the value of the crude oil, and The crude will require heating in transit (which may limit trading tanker selection) and during storage at the refinery.
Water depth:	Approximately 450 m at the Sea Lion location	Limits the feasible choices for drilling and production installation facilities e.g., bottom founded structures are precluded, Low seabed temperature exacerbates the flow assurance issues described above.	n/a
Weather conditions:	Prevailing metocean conditions result in a significant percentage of time with high winds and moderate sea states, little seasonal variation and few periods of benign conditions.	Limits the choice of installation type, offshore construction and subsequent operations including resupply, personnel movements and oil offloading. The tandem offloading operation from the producing installation to the tanker will be limited by wave and wind conditions.	

Challenges		Consequences and potential solutions	
		Production	Oil Export
Remote and geopolitically isolated location:	Limited infrastructure to support oilfield development, production or crude oil export currently exists within the Falkland Islands, No existing oil market and isolation from regional market, Political isolation may limit third-party participation in supply chain and logistical support.	Extensive planning and innovation for personnel and materials management is required, High redundancy, spares inventory and crew maintenance capabilities for all critical equipment, Limited existing logistics means essentially dedicated additional capacity is required, and Facilities / equipment reliability needs to reflect long response time for support.	The remoteness of the field means that: There are significant travel distances involved in order to access the markets for waxy crude oil, A dedicated oil export arrangement is required noting that consistent delivery of oil to a purchaser is a prerequisite for its sale and generation of revenue, and The frequency of offtake operations is directly dependent on the production rate and operating uptime making it vulnerable to delays in tanker schedules etc.
		The ongoing sovereignty dispute over the Falkland Islands has an impact which extends to other countries in the region. It affects both the potential for local / regional markets and the ability to use existing oil transhipment facilities in South America. Potentially greater challenges in management of oil spills in remote location.	

4.3.2 Identification and consideration of options

4.3.2.1 Production

4.3.2.1.1 Option identification and consideration

During the 'Appraise' process, the following were considered for use during the Sea Lion Development:

- Semi-submersible drilling and / or production installation (Table 4.2),
- Tension Leg Platform (TLP) (Table 4.2), or
- Floating Production, Storage and Offloading (FPSO) vessel (Table 4.2).

A description of the above and a list of the advantages and disadvantages of each is provided in Table 4.2. Ultimately the semi-submersible option was rejected as it offered no advantage over the TLP or FPSO options.

Alongside consideration of the above, it was also necessary to review the options for improving oil recovery from the reservoir. The options included gas lift to reduce the density of the oil and make it flow more easily, the use of Electric Submersible Pumps (ESPs) or of Hydraulic Submersible Pumps (HSPs). Four options were shortlisted:

- TLP with a Floating Storage and Offloading (FSO) vessel and dry trees (i.e., topside wells) with ESPs,
- TLP with an FSO and wet trees (i.e., subsea wells) with HSPs,
- FPSO with artificial lift from downhole HSPs, or
- FPSO with gas lift.

The advantages and disadvantages of the above are also listed in Table 4.2.

Table 4.2: Comparison of the offshore production options identified during the 'Appraise' phase

Production installation	Producing installation options				Well options	
	Description	Advantages	Disadvantages	Outcome	Description	Outcome
Semi-submersible	Floating platform with hull pontoons that can be flooded to submerge the vessel to a pre-determined depth with the columns supporting the deck above the sea surface (Figure 4-1)	Relatively stable platform, and Capable of drilling and production in water depths ranging from 600 - 3,600 m.	Lack of deck storage space, Unable to support topside (dry) wells, and Need for separate FSO vessel	**Rejected:** With wet (subsea) X-mas trees and the need for an FSO, it offered no benefit over the TLP or FPSO options.	n/a	
TLP	Has a similar configuration to a semi-submersible but is moored to the seabed with vertical tethers (Figure 4-1)	Stable platform, Able to support dry trees, and Capable of drilling and production in water depths ranging from 300 - 1,500 m.	Limited weight carrying capacity, and Need for separate FSO vessel	Carried forward for consideration	TLP with FSO and ESPs for dry wells and gas lift to subsea wells.	Carried forward for consideration
					TLP with FSO and subsea wells with HSPs	**Rejected**
FPSO	A ship-shaped floating structure which is either based on a (converted) oil tanker hull, or a new build	Large oil storage capacity within the hull, No need for an FSO, and Substantial open deck space on which process and utility equipment can be placed.	Unable to support topside wells, and Requires a complex mooring system	Carried forward for consideration	FPSO with subsea wells and artificial lift from downhole HSPs	**Rejected**
					FPSO with subsea wells and gas lift	Carried forward for consideration

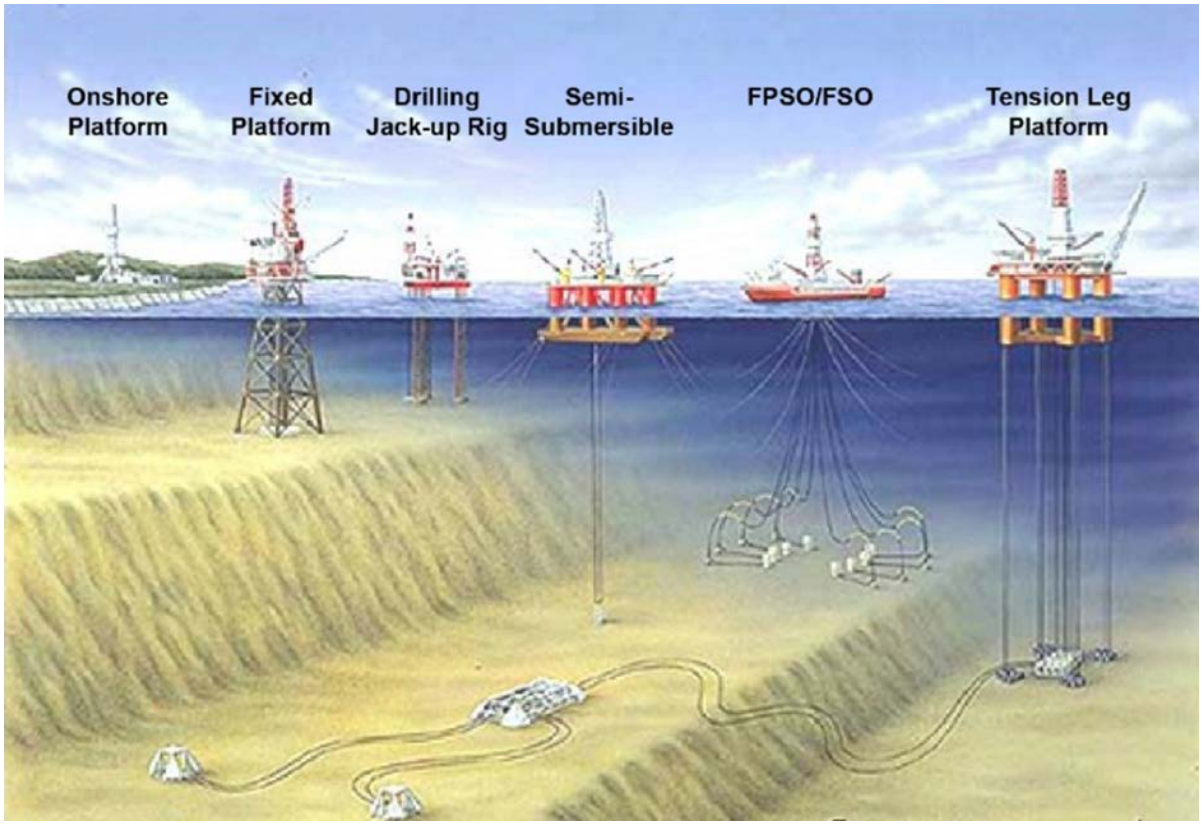


Figure 4-1: Types of offshore exploration and production facilities

4.3.2.1.2 Option selection

The detailed evaluation of the options in Table 4.2 above led to the conclusion that the following two options were the most viable:

- A TLP with artificial lift provided by ESPs (to topside oil production wells) and gas lift (to subsea oil wells), together with an FSO for oil storage, or
- A turret moored FPSO with artificial lift provided by gas lift to subsea (wet) oil production wells.

The Concept Select assessment ranked the proposed options in terms of performance and opportunity to minimise environmental impact against five environmental criteria (Table 4.3). Within each criterion, differentiators were selected to focus attention on those aspects where significant differences between the options might result (Table 4.3).

Both TLP and FPSO options were considered acceptable in terms of environmental criteria. The TLP approach was originally preferred, as it enabled full field development and informal scoping consultations were carried out in 2014 (Chapter 6). However the FPSO provided greater flexibility and enabled a phased development of the field and further scoping was carried out in 2015 (Chapter 6).

The FPSO with a detachable turret and gas lift was ultimately selected by POEPL for the (then) Phase 1 Development because:

- The use of gas lift provides reliability (no rotating equipment in the wells) and acceptable flow performance when compared with the use of ESPs,
- Inclusion of production and storage on an FPSO avoids the need for two infield installations which:

- Minimises the number of crude transfers between the producing, storage and export processes i.e., FPSO direct to oil tanker rather than TLP to FSO to oil tanker, and thus reduces the risk of oil spill, and
- Reduces the potential risk of collision with just a single infield installation and reduced resupply requirement.

- The FPSO can be disconnected from its mooring system and depart from the field should this be necessary (this would be a planned operation rather than an emergency response),
- Use of subsea wells in 450 m is a well-established, proven, and low risk practice with initial drilling undertaken by a dedicated Mobile Offshore Drilling Unit (MODU) which is only in the field during initial well drilling and for any subsequent well intervention if it were to be required, and
- The FPSO was more economic for the operation of (then) up to 30 wells.

Table 4.3: Concept screening differentiators

Environmental criteria	FPSO	TLP
Thermal power of the installation type	<20 MW(th)[1]	>50 MW(th)
Domestic discharges – (number of personnel)	<100	>200
Structural seabed disturbance – (areal extent)	<200,000 m^2	>300,000 m^2
Pipeline seabed disturbance (areal Extent)	<15,000 m^2	>20,000 m^2
Resource usage (steel / material use)	<100,000 te	>125,000 te

[1] Note that MW(th) is an indicator for potential fuel gas usage.

4.3.2.2 Oil export

4.3.2.2.1 Option identification and consideration

Having identified the use of an FPSO with wet wells and the use of gas lift to be the most effective production solution, screening studies identified the oil export system options that could be technically feasible for the Sea Lion Development. These were as follows:

- Offload from the FPSO directly to the export vessel for transport to market using:
  - Conventional Trading Tankers (CTT), or
  - A fleet of suitably equipped vessels.
- Offload from the FPSO to an Offshore Loading Shuttle Tanker (OLST) and Transfer to a CTT:
  - At an offshore / nearshore location,
  - At a sheltered location in another country, or
  - At a sheltered location in the Falkland Islands.

In discussions with FIG and their advisors in the UK (the Health and Safety Executive (HSEx)), it was decided that inshore transfer at a sheltered location in the Falkland Islands should be progressed as the project base-case and that, in parallel, the systems to offload directly to a CTT should be further explored.

Several criteria were considered important in the identification and selection of potential inshore transfer sites and through a desktop operational screening exercise in 2014, three potential inshore sites were identified. A comparative assessment of the environmental sensitivities of all three sites was carried out to enable differentiation, and ranking, of the sites (Premier, 2015c). Berkeley Sound was identified as the most appropriate site and an EIS for the whole development was submitted and underwent statutory consultation in 2018 (Chapter 6). Detail on the representations made, and the POEPL responses are provided in Appendix 3.

However, work to determine the viability of direct offtake (Premier, 2017b) as an option was also underway and a feasibility study was carried out to identify the key differences between offloading from the FPSO to an OLST (for transit to the inshore location for ship-to-ship transfer) and offloading from the FPSO directly to a CTT (for shipment direct to market). Six key differences were identified (Table 4.4). Proposals for ways in which these six areas could be managed to ensure that they were acceptable in terms of operational risk and health and safety are presented in Table 4.4 below.

Further work built on the above report and included:

- Gathering of updated and enhanced metocean datasets (including direct measurements from metocean buoys at the Sea Lion Field location), and
- Further studies to enhance the design of the process for direct offtake from the FPSO to a CTT to maximise availability and reduce risk, thus enhancing the likelihood of Safety Case acceptance by FIG and the HSEx. These were carried out following the commencement of the FEED, and with the support of an experienced FPSO operator.

A summary of the strengths and weaknesses of the direct offtake option is provided in Table 4.5.

Table 4.4: Six key areas that require management to successfully complete direct offtake

Key area	Issue	Proposed solutions
Tanker suitability and crew competency	The CTT (a 'tanker of opportunity') will not be dedicated to this duty and it may be its first time in the Sea Lion Field.	Tanker vetting and verification process implemented to select tankers to ensure they meet a pre-defined specification that includes assessment of suitability of equipment and crew competence, Minimum standard set for tanker crew competency and experience, and A tanker berthing crew will be sent to the CTT consisting of the Mooring Master and Assistant to supplement the CTT crew.
Personnel transfer	Safety of personnel (berthing crew) being transferred to the CTT.	CTT selection will ensure that as a minimum the tanker has winch landing facilities for lowering personnel by helicopter. During the CTT selection process, options for basket transfer and ladder access will also be considered. At the time of each transfer, the prevailing weather conditions will drive the selected transfer method. Safe personnel transfer supported by a detailed procedure. In addition to personnel (berthing crew) a 'mooring and offloading toolbox' will be transferred. The preferred method of transfer of the toolbox is *via* the CTT crane from the Multi-Role Supply Vessel (MRSV) in the field.
Tanker manoeuvring and maintaining appropriate position	The CTT has no Dynamic Positioning (DP) but will be connected to a hold-back tug; and Harsh environmental conditions.	Given the harsh environmental conditions, a controlled and consistent approach of the CTT to the FPSO is essential and should have sufficient uptime probability. The berthing of the CTT has been assessed under various conditions *via* Bridge Simulations involving the CTT and hold-back tug. Conditions including 3 m significant wave height and 30 knot winds were investigated and found feasible, meaning safe berthing is possible in Sea Lion conditions. Manoeuvring only requires a single tug, there was no occasion where a second tug was required at the bow of the CTT during simulations. The governing factor of a safe approach is the ability to safely abort the procedure, so a low speed of approach is required. It is recommended the approach of the CTT and tug is monitored electronically. In addition to speed of approach aids, GPS units may be a useful addition. During offloading, the CTT and its hold-back tug shall assure safe position, heading control and monitoring. An operability study has been undertaken to determine the feasibility and uptime for offtake under prevailing metocean conditions. The study showed a high availability for direct offtake, taking into account the limiting environmental conditions and procedure limits shown above. There are two specific dynamic interactions between the CTT and FPSO that could give particular cause for concern: namely fishtailing (or yaw), and surging.

Key area	Issue	Proposed solutions
		These can potentially lead to high hawser tensions and the need for disconnection if the CTT cannot maintain proper alignment. The studies performed to date have indicated these risks are not significant.
Connection and disconnection	Safety of personnel; and No bow loading system on the CTT; connection will be to a midship manifold	Optimising hawser design to minimise risks during connection and disconnection shall be reviewed during detailed design. Residual risks to be mitigated through development of detailed procedures for safe boatless hawser handling and midship loading hose operations. All operations can be performed without the need for a workboat (i.e., only personnel on the FPSO and CTT are involved). Acceptable environmental operating conditions have been developed for approach and berthing including: Mean 10-min wind speed < 30 knots, Significant wave height <3 m, and Visibility > 1,000 m.
Safety systems	The CTT has no DP but is connected to a hold-back tug; No 'green line system established'[1]	Manual shut down interface and firefighting capabilities shall be in place on both the FPSO and CTT during transfer operations. A tanker position reference system will be provided and shall comply with relevant maritime recommendations, following the 'Tandem Loading Guidelines' (OEUK, 2014). The tanker position reference system will be equipped with a capability to interface with various controls, monitoring systems and communication systems allowing the Berthing Master to initiate manual emergency shutdown. This would cause the FPSO cargo offloading pumps to stop and the offloading valve to close. During offtake, the CTT crew shall monitor the mid-ship manifold and bow mooring. In case of any abnormality the CTT cargo control room and Mooring Master will be informed and action initiated. The MRSV located near to the operation, but outside the exclusion zone, shall have firefighting capabilities.
Emergency disconnection	No bow loading system on the CTT; connection will be to a midship manifold	In case of emergency all effort will be made to stop offload and disconnect the hose in a controlled manner prior to hawser disconnection (and CTT departure) to prevent engaging of the Marine Breakaway Coupling on the floating hose. Controlled emergency disconnection of the CTT from the hawser connect shall be achieved. An emergency disconnection can take place in less than one minute by release of the hawser Quick Release Hook from the FPSO and parting of the Marine Breakaway Coupling on the floating hose. The coupling is designed stop leaks during unplanned disconnection and also protect the hose sections

[1] In the North Sea, DP OLSTs use the term "greenline system" to describe the "permit to pump" telemetry system installed. Sensors are fitted to various systems on the tanker and it is only when all of these sensors are in the correct position that the permit to pump signal is given to the FPSO, which allows the offloading pump to be started.

Table 4.5: Strengths and weaknesses of oil export *via* direct offtake in the Falkland Islands

Strengths	Weaknesses
Avoids bringing crude oil inshore.	Longer transfer hose means a bigger potential transfer spill inventory
Inherently safer as removes three vessels from the field and avoids two oil transfer operations (i.e., FPSO to OLST and then OLST to CTT).	FPSO offloading undertaken by tankers of opportunity so crew competency requires assurance
Best energy efficient option as three vessels are removed.	Fewer associated employment opportunities (local content)
Low fixed costs.	-
No DP operations; reduces underwater noise	-
Large available fleet of CTTs (i.e., no single point failure).	-
Only one support vessel required.	-
No permanent exclusion zones in Berkeley Sound.	-

4.3.2.2.2 Option selection

The above investigations ultimately demonstrated that direct offtake was indeed viable and could commence from the start of operations. POEPL and FIG were satisfied that direct offtake represented the best option. It was considered to be inherently safer and proved to be the best environmental option. As a result, the inshore transfer was removed from the basis of design. The EIS was amended and underwent a second statutory consultation in 2020 (Chapter 6). The EIS describing the Sea Lion Development, with direct offtake as the base-case oil export option, was accepted in 2020.

4.4 Development optimisation by Navitas

Navitas' primary focus has been to accelerate the path to First-Oil and deliver a lean and financeable development plan for the Sea Lion Field, without compromising environmental or safety standards, or potential reservoir performance. Following an internal document review of POEPL's concept selection process, Navitas was aligned with the proposed basis of design with regard to the use of an FPSO with subsea development and direct offtake as the oil export method. Recognising this as the most cost-effective development solution, Navitas further refined the Development concept by considering the following:

- Drilling:
  - Phased drilling schedule,
  - Reduction in well count, and
  - Optimisation of First-Oil and the Phase 1 & 2 well counts.
- The FPSO and considerations of:
  - The source of the vessel (new-build *vs*. redeployment of an existing vessel), and
  - The size of the FPSO and daily production figures.
- The well completion design, and
- Field life.

Of note, some options were ruled out on technical grounds rather than environmental grounds, however, where environmental criteria were considered key to the selection process, this is indicated in the narrative below.

4.4.1 Well count and phased drilling schedule

Two development phases have been considered so far for the Sea Lion Field Northern Development Area, with the potential for a third development phase to be evaluated, post development and during early production. The base-case for the Phase 1 & 2 Development is to complete 23 wells and to conduct the drilling campaign over the two separate phases, resulting in two episodes of simultaneous operations (SIMOPs) separated by a period of steady state production. This is considered optimal in order to:

- Ensure First-Oil can be achieved within approximately three years,
- To enable assessment of the reservoir performance prior to ongoing expenditure on drilling,
- To provide opportunity for learning from the first tranche of wells, and
- To optimise use of the MODU with regard to exploration of less economic (and more remote) targets which may be matured as additional data is acquired.

The phased options considered included:

- Option 1 (23 wells):
  - Phase 1: up to 12 drilled wells, with five completed before First-Oil, and
  - Phase 2: up to 12 drilled wells.
- Option 2 (23 wells):
  - Phase 1: 18 wells, with 11 completed before First-Oil, and
  - Phase 2: 5 wells.

Of importance, the number of wells to be delivered in each phase is a function of the host facility (the FPSO) and expected production performance.

4.4.2 FPSO

4.4.2.1 Sourcing the FPSO

Navitas has performed market surveys and contracted an FPSO broker to assist in assessing the current FPSO market conditions. Upon evaluating newbuild hulls, CTT conversions, and redeployment of an existing FPSO, the most compelling investment opportunity was for the redeployment of an existing FPSO. The benefit of redeployment is the potential for quicker project execution and lower overall capital cost, as well as the opportunity to finance the FPSO *via* Operating Expenditure, through a long-term charter with the owner of the vessel. It also has environment benefits compared to a new-build with regard to the life-cycle footprint.

4.4.2.2 Optimal vessel size

Navitas has assessed numerous vessel sizes, production capacities and hull configurations to find the best solution for Phase 1 & 2 Development.

Options considered included:

- An FPSO with capacity for peak 55,000 bopd using Option 1 for the drilling schedule, i.e:
  - Phase 1: up to 12 drilled wells (seven OP wells drilled & completed prior to First-Oil), and
  - Phase 2: up to 12 drilled wells.
- An initial FPSO with capacity for 45 k bopd, subsequently replaced by a vessel with 80k bopd, again using Option 1 for the drilling schedule, or
- An FPSO with capacity for 80,000 bopd, and Option 2 phased drilling schedule, i.e:
  - Phase 1: 18 wells, with 11 completed before First-Oil, and

- Phase 2: 5 wells.

An economic analysis, comparing the use of a 55,000 bopd capacity FPSO *vs* the larger vessel with capacity for 80,000 bopd is presented in Navitas' Long-term Development Philosophy Document (SLN-SUB-SBS-PLN-00001-06). The study demonstrated only a marginal benefit with the larger vessel in terms of NPV10[12] and recoverable resource. However, the main advantage of the 55,000 bopd capacity FPSO will be reduced capital exposure by leasing a redeployed FPSO, and the ability to subsequently develop other field areas to the south.

The result of this assessment was to select an Aframax (or larger) hull with 55,000 bopd capacity which will ensure more efficient utilisation of the FPSO and therefore a lower emissions intensity per barrel of oil.

4.4.3 The well completion design

The base-case is to run Open Hole Gravel Pack (OHGP) well completions as opposed to the perforation completion proposed by POEPL. The advantages of the OHGP are:

- Less debris in the wellbore thus minimising risk to the FPSO so that the wells can be initially cleaned up to the FPSO rather than the MODU, the latter of which would require flaring;
- Minimises the likelihood of sand within the produced fluids, and
- Removes the requirement for perforation guns and the use of explosives for completion:
  - Note that while this decision was made on technical grounds, it is also considered the best environmental option as it lessens the risk of debris downhole such that well clean-up can be carried out to the FPSO rather than the MODU thus negating the base case need for flaring during clean-up, and requires less use of land onshore in the Falklands for storage of explosives.

4.4.4 Field life

The reduced daily production rate that results from fewer wells producing to the smaller FPSO than that proposed by POEPL means that while the FPSO is more fully utilised, thus increasing overall efficiency per barrel of oil, the overall Field Life is longer. Navitas anticipate a Field Life of up to 30 years.

4.4.5 Selected basis of design

The full basis of design is described in the Development Description (Chapter 5). However, by way of summary, and following all the considerations above, the optimised Sea Lion Development basis of design is as follows:

- A phased drilling campaign,
- Use of a redeployed FPSO with capacity for 55,000 bopd production,
- Up to twelve wells will be drilled overall in Phase 1, with five wells completed prior to First-Oil (Stage 1),
- The remainder of the Phase 1 wells will be drilled alongside the producing FPSO in Stage 2a, which will be a period of SIMOPs (simultaneous operations),
- This will be followed by a duration of steady state production while the reservoir performance is assessed,
- The Phase 2 wells will be drilled during a second stage of SIMOPS, Stage 2b, and
- Oil export *via* the direct offtake method will commence after First-Oil.

[12] NPV10 means Net Present Value in money of the day using a 10 % forward discount rate.

4.5 Mitigations not used

As required by the FIG EIA Guidance, the sections below list the mitigation measures potentially available but not proposed for use in this project, and details why they are not considered appropriate for this development.

4.5.1 Drill Cuttings disposal

During drilling the re-injection of drill cuttings into a dedicated well was rejected as an option because the benefits of disposing of the cuttings was negated by the cost of drilling another well to receive the cuttings (a disposal well). Another option for cuttings disposal was to take them back to shore but as there are no suitable facilities on the Islands for appropriate treatment and/or disposal this option was not progressed further. Similarly, it was not considered viable to send the cuttings back to the UK for treatment and disposal. As noted in Section 5.4.5.3.1, a Thermo-Mechanical Cuttings (TCC) unit is being deployed on the rig, which is able to treat the cuttings offshore and they will be disposed of over the side of the rig, falling to the seafloor – this impact is assessed in Section 10.6.

4.5.2 Drilling mud

There was an option to use Water-based Mud (WBM) in the reservoir sections but WBM cannot be used for lower sections of the Sea Lion wells as only Non-Aqueous Drilling Fluid (NADF) (see Section 10.6.4.1.3.1) gives confidence around hole stability through highly deviated sections. NADF will be used for the lower sections of the wells and the use of this is considered in Section 10.6 and Section 10.7.

4.5.3 Hydrotest water

It is currently planned that hydrotest water will not be routed back to the FPSO during commissioning so will be disposed of overboard. The impact of this discharge is assessed in Section 10.7. Navitas will investigate routing of hydrotest water in detailed design to determine whether any can be returned to the FPSO before being injected downhole.

4.5.4 Atmospheric emissions

Electrification (power from shore) is not a viable option as there is not sufficient power available from the shore in this region, nor is there a realistic prospect of this being available in the future.

It was considered whether the vent gases from the CTT would be recovered as opposed to vented but CTT vent gas recovery capability is not sufficiently widespread in the fleet.

An ‘on demand’ HP flare ignition to remove the need for a pilot flame will be investigated during the FEED process but is not yet included as a project-specific mitigation in the impact assessment.

The impact of the atmospheric emissions from the Sea Lion Development is assessed in Section 10.9.

4.5.5 Waste

Construction of a Navitas landfill site in the Falklands has been discounted as this is not considered commercially viable. Additionally, it is considered more beneficial for a collaborative approach to be taken in long-term waste plans. Navitas will continue to collaborate with FIG on longer-term waste plans. The waste produced from the Sea Lion Development and the disposal of that waste is assessed in Section 10.10.

4.5.6 Marine invasives

The use of antifouling measures, e.g., slick paints is being investigated to reduce marine growth on the hull of the FPSO. The assessment of marine invasive species (Section 10.12) does not take this mitigation into account at this time, to ensure the worst-case is assessed.

4.5.7 Disturbance to other users of the sea

Over-trawlable subsea infrastructure is not considered necessary here due to the water depth and the lack of fishing activity in the area targeting benthic species. The impact to other users of the sea from the placement of the subsea infrastructure is considered in Section 11.1.

4.5.8 Resource competition – Water

Importing fresh water by vessel was considered and discounted in favour of implementing a freshwater header tank at the TDF, which will alleviate pressure on supply. The assessment of water use by the Development is considered in Section 11.4.

4.5.9 Resource competition – Electricity

Building a local (renewable) power supply for the onshore supply base was considered but Navitas has decided to buy electricity from the existing grid. See Section 11.5 for an assessment of the power usage of the Sea Lion development.

4.5.10 Oil spill offshore

The use of dispersants for responding to an oil spill from the Sea Lion Field were discounted as dispersants are not a viable response option for Sea Lion crude as found during oil tests (CEDRE, 2017) as the oil is too waxy to respond to chemical dispersal.

Similarly, the tests conducted at CEDRE (2017) found that oleophilic and weir skimmers were not viable for use with the very waxy Sea Lion crude.

Of note, other skimmer devices were considered viable for the Sea Lion crude and weir skimmers are viable for use with MGO. The impacts and risks of an oil spill at the Sea Lion Field are considered in Section 12.1.

5 SEA LION FIELD, PHASE 1 & 2 DEVELOPMENT DESCRIPTION

Table of Contents

5.1 Introduction 136
5.1.1 Chapter structure 136
5.2 Project overview 136
5.2.1 Project schedule 143
5.3 Sea Lion reservoir characteristics 145
5.4 Phase 1 & 2 Drilling operations 145
5.4.1 Drilling location 145
5.4.2 Drilling Schedule 146
5.4.3 Mobile Offshore Drilling Unit (MODU) 147
5.4.3.1 MODU moorings 148
5.4.4 Number and type of wells 148
5.4.4.1 Phase 1 - Pre-First-Oil wells (Stage 1) 148
5.4.4.2 Phase 1 - Post-First-Oil wells (Stage 2a) 149
5.4.4.3 Phase 2 wells (Stage 2b) 149
5.4.4.4 Assumptions about the drilling operation 149
5.4.4.5 Re-drill contingency 150
5.4.5 Well design 151
5.4.5.1 Drilling, casing and wellheads 151
5.4.5.2 Drilling sequence (batch or sequential drilling) 153
5.4.5.3 Drilling muds and drill cuttings management 153
5.4.5.3.1 NADF: Lower-hole sections 153
5.4.5.4 Well suspension 156
5.4.5.5 Well completion 156
5.4.6 Well chemical use and discharge 157
5.4.6.1 Drilling chemicals 157
5.4.6.2 Cementing chemicals 158
5.4.6.3 Well suspension, completion, and gravel pack fluids 158
5.4.6.4 Well completion 159
5.4.6.4.1 Completion chemicals 159
5.4.6.5 Other MODU discharges 159
5.4.7 Use of explosives 159
5.4.8 Well clean-up and initial well testing 159
5.4.9 GI Well commissioning 161
5.4.10 Well control and blow-out prevention during drilling 162
5.5 Construction: Installation of drilling, production and export facilities 163
5.5.1 Large Transport Vessel (LTV) support 163
5.5.2 FPSO mooring system 165
5.5.3 Subsea production facilities 165
5.5.3.1 Subsea X-mas trees 165
5.5.3.2 Subsea manifolds and pipelines 165
5.5.3.3 Installation supports 165

5.5.4 Arrival and positioning of the FPSO 171
5.6 FPSO Hook-up and commissioning 172
5.7 Simultaneous Operations (SIMOPS): drilling and production 172
5.8 Production facilities 173
5.8.1 Subsea production facilities 173
5.8.1.1 Subsea Production Systems (SPS) 173
5.8.1.2 Subsea Umbilicals, Risers and Flowlines (SURF) 173
5.8.1.3 Subsea Controls 173
5.8.2 FPSO design 173
5.8.2.1 FPSO Drainage facilities 174
5.8.2.2 FPSO capacity and production 175
5.8.2.2.1 Production Profile 175
5.8.2.3 FPSO combustion equipment 176
5.8.3 FPSO vessel utility systems 177
5.8.3.1 Anti-fouling 177
5.8.3.2 Heating, ventilation and air conditioning (HVAC) 177
5.8.3.3 Power generation and fuel sources 177
5.8.3.4 Bunkering and bulk storage 179
5.8.3.4.1 Diesel bunkering, storage and treatment system 179
5.8.3.4.2 Chemical bunkering and storage 179
5.8.3.5 Freshwater systems 180
5.8.3.6 Vessel and domestic waste treatment systems 181
5.8.4 FPSO oil and gas utility systems 182
5.8.4.1 Flow assurance facilities 182
5.8.4.2 Heating and cooling facilities 183
5.8.4.3 Gas management system 184
5.8.4.4 Flaring facilities 184
5.8.4.5 Venting and fugitive emissions 184
5.8.4.6 Tank blanketing and venting 184
5.8.4.7 FPSO Off-Spec and Slops tanks 185
5.8.5 FPSO oil and gas process facilities 185
5.8.5.1 Total fluid separation 185
5.8.5.2 Oil Process 188
5.8.5.3 Gas process 188
5.8.5.3.1 Gas compression 188
5.8.5.3.2 Gas Dehydration 188
5.8.5.4 Produced water process 188
5.8.5.4.1 Discharge to Sea 189
5.8.5.5 Management of Solids 190
5.8.5.6 Improved Oil Recovery (IOR) 190
5.8.5.7 Field life well testing 190
5.8.5.8 Water injection / Produced Water Reinjection (PWRI) facilities 190
5.8.5.9 Gas Lift Facility 191
5.8.6 FPSO crude storage tanks 191

5.9 Steady state production 191
5.9.1 Chemical use 191
5.9.1.1 Operational chemicals 191
5.9.1.2 Non-operational chemicals 192
5.9.2 Routine monitoring and maintenance 192
5.9.3 Well workovers 193
5.9.4 Process shutdown and start-up 193
5.10 Oil export process and facilities 193
5.11 Logistics and infrastructure 196
5.11.1 Port facilities and onshore supply base(s) 196
5.11.1.1 Port facilities 196
5.11.1.1.1 The Temporary Dock Facility (TDF) 197
5.11.1.1.2 FIPASS 198
5.11.1.1.3 Mare Harbour 198
5.11.1.2 Onshore supply bases 198
5.11.1.2.1 Diesel generators 201
5.11.1.2.2 Waste incinerator 201
5.11.1.2.3 Oil spill response equipment 201
5.11.1.2.3.1 OSR equipment at the TDF for MGO 202
5.11.1.2.3.2 OSR equipment at the Operational Base 202
5.11.2 Use of vessels 207
5.11.3 Personnel transportation and search and rescue (SAR) operations 211
5.11.3.1 Transportation of personnel 211
5.11.3.1.1 Transportation to the Falkland Islands 211
5.11.3.1.2 Transportation to the Sea Lion Field 211
5.11.3.1.3 Transportation between Mount Pleasant Complex (MPC) and Stanley Airport 211
5.11.3.1.4 Transportation to the CTT 212
5.11.3.2 Search and Rescue (SAR) exercises 212
5.11.4 Use of finite resources 213
5.11.4.1 Accommodation requirements 213
5.11.4.1.1 Accommodation provided by Navitas 214
5.11.4.1.2 Accommodation type 214
5.11.4.2 Freshwater requirements 217
5.11.4.2.1 MODU 217
5.11.4.2.2 FPSO 218
5.11.4.2.3 Vessels 218
5.11.4.2.4 Onshore Construction 218
5.11.4.2.5 Laydown yards, storage, and propriety TDF usage 219
5.11.4.2.6 Accommodation 219
5.11.4.2.7 Total estimated freshwater requirement for Phase 1 & 2 219
5.11.4.3 Electricity requirements 220
5.11.4.4 Waste management plan 221
5.11.4.4.1 Oil spill waste management 222

5.12 Decommissioning 222
5.12.1 Decommissioning programme 224
5.13 Development resilience to the effects of climate change 224
5.14 Phase 1 & 2 base-case mitigation technologies 225
5.15 Estimated quantities of residues and emissions resulting from the project 228

5.1 Introduction

In order to identify and understand the potential environmental impacts and risks, and to enable quantification of the residues and emissions to the environment (as requested in the Falkland Islands Government (FIG) EIA Guidance Note (FIG, 2016e), it is necessary to understand:

- What activities will be carried out during the Sea Lion Field Northern Development Phase 1 & 2 (hereafter referred to as the Phase 1 & 2 Development), and
- What technologies will be built-in to the design of the facilities.

Whilst some of the details can only be finalised upon the final award of contracts to specific vendors, the Phase 1 & 2 activities will be consistent with the description provided here which has been prepared to be conservative and therefore aims to describe the worst-case with regard to the residues and emissions.

Note: the following chapter introduces many technical terms and abbreviations. The abbreviations are explained at the first use in the narrative, and in the tables / figures throughout. However, they are also listed in the Abbreviations table in Chapter 18 and a Glossary is included in Chapter 19 to explain any technical terms. These two sections may be of use when reading the below.

5.1.1 Chapter structure

The following chapter describes:

- An overview of the project (Section 5.2)
- The project schedule (Section 5.2.1),
- The Sea Lion Field reservoir characteristics (Section 5.3),
- The drilling operation (Section 5.4),
- Construction: installation of offshore drilling, production and export facilities (Section 5.5),
- Hook-up and commissioning of the FPSO (Section 5.6),
- Simultaneous drilling and production operations – SIMOPS (Section 5.7),
- The production facilities (Section 5.8),
- Steady state production (Section 5.9),
- Oil export process and facilities (Section 5.10),
- Logistics and infrastructure (Section 5.11),
- Decommissioning (Section 5.12),
- Development resilience to the effects of climate change (Section 5.13),
- The Phase 1 & 2 Development base-case mitigation technologies (Section 5.14), and
- The estimated output quantities of residues and emissions from the Phase 1 & 2 Development (Section 5.15).

Sufficient detail is provided below to enable assessment of the environmental impacts of Stages 1-3 under planned, unplanned and accidental conditions. As described in Section 5.12, full details on the decommissioning operation (Stage 4) will be described in a dedicated decommissioning Environmental Impact Assessment (EIA), which will be developed prior to cessation of production.

5.2 Project overview

The Sea Lion Field lies in water depths of approximately 450 m and is located in Block 14/10 in the hydrocarbon license area PL032, which is approximately 220 km to the north of the Falkland Islands. Hydrocarbons are reservoired in sandstones of early Cretaceous age approximately 2,000 m below the

seabed. A Field Life of up to 30 years has been projected and it is estimated, using the P50 case, that approximately 310.5 million stock tank barrels (MMstb) of oil can be recovered in this timeframe.

The proposed Phase 1 & 2 development wells will be drilled from six Drill Centres (DC) with a contingency for an alternative gas injection DC, by a Mobile Offshore Drilling Unit (MODU).

The Development will therefore involve drilling a maximum of 26 wells and completing a maximum of 23 wells as follows:

- The Sea Lion Field Northern Development Area - Phase 1:
  - Seven Oil Production (OP) Wells,
  - Three Water Injection (WI) Wells,
  - One Gas Injection (GI) well, and
  - One contingent GI well at the 'Casper' gas reservoir (in the event the planned location is unsuitable for gas injection, e.g., oil encountered on the NW flank instead of gas).
- The Sea Lion Field Northern Development Area - Phase 2:
  - Nine OP wells, and
  - Three WI wells.
- Either Phase 1 or Phase 2:
  - Two contingent re-drills (the complete re-drilling of individual wells, or of sections of wells (collectively referred to as 're-drills'), may be required in response to technical problems).

To account for the worst-case (as requested in the EIA Guidance Note (FIG, 2016e)), this EIS assesses the impact of:

- Drilling up to 26 wells, and
- Production operations from 23 completed wells.

Production operations will be carried out using a Floating Production, Storage and Offloading (FPSO) unit located approximately 2 km from the main Production Drill Centre (DC) (NA-P-01), 3.5km from the Water Injection DC (NA-W-01), 5.3 km from the Gas Injection DC (NA-G-01), 3.5 km from the Southern Production DC (NA-P-02), 2.7 km from the East Water Injection DC (NA-W-02) and approximately 4.5 km from the Southern Water Injection DC (NA-W-03). An illustration of the main project elements is shown in Figure 5-1 and Figure 5-2.

In addition to crude oil (which is the target product), there will also be hydrocarbon gas in the Sea Lion reservoir fluids which will be produced from the oil wells. Gas that comes out of the oil wells is referred to as 'associated gas'. This associated gas will be used for fuel on the installation, for 'gas blankets' in cargo / slops tanks and for 'gas lift' to improve the oil recovery. Any surplus gas will be re-injected into the GI well.

Seawater injection will also be used to improve oil recovery and will be distributed to the dedicated WI wells. In addition to this, water which comes out of the reservoir along with the oil and associated gas (referred to as 'produced water') will also be re-injected, both to enhance recovery and as an alternative to discharge. In the case of temporary operational or maintenance issues e.g., downtime in the Produced Water Reinjection (PWRI) system (Section 5.8.5.8), produced water may be discharged overboard whilst being monitored for the specified limits (Section 5.8.5.4.1). The amount of produced water available for re-injection will increase over time as the oil content of the reservoir depletes.

Once the oil has been processed on the FPSO, it will be ready for export to market *via* direct offtake from the FPSO. The direct offtake of oil from the FPSO will:

- Minimise the risk of exposure of environmentally sensitive areas in, and around, the Falkland Islands to hydrocarbon spills from offloading operations, and
- Require additional offshore mitigations to be put in place e.g., a dedicated Offshore Support Vessel (OSV) to attend the Commercial Trading Tanker (CTT) offshore in addition to the presence of the Emergency Response and Rescue Vessel (ERRV).

For the purposes of this EIS, the Development has been divided into four stages to differentiate construction and production operations activities. The activities and processes associated with each stage are explained in more detail later in this chapter. However, by way of introduction, an overview of the stages of the initial Phase 1 & 2 Development is provided in Table 5.1.

Table 5.1: Overview of the activities associated with the four stages of the proposed Sea Lion Phase 1 & 2 Development

Phase 1 (11 wells + 1 contingency GI well))	**Stage 1: 31 Months (5 completed wells + 1 contingency GI well)**	**Stage 1 – Pre-First-Oil (construction only): All activities up to 'First-Oil'- drilling / well construction and installation of production facilities, including:** • Commissioning and operation of the onshore production support and drilling support bases, • Mooring of maximum two Large Transport Vessels (LTVs) at any one time in Berkeley Sound for equipment storage and associated vessel activity (for a non-consecutive total of 13 months over Stages 1, 2a, interim Stage 3, and Stage 2b), • Commissioning and operation of an onshore drilling mud plant, • Use of the existing Temporary Dock Facility (TDF), • Drilling, completion and suspension of the first tranche of Phase 1 wells using a MODU **Note:** up to eight wells will be drilled with only five completed prior to First-Oil), • Installation of the MODU anchor and mooring system, wellheads / conductors, FPSO mooring system and turret buoy, connection of the flowlines and risers to the turret buoy and the offshore subsea production infrastructure (e.g., X-mas trees, subsea manifolds, manifold support pile, umbilicals, risers, flowlines, jumpers, hydraulic and electric flying leads and, potentially mud mats for support), • Pre-commissioning of the Subsea System, • Arrival and installation of the FPSO, • Hook-up and commissioning of the FPSO to the pre-installed turret buoy and subsea production equipment, • Introduction of hydrocarbons to the production facilities and commencement of production operations Production Drill Centre (NA-P-01), Water Injection Drill Centre (NA-W-01) and the Gas Injection Drill Centre (NA-G-01), • Flow-back of the OP and GI wells to the FPSO: o Overall contingency for four well tests to the MODU with flaring. • 'First-Oil' with Production Operations commencing from the first completed Phase 1 wells, • Use of supply vessels and Emergency Response and Rescue Vessel (ERRV) to support operations in the field, and • Use of fixed-wing aircraft, road transport, vessels and helicopters throughout.
	Stage 2a: 7 Months (6 wells)	**Stage 2a – Simultaneous operations (SIMOPS) - concurrent drilling and initial (post First-Oil) production (i.e., having the MODU drilling in-field with early production from the FPSO occurring at the same time):** • Use of the onshore supply base, liquid mud plant and TDF, • Anchoring of maximum LTVs at any one time in Berkeley Sound and associated vessel traffic (for a non-consecutive total of 13 months over Stages 1, 2a, interim Stage 3, and Stage 2b), • Drilling and completion, *via* a MODU, of the remaining Phase 1 wells (six wells including completion of three of the wells drilled in Stage 1), • Installation of the remaining subsea production infrastructure (e.g., X-mas trees, jumpers, hydraulic and electric flying leads), • Flow-back of the OP and GI wells to the FPSO: o Overall contingency for four well tests to the MODU with flaring.

Phase 2 (12 wells)		• Production Operations of all 11 subsea Phase 1 wells controlled from the FPSO, and • Direct offtake (offload) of crude from the FPSO to the purchaser's CTT. • Use of supply vessels and ERRV on standby to support operations both in the field and offshore, construction vessels at the LTV mooring location in Berkeley Sound, and • Use of fixed-wing aircraft, road transport, vessels and helicopters throughout.
	Stage 3 (28 Months)	**Stage 3 – Steady State Production (Production Only):** • Production Operations of up to 11 subsea wells controlled from the FPSO, • Ongoing use of the onshore supply base and TDF, • Direct offtake (crude oil offload) from the FPSO to the purchaser's CTT for export to oil market, • Use of supply vessels and ERRV on standby to support operations in the field, and • Use of fixed-wing aircraft, road transport, vessels and helicopters throughout.
	Stage 2b: 28 Months	**Stage 2b –SIMOPS, Production alongside drilling and construction of up to 12 Phase 2 wells:** • Use of the onshore supply base, liquid mud plant and TDF, • Anchoring of maximum LTVs at any one time in Berkeley Sound and associated vessel traffic to support the Stage 2b Subsea construction campaign (for a non-consecutive total of 13 months over Stages 1, 2a, interim Stage 3, and Stage 2b), • Drilling and completion of 12 Phase 2 wells from a MODU: • Flow-back of the OP and GI wells to the FPSO: o Overall contingency for four well tests to the MODU with flaring. • Installation of the remaining subsea production infrastructure (e.g., X-mas trees, jumpers, hydraulic and electric flying leads), • Production Operations of all subsea wells controlled from the FPSO, • Direct offtake (offload) of crude from the FPSO to the purchaser's CTT, • Use of supply vessels and ERRV on standby to support operations both in the field and offshore, construction vessels at the LTV mooring location in Berkeley Sound, and • Use of fixed-wing aircraft, road transport, vessels and helicopters throughout.
Stage 3 - Ongoing Steady State production for Field life		
N/A	Stage 4	**Stage 4 – Decommissioning (No Production):** • Decommissioning activities once the field is ready for abandonment: o Decommissioning of the wells, subsea production infrastructure, and demobilisation / removal of the FPSO, and o Decommissioning of at-shore (TDF) and onshore infrastructure.

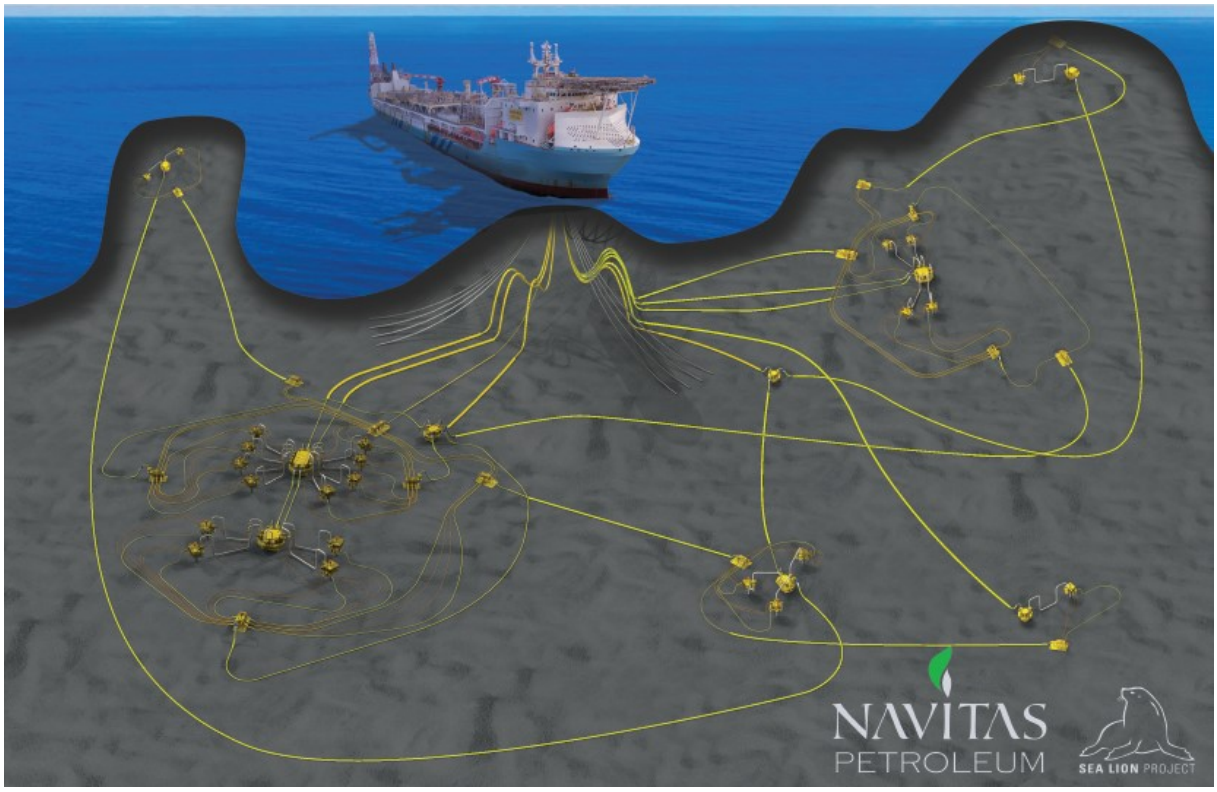


Figure 5-1: The Sea Lion Field Northern Development Area Phase 1 & 2 field configuration (illustrative only)

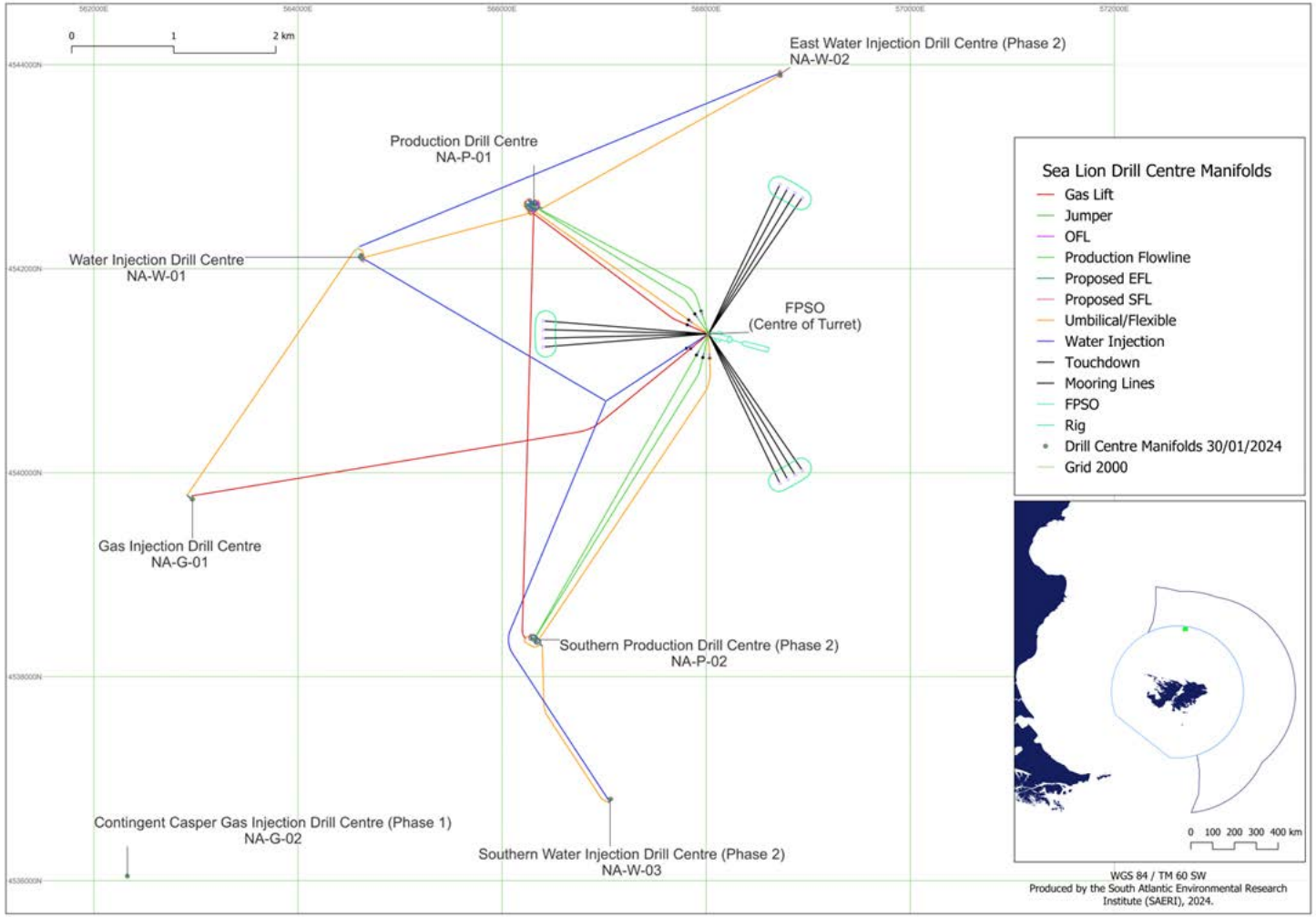


Figure 5-2: The Sea Lion Northern Development Area Phase 1 & 2 plan of development layout

5.2.1 Project schedule

The duration of each of the Stages is presented in Table 5.2. The overall project timescale is provided in Table 5.3 below, however, please note that this may be subject to change depending upon the award of project contracts.

Table 5.2: Duration of Stages within the Sea Lion Field Northern Area Phase 1 & 2 Development

Development stage		Duration				
		Months	Years	Weeks[1]	Days[2]	Fortnights[3]
Stage 1	Pre-First-Oil drilling	31	2.6	133	942	67
Stage 2a	Post-First-Oil SIMOPS	7	0.6	30	213	15
Stage 2b	SIMOPS	28	2.3	120	851	61
Stage 3	Steady state production	325	27.1	1,398	9880	706

[1] Calculated as the number of months multiplied by 4.3.
[2] Calculated as the number of months multiplied by 30.4.
[3] Calculated as the number of days divided by 14.

Table 5.3: Indicative Sea Lion Field Northern Area Phase 1 & 2[1] Development timeline

Activity	Phase 1																								Phase 2								Phase 1 & 2 complete							
	Year 1				Year 2				Year 3				Year 4				Year 5				Year 6				Year 7				Year 8				Onward →							
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Milestones								★	Spud Phase 1			★	First Oil															★	Spud Phase 2											
Stage		Stage 1 - Pre-first Oil: Drilling & Construction										Stage 2a - SIMOPS				Stage 3 - Steady State Production												Stage 2b - SIMOPS: D&C and Production										
Onshore Activity		Infrastructure & Construction																																						
Offshore Drilling								Drill: 11 wells + 1 contingency																				Drill: 12 wells + 1 contingency												
Offshore Construction							OCVs				OCVs														OCVs				OCVs											
FPSO Operations												FPSO *in situ*																												

[1] Stage 4 decommissioning is outwith the scope of this EIS. See Section 5.12.

Note: the stars indicate key milestones.

5.3 Sea Lion reservoir characteristics

Based upon the results of the exploration and appraisal wells previously drilled into the reservoir, Sea Lion crude is known to be a medium density, sweet (low sulphur) crude with a high wax content (23 % using the n-alkane method and 42.3 % using the wax crystallisation method). The crude has a 'live' (i.e., when it still contains gas) pour point of 25 °C and a dead (i.e., once gas has been removed) pour point (the temperature below which stabilised crude does not pour out of an upturned container) of 36 °C. Further, the crude has a Wax Appearance Temperature (WAT, the temperature at which wax starts to crystallise) of 66 °C such that viscosity of the crude increases below 66 °C.

Therefore, flow assurance needs to be factored into the design of the subsea facilities, FPSO and oil export facilities (Section 5.8.4.1). The Sea Lion reservoir properties are summarised in Table 5.4.

Table 5.4: Sea Lion reservoir properties

Reservoir	Eastern Area (or "East Flank") [well 14-10/5]	Western Area (or "West Flank") [well 14-10/6]
Gas Oil Ratio (GOR) standard cubic feet / stock tank barrel (scf/stb)	268 (with a range = 215-284)	418 (with a range = 403-466)
Gas Specific Gravity (SG)	0.712-0.787	0.749-0.761
API (calculated) gravity (SL10 and SL20 sands)	28-29	28.5-29
Reservoir depth Total Vertical Depth (TVD) Mean Sea Level (MSL)	2,415 m	
Initial reservoir pressure	242 bara (3,509 psia)	
Initial reservoir temperature	86°C	
Wax content	23 % (n-alkane method) 42.3 % (wax crystallisation method)	
Asphaltene content	0.05 – 0.7 %	
Wax Appearance Temperature	66°C Topsides, storage & offloading (dead single phase oil) 60°C Subsea (live multiphase oil)	
Pour point crude	36°C Topsides, storage & offloading (dead single phase oil) 25°C Subsea (live multiphase oil)	

5.4 Phase 1 & 2 Drilling operations

This section provides a description of the drilling location and schedule, the MODU and its moorings and detail on the number, type and location of wells to be drilled, the well design, management of drill cuttings and all fluids and chemicals associated with the drilling operation. The description is applicable to all wells drilled during Phases 1 & 2 of the Development.

5.4.1 Drilling location

The planned and contingent drill centre locations are provided in Table 5.5.

Table 5.5: Sea Lion drill centre co-ordinates by Development phase

Drill Centre	Northing / Easting[1]	Latitude / Longitude	Phase 1 Wells	Phase 2 Wells
Production Drill Centre, NA-P-01	566 312.62 E	49 15´ 56.329 S	7 (2 pre-1st oil)	5
	4542 613.14 N	59 05' 18.654 W		
Water Injection Drill Centre, NA-W-01	564 612.6 E	49 16´ 13.178 S	3 (2 pre-1st oil)	-
	4 542 113.00 N	59 06´ 42. 475 W		

Drill Centre	Northing / Easting[1]	Latitude / Longitude	Phase 1 Wells	Phase 2 Wells
Gas Injection Drill Centre, NA-G-01	562 966.63 E	49 17´30.566 S	1 (pre-1st oil)	-
	4 539 742.00 N	59 08´ 02.576 W		
Southern Production Drill Centre (Phase 2), NA-P-02	566 312.79 E	49 18´ 13.933 S	-	4
	4 538 363.26 N	59 05´ 16.108 W		
Southern Water Injection Drill Centre (Phase 2), NA-W-03	567 058.43 E	49 19´04.263 S	-	1
	4 536799.76 N	59 04´38.243 W		
East Water Injection Drill Centre (Phase 2), NA-W-02	568 716.13 E	49 15´ 13.675 S	-	2
	4 543 901.00 N	59 03´20.534 W		
Contingent Casper Gas Injection Drill Centre (Phase 1), NA-G-02[2]	562 327.75 E	49 19´ 30.490 S	1 (contingent)[3]	-
	4 536 045.50 N	59 08´ 32.126 W		

[1] Co-ordinate system: WGS84 Transverse Mercator (TM) 60W and co-ordinates are for the centre point of the Drill Centre. Well locations are notional and may be subject to revision prior to drilling.
[2] There will be only six operational DC's in total as only one of the GI's will be completed.
[3] The requirement for the contingent GI well will become apparent during Stage 1. if required it will be drilled in Stage 1.

5.4.2 Drilling Schedule

The indicative schedule for drilling, completion and suspension of the wells by the MODU, and flow back of the wells to the FPSO, is shown in Table 5.6. First-Oil (Stage 1) is anticipated from the field 18-24 months after the project is sanctioned.

Table 5.6: Indicative drilling by MODU at the Sea Lion Field development

Activity	Development stage	Number of wells	Number of days
MODU in-field preparation	Stage 1	-	5 days mobilisation[1]
Drill eight Phase 1 wells: (5 x OP, 2 x WI and 1 x GI). Complete 5 wells. **Note:** only two of the OP wells will be completed prior to First-Oil[2].	Stage 1	5	52 days per well
FPSO arrives	Stage 1	-	-
FPSO installation, hook up and commissioning	Stage 1	-	-
First-Oil	Stage 1	-	-
Complete the three pre-drilled OP wells. Drill and complete a further three Phase 1 wells (2 x OP and 1 x WI)[3]	Stage 2a	6	52 days per well
MODU moves off	Stage 2a	-	5 days
Steady State Production	Stage 3		
MODU in-field Preparation	Stage 2b		5 days
Drill and complete 12 Phase 2 wells (9 x OP & 3 x WI)	Stage 2b	12	52 days per well
MODU moves off	Stage 2b		5 days

[1]As yet it is unknown where the MODU will mobilise from, this will be resolved during the rig tendering process.
[2] In the event that the contingent GI well is required to be drilled it would be included within Stage 1.

[3] **Note:** The drilling in Stages 1 and 2a will run as a continuous drilling campaign. The distinction between Stage 1 and 2a is that 2a is post-First-Oil and drilling will continue as the FPSO starts production.

5.4.3 Mobile Offshore Drilling Unit (MODU)

Drilling operations for Phase 1 & 2 will be carried out using a semi-submersible drilling rig, an example of which is shown in Figure 5-3. Semi-submersible drilling rigs are one of the more commonly used types of MODU worldwide with the ability to drill in deeper water. The MODU will be de-ballasted during transit and ballasted down while on station and drilling to provide a stable platform and keep the MODU on location. The MODU is secured into position using anchors.

At the time of writing, the contract for the MODU has not yet been awarded for the Phase 1 & 2 Development. However, for the purposes of assessing the environmental impacts of drilling activities, generic details of an anchored MODU have been assumed. Where specific details require confirmation, worst-case assumptions have been made.

While in position, a statutory 500 m exclusion zone will be established around the MODU in accordance with safety legislation. Unauthorised vessels, including fishing vessels, will not be permitted access to the 500 m zone. An ERRV (sometimes referred to as a stand-by vessel) will be present in the field while the MODU is on location.



Figure 5-3: Photograph of a typical anchored semi-submersible drilling rig (the *Ocean Valiant*)

5.4.3.1 MODU moorings

On location, the MODU will be held in place by anchors, or will be attached to pre-installed moorings. Anchor layouts will vary based on final MODU selection. It is anticipated that, as a worst-case, the selected MODU will require ten anchors with different lengths of chain required in order for the rig to maintain position. Approximately 300 m of chain are expected to be in contact with the seabed per anchor.

When all anchors have been deployed in their correct position, the rig will be ballasted down and the anchors bedded in firmly by appropriately tensioning each chain. At each DC location, all wells will be accessible to the MODU without the need to relocate anchors. However, the mooring will be recovered and re-laid when the MODU is required to move from one DC to another. Anchors will also be re-laid if the MODU has to move away from the DCs for any reason. Pre-set anchors may be suction piled or conventional anchors and will be reviewed during the detailed design of the project.

Details on the vessels used to transit, position and anchor the MODU are provided in Section 5.11.2.

5.4.4 Number and type of wells

For the Phase 1 & 2 Development a maximum of 26 wells will be drilled by the MODU, with only 23 of the wells completed and connected ('tied-back') to the FPSO.

The maximum 26 development well configuration comprises:

- 16 x OP wells (also referred to as 'production' wells),
- 6 x WI wells,
- 1 x GI well,
- 1 x contingent GI well, and
- 2 x contingent re-drills / side-tracks.

The production wells will produce oil (the target product), associated gas and produced water. The associated gas from these wells will be used to:

- Provide fuel gas for power generation on the FPSO (Section 5.8.3.3),
- Blanket the oil storage / slops / off-spec tanks (tank blanketing, Section 5.8.4.6), and
- Improve the production of oil from the reservoir *via* 'gas lift', which reduces the density of the oil enabling it to flow at higher production rates (Section 5.8.5.6).

The WI wells will also be used to improve oil recovery as water is injected into the reservoir to replace the extracted oil and maintain the pressure in the reservoir (Section 5.8.5.6). The WI wells will initially inject treated seawater into the reservoir. However, after an initial period, water from the reservoir will be produced onto the FPSO with the oil (produced water). Once the produced water 'breaks-through'[13], the WI wells will then be used to inject a combination of treated produced water and seawater.

The GI well will be used to re-inject produced gas back into the reservoir.

5.4.4.1 Phase 1 - Pre-First-Oil wells (Stage 1)

Of the maximum 26 wells to be drilled, eight wells (potentially nine if it is necessary to drill the contingency GI well) will be drilled and five completed before First-Oil.

[13] Produced water refers to the water that comes out of the well along with the oil. It contains injected water and formation water. Produced water 'break-through' refers to the time when the well begins to produce this water as well as the targeted oil.

The eight wells comprise:

- 2 x OP wells (Production Drill Centre: NA-P-01) drilled and completed,
- 3 x OP wells (Production Drill Centre: NA-P-01) drilled and suspended for completion in Stage 2a),
- 2 x WI wells (Water Injection Drill Centre: NA-W-01) drilled and completed,
- 1 x GI well (Gas Injection Drill Centre: NA-G-01) drilled and potentially completed, and
- 1 x contingency GI well (NA-G-02) potentially drilled and completed (if drilled).

Note: if the contingency GI well becomes necessary, it may be that nine wells are drilled pre-First-Oil but only eight will ultimately be commissioned for use.

For drilling efficiency, the Stage 1 wells will be batch drilled (Section 5.4.5.2) and cleaned up to the FPSO (Section 5.4.8).

5.4.4.2 Phase 1 - Post-First-Oil wells (Stage 2a)

Once production has commenced, the remaining Phase 1 wells will be drilled and completed using the MODU. These wells will comprise:

- Completion of the three suspended OP wells (drilled in Stage 1),
- 2 x OP well (Production Drill Centre: NA-P-01) drilled and completed, and
- 1 x WI well (Water Injection Drill Centre: NA-W-01) drilled and completed.

All wells will be cleaned up to the FPSO.

5.4.4.3 Phase 2 wells (Stage 2b)

To maintain production plateau, 12 further wells will be drilled and completed several years after 1st oil. These wells will comprise:

- 9 x oil wells:
  - Five at the Production Drill Centre: NA-P-01, and
  - Four at the Southern Production Drill Centre: NA-P-02.
- 3 x WI wells:
  - One at the South Water Injection Drill Centre: NA-W-03, and
  - Two at the East Water Injection Drill Centre: NA-W-02.

The exact timing of Phase 2 will be subject to production performance and will be timed to minimise production interruption, where possible. For the purposes of this EIS, approximately three years has been assumed between First-Oil and commencement of Phase 2 drilling.

5.4.4.4 Assumptions about the drilling operation

Development wells designed to produce hydrocarbons (either directly *via* oil producing wells or indirectly *via* injection wells) are fundamentally different from exploration and appraisal wells. Exploration and appraisal wells are most commonly drilled vertically into the reservoir with the sole objective of confirming the presence or absence of hydrocarbons. Development wells however, need to fully exploit the potential for recovery of hydrocarbons from the producing reservoir. In order to achieve this, they are typically designed to ensure maximum contact with the producing horizons of the reservoir sandstone. Therefore, development wells are initially drilled vertically from the seabed, then deviate as the depth increases therefore entering the reservoir at either a high angle, horizontally or even a U-shaped trajectory.

Such deviated wells expose a greater measured length of reservoir and it is often necessary to control wellbore stability using drilling muds (drilling fluids) other than Water-based Mud (WBM), which has been used in all Falkland Islands exploration campaigns to date.

The current assumptions relating to the development wells are:

- Tophole well sections and conductor installation:
  - A conductor will be drilled and cemented into each well prior to drilling through the conductor:
    - The conductors will be installed by drilling with seawater and sweeps (a small volume of viscous drilling fluid designed to sweep or remove any debris) and displacing to an inhibited WBM to keep the hole open at target depth prior to installation of the conductor pipe.
  - The tophole sections of the wells will be drilled using seawater and sweeps and displaced to an inhibited WBM sequentially to keep the hole open at target depth prior to installation of the first casing string, and
  - Tophole cuttings and associated sweeps and displacement WBM will be discharged to seabed (details on the 'sweeps' are provided in Section 10.6.4.1.3.1).
- The production wells will have a horizontal well section through the reservoir,
- The water injection wells will likely have a high angle section into the reservoir of approximately 60 - 70°,
- The GI well(s) will be vertical through the reservoir,
- Lower well sections will be drilled using a Non-Aqueous Drilling Fluid (NADF):
  - Cuttings associated with NADF will be treated to meet FIG regulations / UK guidelines and OSPAR requirements to remove the NADF prior to discharge of the cuttings (Section 5.4.5.3.1).
- Wells drilled from the MODU will be completed with OHGP through the reservoir and then suspended with a dual mechanical barrier (retrievable plugs), and
- All wells will be cleaned up to the FPSO, with a contingency option to clean-up to the MODU, if required.

5.4.4.5 Re-drill contingency

The re-spudding, re-drilling or side-tracking of wells may be required in the event that:

- It is not possible to maintain an angle of <1° in the 36" tophole section for cementing of the 30" conductor. This may require a re-spud.
- A significant stuck pipe incident occurs where it is impossible to retrieve the casing or drill-string. This may require a re-spud, re-drill or sidetrack depending on the scenario.
- Unexpected geology necessitates a side-track from a previous casing shoe.

The reservoir is geologically benign with existing well control providing high confidence in a predictable reservoir pressure regime. All wells drilled to date within the Phase 1 & 2 area were within +/- 2 psi of each other on a depth corrected basis. To mitigate any risk, the drilling strategy will be to target areas of high well control first, creating an expanding halo of certainty as the campaign progresses.

Historically, 15 primary wellbores have been drilled in the Sea Lion field with four of these requiring sidetracks. This resulted in 19 penetrations overall. However, of the four sidetracks carried out, only one (6.7 %) was required for unexpected operational reasons (such as those above), as opposed to

planned sidetracks for appraisal purposes. Applying this statistic to a 23 well campaign results in a requirement for two contingency sidetracks / re-drills.

5.4.5 Well design

5.4.5.1 Drilling, casing and wellheads

The basic well profile for the wells is summarised in Table 5.7. Each well will have a different trajectory and endpoint and well sections will vary in length along with overall volumes of cuttings and mud. These profiles are based on the longest planned well and therefore the assessment that follows is precautionary for the Development as a whole.

It is possible that, in the event that the progress of a well is not satisfactory, it is sealed downhole and a new trajectory is re-drilled. This is not a planned event and is difficult to predict so two contingent re-drills have been accounted for. The time taken to undertake these re-drills is included in the overall forecast of rig time and therefore emissions and discharges are included in the assessment.

The development wells will be drilled in up to five sections, depending on the well type. The diameter of the wellbore will decrease with each subsequent well section (Table 5.7). The lengths and diameters of each section of the well are determined prior to drilling and are dependent on the geological conditions through which the well is to be drilled. Once each section of the well has been drilled, the drillbit and drillpipe (or 'drill string') will be lifted out of the wellbore and a protective steel casing will be lowered into the well and cemented into place.

While all casings are essential to support the wellbore and thus contribute to well control, blow-out prevention and environmental management, each type of casing serves a different purpose. In particular, the conductor casing provides structural strength to support the wellhead and the Blow-Out Preventer (BOP), which is used during drilling, and latterly the subsea X-mas tree which is used during production. Further, the conductor prevents unstable upper formations from caving in and pinning the drill string to the side of the wellbore, or forming large caverns in the wellbore.

The main subsea infrastructure that requires installation prior to, and during, the drilling operation includes the following:

- Well conductor and casings:
  - Conductor will be drilled and cemented into place by the MODU. Subsequent casing sections will be drilled and cemented by the MODU.
- A wellhead for each well:
  - Landed on the conductor by the MODU.
- A BOP for each well:
  - Installed onto the wellhead by the MODU.

The tophole sections of wells will be drilled with the drill string and drill bit left open to the seawater (riserless drilling). Consequently, drilling mud and cuttings are discharged straight to the seabed as there is no means of containing them. The conductor and surface casing are then cemented into position.

All wells will commence with 42 / 36" diameter tophole with a 36" conductor casing cemented in place from the MODU. Where the following 26" and / or a 17.5" sections are drilled with WBM, all cuttings will be discharged at the seabed along with the bentonite sweeps.

Once the conductor and surface casings have been installed, a temporary BOP is installed on the wellhead to maintain well control during drilling (Section 5.4.10).

Prior to drilling the lower-hole sections of each well, a pipe known as a 'marine riser' will be run from the MODU and secured to the wellhead on the seabed. The drill string will subsequently be deployed through the centre of this riser. The marine riser provides a closed system through which the drilling mud can be circulated into the well (through the centre of the drill string) and returned to the rig in the annular space between the drill string and the casings and the riser. On some wells, the 17.5" section may be drilled with NADF (Table 5.7). All cuttings and mud will be returned to the MODU *via* the marine riser and the cuttings will be treated to meet Falkland Islands Government (FIG) regulations / UK guidelines and OSPAR requirements to remove the NADF prior to their discharge (Section 5.4.5.3.1).

Table 5.7: Phase 1 & 2 Development well profiles[1]

Hole section	Casing	Drilling Fluid	Section Length (m)
Oil Production Wells Slim Hole design (x 14)			
42"	36" Conductor	Seawater with viscous sweeps	77
17 ½"	13 $^{3}/_{8}$" intermediate casing	Seawater with viscous sweeps	650
12 ¼"	9 $^{5}/_{8}$" production casing	NADF	2,100
8 ½"	8 ½" OHGP	NADF	1,160
Oil Production Wells Big Bore (x 2)			
42"	36" Conductor	Seawater with viscous sweeps	77
26"	20" surface casing	Seawater with viscous sweeps	552
17 ½"	13 $^{3}/_{8}$" intermediate casing	NADF	655
12 ¼"	9 $^{5}/_{8}$" production casing	NADF	2,475
8 ½"	8 ½" OHGP	NADF	1,200
Contingent Re-drills (x 2)			
42"	36" Conductor	Seawater with viscous sweeps	77
17 ½"	13 $^{3}/_{8}$" intermediate casing	Seawater with viscous sweeps	650
12 ¼"	9 $^{5}/_{8}$" production casing	NADF	2,100
8 ½"	8 ½" OHGP	NADF	1,160
WI Wells (x6)			
42/36"	36" Conductor	Seawater with viscous sweeps	77
17 ½"	13 $^{3}/_{8}$" intermediate casing	Seawater with viscous sweeps	651
12 ¼"	9 $^{5}/_{8}$" production casing	NADF	2,622
8 ½"	8 ½ " OHGP	NADF	50
GI Well (x1 / x1 Contingent)			
42	36" Conductor	Seawater with viscous sweeps	77
17 ½"	13 $^{3}/_{8}$" intermediate casing	Seawater with viscous sweeps	850
12 ¼"	9 $^{5}/_{8}$" production casing	NADF	940
8 ½"	8 ½" OHGP	NADF	50

[1] All well designs will be supported by PON4 applications to drill, including well designs and geological well evaluations which will be reviewed by DMR with support from UK HSEx and BGS.

5.4.5.2 Drilling sequence (batch or sequential drilling)

With the exception of the GI well, the Stage 1 (pre-First-Oil) OP and WI wells will be batch drilled and completed. This is where all the drilling operations for each well are performed first followed by all the completion operations (when production tubing is installed in the well), for those wells. Batch operations are generally more efficient with regard to mud use and time.

The remaining Stage 2a and Stage 2b drilling operations may be further sub-divided into batch drilling all the tophole sections first, and then all the lower-hole sections, however this is yet to be determined.

5.4.5.3 Drilling muds and drill cuttings management

During drilling operations, mud of a specified density (or 'weight') is pumped down the drill string to the drill-bit. Drilling mud performs the following functions:

- Ensures that the hydrostatic pressure in the wellbore is higher than that of the surrounding formation so that the well is 'overbalanced', thus preventing a 'kick' of formation fluid (i.e., the oil) flowing into the wellbore and causing a potential well blow-out,
- Removes the drill cuttings from the bottom of the wellbore and carries them to the surface where they are either:
  - Discharged to sea in riser-less drilling (tophole sections), or
  - Treated on the MODU once the marine riser is in place (bottom-hole sections).
- Suspends the drill cuttings in the wellbore in the event that circulation / drilling is interrupted,
- Lubricates and cools the drill-bit as it penetrates the formation, and
- Deposits an impermeable 'mudcake' on the wall of the well bore, which effectively seals the wellbore and stabilises the formation while it is being drilled and prior to installation of the casings.

Two types of mud[14] will be used in the Phase 1 & 2 Development:

- Tophole sections (42/36" and 26" sections) - Seawater with high-viscosity sweeps with heavier Water-based Mud (WBM) pumped downhole to maintain well stability prior to running the conductor or casing (used in the tophole sections (42/36" and 26", and occasionally in the 17 ½" sections), and
- Lower- hole sections (17 ½", 12 ¼" and 8 ½" sections) Non-Aqueous Drilling Fluid (NADF).

As a worst-case from the perspective of drill cuttings and WBM discharge, the 42/36" and 26" top-hole sections will be drilled with seawater and periodic bentonite viscous sweeps, with mud and cuttings being discharged directly to the seabed (Table 5.8 below). Bentonite viscous sweeps will be circulated to remove debris and residual fluids. Once the tophole sections have been drilled, the wellbore will be filled with a WBM to maintain wellbore stability prior to running the conductors / casings.

5.4.5.3.1 NADF: Lower-hole sections

Following installation of the marine riser, the 17 ½" (where applicable, see previous section), 12 ¼" and 8 ½" sections (where applicable) will be drilled with NADF[15] (Table 5.8). The NADF and cuttings will be circulated within the closed system and returned back to the MODU for treatment.

The discharge of NADF contaminated cuttings will be managed in accordance with FIG Petroleum Operations Notice (PON) 10 to ensure best practice (Section 3.1.7.4). FIG PON 10 reflects the

[14] Please note that WBM and NADF drilling muds do not contain plastics or microplastics.
[15] Details of what Non-Aqueous Drill Fluid is composed of are given in Section 10.6.4.1.3.1.

requirement of OSPAR Decision 2000/3 on the 'Use of Organic-Phase Drilling Fluids (OPF/NADF) and the Discharge of OPF/NADF-Contaminated Cuttings'. The PON 10 therefore prohibits:

- The discharge of whole OPF/NADF,
- The discharge of whole OPF/NADFs when drilling tophole sections, and
- The discharge of cuttings contaminated with oil based fluids at a concentration >1 % by weight on dry cuttings.

A Thermomechanical Cutting Cleaning Unit (TCC) unit will be used on the MODU to process the NADF contaminated cuttings which are returned to the MODU *via* the marine riser. The TCC unit (Figure 5-4) will separate the mud and the cuttings to maximise recovery of the mud for re-use during drilling. Prior to discharge, the cuttings will be heated to evaporate the remaining oil and then powdered. They will then be tested to ensure that the oil concentration of NADF is less than 1 % by dry weight on the cuttings at which point they will be discharged to sea below the waterline. If any cuttings are sampled and the concentration of entrained oil is not <1 % by weight on cuttings, the outlet of the mill can be maneuvered onto a skip and the material can then be returned to the feed hopper for re-processing.

The TCC unit will be spared (i.e., critical spares will be held in Stanley) and maintained to sustain the required reliability. In the event of a major malfunction, initial cuttings would be stored in skips offshore whilst awaiting the TCC unit to be re-instated. Untreated cuttings will not be discharged to sea. If the failure of the TCC unit continues, there are two options:

- The skips containing untreated cuttings may be shipped to shore for interim storage whilst the TCC unit is re-instated or a replacement unit is brought in. The stored cuttings could then either be re-transported out to the rig for treatment or sent for treatment elsewhere in the world, or
- Drilling would cease until the TCC unit is commissioned and ready to accept cuttings.

The batch sequencing of the pre-First-Oil sections means that changes in the mud system (from WBM to NADF and *vice versa*) are kept to a minimum, as are unused or waste volumes of mud. Once the drilling operation is complete, NADF left in the mud pits[16] will be returned to the mud plant at the onshore supply base along with other rig materials. All unused inventories will be disposed of in line with the available outlets and principles in the Waste Management Plan. No discharge of whole NADF to sea will occur.

Table 5.8: Typical mud requirements and cuttings volume per well for Sea Lion wells

Wellbore section	Mud	Volume of Mud used (m^3) Gross[1]	Volume of mud used (m^3) Net[1]	Cuttings volume (m^3)	Fate of mud and cuttings
Oil Production Wells Slim Hole design (x 14)					
42"	Seawater with viscous sweeps	250	250	85	Discharged at seabed
17 ½"	Seawater with viscous sweeps	440	440	122	
12 ¼"	NADF	700	250	200	Cuttings cleaning up *via* TCC Unit and dry cuttings discharged from MODU with oil content on cutting of <1 % dry weight. The reclaimed mud will be re-used.
8 ½"	NADF	416	95	50	
Total		**1,806**	**1,035**	**457**	-

[16] Mudpits are located on the 'tween' deck which is between the main deck and riser bay on the upper deck on the MODU. They are adjacent to the shale shakers and situated directly above the mud pumps on the main deck.

Wellbore section	Mud	Volume of Mud used (m^3) Gross[1]	Volume of mud used (m^3) Net[1]	Cuttings volume (m^3)	Fate of mud and cuttings
Oil Production Wells Big Bore (x 2)					
42"	Seawater with viscous sweeps	250	250	85	Discharged at seabed
26"	Seawater with viscous sweeps	635	635	230	
17 ½"	NADF	615	185	122	Cuttings cleaning up *via* Themormechanical Cuttings Cleaner (TCC) Unit and dry cuttings discharged from MODU with oil content on cutting of <1 % dry weight. The reclaimed mud will be re-used.
12 ¼"	NADF	800	370	230	
8 ½"	NADF	440	175	55	
Total		**2,740**	**1,615**	**722**	-
Sidetrack / Redrill Contingency (x 2)					
42"	Seawater with viscous sweeps	250	250	85	Discharged at seabed
17 ½"	Seawater with viscous sweeps	900	900	122	
12 ¼"	NADF	700	250	200	Cuttings cleaning up *via* TCC Unit and dry cuttings discharged from MODU with oil content on cutting of <1 % dry weight. The reclaimed mud will be re-used.
8 ½"	NADF	416	95	50	
Total		**2,266**	**1,495**	**457**	**-**
WI Wells (x6)					
36"	Seawater with viscous sweeps	250	250	85	Discharged at seabed
17 ½"	Seawater with viscous sweeps	440	440	120	
12 ¼"	NADF	800	315	240	Cuttings cleaning up *via* TCC Unit and dry cuttings discharged from MODU with oil content on cutting of <1 % dry weight. The reclaimed mud will be re-used.
8 ½"	NADF	340	10	2	
Total		**1,830**	**1,015**	**447**	-
GI Well (x 2)					
36"	Seawater with viscous sweeps	250	250	85	Discharged at seabed
17 ½"	Seawater with viscous sweeps	550	550	160	
12 ¼"	NADF	470	130	85	Cuttings cleaning up *via* TCC Unit and dry cuttings discharged from MODU with oil content on cutting of <1 % dry weight. The reclaimed mud will be re-used.
8 ½"	NADF	282	30	2	
Total		**1,552**	**960**	**332**	-

[1] In the above table the Gross mud volume is the total volume of mud that will be handled by the rig for the drilling of the section and the Net volume is the volume used in drilling the section taking into account mud that is recycled/returned for use on other wells.

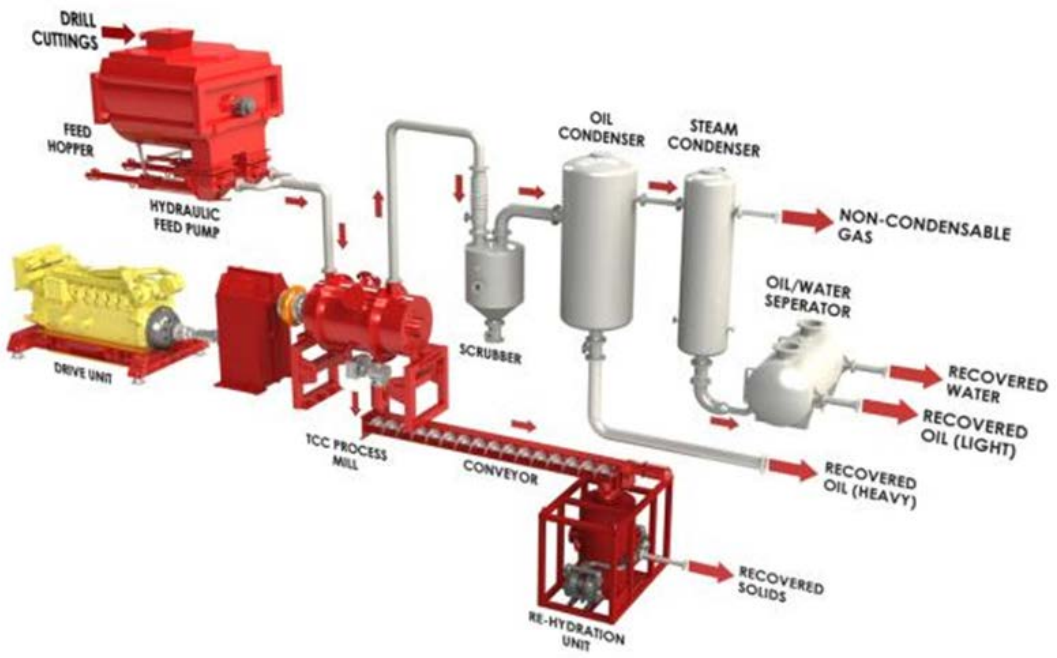


Figure 5-4: Typical Thermomechanical cuttings cleaner used to treat NADF coated drill cuttings

5.4.5.4 Well suspension

Following the batch drilling process for the Stage 1 wells, all wells will be suspended by the MODU using an engineered plug to preserve the integrity of the well bores allowing the BOP to be removed. This is followed by batch completion from the MODU involving reattachment of the BOP, removal of the plug, and installation of the completion and X-mas tree (Section 5.4.10).

Oil production and WI wells will be suspended using two mechanical barriers which are retrievable crown plugs which seal in the top of the X-mas tree. Both the mechanical barriers create dual barriers in the well which allows the BOP to be removed after the completion is installed.

The GI well(s) will be suspended in an underbalanced state (where pressure in the wellbore is less than that in the surrounding formation) to facilitate the initial flow of gas to the FPSO.

All wells will be suspended in accordance with FIG / UK legislation and regulatory requirements, as well as industry-standards e.g., OEUK Offshore Energies UK guidelines.

Further detail on well suspension will be available nearer the time of project execution and presented within the subsequent PON applications submitted to FIG for prior approval (Section 3.1.7.4).

5.4.5.5 Well completion

Well completion refers to the equipment and process of installing the final flow conduit from reservoir to wellhead. This includes the selection of established safety components and materials of construction appropriate for the well fluids and conditions. For Sea Lion, the completion phase shall:

- Install a reservoir (lower) completion which shall be an Open Hole Gravel Pack (OHGP) which enables more robust sand management. The OHGP consists of installing sand screens inside the open hole across the reservoir section and pumping gravel around the screens for an active sand control reservoir completion. The lower completion is installed and the well suspended with the use of two mechanical barriers to allow the removal of the BOP to facilitate batch completion stages. Of note, there are no plastics in the circulation fluids used

for gravel packing. The circulation fluid is water-based and has a gelling agent to increase its viscosity, to improve the ability to transport the proppant[17] into the wellbore. The gelling agent is normally a polysaccharide, such as xantham, which is a common food additive. The proppant is placed in the well during the completion phase of the well, which acts as a filter medium during the production of the well. The proppant is inert ceramic with no plastics.

- Install the X-mas tree (as a contingency the X-mas tree may be installed prior to drilling the bottom hole section or prior to the lower completion).
- Install an upper completion with pressure containing capability consisting of completion tubing, production packer (a device used to isolate the annulus and anchor or secure the bottom of the production tubing string), tubing hanger (a device attached to the topmost tubing joint in the wellhead to support the tubing string) and downhole safety valve (all well types),
- Test the critical pressure retaining equipment items, and
- Enable compliance with the industry principle of ensuring two barriers are in place to prevent uncontrolled flow at all stages of the well completion sequence.

All completion operations will be performed from the MODU. Materials, tubing sizes and other tangibles will vary between well types but the design principles above will be consistent. The detailed design is documented in the Sea Lion Completion Basis of Design (SLN-CMP-WEL-BOD-00001-00).

Further detail on all well completions will be available nearer the time of project execution and presented within the subsequent PON applications submitted to FIG for prior approval (Section 3.1.7.4).

5.4.6 Well chemical use and discharge

Details on the specific well chemicals which will be used during the Phase 1 & 2 Development drilling are not yet known. Importantly however, throughout the Development, all chemicals will be selected to minimise environmental impacts as much as possible, in compliance with legislation. Moreover, all chemical use will be included in PON applications submitted to FIG for approval prior to use (Section 3.1.7.4). Further detail on the legislation regarding chemical use is provided in Sections 10.6.1.1 and 10.7.1.1.

For the purposes of this EIS, analogue chemicals have been used to enable a representative impact assessment, as detailed in the relevant chapters below.

5.4.6.1 Drilling chemicals

It is necessary to add various chemicals to the drilling mud to ensure the correct properties are maintained. Mud additives may be dosed into the mud prior to drilling or may be available as a contingency in the event that they are needed.

Mud additives dosed into the high-viscosity sweeps and displacement WBM will be discharged to sea along with the mud volumes. Mud additives dosed into the whole NADF will not be discharged to sea as the used NADF is recycled and cuttings are treated prior to discharge. Very small quantities may be present on the NADF cuttings, discharges of which will comply with OSPAR 2000/3 (Section 5.4.5.3.1).

Typical primary and contingency mud additives include:

- Potassium chloride (KCl) based fluid for chemical inhibition,
- Weighting agents,

[17] A proppant is a solid material, typically sand, treated sand or man-made ceramic material, designed to keep an induced hydraulic fracture open, during or following a fracturing treatment.

- WBM and NADF Viscosifiers for rheology control,
- WBM and NADF mud filtrate reduction, and filtrate control agents,
- Emulsifiers to control NADF emulsion,
- Bridging materials such as $CaCO_3$ to prevent formation damage,
- Oxygen scavenger for corrosion control,
- Buffers to regulate pH,
- Polymer addition for clay cuttings encapsulation,
- Naturally occurring fibrous, filamentous, granular or flake materials,
- Glycol for hydrate suppression and fluid lubricity, and
- Lime, for NADF alkalinity and for H_2S neutralisation, should it be present (not expected).

5.4.6.2 Cementing chemicals

The cement used to secure the well casings requires several additives to manage its working characteristics, thus ensuring that the casing is safely adhered to the wellbore. For example, the speed at which cement sets can be affected by numerous factors such as depth, temperature and pressure, and may require chemical manipulation to achieve optimal results in each section.

Typical cementing chemicals include:

- Anti-settling agents used to stabilise mixed cement,
- Wetting agents used to alter the 'wettability' of the casing / formation from 'oil wet' to 'water wet' to ensure an improved cement bond,
- Cement slurry dispersants used to reduce the viscosity of the slurry and aid displacement,
- Fluid loss reducers used to control water loss from cement slurries,
- Cement slurry spacer viscosifier used to build weighted fluid spacers to separate cement slurry from drilling muds during slurry displacement,
- Cement slurry retarders for use in well bores where the temperature range is between 50 - 120°C, and
- Cement accelerants used to reduce the time taken for cement to set.

At the time of writing, the detailed cement design has yet to be finalised. However, estimates of cement volume are provided in Table 5.9. Some cement will be discharged at the seabed during installation of the conductor casing as the cement will be pumped until it can be seen at the seabed to ensure the annulus is full. These cement depositions will extend up to 10-15 m away from the well. All cement will be mixed as required and as a result there should be limited operational discharge of any mixed cement or mix-water.

Table 5.9: Typical cement requirements per well

Conductor / Casing	Volume of cement (m^3)
36" conductor	20
20" surface casing	120
13 $^3/_8$" intermediate casing	110
9 $^5/_8$" production casing	40

5.4.6.3 Well suspension, completion, and gravel pack fluids

Full details on the chemicals required during the suspension, completion, and application of the gravel packs for the Phase 1 & 2 wells will be provided in the Completion Programme (SLN-CMP-WEL-BOD-00001-00), post project sanction.

5.4.6.4 Well completion

Completion brines are weighted according to the well type and design and will be dosed with various chemicals as considered necessary. Typically, however, suspension fluids will comprise brine dosed with:

- Weighting agents,
- Corrosion inhibitor,
- Biocide, and
- Oxygen scavenger.

5.4.6.4.1 Completion chemicals

Completion fluids are required to optimise the functionality of the well and to prevent damage to the formation. Completion fluids typically include:

- pH management chemicals,
- Biocides,
- Pipe dope (lubricating grease that prevents thread galling) / asphaltene / oil dissolvers, and
- Brine viscosifier for gravel pack fluids.

5.4.6.5 Other MODU discharges

Liquid storage areas on the MODU, and areas that might be contaminated with drilling muds and additives, are segregated from other deck areas to ensure that any contaminated drainage water can be treated prior to discharge, and that leaks / spills to deck can be contained. Drainage water from these areas, and from machinery spaces, is collected and treated to reduce hydrocarbon concentrations to less than 15 ppm prior to discharge to sea, as is required under the MARPOL Convention 73/78 Annex I.

Black (sewage) and grey (domestic) water is also collected and treated to meet the requirements of the MARPOL Convention 73/78 Annex IV prior to discharge to sea.

During well completion, the NADF fluids are pumped out of the well by circulating a brine mixture so that brine containing residues of NADF is returned to the MODU. In line with UK practice, once returns are visibly oil-free they will be sampled and discharged to sea. Any returns with visible oil would not be discharged and would be treated before discharge either onshore or offshore.

Similar returns of contaminated brine or seawater may occur if the MODU needs to detach the marine riser while drilling with NADF. In this case, the riser is first displaced to brine or seawater before it is detached to prevent a release of NADF. This may be necessary during periods of extreme weather for example. Brine or seawater subsequently returned to the MODU during riser disconnection and reconnection would be treated in the same way as well clean-up fluids.

5.4.7 Use of explosives

Explosives may be required during the drilling operations as a contingency if the drill string gets stuck in the wellbore. If required, the explosives will be deployed at depths greater than 100 m downhole. All explosives will be stored as described in Section 5.11.1.2. A small quantity of explosives will be stored both onshore at the supply base and on the MODU in a jettisonable bunker.

5.4.8 Well clean-up and initial well testing

Following traditional completion of wells using cement and perforation, 'clean-up' operations can be required to ensure the wellbores are clean prior to 'bringing them on', to prevent damage to the subsea

system, turret and FPSO. Damage can result from debris in the wellbore (due to the use of explosives for perforations) or the long-term retention of completion chemicals in the well.

However, as OHGPs will be used for the well completions (Section 5.4.5.5), rather than cement and perforation, Navitas will have more robust sand control and it is anticipated that there will be little solid material debris. This minimises the risk of damage to the subsea and FPSO facilities such that extensive clean-up / flowback operations to the MODU will not be required. As such, the base-case is to leave the OP wells suspended with a suitable completion fluid that can safely be flowed back to the FPSO.

Nonetheless, the contingency will be retained to flow up to four wells (three OP wells and one GI well) back to temporary testing equipment on the MODU. The objectives of these flow backs / well tests will include:

- Confirmation of the integrity of the initial well completions, and
- Establishing well productivity to assess the production potential of up to three OP wells for reservoir management planning and production forecasting.

This process would involve flowing wells to the MODU and flaring off the hydrocarbons, which minimises the risks associated with capturing and handling them. Should this be required, it is estimated that each well would be flowed for approximately one day, at the following rates:

- 1,262 tonnes of reservoir oil and 105 tonnes of gas to be burned from each oil well, and
- 751 tonnes of gas and 76 tonnes of reservoir oil to be burned from the gas well.

Details on the quantities of oil and gas produced and flared are provided in

Table 5.10 and Table 5.11.

Should flaring be carried out, base oil will be used to promote efficient combustion and minimise risk of drop-out from the flare from the well tests. This is common practice whereby the flare is initiated with base oil, which is highly combustible in the atomised form that is emitted from the flare tip, and pumping of base oil continues while crude oil and gas are also sent to the flare. Due to the waxy nature of Sea Lion crude, a higher quantity of base oil will be required to support the combustion of oil wells compared with gas wells.

These operations will be conducted with the highest regards to safety of personnel, infrastructure and duty of care to the environment. Flow period durations and produced volume estimates for each required well test would be established in advance to enable assessment of associated emissions. Any residual oil from the well left in equipment after flaring will be stored, transported to the Islands and then processed in an onshore incinerator, or, if not suitable, would be prepared for transfer to another country for appropriate disposal.

The atmospheric emissions associated with the Sea Lion Development as a whole are presented in Section 10.9. The two outcomes in terms of emissions are:

- Flowback of all wells to the FPSO, i.e., no flow-back / well testing to the MODU and therefore no flaring (base-case), and
- Contingency flow-back / testing of three OP wells and one GI well to the MODU, with associated flaring (
- Table 5.10 and Table 5.11).

Plans for these operations will be undertaken with consultation and the approval of FIG. Emissions accounted for here are a worst-case and Section 10.9 presents the emissions both with and without flaring for these purposes.

Table 5.10: Quantities of oil and gas produced during the contingent flow-back / tests of three oil wells to the MODU

Well clean-up / test flaring quantities					
Oil		**Gas**		**Base oil**	
Well test (stb / day)	10,000	Well test mmscf / day	4.18	Per well test (stb)	400
Duration / well (days)	0.9	Duration / well (days)	0.9	Duration / well (days)	n/a
Total volume oil (stb) / well test	9,000	Total volume gas (mmscf) / well test	3.762	Total volume oil (stb) / well test	400
stb to m^3 conversion	0.1589	Mmscf to m^3 conversion	28,317	stb to m^3 conversion	0.1589
Total volume oil (m^3) / well test	1,430	Total volume gas (m^3) / well test	106,529	Total volume oil (m^3) / well test	63.6
Density oil (t / m^3)	0.8828	Density (kg / m^3)	0.982	Density base oil (kg / m^3)	885
Tonnes of oil / well test	1,262	Tonnes of gas / well test	105	Tonnes of oil /well test	56.3
No. of well tests	3	No. of well tests	3	No. of well tests used for oil wells only)	3
Total oil flared (t)	3,787	Total gas flared (t)	314	Total base oil flared (t)	169

Table 5.11: Quantities of oil and gas produced during the contingent flow-back / test of the GI (or contingent GI well) to the MODU

Well clean-up/test flaring quantities					
Oil		**Gas**		**Base oil**	
Well test (stb / day)	600	Well test mmscf / day	30	Per well test (stb)	300
Duration / well (days)	0.9	Duration / well (days)	0.9	Duration / well (days)	n/a
Total volume oil (stb) / well test	540	Total volume gas (mmscf) / well test	27	Total volume oil (stb) / well test	350
stb to m^3 conversion	0.1589	Mmscf to m^3 conversion	28,317	stb to m^3 conversion	0.1589
Total volume oil (m^3) / well test	86	Total volume gas (m^3) / well test	764,559	Total volume oil (m3) / well test	48
Density oil (t / m^3)	0.8828	Density (kg / m^3)	0.982	Density base oil (kg / m^3)	885
Tonnes of oil / well test	76	Tonnes of gas / well test	751	Tonnes of oil /well test	42
No. of well tests	1	No. of well tests	1	No. of well tests	1
Total oil flared (t)	76	Total gas flared (t)	751	Total base oil flared (t)	42

5.4.9 GI Well commissioning

Two types of gas system require commissioning:

- The first is the gas lift system, which provides lift gas to the production wells and is injected down the anulus of the well and enters the production tubing deep in the well, just above the gravel pack. This is used for increasing the productivity of the OP wells.
- The second is the gas injection system, which includes the GI well, down which excess associated gas can be stored.

Associated gas (liberated from the oil producing wells) will be used for both systems and a certain amount of gas is required in order to meet with the safe minimum operating parameters of the gas compression system on the FPSO. When oil production first commences there will not be enough associated gas to commission the gas lift or injection systems. At start-up there will be a stage where gas is being liberated, causing pressure to build within the flowlines, but not enough gas has yet been generated to initiate the gas compression system for use. As there is nowhere on the FPSO for gas to be stored, the gas must be flared until there is a sufficient amount to initiate start-up.

During commissioning, the initial start-up of the gas compression system takes longer than a normal start-up as control and instrumentation systems need to be calibrated and tuned before handing over to normal operations.

Once gas arrives at the topsides of the FPSO it is possible to build up a sufficient inventory to commission the FPSO compressors. Once the compressors are operational it is possible to start using the gas lift line so production from the oil wells can be increased. Once there is the maximum required gas lift, it is possible to start sending gas down the GI line to be stored in the reservoir *via* the GI well.

Robust pre-commissioning and commissioning efforts will ensure start-up runs as quickly as possible which will reduce flaring. However, in order to achieve these commissioning operations it will be necessary to flare the associated gas for up to 30 days at a conservatively estimated rate of up to 306.2 tonnes of gas per day.

5.4.10 Well control and blow-out prevention during drilling

Well control and blow-out prevention during drilling is managed by:

- Well design based on appreciation of the formation pressures e.g., the use of appropriately weighted drilling muds and additives to overbalance the well so that pressure in the wellbore is greater than the pressure of the surrounding formation, but is less than the formation fracture pressure,
- The use of appropriate well casings and a wellhead, and
- The use of a Blow-out Preventer (BOP) stack.

Details on the drilling mud, additives, casings and wellheads are provided above. In addition to these, a BOP 'stack' will be installed onto each wellhead for the duration of the drilling operation. The function of the BOP is to prevent uncontrolled hydrocarbon flow from the well by positively closing in the wellbore in the event that flow from the wellbore is detected.

The development wells of the Phase 1 & 2 operation are not expected to encounter any zones of abnormal pressure and the BOP will be rated for pressures sufficiently in excess of those predicted. BOP integrity will be tested prior to usage and rated over the range of pressures predicted to occur within the wells. Further tests will be conducted on the BOP approximately every three weeks during drilling operations. Small amounts of water-based hydraulic fluid will typically be discharged every three weeks when valves are actuated during regular operational testing of the BOP.

Pressure testing of the BOP will be undertaken in line with the drilling contractor and Navitas' standards and procedures and in line with FIG / UK legislation and industry-standards.

Use of the BOP is temporary and specific to drilling activities. Following completion of the well the BOP will be removed and replaced with a permanent subsea X-mas tree, which is used during the production phase to ensure well control (Section 5.8.1.1).

5.5 Construction: Installation of drilling, production and export facilities

In order to produce oil from the Phase 1 & 2 Development, and to export the oil to market, it is necessary to install:

- MODU foundation moorings / anchors (see Section 5.4.3.1),
- Subsea well infrastructure e.g., well conductors and casings, wellheads and BOPs,
- Subsea production facilities e.g., manifolds, umbilicals, X-mas trees, flexible flowlines / risers, jumpers, flying leads, and
- The FPSO mooring system, including foundation anchors (see Section 5.5.2).

The installation of the above will be carried out with construction vessels supported by LTVs.

5.5.1 Large Transport Vessel (LTV) support

The offshore installation process will be supported by LTVs. Detailed design of the project is required to size the LTVs and confirm the quantity but it is expected no more than four LTVs will be utilised to support the project, with a maximum of two LTVs present, anchored in Berkeley Sound, at any one time (see below and also Section 5.11.2). These vessels will act as floating logistics and storage bases while installation / construction vessels will transit between the LTVs and the Sea Lion Field picking up equipment for installation.

Each LTV will be spread moored, using anchors, and a 500 m radius exclusion zone will be in place to give a safe clearance. The LTVs will be around 160 m in length and the anchor lines are approximately 100 m horizontally from the bow to the anchor point. The LTVs (and 500m radius exclusion zones around both vessels) will take up *c.* 1.349 % of the area of Berkeley Sound and will be visited by a minimal number of vessels during this time so are not considered to pose a significant impact to other users of the area.

Three indicative mooring locations (Figure 5-5) have been identified for the LTVs in Berkeley Sound (although only two will ultimately be used by the two vessels *in situ*):

- LTV1 Mooring Position: 51.582800 S, 57.886686 W,
- LTV2 Mooring Position: 51.582800 S, 57.872336 W, and
- LTV3 Mooring Position: 51.582800 S, 57.857986 W.

The temporary anchorages will be 1.2 nm (or more) from shore and may be slightly further east or west than shown[18]. Navitas shall work closely with FIMA, and identified relevant stakeholders, throughout the planning and execution stages of the development to ensure that:

- Final locations will be determined with decision criteria covering both environmental and socio-economic (other users of Berkeley Sound) considerations,
- Final positions for the LTV anchorage sites are agreed and well communicated to mariners and other users of the sea,

[18] These indicative locations were initially identified by POEPL in consultation with the FIG Harbour Master as they appeared to offer sufficient sea-room for the mooring and offload of the LTVs, without hindering other Berkeley Sound users, and were not considered to be of particular environmental sensitivity.

- Activity Specific Operating Guidelines (ASOGs) are developed for the vessels operating in the area[19],
- FIMA is advised of all vessels planning to operate in the area, and
- FIMA is advised of the activities and equipment / product transferred between vessels.

The duration of the LTV presence is estimated to be as follows:

- Stage 1 and 2a:
  - Up to two LTVs at any one time, and
  - Present for seven months.
- Stage 2b and 3 (interim between Stages 2a & 2b):
  - Up to two LTVs at any one time, and
  - Present for six months.

Therefore, two LTVs will be present in Berkeley Sound for a non-consecutive total of 13 months.

Detail on all transportation and installation vessels required throughout the Development is provided in Section 5.11.2.

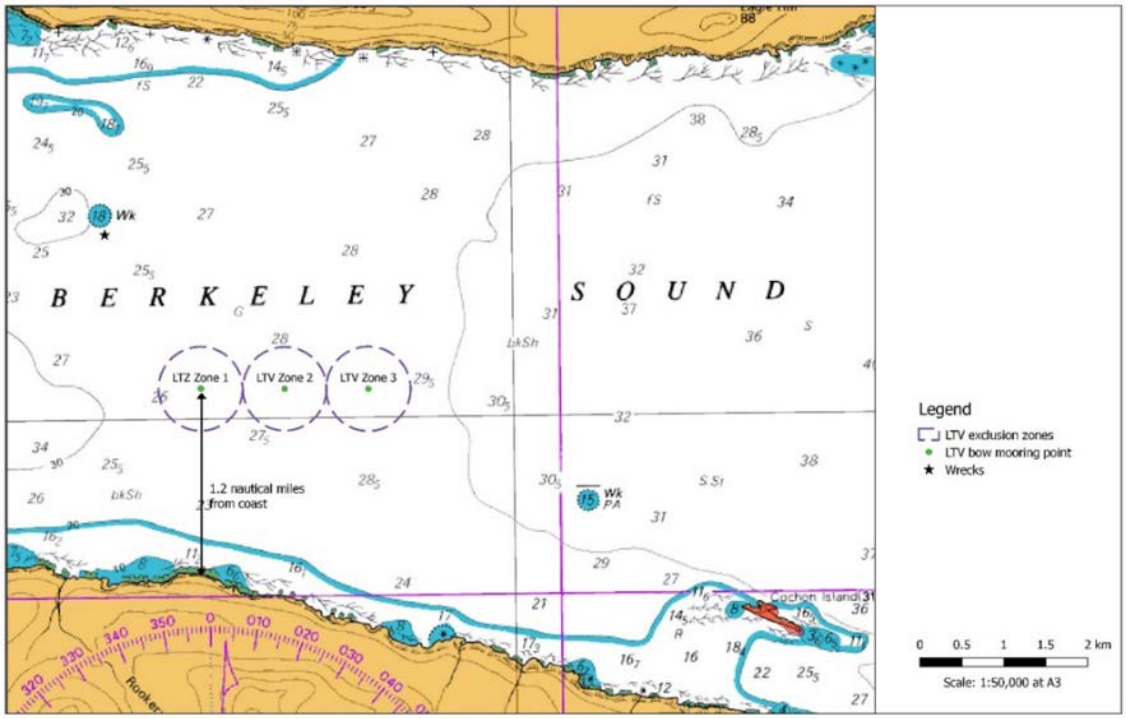


Figure 5-5: Indicative positioning of LTVs (three potential locations shown to accommodate a maximum of two LTVs anchored at any one time) in Berkeley Sound during the installation period

[19] **Post-consultation note (July 2025):** The contents of the ASOGs will be determined in consultation with FIMA and other relevant stakeholders and, as necessary, may include guidance on taking the most northerly possible safe passage into Berkeley Sound to give maximum clearance to Kidney and Cochon Islands as well as consideration of no-transit times e.g., at dusk, between the hours of 1900 – 2300 hours.

5.5.2 FPSO mooring system

The FPSO mooring will comprise 12 anchors connected to the FPSO turret buoy. The anchors are expected to be suction piles approximately six metres in diameter and the installation aids will protrude from the top of the suction anchors by approximately 1-2 metres.

The 12 anchor lines will consist of chain, polyester rope or wire and spring buoys, which will be installed and attached to the FPSO turret buoy. Up to approximately 300-500 m of mooring line is expected to be in contact with the seabed, per anchor.

The turret buoy, which connects directly to the turret mounted in the forward part of the FPSO, will be submerged at a depth of approximately 50 m when the anchors and lines are installed, awaiting arrival and hook-up to the FPSO.

5.5.3 Subsea production facilities

The subsea production facilities consist of:

- A X-mas tree located on each well,
- Subsea manifolds and pipelines:
  - Up to six subsea manifolds for production, GI and WI wells,
  - Subsea Umbilicals, Risers and Flowlines (SURF),
  - Subsea Distribution Units (SDUs),
  - Flexible flowlines between the manifolds and the FPSO,
  - Well jumpers between the manifolds and between wells and manifolds,
  - Hydraulic, optical and electric ‘flying leads’ between the manifolds, wells, SDUs (Subsea Distribution Unit) and SUTA (Subsea Umbilical Termination Assembly), and
  - Control and chemical injection umbilicals.
- Installation supports:
  - Sandbags, grout bags and gravel bags used as markers and construction aids, and
  - Temporary clump weights for installation of equipment and downlines for hydrotesting.

5.5.3.1 Subsea X-mas trees

The X-mas trees will be fully tested on leaving the manufacturer and again upon receipt in the Falkland Islands (site receival tests) for integrity testing prior to installation. The site receival tests of the X-mas trees is expected to be conducted on the LTVs but may be conducted once the trees are loaded onto the installation vessel.

5.5.3.2 Subsea manifolds and pipelines

The flowlines between the manifolds and FPSO will include both a seabed and midwater (riser) section. These flowlines will convey:

- Produced fluids (oil, gas and water) from the wells to the FPSO (production), and
- Water and gas from the FPSO to the wells (injection).

Full detail on the planned Subsea Production System (SPS) and Subsea Umbilicals, Risers and Flowlines (SURF) including function, installation, number and dimensions are provided in Table 5.12.

5.5.3.3 Installation supports

Gravel / sandbags will be used as the primary markers and construction aids during installation of the subsea equipment. Typically, one sandbag with a float would be placed at each corner of significant subsea structures, namely four sandbags per structure. Gravel / sandbags are roughly 330 mm x 675

mm (i.e., 0.22275 m^2 / sandbag). All bag placements will either be within 100 m of the centre of the production DC, the WI DC, water injection splitter manifold or the GI DC, and also within 10 m of the FPSO mooring pile locations.

Including for a contingency allowance, which doubles the estimated number of bags required, it is estimated that the permanent seabed footprint would amount to *c.* 50 m^2. Additional clump weights and tethers may also be required on an 'as needed' basis.

Clump weights may be used as installation aides to temporarily anchor items to the seabed (e.g., to overcome riser buoyancy during connection of riser tethers to the mudmats), to ensure the FPSO mooring buoy is submerged prior to connection to the FPSO turret and riser and umbilical attachments etc., and to enable controlled connection of buoyancy modules to FPSO moorings. The above installation supports will be left on the seabed as permanent deposits until the time of decommissioning.

Further, temporary laydown areas for pre-installation storage may also be used in the event, for example, that the installation sequence changes (Table 5.12). For example, wet storage may be used:

- To park risers and umbilicals on the seabed prior to recovery to the FPSO mooring buoy,
- To park FPSO mooring lines prior to attachment to FPSO mooring buoy,
- For electrical and optical flying lead installation frames which will be landed on the seabed prior to the removal and then installation of the leads, and
- For ROV baskets used for ROV tooling etc.

At the time of writing the EIS, the FEED process had not commenced and while predictions and estimations could be made on the specific number of supports and aides required, these may prove an underestimate in the absence of all the required data. Therefore, as indicated in Table 5.12, a highly conservative and worst-case estimate has been made, assuming an additional 5 % of the overall seabed footprint may be required for temporary and permanent deposits, and a further 5 % of the area estimated for temporary laydown.

It is considered extremely unlikely that the area of seabed temporarily affected will reach the estimated 5 % for each type (i.e., supports, aides and laydown) but this is assessed as a worst-case. Quantification of the potential areal impacts are provided in Section 10.3 on Seabed Disturbance.

Table 5.12: SPS and SURF requirements for Sea Lion Phase 1 & 2 Development

Facility / SURF	Description	Location / Route		Nominal dimensions	Installation and support
		From	To		
Manifolds	Production manifold (3)	Towards middle of each Drill Centre		18m x 8m	Lift installed by installation vessel on seabed with foundation pile or mudmat
	Water Injection manifold (4)			11m x 7m	
	Gas Lift Manifold (2)	In the vicinity of the drill centre		9m x 9m	Lift installed by installation vessel on seabed
	Gas Injection Manifold (1)	In the vicinity of the drill centre		9m x 9m	Lift installed by installation vessel on seabed
Subsea X-mas trees	23 x subsea X-mas trees:	At each individual well		6 m x 6m	Installed by installation vessel onto each wellhead
Umbilicals[1]	1 x Main Drill Centre Dynamic and Static Umbilical #1	FPSO	Main Production manifold	OD 180 mm x 2.7 km	Installed by installation vessel mainly on seabed with riser section to Turret Buoy supported midwater by distributed buoyancy modules
	1 x Static Umbilical #2	Main DC Production manifold	Water Injection Well Site	OD 110 mm x 1.8 km	Laid on seabed from reel on installation vessel
	1 x Static Umbilical #3	Water Injection Well Site	Gas Injection Well Site	OD 110 mm x 3.9 km	Laid on seabed from reel on installation vessel
	1 x Static umbilical #4	Main DC Production manifold	East Water Injection Drill Centre	OD 110 mm x 2.8 km	Laid on seabed from reel on installation vessel
	1 x Dynamic and Static Umbilical #5	FPSO	Southern Production Drill Centre	Outer Diameter (OD) 180 mm x 4.1 km	Installed by installation vessel mainly on seabed with riser section to Turret Buoy supported midwater by distributed buoyancy modules
	1 x Static Umbilical #6	Southern Production Drill Centre	Southern Water Injection Drill Centre	OD 110 mm x 1.9 km	Laid on seabed from reel on installation vessel
Production flowlines / risers	4 x insulated flexible production flowlines / risers	Main Production manifold	FPSO	OD 480 mm x 2.8 km	Installed by installation vessel mainly on seabed with riser section to Turret Buoy supported midwater in pliant wave

Facility / SURF	Description	Location / Route		Nominal dimensions	Installation and support
		From	To		
					configuration by distributed buoyancy modules
		Main production manifold	FPSO	OD 480 mm x 2.8 km	
		FPSO	Southern production manifold	OD 480 mm x 4.1 km	
		FPSO	Southern production manifold	OD 480 mm x 4.1 km	
WI flowline / riser	1 x insulated flexible WI line	FPSO	Water Injection tie in	OD 470 mm x 1.7 km	
	1 x insulated flexible WI line	Water Injection tie in	Water Injection Drill Centre	OD 420 mm x 3.0 km	
	1 x insulated flexible WI line	Water Injection Drill Centre	East Water Injection Drill Centre	OD 420 mm x 5.0 km	
	1 x insulated flexible WI line	Water Injection tie in	Southern Water Injection Drill Centre	OD 420 mm x 4.7 km	
Gas Lift flowline / riser	1 x flexible Gas Lift line	FPSO	Main production manifold	OD 280 mm x 2.7 km	
Gas Lift Jumpers	4 x Gas lift jumpers	Gas Lift Manifold		OD 260 mm x 0.2 km	Laid on seabed and connected by installation vessel
GI flowline / riser	1 x flexible Gas injection line	FPSO	Gas Injection Drill Centre	OD 280 mm x 7.0 km	

Facility / SURF	Description	Location / Route		Nominal dimensions	Installation and support
		From	To		
GI flowline	1 x flexible Gas Production & injection line	Main Production Drill Centre	Southern Drill Centre	OD 260 mm x 4.4 km	
Well Jumpers	16 x production jumpers	Main and Southern production manifold	Production wells	OD 470 mm x typically 50 m	
	6 x WI jumpers	WI Well Sites	WI wells	OD 420 mm x typically 50 m	
	1 x Gas Injection jumper	GI Well Site	GI wells	OD 260 mm x typically 50 m	
Flying Leads	70 x Flying Leads including electrical, hydraulic and chemical injection paths to each well	Drill Centres		OD 120 mm x 150 m (worst-case, longest length)	Laid on seabed and connected by installation vessel
Crossing	7 x GRP Bridge Crossing Structure installed to allow laying over other lines	-	-	13.6 m x 7 m	Laid on the seabed by installation vessel
Permanent sand, gravel bags, additional clump weights and tethers.	Used as markers and construction aids during installation of the subsea equipment	Placed at the corners of key subsea structures		An estimated 5 % of total seabed disturbance area is allowed for in the assessment	Laid on the seabed by installation vessel
Temporary installation aides e.g., clump weights, tethers, ROV basket, flying lead installation frame, concrete mattresses, etc.)	Installation ancillaries which facilitate installation of permanent equipment	At both drill centres and FPSO mooring location			Laid on the seabed by installation vessel

Facility / SURF	Description	Location / Route		Nominal dimensions	Installation and support
		From	To		
Temporary storage and laydown areas	For use pre-installation of equipment (e.g., mooring lines, flexible risers, umbilicals, etc.) whereby permanent works may be wet parked on the seabed for a relatively short duration (less than 12 months)	At both drill centres and FPSO mooring location		An estimated 5 % of total seabed disturbance area is allowed for in the assessment	Laid on the seabed by installation vessel
SDUs	4 x Subsea Distribution Units	Drill Centre		9m x 9m	Lift, installed by installation vessel
Mudmats to support Subsea Umbilical Termination Assembly (SUTA)	9 x mudmats	Drill Centre		3m x 3m	Lift, installed by installation vessel

5.5.4 Arrival and positioning of the FPSO

All practicable pre-commissioning and commissioning activities will be completed prior to the arrival of the FPSO in Falkland Islands waters.

The FPSO (Figure 5-6) will be transported to the Falkland Islands. The route will be selected in consultation with other users of the sea, with the aim of minimising interference to other vessels, the risk of collision, and security risks.

On arrival in Falkland Islands waters, the FPSO is expected to transit directly to the Sea Lion Field where the pre-installed turret buoy will be connected to the turret within the FPSO (Figure 5-7). The connection operation will be undertaken with the assistance of support vessels, which will arrive with the FPSO or will already be in the field supporting the drilling operation (Section 5.11.2).

The location of the FPSO is shown in Table 5.13. Once *in situ*, the FPSO will be surrounded by an exclusion zone of 1,275 m in radius. This is effectively 500 m beyond the installation extremities (including the hose and tanker during crude oil offload) and is considered sufficient to encompass the CTT during the direct offtake operation (Section 5.10).

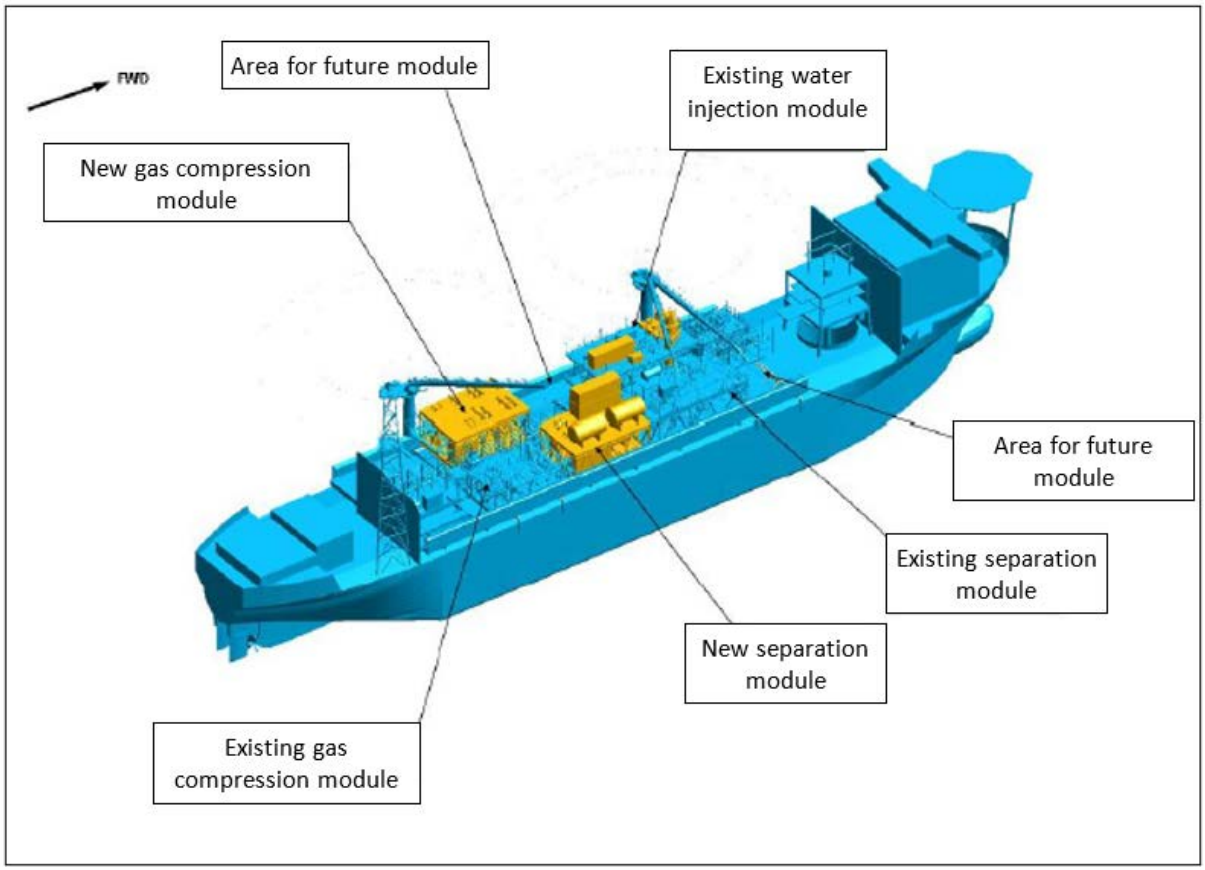


Figure 5-6: An illustration of the Sea Lion FPSO

Table 5.13: Co-ordinates of Production facilities

Parameter	Northing / Easting [1]	Latitude / Longitude
FPSO (centre of turret)	568 024.00 E	49 16’ 36.3” S
	4 541 360.00 N	59 03’ 53.2” W

[1] Co-ordinate system: WGS 1984 Universal Transverse Mercator. Map Zone 21S.

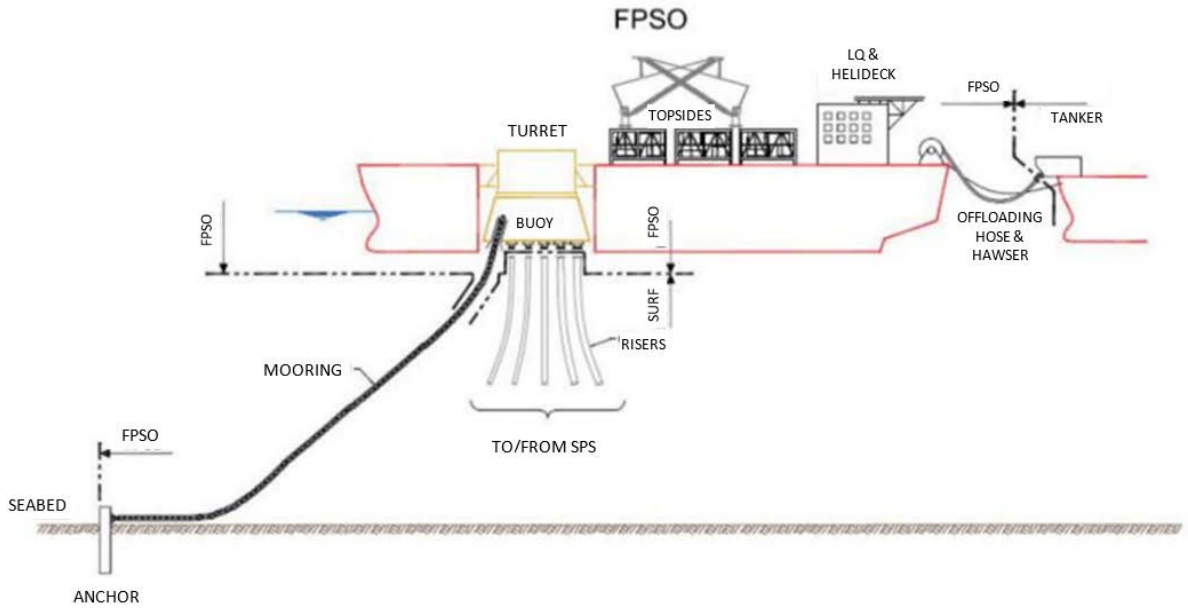


Figure 5-7: FPSO schematic showing the disconnectable turret and offloading tanker

5.6 FPSO Hook-up and commissioning

Once the FPSO is connected to the turret buoy (which will already be carrying the flowlines, risers and umbilicals), the hook-up operation to the SPS and SURF will be completed and commissioning activities will commence. This is collectively referred to as the Hook-up and Commissioning (HUC) process.

The FPSO 'hook-up' refers to making connections between:

- The wells and the FPSO e.g., connecting the flowlines / risers to the FPSO piping within the turret, and
- All utility and control facilities e.g., connecting the subsea umbilicals with the FPSO.

The 'commissioning' process refers to activating the system once it is hooked up. This involves numerous tests to ensure that:

- The system is safe for the introduction of hydrocarbons, and
- All production systems are working appropriately prior to commencement of production.

Leak testing will be carried out on the necessary elements of the systems, including those between the subsea facilities and the FPSO. Any leak testing with water will use seawater containing a biocide, an oxygen scavenger, a corrosion inhibitor and tracer dyes, which will ultimately be discharged to sea. As with all chemical use, chemicals will be selected to minimise environmental impact in line with legislation.

A summary of the transportation and installation vessels used during the Development is provided in Section 5.11.2.

5.7 Simultaneous Operations (SIMOPS): drilling and production

Once the first tranche of Phase 1 wells (nominally five pre-First-Oil in Stage 1) has been drilled and the FPSO has been hooked up and commenced production, there will follow a period of concurrent production and drilling (simultaneous operations). At this time, the MODU will drill the second tranche of Phase 1 wells (six post-First-Oil wells in Stage 2a) while the FPSO produces oil. A period of steady state production will follow before further subsea construction and the drilling of up to 12 planned Phase 2 (in Stage 2b) wells commences alongside simultaneous production from the Phase 1 wells.

With regard to the export of oil during this stage, the separation distance between the FPSO and the MODU will be sufficient to ensure that the CTT, which offloads crude from the FPSO (Section 5.10), remains outside of the MODU 500 m exclusion zone.

Support vessels used during the FPSO and MODU SIMOPS are described in Section 5.11.2.

5.8 Production facilities

5.8.1 Subsea production facilities

This section describes the purpose of the SPS and the SURF and both the subsea and topside facilities required to enable control of the reservoir *via* the FPSO.

5.8.1.1 Subsea Production Systems (SPS)

The production manifolds act as subsea flow routers and are connected to the production wells *via* jumpers. The production manifolds receive the fluid from each production well and co-mingle the produced fluids, which are ultimately carried to the FPSO by the flowlines / risers.

To achieve water injection, the seawater and / or treated produced water is pumped from the FPSO, *via* a WI flowline, to the WI manifold which distributes the water to the WI wells, again *via* jumpers. Manifolds thus reduce the number of flowlines / risers which need to be connected to the FPSO.

The subsea X-mas tree is an assembly of valves, spools, and fittings, which caps the well and controls the flow out of, or into, the well thereby enabling control of the wells during production.

5.8.1.2 Subsea Umbilicals, Risers and Flowlines (SURF)

The SURF (Table 5.12 above) enables:

- The transportation of reservoir fluids from the production wells to the FPSO,
- Communication between the FPSO and the SPS, and
- Injection of fluids (liquid and gas) to the wells from the FPSO.

Risers refer to the length of flowline that runs upwards through the water column between the seabed and the FPSO. Umbilicals are used to provide power, electrical and / or fibre optic and hydraulic control and chemicals to the subsea equipment.

5.8.1.3 Subsea Controls

The SPS and SURF facilities will be controlled by the Master Control System (MCS) and monitored by the Integrated Control and Safety System (ICSS) located in the FPSO Central Control Room.

The ICSS regulates the production process and provides the functionality to:

- Remotely control and monitor all the wells, subsea facilities (manifolds and X-mas trees), and flowlines / risers from the FPSO, and
- Monitor the chemical metering (where provided) and chemical transfer systems to ensure an adequate supply of production chemicals to the relevant injection points within the production system.

5.8.2 FPSO design

Navitas propose to use a 'lease and operate' FPSO with a required service life of 30 years. Subject to production performance, macro-economic factors and asset integrity, the service life may be extended further. The FPSO will utilise a redeployed FPSO that will be moored at the Sea Lion Field upon arrival in the Falkland Islands (Section 5.5.2). The cargo tanks of the vessel will be double-hulled and the redeployment will involve the installation and / or upgrade of the following onto the vessel:

- Processing facilities, marine equipment, utilities and control systems,
- Living quarters, and
- An internal turret mooring system which will be disconnectable (Figure 5-7 above) and will enable the FPSO to weathervane.

The FPSO will operate as a self-sufficient unit with export of produced oil *via* offloading directly to a CTT. The oil export process is further described in Section 5.10.

The hull will comply with FIG / UK legislation, flag state and will be class registered for offshore classification rules. The design, and all topsides pipework, equipment, skids, instrumentation, fittings and installation materials, will be:

- Sufficient to operate in the Sea Lion Field metocean conditions under continuous offshore duty for the service life,
- Rated for the range of ambient and extreme temperatures likely to be experienced, and
- Designed to withstand all forces and movement resulting from the sea state and wind conditions.

5.8.2.1 FPSO Drainage facilities

It is necessary for the FPSO to be designed in such a way that fluids exposed to the deck e.g., operational fluids, spills / leaks to deck and water from heavy rainfall, waves and firewater deluge can be segregated, contained, routed and managed *via* a series of drains.

The FPSO drains system will:

- Be compliant with current FIG / UK regulations and standards,
- Ensure all discharges are compliant with MARPOL 73/78 Annex I,
- Prevent hydrocarbon / chemical spills overboard,
- Prevent hydrocarbon / chemical spills to main deck,
- Prevent hazardous liquids collecting on module floors, due to the risk of pool fires and slip hazards,
- Enable recovery of hydrocarbons / chemicals from fluids prior to disposal *via* the drainage system,
- Prevent the migration of spills, gas and / or fire between process areas or modules *via* the drains system,
- Allow the safe disposal of clean water from rain / firewater, deluge and drains systems effluent, and
- Ensure segregation exists between hazardous and non-hazardous open drains systems.

The FPSO drains system will comprise:

- Open Drains - which will be routed to the marine systems:
  - Hazardous open drains – for collection of liquids from hazardous areas, or directly from hydrocarbon processing equipment, which has been depressurised (in some cases *via* a Process Drain) or operates at atmospheric pressure,
  - Non-hazardous open drains – for collection of liquids from equipment located in non-hazardous areas, or directly from non-hydrocarbon processing equipment, which has been depressurised or operates at atmospheric pressure.
  - **Note:** all open drains water phase will meet MARPOL 73/78 Annex I requirements prior to discharge to sea.

- Deck drains – open drainage for areas where there is no pollution, and
- Closed Drains - the closed drains system will be part of the oil processing system and will be segregated from the open drains systems. The closed drains collect liquid hydrocarbons, produced water or other hazardous substances directly from equipment that normally operate at pressure. Liquid hydrocarbons will be routed to a Closed Drains Vessel from where they are pumped back into the oil processing system.

5.8.2.2 FPSO capacity and production

The FPSO processing capacity will be designed to meet the requirements of Phase 1 & 2 production volumes, with estimated peak production rates (Table 5.14) determining the design capacity of the FPSO topsides. Minor upgrades to topsides equipment or updated operating procedures may be implemented to achieve target rates. The FPSO will be designed to deliver the FDP production profile for both Phase 1 and 2.

Table 5.14: Facility design rates

Service	Phase 1, Maximum design rate	Phase 2, Maximum design rate
Oil production capacity (bbl/d)	45,000	55,000
Total produced liquids (oil, gas and water) capacity (bbl/d)	50,000	110,000
Injection water (produced water + seawater) (bbl/d)	60,000	90,000
Gas handling capacity (mmscfd)	50	90
Seawater Lift ((bbl/d)	60,000	90,000

5.8.2.2.1 Production Profile

Figure 5-8 presents the expected production profile of oil, water and gas (production and gas lift) for the P50 case of 310.5 MMstb and shows the peak in production shortly after the completion of Phase 2 and then the steady decline over Field Life. An average production rate of 28,356 bopd is assumed. The actual production and injection rates will vary according to the performance of the reservoir and the production systems.

Further details on the P10 and P90 production cases are provided in Section 10.9 (see Figure 10-40) which quantifies and assesses the impact of atmospheric emissions associated with the Sea Lion Development.

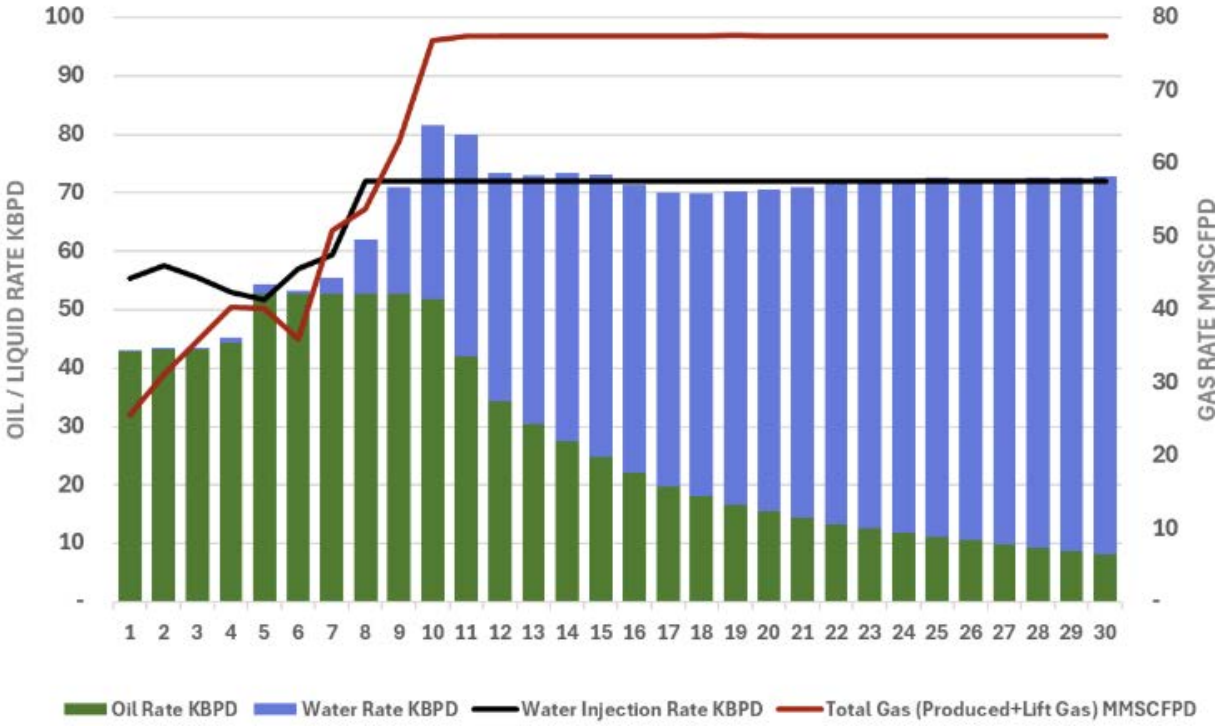


Figure 5-8: P50 Production forecast for the Sea Lion Field Northern Area Phase 1 & 2 Development. Note: kbpd = thousand barrels per day

5.8.2.3 FPSO combustion equipment

While all sources of emissions of Greenhouse Gases are itemised in the emissions impact assessment (Section 10.9), the main combustion equipment on the FPSO is listed in Table 5.15.

Table 5.15. Combustion equipment on the FPSO

Power generating combustion equipment	Fuel system	Typical fuel consumption rate (t/d)	Purpose
3 x Solar Mars 100 Dry Low Emission (DLE) Gas Turbine Generators	Dual fuel	5.5 mmscfd of fuel gas[1] 50 t/day of diesel per GTG (if not operating on fuel gas)	Main source of power generation for all consumer units on the FPSO (See Section 10.9.2).
Gas Fired Boiler (Steam boiler)	Fuel gas	*c.* 2.5 mmscfd of fuel gas	Used to heat injection water during the first year of production.
2 x Auxiliary Steam Boilers	Diesel	15.3 per unit	Operated as back up in the event GTG WHRU and / or Gas Fired Heater out of service. The units would also be routinely operated for *c.* 24 hours each per month.
2 x Essential Diesel Generators	Diesel	22 per unit	Used to provide interim minimum constant power for essential utility and production support systems in the event that all three Gas Turbine Generators malfunction. Weekly test run of 30 minutes each.
1 x Emergency Diesel Generator	Diesel	4.7	Used to ensure living support and to keep safety systems available in the

Power generating combustion equipment	Fuel system	Typical fuel consumption rate (t/d)	Purpose
			event of emergencies. The generator supplies sufficient power for the emergency services and some essential FPSO services. Weekly test run of one hour.
1 x Diesel driven hot oil circulation pump	Diesel	0.9	For use in the hot oil circulation system required to maintain subsea temperatures and flow assurance during emergency shutdowns (Section 5.8.4.1). Weekly test run of one hour.
2 x Diesel driven fire pumps	Diesel	3.8 per unit	For use in the event of fire. Weekly test run of one hour.
4 x Diesel driven Totally Enclosed Motor Propelled Survival Craft (TEMPSC)	Diesel	0.24 per unit	For use in the event of an emergency evacuation. Each engine will be run for 20 minutes per week.

[1] The estimated fuel gas usage includes all GTGs and is for all three turbines. Of note, mmscfd = million standard cubic feet per day.

5.8.3 FPSO vessel utility systems

The following sections describe the utility and safety systems of the FPSO.

5.8.3.1 Anti-fouling

Anti-fouling paint will be applied to the hull of the FPSO prior to its departure for the Falkland Islands to prevent fouling of the steel by marine growth. This prevents additional weight on the hull structure and reduces drag as well as minimising the risk of introducing non-native species upon entry into Falkland Island waters. Paint complying with latest international standards for environmental protection will be used (Section 15.7.2).

5.8.3.2 Heating, ventilation and air conditioning (HVAC)

HVAC systems will be provided for accommodation and enclosed spaces within the hull that are regularly accessed by authorised personnel.

Ozone Depleting Substances (ODS) will not be used in the HVAC systems which will deploy F-Gases instead. During the design process, Navitas aim to use F-Gases which have a comparatively low Global Warming Potential (GWP) wherever possible. No F-gases will be released under normal operations.

5.8.3.3 Power generation and fuel sources

Considerable effort has been invested in ensuring that power generation onboard the FPSO is as efficient as possible. Energy efficiency and the minimisation of atmospheric emissions was evaluated as part of the decision-making process when assessing options for the main power generation system and the main consumer equipment e.g., electric motor driven gas compressors, pumps etc. Fuel use will therefore be minimised throughout design and subsequent operation.

The power generation package will comprise three dual fuel (fuel gas and diesel) Solar Mars 100 Dry Low Emission (DLE) Gas Turbine Generators (GTG) rated at 9.7 MW electrical output (Table 5.16). During normal production, and during production plus offloading operations, all electrical power consumers will be supplied by two of the GTGs in a two out of the three configuration. The concurrent use of all three turbines is not expected even at times of high demand and the third GTG will be a like-for-like unit for sparing and availability requirements. The third GTG unit will be fully maintained on

standby to allow for maximum reliability. This aims to ensure constant GTG availability thus ensuring maximum processing availability, less downtime and less reliance on diesel fuel.

Two types of fuel will be used on the FPSO, namely produced gas (i.e., separated associated gas and from the proven gas cap) and diesel (e.g., Marine Gas Oil (MGO) or Marine Diesel Oil (MDO)). Notwithstanding the implications for resource use and emissions, the use of diesel for the main power generation at Sea Lion is also limited by the available storage on the FPSO and resources in the Falkland Islands. It is therefore anticipated that the oil and gas process will be reliant on associated gas produced from the oil wells which will be the primary fuel source on the FPSO (Section 5.8.4.3).

Therefore, the two GTG units will run continuously through much of the Field Life and will be run on fuel gas except for:

- A duration of up to four weeks after First-Oil while fuel gas is coming online and the equipment is being commissioned, and
- During times of process safety or emergency shutdown when fuel gas will not be available.

The diesel reliant essential power generator (Table 5.16) will be used immediately following First-Oil while commissioning of the systems is proven and steady state is achieved. Further, during commissioning, establishing the GTGs onto fuel gas will take up to *c.* four weeks, so they will use more diesel until production has stabilised. Once into steady state production, with three GTGs available, diesel fuel usage will be low on the GTGs.

With the associated gas and proven gas cap, it is expected that fuel gas will be available for 100 % of the time once the system is fully commissioned. Further, should it be necessary in later Field Life, when less associated gas is being liberated, it will be possible to bring gas back up the GI well riser. Nonetheless, to take a precautionary approach it is estimated that fuel gas may be unavailable for 5 – 7 % of the time owing to process safety and / or emergency shutdowns. During these times, the GTGs will be run on diesel until the fuel gas can be reinstated. This is reflected in the emissions estimates and impact assessment presented in Section 10.9.

Once into steady state operations essential and emergency power usage are nearly always used in an unplanned scenario, when there is a process upset that leads to either a Process Shutdown (PSD) or an Emergency Shutdown (ESD). Therefore, the use of diesel driven emergency power (Table 5.16) will be rare. It may be required on occasion during start-up, but will not be common in steady state operations. Nonetheless, it will be test run every week for at least one hour and such tests are included in the emissions estimate and impact assessment provided in Section 10.9.

Waste heat will be recovered from the exhaust gas of the main power generation system and will be utilised to supplement the heating demand on the FPSO (Section 5.8.4.2) and so reduce overall fuel consumption and associated emissions.

Equipment defined as essential will be provided with an uninterruptable electrical power supply according to DNV GL and SOLAS (International Convention for Safety of Life at Sea) rules. Dedicated emergency power generation will be available on the FPSO.

Details on all power generation systems are provided in Table 5.16.

Table 5.16. Power generation equipment on the FPSO

Power generating combustion equipment	Fuel system	Output (MW)	Purpose
3 x Solar Mars 100 Dry Low Emission (DLE) Gas Turbine Generators (GTGs)	Dual fuel	9.7	Two units will be run continuously as the main source of power generation for the FPSO. The third will be maintained as a standby unit to ensure redundancy and to optimise the availability of power.
2 x Essential Diesel Generators	Diesel[1]	5.6	To provide minimum constant power for essential utility and production support systems in the event that main power is unavailable.
1 x Emergency Diesel Generator	Diesel[1]	1.1	The emergency generator ensures living support and keeps safety systems available in the event of emergencies. The generator supplies sufficient power for the emergency services and some essential FPSO services.

[1] Owing to the limitations on diesel storage and supply described above, the essential power generators may be converted to dual fuel, subject to further design development work conducted through FEED.

5.8.3.4 Bunkering and bulk storage

5.8.3.4.1 Diesel bunkering, storage and treatment system

Diesel will be stored in hull storage tanks. In total, a maximum diesel storage volume of 3,130 m^3 is available for a capacity of approximately 2,524 tonnes of diesel (i.e., MGO) to be stored on board for the following diesel consumers:

- Single-fuel diesel consumers (Section 5.8.3.3), and
- Dual fuel consumers when fuel gas is unavailable.

A minimum of 1,200 m^3 storage will be reserved for the subsea flowline displacement system used for flow assurance (Section 5.8.4.1) in the event of an extended shutdown, which would lead to unacceptable cool down of the flowlines.

Diesel is bunkered from supply vessels to the FPSO diesel storage tanks. Bunding will be arranged at the receiving manifold and hose handling area to contain inadvertent spills during bunkering operations.

The diesel treatment system will be designed to ensure management of any diesel contaminated with water and particulates in order to meet the turbine cleanliness requirements.

5.8.3.4.2 Chemical bunkering and storage

During production, numerous chemicals will be required in order to facilitate the process. The hull of the FPSO will be designed to enable the storage of bulk chemicals following receipt *via* either bulk hose transfer directly into the hull, or tote tanks from the supply vessels. A laydown facility will be provided on the FPSO to enable storage and decanting of chemicals from tote tanks into hull storage when required. The method of chemical receipt (i.e., *via* bulk hose transfer or tote tank) will be dependent on the volumes and frequency of delivery.

Preliminary production and utility chemical groups required during the production of oil and gas are provided in Table 5.17 alongside details on the function of the chemical, the volumes that the hull tanks will be designed to carry and the most likely method of delivery. These volumes are preliminary and will be verified during the detailed design phase of the project development (Section 3.2.2).

Table 5.17: Production chemical functional groups and hull chemical tank storage volumes

Chemical type	Chemical function	Maximum FPSO storage capacity (m^3)
Demulsifiers	Used to break emulsions in the produced fluids i.e., separate the oil and water phases. The type of demulsifier selected depends on the type of emulsion, either oil-in-water or water-in-oil	29 m^3
Deoilers	Used to destabilise the oil in water emulsions	12 m^3
Biocides	Two biocides will be used to kill bacteria in the injection water and produced fluids to prevent or remove biological contamination	5 m^3 / biocide
Solid flocculants	Flocculants are used to aid in the removal of solids from the seawater and produced water by intentionally gathering together small particles and making them larger and thus easier to remove (flocculation)	13 m^3
Oil antifoams	Used to prevent foaming in hydrocarbon based fluids by decreasing surface tension	19 m^3
Water antifoam	Used to prevent foaming in water-based fluids by decreasing surface tension	8 m^3
Oxygen scavengers	Used to remove or decrease the level of oxygen in injected seawater to prevent oxygen induced corrosion	8 m^3
Hydrate Inhibitors	Triethylene glycol (TEG) - used to dehydrate gas and lower the dew point of gas Methanol - used for hydrate inhibition in the production and gas flowback system.	10 m^3 471 m^3
Scale inhibitors	Used to prevent the precipitation of inorganic solids from produced formation water and as formation water and injected seawater commingle. Typical scales are calcium carbonate and barium sulphate. Carbonate scales primarily form when produced water becomes supersaturated with salts due to variation in temperature, pressure or pH. Barium sulphate scale deposition can occur due to mixing of incompatible waters with differing water chemistries A broader range of scales also can be observed, depending on the reservoir conditions and production regime	45 m^3
Wax Treatment chemical	(also known as pour point depressant) Used to minimise wax deposition, oil viscosity and restart pressures after gels have formed	660 m^3
Wax Dissolvers	Used to dissolve wax in the event that it forms	Brought on board as required
Calcium nitrate	Used to prevent the formation of hydrogen sulphide. Calcium nitrate will only be utilised if the Sea Lion reservoir becomes sour (not expected)	126 m^3
Diesel	There will be a separate storage tank for diesel which will be used for flowline displacement (Section 5.8.4.1)	1,200 m^3

5.8.3.5 Freshwater systems

Freshwater is required on the FPSO to provide:

- Drinking (potable) water for personnel,
- Hot and cold water for domestic use,

- Make-up volumes for the cooling and heating water systems,
- Water for the safety showers, general utilities and workshops, and
- Water for slop tanks washing.

Freshwater will be generated on the FPSO from seawater using distillers. Seawater will be pumped onboard *via* seawater lift pumps and the water systems will be designed to produce, bunker, store, sterilise and distribute potable water for domestic consumption and service water for general use on the FPSO.

Based on an estimate of 60 tonnes / day of freshwater required for the marine and topside systems (including personnel water usage), it is estimated that 276 m^3 per day of hypersaline water may be discharged from the FPSO desalination plant. Note that the discharge rate of hypersaline water will be confirmed during detailed design.

5.8.3.6 Vessel and domestic waste treatment systems

Wastewater and food that will be generated on the FPSO includes:

- Food waste from the galley,
- Grey water (from showers, wash basins, kitchen and laundry),
- Black water (domestic wastewater arising from toilets), and
- Bilge water (from machinery spaces, which may contain traces of hydrocarbon, grease etc.).

The following treatment facilities will be in place:

- Food waste:
  - Food waste will be ground to an extent that it can pass through a 25 mm grid before being discharged overboard without further treatment.
- Grey water:
  - Galley drains receiving grey water will be fitted with grease traps, and
  - Laundry drains will be fitted with lint filters.
- Black water:
  - A macerator will be fitted to the inlet of the sewage unit to macerate biodegradable solids prior to discharge.
- Bilge water:
  - Drains from the equipment in the machinery spaces will be pumped into a bilge holding tank for separation,
  - Water from the holding tank will be further treated in an oily water separator to ensure a maximum Oil in Water (OiW) concentration of 15 mg/L is not exceeded prior to discharge, and
  - Separated oil or sludge will be routed to the waste oil drain tank, which will be transferred to tote tanks for onshore recovery or disposal. Alternatively, the separated oil will be recycled *via* the hazardous open drain tank (Section 5.8.2.1) and thus routed back into the oil processing stream.

All treatment and discharge of grey and black water will be in compliance with FIG / UK environmental regulations and classification requirements, and with MARPOL Annex IV. Similarly, the bilge system will comply with FIG / UK environmental regulations and MARPOL 73/78 Annex I.

5.8.4 FPSO oil and gas utility systems

The following sections describe the FPSO utility systems that support the production and processing of oil and gas.

5.8.4.1 Flow assurance facilities

During production, it is necessary to ensure that the produced fluids can flow from the reservoir to the FPSO process equipment, into the storage tanks and on to the point of sale without interruption, deterioration of the crude quality and / or asset damage. Maintaining the ability of the fluids to flow is called 'flow assurance'.

Flow assurance plays a major part in how the Sea Lion system is to be designed owing to:

- The waxy nature of the Sea Lion crude oil, which has a Wax Appearance Temperature of between 60 - 66°C and Oil Pour Points of 25 - 36°C,
- The total fluids propensity to form hydrates which are ice-like solids that form when free water and natural gas (both of which will be present in the produced fluids) combine at high pressure and low temperature, and
- The ambient sea temperature, which ranges from 3 - 9°C.

In addition to the nature of the crude, flow assurance can also be affected by produced fluid chemistry, injection water chemistry and synergistic effects between the production chemicals used. Therefore, maintaining flow assurance is most commonly achieved using a combination of both chemical and technical measures, with effective technical design minimising the need for chemical use as well as the energy requirements associated with active heating of the system.

All subsea and FPSO facilities will be designed to prevent the formation of hydrates, waxes and gels, which may block the system e.g., by insulating the pipework thereby passively maintaining topside arrival temperatures in excess of the live oil wax appearance temperatures (Section 5.3). However, facilities will also be designed to mitigate their effects should blockages occur, and to enable their safe removal.

Table 5.18 gives an overview of the technical flow assurance facilities built-in to the well system and the SPS, SURF and FPSO during the development of the project. These will be developed further after the project is sanctioned. The table lists those methods that will be applied on a continuous and preventative basis as well as those that may be applied on an active, or intervention basis e.g., following a shutdown (Section 5.9.4). Where it is necessary to maintain temperatures to ensure flow assurance, the majority of the measures used will be based on passive heat retention methods, rather than active heating systems in order to minimise the energy demand and associated emissions. Detail on the production chemicals that will be required for flow assurance during steady state production (Stage 3) is provided in Section 5.9.1.1.

Table 5.18: Technical flow assurance strategy for continuous operation & interventions in the Sea Lion Development

Facility	Preventative flow assurance method	Intervention (active) flow assurance method
Downhole production tubing	Passive – Vacuum Insulated Tubing Active – Wax Treatment Chemical / Pour point depressant chemical injection	In the event of wax deposition on the upper section in the tubing, chemical injection will be carried out to reduce the gel strength and reduce the wax deposition.

Facility	Preventative flow assurance method	Intervention (active) flow assurance method
SPS Equipment	Passive – insulation	Two Flow Line Circulation (FLC) pumps will be installed, one electric driven and one diesel driven. This is a new system to be installed on the FPSO as part of the Sea Lion project. Its primary objective is to circulate hot oil and displace flowline fluids in the event of subsea shutdown (and prior to wells re-starting when cooling has occurred), to mitigate against gelling and hydration formation in the flowlines. The hot diesel oil will be circulated through the system and back to the crude oil tanks and comingled as stored product. The electric driven pump will be the primary unit (fed from essential power (Section 5.8.3.3 above)). The diesel driven pump will only be used in the event that there is no essential power, or the electric driven pump[1]. malfunctions.
SURF - production (flexible flowlines / risers)	Passive – insulation	
FPSO and export tankers	System drainage, heat tracing for piping and equipment not in continuous operation, insulation to maintain temperatures. Injection water leaving FPSO is heated so that the flowing bottom hole temperature is >60°C. Crude oil storage tank heating up to 60°C for both the FPSO and export tankers	Flushing - connections for piping, offloading hose, instruments and equipment provided.

[1] Emissions from the potential use of the diesel driven hot oil circulation pump are included within the emissions estimate and impact assessment within Section 10.9.

5.8.4.2 Heating and cooling facilities

During steady state operating conditions, it is anticipated that well fluids will be between 60 – 80 °C depending on the level of reservoir depletion. As the proportion of produced water ('water cut') increases, FPSO arrival temperatures will increase. As described above, it is necessary to manage the temperature of the Sea Lion crude as it flows through the subsea and topside processes to ensure that it is hot enough to remain in a fluid phase. However, it is also important that the crude is not too hot for the storage tanks.

Heating for the water injection system (Section 5.8.5.8 below) during the first year of production will be provided by a gas fired steam boiler (Section 5.8.2.3), the energy demands for which are included in the emissions estimations and impact assessment chapter (Section 10.9).

Both heating and cooling, as necessary, are managed by closed loop systems that will provide efficient and reliable heating / cooling whilst minimising environmental impact:

- The heating medium used in the closed loop will recover waste heat from the main power generator gas turbine exhausts *via* Waste Heat Recovery Units (WHRU), and
- The cooling medium is cooled by cross exchange with seawater and within this system, approximately 70,000 m^3 of seawater will be discharged to sea per day.

5.8.4.3 Gas management system

Produced gas (associated gas from the oil wells) will be required on the FPSO to provide:

- Fuel for the FPSO power generation and seawater heaters,
- Tank blanketing (Section 5.8.4.6),
- Flare purge and pilot, and
- Gas lift for the production wells that require artificial lift (Section 5.8.5.6).

The FPSO has a gas handling / compression capacity of 50 – 90 mmscfd (Section 5.8.2.2).

The daily fuel gas requirement is expected to be, on average, 5.5 mmscfd and the gas requirement for gas lift averages at approximately 15-30 mmscfd, which is recycled. Any gas not required for fuel or lift gas will be re-injected into the GI well. The maximum amount of gas to be reinjected into the gas well is expected to be up to 50 mmscfd.

5.8.4.4 Flaring facilities

The design shall be based, as far as possible, on a 'zero flaring' philosophy during steady-state production with flaring only permitted for significant process upsets, process shutdowns, emergency shutdown or unavoidable maintenance.

On the High Pressure (HP) flare system there are no continuous sources such that no recovery system is required. Both the High Pressure and Low Pressure headers and tips will include a purge and pilot flame to ensure readiness for sudden reliefs from the process. The pilot flames are expected to burn at a rate of approximately 0.5 mmscfd.

With regard to when steady state production commences in the context of zero flaring, the best prediction is that steady state production operations could be achieved as early as within four weeks from startup. However, it could take as long as three months considering modified facilities can sometime be more challenging to start up than a new build.

Measures intended to ensure the best case include:

- Due consideration given to production facility integration and operations in design,
- Robust pre-commissioning in shipyard and during sail over to location,
- Core crew familiarity with new modifications (training and as part of pre-commissioning teams), and
- Robust commissioning plans and procedures in place applied through cross-functional competent teams.

5.8.4.5 Venting and fugitive emissions

The FPSO basis of design is such that the venting of gases will not be carried out during routine operations and good practice will be followed in minimising fugitive emissions including low loss fittings and active leak detection and repair. Use of a Vapour Recovery Package (VRP) is also being studied to minimise fugitive emissions of Volatile Organic Compounds (VOCs).

5.8.4.6 Tank blanketing and venting

Tank blanketing is used in the FPSO oil cargo storage tanks as well as the slops and off-spec tanks to maintain a non-explosive atmosphere in the space above the liquids inside the tanks. The Hydrocarbon (HC) gas blanketing system will use the produced and treated fuel gas on the FPSO. This will ensure that oxygen is eliminated from the tanks forming an atmosphere saturated with hydrocarbon to a level

above the Upper Explosive Limit (UEL), at which combustion cannot be supported (i.e., an atmosphere that cannot burn). Advantages to the HC blanketing system are:

- Use of a gas that is readily available in large volumes, which can continuously protect a number of large tanks, and
- Evaporation in the tanks is minimal.

In the event that fuel gas cannot be used for the blanket or that the gas blanket must be vented (e.g., in the event of VRP malfunction), inert gas from the inert gas generator exhaust will be used as blanket gas. The inert gas will comprise mainly nitrogen and carbon dioxide with restricted oxygen content below permissible levels. In the event of VRP malfunction and the subsequent switch to inert gas, it may be necessary to vent off some of the HC gas blanket. The potential for unplanned emissions such as this is included within the impact assessment for emissions described in Section 10.9.

5.8.4.7 FPSO Off-Spec and Slops tanks

Off-spec oil and water is sent to designated cargo tanks for settling, with a capacity of approximately 13,490 tonnes in a storage volume of 17,038 m^3. Two slop tanks will also be provided on the FPSO with a minimum combined capacity of approximately 7,596 tonnes in a storage volume of 7,751 m^3. The slops tanks and associated systems will be designed to accommodate the:

- Fluids from the open drains system (Section 5.8.2.1),
- Contaminated water resulting from the flushing and cleaning of the cargo loading pipework, discharge pipework and offloading hose,
- Temporary storage of off-spec crude oil and produced water prior to their recycling back through the process for further treatment, and
- Fluids displaced to allow entry into vessels for maintenance purposes.

Prior to being discharged to sea, the slops water will be cleaned to less than 15 ppm OiW content in accordance with MARPOL Annex I regulations. To achieve this, the slops tanks will be arranged in a cascade to enable gravity and time based (two stage) oil / water separation.

Further, inline OiW monitors will be provided in order to isolate the overboard discharge and re-route any off-spec slops water back to the slops tanks for reprocessing if OiW content exceeds the allowable limits.

5.8.5 FPSO oil and gas process facilities

The following sections describe the FPSO facilities that process the produced oil, gas and water.

5.8.5.1 Total fluid separation

The fluid produced from the oil production wells will contain oil, water, gas and possibly solids (predominately sand (Section 5.8.5.5)) and is therefore a multiphase fluid. This multiphase fluid is referred to as ‘total fluids’. The ratio of each of the components will change over time as the reservoir becomes depleted, increasing the reservoir water cut, and also as injection water passes through the reservoir, ‘breaks through’ at the production wells and starts to be produced. Once the multiphase fluid from the wells is produced onto the FPSO, it is necessary for it to be separated into the different components.

The purpose of the separation process is to:

- Remove as much of the water and gas from the oil as possible prior to oil offload and export,
- Remove water from the gas so the gas can be compressed and made ready for use as fuel gas (Section 5.8.4.3) or gas lift (Section 5.8.5.9), or in the event that excess gas needs to be reinjected into the reservoir *via* the GI well(s), and

- Clean the produced water prior to re-injection into the reservoir for Improved Oil Recovery (IOR) (Section 5.8.5.6) or prior to discharge to sea in the event that the Produced Water Reinjection (PWRI) system is unavailable.

The FPSO for the Sea Lion Development will be equipped with a first stage High Pressure (HP) separator used for the initial separation of the total fluids. During normal operations, the reservoir fluids, which have been co-mingled at the subsea manifolds, will arrive at the FPSO and will be routed to the HP separator. The internal design of the separator promotes the separation of the phases owing to the different specific gravities of oil, gas and water.

Following initial separation, each component must then be further treated and stabilised to enable either; its export as the target product (oil), its use elsewhere on the FPSO (gas, produced water), or its discharge to the environment in line with regulatory limits (produced water). To achieve this, the different components are distributed accordingly into the ‘oil process’, the ‘gas process’ and the ‘produced water process’ (Figure 5-9).

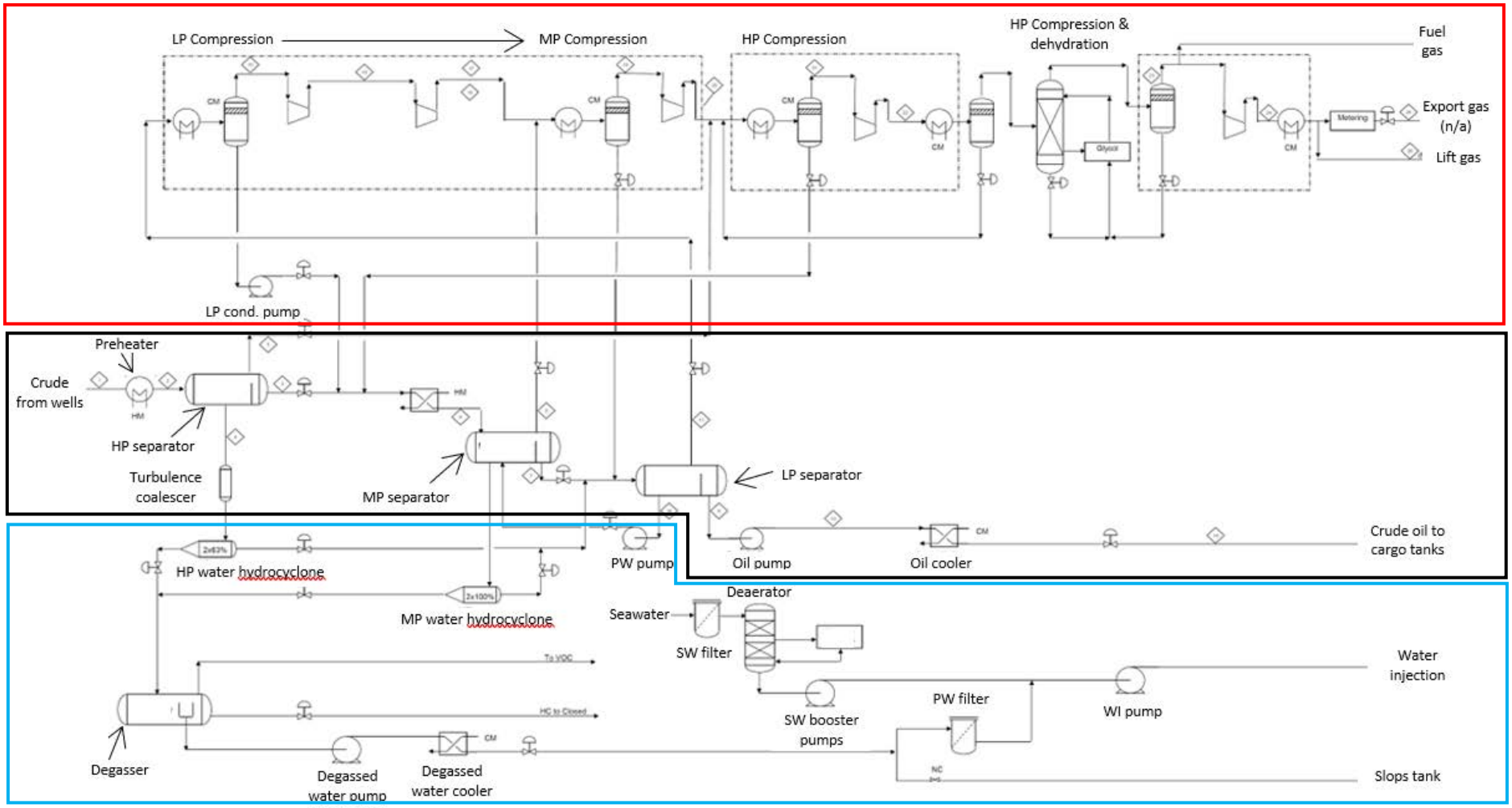


Figure 5-9: Block flow diagram of the FPSO separation and stabilisation processing facilities (before any upgrades/debottlenecking). Black = Oil process, Red = Gas process, Blue = Water process

5.8.5.2 Oil Process

The oil process facilities will receive production fluids at between 60 - 80°C. Following initial separation, oil from the HP separator will be routed to the Medium Pressure (MP) and Low Pressure (LP) separators and possibly an electrostatic coalescer (to be determined) where it is stabilised to meet the export specification. From here, the oil will be treated to achieve the export specifications for salt and water content.

All oil process vessels, piping and instruments with the potential for wax deposition will be trace heated and / or insulated to prevent the crude cooling and solidifying in the lines. The stabilised oil will then be cooled to the appropriate storage temperature to avoid damage to the cargo tanks, while maintaining sufficient heat to prevent the crude oil solidifying, thus maintaining flow assurance to allow offload. The oil export and storage specification is presented below in Table 5.19.

Table 5.19: Stabilised oil specification

Parameter	Specification
Pressure	Atmospheric
CO_2	0.1 mol%
H_2S	3 ppm weight (No H_2S removal facilities shall be provided. H2S management shall be *via* injection of calcium nitrate)
Reid Vapour Pressure (RVP)	8-10 psia max
Basic Sediment & Water (BS&W)	0.5 %
Salt	40 pounds per thousand barrels
Methanol	≤ 25 ppm (export specification)
Crude Oil Temperature	55 °C min (FPSO storage / tanker) 60 °C max (offload)
Export Pressure	Minimum 2 barg delivered to offtake tanker

5.8.5.3 Gas process

Gas in the process will originate from the oil production wells.

Following initial separation, the gas process includes:

- Compression in three stages, depending upon the fate of the gas (fuel gas, gas lift, storage tank blanket gas, or reinjection), and
- Dehydration.

5.8.5.3.1 Gas compression

The aim of the gas compression system is to compress the gas extracted from oil in the separation system, maximising the gas available for re-injection, gas lift and fuel gas. Gas compression occurs in three different stages within the gas processing system. Gas used as fuel gas will be compressed in the 1st stage of the Main Gas Compression Package and dehydrated prior to use. Following the dehydration process, gas required for gas lift and reinjection will be compressed in the 2nd and 3rd stages of the Main Gas Compression package prior to use.

5.8.5.3.2 Gas Dehydration

After first stage of compression the gas stream will be dehydrated. The gas stream is dehydrated to a water concentration of 2 lbs/mmscf maximum to minimise the water content and therefore avoid formations of 'hydrate' in the gas injection or gas lift systems, which could cause blockages.

5.8.5.4 Produced water process

The 'produced water' refers to all the water that is produced with the oil from the oil wells and comprises a mixture of:

- Formation water from the reservoir,
- Seawater which has been injected (or produced water that has been reinjected) into the reservoir and has flowed through the reservoir and 'broken through' at the production wells such that it is produced with the total fluids back to the FPSO, and
- Solids / sand which is suspended within the water (not expected).

Following initial separation in the HP separator, it is necessary to further clean, treat and de-sand (if necessary) the water in the 'produced water process' so that it may be used for Produced Water Re-Injection (PWRI) for improved oil recovery (Section 5.8.5.6). The produced water treatment facilities comprise de-oiling hydro-cyclones, a degasser and a cooler. A flotation unit may also be added, subject to further design work

In order to be suitable for reinjection back into the reservoir, the OiW concentration needs to be <10 mg/l at the point prior to the produced water / seawater mixing point.

Oil removed from the water during the produced water treatment process will be routed back to the 'oil process' and gas will be routed to the 'gas process'. Sand removed from the process will be treated as described in Section 5.8.5.5 below.

5.8.5.4.1 Discharge to Sea

In the event that the PWRI units are unavailable (Section 5.8.5.8) which is estimated to be approximately 7 % of the time, or that the OiW concentration cannot be reduced to <10 mg/l, the treated produced water will be diverted to the off-spec/slop storage tanks which are heated to assist in gravity separation of oil and water before being re-routed back into the separation process. Off-spec PW will not be discharged.

The Sea Lion reservoir has no active aquifer and the Development is therefore critically dependent on water injection for pressure maintenance to support production and deliver reserves. Heated Seawater will initially be injected on Sea Lion to assure crude mobility and, as such, the water injection wells will not thermally fracture, as is the case in other oil fields, but will instead rely on hydraulic fracturing from surface pumps. Produced Water Re-Injection will follow later once injection water breakthrough occurs at production wells.

Over time, and despite adopting Best Available Technologies (BAT) and Best Environmental Practice (BEP), physical and thermal effects and chemical reactions in the receiving reservoir can cause significant losses in produced water injectivity. In the case therefore that produced water reinjection causes a significant reduction in injectivity, Navitas would expect that this would alter the arguments for BAT/BEP such that permission for overboard discharge may be sought, whilst maintaining compliance with OSPAR and the UK OPPC regulations (i.e., achieving the lowest practicable dispersed oil concentrations, with sample concentrations that would amount to a monthly average of <30 mg/l with no single sample exceeding 100 mg/l). The OSPAR Risk-Based Approach to PW would also be applied per UK/OSPAR practices to demonstrate that environmental risks were managed to the lowest practicable levels and to show PW was managed to continue reducing the main elements of risk.

In the event that produced water needs to be discharged, Navitas will sample the produced water twice daily to determine the OiW concentration to ensure compliance. Further, the FPSO will have constant inline OiW measuring devices. If the OiW content is higher than the set limit, the stream will be re-routed back to the tanks for further separation.

In practice, it is anticipated that any produced water discharged to sea will have an OiW concentration in the region of 10 - 15 mg/l.

5.8.5.5 Management of Solids

The production of sand in the multiphase fluid is not anticipated. However, in the event that sand is present, it will most likely fall out of suspension within the HP separator and within the produced water process. Any sand retrieved from the separators and water production process vessels will be tested for Naturally Occurring Radioactive Material (NORM) and to measure its oil content and will be:

- Re-injected, if possible, or
- Transported to shore for clean-up and disposal.

The management of hazardous waste is described in Section 10.10.

5.8.5.6 Improved Oil Recovery (IOR)

IOR will be required for the Sea Lion Field as the reservoir pressure will decline during the Field Life. IOR will be achieved using water injection / reinjection and gas lift, as described below.

5.8.5.7 Field life well testing

Well testing of the oil production wells is periodically carried out to:

- Broaden the knowledge and understanding of hydrocarbon properties and characteristics of the reservoir, and
- To obtain data on the individual well flow rates, water cut and Gas to Oil Ratio (GOR).

Over the life of the field, well testing to the FPSO, to measure individual well flow rates, is carried out *via* multiphase meters which are installed on each well where well metering will be conducted throughout the life of the field as part of day-to-day operations and requires limited, or no, incremental flaring emissions. See also Section 5.8.4.4 on flaring facilities.

5.8.5.8 Water injection / Produced Water Reinjection (PWRI) facilities

Water injection will be used to achieve 'voidage replacement' in order to maintain reservoir pressure whereby oil is extracted and replaced with water. Water will be heated and injected into the reservoir by pumps on the FPSO. During the first year of production it will be necessary to heat the injection water using the gas fired steam boiler (Section 5.8.4.2) to prevent wax formation when the water contacts oil in the reservoir. However, after the first year, it will no longer be necessary to heat the water as there will be sufficient hot water in the reservoir to act as a buffer between the cold water and the oil such that there will be no risk of downhole wax formation. The energy costs associated with the steam boiler use are factored into the FPSO fuel use data provided in Section 10.9.

During the first year of production, when mostly 'dry' oil is being produced with little water, the WI system will use treated and heated seawater. After the injected water starts to be produced with the oil, a combination of unheated seawater and treated produced water will be re-injected. The mixture of seawater and produced water will meet the required reservoir specifications (Table 5.20) prior to re-injection into the reservoir.

Table 5.20: Injection water treatment specifications

Parameter	Specification
Temperature	70 °C for all WI wells will be required for the first year of water injection. Hereafter the injection water will not require heating as there will be a sufficient volume of hot water already in the reservoir to provide a buffer between the cold injected water and the oil to prevent wax formation.
Filtration	98 % removal of particles ≥ 10 microns Total Suspended Solids (TSS) < 2.0 mg/l
De-aeration	<10 ppb O_2
Sterilisation	Sodium hypochlorite in seawater = 3 ppm (achieved by continuous dosing)

Parameter	Specification
	Bacteria and micro-organisms < 500 Bac/l
Produced Water	Free oil in water < 10 mg/l

5.8.5.9 Gas Lift Facility

Gas lift will be used to improve oil production rates of individual wells, particularly when the water-cut increases.

For Phase 1 & 2, at peak approximately 50 mmscfd of produced and treated gas from the associated oil production will be injected into the oil production wells to reduce the density of the produced fluids so they can flow more easily to the surface. The gas within the gas lift system will be circulated through the production system such that it will not be released to atmosphere.

5.8.6 FPSO crude storage tanks

The FPSO crude oil storage capacity will be approximately 605,000 bbls arranged in five pairs of cargo tanks of similar size plus one larger tank. These tanks are situated within the inner hull, being surrounded by either water ballast tanks or void spaces.

5.9 Steady state production

5.9.1 Chemical use

Chemicals used during the operations include:

- Operational Chemicals, and
- Non-operational Chemicals e.g., laboratory chemicals.

5.9.1.1 Operational chemicals

Operational Chemicals include:

- Production chemicals e.g., for enhancing and maintaining flow assurance, maximising separation of the multiphase fluids, minimising the risk of hydrate and wax formation, preventing corrosion, treating water for injection, treating gas for use as fuel, use as the actuating fluid in hydraulic control systems, use in closed systems which require periodic refill, and
- Utility chemicals e.g., detergents and turbine wash chemicals.

Under normal operations, chemicals dosed into the produced fluids to aid flow assurance and separation will not be discharged to sea and will either be exported with the oil or re-injected downhole with the produced water. However, in the event of PWRI downtime, or the unsuitability of the produced water for re-injection[20], the water, and those chemicals that partition to the water phase, may be discharged.

Details on the specific operational chemicals which will be used during the Phase 1 & 2 Development are not yet known. Nonetheless, all operational chemicals used during the Phase 1 & 2 Development will be selected to minimise environmental impacts as much as possible. All chemicals selected will be listed on the Offshore Chemical Notification Scheme (OCNS) List of Notified and Ranked Product generated by CEFAS. Moreover, all chemical use will be included in PON applications submitted to FIG for approval prior to use (Section 3.1.7.4).

[20] Produced water can be unsuitable for reinjection if the specification of water exceeds 10 mg/l of oil in water. However, produced water compatibility tests have been performed to demonstrate that it can be reinjected into the reservoir and process equipment has been designed to ensure the water meets the standards to be reinjected.

For the purposes of this EIS, analogue chemicals have been used to enable a representative impact assessment, as detailed in the relevant chapters below. The functional groups of chemicals which may be required during the steady phase production of Sea Lion crude are listed in Table 5.21.

Table 5.21: Production and utility chemicals which may be required during steady state production

Operational facility	Functional chemical groups anticipated for use [1]
Wells	Wax treatment chemicals / Pour point depressants and methanol
SPS / SURF	Wax treatment chemical / Pour point depressants, methanol, demulsifier, water-based hydraulic control fluids
Topside production process	Demulsifier, scale inhibitor, wax treatment chemical / pour point depressants, oil anti-foam, de-oiler, solids flocculant, and methanol
Topside WI process	Scale inhibitor, sodium hypochlorite, biocides[2], water anti-foam, oxygen scavenger, solids flocculant and calcium nitrate
Topside process utilities	Heating water corrosion inhibitor, heating water, biocide, Triethylene glycol (TEG), TEG pH adjustor, diesel biocide, cooling medium, cooling medium corrosion inhibitor and cooling medium biocide.
FPSO utilities	Detergents and turbine washes

[1] Note that the actual chemicals intended for use are not yet known. Where necessary, analogue chemicals have been used during the current impact assessment as detailed in the relevant chapters below.
[2] Note: by nature, biocides are intended to harm marine life, but efforts will be made to ensure selection of a Cefas Gold product with no Substitution warnings (at the time of writing there are >40 such products on the Ranked listings for production and *c.* 15 for drilling operations).

5.9.1.2 Non-operational chemicals

Non-operational chemicals include:

- Domestic chemicals e.g., potable water additives, detergents, cleaning products,
- Fabrication chemicals e.g., paints and other coatings (including those supplied in aerosol cans),
- Laboratory chemicals e.g., for checking OiW concentration, and
- Other chemicals e.g., fuels, consumables, lubricants, fire-fighting foams and other chemicals in firewater systems, chemicals in 'closed systems' where periodic refill is not needed and hydraulic fluids used in cranes and other machinery.

Non-operational chemicals are not covered under the OCNS or the UK offshore Chemical Regulations (2002). They are however covered and assessed under the UK Control of Substances Hazardous to Health (COSHH) Regulations 2002.

The majority of non-operational chemicals will not be discharged to sea. Where they will, or may be, discharged to sea e.g., in bilge / drainage water contaminated with emulsified oil and grease, diesel, hydraulic oil, lube oil, marine fuel oil and grey water etc., these discharges will comply with the requirements of MARPOL 73/78.

5.9.2 Routine monitoring and maintenance

Routine monitoring and maintenance will be carried out on the FPSO and SPS / SURF to ensure the integrity and efficiency of all equipment. Maintenance will be carried out using a Centralised Maintenance Management System (CMMS) to enable the prioritisation and regular inspection / maintenance of safety and environmental critical equipment.

Environmental criticality is a feature built into the CMMS which allows for prioritisation of environmentally important maintenance and this will be used to schedule maintenance necessary to maintain environmental objectives and to monitor and manage any backlogs.

5.9.3 Well workovers

Wells must be monitored and maintained over the course of the Field Life and, in some cases, it can be necessary to mechanically alter the well in response to changing conditions. The latter is referred to as a well workover. The intention however, is to have a minimum intervention policy and as such, there are no workovers planned.

Should a well workover become necessary, it will only be performed if it is economically viable with regard to the mobilisation / demobilisation of a MODU. In the event that a well workover is considered economically viable, discussion will be held with FIG on the most appropriate way to ensure that an EIA is carried out for the operation.

5.9.4 Process shutdown and start-up

Shutdown of the process and utility facilities may be required in order to carry out maintenance activities (planned) or in the event of abnormal operation or an emergency (unplanned).

With a minimum ambient sea temperature of 3°C, when planned or unplanned shutdowns occur, it is possible that the produced fluids within the subsea and topside infrastructure will begin to cool. Given the characteristics of the Sea Lion crude, cooling could lead to the appearance of wax (at < 60°C), hydrate or gel (at < 25°C) which in turn could lead to blockages within subsea wells, jumpers, manifolds, risers / flowlines and topsides facilities.

Shutdown preservation and start-up procedures will be integral to prevent gelling and wax deposition. During shutdowns, the wax and gel management strategies will ensure that the system will be left in a preserved condition with a fall-back strategy in the event that a restart is required with hydrates or gel plugs in the system.

Flow assurance facilities (Section 5.8.4.1) are in place within the Development design to actively prevent or mitigate against blockages during times of 'no flow' and to enable start-up even if the facilities have cooled. Production chemicals may also be used (Section 5.9.1.1).

The flaring facilities are described in Section 5.8.4.4. While flaring is not anticipated during normal routine operations, it will be required during:

- Significant shutdowns,
- Plant malfunctions that require a depressurisation (blowdown) of part or all of the gas inventory,
- Process emergency shutdowns for unavoidable maintenance reasons, and
- Potentially during depressurisation of flowlines and flexible risers when required.

5.10 Oil export process and facilities

The project oil export route involves the direct offtake of crude oil from the FPSO to a Conventional Trading Tanker (CTT) at the Sea Lion location and from there the crude will be exported to market. To ensure that the offloading operations can be controlled within strict safety limits, direct offtake will require an OSV (i.e., a hold back tug) to attend the CTT offshore, in addition to the presence of the ERRV.

Oil offtakes at peak production rates are expected approximately every 7-10 days. As the rate of oil production reduces over time, it is expected that the oil export operation will occur less frequently and/or smaller parcel offtakes will occur over time.

To ensure safe and efficient offshore loading operations, each CTT shall undergo an in-depth Navitas assurance process, prior to being approved for use on Sea Lion. The Navitas assurance process in respect of the direct offtake operation is described below. Following agreement on the purchase of

the Sea Lion crude 'parcel', the purchaser will nominate a CTT to Navitas. At this time, Navitas will carry out a series of checks and audits to vet the nominated CTT, including verification of:

- Compliance with the requirements of MARPOL 73/78 Annex I on discharges of oil to sea:
  - Oil record book.
- Compliance with the requirements of MARPOL 73/78 Annex IV on discharges of sewage to sea:
  - International Sewage Pollution Prevention Certificate (ISPPC).
- Compliance with the requirements of MARPOL 73/78 Annex V on garbage management at sea,
- Compliance with the requirements of MARPOL 73/83 Annex VI on air pollution by shipping:
  - Air quality and pollution:
    - International Air Pollution Prevention (IAPP) Certificate.
  - NOx emissions reduction:
    - Engine International Air Pollution Prevention (EIAPP) Certificate.
  - SOx emissions and particulate matter reduction:
    - Marine Fuel Sulphur Record Book and compliance with the global sulphur fuel limit of 0.5 %, as required since January 2020.
  - VOC emissions:
    - VOC Management Plan.
  - GHG emissions reduction and energy efficiency:
    - Ship Energy Efficiency Management Plan (SEEMP) as required since 2013, and
    - The CTT's position within the Energy Efficiency Design Index (EEDI) (new vessels only).
- The validity of the Shipboard Oil Pollution Emergency Plan (SOPEP) in line with the International Maritime Organisation (IMO) regulations:
  - Oil spill risks and mitigations, including those relating to whether or not the fuel tanks are double-skinned, will be taken into account in the decision-making process and in determining whether specific operational controls should be put in place to manage risks.
- Compliance with the IMO International Convention for the Control and Management of Ships' Ballast Water and Sediments (ratified in 2017):
  - Verification of compliance with IMO Convention standards D1 and D2 (noting that D2 treatment systems need not be installed until the first vessel survey / docking following enforcement),
  - Inspection of the CTT Ballast Water Management (BWM) Plan and Ballast Water Record Book, and
  - Inspection of the BWM System International certificate (if applicable).
- Inspection of the CTT Biofouling Management Plan and Biofouling Record Book as required by IMO.

Additional requirements that may be necessary for vessel insurance (to be advised), are as follows:

- Oil / Bulk Ore (OBO) vessels will not be accepted,
- All CTTs must be double-hull construction, including the vessel's fuel oil tanks,

- Maximum Length Over All (LOA) of the CTT will be specified (to be advised),
- The CTT must be equipped with eight wire mooring lines on fixed drums forward and aft, complete with rope tails, capable of mooring four head, two breast and two springs both forward and aft,
- The CTT will have aft towing bitts with a minimum 80 tonne SWL (Safe Working Load). These mooring bitts will be used for securing the tug towing wires,
- The CTT will have an amidships crane with minimum SWL of 15 T with a 4.5 m outreach,
- CTT manifolds will be fully compliant with OCIMF recommendations,
- The CTT's main engine will be capable of running astern continuously for an extended period,
- The CTT must be fitted with helicopter landing / winching area,
- The CTT must be capable of slop reception in an emergency pollution incident,
- The CTT must be capable of purging H_2S in cargo tanks, and
- Ballast water exchange will be carried out in open ocean when *en route* to the Falkland Islands, in full compliance with MARPOL. Navitas will prepare Sea Terminal Operations Procedures which will ensure that during the selection process of suitable CTT's, MARPOL Ballast Water Management Convention requirements will be followed and that ballast water is treated by a 'D2' water treatment system before being discharged.

The following sequence will then take place within the FPSO 1,275 m radius exclusion zone:

- The purchaser's CTT will arrive in Falkland Islands waters and will tender its Notice of Readiness,
- When the offload operation is imminent, the berthing crew will be transferred to the CTT either by helicopter transfer, or vessel to vessel transfer (weather dependent) (solution shall be dependent on risk assessment which shall be completed with the FPSO contractor in advance of any operations.),
- The CTT will proceed to rendezvous with the OSV, i.e., a tug with sufficient bollard pull to safely support the manoeuvering of the CTT and an over-the-bow winch so it can stay bow on to the CTT,
- The OSV will connect to the stern of the CTT and remain connected while applying light power to control:
  - Heading through approach,
  - Connection to the FPSO, and
  - Pumping, disconnect and departure.
- There will also be the MRSV (acting as ERRV) on standby duty in the field and equipped with oil spill response equipment,
- The CTT and OSV will approach the stern of the FPSO, and will manoeuvre into position, followed by connection of the hawser. A tight hawser connection will be made,
- Once the hawser is connected, the transfer hose will be unreeled from the FPSO and passed to the tanker using its winches. The hose will connect to the manifolds amidships, on one side of the CTT. No additional vessel is required for this process,
- Once connection has been completed, the oil transfer will commence slowly until proven, and then increased to full rate,
- Once completed:
  - The CTT will disconnect and move away from the FPSO.

  - The OSV will detach from the CTT once at a safe distance from the FPSO, and
  - The Berthing crew will disembark *via* helicopter transfer or support vessel (solution shall be dependent on risk assessment which shall be completed with the FPSO contractor in advance of any operations).
- The CTT will then proceed to deliver the crude to market.

5.11 Logistics and infrastructure

The infrastructure required to support the logistics operation for the Sea Lion Phase 1 & 2 project includes:

- Port facilities and onshore supply base, including the:
  - Temporary Dock Facility (TDF),
  - Onshore laydown yards,
  - Storage areas (including warehousing) and offices, and
  - Liquid mud and cement plant facility.
- Use of OSVs for the movement of materials and equipment, installation and support,
- Use of *ad hoc* freighters to support the drilling and completions international equipment requirement as well as use of freighters for the delivery of the subsea construction equipment,
- Personnel transportation facilities:
  - International fixed-wing flights,
  - Helicopters flights to and from the Sea Lion field, and
  - Land transportation.
- Use of other finite resources in the Stanley area, including:
  - Accommodation (short and long term), and
  - General utilities such as freshwater, electricity, roads and waste management / disposal facilities.

5.11.1 Port facilities and onshore supply base(s)

Although the plan for the Phase 1 & 2 Development is to make use of the existing port and onshore yards where possible, it is anticipated that there may be a need to develop further facilities. Discussion on the EIA requirements for the *construction* of any new facilities will be held with FIG prior to the submission of the relevant planning applications / requests for extension of existing planning permission. However, the *use* of the proposed facilities required to support the Phase 1 & 2 Development is covered in this EIS and therefore, it is necessary to describe what may be required.

5.11.1.1 Port facilities

Marine logistics will be centred around the Temporary Dock Facility (TDF) and the adjacent industrial land areas onshore. These facilities will be used for a variety of operations including, but not limited to:

- The loading, offloading and transfer of goods,
- Vessel crew change,
- Refuelling, and
- Re-supply of bulk products, chemicals and consumables *via* both hard pipe and dedicated tanker trucks.

The TDF and its environs will be the primary area of operation; however, Navitas may, on occasion also utilise the capability provided by either Falklands Interim Port And Storage System (FIPASS), owned by FIG; and / or Mare Harbour which is operated by the Ministry of Defence (MoD).

Both options are very much considered a back-up contingency to Navitas' owned and primary TDF.

5.11.1.1.1 The Temporary Dock Facility (TDF)

The TDF in east Stanley is a floating barge facility with pontoon causeway installed by POEPL and Noble Energy Falklands Limited (NEFL) in 2014-15 for the combined exploration drilling campaign (Figure 5-10). The TDF is the principal port facility that will be used to support the Sea Lion Phase 1 & 2 Development.

All vessels, with the exception of the FPSO, the CTTs, the Offshore Construction Vessels (OCV's) and the LTVs (Section 5.11.2), are expected to use the TDF during Sea Lion Phase 1 & 2 Development and production lifecycle.

An upgrade of the TDF causeway is planned to take place from Q3 2025 – Q3 2026. The final design of the proposed causeway is a 'rock berm structure'. The work programme will be evaluated and appropriate planning approval sought during mid-2025. The upgrade is proposed to include:

- Improvement to the causeway, (two-way traffic, lighting, pedestrian walkways),
- Increased draught for the berthing pocket and entry channel, and
- Installation of bulk fluid and cement lines, fuel and water lines.

Any additional works may require a full EIA to support the planning application, and this would be dependent upon the scale of the upgrade and any potential environmental impacts arising. In the event that any additional upgrade is required, discussions will be held with FIG to determine whether an EIA is necessary.



Figure 5-10: Photograph of the existing Temporary Dock Facility with a PSV alongside

5.11.1.1.2 FIPASS

FIPASS is located 500m to the west of the TDF. Due to the current weakness of the deck plates, FIPASS is not able to support the loading or unloading of heavy items of cargo or equipment, however, it may be used to load fuel and water onto Sea Lion's offshore vessels, and for importing initial onshore construction materials / offshore OCTG (Oil Country Tubular Goods), in the event that this cannot be done at the TDF. FIPASS is also the Falkland Islands primary port facility and therefore Navitas is mindful not to over-use the facility, potentially disrupting other industry and trade requirements, unless absolutely necessary.

5.11.1.1.3 Mare Harbour

Outside of Stanley, the only alternative port facility which currently has the capability of handling and unloading large items of equipment is the military port at Mare Harbour. Mare Harbour has a deep water draught (nine metres), a concrete quayside and a Roll On-Roll Off (RO-RO) ramp.

The use of Mare Harbour does not form part of the Sea Lion development "base-case" but may be considered during the life of the project in consultation with MoD and FIG. If Mare Harbour is to be used in future, this may be subject to planning permission and an associated EIA. However, it is expected that the environmental impacts and risks from Sea Lion activity at the Mare Harbour location would be similar to those presented in Stanley and that the impacts to the local population in Stanley would be reduced.

5.11.1.2 Onshore supply bases

The onshore supply base used during POEPL's 2015 exploration campaign was located in the Gordon Lines area to the east of Stanley and extended to approximately 51,000 m² (Table 5.22). It included:

- Pipe and container laydown areas as well as bulk goods warehousing,
- Spare parts and maintenance areas,
- Storage of containerised Tier 2 Oil Spill Response (OSR) equipment,
- Storage of drilling chemicals, fluids and dangerous goods,
- Facility vehicles such as forklift trucks, cranes, minibuses, 4x4 and heavy equipment transporters,
- Power generation in the form of diesel generators with dedicated fuel storage to enable self-sufficiency, and
- A waste storage and management area

The onshore supply base(s) have not yet been selected for the Phase 1 & 2 development; however they are expected to be located in a similar geographical area and similar in composition to the previous exploration and appraisal campaigns but larger in scale due to the increased volume of equipment required for the Phase 1 & 2 Development campaigns and future production needs. During tendering, tenderers will be asked to provide detail of their proposed incorporation of sustainable design features in their tender submissions. Environmental considerations and sustainable design will form part of the contract evaluation criteria. Detail on the additional supply base facilities required for the Phase 1 & 2 Development is provided in Table 5.22.

Table 5.22: Potential supply base requirements for the Sea Lion Field Northern Area Phase 1 & 2 Development

Facility	Exploration yard space (m^2)	Estimated area Required for Phase 1 & 2 (m^2)	Duration of requirement
Supply Base: Onshore representatives' office, Pipe and container laydown (covered & open), Service Companies' yard, Waste storage and management yard, Oil spill response equipment storage, Onshore storage and testing area for equipment, Waste storage and management area, and Radioactive sources (which will need to be sited appropriately).	51,000	120,000[1]	*c.* 9 years[2]
Quayside NADF mud and bulks facility: Liquid Mud Plant (LMP), Dry bulk plant, Water header tank, and TDF car parking.	-	7,500[1]	*c.* 9 years[2]
FPSO Operations support base: Re-supply base, Production chemical laydown yard: A facility to store 24,000 litre production chemical ISO (International Standards Organisation) tanks from the time when they arrive on the islands to the time they are transported offshore to the FPSO, and A separate isolated laydown area to store up to 400 m^3 methanol which will require its own bespoke fire detection and protection system. Materials, equipment, maintenance & spare parts storage base, Oil spill response equipment storage, NORM contaminated materials, Diesel generators, Explosives which require a bespoke and secure storage facility[3], and Contingency Waste incinerator (Section 5.11.1.2.2) (if required)	-	20,000[4]	FPSO 25 years
Total area required	**51,000**	**147,500**	**-**

[1] These areas are required during Stages 1, 2a & 2b (*c.* 5 years).

[2] The drilling supply base and the LMP will only be in active use for approximately five years during the Phase 1 and Phase 2 Development drilling campaigns. However, due to the scheduling of the programme, it will be in place a short time prior to the commencement of Phase 1, during the break between Phase 1 and Phase 2 and throughout Phase 2. If no further drilling activity is planned, after Phase 2 it shall be dismantled. Therefore, the LMP will be *in situ* for up to nine years but only active for five.

[3] Explosives may be required in the event of stuck-pipe, to release a pipe should it get stuck down-hole. Explosives and dangerous goods will be stored in the specialised bunker containers that they are shipped in from their point of origin in compliance with industry best practice and FIG legislative and policy requirements. If they are not shipped offshore immediately, security measures within the dedicated supply base shall be in place. These will be as follows:

- Use of a dedicated fenced off location which will be secured and surveyed 24/7,
- Limited access / egress with only named / nominated personnel able to access the area,
- Training of the named / nominated personnel,
- Use of signage which will be clearly displayed to advise personnel of the security in place and the risks from the goods stored, and
- Storage of the detonators separate from ignition sources.

[4] This area will be required for Stage 3 (*c.* 27 years) and will likely be part of the area already used during Stages 1-2, rather than additional area.

5.11.1.2.1 Diesel generators

The base-case assumption is that electricity at the supply base(s) will be provided by Stanley power station. However, in order to ensure reliable operations in the event that the municipal power supply is not available, Navitas intends to install up a back-up diesel generator for the liquid mud and cement facility. The generator will only be used in the event of interruptions to the Stanley power supply at critical times or in the event that the planned construction of the new municipal power station or upgrades to the distribution network in East Stanley are delayed. Consequently it is not possible to estimate potential running hours although these are expected to be very low. However, if deployed, the use of fuel for the back-up generator would be offset against the reduced fuel use at the power station such that no additional emissions would result. This assumes that power generation efficiency is roughly equivalent.

At the time of writing, the generator model has not yet been selected but this will be provided through the mud plant service company, and would be selected in line with the contract management process (Section 3.2.15) which would include a pre-selection review of environmental performance.

5.11.1.2.2 Waste incinerator

The Falkland Islands Government is planning to build a new waste management facility to service the needs of the community and industry. The proposed facility is expected to be ready for operation well in advance of the commencement of the Sea Lion development campaign and has the capacity to take the majority of Sea Lion project waste. Navitas plans to enter into an agreement with FIG to secure this as the primary route for project waste which cannot be recycled / repurposed.

The project had previously planned to install a portable incinerator at the onshore supply base as a means of:

- Reducing the volume of waste that requires disposal, thus mitigating against landfill impacts, and
- Reducing the number of shipments of waste back the UK or other overseas jurisdiction.

This option would now only be reinstated should an unlikely change to FIG's waste infrastructure upgrade plans occur resulting in the new facilities not being available to the project. The exact model of portable incinerator that could be used has not yet been decided and will be subject to Navitas' tender process. However, if utilised, the model shall comply to all UK standards enabling incineration of all combustible materials, including plastics and rubbers.

The resultant ash from the incineration process would be returned to another country under the auspices of the UN Environment Programme's Basel Convention for disposal if a suitable disposal route cannot be established on the Falkland Islands itself.

The final location of the incinerator would be developed in discussion with FIG and with stakeholder input through the planning process.

5.11.1.2.3 Oil spill response equipment

In the unlikely event of an uncontrolled spill, the local storage of oil spill response (OSR) equipment is necessary to efficiently mitigate the consequences of spill incidents occurring either offshore (crude or MGO) or at-shore (MGO). While offshore OSR equipment will be stored on various vessels (Section 5.11.2), equipment will also be stored onshore at:

- The TDF for Tier 1 MGO spills, and
- The operations support base for Tier 2 MGO and / or Sea Lion crude spills.

5.11.1.2.3.1 Tier 1 OSR equipment at the TDF for MGO release

The OSR equipment at the TDF will be used to minimise the consequences of any MGO fuel spills at the TDF. The proposed OSR equipment at the TDF is as follows:

- Absorbent boom in bales,
- High fence boom,
- Weir / delta head / dragonfly skimmer,
- Portable transfer pump,
- Intermediate Bulk Containers (IBC) for use as storage tanks,
- Coils of rope,
- Metal anchor stakes, and
- Personal Protection Equipment (PPE) for up to 20 persons.

The main response would be to use the absorbent materials to contain and collect any spilled MGO. Some provision will be made to 'wring out' and temporarily store the recovered sorbents after use prior to incineration. Conventional oily waste skips will be used for this purpose.

The fence boom would be used to protect the dock area and the entrance to the Canache or can be deployed in the harbour to 'corral' any spills. In addition, a simple weir / delta head skimmer and pump system will be used to recover / transfer spilled MGO products. The recovered oil will be stored in the IBCs prior to final disposal.

5.11.1.2.3.2 Tier 2 OSR equipment available for MGO / Sea Lion crude release

Proposed equipment is listed in Table 5.23. The supply base will be equipped with a workshop to undertake a planned maintenance programme and will carry critical spares for both the shore-based and the vessel-based OSR kit to ensure the key equipment will be reliable and effective should it be required.

Table 5.23: Indicative Tier 2 oil spill equipment / action set out according to the Development Stages

OSR Resource	No. of Items	Description	Stage		
			1	2a & b	3
Surveillance equipment					
Helicopter Surveillance	2	Crew change helicopters will be utilised to conduct aerial surveillance. Personnel will be trained in aerial surveillance.	✓	✓	✓
Tracking Buoy	1	A tracking buoy will be stored in the warehouse and transported to the field if required. The tracking buoy will accurately track a surface oil spill dependent on prevailing Metocean conditions.	✓	✓	✓
Modelling capability	N/A	The ability to model the fate and effects of a spill event is incremental to prioritising response efforts and predicting the potential impact of the incident. Navitas shall have access to such modelling capability with an internationally recognised third party.	✓	✓	✓
Long wave Infrared Surveillance Equipment	1	Test results from CEDRE experiments suggest that infrared remote sensing tools will enhance the company's capability to detect the location and movement of Sea Lion Crude Oil on the water's surface. Navitas shall have access to such equipment.	✓	✓	✓
Satellite	1	Navitas shall have access to satellite surveillance.	✓	✓	✓
Vessels and equipment					
2 x Anchor Handling Tug Supply vessels (AHTS) *for Stages 1 & 2 and shall be replaced with and OSR equipment transferred by:* 2 x Multi-Role Support Vessels (MRSV)	1 per vessel	**300m (1,500 mm overall height) of heavy-duty oil containment boom**, constructed of robust material for example moulded rubber, neoprene or similar material, and formed of individual floatation chambers to provide additional resilience. (The size of 1,500 mm was chosen due to the ease of handling and to ensure the FRCs can tow the boom using the guiding principles in the IMO, Section IV, Combating Oil Spills 2nd edition, 2005. Can operate in conditions up to Beaufort scale force 4).	✓	✓	✓
	1 per vessel	**Single vessel recovery system bellowed with boom vane (1,500mm overall height)**, constructed of robust material for example moulded rubber, neoprene or similar material. Can be deployed from one vessel utilising a boom vane. To enhance the recovery capability of the available vessels and provide resilience and alternative response options based of the response priorities.	✓	✓	✓

OSR Resource	No. of Items	Description	Stage		
			1	2a & b	3
	1 per vessel	**Large belt skimming system** Selected due to the ability to recover the highly viscous crude oil. Belt systems when operated correctly are proven to reduce water intake. The skimmer will have the ability provide steam and water injection to aid pumping. The skimming system will be accompanied with a heavy-duty multipurpose Archimedes screw pump with a minimum proven transfer rate of 30m^3 per hour for highly viscous oils and with water injection to aid oil transfer. Both the skimmer and pump will be powered by a compatible, diesel driven, intrinsically safe, hydraulic power pack. Can operate in conditions up to Beaufort scale force 4.	✓	✓	✓
	1 per vessel	**Large diameter free floating weir skimmer** Selected to respond to MGO spills in the field. The weir skimming device is to be self-levelling with the ability to recover oil from the surface of the water. The pump attached to system will be an Archimedes screw pump with a minimum proven transfer rate of 30m^3 per hour with water injection to aid pumping. This allows the pumps to be interchangeable between skimmers to increase the resilience of equipment during a response. Both the skimmer and pump will be powered by a compatible, diesel driven, intrinsically safe, hydraulic power pack which can also power mechanical belt skimmers. Can operate in conditions up to Beaufort scale force 4.	✓	✓	✓
	2 per vessel	**100 tonne capacity free floating waste storage bladders** The floating bladder is towable, and collapsible being stored in a small container on the deck of the vessel and when deployed can be towed at a maximum speed of five knots. The bladder is equipped with an integrated pump to assist in the transfer of recovered product.	✓	✓	✓
1 x Emergency Response and Rescue Vessel (ERRV)	n/a	Would act as a boom towing vessel, command control centre and / or runner to and from the operations area to the Stanley facility.	✓	✓	✓
1 x Platform Supply Vessel (PSV)	n/a	Would act as a boom towing vessel, command control centre and / or runner to and from the operations area to the Stanley facility.	✓	✓	

OSR Resource	No. of Items	Description	Stage		
			1	2a & b	3
Vessels of opportunity	n/a	Dependent on the tiered size of the spill, Navitas would charter vessels to respond to a spill in accordance with the emergency response procedure and the incident's requirements.	✓	✓	✓
MODU	n/a	If available and suitable, can: Provide a remotely operated underwater vehicle (ROV), Act as an incident command centre, Provide a helipad and Heli-refuelling station, and Provide a welfare area.	✓	✓	
FPSO	n/a	If available and suitable, can: Act as an incident command centre, Provide a helipad and Heli-refuelling station, and Provide a welfare area.		✓	✓
TDF and Supply Base (Stanley Area)					
TDF Response Equipment	1	Standard quayside Shipboard Oil Pollution Emergency Equipment (as per the IMO Shipboard Marine Pollution Emergency Plan SMPEP) and, in addition, oil spill response fish totes, chemical response totes, two trailers and hand tools	✓	✓	✓
Supply Base / Warehouse / pre-prepared offshore containers	n/a	Tier 2 Shoreline Response Kit: Inshore solid floatation boom, Shore sealing boom, 200m air inflatable boom, Oleophilic skimmer and small weir skimmer (MGO only), Flexible and rigid IBCs, Floating bladders, Waste storage tank, Hazardous waste sacks, A pressure washing system, Oil snares, oil snares on rope, Steam generator, Range of hand tools for shoreline recovery (rakes, shovels, spades) Sufficient PPE for 5 days of offshore and shoreline response, signage to prevent unauthorised access	✓	✓	✓

OSR Resource	No. of Items	Description	Stage		
			1	2a & b	3
		Tier 2 Offshore Response Kit (back up to equipment already on board the vessels): Heavy duty oil containment boom Single vessel recovery system bellowed with boom vane Large belt skimmer Large diameter free floating weir skimmer (MGO only) Floating storage bladder	✓	✓	✓
Oiled Wildlife Response Facility	1	Access to a sufficient warehouse ready to stabilise, clean and recondition up to 200 birds with: Unlimited quantities of soft, warm water (39 – 41°C) of good pressure (60 – 80 psi) Good ventilation to prevent excessive oil fumes and humidity, and to help prevent diseases Temperature control to maintain a draught free, warm environment (24–29 °C) Electrical capability, min. 200 amps, 120/240 volts Adjacent outdoor area for pools, physical reconditioning and response expansion Means to dispose solid and liquid contaminated waste	✓	✓	✓

5.11.2 Use of vessels

Vessels are required throughout the Phase 1 & 2 Development and production project to serve the following purposes:

- To tow and position the MODU and its associated anchors,
- To provide general operational supply and support as well as provide emergency response (if required),
- To support the internal supply chain providing a linkage between the project to its global contractors and key international hubs,
- To transport and install the subsea drilling, SPS and SURF infrastructure,
- To provide floating logistics / lay-down barges in Berkeley Sound for storage of equipment awaiting installation subsea,
- To support and assist the FPSO Hook Up Connection (HUC) process, and
- To support the direct offtake oil offloading and export operations.

A detailed summary of all the vessels that may be used is provided in Table 5.24, which aims to:

- List the worst-case number of vessels anticipated for use in each stage of the Development and production life cycle,
- Describe the purpose of the vessels, and
- Provide a credible worst-case estimate of vessel use with regards to:
  - The origin of the vessel,
  - The time in transit (i.e., to and from the Falkland Islands), and
  - The time in-field (i.e., on location in the Sea Lion Field or in Berkeley Sound).

Note: where the vessel is frequently in transit between the Sea Lion Field and the Islands themselves, the time is averaged out.

At the time of writing, there is a degree of uncertainty over the number and type of vessels that will be used and whether or not synergies will be possible to minimise vessel use. It is known that synergies will exist between the standard Platform Supply Vessels (PSVs) / Anchor Handling Tug Supply (AHTS) vessels and other offshore support vessels. However, it may also be possible for the supply vessels (the PSVs), to be used for the installation of moorings instead of using dedicated AHTSs.

The specifics on the vessel type and use, and any synergies, will not be known until charter parties are awarded following project sanction. Therefore, the data in Table 5.24 assumes the maximum number of vessels to provide the worst-case for all impact and risk assessments relating to the use of vessels e.g., emissions, underwater noise, disturbance to other users of the sea, introduction of non-native species and collision risks etc. Specific detail on the behaviour of the vessels as it pertains directly to the impact and risk assessments are provided, as necessary, in the specific EIA chapters below (Chapters 10, 11 and 12).

Table 5.24: Summary of the worst-case vessel activity anticipated during the Phase 1 & 2 Development[1]

Vessel		Vessel purpose	Expected shipping from	Number of vessels[2]	Duration of use (days)[3]
Stage 1: Pre-First-Oil (approx. 31 months, 942 days)					
Project Support	*Ad hoc* Freighters	Delivery of drilling, development and production equipment and general re-supply.	Europe / USA	5	35
Drilling	Anchor Handling Tug Supply (AHTS) vessel	Towing and positioning of MODU at the Sea Lion Location(s)[4].	Europe	2	15
		Support of MODU throughout pre-First-Oil development drilling.	n/a		684
	Emergency Rescue and Response Vessel (ERRV)	Stand-by support of MODU and other Sea Lion field vessels.	Europe	1	638
	Mobile Offshore Drilling Unit (MODU)	Drilling of development /production wells.	Europe	1	638
Construction	Large Transport Vessel (LTV) (No. 1)	Transportation of drilling, SPS / SURF, FPSO mooring infrastructure, equipment and bulks to the Falkland Islands.	Europe	1	213
	LTV (No. 2)	To serve as floating storage barges located within Berkeley Sound. Materials and equipment will be collected from the LTVs and transported offshore to Sea Lion for installation. Up to two (maximum) LTVs may be moored in the Sound at any one time, though these may change out over time.	USA	1	213
	Offshore Construction Vessel (OCV)	Construction and installation of SPS and SURF.	Norway	2	274
	Platform Supply Vessel (PSV)	Assistance to construction vessels.	Europe	1	365
FPSO	Anchor handling tug (AHT) / ERRV	Offtake Tanker Support Vessel and FPSO support.	Europe	1	395
	Multi-Role Support Vessel (MRSV) /ERRV	Supply and support vessel.	Europe	1	395
	FPSO	Floating Production, Storage and Offloading.	Middle East	1	395

Vessel		Vessel purpose	Expected shipping from	Number of vessels[2]	Duration of use (days)[3]
Stage 2a & 2b: SIMOPS – concurrent drilling, construction and production (approx. 7 months, 213 days (Stage 2a) and 28 months, 851 days (Stage 2b)					
Project Support	*Ad hoc* Freighters	Delivery of drilling, development and production equipment and general re-supply.	Europe / USA	4	28
Drilling	AHTS	Support of MODU throughout pre-First-Oil development drilling.	n/a	2	760
	ERRV	Stand-by support of MODU and FPSO.	n/a	1	699
	MODU	Drilling of development /production wells.	n/a	1	699
Construction	LTV (No. 1)	As above.	Europe	1	152
	LTV (No. 2)		USA	1	152
	OCV	Construction and installation of SPS and SURF.	Norway	2	182
	PSV	Assistance to construction vessels.	Europe	1	182
FPSO	AHT / ERRV	Offtake Tanker Support Vessel and FPSO support.	n/a	1	1,064
	MRSV / ERRV	Supply and support vessel for FPSO and CTT.	n/a	1	1,064
	FPSO	Floating Production Storage Offloading.	n/a	1	1,064
	Conventional Trading Tanker (CTT)[5]	Purchaser's vessel used for receipt of Sea Lion crude and export to market.	Unknown	n/a	n/a
Stage 3: Steady state production (per annum for 27 years)					
Project Support	*Ad hoc* Freighters	Delivery of drilling, development and production equipment and general re-supply.	Europe / USA	3	21
Drilling	AHTS	Support of MODU throughout pre-First-Oil development drilling.	n/a	2	30
	ERRV	Stand-by support of MODU and FPSO.	n/a	0	0
	MODU	Drilling of development /production wells.	n/a	0	0
Construction	LTV1	As above.	n/a	1	30
	LTV2			1	30
	OCV	Construction & installation of SPS and SURF.	n/a	0	0
	PSV	Assistance to construction vessels.	n/a	0	0
FPSO	AHT / ERRV	Offtake Tanker Support Vessel and FPSO support.	n/a	1	365 / year
	MRSV / ERRV	Supply and support vessel for FPSO and CTT.	n/a	1	365 / year
	FPSO	Floating Production Storage and Offloading.	n/a	1	365 / year
	CTT	Purchaser's vessel used for receipt of Sea Lion crude and export to market.	Unknown	n/a	n/a

[1] Note that these data are subject to change following contract award and are estimated here for the purposes of enabling the EIA. It is anticipated that the above vessel list describes the worst-case to ensure that the EIS remains representative.

[2] This refers to the number of vessels or the number of uses of the same vessel e.g., in Stage 1, *ad hoc* freighters will be used 5 times although it may be a different actual vessel.

[3] Note that for the purposes of emissions calculations (Section 10.9) the duration of use for vessels also includes mobilisation and demobilisation (mob / demob) days to ensure the worst-case emissions are estimated. The durations provided above do not include the mob / demob days as these do not affect the majority of the impact assessments related to vessel use.

[4] To minimise the need for vessels, it is anticipated that the MODU supply vessels may also be used as AHTs to position the MODU. This assumption ensures that the worst-case is assessed.

[5] Impacts associated with the CTT outside of the 500m zone are out with the scope of this EIS as the vessel will be owned and operated by the purchaser of the crude.

5.11.3 Personnel transportation and search and rescue (SAR) operations

5.11.3.1 Transportation of personnel

At the time of writing, there is a degree of uncertainty over the exact frequency with which each personnel transportation method will be used. Details will be confirmed upon contract award. However, while subject to change, the below describes the transportation methods and the worst-case frequency of use that is anticipated. A summary of all the personnel transportation requirements and helicopter usage is provided in Table 5.25 below.

Note: the data in Table 5.25 are used as the basis for all impact assessments relating to the use of helicopter and fixed-wing flights e.g., emissions, onshore noise and disturbance and resource use etc. These data will be summarised, as appropriate, within each relevant impact / risk assessment chapter (Chapters 10, 11 and 12).

5.11.3.1.1 Transportation to the Falkland Islands

During Stages 1 and 2 of the Development, which will involve the highest levels of activity, personnel will be transported to the Falkland Islands *via* dedicated charter flights. All fixed-wing flights will land and depart from Mount Pleasant International Airport (MPN), which is the only airfield in the Falkland Islands which is able to receive international / long-range, wide-bodied aircraft. Charter flights will operate once per fortnight for the 3 months prior to drilling and weekly during the drilling campaign. The start / end point of the charter flight has not yet been finalised but is expected to be one of: Santiago, Chile; Sao Paulo, Brazil; or London, U.K. Should the flight be from London, a re-fuelling stop in the mid-Atlantic i.e., Cape Verde, will be required. For the purposes of this document, the 'worst-case scenario' will be considered which is a chartered flight from London – Cape Verde – Mount Pleasant.

During steady state production of the Sea Lion field, once the drilling unit and construction vessels have departed the operation, reliance on charter flights may diminish in favour of weekly commercial flights. However, the varying options will be further informed by the Navitas project design process and the FIG / public consultation processes. Details on the fixed-wing transportation requirements during each Stage of the Development are provided in Table 5.25. For the basis of this document and "worst-case scenario" planning, Navitas shall base the environmental impact on retaining the proposed fortnightly charter flight from the UK to the Falklands for the duration of all three stages: Stage 1 (pre-First-Oil), Stage 2a & b (SIMOPs) and Stage 3 (steady state production.)

5.11.3.1.2 Transportation to the Sea Lion Field

Two helicopters will be used throughout the Development project. The helicopters will be used to transport personnel offshore for routine maintenance and crew change / CTT pilot transfers. Based on the 2015 exploration drilling campaign, each crew change to the MODU / FPSO is estimated to require up to five helicopter round trips (i.e., Stanley – MODU – Stanley). Details on estimated helicopter flights are provided in Table 5.25.

5.11.3.1.3 Transportation between Mount Pleasant Complex (MPC) and Stanley Airport

The project's helicopters will be based at Stanley Airport for both operations and engineering maintenance. On crew change-out days, it is anticipated that personnel will be transported by road between the MPC and Stanley Airport, where they will be briefed prior to boarding the helicopters to fly offshore. However, there is the potential that arriving crew may be picked up directly from MPC by helicopter although this will be subject to approval from FIG/MoD.

5.11.3.1.4 Transportation to the CTT

As described in Section 5.10, oil shall be exported *via* direct offtake which may require the use of helicopters to transfer berthing personnel to the CTT. In this scenario, the berthing crew will be boarded on to the CTT at a safe distance from the FPSO.

Details on estimated helicopter flights are provided in Table 5.25.

5.11.3.2 Search and Rescue (SAR) exercises

The Phase 1 & 2 Development will require SAR helicopter cover. Confirmation is still required with regard to the provision of SAR helicopter(s) and the number of SAR training flights that will be required. However, for the purposes of this EIS it is estimated that 20 hours of SAR training flights will be carried out per month as occurred during the 2015 exploration campaign (Table 5.25).

Table 5.25: Sea Lion Development transportation of personnel and SARs

Activity		Frequency	Stage Duration	Number of trips	Duration per trip (hrs)	Total (hrs)
Stage 1: Pre-First-Oil (approximately 31 months (942 days[1]))						
Charter flights	Delivery of personnel from UK to MPC	Fortnightly	31 months	67	36	2,412
Helicopter transfers of personnel to FPSO, MODU, OCVs and LTVs	MODU & OCVs Crew change	Ten flights per fortnight		670	3	2,010
	LTV crew change	By boat		n/a	n/a	n/a
SAR	SAR exercises and test flights	20 hours per month		-	3	620
Road transport[2]	MPC to Stanley airport (return)	11 buses / vans /Fortnight		737	2	1,474
Stages 2a & 2b: SIMOPs - Concurrent drilling, production and export (approximately 7 months (213[1] days) in Stage 2a and 28 months (851[1] days) in Stage 2b (*c.* total 1,064 days[1]))						
Charter flights	Delivery of personnel from UK to MPC	Fortnightly	35 months	75	36	2,700
Helicopter transfers of personnel to FPSO, MODU and OCVs	FPSO, MODU and OCVs crew change	Ten flights per fortnight		750	3	2,250
LTVs	LTV crew change	By boat		n/a	n/a	n/a
Helicopter transfers to FPSO / CTT	Transfer of Berthing crew to FPSO / CTT in the Sea Lion Field	Per direct offtake (average every 10 days over duration)		106	3	318
SAR	SAR exercises and test flights	20 hours per month		-	3	700
Road transport[2]	MPC to Stanley airport (return)	11 buses/vans /Fortnight		825	2	1,650

Activity		Frequency	Stage Duration	Number of trips	Duration per trip (hrs)	Total (hrs)
Stage 3: Steady state production and export (27 years)						
Charter flights	Delivery of personnel from UK to MPC	Fortnightly	27 years	699	36	25,164
Helicopter transfers to FPSO and CTT	FPSO crew changes	2 flights per week		2,795	3	8,385
	Transfer of Berthing crew to FPSO / CTT in the Sea Lion Field	Per direct offtake (average of 36 pa over Field Life)		972	3	2,916
SAR	SAR exercises and test flights	20 hours per month		-	3	6,500
Road transport[2]	MPC to Stanley airport (return)	6 buses/vans / Fortnightly		4,194	2	8,388

[1] Based on an average of 30.4 days per month, and an average of 4.3 weeks per month.

[2] Crews will be transported to MPC either by coach or minibus. Minibuses are assumed here to give a worst-case environmental impact. Stages 1 & 2(a&b) will require approximately eight minibuses and three luggage vans; Stage 3 will require approximately four minibuses and two luggage vans.

5.11.4 Use of finite resources

Local resources that may be required specifically to support the Phase 1 & 2 Development include:

- Existing accommodation,
- Existing supply bases and warehousing in the East Stanley area,
- Plants, trucks, cars, mini-buses and coaches,
- Stanley Airport and the Mount Pleasant Complex,
- Fuel (land, sea and air),
- Local personnel and personnel services and offices,
- Freshwater for potable use, tophole drilling and cementing in the event that the MODU / FPSO desalination plants malfunction,
- Electrical power supply for the onshore supply base,
- Use of existing road network, and
- Waste management facilities (if available).

Detail on the existing resources on the Islands is provided in the Environmental and Social Baseline (Chapter 7). The following estimates of resource use are based on data extrapolated from the POEPL 2015 exploration drilling campaign and the associated End of Well Reports (EOWR) (rationalised where possible given that resource use during steady state production is likely to be less than during drilling and simultaneous operations).

The following estimates of resource requirements are considered to be worst-case.

5.11.4.1 Accommodation requirements

The development drilling (Stage 1) and the simultaneous operations (Stages 2a & 2b) will require the highest total number of onshore and offshore personnel. When steady state production commences and the MODU and construction vessels depart the field the accommodation requirements will decrease.

Accommodation will be required in Stanley for personnel who are:

- employed at the supply base,
- employed on a rotational basis in Navitas' Stanley office,
- Crew and maintenance personnel supporting the helicopters,
- Crew and maintenance personnel supporting the fixed wing charter flight,
- in transit and resting-up overnight prior to flying offshore / returning from offshore,
- being temporarily housed onshore in anticipation of being called offshore, and
- If required, needing shelter following emergency down-manning of any of the offshore assets.

The profile of the accommodation requirements over the life of field is as shown below in Table 5.26.

5.11.4.1.1 Accommodation provided by Navitas

Recognising the current pressure on housing stock and hotel accommodation (Section 7.7.4.5.1), Navitas is committed to increase local housing supply to meet Sea Lion needs and will enter into a contract or contracts for the construction of *c.* 20 management housing units. Navitas is committed to commission provision of hostel type / 'hotel' accommodation that will meet transit requirements and fulfil contingency needs (Table 5.26). Capacity will be fixed to meet the forecast personnel accommodation need within the current design. In terms of management housing requirements, only a small number of personnel (*c.* 26) (Table 5.26) will be required to permanently live in Stanley and these needs will be met by a contracting strategy that will promote and encourage housing built by the private sector. An expression of interest exercise undertaken in Q1 2024 has already determined that there is interest and capability in the Falklands private sector in responding to this demand and engaging in the competitive tender process.

Specifically, Navitas shall commit to providing:

- Hostel-type accommodation,
- Temporary accommodation unit,
- In-transit accommodation unit, and
- Management housing units.

Further detail in provided in Section 11.3.

5.11.4.1.2 Accommodation type

Plans for the hostel-type / hotel accommodation (for transitory / offshore personnel) are not currently finalised and will be determined through the contracting process with tenderers and assessed against a Statement of Requirements as to whether they are fit for purpose by Navitas. It is expected that innovative solutions will be driven by the private sector.

The hostel-type / hotel accommodation will be:

- Based on single room occupancy with double bed in normal conditions but will be equipped with second fold-down bed (or similar) to double accommodation capacity in the unlikely event of an emergency shut-down of one of the offshore assets or a long delay to the fixed wing charter,
- Emergency accommodation with double occupancy suitable for short durations as in extended down-manning it would be likely that crew would be flown out of the Islands and repatriated on a specially chartered flight,
- Available for the whole Field Life of the Sea Lion Development, and
- Within easy access of the By-pass / Airport Road, TDF and supply bases.

This accommodation will be suitable for in-transit accommodation of personnel on crew change days and to accommodate all offshore crews in the event of a down-manning of the offshore assets throughout all stages of the project. During the tendering process, tenderers will be asked to provide detail of their proposed incorporation of sustainable design features in their tender submissions. Environmental considerations and sustainable design will form part of the contract evaluation criteria.

Design and location(s) of the management housing units are not currently finalized. These will be determined through the contracting process with tenderers and will be assessed against a Statement of Requirements as to whether they are fit for purpose by Navitas. Construction of a small number of single flat-type units is currently envisaged. As with the hostel-type / 'hotel' accommodation, during the tendering process, tenderers will be asked to provide detail of their proposed incorporation of sustainable design features in their tender submissions. Environmental considerations and sustainable design will form part of the contract evaluation criteria.

Table 5.26: Estimated maximum accommodation requirement for personnel required during the Sea Lion Phase 1 & 2 Development

Personnel type	Accommodation Requirement[1]	Stage 1		Stage 2a &2b:		Stage 3:		Base-case provision of accommodation by Navitas[2]
		31 months		35 months		27 years		
		Max no. people[2]	% Stanley pop[3]	Max no. people[2]	% Stanley pop[3]	Max no. people[2]	% Stanley pop[3]	
Permanent onshore personnel who live in Stanley (office, supply base, TDF)	The ability to accommodate all the personnel employed onshore will be required four to six months prior to the start of drilling activity and will endure for the duration of the Sea Lion Field life	26	0.91	24	0.84	24	0.84	Housing strategy to encourage private sector provision
Temporary rotational onshore personnel required during high intensity periods or stand-by personnel who live in Stanley for a few weeks to a few months	Routine and surge hostel-type accommodation for personnel employed onshore within support yards and logistics (on a 28 x 28 day rotation), who are on stand-by, and overnighting fixed wing air crew.	74	2.6	70	2.46	13	0.46	Temporary modular accommodation units initially provided by Navitas, supplemented by local hotels. Transferring to in-transit accommodation as soon as available.
Offshore personnel (in transit) prior to going offshore	Overnight hostel-type accommodation for personnel at the beginning and end of offshore rotations	62	2.18	62	2.18	60	2.11	In-transit accommodation unit provided by Navitas.
Personnel down-manned to shore in the event of an emergency	Short term contingency accommodation in the event of an emergency down manning of the drilling rig or the FPSO. Required for Field Life[4]	140	4.92	140	4.92	100	3.51	The above accommodation can be double occupancy for up to three days
Visiting senior personnel	*Ad hoc* hotel accommodation	Anticipated to be similar to levels during the exploration campaign						None
Total requiring accommodation at any time		302	10.6	296	10.39	197	6.92	-

[1] Based on Navitas' Sea Lion Phase 1 & 2 Development projections.
[2] See Development Description (Section 5.11.4.1) for detail.
[3] Stanley population from the last census, 2,848 inhabitants (FIG, 2023l).
[4] Figures provided by Navitas Logistics and Infrastructure Overview.

5.11.4.2 Freshwater requirements

Freshwater, which is a finite resource in the Falkland Islands, will be required offshore, onshore and at-shore for operational, domestic and general use.

Freshwater requirements during the Phase 1 & 2 Development include those associated with:

- The MODU and drilling activities (Section 5.4),
- The FPSO and production (Section 5.8),
- The offshore marine vessels (Section 5.11.2),
- Onshore / shoreline activities including the:
  - TDF (Section 5.11.1.1.1),
  - Onshore laydown yards, storage bases and associated offices (Section 5.11.1.2), and
  - Personnel accommodation (Section 5.11.4.1).

The following sections aim to:

- Quantify the Phase 1 & 2 freshwater requirements,
- Describe the Phase 1 &2 measures for meeting the water demands, and
- To describe activities for which local freshwater resources may be required.

5.11.4.2.1 MODU

The estimation of freshwater use during drilling is based upon the well design and the way drilling is to be managed in Phase 1 & 2 of the Development (as described in Section 5.4).

The forecast water demand (Figure 5-11) is based upon the daily water requirements associated with:

- Drilling,
- Cementing,
- Well suspension, and
- Completion.

In Stage 1, prior to First-Oil, the wells will be batch drilled (Section 5.4.5.2). This will result in peaks and troughs in water demand over time as activities that are more water intensive are undertaken at each well within the batch process, followed by activities that are less water intensive. The average water demand will be 19 m^3 / day, however, over two, one-month periods, water use will peak at 37 m^3 / day.

Following First-Oil, the wells will be drilled and completed in sequence (Section 5.4.5.2). Therefore, water use will decline to a more uniform 21 m^3 / day. Upon the completion of all drilling activities and once the MODU departs there will be no further requirement for offshore drill-water.

The MODU will be equipped with water-makers and is assumed to be self-sufficient for domestic uses. However, it is likely that the water-makers may not meet the need for drill water such that there be a requirement for local water resources.

With the daily water supply in Stanley currently limited to 1,000 m^3/day under standard working conditions, and 918 m^3/day being used in 2023, this shows that there is only 82 m^3/day of excess production capacity. This is shown below in Figure 5-11 as the 'assumed Stanley potable water supply limit'. For more details on Stanley's water capacity and predicted Sea Lion usage, please refer to Section 11.4.

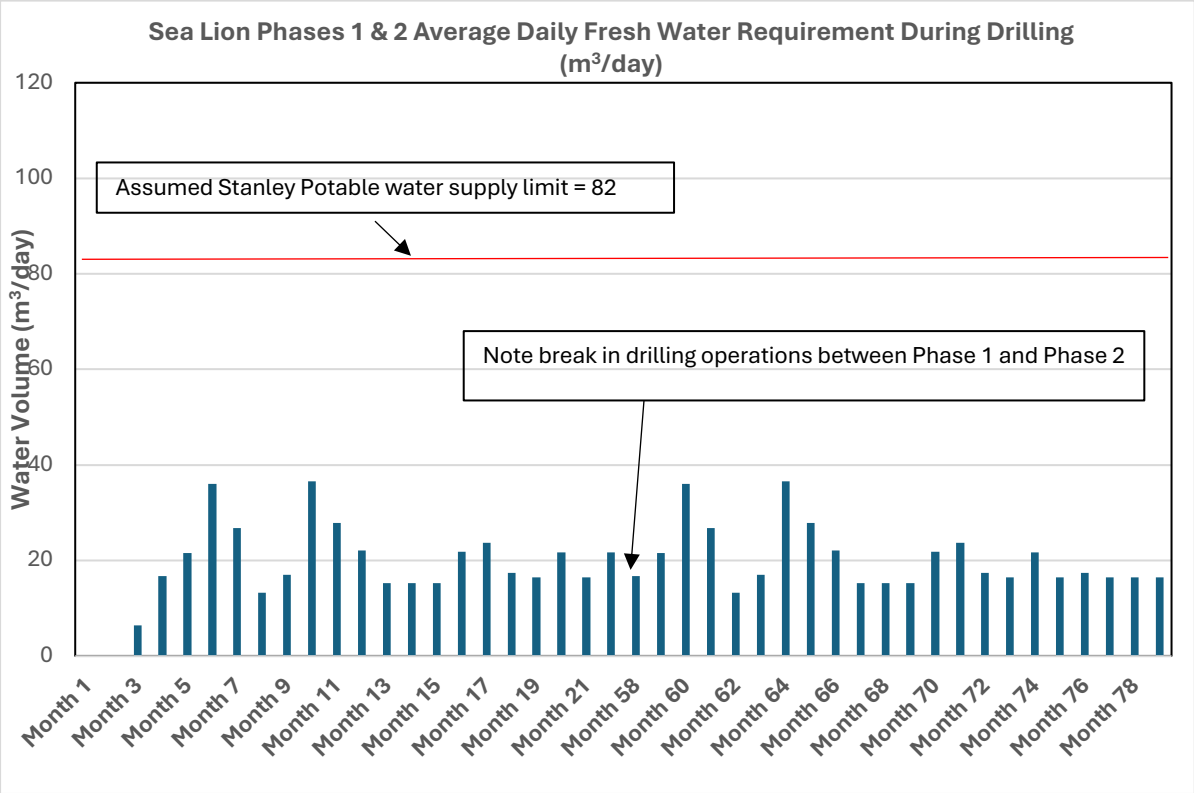


Figure 5-11: Forecast estimates of freshwater demand for Phase 1 & 2 drilling requirements

5.11.4.2.2 FPSO

During production, the FPSO will require water for domestic use and marine and topsides systems.

It is estimated that the FPSO will require 40 m^3 / day. To meet this demand, it will carry a water-maker of sufficient capacity and with redundancy (i.e., a spare unit). It is anticipated that the FPSO will be able to produce enough water to meet its own demand and thus be self-sufficient in water.

5.11.4.2.3 Vessels

The number and types of vessels required varies during the different stages of development depending on the activities being undertaken. Vessels will be equipped with water-makers sufficient for their needs, however a contingency requirement of 10 m^3 / day from local freshwater resources will be assumed for occasional opportunistic top-up of tanks when berthed at the TDF.

The OSVs which support the MODU and the FPSO will carry the water out to the MODU and FPSO.

5.11.4.2.4 Onshore Construction

Where possible, Navitas will utilise existing Stanley-based infrastructure to support Sea Lion operations, acknowledging however that there will be a need to develop further infrastructure to support the project. Additional Infrastructure requiring construction includes:

- Construction Contractors Compound (e.g., laydown area),
- Offshore Transit Hotel Accommodation,
- Wells Infrastructure,
- Liquid Mud Plant (based within property of TDF),
- Chemical Storage facility (Navitas potentially to lease site from FIG in East Stanley),

- Helicopter Hangar and Passenger Exchange (within the curtilage of Stanley Airport),
- Upgrades and refurbishments to the existing TDF and its causeway, and
- Waste Treatment Site.

At the time of writing, it is anticipated that construction of these additional infrastructure requirements will commence in 2025[21].

Water use for welfare of the construction team at work is budgeted at 40 litres per person per day. If everyone was at one location (75 people max) they would consume 3,000 litres per day.

Water requirements for the concrete batch plant and other construction uses is estimated at 3,000 – 4,000 m^3 over the *c.* 15 months of the construction projects. For the batch plant, peak demand will be buffered by up to 40 m^3 of water onsite.

5.11.4.2.5 Laydown yards, storage, and propriety TDF usage

The TDF has minimal use of water (i.e., <1 m^3/day) and water use by the TDF is included within the above estimates of MODU, FPSO and vessel water use.

Water use by the on-shore laydown yard and storage facility has been estimated using the 2015 exploration campaign data and has been scaled according to the anticipated changes in yard area (Section 5.11.1.2).

Water use at the liquid mud-plant, brine and bulk storage facility is included within the offshore drilling use estimates and is not considered separately to avoid double-accounting.

A freshwater tank storage will be provided to service the TDF and bulk plant needs, if required. This will require planning approval. This tank storage will buffer supply to average use levels and prevent water demand spikes during vessel supply or batching.

5.11.4.2.6 Accommodation

As detailed in Section 5.11.4.1, the personnel requirements will vary during the stages within the Phase 1 & 2 Development. Average water use is proportional to the number of personnel based ashore, and therefore peak periods of use relate to the two days fortnightly when crew changes occur. Water use is based upon an average *per capita* use of 300 litres per person per day for domestic usage (UNDP, 2006)

5.11.4.2.7 Total estimated freshwater requirement for Phase 1 & 2

An estimate of the total Phase 1 & 2 water use, based on the above, is presented in Table 5.27.

In addition to direct usage by the MODU, FPSO, vessels etc., data from the previous O&G exploration campaigns indicate that an additional, but unallocated, increase in water use results from:

- The use of sub-contractors and services (e.g., offices, laundry, rental accommodation, etc.), and
- Indirect, but associated, water use by other economic sectors (e.g., hotels, hospitality, retail suppliers, etc.).

It is not possible to accurately separate the direct and indirect water use associated with the O&G industry from that associated with unrelated activities. However, in previous O&G exploration

[21] The predicted timeline for commencement of construction of the TDF causeway did not materialise as anticipated at the initial time of writing the EIS. Timing for replacement of the causeway is dependent on timing of final regulatory approval, but the TDF causeway is required to be operational to support development drilling activities.

campaigns, an additional unallocated usage of *c.* 81 m^3 / day was recorded and this has been included within the estimate in Table 5.27.

Table 5.27: Estimated freshwater use by the Phase 1 & 2 Development

Activity	Assessment	Stage 1 – Pre First-Oil		Stage 2a &b – SIMOPs		Stage 3 – Steady State Production	
		Average (m^3/day)	Peak[1] (m^3/day)	Average (m^3/day)	Peak[1] (m^3/day)	Average (m^3/day)	Peak[1] (m^3/day)
Offshore Demand (supplied *via* TDF)							
MODU Drilling requirements inc. bulks, mud and brines	Drilling Estimates	19	37	20	21	0	0
Vessel requirements	Tank-top up allowance	10	10	10	10	10	10
FPSO	Self-sufficient	0	0	0	0	0	0
Onshore Demands							
Onshore Construction	Construction Estimates	8	44	n/a	n/a	n/a	n/a
Laydown yards and warehousing	Exploration with proportional increase	7	7	7	7	2	2
Bulk, mud & brine storage	Included in offshore drill estimates	0	0	0	0	n/a	n/a
Personnel and accommodation	Per capita rate of 300l/pp/day	70[2]	140	64	126	32	65
Total O&G Demand		114	238	101	164	44	77
Unallocated activity demand[3]	Stanley total usage above allocated exploration use	81	-	81	-	81	-
Total forecast demand		195	-	182	-	125	-

[1] Peak usage relates to the month with the highest daily average usage during drilling and to accommodation during peak in-transit crew exchanges.
[2] This includes offshore personnel as well to account for a worst-case in the event of a 'down man'. Otherwise, water will be mostly made up offshore by watermakers on the MODU/FPSO for personnel use.
[3] Estimates based on the observed additional, but unallocated, increases in water use between 2014 - 2015 during exploration campaigns.

5.11.4.3 Electricity requirements

With regard to electricity requirements, the critical factor is the instantaneous power demand at any one given time, which must be matched by electrical generators within the Stanley supply system.

The following power demand figures are based upon directly recorded or estimated data by FIG Public Works Department during previous oil exploration rounds within the Falkland Islands. Where appropriate, the estimates have been scaled up or down from the observed exploration use according to, for example, the increase in land area used (in the case of the laydown yard) or *per capita* personnel increases (in the case of accommodation usage).

Figures are provided in Table 5.28 for the main infrastructure centres:

- Heliops hangar,
- Accommodation facilities,
- TDF, and
- Drilling and operations bases (including the liquid mud plant, and laydown yards).

In addition to the attributed infrastructure centres listed above, there are a number of directly associated miscellaneous power demands from offices (Navitas and service contractors), separate rental accommodations (for oil personnel) and directly sub-contracted services, such as laundry.

Furthermore, there are associated demands from indirect economic activities such as hotels, entertainment, and retail that will increase due to the presence of oil personnel.

Finally, there may be incidental increases in demand from unassociated economic activity that is wholly separate from the Phase 1 & 2 Development activity, e.g., if fisheries cold-storage practices change. Such changes are out with Navitas' control and will affect the baseline power availability against which the Phase 1 & 2 Development power usage is compared in this EIS.

In POEPL's Sea Lion exploration campaigns, the additional electricity requirements contributed a further 9 % of Stanley's overall energy use although it is not possible to fully separate the proportional increases resulting from the those that are linked to oil activity and those which are not.

Table 5.28: Power demand of Phase 1 & 2 Development infrastructures

Facility	Peak Power (kW) use during exploration	Estimated Stage 1 & 2a & 2b peak power (kW)	Estimated Stage 3 peak power (kW)
Heliops hangar	250 a	250	250
Accommodation facility	120 – 140[1]	264 - 308	120 - 140
TDF (estimate)	25[2]	25	25
Drilling and operations bases (estimate)	75	225	45
Total attributable load	**470 - 490**	**764 – 808**	**440 - 460**

[1] PWD figures (G. Ross, *pers. comm.*).

[2] Estimate assuming that peak power use is 5-times averaged power use over 24-hours.

5.11.4.4 Waste management plan

Wastes will be managed in accordance with the project-specific Waste Management Plan (WMP) which will be developed from the Navitas Falkland Islands Waste Management Procedure, which sits within the company OMS (Section 3.2).

The bulk of waste, including all non-hazardous waste and potentially some hazardous waste, will require a waste handling / treatment facility. It is envisaged that additional municipal disposal facilities will be available in the Falkland Islands that will be sufficient for the Sea Lion Phase 1 & 2 project.

All waste received from the offshore Development will be transported to the onshore supply base by the supply vessels where it will be stored temporarily, in accordance with best practice, in the waste laydown area prior to transportation to FIG's waste reception facility, or export from the Islands for treatment.

Waste streams that are unsuitable for incineration disposal on Island will be sent to another country in accordance with the UN Environment Programme's Basel Convention for treatment / disposal (see Section 10.10).

At all times, and as a responsible operator, Navitas shall ensure that:

- The '5Rs' Waste Hierarchy (Remove, Reduce, Reuse, Recycle / Recover, Residue (Treatment)) is applied,
- Wastes are accurately described / characterised and consigned when they leave the Navitas site where the waste was generated,
- Wastes are securely packed to ensure no loss of containment in transit,
- All parties handling waste on behalf of the company are competent and authorised to do so, and
- Wastes are disposed of in an appropriate way, at a site that is authorised to accept them.

Navitas will provide details of all envisaged waste streams and planned treatment and disposal options from the commencement of field operations within the WMP. A summary of the anticipated waste volumes anticipated throughout the Sea Lion Development can be found in Section 10.10.4.4.

5.11.4.4.1 Oil spill waste management

In the event of an oil spill, clean-up operations intended to restore the site of the spill, will generate large volumes of waste materials which can be contaminated with oil. The management of this waste up to, and including, its final disposal, can cause significant challenges for response coordinators. In order to ensure greater preparation, Navitas has developed Oil Spill Strategies that detail the approach for dealing with such wastes.

In the highly unlikely event that a spill incident should occur, Navitas would be supported by international oil spill response contractors who have significant expertise and resources in the appropriate management of oil spill response waste. These response contractors would be deployed to the Islands in the event of a Tier 2 or 3 oil spill event. There will be oil spill response and interim waste storage capability on the various offshore support vessels, at the TDF (Section 5.11.1.2.3) and at the onshore supply base facility.

The proposed approach will be to develop temporary, lined, storage areas. All solid waste streams will be corralled / contained in the temporary lined storage areas and liquid wastes (i.e., oily water from washing of equipment, for example) will be stored in drums and Intermediate Bulk Containers (IBCs). Final disposal will be agreed with FIG as part of the contingency planning (see Section 10.10.2.2.3). Plans for monitoring of the disposal site and detail of oil spill waste clean-up plans will be detailed in the Phase 1 & 2 Development Waste Management Plan.

5.12 Decommissioning

The Field Life of the Phase 1 & 2 Development is estimated to be 30 years. The date of Cessation of Production (CoP) and the commencement of decommissioning of associated facilities will depend upon field performance and economics. Navitas is required to ensure that all structures are designed to be fully decommissioned in a safe and environmentally responsible manner.

Part V of the Offshore Minerals Ordinance 1994 confers obligations for decommissioning and a decommissioning programme has to be approved by FIG in advance. FIG has powers under the Ordinance to develop additional regulations in relation to field decommissioning. Therefore, decommissioning will be carried out in accordance with the legislation in place at the time. However, at the time of writing, the project defers to the current UK legislation and its sources.

OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations prohibits dumping, and leaving wholly or partly in place, of disused offshore installations within the OSPAR maritime area. While derogation from this prohibition may be sought for qualifying installations, e.g., large steel or concrete footings of fixed platforms, this will not apply to the proposed project which will utilise an FPSO with subsea wellheads and infrastructure. Under OSPAR, all subsea structures must be removed with any

associated piles, well conductors etc. cut to a level below the natural seabed which ensures they remain below the seabed in the face of prevailing conditions.

Of importance, pipelines and other structures which are listed in a UK Pipeline Works Authorisation are excluded from OSPAR Decision 98/3 and in the UK, decommissioning of these is managed in line with the Petroleum Act 1998 (Part IV) and the Pipeline Safety Regulations 1996.

These require a similar assumption of complete removal where reuse of the pipeline and associated structures for further hydrocarbon development is not possible. However, under the UK regulations, there are certain pipelines and/or circumstances in which a pipeline may be wholly or partially left *in situ* e.g., pipelines that are adequately buried or trenched, are not subject to development of spans[22], and are expected to remain so. However, the decision to do so would need to be informed by an EIS which is supported by a formal Comparative Assessment of the options which must include a robust assessment of the environmental impact of removal *vs.* that of leaving wholly or partially *in situ*.

In accordance with the above, the Phase 1 & 2 Development infrastructure has been designed to enable complete removal of all structures. Equally, the flowlines will be surface laid and will not be trenched or buried thus facilitating complete removal (noting that the seabed is very soft, so flowlines may self-bury which could change the methods required for complete removal). Also in line with legislation, all relevant 'As Left' surveys will be carried out to ensure that the seabed is left clear.

Specifically, the Development has been designed to enable:

- Abandonment of wells in accordance with The OEUK Guidelines for the Suspension and Abandonment of Wells,
- Cutting of the well casings to a level below the natural seabed, which ensures they remain below the seabed in the face of prevailing conditions,
- Removal of the 'disused offshore installation':
    - Removal the FPSO and moorings for legitimate use elsewhere - the FPSO will be on a 'lease and operate' contract so may be re-deployed following decommissioning of the Phase 1 & 2 Development,
    - Removal of all subsea infrastructure associated with the installation (i.e., wellheads and X-mas trees) for waste recovery (e.g., reuse or recycling) or final disposal on land. Infrastructure removed will be transported to shore and managed in accordance with the Waste Hierarchy. Any disposal will be justified by demonstrating that recovery and recycling options are not feasible or reasonably practicable, and
    - Any piles will be cut to a level below the natural seabed, which ensures they remain below the seabed in the face of prevailing conditions.
- Removal of the SURF:
    - All subsea umbilicals, risers, flowlines, and associated infrastructure will be removed unless comparative assessment of the safety, environmental, technical, societal and economic impacts indicate that leaving wholly or partially *in situ* is the best practicable option.
- Removal of any debris associated with the production or decommissioning phases.

Note: No part of the Phase 1 & 2 installation will qualify for derogation under the current OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations. As stated, the Phase 1 & 2

[22] A pipeline span is a section of a pipeline that is no longer supported by the seabed due to erosion or scouring. Free spans can develop for a number of reasons, including uneven seabed, tidal currents, scouring, and wave action.

Development will be decommissioned in accordance with legislation and best practice relevant to the time.

Decommissioning will be considered a separate project and will thus follow the standard Navitas planning process and will warrant its own EIA and EIS. However, at this time, the seabed has been extensively surveyed to explore environmental sensitivity. These have not indicated that the structures will cause adverse environmental impact, however, location-specific site surveys will be undertaken immediately prior to installation to ensure there are no localised environmental sensitivities that suggest installation is inadvisable at that location.

5.12.1 Decommissioning programme

The base-case is the complete removal of all structures to approximately two metres below the seabed. However, it is not possible to assess the environmental impacts and risks associated with the decommissioning process at this time due to:

- The varying options for removal,
- Unknowns about the status of the infrastructure at the end of Field Life (e.g., flowlines may self-bury), and
- The potential for technological advances that emerge during the life of the Phase 1 & 2 Development.

Toward the end of Field Life, a detailed Decommissioning Programme outlining the methods for removal and outcomes of the comparative assessment for pipeline decommissioning options will be submitted to FIG for the FPSO, pipelines and subsea infrastructure.

The Decommissioning Programme/s will be supported by:

- An ENVIID which will be carried out to inform the EIA that will accompany the decommissioning programme,
- A comparative assessment for the pipeline decommissioning options,
- An EIS detailing the impacts and risks associated with the selected removal options and waste management strategies, and
- A Stakeholder Engagement Plan.

5.13 Development resilience to the effects of climate change

The impacts of climate change are described in Section 10.9 which estimates the Development's atmospheric emissions and its contribution to this global phenomenon. However, the impacts of climate change, as a global and cumulative concern, have already begun and it is necessary to consider the resilience of the proposed project to such changes.

The key relevant impacts of climate change are:

- The potential for rising sea levels owing to the melting of Arctic, Antarctic and worldwide glacial ice,
- The potential for drifting icebergs which may break away owing to warming temperatures,
- Changing coastlines, and
- More extreme weather.

By design the project is expected to be resilient to such changes. The mitigations e.g., the Iceberg Management Strategy (Section 3.2.18.1), no sea level onshore facilities and the selection of a harsh environment FPSO which is designed to withstand metocean conditions worse than those expected at Sea Lion are built-in to the project design.

5.14 Phase 1 & 2 base-case mitigation technologies

In order to assess the impact and risks it is necessary to quantify, where possible, what the outputs of the Phase 1 & 2 Development may be e.g., how much CO_2 will be emitted, how much light, how much produced water etc. Here it is necessary to understand the project activities and the technologies used to reduce the main outputs. The base-case impact and risk reduction technologies built-in to the design are listed in Table 5.29.

Table 5.29: Summary of the technologies and measures which are built-in to the Sea Lion Field Northern Area Phase 1 & 2 Development basis of design in order to reduce outputs

Project activity	Mitigation technologies built-in to the Sea Lion Field Northern Area Phase 1 & 2 basis of design
General	• All materials, fittings and system contents contained in the FPSO hull will be non-toxic, non-smoke emitting, fire retardant or 'low flame spread'.
Drilling and production	**The following will reduce the amount of atmospheric emissions:** • The main fuel supply for the FPSO will be produced gas, use of which will be facilitated by the availability of three Dual Fuel GTG Turbines, • Use of waste heat recovery to reduce the need for active heat generation and therefore to reduce fuel consumption / CO_2 emissions, • No planned flaring during ongoing well testing throughout Field Life, • No routine flaring during normal production (notwithstanding the flare pilot light), • Use of a Flare Recovery Package during normal operations, • No venting from the FPSO during normal production, • Follow international standards for piping, valves etc. and best practises for integrity management e.g., UK Step Change Hydrocarbon Toolkit • Use of Vapour Recovery Package (VRP) during normal operations, • Use of a vapour balancing system to pass blanket gases from the FPSO cargo tanks to the CTT cargo tanks, when available, during transfer of oil, • The use of passive heat retention systems wherever possible to maintain working temperatures and flow assurance, thereby preventing energy expenditure, and its associated emissions, on active heating systems, • Use of Open Hole Gravel Pack (OHGP) completions which minimise downhole debris and reduce the requirement for well clean-up to the MODU, and thus the likelihood of associated flaring. The base-case is for the wells to be flowed straight back to the FPSO (**Note:** there is a contingency to flow / test four wells to the MODU if considered necessary which would require flaring), • Use of F-Gases with the lowest Global Warming Potential, • Back-up inert gas generator for use as gas blanket in the event that the VRP malfunctions to prevent venting of hydrocarbon gas, and • Use of Marine Gas Oil (MGO) instead of Intermediate Fuel Oil (i.e., a lighter fuel) when operating inshore. **The following will reduce the volumes of drilling discharges:** • Use of seawater sweeps, bentonite and WBM for tophole drilling, and • Batch drilling to optimise drilling mud use. **The following will reduce the volumes of, or negate the need for, discharges of oil and chemicals to sea:** • Produced Water Reinjection (PWRI) as a base-case to alleviate the need to discharge produced water to sea during normal production operations, • Subsea and topside technical flow assurance measures, e.g., insulation and heating, will minimise the use of flow assurance chemicals, • Diversion of produced water to slops / off-spec tanks for retreatment in the event that PWRI is down and produced water is out with discharge specifications, and • Oil in ballast tank detection on the FPSO.

Project activity	Mitigation technologies built-in to the Sea Lion Field Northern Area Phase 1 & 2 basis of design
	The following will reduce the volume of oily waste returned to shore: • Use of a Thermomechanical Cuttings Cleaner (TCC) during drilling which will clean-up drill cuttings on the rig so they may be discharged to sea, reducing the amount of oily waste sent to shore for treatment. **The following will reduce the volume of waste being returned to the UK for disposal:** • Use of municipal waste facilities. **The following will reduce the competition for resources:** • Use of buffer storage water tanks at the TDF, the mud plant and potentially the at-shore bulk supply base to ensure management of peak water use requirements.
Oil spill prevention measures	**Note: many industry-standard preventative mitigation measures must be built-in to the basis of design. Therefore, there are very few 'extra' base case mitigation options available and the standard requirements are summarised below:** **Preventative measures built-in to the FPSO include:** • Cargo and fuel tanks of the vessel will be double skinned, • Bunding of all liquid containing equipment and chemicals, • Open deck drains to catch and collect spills to a dedicated slops tank, • High level tank filling alarm and emergency shutdown of the process, • FPSO offloading hose quick-break connectors to prevent spills on unplanned disconnection, and • Automatic Identification Systems and Marine procedures to prevent collisions. **Preventative measures built-in to the well design include:** • Development of the appropriate, and peer reviewed, well design, • Use of appropriately weighted drilling muds, • The use of appropriate mud additives to ensure over-balanced drilling, and • Use of Blow-Out Preventers and production X-mas trees. **Preventative measures built-in to the CTT nomination and selection include:** • Cargo tanks, and potentially the fuel tanks, of the vessel will be double-skinned, • Vetting and auditing prior to acceptance of the nominated vessel, • Transfer of Falkland Islands' authorised Berthing Master / Pilot and assistant to CTT to manage the offshore direct offtake operation, • Cargo tank hi level and hi-hi level alarms to prevent overfilling, • Bunding of all liquid containing equipment and chemicals, and • Open deck drains to catch and collect spills to a dedicated slops tank.

5.15 Estimated quantities of residues and emissions resulting from the project

In line with Paragraph 1, Schedule 4, sub-paragraph 4c of the Offshore Minerals Ordinance 1994 (and 2011 amendment), the residues and emissions resulting from the Sea Lion Phase 1 & 2 Development are estimated in Table 5.30.

Table 5.30: Estimated quantities of residues and emissions resulting from Stages 1, 2 and 3 of the project

Type of Emission or Residue	Total quantity of emission or residue	EIA chapter / section detailing full characterisation and quantification
Disturbance footprint of temporary MODU anchors installation	0.66 km^2	**Section 10.3**
Disturbance footprint of FPSO anchor installation	0.095 km^2	
Long-term footprint of FPSO anchors	0.0016 km^2	
Disturbance footprint of LTV anchors in Berkeley Sound	0.06 km^2	
Temporary disturbance footprint of SPS / SURF installation and support deposits / wet storage	0.143 km^2	
Long-term footprint of SPS / SURF	0.024 km^2	
Underwater noise offshore – maximum source level during all stages	188 dB re 1 µPa at 1m	**Section 10.4**
Underwater noise inshore from inshore operations – maximum source level	165 dB re 1 µPa at 1m	**Section 10.5**
Water-based Mud (WBM) drill cuttings discharged	18,756 t	**Section 10.6**
Non-Aqueous Drilling Fluid (NADF) drill cuttings (cleaned)	20,905 t	
Oil discharged on cleaned cuttings	106 t	
Potential produced water (PW) discharges (during 7 % PWRI downtime, or 25.5 days in a year) - early Field Life	41,461 m^3 / year	**Section 10.7**
Potential produced water (PW) discharges (during 7 % PWRI downtime, or 25.5 days in a year) - late Field Life	428,294 m^3 / year	
Grey water (over 32.6 years)	330,447 m^3	
Black water (over 32.6 years)	115,656 m^3	
Hypersaline water (for consumption over 32.6 years)	495,670 m^3	
Hypersaline water (for operational use over operational Field Life)	1,519,495 m^3	

Type of Emission or Residue	Total quantity of emission or residue	EIA chapter / section detailing full characterisation and quantification
Currently expected atmospheric emissions (including four contingency well tests) (over 30 years)	5.6 $MtCO_2e$	**Section 10.9**
Worst-case total atmospheric emissions (over 30 years)	7.31 $MtCO_2e$	
Worst-case atmospheric emissions plus contingency of four well flowback / tests)	7.33 M tCO_2e	
Indirect emissions from 100 % combustion of sold product (outwith Navitas's control)	110 - 150 $MtCO_2e$	
Total waste (over Field Life)	28,537 t	**Section 10.10**
Total waste incinerated or going 'waste-to-energy' in the Falkland Islands	24,698 t	
Total waste to recycling (over Field Life)	1,507 t	
Total waste to landfill (over Field Life)	462 t	

6 SCOPING AND STATUTORY CONSULTATIONS

Table of Contents

6.1 Introduction 231
6.1.1 Relevant Guidance 233
6.1.2 Informal scoping Consultation Process 233
6.1.3 Key Stakeholders and interested parties 233
6.2 Historical scoping and statutory consultations 236
6.2.1 Informal scoping consultation in 2014 237
6.2.2 Informal scoping consultation in 2015 237
6.2.2.1 Informal Scoping Workshop 237
6.2.2.1.1 Determination of EIA scope 238
6.2.3 Informal scoping consultation in 2016 239
6.2.3.1 Consultation format 240
6.2.3.1.1 Commitments resulting from the 2016 scoping 240
6.2.4 Statutory 42-day public consultation in 2018 241
6.2.4.1.1 Commitments resulting from the 2018 formal consultation. 242
6.2.5 Statutory 42-day public consultation in 2020 242
6.3 Navitas informal scoping consultation 2023 242
6.4 Summary of all informal scoping consultation outcomes 242
6.5 Navitas statutory 42-day public consultation 247

6.1 Introduction

As is described in the Falkland Islands Government (FIG) Environmental Impact Assessment (EIA) Guidance (FIG, 2016e), it is considered beneficial for an operator to consult informally with all relevant interested parties on the proposed development plans prior to the execution of the EIA and writing of the associated Environmental Impact Statement (EIS). This 'informal' consultation is intended to focus the EIA and ensure that the environmental assessment underlying the EIS is adequate.

Should the FIG Department of Mineral Resources (DMR) indicate to FIG Executive Council that a valid EIS which is compliant with Schedule 4 of the Minerals Ordinance has been submitted, the statutory 42-day consultation period will follow. This will comprise formal consultation with FIG, its expected consultees and the general public.

As described in Chapter 4, under the previous operator, POEPL, the Sea Lion Field was originally going to be developed *via* an offshore Tension Leg Platform (TLP) and numerous oil export options were under consideration. Direct scoping consultations on development with the TLP concept began in 2014 and included the public, interest groups and other consultees. Also in 2014, additional scoping and statutory consultation was undertaken for the 2015 exploration drilling campaign with FIG departments, key focus groups and members of the public.

Following the decline in the oil price in 2015, the proposed offshore component of the Sea Lion Development was changed and the use of a Floating Production, Storage and Offloading (FPSO) Vessel was proposed instead of the TLP, while the various oil export options remained under consideration (Table 6.1). Further scoping consultations were carried out following each major evolution of the project (Table 6.1), for example, on the oil export options. Statutory consultations were carried out on the submitted EIS, under POEPL in 2018 and 2020.

In 2023, the Sea Lion Development was further optimised, resulting in the basis of design presented in this document, the need for a further informal scoping exercise and the potential for another statutory consultation.

The following chapter describes:

- The historical scoping and statutory consultations carried out between 2014 to 2020 under POEPL (now Navitas Petroleum Development and Production Limited (Section 2.1.1) (hereafter referred to as Navitas), and
- The most recent scoping consultation carried out by Navitas in 2023.

Table 6.1: Comparison between the previous and the current Sea Lion O&G Development proposals

Activity	2014[1]	2015[1]	2016 [1]	2018[2]	2020[3]	2023[4]
Number of completed wells:	33	Reduced to 18 wells	Up to 30	No Change	No Change	23
Well completion	Cement and perforation	Cement and perforation	Cement and perforation	No Change	No Change	Open Hole Gravel Pack (OHGP)
Oil produced and processed by:	TLP with processed oil transferred to a permanently connected Floating, Storage and Offloading (FSO) Vessel	FPSO unit	No Change	No Change	No Change	Smaller FPSO
Gas management:	Gas to be used for fuel gas, gas blanketing and 'gas lift' to enhance oil recovery	No Change	No Change	No Change	No Change	No Change
Produced water management:	Produced water to be reinjected to enhance oil recovery	No Change	No Change	No Change	No Change	No Change
Offloading of oil:	Oil processed on TLP and transferred to FSO, then transferred to a Dynamically Positioned (DP) Offshore Loading Shuttle Tanker (OLST)	Oil processed and stored on FPSO and then transferred to a DP OLST or Conventional Trading Tanker (CTT)	Oil processed and stored on FPSO and then transferred to DP OLST.	No Change	Oil processed and stored on FPSO and then transferred to CTT	No Change
Oil export:	A number of oil export options were under consideration but the preferred route was not defined	Still under consideration. Options were: Inshore Transfer in Berkeley Sound from a DP OLST to a CTT, or direct offtake to CTT from FPSO at the Sea Lion Field	Inshore Transfer in Berkeley Sound from a DP OLST to a CTT	No Change	Direct offtake from FPSO to CTT at Sea Lion Field location	No Change
Field Life:	25 years	20 years	20 years	20 years	20 years	30 years

[1] Informal consultations on the (then) Phase 1 Development as proposed by POEPL.
[2] Statutory and public consultation on the formally submitted EIS (Rev B03) describing the (then) Phase 1 Development as proposed by POEPL.
[3] Statutory and public consultation on the submitted, and revised, EIS (Rev B04) describing the (then) Phase 1 Development as proposed by POEPL.
[4] Informal consultation on the current proposed Phase 1 & 2 Sea Lion Development as optimised under Navitas (previously POEPL).

6.1.1 Relevant Guidance

The informal scoping consultation process is guided by:

- FIG Guidance:
  - The Executive Council (ExCo) 'Falkland Islands Hydrocarbon Development Policy Statement, 158/13', 2013 (Section 3.1.6.2),
  - The FIG Hydrocarbons EIA Guidance Note (2016e), and
  - Schedule 4 of the FIG Offshore Minerals Ordinance 1994 (as amended) which outlines the required contents of an EIS (Section 3.1.7.3.1). See also Appendix 2.

6.1.2 Informal scoping Consultation Process

The informal scoping consultations typically included:

- Development and distribution of a pre-read document,
- A presentation by the operator on the scope of the Development,
- Detail on the key aspects of the project,
- Detail on the oil export activities and the associated oil spill response strategy,
- Detail on the onshore and at-shore activities,
- A summary of the EIA / EIS process, and
- An open Q&A discussion where all comments and queries were recorded anonymously for inclusion in this chapter (see Section 6.4).

6.1.3 Key Stakeholders and interested parties

The relevant interested parties and statutory bodies are identified are listed in Table 6.2.

Table 6.2: Statutory stakeholders and Interested Parties consulted during scoping

Interested party	General purpose	When consulted					
		2014[1]	2015[1]	2016[1]	2018[2]	2020[2]	2023[3]
Department of Mineral Resources (DMR) (FIG)	The regulatory body charged with oversight of the offshore O&G industry and any onshore mining or mineral exploration. Core responsibilities include the role of licensing authority, offshore health and safety enforcement, and offshore environmental approvals (FIG, 2023e).	✓	✓	✓	✓	✓	✓
Public Works Department (PWD) (FIG)	Responsible for Government construction projects in the Falkland Islands, including house building and maintenance as well as larger infrastructure projects such as, road maintenance, power and freshwater.	✓	✓	✓	✓	✓	✓
Policy Unit and Environmental Planning Department[4]	Provides economic, environmental planning and policy advice to Elected Members, the Central Management Team and FIG Departments. It also assists in the development of specific environmental economic and social programmes, working across Government and the community to support the attainment of the goals of the Falkland Islands Plan (FIG, 2023f).	✓	✓	✓	✓	✓	

Interested party	General purpose	When consulted					
		2014[1]	2015[1]	2016[1]	2018[2]	2020[2]	2023[3]
FIG Harbour Master /Falkland Islands Maritime Authority (FIMA)	Marine Officer for the Falkland Islands and Harbour Master for Port Stanley[5]. Responsible for policy development, operational tasks and regulatory functions applicable to Falkland maritime, harbour, port operation and fishery issues.		✓	✓	✓	✓	✓
Ministry of Defence (MoD)[6]	A military presence is based in the Falklands to demonstrate the UK Government's continued commitment to the security of UK Overseas Territories in the South Atlantic. They include air defence assets, maritime patrol capability and infantry forces (UK Gov, 2015).	See note[6]					
Falkland Islands Fisheries Department (FIFD), Department[7] of Natural Resources (DNR) (FIG)	Responsible for the sustainable management of the fisheries within the Falkland Islands conservation zones (FIG, 2023d).	✓	✓	✓	✓	✓	
Members of the Legislative Assembly (MLAs)	Elected members of the legislative assembly, who are empowered to pass legislation for the peace, order and good government of the Falkland Islands. All members are elected as independents (FIG, 2023a).			✓	✓	✓	
Rural Business Association	The Rural Business Association represents Camp-based business interests in discussions with the Government and other stakeholders and provides a focal point for communication with the rural community.	✓		✓	✓	✓	
Falklands Conservation (FC)	A non-governmental organisation working to protect all the wildlife of the Falkland Islands for future generations (FC, 2015).	✓		✓	✓	✓	
RSPB	The Royal Society for the Protection of Birds is a charitable organisation based in the UK, working with BirdLife and FC.			✓	✓	✓	
Wildlife Conservation Society	A US based conservation charity that owns the Jason Islands NW of West Falkland.	✓			✓	✓	
Falkland Islands Civil Aviation Department (FICAD)[6]	Responsible for overseeing aviation activity in the Falkland Islands to ensure compliance with international and British Overseas Territory legislation (FIG, 2023i). The work of FICAD provides assurance that: The aviation industry meets the highest safety standards, and There are improvements in airlines and airports' environmental performance	See note[6]					

Interested party	General purpose	When consulted					
		2014[1]	2015[1]	2016[1]	2018[2]	2020[2]	2023[3]
Agriculture (including Biosecurity Officer) (DoA), Department[7] of Natural Resources (DNR) (FIG)	The department engages in sheep improvement work, support for meat export and support to farmers to run their farms as profitable businesses. It seeks to foster a viable and internationally competitive agricultural industry through integrated applied research, extension, business skill development and regulatory programmes. The Department also provides veterinary, quarantine and agricultural laboratory services, FIG (2023g).	✓			✓	✓	
Falkland Islands Fishing Company Association (FIFCA)	The Association represents the interests of all holders of fisheries quota under the Falklands Individual Transferable Quota System. It works with members to ensure industry views are presented to FIG in areas of interest to the fishing industry, participates in a number of Government and non-Government committees and jointly funds and provides resources for the advancement of knowledge regarding the fishery including its biological, operational, environmental and economic aspects (FIFCA, 2023).	✓		✓	✓	✓	✓
Falkland Islands Tourist Board (FITB)	Constitutionally a 'Company Limited by Guarantee' responsible for the strategic development of the tourism industry in the Falklands and the marketing of the Islands' tourism product (FIG, 2023h).	✓		✓	✓	✓	
Chamber of Commerce	The Chamber of Commerce is the Falkland Islands leading private sector, member focused business organisation. The Chamber is a key player in the Falkland Islands for lobbying, service provision and setting the business and economic agenda (FICoC, 2023).	✓		✓	✓	✓	
South Atlantic Environmental Research Institute (SAERI)	An academic organisation conducting research in the South Atlantic from the tropics down to the ice in Antarctica. SAERI's remit includes the natural and physical sciences. It aims to conduct world class research, teach students, and build capacity within and between the South Atlantic Overseas Territories (SAERI, 2015)	✓		✓	✓	✓	
Shallow Marine Surveys Group (SMSG)	A group of marine scientists, dive enthusiasts, and volunteers conducting research through diving and exploration in the South Atlantic (SMSG, 2016)	✓		✓	✓	✓	

Interested party	General purpose	When consulted					
		2014[1]	2015[1]	2016[1]	2018[2]	2020[2]	2023[3]
Agreement for Conservation of Albatross and Petrels (ACAP) Co-ordinator (Joint Nature Conservation Committee) (JNCC)	Falklands based co-ordinator working to implement the plan for the Agreement on the Conservation of Albatrosses and Petrels	✓		✓	✓	✓	
DESNZ (UK) (previously DBEIS (Department for Business Energy and Industrial Strategy)	UK Department for Energy Security and Net Zero, which manages O&G applications and permits in the North Sea	✓			✓	✓	
HSEx (UK)	UK Health and Safety Executive with responsibility for offshore O&G operations	✓		✓		✓	
Berkeley Sound farm owners	Stakeholders who own or manage land directly adjacent to Berkeley Sound and whose rights and interests may not be represented during statutory consultations			✓		✓	
General public / private companies	Wider stakeholders whose rights and interests may not be represented during statutory consultations.	✓		✓	✓	✓	✓

[1] Informal scoping consultation carried out on the (then) Phase 1 Development proposed by POEPL.
[2] Statutory consultations carried out on the EIS as submitted by POEPL.
[3] Informal scoping consultation on the current proposed basis of design under Navitas.
[4] Now known as the Policy Department and the Environment Department which both sit within the new Directorate of Policy, Economy and Corporate Services (as at 2023).
[5] Note that when scoping was undertaken the 'Marine Officer/Harbour Master' was a role which is now all included under FIMA.
[6] The MoD and FICAD are important stakeholders and were consulted *via* separate face to face meetings. As MoD and FICAD concerns are generally logistical, as opposed to environmental, they were not consulted as part of the EIA scoping consultations.
[7] Now known as the Directorate of Natural Resources (as at 2023).

6.2 Historical scoping and statutory consultations

Consultations on the (then) Phase 1 Development were carried out under POEPL (now Navitas) as follows[23]:

- Informal scoping consultation in 2014 on the proposed Sea Lion Development with production from 33 wells using a TLP:
  - This initial consultation included the public, interest groups and other consultees (Genesis, 2014).
- Informal scoping consultation in 2015 on the offshore component of the (then) Sea Lion Phase 1 Development with oil production *via* 18 wells using an FPSO:
  - This consultation included the FIG Departments only, as described below.
- Informal scoping consultation in 2016 on the whole (then) Phase 1 Development (including the offshore, onshore, at-shore and the inshore oil export components):

[23] Although not relating to the (then) Phase 1 Development, POEPL (now Navitas) also carried out consultations prior to the 2015 exploration drilling campaign covering the drilling operation and associated activities. The information gathered during this consultation contributed to the overall scoping boundaries for the subsequent (then) Phase 1 Development scoping exercises.

  - This consultation included all interested parties including the general public.
- Statutory public consultation in 2018 on the (then) Phase 1 Development EIS revision B01. **Note:** at this time the selected oil export option was inshore ship-to-ship transfer which was intended to occur in Berkeley Sound. Rev B02 was then issued with detail on the outcomes of the consultation and the operator responses included. Rev B03 was issued in 2019 and provided updated information requested by FIG ExCo as a condition to EIS acceptance, and included an Environmental Monitoring and Management Plan.
- Second statutory public consultation in 2020 on the (then) Phase 1 Development EIS revision B04. **Note:** this second formal consultation was carried out as the basis of design had changed from inshore ship-to-ship transfer oil export option to direct offtake to a CTT at the Sea Lion location offshore and POEPL had made some optimisations to the Field Layout and altered the size of FPSO storage.

6.2.1 Informal scoping consultation in 2014

The informal consultation in 2014 included all interested parties, as listed in Table 6.2 above, and was carried out via:

- Organised meetings with FIG Departments - feedback was received following a presentation describing the TLP Development, and
- Open public meetings and workshops.

A summary of the key outcomes is provided in Section 6.4 below.

6.2.2 Informal scoping consultation in 2015

While representations from the 2014 public consultation on the full field TLP Development remained relevant and were carried forward, it was considered necessary to carry out a secondary informal consultation following the adjustment of the Development to 18 wells and an FPSO (Table 6.2 above).

However, given that the public had already been consulted on the offshore component when the Field was to be produced using 33 wells and a TLP, the second consultation included FIG Departments only. This decision was based on:

- The interests of avoiding stakeholder fatigue given that numerous other consultations had been carried out for the previous exploration campaigns by POEPL (now Navitas) and other operators,
- Recognition that POEPL (now Navitas) had not yet decided upon the oil export process which was likely to be the subject of most interest, and
- The fact that the opportunity to comment on the whole development would be provided in 2016.

The 2015 scoping consultation with FIG Departments was conducted *via* an informal workshop. This aimed to provide an opportunity for stakeholders to raise any issues given the changes to the offshore component of the project.

6.2.2.1 Informal Scoping Workshop

The consultation with the consultees was carried out in a scoping workshop on the 24th November 2015, in the POEPL (now Navitas) Office, Argos House, Stanley, Falkland Islands.

A basic pre-read document describing the revised offshore development was issued to workshop participants and used in the workshop to identify potential environmental impacts associated with the offshore development.

Workshop participants representing FIG were as follows:

- Department of Mineral Resources (DMR),
- Department[24] of Natural Resources (DNR),
- Environmental Planning Department (EPD)[25],
- Policy Unit[26], and
- Public Works Department (PWD).

The main objectives of the workshop were to:

- Provide consultees with an update on the proposed offshore development,
- Inform consultees of the EIS delivery timeline,
- Provide consultees with an indication of the current EIA scope and content in order to determine:
  - Whether this was in keeping with their expectations with regard to Schedule 4 of the Minerals Ordinance (Section 3.1.7.3.1 and Appendix 2), and
  - What could be considered 'in-scope' and 'out-of-scope' in the EIA in order to comply with the Ordinance.
- Identify potential environmental impacts and risks of concern to the consultees to ensure these are included within the EIS, where appropriate.

6.2.2.1.1 Determination of EIA scope

With regard to meeting the requirements of the Ordinance, it was demonstrated that the EIA methodology (Chapter 8) provides for the assessment of the 'sensitivity of', and 'severity of effect on', all the environmental components listed in Clause 4 (2). However, clarity was sought from the consultees on whether or not SAERI's interpretation of 'Human Population' and 'Tangible Property' was appropriate with regard to the inclusion of social impacts and risks.

The FIG Hydrocarbons Environmental Impact Assessment Guidance Note 2016 (FIG, 2016e) lists the following impacts as unlikely to be relevant within the scope of an EIS:

- Tax revenues,
- Wages / cost of living,
- Threats and opportunities for local businesses,
- Land value / rents, and
- Availability of housing and services / facilities (e.g., hospital and school capacity).

Therefore, with regard to the 'Human Population' and 'Tangible Property' components listed in Clause 4 (2) of the Ordinance, SAERI proposed assessment of the following:

- Human Population:
  - Competition for resources including:
    - Accommodation,
    - Fuel,
    - Freshwater,

[24] Now known as the Directorate of Natural Resources (as at 2023).
[25] Now known as the Environment Department which sits within the new Directorate of Policy, Economy and Corporate Services (as at 2023).
[26] Now known as the Policy Department which sits within the new Directorate of Policy, Economy and Corporate Services (as at 2023).

        - Food,
        - Landfill sites,
        - Port facilities (Stanley Harbour, FIPASS, TDF),
        - Electricity,
        - Sewage facilities, and
        - Space on MoD Airbridge flights.
    - Disruption to other users of the sea:
        - Impact from presence of other vessels,
        - Risk of collision between boats, and
        - Risk of snagging by trawlers.
    - Disturbance to the human population from:
        - Light,
        - Noise,
        - Odour,
        - Visual impact, and
        - Changes to air quality.
- Tangible Property:
    - Port facilities,
    - Fishing industry,
    - Road networks,
    - Airports and airlinks,
    - Waste facilities,
    - Tourism facilities, and
    - Protected sites supporting wildlife and managed tourism.

Therefore, in terms of what is considered 'in-scope' and 'out-of-scope', it was agreed that social impacts, such as those listed above were in-scope, and economic issues e.g., impacts upon revenue and house prices etc. were out-of-scope based on interpretation of the Ordinance and the FIG EIA Guidance Note (FIG, 2016e). In light of this agreement, disruption to other users of the community, with regard to impacts on health services, police services, civic amenities etc. was also considered out-of-scope.

Importantly however, while the EIS was not considered to be the appropriate vehicle for assessing and reporting these issues, the need for awareness, assessment, reporting and mitigation of economic impacts and risks was noted by all at the workshop. As described in Section 6.2.2.1.1, an additional and separate socio-economic impact assessment will be developed.

6.2.3 Informal scoping consultation in 2016

By 2016, inshore ship-to-ship transfer had been selected as the oil export option (Table 6.1 above). Scoping consultations for the whole (then) Phase 1 Development were held between the 15th and 26th August 2016 and were carried out via:

- Workshops / meetings with:
    - FIG departments: DMR, EPD[ibid], PWD, DNR, Policy Unit[ibid] and Harbour Master[27],

[27] The Harbour Master function now sits within the Falkland Islands Maritime Authority (FIMA).

- Members of the Legislative Assembly (MLAs),
- Chamber of Commerce members and Tourist Board,
- Fishing Company representatives (FIFCA) and Fisheries Department (FIFD),
- Falklands Conservation,
- Environmental NGOs including: Shallow Marine Surveys Group and ACAP Co-ordinator (JNCC),
- Other Groups: SAERI and the Offshore Hydrocarbon Environmental Forum (OHEF),
- Public in Stanley, and Camp (Hill Cove, Fox Bay, Goose Green and Lorenzo), and
- Berkeley Sound residents and landowners.

A summary of the key outcomes is provided in Section 6.4 below.

6.2.3.1 Consultation format

During the scoping, statutory stakeholders and interested parties were invited to:

- 'By invitation' sessions which included a presentation by POEPL (now Navitas) on the scope of the project identified to date, followed by a Q&A session,
- Open sessions which were held for all stakeholders, including the public at various locations, both in Stanley and in Camp (both East and West Falkland). This again consisted of a presentation followed by open Q&A sessions, and
- Individual consultations which were offered to landowners and managers whose land is directly adjacent to Berkeley Sound.

Additionally, drop-in sessions were offered to all public, statutory stakeholders and NGO's e.g., RSPB. A follow up session was offered to the fisheries groups (FIFD and FIFCA), which was taken up by FIFCA.

A revised project Pre-Read was distributed to the stakeholders, made available at the sessions and emailed or posted to them directly on request. Notice of the 'Sea Lion EIA Scoping Consultation Sessions' were advertised in the Penguin News along with a dedicated consultation contact number and an email address for queries and comments.

6.2.3.1.1 Commitments resulting from the 2016 scoping

As a result of discussions during the scoping consultation, POEPL (now Navitas) committed to:

- Produce a Socio-economic Impact Assessment (SIA) for consideration by FIG (although it was agreed this EIA / EIS was not an appropriate vehicle for this assessment (Section 6.2.2.1.1)). POEPL (now Navitas) will produce an additional and separate socio-economic impact assessment building on and updating the previous work undertaken for FIG and Rockhopper by Regeneris (2013 & 2015) and Plexus Energy (2012),
- Continued discussions with DMR on offsetting,
- Conducting further work on the effect of Sea Lion crude on fur and feathers, weathering and persistence effects and toxicity. This was planned both pre- and post-submission of the EIS,
- Holding an Environmental Monitoring and Management Programme (EMMP) workshop to determine scope, protocols, methodology, reporting and governance (Chapter 15),
- Holding a Wildlife Response Workshop to determine scope, protocols, methodology, reporting and governance which could further inform the Wildlife Response Plan. This was incorporated into a wider 'Oil Spill on Paper' Workshop held in June 2017 (Premier, 2017e), and

- Sharing the outcomes of the ongoing waste assessment with interested parties (e.g., FIG departments).

6.2.4 Statutory 42-day public consultation in 2018

During 2018, the statutory consultation in support of the revised EIS (Rev B03), was held between 10th January and 9th March. At this time the proposed oil export process involved the inshore ship-to-ship transfer. The public consultation process included face to face briefings to FIG departments, NGOs, the general public and other materials including:

- Project flyers,
- Advertisements placed in Penguin News,
- Posters,
- Maps,
- Computer models of reservoir (subsurface),
- Video (drone footage), sound files and animations,
- Samples of crude and drill cuttings, and
- Radio and TV Interviews.

The range of Consultees included:

- Statutory stakeholders: MLAs, DMR, EPD[ibid], PWD, DNR, Policy Unit[ibid],
- Industry Reps: CoC, FIFCA, RBA, Tourist Board, FIDC, Museum / NT,
- NGO's: FC, SMSG, New Island Trust, ACAP (JNCC),
- Others: FIOHEF, SAERI, Berkeley Sound farm owners, and
- The general public.

Following completion of the formal consultation period on the 9th March 2018, the EIS was finalised. On the 10th April 2018, POEPL (now Navitas) submitted responses to *c.* 300 points raised by 11 parties (Appendix 3).

Key points raised during the consultation phase included the following aspects:

- Reinforcement of the importance of progressing the evaluation / decisions on a direct offtake oil export option (as opposed to the proposed inshore transfer),
- Querying the (contingency) well test flaring volumes,
- Requesting an update the underwater noise assessment as new standards had recently been issued,
- Including an air quality assessment for oil spills,
- Management of artificial light and potential for bird strike,
- How the EMMP will operate,
- Coverage of baseline survey data,
- Interpretation of oil spill impact,
- Additional scientific papers to be included, and
- How social impacts will be addressed (via separate studies - the EIS was compliant).

Overall, a total of 270 representations required a detailed and thoughtful response (Appendix 3).

The additional underwater noise assessment continued past the end of the consultation period and was submitted to FIG at the end of May 2018.

The outcomes of the 2018 statutory consultation were reported in the approved EIS (Rev B03) alongside responses from POEPL. For completeness, these are now presented in Appendix 3.

6.2.4.1.1 Commitments resulting from the 2018 formal consultation.

As a result of discussions during the 2018 consultation, POEPL (now Navitas) committed to:

- Update the project Socio-economic Impact Assessment (SIA),
- Respond to matters raised during Bank Due Diligence,
- Hold an EMMP workshop to determine scope, protocols, methodology, reporting and governance (already committed to in 2016),
- Complete seasonal Berkeley Sound Bird Surveys,
- Complete the ongoing Invasive Species Monitoring Programme, and
- Review and update the project PLANC (Permits, Licences, Authorisations, Notifications and Consents) Registers.

6.2.5 Statutory 42-day public consultation in 2020

During 2019, the oil export process was revised and changed from inshore ship-to-ship transfer in Berkeley Sound to direct offtake from the FPSO to a CTT at the Sea Lion location offshore. As this was a material change, the EIS was resubmitted (Rev B04) and underwent a second statutory consultation period, as required under the Ordinance. This consultation period ran from 2nd January 2020 to 25th February 2020 and followed a similar format to the 2018 consultation described above.

The outcomes of the statutory consultation were reported in the approved EIS (Rev B05) alongside responses from POEPL. For completeness, these are now presented in Appendix 3.

6.3 Navitas informal scoping consultation 2023

Following the acquisition and renaming of POEPL by Navitas in 2022 (Section 2.1.1), the Sea Lion Development underwent a process of review and optimisation which led to a number of changes. As such, it is necessary to undertake an impact assessment reflecting the changes to the project and submit a new EIS. While the proposed "Sea Lion Field Northern Development Area, Phase 1 & 2" is largely smaller than the previous POEPL Phase 1 Development (EIS Rev B05 approved in 2020), it was also necessary to conduct a further scoping consultation to inform stakeholders of the changes to the project, the impacts and risks identified and explore any particular concerns.

This informal scoping consultation was carried out between 4th - 8th December 2023. As in the previous consultations, a Pre-Read document was developed and disseminated to FIG and industry bodies prior to meetings, and to other stakeholders on request.

The informal consultation in 2023 included the interested parties as indicated Table 6.2 above, and was carried out via:

- Organised meetings with FIG Departments - feedback was received following a presentation describing the optimised Development, and
- Presentations with Q&A sessions at open public meetings and focus- group workshops.

Details on the key outcomes are summarised in Section 6.4

6.4 Summary of all informal scoping consultation outcomes

Table 6.3 provides a summary of the key themes that were raised by the consultees during the historical and recent informal scoping consultation processes. An indication of the number of times that the theme was raised, and guidance on where in the EIA the comment has been addressed is

provided. For the socio-economic and economic issues that are out-with the scope of the EIA (see above), reference is made to the relevant documentation.

Of note, Table 6.3 does not include the representations of the historical 42-day *statutory* consultations which, by design, included very detailed and technical questions. Full detail on the historical representations, and the operator responses, are provided in Appendix 3.

The number of consultees met during each *informal* consultation is as follows:

- 2014 - Exploration programme: 63 stakeholders met,
- 2014 – TLP proposal: 124 stakeholders met,
- 2015 – Change from TLP to FPSO: with FIG Departments only - 10 stakeholders met,
- 2016 - All components of current EIS: 130 stakeholders met, and
- 2023 - All components of the optimised Sea Lion Development: 38 stakeholders met.

The key themes highlighted by stakeholders over time were:

- Control of vessels and general management in Berkeley Sound,
- Oil spill mitigations and clean-up,
- Onshore infrastructure,
- Offsetting,
- Decommissioning,
- The impact of this particular type of crude,
- Jobs, employment and numbers of people,
- Standards and governance, and
- The use of MMOs on vessels near and on the Sea Lion field prior to the current EIA to update data on marine mammal and seabird distribution.

Table 6.3: Summary of informal scoping consultation outcomes from 2014, 2015, 2016 and 2023 consultations[1]

Consultation	Theme	Concern / comment	2014	2015	2016	2023	Number of mentions[2]	Pos / Neg[3]	Addressed
2014, 2015 & 2016	Social	The carrying capacity of existing onshore infrastructure	✓	✓	✓		11	Neg	**Section 11.3 Section 11.4 Section 11.5 Section 11.6 Section 11.7**
2014, 2015 & 2016	Social / Environmental	Competition for resources e.g., waste facilities, food, water, power supply, health services, schools, aggregates and rental accommodation	✓	✓	✓		10	Neg	
2014, 2015 & 2016	Environmental	Risk of oil spills	✓	✓	✓		10	Neg	**Chapter 12**
2014, 2015 & 2016 & 2023	Socioeconomic	Local content and employment related challenges, including wage inflation, labour shortages and immigration	✓	✓	✓	✓	11	Neg	**SIA (Section 6.2.2.1.1)**
2014, 2015 & 2016	Economic	Inflation e.g., impacts on food prices and availability, and rising costs for housing	✓	✓	✓		10	Neg	**SIA (Section 6.2.2.1.1)**
2014, 2015 & 2016	Environmental	Mitigation measures and offsetting	✓	✓	✓		9	Neg	Base-case, industry standard and project-specific measures are described in **Chapters 10, 11** and **12.** The offsetting strategy is described in **Section 8.11**
2014, 2015 & 2016 & 2023	Social / Environmental	Competition between sea users, in particular management of Berkeley Sound and exclusion zones, and risk of collision	✓	✓	✓	✓	9	Neg	**Section 11.1 Section 11.2**
2014, 2015 & 2016 & 2023	Social / Environmental	Falklands services may improve, e.g., waste management, flight routes, shipping routes and medevac	✓	✓	✓	✓	9	Pos	**Chapters 10** and **11**

Consultation	Theme	Concern / comment	2014	2015	2016	2023	Number of mentions[2]	Pos / Neg[3]	Addressed
2014 & 2016	Environmental	Standards applied by POEPL and extent of liability, particularly in relation to the CTT	✓		✓		7	Neg	**Section 3.2**
2014, 2015 & 2016 &2023	Socioeconomic	Other general community benefits will be made possible by economy of scale as the population grows, increased investment in the Falkland Islands	✓	✓	✓	✓	8	Pos	**SIA (Section 6.2.2.1.1)**
2014, 2015 & 2016	Environmental	Waste generation and management in the Falkland Islands and offshore	✓	✓	✓		6	Neg	**Section 10.10**
2014 & 2016 & 2023	Environmental	Lack of sufficient environmental data in some fields making effective assessment of impacts difficult	✓		✓	✓	7	Neg	**Section 7.2.4**
2015 & 2016	Environmental	Emissions and discharges	✓		✓		6	Neg	**Section 5.15** **Section 10.7** **Section 10.9**
2014, 2015 & 2016	Environmental	Increased light pollution with particular impact on sensitive bird species both inshore and offshore, and risk of bird strike but also as a nuisance to humans	✓	✓	✓		5	Neg	**Section 10.1** **Section 11.8**
2014, 2015 & 2016 and 2023	Socioeconomic	Job opportunities and training	✓	✓	✓	✓	6	Pos	**SIA (Section 6.2.2.1.1)**
2014 & 2016	Environmental	Disturbance to fisheries spawning grounds and migration routes	✓		✓		4	Neg	**Section 7.4.4**
2014 & 2016	Political	FIG decision and policy making perceived as reactive rather than proactive	✓		✓		4	Neg	Out of scope **(Section 6.2.2.1.1)**

Consultation	Theme	Concern / comment	2014	2015	2016	2023	Number of mentions[2]	Pos / Neg[3]	Addressed
2016	Environmental	Vessel Traffic Management System (VTMS) in Berkeley Sound would benefit everyone[4]			✓		3	Pos	N/A[4]
2014 & 2015	Environmental	Introduction of non-native species and biosecurity issues	✓	✓			3	Neg	**Section 10.12 Section 10.13**
2014, 2015 & 2016	Social / Environmental	Noise pollution affecting sensitive receptors including humans	✓	✓	✓		3	Neg	**Section 11.9**
2014 & 2016	Social / Environmental	Conversion of Stanley Common and impacts on aesthetics, visual impact	✓		✓		3	Neg	**SIA (Section 6.2.2.1.1)**
2014, 2015 & 2016	Social	Effects on the 'Falkland Islands way of life' including increased marginalisation of Camp, the potential for increased social disturbance, crime and prostitution	✓	✓	✓		3	Neg	**SIA (Section 6.2.2.1.1)**
2014	Political	Security issues related to the sovereignty dispute with Argentina	✓				1	Neg	Out of scope **(Section 6.2.2.1.1)**

[1] **Note:** the formal outcomes of the statutory consultations carried out in 2018 and 2020 are not included in this table. All representations are provided in Appendix 3.
[2] The 'Number of mentions' refers to the number of times an issue was raised by a group of consultees, as opposed to the number of individuals who raised it.
[3] Denotes whether the majority of comments received on this topic were considered positive or negative.
[4] Note that inshore transfer is no longer included within the basis of design.

6.5 Navitas statutory 42-day public consultation

Following review by FIG DMR, and confirmation by the Executive Council that the EIS complied with the Schedule 4 of the FIG Offshore Minerals Ordinance, the EIS was formally submitted and underwent formal consultation in July - August 2023.

Following the 42-day consultation, all material representations were provided to Navitas by DMR and recorded within this EIS (Chapter 0). This chapter also contains Navitas' responses and, where necessary, indicates what changes have been made to this post-consultation EIA / EIS in response to the representations made.

7 ENVIRONMENTAL AND SOCIAL BASELINE

Table of Contents

7.1 Introduction 256
7.1.1 Falkland Islands location 256
7.1.2 Sea Lion (offshore) licence location 256
7.1.3 Location of Berkeley Sound in the Falkland Islands 258
7.2 Data Sources 259
7.2.1 Literature sources 259
7.2.2 Sea Lion environmental surveys 259
7.2.3 Berkeley Sound environmental surveys 264
7.2.3.1 Shallow Marine Surveys Group (SMSG) 264
7.2.3.2 Marine Spatial Planning (MSP) 264
7.2.3.3 Operator commissioned environmental surveys 264
7.2.3.3.1 Habitat assessments of Berkeley Sound 264
7.2.3.3.2 Geophysical and environmental surveys. 264
7.2.3.3.3 Coastal bird survey 265
7.2.3.4 Third-party surveys 265
7.2.4 Data gaps 265
7.2.4.1 Key data gaps relevant to Sea Lion EIA 266
7.2.4.2 Gap Analysis Programme (GAP) 267
7.2.4.2.1 Seabird and marine mammal telemetry 267
7.2.4.2.2 Consolidation and curation of existing data 267
7.3 Physical Environment 267
7.3.1 Global atmosphere 268
7.3.1.1 Atmospheric structure 268
7.3.1.2 Atmospheric composition 269
7.3.2 Meteorology of the Falkland Islands 270
7.3.2.1 General conditions in the Falkland Islands 270
7.3.2.1.1 Wind speed 270
7.3.2.1.2 Temperature 270
7.3.2.1.3 Precipitation 270
7.3.2.1.4 Visibility 270
7.3.2.2 Inshore (east coast) metocean conditions 270
7.3.2.2.1 Wind speed and direction recorded at MPN 271
7.3.2.2.2 Temperature recorded at MPN 272
7.3.2.2.3 Precipitation recorded at MPN 273
7.3.3 Oceanography of the region 273
7.3.3.1 Main oceanographic features on the Patagonian Shelf 274
7.3.3.2 Oceanographic features on the Falkland Islands Shelf 274
7.3.3.3 Oceanographic features in the region of the Sea Lion Field 276
7.3.3.4 Oceanography in Berkeley Sound 277
7.3.4 Bathymetry 278
7.3.4.1 NFB and the Sea Lion Field bathymetry 278
7.3.4.2 Berkeley Sound bathymetry 279

7.3.5 Metocean data used in modelling 282
7.3.5.1 Ocean currents data 282
7.3.5.1.1 NEMO PS4 data set 283
7.3.5.1.2 TUFLOW FV coastal data sets 284
7.3.5.2 Current speed and direction at Sea Lion 285
7.3.5.3 Wind data 286
7.3.5.3.1 WRF wind data 287
7.3.5.3.2 CFSR wind data 288
7.3.5.3.3 Wind speed and direction at Sea Lion 289
7.3.5.4 Bathymetry data 289
7.3.6 Geology and subsurface description 290
7.3.6.1 NFB and Sea Lion Field geology 290
7.3.6.2 Berkeley Sound geology 291
7.3.7 Sediment characteristics 291
7.3.7.1 NFB and Sea Lion Field sediments 291
7.3.7.1.1 Sediment type 291
7.3.7.1.1.1 Grain / Particle size 291
7.3.7.1.1.2 Total Organic Matter and Total Organic Carbon 292
7.3.7.1.2 Sediment chemistry 293
7.3.7.1.2.1 Sediment hydrocarbons 293
7.3.7.2 Berkeley Sound sediments 294
7.3.7.2.1 Sediment type 295
7.3.7.2.1.1 Grain / Particle size 295
7.3.7.2.1.2 Total Organic Matter and Total Organic Carbon 298
7.3.7.2.2 Sediment chemistry 299
7.3.7.2.2.1 Sediment hydrocarbons 299
7.3.7.2.2.2 Heavy and trace metal concentrations 302
7.3.8 Summary of physical environment 303
7.4 Biological Environment 307
7.4.1 Plankton 307
7.4.1.1 Introduction 307
7.4.1.2 Phytoplankton 307
7.4.1.2.1 Offshore phytoplankton 307
7.4.1.2.2 Inshore phytoplankton and Harmful Algal Blooms 308
7.4.1.3 Zooplankton 309
7.4.1.3.1 Offshore zooplankton 309
7.4.1.3.2 Inshore zooplankton 309
7.4.1.3.2.1 Lobster krill (*Grimothea* spp.) 310
7.4.2 Marine and intertidal vegetation 310
7.4.2.1 Introduction 310
7.4.2.2 Seaweeds and algae of the inshore environment 310
7.4.2.2.1 Brown algae (Phylum: Phaeophyta) 311
7.4.2.2.1.1 Giant kelp (*Macrocystis pyrifera*) 311
7.4.2.2.1.2 Tree kelp (*Lessonia* spp.) 312
7.4.2.2.1.3 Bull kelp (*Durvillaea antarctica*) 312

7.4.2.2.2 Green algae (Phylum: Chlorophyta) 313
7.4.2.2.3 Red algae (Phylum: Rhodophyta) 313
7.4.2.3 Mapping of kelp beds 313
7.4.3 Benthic environment 315
7.4.3.1 Introduction 315
7.4.3.2 NFB and Sea Lion Field benthos 315
7.4.3.2.1 Offshore benthic flora and fauna 315
7.4.3.2.2 Offshore benthic habitat assessments 316
7.4.3.2.3 Deep water benthos predictive modeling 316
7.4.3.3 Berkeley Sound benthos 318
7.4.3.3.1 Berkeley Sound benthic flora and fauna 319
7.4.3.3.1.1 Inter-tidal and shallow marine benthos 319
7.4.3.3.1.2 Deeper water benthos 320
7.4.3.3.2 Inter-tidal and shallow marine habitat mapping and classification 322
7.4.3.3.2.1 Shallow marine surveys undertaken 322
7.4.3.3.2.2 Shallow marine habitat mapping 325
7.4.3.3.2.3 Inter-tidal habitat mapping 330
7.4.3.3.3 Deeper water (>10m) habitat mapping and classification 332
7.4.3.3.3.1 Rock face and cobbles 335
7.4.3.3.3.2 Mud 335
7.4.3.3.3.3 Sand 336
7.4.3.3.3.4 Kelp forest 336
7.4.3.3.3.5 Mussel beds 336
7.4.3.3.3.6 Other habitats 337
7.4.3.3.3.7 Anthropogenic habitat 337
7.4.3.3.4 Berkeley Sound environmentally sensitive habitats 338
7.4.3.3.4.1 Geogenic reefs 338
7.4.3.3.4.2 Biogenic reefs 338
7.4.3.3.4.3 Kelp forests 339
7.4.3.3.5 Marine non-native/invasive species 339
7.4.3.4 Marine flora and fauna in Stanley Harbour and surrounding areas 341
7.4.3.5 Summary of the offshore and inshore benthic environment 342
7.4.4 Fish and invertebrate ecology 344
7.4.4.1 Introduction 344
7.4.4.2 NFB and Sea Lion Field fish and invertebrate ecology 344
7.4.4.2.1 Patagonian Shelf habitats 344
7.4.4.2.1.1 Conservation and management zones 344
7.4.4.2.2 Seasonal abundances around the Falkland Islands 346
7.4.4.2.2.1 Seasonal abundances on the Northern Slope 346
7.4.4.2.2.2 Other commercial and non-commercial fish on the Northern Slope 346
7.4.4.2.3 Species-specific summary of fish characteristics 347
7.4.4.2.3.1 Sub-Antarctic fish and squid 347
7.4.4.2.3.2 Temperate fish and squid 349
7.4.4.2.4 Summary of offshore fish and invertebrate ecology 351
7.4.4.3 Berkeley Sound fish and invertebrate ecology 353

7.4.4.3.1 Fish species 353
7.4.4.3.1.1 Southern rock cod 353
7.4.4.3.1.2 Falklands' mullet 353
7.4.4.3.1.3 Smelt 354
7.4.4.3.1.4 Falklands sprat 354
7.4.4.3.2 Invertebrate species 354
7.4.4.3.2.1 Loligo (Patagonian long-finned squid (*Doryteuthis gahi*)) 354
7.4.4.3.2.2 Other commercially exploitable invertebrates 355
7.4.4.4 Fish and squid in Stanley Harbour and surrounding areas 356
7.4.4.5 Summary of inshore fish and invertebrate species 356
7.4.5 At sea surveys, seabird vulnerability and tracking 358
7.4.5.1 Introduction 358
7.4.5.2 Seabirds in the NFB and Sea Lion Field 358
7.4.5.2.1 Seabird abundance and distribution surveys and tracking 358
7.4.5.2.1.1 JNCC Seabirds At Sea Team (SAST) surveys 360
7.4.5.2.1.2 Seabird surveys from seismic vessels in NFB during 2011 363
7.4.5.2.1.3 Satellite tracking studies 364
7.4.5.2.1.4 GAP project overview and data availability 366
7.4.5.2.2 Species-specific distribution and abundance 374
7.4.5.2.3 Summary of offshore bird behavioural characteristics 385
7.4.5.3 Birdlife of Berkeley Sound 392
7.4.5.3.1 Seabird distribution and abundance surveys 392
7.4.5.3.1.1 Berkeley Sound coastal bird survey, summer 2016 392
7.4.5.3.1.2 Falklands Conservation annual monitoring programme 397
7.4.5.3.1.3 Bird distribution data gaps and limitations 400
7.4.5.3.2 Species-specific distribution and abundance 400
7.4.5.3.3 Summary of inshore bird characteristics 411
7.4.5.4 Birds in Stanley Harbour and surrounding areas 417
7.4.5.4.1 Falkland steamer duck 419
7.4.5.4.2 Kelp goose 419
7.4.5.4.3 Passerines 419
7.4.5.4.4 Waders 419
7.4.5.5 Seabird population and conservation status 419
7.4.5.5.1 Threats to seabirds 420
7.4.5.5.2 Agreement for the Conservation of Albatrosses and Petrels (ACAP) 422
7.4.5.6 Seabird vulnerability to oil spill 423
7.4.5.6.1 JNCC Oil Vulnerability Index (OVI) 424
7.4.5.6.1.1 AVS in the Sea Lion Field 424
7.4.5.6.1.2 AVS in Berkeley Sound 425
7.4.6 Marine Mammals 430
7.4.6.1 Introduction 430
7.4.6.1.1 Cetaceans 430
7.4.6.1.2 Pinnipeds 430
7.4.6.2 Marine mammals in the NFB and Sea Lion Field 431
7.4.6.2.1 Cetacean abundance and distribution surveys in the NFB and Sea Lion Field 431

7.4.6.2.1.1 Marine mammals recorded during JNCC SAST survey 431
7.4.6.2.1.2 Acoustic surveys of marine mammals in the Sea Lion Field 434
7.4.6.2.1.3 Marine mammal observations during seismic surveys in the NFB 438
7.4.6.2.1.4 Species-specific summary of cetacean distribution offshore 438
7.4.6.2.2 Pinniped abundance and distribution surveys in the NFB 444
7.4.6.2.2.1 Species-specific pinniped distribution and abundance in the NFB 444
7.4.6.2.3 Summary of cetaceans in the NFB 448
7.4.6.3 Marine mammals in and around Berkeley Sound 453
7.4.6.3.1 Cetacean surveys in and around Berkeley Sound 453
7.4.6.3.1.1 Cetaceans recorded during Berkeley Sound coastal bird surveys 453
7.4.6.3.1.2 Anecdotal inshore cetacean sightings 454
7.4.6.3.1.3 Falklands Conservation cetacean surveys in Berkeley Sound 456
7.4.6.3.1.4 Dolphins of the Kelp (DOKE) 462
7.4.6.3.1.5 Seal tracking studies 466
7.4.6.3.1.6 Cetaceans recorded during JNCC SAST survey 466
7.4.6.3.1.7 Species-specific summary of cetacean distribution inshore 468
7.4.6.3.2 Pinniped surveys in and around Berkeley Sound 472
7.4.6.3.2.1 Pinnipeds recorded during the 2016 and 2017 coastal survey 472
7.4.6.3.2.2 Pinnipeds recorded during JNCC SAST survey 472
7.4.6.3.2.3 Tracking Studies 472
7.4.6.3.2.4 Species-specific summary of pinniped distribution inshore 473
7.4.6.3.3 Summary of marine mammals in and around Berkeley Sound 474
7.4.6.4 Marine mammals in Stanley Harbour and surrounding areas 479
7.4.6.5 Terrestrial habitats surrounding Berkeley Sound 479
7.4.6.5.1 Terrestrial habitat mapping and classification 479
7.4.6.6 Environmental sensitive terrestrial habitats 482
7.5 Conservation Designations for sites, species and habitats 484
7.5.1 Protected species and sites 484
7.5.1.1 Benthic marine species 484
7.5.1.2 Fish species 484
7.5.1.3 Wild bird species 484
7.5.1.4 Marine mammals 484
7.5.1.5 Terrestrial plants species 488
7.5.2 Protected habitats 488
7.5.2.1 Terrestrial National Nature Reserves (NNR) 489
7.5.2.2 Marine Protected Areas (MPAs) / Marine Managed Areas (MMAs) 491
7.5.2.3 Scientific designations for globally important habitats and sites 493
7.5.2.3.1 Important Birds Areas (IBAs) 493
7.5.2.3.1.1 IBAs in Berkeley Sound 494
7.5.2.3.2 Important Plant Areas (IPAs) 496
7.5.2.3.3 Ramsar sites 496
7.5.2.3.4 Key Biodiversity Areas 496
7.5.2.3.5 Important Marine Mammal Areas (IMMAs) 497
7.5.2.4 Threatened terrestrial Habitats 498
7.5.3 Priority conservation species and habitats 498

7.6 Coastal Sensitivity to Oil Spills 499
7.6.1 Environmental Sensitivity Index (ESI) 499
7.6.2 Sensitivity of north Falklands coastline to offshore oil (crude/diesel) spills 500
7.6.2.1 Coastal sensitivity assessment outputs 501
7.6.2.1.1 Environmental sensitivity to offshore oil spill 502
7.6.2.1.2 Socio-economic sensitivity to offshore oil spill 502
7.6.2.1.3 Prioritisation and management of offshore oil spill response 503
7.6.3 Sensitivity of Berkeley Sound coastline to inshore oil (diesel) spills 504
7.7 Social Environment 506
7.7.1 Introduction 506
7.7.2 Human population 506
7.7.2.1 National identity 506
7.7.2.2 Population size and main settlements 507
7.7.2.3 Berkeley Sound residents 508
7.7.2.4 The Falkland Islands economy 509
7.7.3 Other users of the sea 510
7.7.3.1 Other users of the NFB 510
7.7.3.1.1 Fishing industry 510
7.7.3.1.1.1 Fisheries operating within vicinity of the Sea Lion Field 512
7.7.3.2 Other users of Berkeley Sound and the east coast 513
7.7.3.2.1 Fisheries 513
7.7.3.2.1.1 Fisheries operating in the approaches to Berkeley Sound 513
7.7.3.2.1.2 Fisheries related activity within Berkeley Sound 515
7.7.3.2.2 Tourism service providers and Berkeley Sound 516
7.7.3.2.3 Military uses of Berkeley Sound 516
7.7.3.2.4 Other vessels and uses of Berkeley Sound 516
7.7.3.2.5 Summary of vessel numbers and position in Berkeley Sound 517
7.7.4 Tangible property 518
7.7.4.1 Port facilities 518
7.7.4.1.1 Mare Harbour (East Cove Military Port) 518
7.7.4.1.2 Stanley Harbour – jetties and FIPASS 518
7.7.4.1.2.1 Temporary Dock Facility (TDF) 520
7.7.4.1.3 Port facilities in Berkeley Sound 520
7.7.4.1.4 Vessel visits 520
7.7.4.1.4.1 Fishing vessels 520
7.7.4.1.4.2 Fisheries Patrol Vessels (FPVs) 522
7.7.4.1.4.3 Cargo vessels 522
7.7.4.1.4.4 Cruise ships 522
7.7.4.1.4.5 Reefers 522
7.7.4.1.4.6 Tankers 522
7.7.4.1.4.7 Yachts 523
7.7.4.1.4.8 Royal Navy vessels 523
7.7.4.1.4.9 Research vessels 523
7.7.4.2 Road network 523

7.7.4.2.1 Roads supporting Berkeley Sound 525
7.7.4.3 Airport and air-links 525
7.7.4.3.1 Mount Pleasant International Airport 525
7.7.4.3.2 Stanley airport 527
7.7.4.4 Importers of supplies / goods to and from the Falkland Islands 527
7.7.4.4.1 Falkland Islands Resupply Service (FIRS) 527
7.7.4.4.2 South American Atlantic Service (SAAS) 527
7.7.4.4.3 Air freight 527
7.7.4.5 Existing resource infrastructure and use 527
7.7.4.5.1 Accommodation 527
7.7.4.5.1.1 Existing housing 527
7.7.4.5.1.2 Future developments and town planning 528
7.7.4.5.1.3 Hotels and guest houses 528
7.7.4.5.2 Fresh (potable) water supply 528
7.7.4.5.2.1 Freshwater required by Stanley 529
7.7.4.5.2.2 Freshwater available to Stanley 529
7.7.4.5.3 Non-potable process water 532
7.7.4.5.4 Fuel and bunkering 532
7.7.4.5.5 Electricity 532
7.7.4.5.5.1 Power required by Stanley 532
7.7.4.5.5.2 Power available in Stanley 535
7.7.4.5.5.3 Future power output 535
7.7.4.5.6 Waste management infrastructure – Landfill sites 535
7.7.4.6 Scenery, wildlife and tourism resources 536
7.7.4.6.1 Tourism in Berkeley Sound 537
7.7.4.6.2 Tourism service providers 537
7.7.4.7 Livestock and agricultural resources 537
7.7.4.8 Fisheries resources 538
7.7.5 Baseline noise, odour and light levels 538
7.7.5.1 Stanley 538
7.7.5.1.1 Noise 538
7.7.5.1.1.1 Conclusions from previous surveys 539
7.7.5.1.2 Odour 544
7.7.5.1.3 Light 544
7.7.5.2 Berkeley Sound 544
7.7.5.2.1 Noise 544
7.7.5.2.1.1 Long Island Farm - August 2016 544
7.7.5.2.1.2 Long Island Farm - February 2017 545
7.7.5.2.2 Odour 546
7.7.5.2.3 Light 546
7.7.6 Marine archaeology 546
7.7.6.1 Wrecks in the NFB and Sea Lion Field 546
7.7.6.2 Berkeley Sound 547
7.7.6.2.1 Wrecks 547
7.7.6.2.2 Anchor scars 548

7.7.6.2.3 Man-made objects 548
7.7.6.3 Aviation wrecks and UXO (Unexploded Ordinance) 549
7.8 Summary of Key Environmental and Social Sensitivities 550
7.8.1 Key environmental sensitivities 550
7.8.2 Key social sensitivities 553

7.1 Introduction

Having identified the proposed Sea Lion Field Northern Area Phase 1 & 2 Development (hereafter referred to as the Phase 1 & 2 Development) activities (Chapter 5), it is necessary to understand the local environments in which Navitas will be operating and to identify the main environmental and social sensitivities.

Understanding of the environmental baseline was achieved using desktop studies and literature reviews, collation of existing survey data and execution of additional and site-specific surveys where necessary, in line with:

- Navitas Operating Management System (SEL-REG-OPM-PLN-00001-00).

Given that the production and export of oil will be carried out offshore, and that all the Phase 1 & 2 Development activities will require support from the onshore, inshore (Berkeley Sound) and at-shore bases (Chapter 5), the following chapter describes the offshore, inshore and onshore environments. The limits of 'coastal' and 'inshore waters' are not specifically defined; however, in general 'coastal' is used to describe waters within three nautical miles (nm) of the coastline and 'inshore waters' describes a broader zone out to approximately the limit of the Territorial Sea around the Islands (i.e., 12 nm from the coastline). The chapter concludes with an overall summary of the key environmental and social sensitivities identified in the following baseline description.

This EIS is supported by a number of surveys and reports. These supporting documents can be requested from Navitas at sealion.enviro@navitaspet.com.

Note: while some detail on Stanley Harbour is provided below, the full environmental baseline of Stanley Harbour is provided in the EIS previously submitted to support the construction of the Temporary Dock Facility (NEFL, 2013).

7.1.1 Falkland Islands location

The Falkland Islands are an archipelago in the South Atlantic Ocean that sit on the Patagonian Shelf and have a cold, windy and humid maritime climate. The Islands cover an area of 12,000 km^2 and comprise East Falkland, West Falkland and 776 smaller islands. The principal islands are about 500 km east of South America's southern Patagonian coast, and lie between the latitudes of 52 – 53 °S.

7.1.2 Sea Lion (offshore) licence location

The Sea Lion Field is located in the North Falkland Basin (NFB), approximately 220 km north of the Falkland Islands, 770 km north-east of Cape Horn and 480 km from the nearest point on the South American mainland (Figure 7-1).

The Falkland Islands' Exclusive Economic Zone (EEZ) extends up to 200 nautical miles from the Islands and comprises two fisheries conservation and management zones which were designated in 1986 and 1990, respectively (Figure 7-1). These are:

- The Falkland Islands Interim Conservation and Management Zone (FICZ), and
- The Falklands Outer Conservation Zone (FOCZ).

Oil and gas exploration and production licences are granted within the Falkland Islands Designated Exploration Area, the limits of which are based on the EEZ. The Designated Exploration Area is subdivided into quadrants based on one degree of latitude by one degree of longitude (Figure 7-1), each of which is subdivided into thirty blocks. The Sea Lion Field is located in Quadrant 14, within the northern boundary of the FICZ in Licence Blocks PL032 and PL004b (Figure 7-1). The proposed Phase 1 & 2 Development of the Sea Lion Field is located in Licence Block PL032.

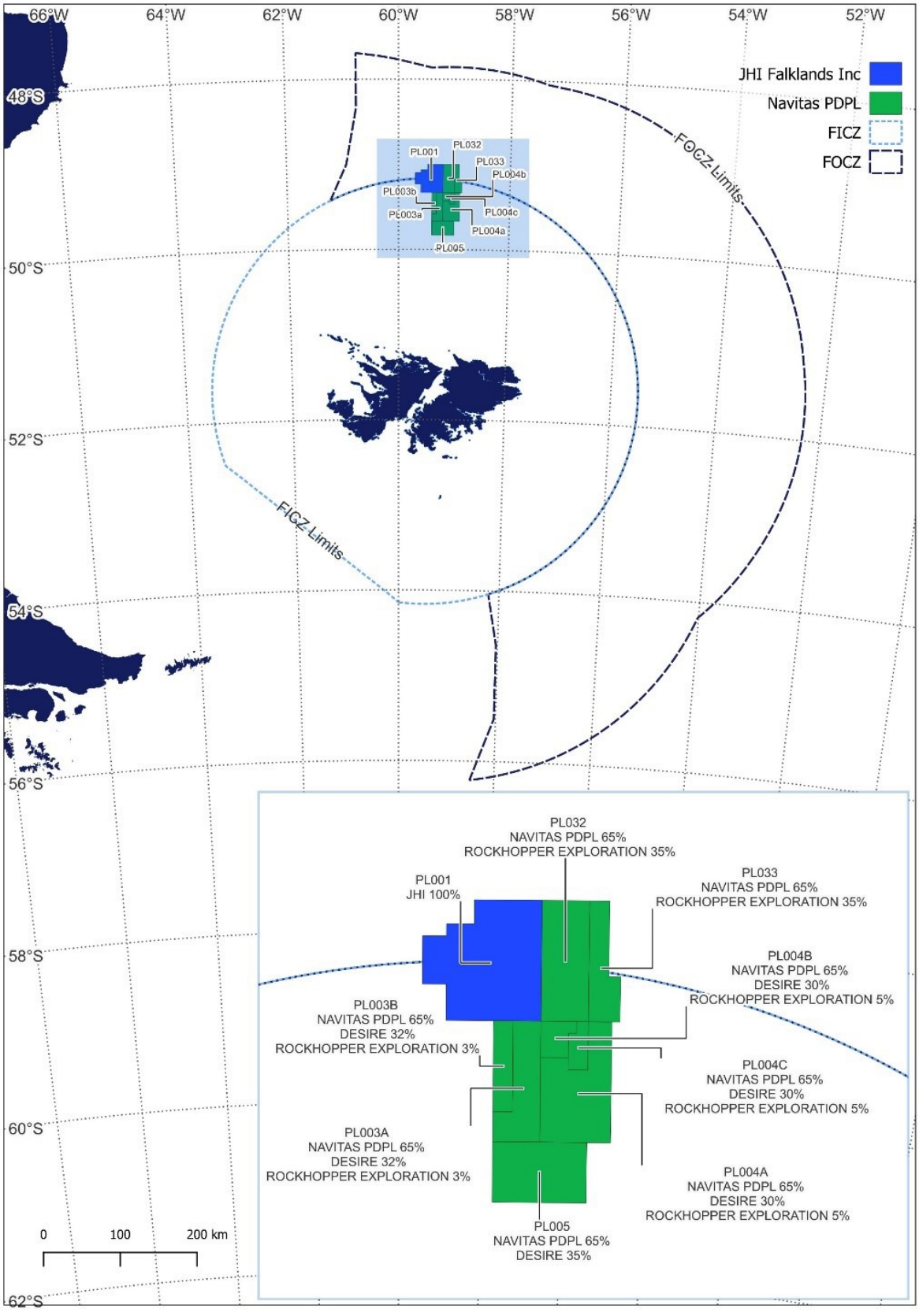


Figure 7-1: Phase 1 & 2 Development drill centre and Licence Block Locations

7.1.3 Location of Berkeley Sound in the Falkland Islands

The sheltered waters of Berkeley Sound have been chosen as the best option for a mobilisation area for the Large Transit Vessels (LTVs) during the construction phase of Phase 1 & 2 Development.

Berkeley Sound is a large east-facing bay in the north-east corner of East Falkland (Figure 7-2) which is approximately 30 km long and 14 km wide at its mouth (Volunteer Point to Mengeary Point; Figure 7-3). The Sound has several smaller bays within it e.g., Port Louis Harbour and Johnson's Harbour, and contains islands such as Cochon and Kidney Islands (National Nature Reserve (NNR)), Hog Island and Long Island. Figure 7-3 provides a map of Berkeley Sound showing all the place names mentioned in this EIS. Due to differences in habitat type and species distribution it is convenient to refer to the 'inner' and 'outer' Sound, with Strike-off Point marking the boundary between the two (Figure 7-3).

Currently, Berkeley Sound's primary use is as a designated locality for the transhipment of fish and bunkering by the Falklands' fishing industry.

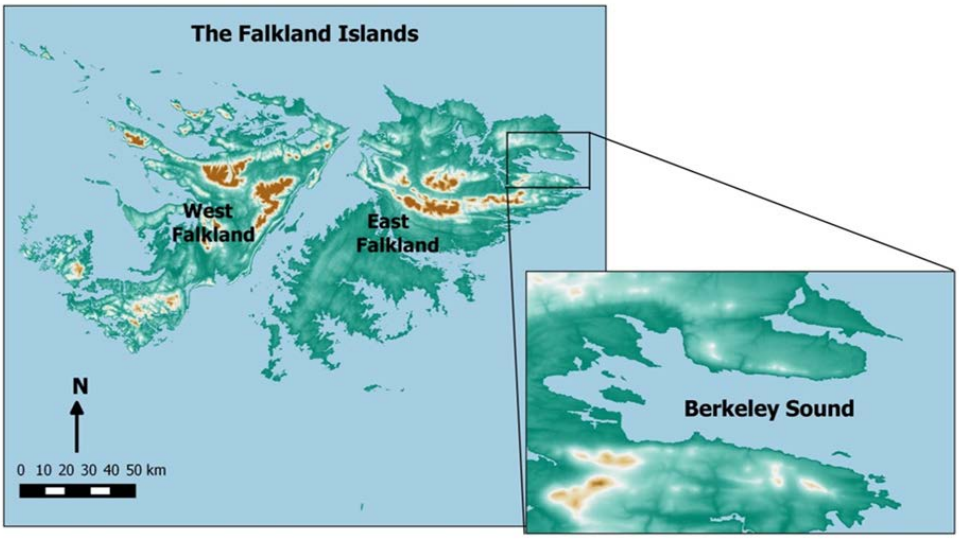
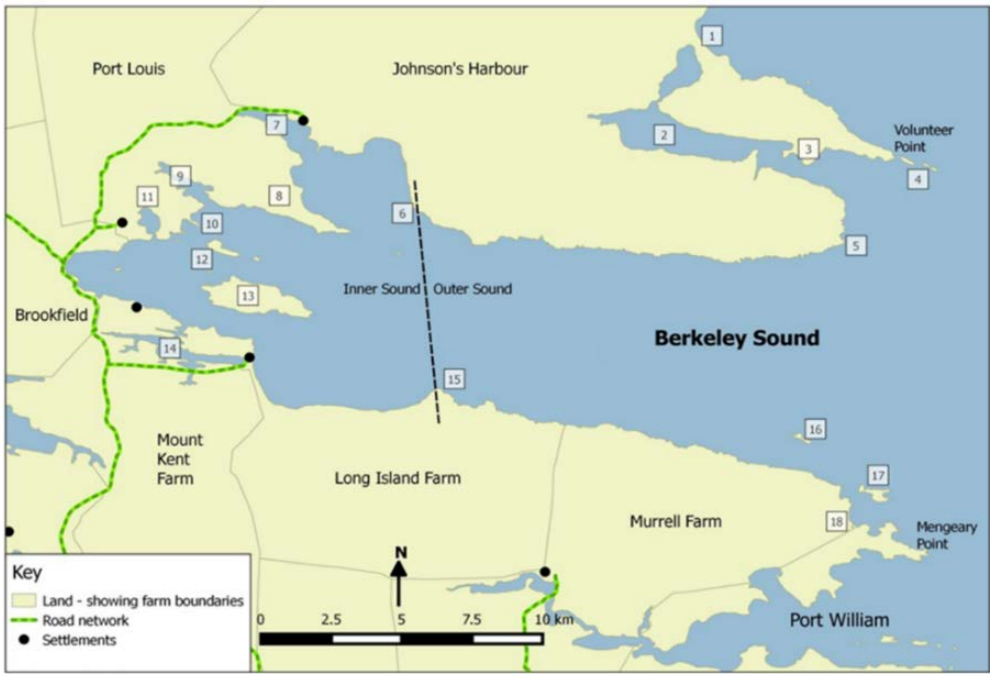


Figure 7-2: The location of Berkeley Sound within the Falkland Islands archipelago



1 Volunteer Beach
2 Volunteer Lagoon
3 Lagoon Sands
4 Volunteer Rocks
5 Eagle Point
6 Lamarche Point
7 Chabot Creek
8 Johnson's Rincon
9 Fish Creek
10 Black Point
11 Port Louis
12 Hog Island
13 Long Island
14 Duperrey Harbour
15 Strike-off Point
16 Cochon
17 Kidney Island
18 Kidney Cove

Figure 7-3: The location of settlements and place names mentioned in the text within Berkeley Sound

7.2 Data Sources

7.2.1 Literature sources

Literature reviews were carried out, where necessary, in order to inform understanding of the local environment. The information and data therefore come from a number of sources including scientific peer reviewed literature, scientific reports, grey literature, data provided directly by a number of organisations, web-distributed data, and data available within the Falkland Islands Data Portal, which collates information from recent surveys and historical sources (http://dataportal.saeri.org/). Where appropriate, personal observations (*pers. obs.*) and personal communications (*pers. comm.*) of learned individuals are referenced throughout the EIS.

In a previous iteration of the Sea Lion project (under POEPL, Section 2.1.1), inshore oil transfer was considered in Berkeley Sound. To aid the decision-making process concerning the choice of the most appropriate inshore transfer site in particular, POEPL commissioned the production of the report 'Environmental Assessment of Potential Inshore Transfer Sites,' (Premier[28], 2015c). This document was one of the primary sources of information used to inform the environmental baseline of Berkeley Sound and surrounding areas described below. Of importance, this inshore transfer concept has been rejected in place of direct offtake at the offshore location, but Berkeley Sound will still be used as an area of mobilisation and support for the construction of Phase 1 & 2. The data gathered is referenced where applicable.

7.2.2 Sea Lion environmental surveys

POEPL and its partner, Rockhopper Exploration, conducted an area-wide environmental baseline survey of the Sea Lion Field in 2012 to determine the physical, chemical and biological characteristics of the environment in support of future development of the area. In addition to the area-wide survey, specific well site surveys comprising six to eight stations each were conducted for five historic well sites drilled in Quadrant 14 of the Sea Lion Field.

Several other environmental surveys have been conducted in the vicinity of the Sea Lion Field and further afield within Falklands waters, which provide background and contextual data for comparison with the Sea Lion area. Table 7.1 provides a summary of all survey and drilling activities conducted in the Falkland Islands waters to date. Figure 7-4 and Figure 7-5 show the location of the 2012 Sea Lion environmental baseline and post-drilling survey locations, and the majority of the other environmental survey sites within Falklands waters. Survey data from the four gridded stations around the project location are shown in Figure 7-6.

Table 7.1: Summary of Falkland Islands drilling and environmental survey activities

Year	Activity - Survey / Drilling	Region	Operator/Reference
1998	Environmental baseline survey – pre-drilling 'Little Blue' 14/09, 'B1' 14/05, Well 14/14, Well 14/23,	NFB	FOSA[1], Gardline, 1998a-h

[28] Please note that while Navitas has acquired POEPL and all intellectual property therein, historical surveys and reports carried out by POEPL are still referenced as 'Premier, XXXX').

Year	Activity - Survey / Drilling	Region	Operator/Reference
	'Braela' 14/24, Well 14/19a, 'Minke' 14/13-B, and 'Galapagos' 14/09.		
1998	Drilling campaign – 6 wells	NFB	FOSA
1998	Post-drilling environmental survey – 1 well site 'Little Blue' (14/09)	NFB	FOSA, Gardline, 1998h
2008	Regional environmental baseline survey – pre-drilling. SFB: Quadrants 61 and 62. Southern NFB: Quadrants 25 and 26.	SFB, southern NFB	Desire Petroleum Plc., Benthic Solutions Ltd. (BSL, 2008a & b)
2009	Environmental baseline survey four proposed well sites – EFB: Endeavour (31/13), Loligo (42/02), Nimrod (41/29), SFB: Toroa (61/05)	EPB, SFB	BHP Billiton, Fugro Survey (Fugro, 2009)
2010-2011	Drilling campaign – 16 wells Drilling – 1 well	NFB FPB	Rockhopper, Desire BHP Billiton
2011	Environmental baseline surveys five proposed well sites – Hero (31/18), Inflexible (60/15), Loligo NW (42/02), Scotia East (31/13), Vinson West (53/16	EPB, SFB	FOGL, Gardline Survey 2012
2012	Drilling campaign 2 wells Drilling campaign 2 wells	SFB EPB	Borders and Southern FOGL
2012	Sea Lion Pre-development area wide survey, Sea Lion Post-drilling environmental survey – 5 historic well sites	NFB	Rockhopper, Gardline, 2013a & b
2014	Coastal sensitivity to oil spill survey	NFB	Premier plc
2015	Drilling campaign 4 wells	NFB	Premier plc, MG3, 2015
2015	Drilling campaign 1 well	EPB	Noble Energy Falklands Ltd
2016	Drilling campaign 1 well	NFB	Noble Energy Falklands Ltd

[1] Falklands Offshore Sharing Agreement.

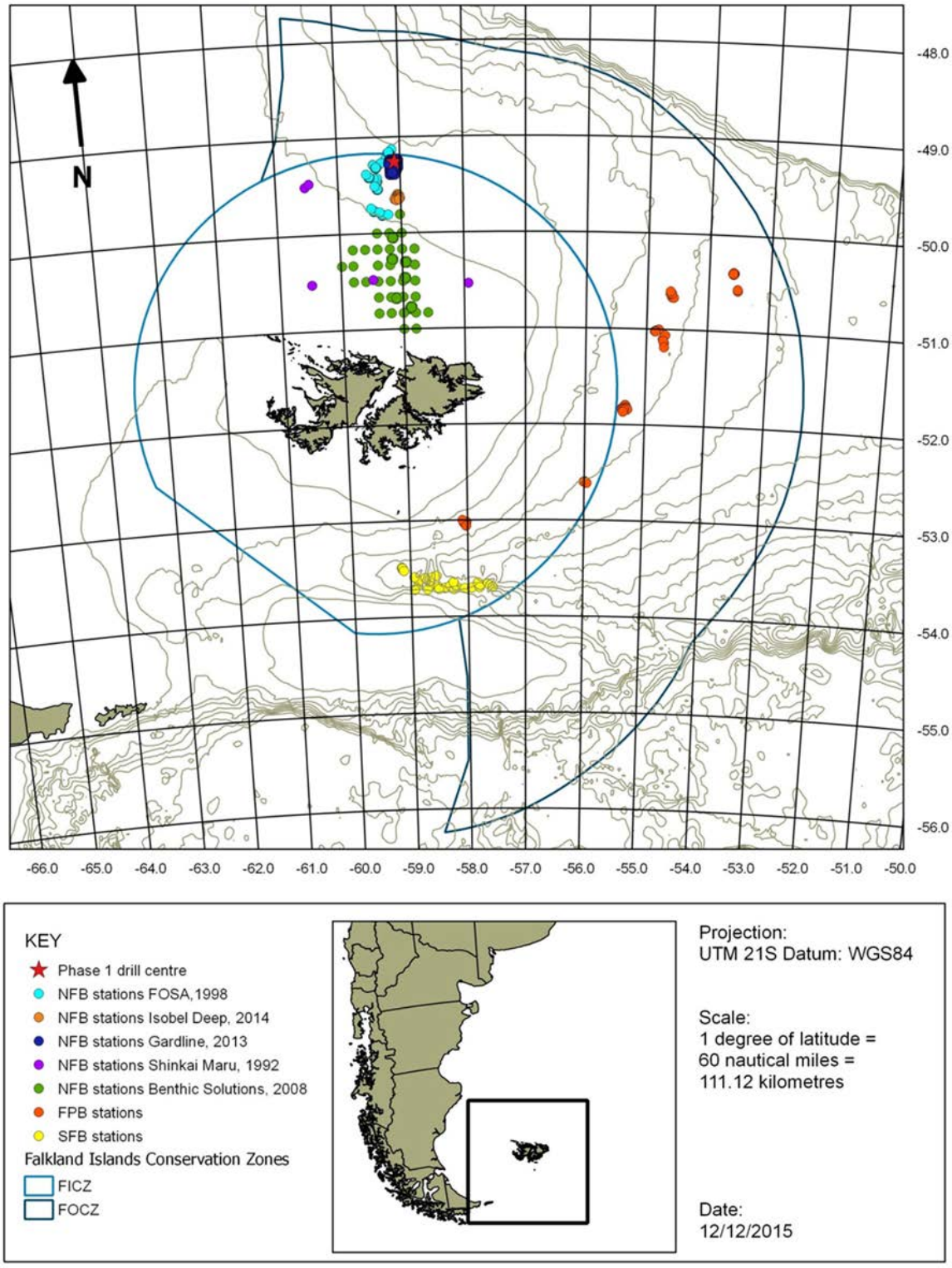


Figure 7-4: Summary of environmental survey locations on the Falklands Continental Shelf

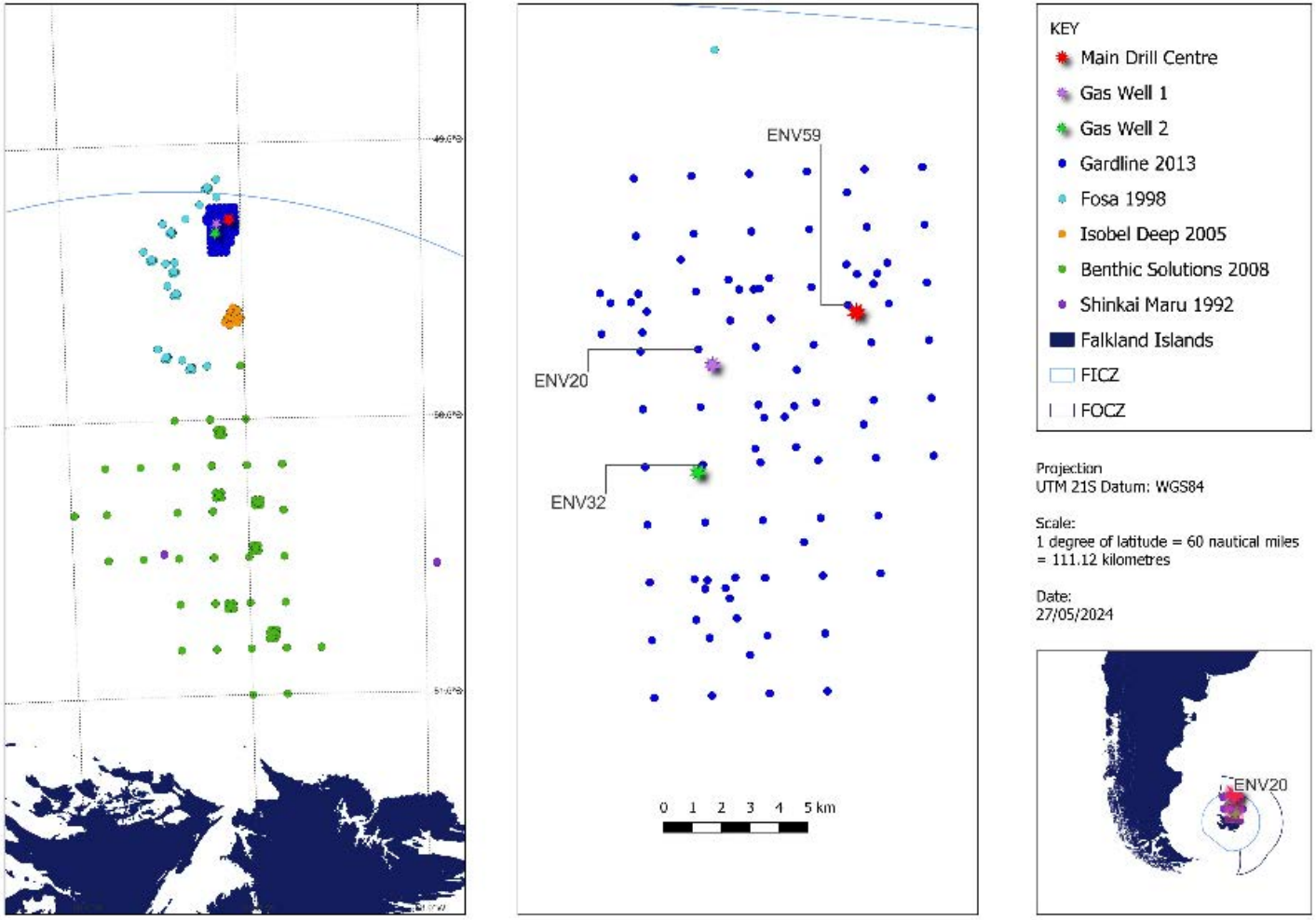


Figure 7-5: Environmental survey locations in the North Falkland Basin and vicinity of the Phase 1 & 2 Development drill centre

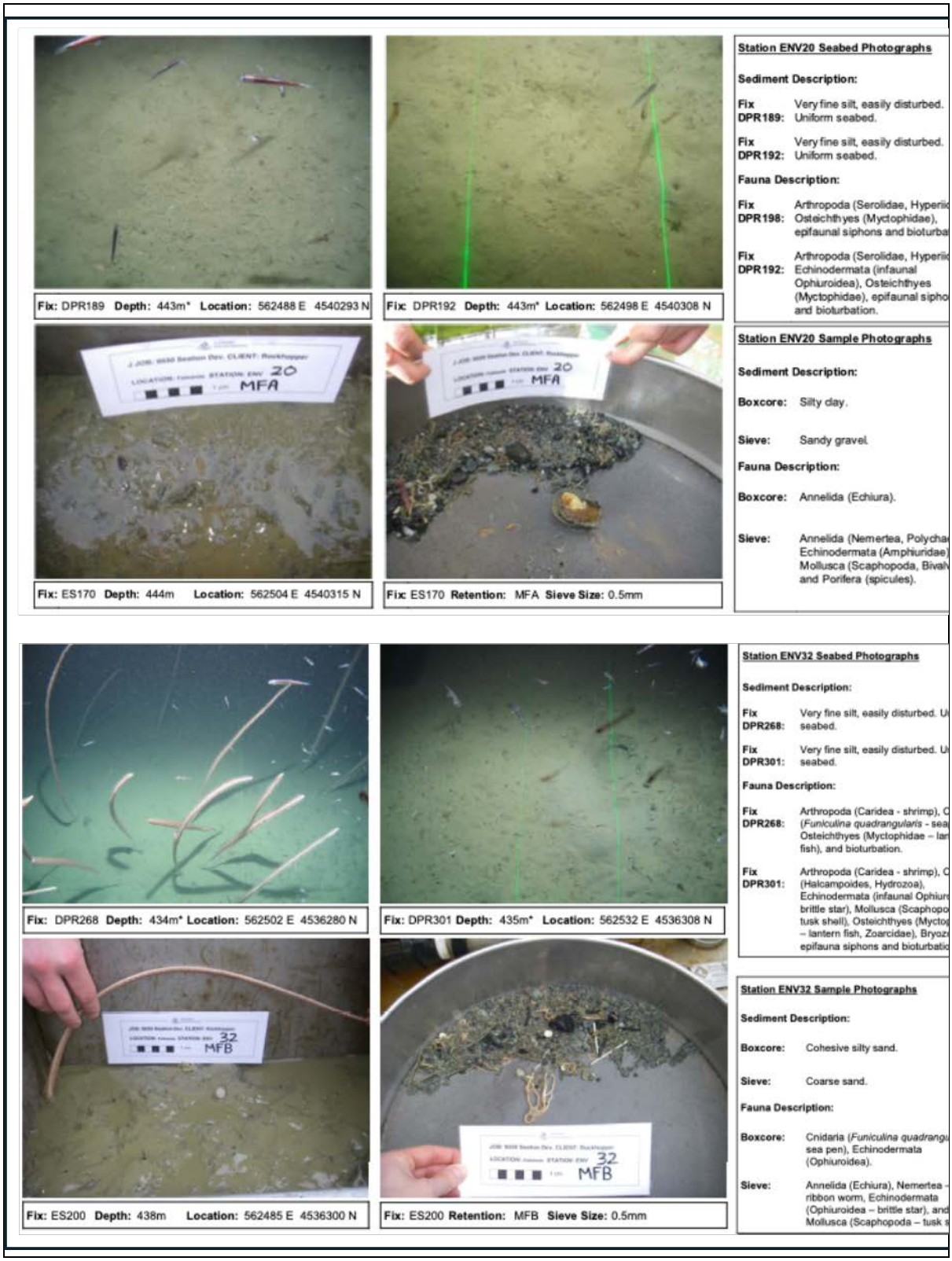


Figure 7-6: Environmental survey information in the vicinity of the Phase 1 & 2 Development drill centre. Note ENV59 is not shown however the area contained anenomes and holothurians on silty brown clay

7.2.3 Berkeley Sound environmental surveys

Several environmental surveys have been conducted in the vicinity of Berkeley Sound (described in this document) which provide background and contextual data for comparison with the Berkeley Sound area. The following provides a summary of the surveys which are referred to throughout the baseline.

7.2.3.1 Shallow Marine Surveys Group (SMSG)

In the mid-1990s, inshore surveys were conducted around the Falkland Islands over a three month period and resulted in the production of 'The first shallow marine survey around the Falkland Islands' (Tingley, *et al.,* 1996). Although the first surveys of their kind in the Falklands, the study lacked a seasonal component and the identification of specimens was not always achieved to species level. In 2006, the Shallow Marine Surveys Group (SMSG) was established in the Falklands. The SMSG conduct regular dive surveys and have greatly advanced the understanding of the sub-tidal shallow water environment of the Islands (Neely, *et al.,* 2010a; Neely, 2010). Combined, this data will go towards improving the classification of marine habitats around the Falkland Islands.

7.2.3.2 Marine Spatial Planning (MSP)

Marine Spatial Planning (MSP) work has been ongoing for a number of years, including the development of a network of Marine Management Areas (MMAs), aligned to international criteria for Marine Protected Areas (MPAs). Following workshops in 2016, and public consultation in 2022, the Falkland Islands Government (FIG) have considered proposals for two offshore MMAs (the Burdwood Bank and Beauchêne Island) and an inshore MMA covering the inshore waters of the Falklands. Following consultation, FIG are now developing a detailed MMA policy for designation and management plans, the main priorities for the MMA Policy in the Falkland Islands are:

- To provide tools and protocols for streamlining the EIA process,
- To help manage shipping and boating,
- To facilitate emergency responses and safety protocols,
- To protect ecologically important areas, and
- To prevent introduction of marine invasive species (biosecurity).

This work is ongoing but has already facilitated the collation of many disparate sources of information, which can be analysed and displayed using Geographic Information System software. This information will be a valuable tool for future management of activities in the marine environment.

7.2.3.3 Operator commissioned environmental surveys

7.2.3.3.1 Habitat assessments of Berkeley Sound

In 2014, POEPL commissioned the South Atlantic Environmental Research Institute (SAERI), along with Environment Systems (EnvSys), to conduct habitat assessments of three potential inshore transfer sites (including Berkeley Sound) on the east coast of East Falkland (Premier, 2015c). This included an assessment of the sensitivity of the coastline, which utilised satellite imagery.

7.2.3.3.2 Geophysical and environmental surveys.

In 2015, POEPL commissioned Benthic Solutions Ltd. (BSL) to conduct an environmental baseline survey of Berkeley Sound. The survey strategy included geophysical and environmental surveys and aimed to determine the geophysical characteristics, sediment chemistry, infaunal communities and macro-faunal assemblages (through sonar, grab and drop down camera surveys) (BSL, 2015a; 2015b & 2015c).

The survey was carried out between June and August 2015 aboard the chartered vessel, *Afon Alaw*. Further details can be found in:

- BSL, 2015a: Geophysical and Environmental Programme Berkeley Sound; 1506 Volume 3: Geophysical survey,
- BSL, 2015b: Geophysical and Environmental Programme Berkeley Sound; 1506 Volume 4: Habitat Assessment Report, and
- BSL, 2015c: Geophysical and Environmental Programme Berkeley Sound; 1506 Volume 5: Environmental Baseline Survey Report.

In 2016, SAERI were commissioned by POEPL to complete the baseline survey programme and worked with the SMSG and EnvSys to map the shallow marine, intertidal and terrestrial habitats found within Berkeley Sound (SAERI and SMSG, 2016).

7.2.3.3.3 Coastal bird survey

POEPL commissioned SAERI to conduct a series of four seasonal coastal bird surveys in and around Berkeley Sound, which were carried out between February 2016 to May 2019. In the course of these surveys, the opportunity was taken to develop an initial shoreline classification index specific to the Falkland Islands for use in oil spill planning.

7.2.3.4 Third-party surveys

Numerous surveys carried out by other parties are used as data sources to inform the assessment of the environmental baseline. These include, for example, those carried out by the Joint Nature Conservation Committee, Falklands Conservation, SMSG, SAERI, SAERI (Falklands) Ltd, and dedicated surveys carried out by other Oil and Gas (O&G) operators or other private or public sector organisations, in support of various proposed coastal and marine operations that required surveys, EIAs, or similar reports. These are described, as necessary, in the relevant sections below.

7.2.4 Data gaps

The Falkland Islands Offshore Hydrocarbons Environmental Forum (FIOHEF) was established in 2011 to facilitate discussion of environmental issues relating to current and future hydrocarbon activities in the Falkland Islands. FIOHEF established a subcommittee, the Gap Analyses Group, to examine the data gaps that needed to be addressed in order to better inform and monitor the potential environmental impacts from offshore hydrocarbon activities operating in the Falkland Islands.

Data gaps were identified and prioritised according to the urgency with which it was perceived that the data was required. Gaps of most relevance to the Development include:

- Offshore benthic ecosystems with regard to collation of data, infauna sampling, sedimentology and chemistry,
- Oceanography in relation to oil spill modelling with regard to hydrographic dynamics, temporal and water column dynamics,
- Seabirds with regard to priority species and temporal movements, and
- Marine mammals (pinnipeds and cetaceans) with regard to populations and breeding activity, spatial and temporal distributions (described further in Section 7.4.6).

Much of these data will take a number of years to collect and assimilate, and this is ongoing through various research projects which are not directly associated with O&G activity. There has however, been significant progress in many areas, e.g., oceanography, offshore benthos and marine mammal distribution. In this EIS, best available data has been used for the assessments including outputs from the GAP Project and parallel studies related to its recommendations.

7.2.4.1 Key data gaps relevant to Sea Lion EIA

The GAP project is complete with most results available (Blockley, *et al.,* 2020), and it is considered necessary to acknowledge the outstanding and project-specific data gaps that have been identified during the Sea Lion EIA process. Note that most of the below were out of the scope of the GAP project.

The remaining key data gaps of relevance to the Sea Lion EIA, and associated actions, are:

- General
  - Predicting the likelihood of introducing invasive species:
    - Settlement plates will be positioned in Berkeley Sound prior to and during the construction phase of the project. Settlement plates will also be positioned at the Temporary Dock Facility / Stanley Harbour for sampling throughout the duration of the project. In the event that a new marine invasive species is discovered, a pathway analysis will be conducted to attempt to determine where / how the species had been brought into the Islands. Marine invasive species will be confirmed using genetic barcoding (see Section 15.6).
  - Auditory sensitivity of penguins and marine mammals:
    - The specific experimental measurement of the auditory sensitivity of penguins and marine mammals is outwith Navitas' responsibility. However, Navitas is committed to the measurement of underwater noise levels *via* hydrophones as a monitoring exercise (see Section 15.6).
  - Quantifying the impact of bird strikes:
    - Navitas is committed to collecting data on bird-strike on all its vessels. Navitas will also investigate the use of alternative spectrum lighting on the FPSO and vessels operating in the field (see Section 15.6).
  - Impact of long-term noise and actual noise outputs from the operations:
    - Navitas is committed to the measurement of underwater noise levels *via* hydrophones as a monitoring exercise (see Section 15.6).
  - Impact of Sea Lion crude on pinniped fur:
    - Investigation of Sea Lion crude impacts on seal fur will be conducted prior to drilling commencing.
- Offshore environment (NFB and Sea Lion Field):
  - Inter-annual distribution and abundance of marine mammals in the NFB,
  - Seabird distribution and abundance,
  - Seasonal abundance of fish and squid in the deeper areas of the Northern Slope (NS), and
  - Benthic habitats and fauna at the Sea Lion drill centre and flowline locations specifically.
- Inshore environment (Berkeley Sound):
  - Location(s) of Loligo (*Doryteuthis gahi*) spawning grounds (this work has been progressed through the GAP project and other projects, but the delineation of the spawning grounds remains a gap in knowledge. However, survey data shows that Loligo do lay their egg clusters on hard surfaced down to approximately 80 m),
  - Inter-annual distribution and abundance of marine mammals, and

- Given the limited operations in Berkeley Sound, the distribution and abundance of Loligo inshore *and* the Inter-annual distribution and abundance of marine mammals will not be specifically investigated by Navitas.

7.2.4.2 Gap Analysis Programme (GAP)

The remit of the Falkland Islands Oil and Hydrocarbons Environmental Forum (FIOHEF) Gap Analyses Group was to examine the data gaps that need to be filled in order to better inform and monitor the potential impacts to the environment from offshore hydrocarbon activities in the Falkland Islands. As a result, the Gap Analyses Programme (GAP) was established by the FIOHEF and led by the Director of SAERI. GAP was supported by two project officers, one of whom co-ordinated the seabird and marine mammal aspects of the work and the other the review, consolidation and curation of oceanic, benthic, inshore and fisheries related data. International researchers were, and continue to be, engaged in this process through workshops and collaborative peer review so the work has international standing and transparency.

7.2.4.2.1 Seabird and marine mammal telemetry

Data gaps were identified for each of the issues of concern and prioritised according to the urgency with which data are required. These data will ultimately be used to inform robust environmental impact and risk assessments for proposed operations associated with the Oil & Gas (O&G) industry. Data collection and analyses are now complete as set out by GAPII objectives. However, it will take further analysis to determine how the results of this work can best be used to quantitatively assess the potential impact of the O&G industry in the Falkland Islands. Examples include quantitative assessments of the overlap of higher predator distribution and oil spill fate modelling for example. So, in the short-term, and until further data analysis is available, existing data will be collated and used to perform assessments through expert-led processes.

At the time of compiling this Environmental Baseline Description, initial analysis of data collected by the GAP project has been published by Baylis, *et al.* (2019a & b; 2021).

7.2.4.2.2 Consolidation and curation of existing data

The hydrocarbons industry and other organisations have collected large amounts of information over the last twenty-five years whilst operating in the Falkland Islands, including data from oceanographic, metocean, seismic, benthic ecology, benthic environmental, multi-beam and Remotely Operated Vehicle (ROV) surveys. Much of these data are held at different locations and the fate / location of some remains unknown. One of the objectives of the GAP project was to create and manage a centralised data repository to hold, manage and curate environmental data collected by the Hydrocarbons Industry and other organisations in the Falkland Islands. Collation of all of the relevant environmental data in the IMS-GIS Data Centre (now called EDS, Environmental Data Service) and the Falkland Islands Data Portal have and will continue to:

- Provide wide spatial and temporal coverage for future EIAs,
- Avoid duplication of work effort,
- Increase the likelihood that these data will be used for future research activities and initiatives that could complement and enhance future EIAs, and
- Increase environmental knowledge of the Falkland Islands continental shelf and slope.

7.3 Physical Environment

The following sections provide data on the physical environment within which the Phase 1 & 2 Development is to be carried out which will be used to inform the impact and risk assessments in Chapters 10, 11 and 12.

7.3.1 Global atmosphere

7.3.1.1 Atmospheric structure

Earth's atmosphere is ultimately very thin when compared to the size of the Earth and is the equivalent in thickness to a piece of paper laid over a beach ball. Nonetheless, atmospheric processes are closely linked to oceanic processes, and together these systems are responsible for keeping Earth habitable for humans where those combined processes are manifested as changing weather (Open University, 2004).

The atmosphere is divided into five main layers, becoming thinner in each consecutive layer until the gases dissipate in space. While there is no distinct boundary between the atmosphere and space, an imaginary line about 110 km from the surface, called the Kármán line, is generally accepted to be the point at which the atmosphere meets outer space (Sharp and Dobrijevic, 2023). Of the five atmospheric layers, (Sharp and Dobrijevic, 2023), the two lowest layers are of relevance to this EIA:

- The troposphere is the layer closest to Earth's surface. It is approximately 8 – 14.5 km in height and contains half of Earth's atmospheric gases (Figure 7-7), and
- The stratosphere starts above the troposphere and ends about 50 km above ground level. Ozone is abundant here and the 'ozone Layer' plays a key role in maintaining atmospheric temperature while also absorbing harmful radiation from the sun (Figure 7-7).

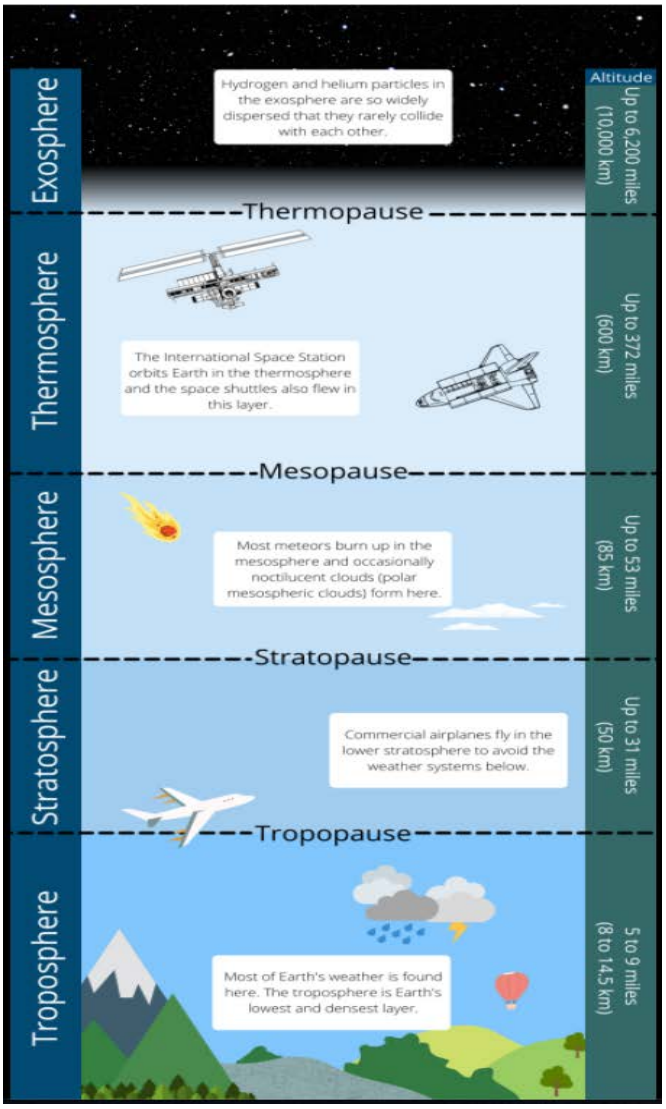


Figure 7-7: Atmospheric structure ***(Source: Tim Sharp, Daisy Dobrijevic last updated July 23, 2023, https://www.space.com/17683-earth-atmosphere.html)***

7.3.1.2 Atmospheric composition

The atmosphere contains many gases, most of which are in small amounts, and water vapour. The permanent gases whose percentage contributions do not change from day to day are nitrogen, oxygen and argon. Nitrogen accounts for 78 % of the atmosphere, oxygen 21 % and argon 0.9 % (Figure 7-8). Trace gases account for about a tenth of one percent of the atmosphere, which includes carbon dioxide, nitrous oxides, methane, and ozone; collectively termed Greenhouse Gases (GHG) and the inert gases neon and helium (Figure 7-8).

GHGs have physical and chemical properties which make them interact with solar radiation and the heat given off from the Earth to affect the energy balance of the globe (Hansen, *et al.,* 2005). The Earth's long-term, globally-averaged equilibrium temperature depends on the balance between the level of incoming solar energy from the sun, and the outgoing radiated heat which has been reflected or emitted from the Earth's atmosphere and the surface of the Earth. Of all the atmospheric gases, the trace GHGs have sufficient thermal absorption to capture energy from the sun and effectively trap heat within the Earth's atmosphere by a natural process known as the 'greenhouse effect'.

The percentage contribution of GHGs varies daily, seasonally, and annually however, and is directly impacted by anthropogenic GHG emissions.

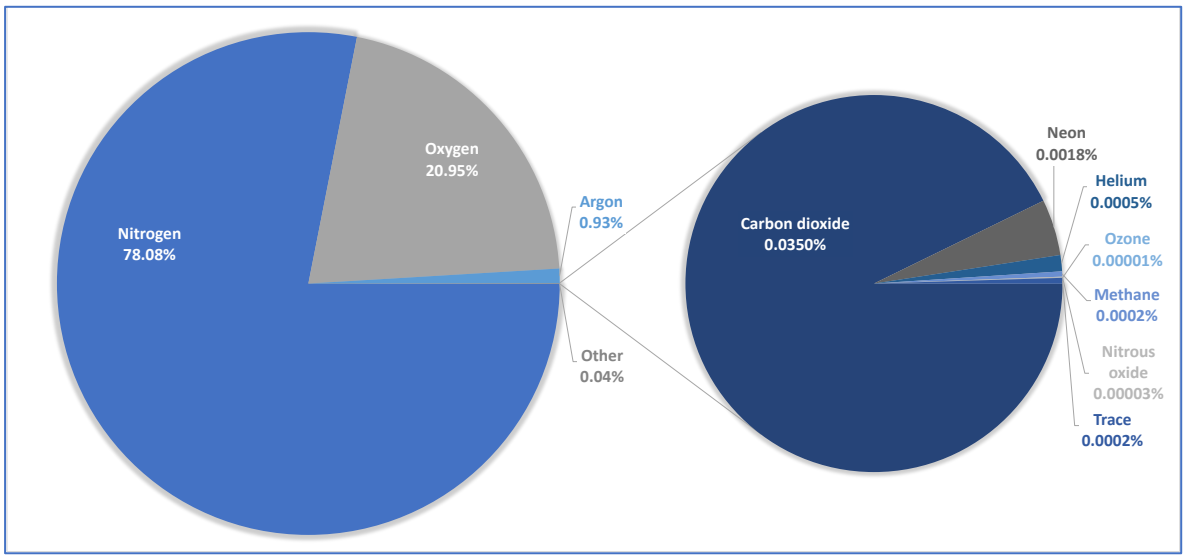


Figure 7-8: Atmospheric composition ***(Source: https://www.noaa.gov/jetstream/atmosphere. Last updated July 28, 2023)***

7.3.2 Meteorology of the Falkland Islands

7.3.2.1 General conditions in the Falkland Islands

7.3.2.1.1 Wind speed

The oceanic climate of the Falkland Islands is temperate, with predominantly west-north-westerly winds (SAERI unpublished weather station data. 14/02/2020 to 16/08/2023). In general, the weather in the NFB is much less extreme than the area south of 50°S, with less frequent storms and squalls (RPS Energy, 2009).

7.3.2.1.2 Temperature

The Falkland Islands have a cold temperate climate with a mean annual temperature of 7.2 °C (max: 23.8 °C, min: -5.1 °C) in Stanley (SAERI unpublished weather station data (14/02/2020 to 16/08/2023)). The range of mean temperatures does not vary substantially over the course of the year, with a summer mean of 10.5 °C and 3.5 °C in the winter, however, variability of the air temperature over the sea is always much less extreme than over land.

7.3.2.1.3 Precipitation

The mean annual rainfall in Stanley is approximately 285.6 mm (SAERI unpublished weather station data, 14/02/2020 to 16/08/2023). Given the rainfall patterns on the Islands, it is expected that the mean annual rainfall within the NFB will be less than this. Snow falls, on average, 11 days of each year, with the highest frequency occurring in August.

7.3.2.1.4 Visibility

Dense fog, reducing visibility to less than 1 km is likely to occur for approximately 3 % of the year in offshore Falkland Islands (Anatec, 2024b).

7.3.2.2 Inshore (east coast) metocean conditions

Understanding the meteorology of the east coast of the Falkland Islands, and Berkeley Sound in particular, is highly important as the weather conditions throughout the year may have an impact on

inshore activities, such as the operation of LTVs and small support vessels. This impact may be from extreme winds or reduced visibility during foggy conditions.

Weather data has been collected elsewhere on East Falkland for a number of years and is summarised below as a proxy for the conditions experienced in Berkeley Sound. The nearest source of weather statistics is Mount Pleasant International Airport (MPN) which is approximately 50 km south-west of Berkeley Sound. Metocean studies for the Sea Lion Field compared measured wind data from MPN, Pebble Island and Stanley Airport. These measured datasets were also compared with output from the regional model covering the Sea Lion location (Climate Forecast System Re-analysis data) and a higher resolution model covering the land and inshore area of the Falkland Islands (Weather Research and Forecasting). Measured wind data available from two MODUs (Borgny Dolphin for 1998 and Eirik Raude for short periods in 2015 and 2016) were also used. Comparisons of the various datasets (measured and modelled) showed good correlation in wind climate and offshore the model is considered to be reasonably representative of offshore conditions. Comparison of the various data sets is described in further detail in the Environmental Modelling Report (Premier, 2017c).

No site-specific measured data is available for Berkeley Sound, although an Automatic Weather Station and Directional Waverider wave buoy were positioned within Berkeley Sound. An analysis of the wave measurements for the period July 2016 to January 2107 indicate that conditions within Berkeley Sound are more benign than the equivalent monthly averages based on modelled data alone, although further data is required to substantiate this.

Two-dimensional gridded atmospheric data, including wind speed and direction, are also available from sources such as the Climate Forecast System Reanalysis project and the European Climate Model.

The following sections describe the wind speed and direction, air temperature and precipitation recorded at MPN over the period 1999 to 2023. This uses data from the Weatherspark data system based on a statistical analysis of historical hourly weather reports from Mount Pleasant Airport and model reconstructions from 1 January 1980 to 31 December 2023.

7.3.2.2.1 Wind speed and direction recorded at MPN

As is shown in Figure 7-9, over the course of the year as recorded at MPN, typical wind speeds vary from 4 m/s to 12 m/s. MPN experiences mild seasonal variation over the course of the year. The windier part of the year lasts for 1.9 months, from July 24 to September 22, with average wind speeds of more than 7.9 m/s. The windiest month of the year is August, with an average hourly wind speed of 8.1 m/s. The calmer time of year lasts for 10 months, from September 22 to July 24. The calmest month of the year is May, with an average hourly wind speed of 7.6 m/s.

As is shown in Figure 7-10 the westerly winds are most common (*c.* 30 % of the time) followed by north winds (*c.* 10 % of the time), north-westerly winds (*c.* 10 % of the time) and then south-westerly winds (*c.* 10 % of the time). South-easterly winds are the least common, occurring only 5 % of the time (Figure 7-10).

Overall, westerly winds are the most likely to occur on the east coast of the Falkland Islands (Figure 7-10).

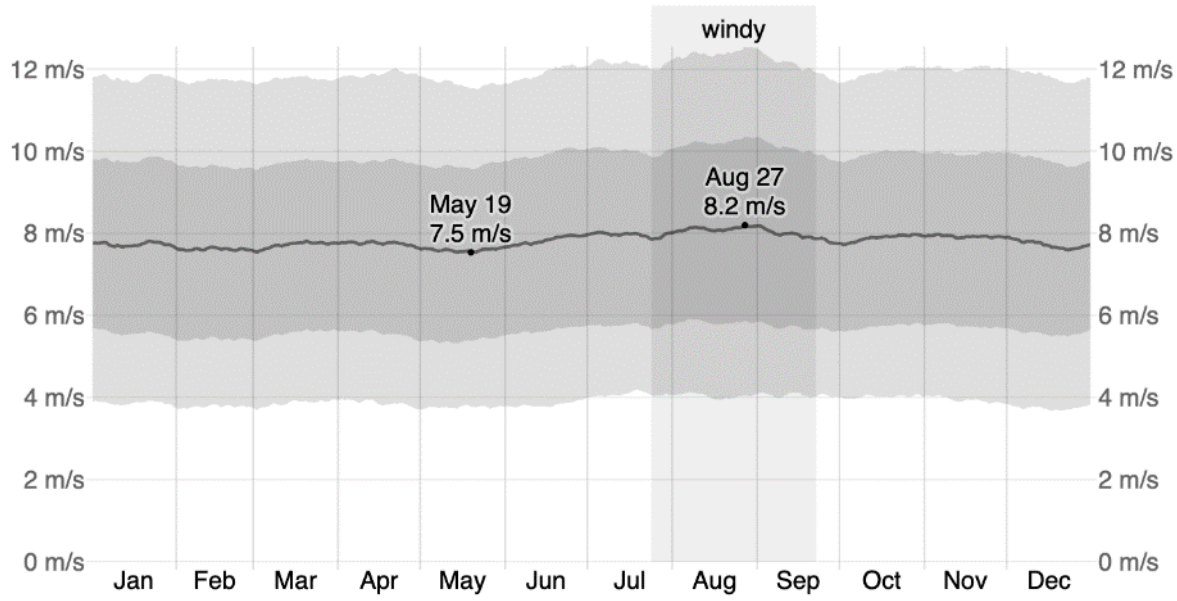


Figure 7-9: The average of mean hourly wind speeds at 10m above ground (dark gray line), with 25th to 75th and 10th to 90th percentile bands ***(Source: Weatherspark, 2023)***

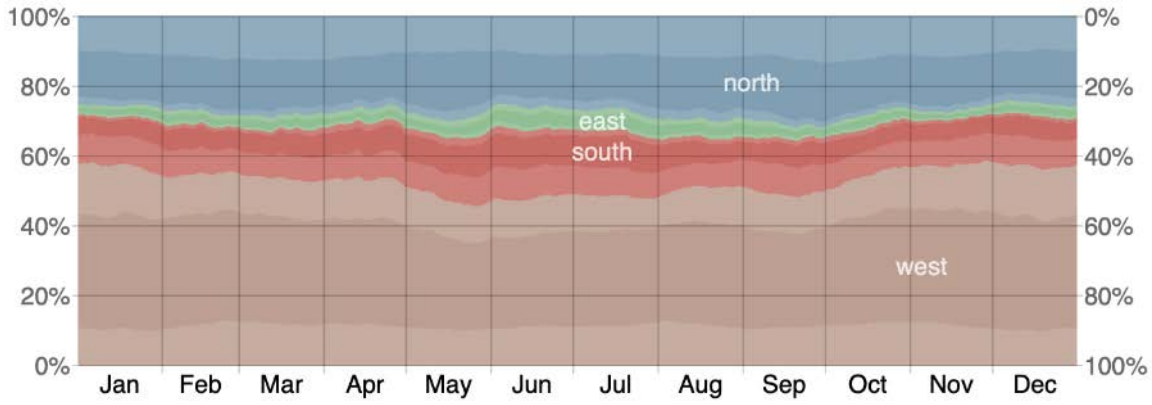


Figure 7-10: The percentage of hours in which the mean wind direction is from each of the four cardinal wind directions, excluding hours in which the mean wind speed is less than 0.4 m/s. The lightly tinted areas at the boundaries are the percentage of hours spent in the implied intermediate directions (north-east, south-east, south-west, and north-west) ***(Source: Weatherspark, 2023)***

7.3.2.2.2 Temperature recorded at MPN

As is shown in Figure 7-11, over the course of a year, the temperature typically varies from 1°C to 15°C and is rarely below -3°C or above 20°C at MPN.

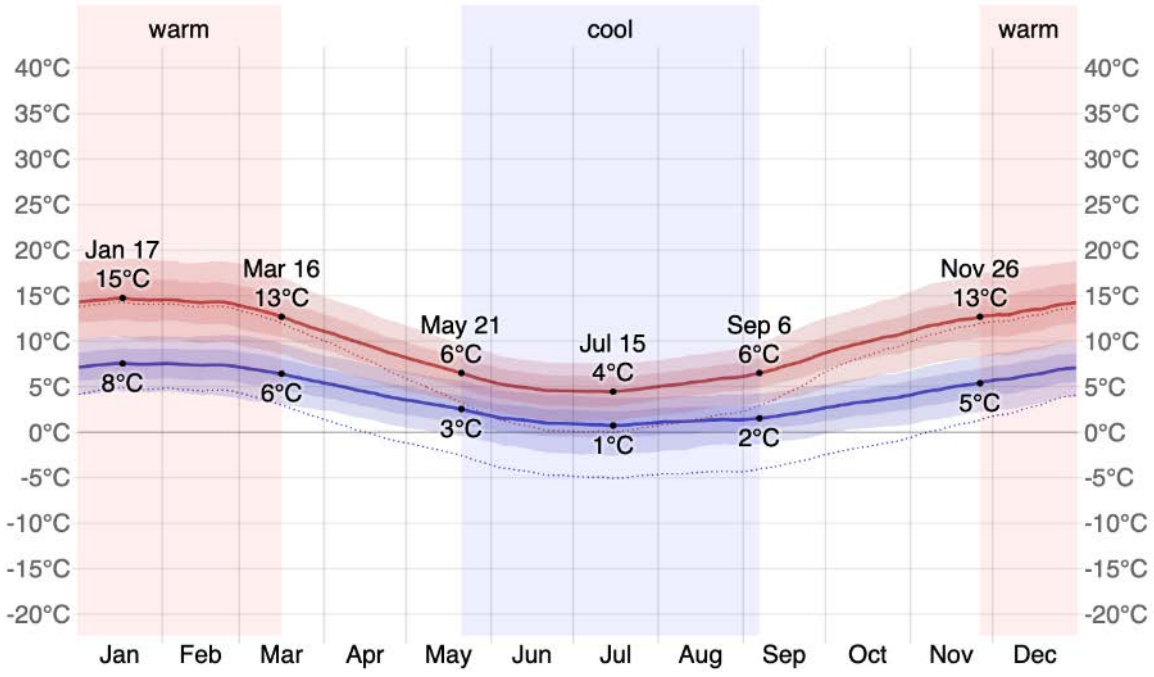


Figure 7-11: The daily average high (red line) and low (blue line) temperature, with 25th to 75th and 10th to 90th percentile bands. The thin dotted lines are the corresponding average perceived temperatures at MPN ***(Source: Weatherspark, 2023)***

7.3.2.2.3 Precipitation recorded at MPN

As is shown in Figure 7-12, rain falls throughout the year at MPN. The month with the most rain at MPN is January, with an average rainfall of 40 millimeters. The month with the least rain at MPN is October, with an average rainfall of 20 millimeters.

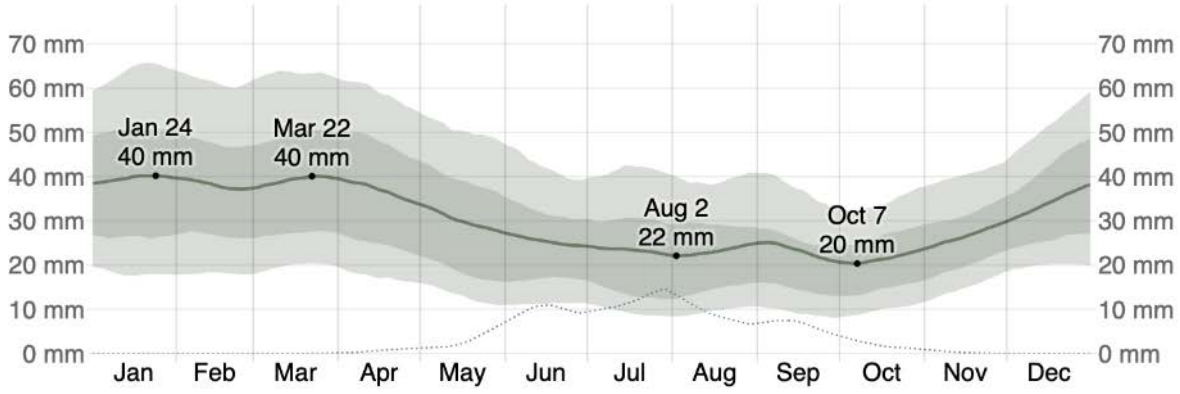


Figure 7-12: The average rainfall (solid line) accumulated over the course of a sliding 31-day period centered on the day in question, with 25th to 75th and 10th to 90th percentile bands. The thin dotted line is the corresponding average snowfall at MPN ***(Source: Weatherspark, 2023)***

7.3.3 Oceanography of the region

It is essential to understand the behaviour of the oceanographic features of the south-west Atlantic owing to their influence on the potential impacts of anthropogenic inputs e.g., how discharges will behave, and also because the biological productivity of the area is a primary factor in the distribution and abundance of all the biological receptors considered hereafter. The following provides a summary

of the key oceanographic features on the Patagonian shelf, which influences the NFB which then influences the Sea Lion Field.

7.3.3.1 Main oceanographic features on the Patagonian Shelf

The Patagonian Shelf is one of the most productive areas in the South Atlantic. Two marine ecosystems, the southern temperate ecosystem and sub-Antarctic ecosystem are separated by a transition zone running from the south-west to the north-east of the Patagonian Shelf through the Falkland Islands archipelago (Boltovskoy, 2000).

The productivity of the Patagonian Shelf is enhanced by the existence of several year-round tidal mixing fronts and seasonal fronts originating from cold freshwater inflows from the Strait of Magellan (Belkin, *et al.,* 2009; Alemany *et al.,* 2009). On the eastern flank, the Patagonian Shelf edge is framed by the Falkland / Malvinas Current Front (FMCF, Belkin, *et al.,* 2009), which runs along the continental slope from 55ºS to 37ºS and comprises multiple smaller fronts running parallel to the shelf break (Franco, *et al.,* 2008). The main oceanographic feature of this front is the cold Falkland Current, which originates from the Antarctic Circumpolar Current (ACC) in the Drake Passage and flows northwards (Peterson and Whitworth, 1989). The ACC reaches the continental slope to the south of the Falklands and splits into two main northward-flowing branches (Figure 7-13), the western branch being the weaker of the two (Bianchi, *et al.,* 1982). The upper 300 m water column in the Falkland Current consists of the Sub-Antarctic Surface Water mass (SASW) with deeper layers occupied by the Antarctic Intermediate Water mass (AIW) (Peterson and Whitworth, 1989).

7.3.3.2 Oceanographic features on the Falkland Islands Shelf

A number of oceanographic fronts exist around the Falkland Islands continental shelf. Primarily these are found in areas to the south and east of the Falkland Islands although, to date, a number of fronts have also been identified on the northern shelf. In particular, four frontal areas have been identified in the southern part of the FMCF (between 54°S and 48°S), all with well-resolved temperature and salinity gradients (Arkhipkin, *et al.,* 2013), interspersed by areas characterised by relatively smooth gradients (non-frontal zones).

As shown in Figure 7-13, the four main fronts are the:

- Southern Front (SF),
- North Eastern Front (NEF),
- Western Offshore Front (WOF), and
- Western Inshore Front (WIF).

The Southern Front is located to the south of the Falkland Islands near Beauchêne Island where the Falkland Current meets the continental slope. It causes a strong upwelling of SASW that mixes with the Shelf water mass forming the Transition Zone (TZ) at depths of between 120-300 m (Zyrjanov and Severov, 1979; Arkhipkin, *et al.,* 2004a). This oceanic front forms one of the most productive areas in Falkland waters and is utilised by squid and fish as a major feeding and spawning ground (Arkhipkin, *et al.,* 2004a; Arkhipkin, *et al.,* 2003; Arkhipkin, *et al.,* 2010). The location of the TZ on the shelf fluctuates both seasonally and inter-annually due to the variation in the intensity and position of the Falkland Current, which in turn influences the distribution of the commercially important loligo squid (*Doryteuthis gahi*), (Arkhipkin, *et al.,* 2004b).

The SF and the NEF appear when the eastern branch of the Falkland Current meanders onto the shelf and mixes with Falkland Shelf waters. However, there is no major counter current in the region, unlike the northern part of FMCF, where the Falkland Current meets with the warmer Brazil Current, creating multiple parallel counter flows along the shelf break (Acha, *et al.,* 2004; Belkin, *et al.,* 2009).

The WOF and the WIF represent the areas of mixing of the western branch of the Falkland Current with Patagonian Shelf waters and Falkland Shelf waters and the TZ respectively.

The northern part of the FMCF (37-38°S) shifts seasonally, offshore in the austral summer and inshore in spring and autumn (Carreto, *et al.,* 1995). Similar shifts of at least two fronts (WOF and NEF) have been observed in the southern part of FMCF (Arkhipkin, *et al.,* 2013). The offshore shifts of these fronts are thought to be a result of seasonal offshore movements of shelf waters. WIF and SF are quasi-stationary throughout the year. The mixing of shelf waters with SASW waters on the western side of the Falkland Current creates a band of increased primary productivity, indicated by higher concentrations of chlorophyll-a (chl-a) especially in spring and summer. This is known as the Patagonia High Chlorophyll Band (PHCB). The distribution of chlorophyll-a in PHCB is patchy and depends on seasonal variability in upwelling intensity along the FMCF (Romero, *et al.,* 2006).

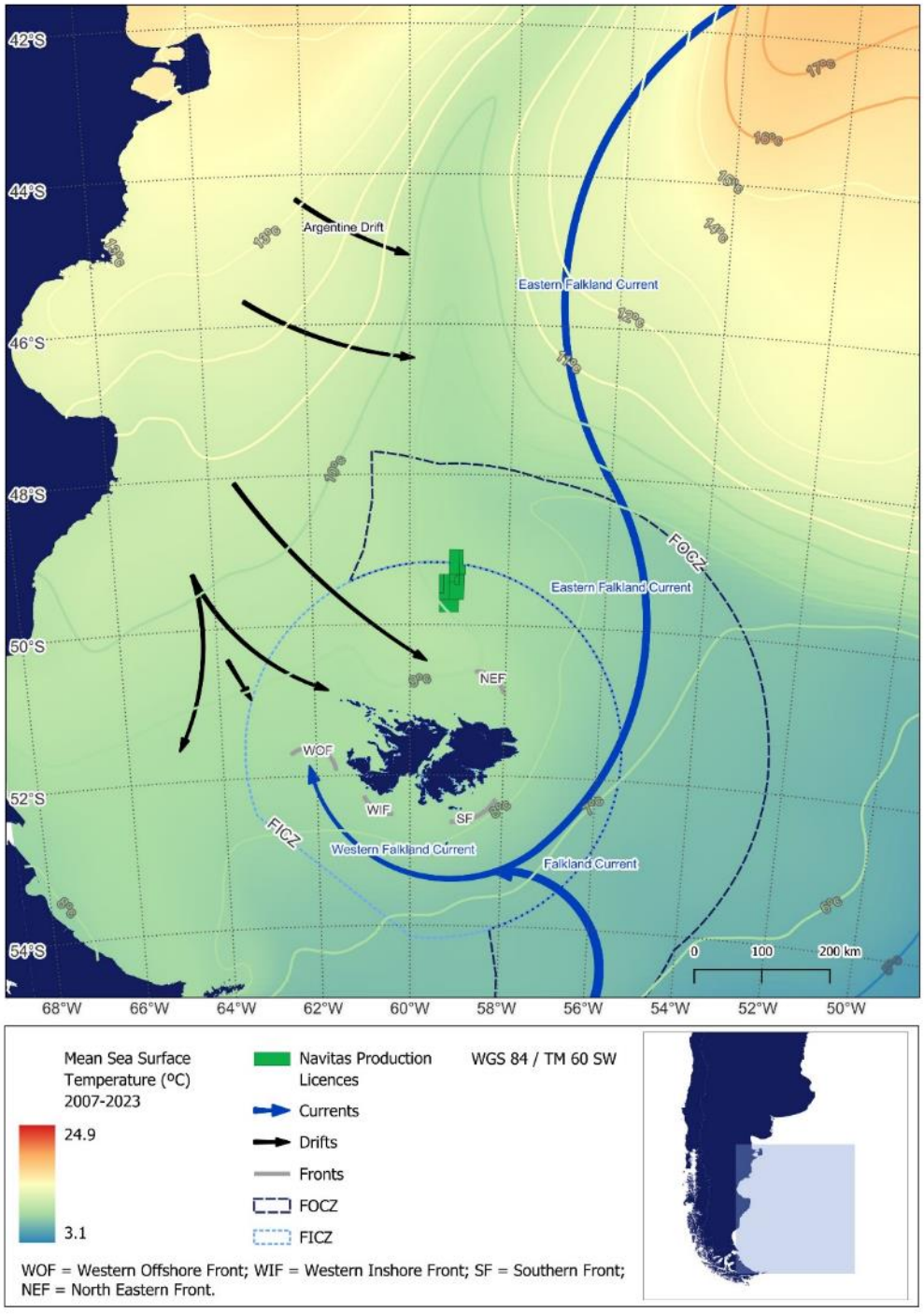


Figure 7-13: Main Patagonian Shelf oceanographic features overlain on Sea Surface Temperature map, March 2008 (WOF = Western Offshore Front; WIF = Western Inshore Front; SF = Southern Front; NEF = North Eastern Front *(adapted from Arkhipkin, et al., 2013)*

7.3.3.3 Oceanographic features in the region of the Sea Lion Field

The Sea Lion Field is located within the near shore area of the Northern Slope (NS) which marks a transition zone between Patagonian Shelf waters and the superficial SASW mass of the Falkland Current.

The currents in the Sea Lion Field predominantly move in northerly and north-westerly directions, with the current speed generally being less than 15 cm/s. At the seabed the currents tend to move in westerly directions with the current speed typically being less than 10 cm/s (BMT Argoss, 2015).

There is only slight seasonal variation in water temperature and salinity. Surface temperatures range from 5-9°C though the year with maximum temperatures observed in April and May. Surface salinity ranges from 34.06–34.11 practical salinity units (psu). The offshore and deeper part of the NS is covered by the SASW mass (Section 7.3.3.1) and shows little variation in near-bottom temperature and salinity which range from 4.1-4.3°C and 34.1–34.2 psu respectively (Arkhipkin, *et al.,* 2012a).

During a one-month environmental baseline survey of the PL032 Licence Block in March and April 2012, water column characteristics were measured using 47 deployments of a CTD (conductivity, temperature, and depth) probe (Gardline, 2013a).

Vertical profiles for temperature, salinity and dissolved oxygen from the 47 CTD deployments were interpolated across horizontal depth horizons at 400 m, 200 m, and 10 m. Temperature and salinity were used to identify the main water masses and their derivatives (Bianchi *et al.,* 1982; Peterson and Whitworth, 1989). Water column dynamics and the dynamics of water masses in the area can fluctuate around seasonal, interannual, and decadal cycles. The following is an illustration of the general water mass pattern in the area.

The CTD data reveal a well-mixed surface layer to a depth of *c.* 40 m. Below 40 m, a distinct thermocline was observed to approximately 80 m, below which temperature decreased gradually to the seabed. Temperature, dissolved oxygen and pH all decreased with depth. Turbidity was slightly higher in the mixed surface layer than the body of water immediately below the thermocline (Gardline, 2013a). Although this survey does not capture seasonal, interannual or decadal variability in water column structure, such variability will likely not be so great that it requires special consideration with respect to the potential impacts or mitigations described in relation to the Sea Lion Development. In other words, the water column characterised at the time will be indicative of the mean field situation. The measurement is therefore believed to be acceptable for this baseline.

7.3.3.4 Oceanography in Berkeley Sound

Eight water quality profiles were completed within the Berkeley Sound survey area using a multi-profiler; four of which were at the beginning of the survey, and a further four in the same locations at the end of the sampling programme, with a temporal separation of approximately two months. The four water quality stations were positioned along an east-west transect along the centre of the Sound, and were spaced approximately 6.5 km apart (see Figure 7-15 and Figure 7-16 below). The multiprofiler, a YSI 6600 V2 model, included sensors to determine temperature, salinity, dissolved oxygen, pH and turbidity.

In addition to the above, an RBRconcerto CTD was deployed affixed to the camera frame at a total of 50 environmental sampling stations to identify the structure of the water column throughout the Sound. A detailed record of a temperature time-series was recorded on a tide gauge (RBR03); this was used to verify temporal changes and observations from the profiling instruments. This device was moored for the duration of the survey in the centre of Berkeley Sound at a depth of approximately 15 m.

Analysis of the water quality profiles taken between the beginning and end of the survey suggest that spatially this body of water is generally well mixed with very little vertical variation with depth. There is a distinct increase of freshwater influence in the west of the Sound however, owing to the proportional increase in surrounding landmass to residual volume of water. A surface temperature of 9 - 10.5°C and a bottom temperature of 7 - 8°C is indicated by two FIG CTD casts. A seabed pressure recorder deployed during the POEPL 2015 survey, between 21st June and 19th August ranged from

3.3°C to 5.2°C. To date the wave buoy has recorded a minimum surface temperature of 4.1°C on 21st August 2016 and a maximum temperature of 12.4°C on 18th February 2017.

Dissolved oxygen showed little variation between the two time periods of CTD sampling, however consistently showed the same trend of decreasing oxygen concentration with depth. The dissolved oxygen concentrations were considered reasonably high, likely owing to the cold water temperature and high energy mixing through wave energy as well as tidal and wind driven systems. During the winter period when the survey was undertaken, phytoplanktonic primary production is expected to be very low, however oxygen may still enter this marine environment through macroalagae such as the *Lessonia* spp. and *Macrocystis pyrifera* kelp forests present within Berkeley Sound.

7.3.4 Bathymetry

7.3.4.1 NFB and the Sea Lion Field bathymetry

The Patagonian continental shelf is one of the largest and flattest continental shelves in the world (Arkhipkin, *et al.,* 2012). For the purposes of the document, Continental Shelf refers to waters less than 200 m in depth, deeper waters are referred to as the Continental Shelf Slope. The Patagonian Shelf varies in width from a few kilometers at 55 °S, south of Staten Island on the tip of Tierra del Fuego, to 850 km at 51 °S (Martos and Piccolo, 1988). The Falklands archipelago is situated on the Patagonian Shelf approximately 500 km north-east of the tip of Tierra del Fuego, between latitudes 52°53' S and 51 °S (Figure 7-1 above).

To the south and east of the Islands the shelf slopes steeply into the Falkland Trough (Platt and Philip, 1995), which is a west-east trench reaching depths greater than 3,000 m and extending 1,300 km from the South American continental shelf to the Malvinas Outer Basin (Cunningham, *et al.,* 2002). South of the Falkland Trough is the Burdwood Bank, which is a large plateau rising to 50 m below the surface and forms part of the regionally dominating Scotia Ridge. There are two major channels crossing the Scotia Ridge that facilitate inflows of the Falkland Current from the ACC. The western channel is 80 km wide and 400 m deep connecting the Scotia Basin with the Falkland Trough between Staten Island and the western Burdwood Bank. The eastern channel connects the Falkland Trough to the Scotia Basin at 55°W east of the Burdwood Bank; the channel is 130 km wide and 1,800 m deep (Guerrero, *et al.,* 1999).

To the west of the Falkland Islands, a north-western extension of the Falkland Trough gradually narrows and reduces in depth as it moves northwards onto the shelf break at the north-west tip of the archipelago. To the north a large area of relatively flat seabed extends to the shelf-break approximately 140 km north of Falkland Sound. Beyond this point, the continental slope represents an increase in the gradient of the seabed and leads into the steep sloping Falkland Escarpment at a depth of approximately 3,000 m. The NFB is the area located between the Falkland Islands and the Escarpment. The NFB is characterised by a gently sloping gradient that increases in water depth from 150 m in the south-west to 1,500 m to the north-east (FIG, 2008a). The Sea Lion Field lies within the central area of the NFB in water depths ranging from 330 m to 463 m (Gardline, 2013a; MG3, 2014).

The seabed in the NFB is characterised by numerous indentations, troughs and trenches. Bathymetric surveys conducted over the NFB indicate the presence of poorly preserved iceberg keel scars, numerous depressions between 4 and 11 m deep, trenches 30 m deep and 500-600 m wide, and furrows or channels commonly up to 1.5 km wide and extending up to 210 km long (Gardline, 1998a-h).

A bathymetric survey of the Sea Lion Field revealed that historic iceberg keel scars and seabed pitting are prevalent throughout the area, and a large trench that runs from the south-west to the east of the survey area (Figure 7-14).

7.3.4.2 Berkeley Sound bathymetry

The bathymetry for the main Berkeley Sound survey area was produced from the results of the concurrent geophysical site survey and is presented in Figure 7-15 and Figure 7-16 (BSL, 2015c). More detailed representations of site-specific bathymetry along with seabed sample photographs and camera tracks are presented in BSL (2015b).

Depths within the area surveyed ranged from approximately 5 m in the west to 55 m in the east. Localised gradients of up to 19° were observed at the pinnacle bedrock features with the highest point elevated 11 m from the surrounding seabed. To the east, the eastward gradient was negligible, ranging from 0.07° to 0.16°; the seabed here was considered to be generally flat, dominated by linear gravel ribbons, except along the northern and southern coasts where bedrock was observed.

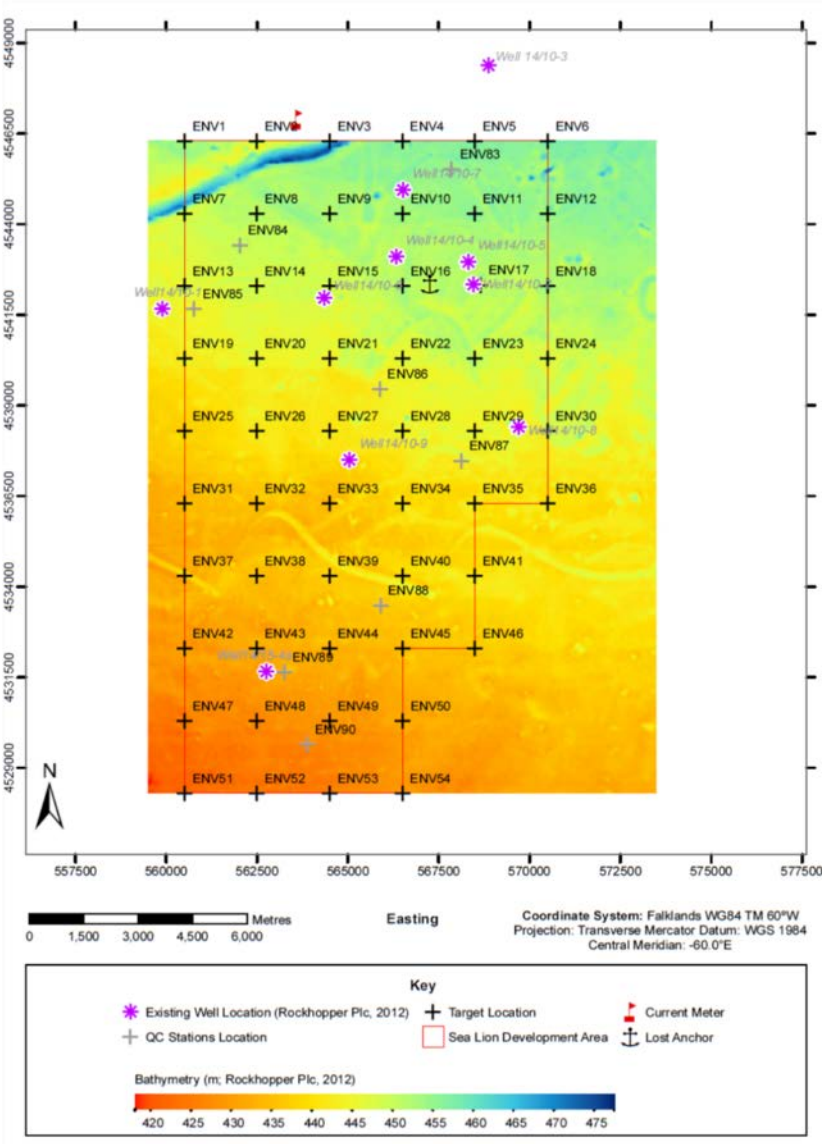


Figure 7-14: Seabed topography in the Sea Lion Field and surrounding area. 'QC stations stands for 'Quality Control'

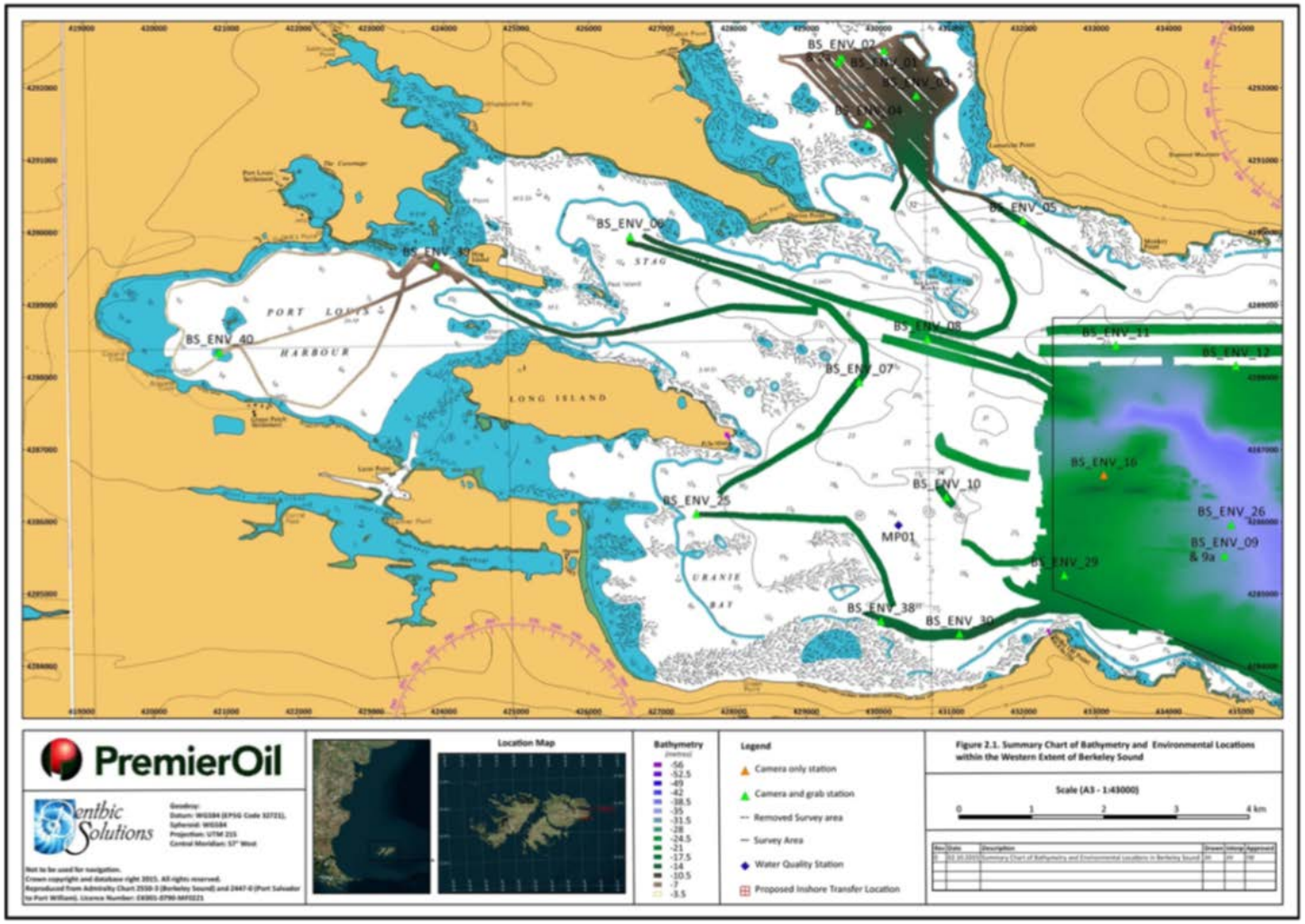


Figure 7-15: Locations of bathymetry and environmental sampling sites within the Inner Sound, the western extent of Berkeley Sound (BSL, 2015c)

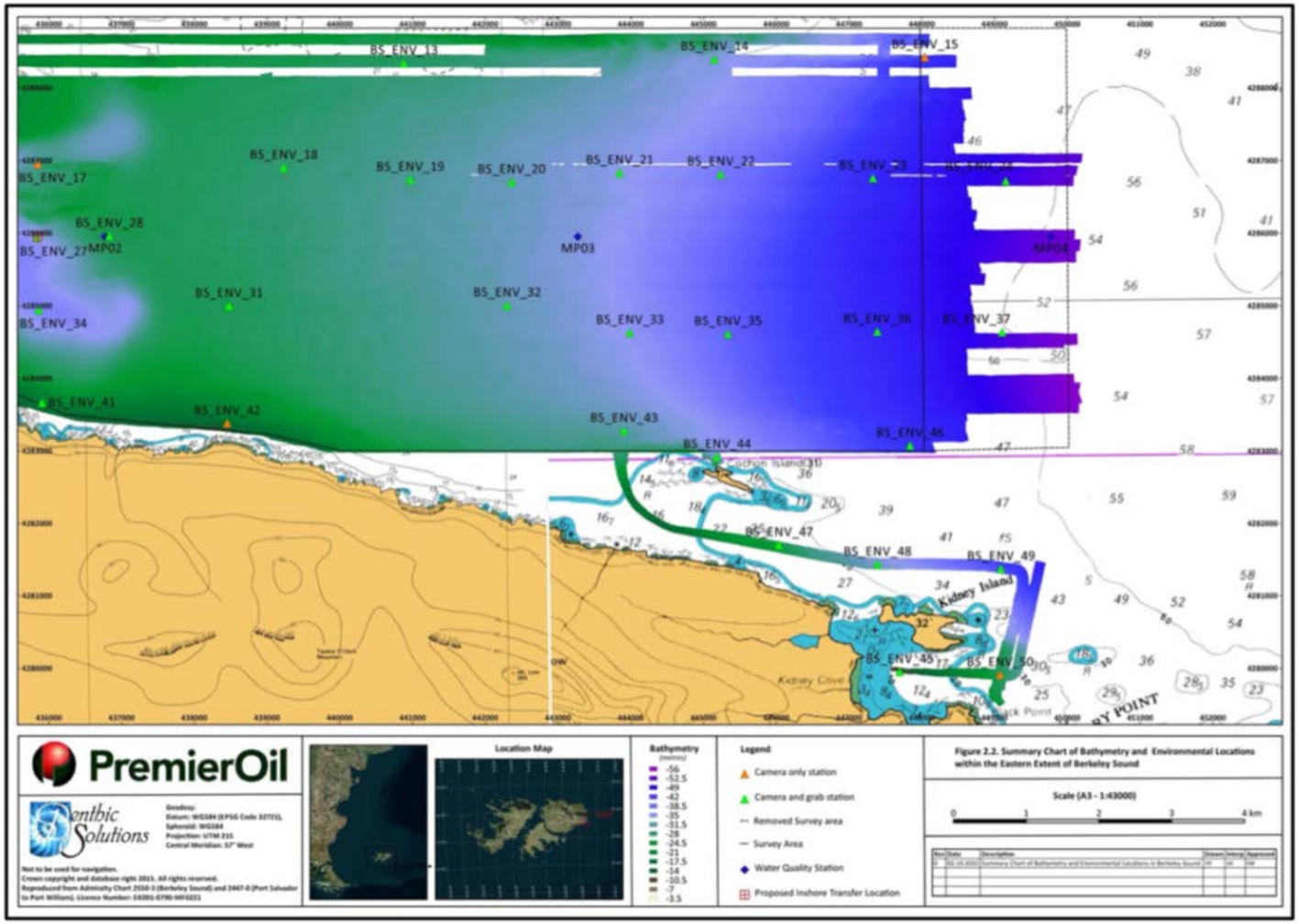


Figure 7-16: Locations of bathymetry and environmental sampling sites within the Outer Sound, the eastern extent of Berkeley Sound (BSL, 2015c), showing the proposed anchorages for LTVs and exclusion zones

7.3.5 Metocean data used in modelling

The impact and risk assessment chapters in the body of the EIA describe only the information required to ensure appreciation and understanding of the modelling results as they are used in the assessment. To avoid repetition, this section is dedicated to describing the metocean data used by SFL and Navitas to model the behaviour of discharges and releases from the Sea Lion Development.

The following metocean data were used in the modelling of:

- Drill cuttings (Section 10.6),
- Produced water (Section 10.7),
- Cooling water (Section 10.7),
- Collision risk modelling around the Sea Lion Field (Section 11.1), and
- Oil spill modelling offshore and inshore (Sections 12.1 and 12.2).

7.3.5.1 Ocean currents data

A hydrodynamic modelling study has been conducted by BMT Argoss, BMT WBM and the UK Met Office to produce high resolution ocean current data sets for the region, which have been utilised as input data for modelling the behaviour of discharges and releases. Details of the hydrodynamic modelling are given in BMT Argoss (2015).

The hydrodynamic modelling consisted of three nested model domains (see Figure 7-17), which have different spatial extents / coverage and spatial resolutions. More specifically, the model system comprised a large scale regional ‘oceanic’ domain that covers the Patagonian Shelf, and two smaller fine resolution coastal domains that cover nearshore areas of complex bathymetry and coastline features around the Falkland Islands.

Ocean currents for the larger regional domain shown in Figure 7-17 were generated by the UK Met Office using the Nucleus for European Modelling of the Ocean (NEMO) PS4 model, whilst currents for the coastal domains were generated by BMT WBM using the TUFLOW FV hydrodynamic model. The current vectors in Figure 7-17 show the average speed and direction of ocean currents over three years of data (2010 to 2012). The strong Falklands Current, which branches of the Antarctic Circumpolar Current, is evident in this graphic and will likely be a dominant transportation mechanism for any oil discharge in the region.

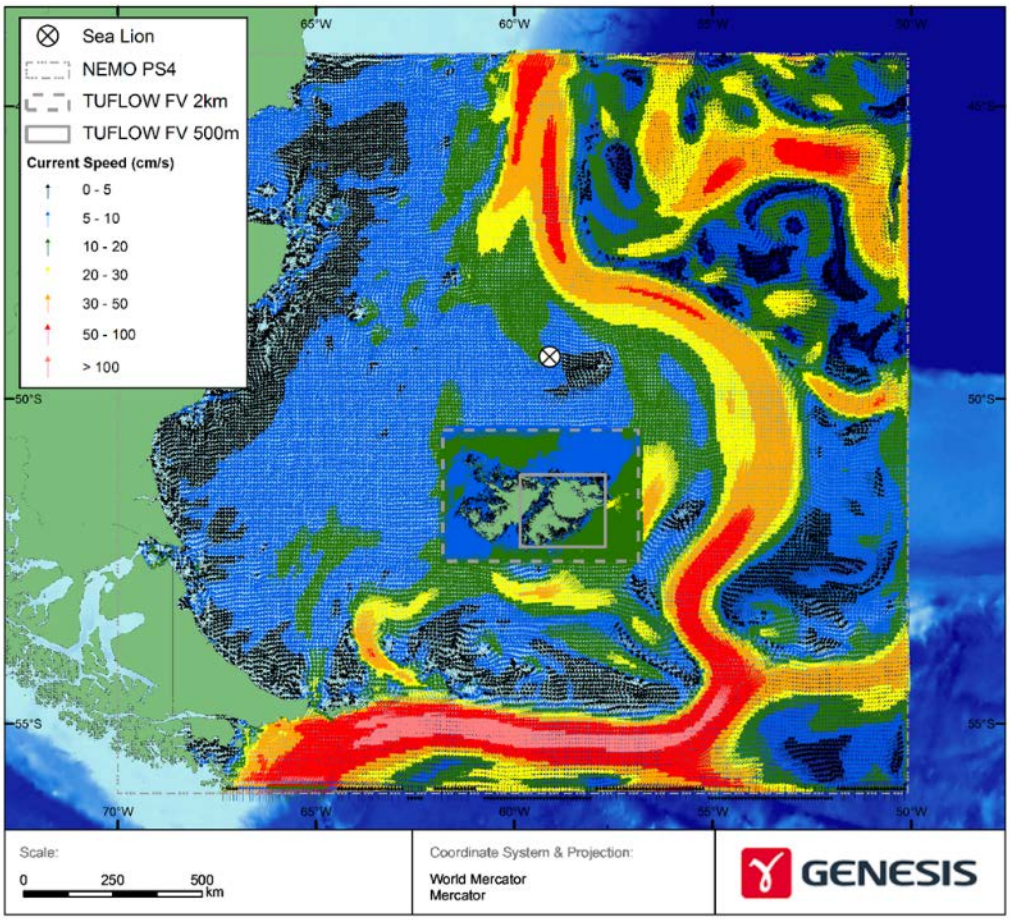


Figure 7-17: Ocean currents field obtained from the hydrodynamic modelling

7.3.5.1.1 NEMO PS4 data set

The NEMO model is a primitive equation model adapted to regional and global ocean circulation problems. NEMO is a flexible tool for studying the ocean and its interactions with the other components of the earth climate system over a wide range of space and time scales. A new NEMO ocean model configuration, named PS4, has been set up by the UK Met Office to cover the Patagonian Shelf and used to provide ocean currents for this area covering the years 2010 to 2012 inclusive.

Ocean currents generated by the NEMO PS4 model were provided on a regular grid that covers the area spanned by longitudes 50° - 70° west and latitudes 44° - 56° south (see Figure 7-17 above). The NEMO PS4 currents data have a longitudinal resolution of 1/12° and latitudinal resolution of 1/16°, which is approximately equivalent to longitudinal and latitudinal resolutions of 6 km and 7 km, respectively.

NEMO PS4 currents were provided in a number of depth layers varying depth resolutions. The depth layering and resolution is such that layers nearer the sea surface (where currents tend to fluctuate significantly with depth) are afforded finer resolutions than deeper layers (where fluctuation with depth is less pronounced). Fine resolution of the surface layers is also important in resolving fluctuations caused by wind driven Ekman currents in these layers. The NEMO PS4 currents were provided in layers consisting of:

- 1 m intervals from sea surface to 10 m depth,
- 5 m intervals from 10 m depths to 50 m depths,

- 10 m intervals from 50 m depths to 500 m depths, and
- 250m intervals from 500 m depths to 7,000 m depths.

The temporal resolution of the data set is 30 minutes i.e., the current speed and direction changes every 30 minutes. The spatial, temporal and depth resolution of this data set are considerably better than any previous available data sets that cover a comparable area.

The NEMO PS4 model has been validated using *in situ* current meter measurements at a number of different locations, and it has been shown that the agreement between modelled and measured currents is very good.

7.3.5.1.2 TUFLOW FV coastal data sets

The coastal currents data sets have been generated by BMT WBM using the TUFLOW FV hydrodynamic model, which is a numerical model that simulates hydrodynamic, sediment transport and water quality processes in coastal waters, estuaries and oceans. Currents generated by TUFLOW FV have been provided on two data grids with spatial resolutions of 2 km and 500 m (see Figure 7-17 above).

The 500 m spatial resolution data set covers the area spanned by longitudes 57.70° - 59.85° west and latitudes 51.22° - 52.35° south, whilst the 2 km spatial resolution data set covers the larger area spanned by 56.87° - 61.80° west and latitudes 50.51° - 52.57° south. Both data sets have a temporal resolution of 30 minutes and are depth layered into 15 bands with varying depth resolution. The depth layering and resolution are such that surface layers (where currents tend to fluctuate significantly with depth) are afforded finer resolutions than deeper layers (where fluctuation with depth is less pronounced). There are approximately five layers representing the top 10 m of the water column, with the remaining ten layers encompassing depths down to approximately 500 m.

Detailed example snapshots of the TUFLOW FV 500 m and 2 km resolution data sets are shown in Figure 7-18 and Figure 7-19, respectively.

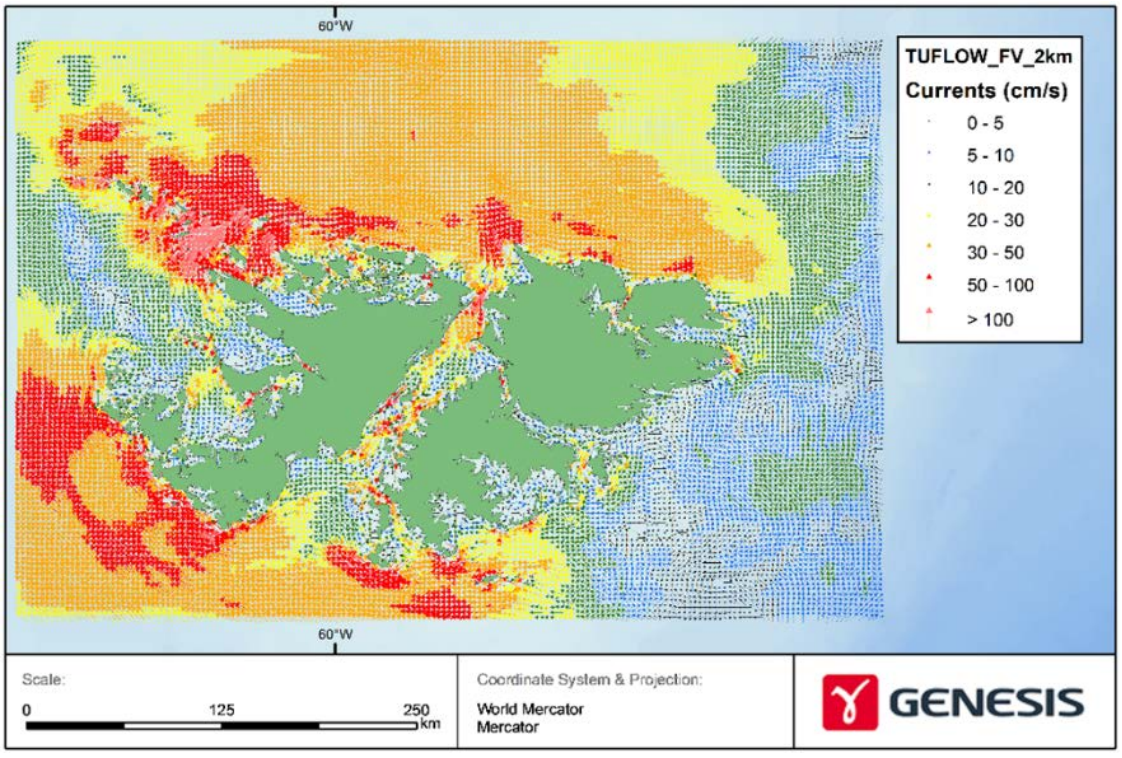


Figure 7-18: Snapshot of TUFLOW FV 2km currents grid

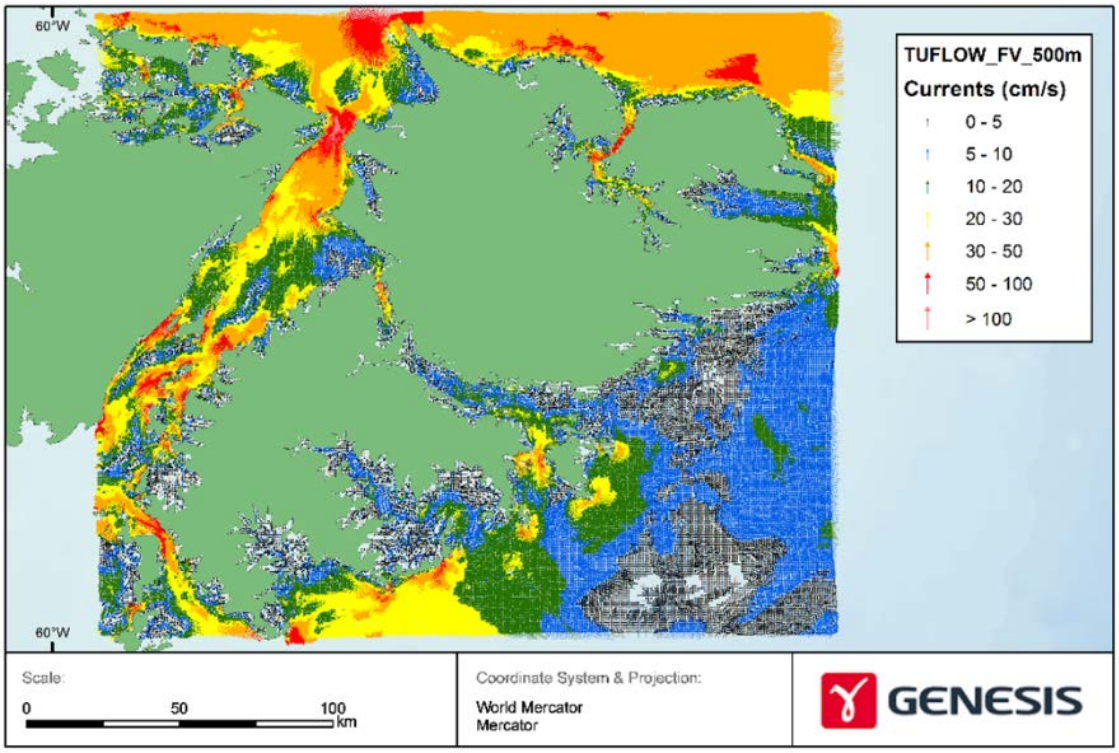


Figure 7-19: Snapshot of TUFLOW FV 500m currents grid

7.3.5.2 Current speed and direction at Sea Lion

The NEMO PS4 currents data set was interrogated at the Sea Lion location to investigate the distribution of currents in terms of speed and direction. The distribution of surface currents at Sea Lion is shown in Figure 7-20, and the distribution of currents nearer the seabed is shown in Figure 7-21. It is observed that the surface currents predominantly move in northerly and north-westerly directions, with the current speed generally being less than 15 cm/s. At the seabed the currents tend to move in westerly directions with the current speed typically being between 5 - 15 cm/s.

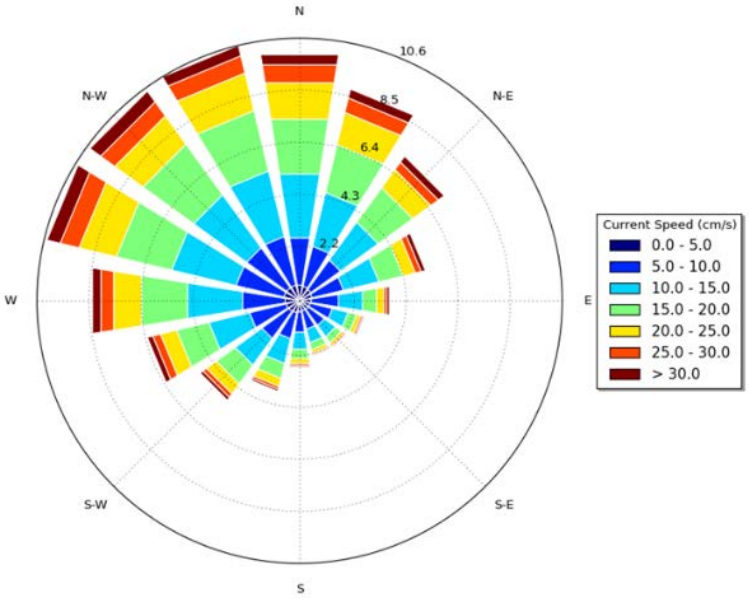


Figure 7-20: Distribution of surface currents at Sea Lion

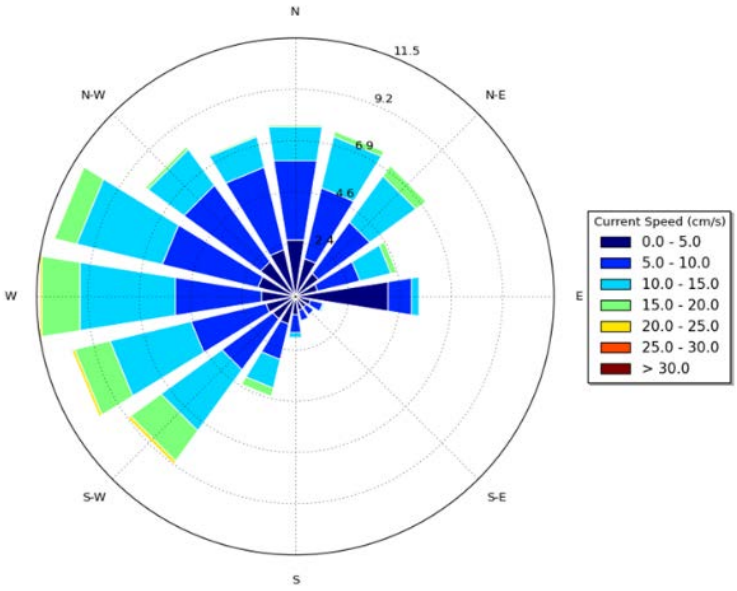


Figure 7-21: Distribution of seabed currents at Sea Lion

7.3.5.3 Wind data

To complement the current data, two different wind data sets have been used in the modelling study. A high-resolution wind data set, which covers the coastal waters around the Falkland Islands, has been produced by BMT Argoss using the Weather Research and Forecasting (WRF) model. Due to the limited coverage of this data set, a second lower resolution data set that covers a larger area has been obtained from the Climate Forecast System Reanalysis (CFSR). Similar to the currents data, the wind data from the WRF and CFSR data sets are combined into a single grid. The combined wind field grid is shown in Figure 7-22, which shows the domains of both the CFSR and WRF models. The vectors displayed in Figure 7-22 show the average wind speed and direction over the full three years (2010 to 2012) of the generated wind data.

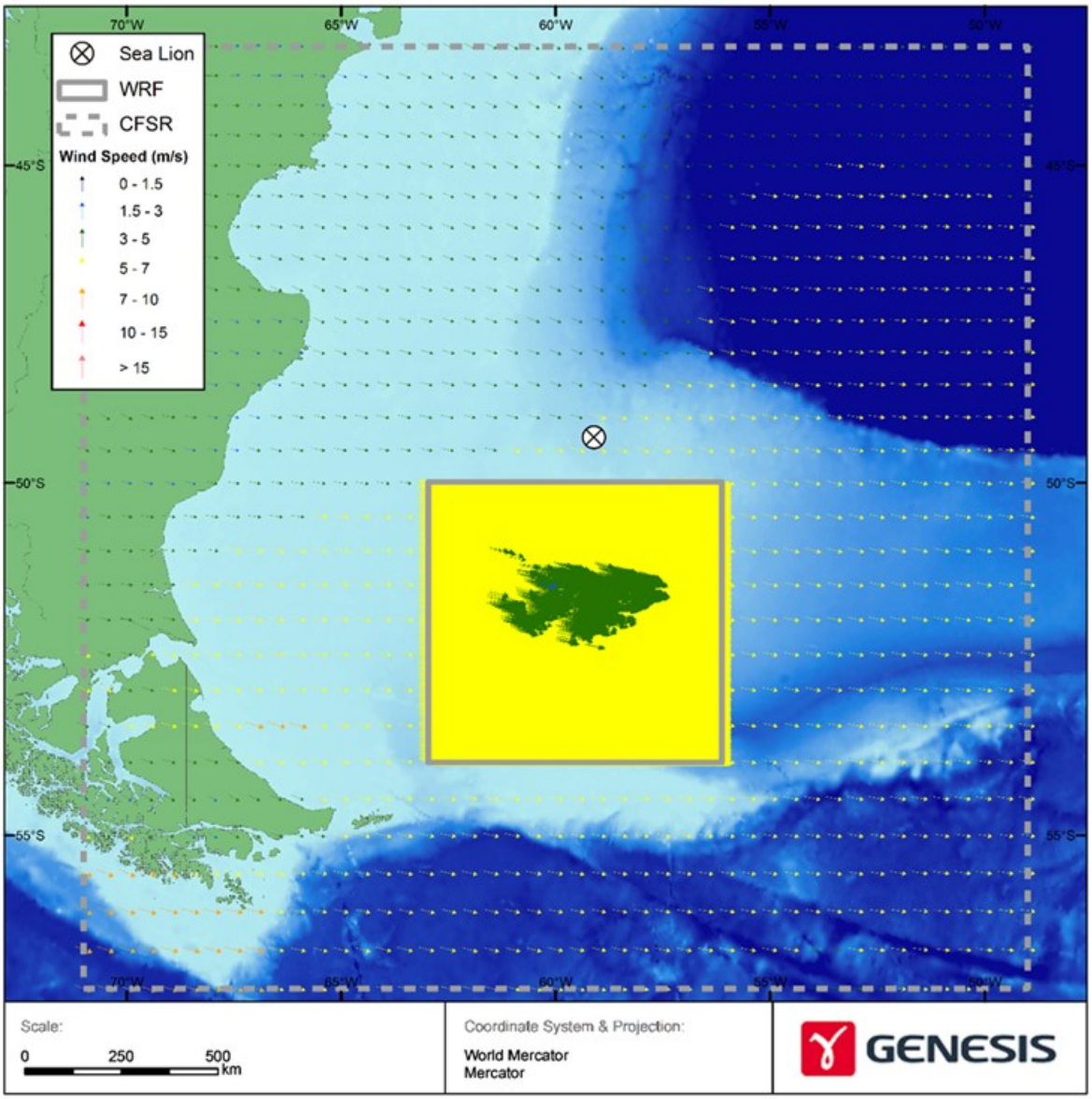


Figure 7-22: Snapshot of combined WRF and CFSR wind field grids

7.3.5.3.1 WRF wind data

The WRF model is a state of the art atmospheric modelling system designed to serve both atmospheric research and operational forecasting applications (Skamarock, *et al.,* 2008). The model has been developed by a number of different agencies including (but not limited to) the National Centres for Atmospheric Research's Meoscale and Microscale Meteorology Division, the National Oceanic and Administration's National Centres for Environmental Prediction and Earth System Research, and the Naval Research Laboratory.

The WRF wind data covers the area spanned by coordinates 50° - 64° west and latitudes 56° - 63° south with a spatial resolution of approximately 3 km and temporal resolution of one hour. In computing wind fields, the model makes use of high-resolution topography data obtained from the Shuttle Radar Topography Mission, and takes into account land / sea effects and local-scale weather variability.

The WRF model parameters and inputs have been optimised by BMT Argoss to produce high accuracy results. The modelled wind speed and direction have been validated against *in situ* measurements made at Mount Pleasant and showed good agreement.

A detailed typical snapshot of the instantaneous wind field generated by the WRF modelling is demonstrated in Figure 7-23, which highlights the spatial resolution of the data set.

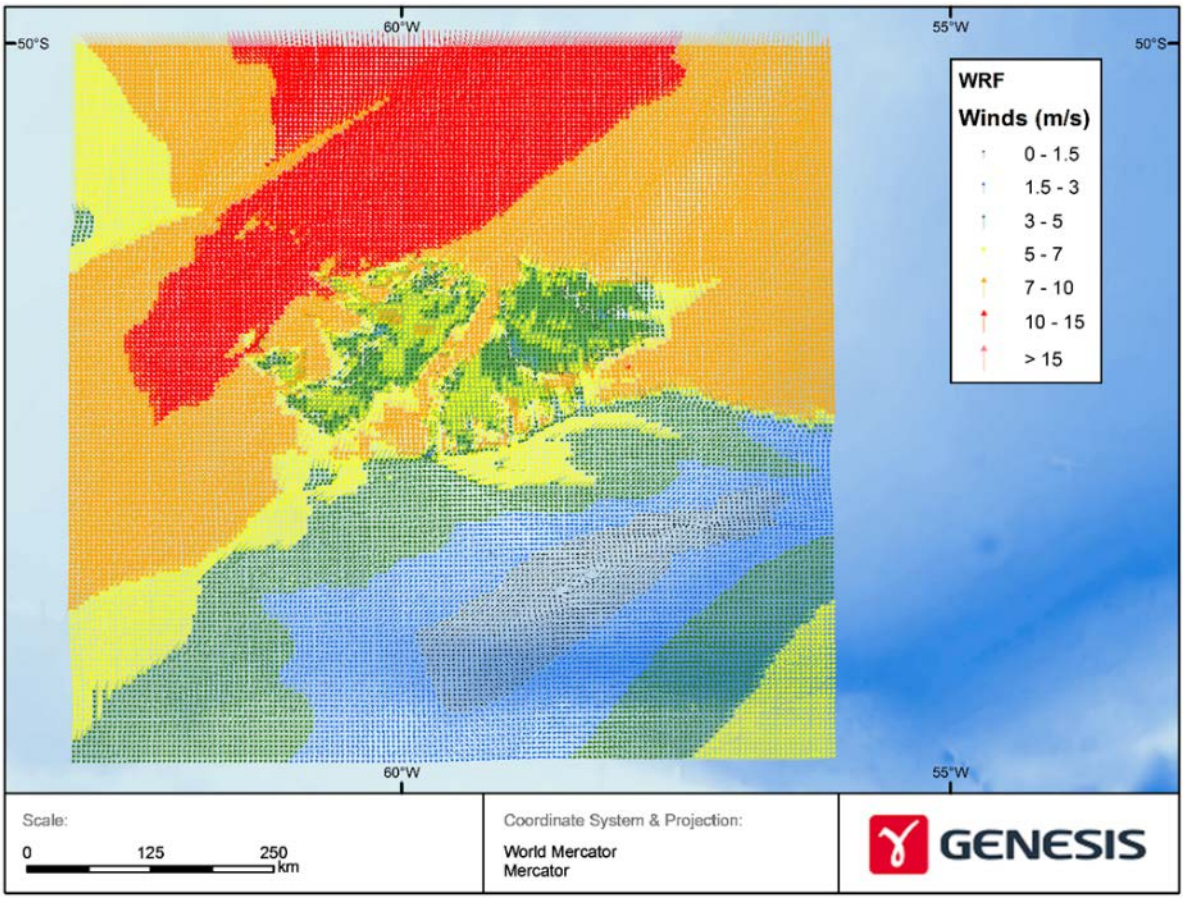


Figure 7-23: Snapshot of wind field produced by the WRF model

7.3.5.3.2 CFSR wind data

A lower resolution wind data set covering a more expansive region than the high resolution WRF data set has also been sourced from the new Climate Forecast System Reanalysis (CFSR) produced by the National Centres for Environmental Prediction (NCEP) (Saha, *et al.,* 2010). CFSR is a third generation global coupled reanalysis product that includes coupled atmosphere, ocean, land surface, and sea ice models, and also assimilates a wide variety of *in situ* and satellite observations.

The CFSR wind data set used in this modelling study contains wind vectors at a height of 10 m above sea level over the same three years as the other metocean data sets (i.e., 2010-2012). The data set covers the area spanned by longitudes 48.8° - 71.2° west and latitudes 42.8° - 56.8° south.

The temporal resolution of the CFSR data set is one hour. The longitudinal and latitudinal resolutions of the data set are 0.5°, which for the area of interest equates to longitudinal and latitudinal resolutions of approximately 36 km and 54 km, respectively. The spatial extent and resolution of the CFSR wind data is highlighted in Figure 7-22 above.

CFSR data is from an internationally recognised source with ongoing calibration and validation. Offshore wind data at the Sea Lion Field has been collected in 1998, 2015 and 2016 and reviewed by

Oceanwise on behalf of POEPL. There is insufficient data to make a statistical annual comparison for the Sea Lion Field, however global hindcast datasets such as CFSR are considered reliable, particularly in marine locations with no land features. In Berkeley Sound, further wind modelling was undertaken to account for local topographical features.

7.3.5.3.3 Wind speed and direction at Sea Lion

The CFSR wind data set was interrogated around the Sea Lion location in order to investigate the distribution of winds in terms of speed and direction. The rose plot in Figure 7-24 shows the distribution of wind at the Sea Lion location.

It is observed from Figure 7-24 that at the Sea Lion location the winds generally blow from westerly directions towards the east, with the wind speed typically being between 6 - 12 m/s.

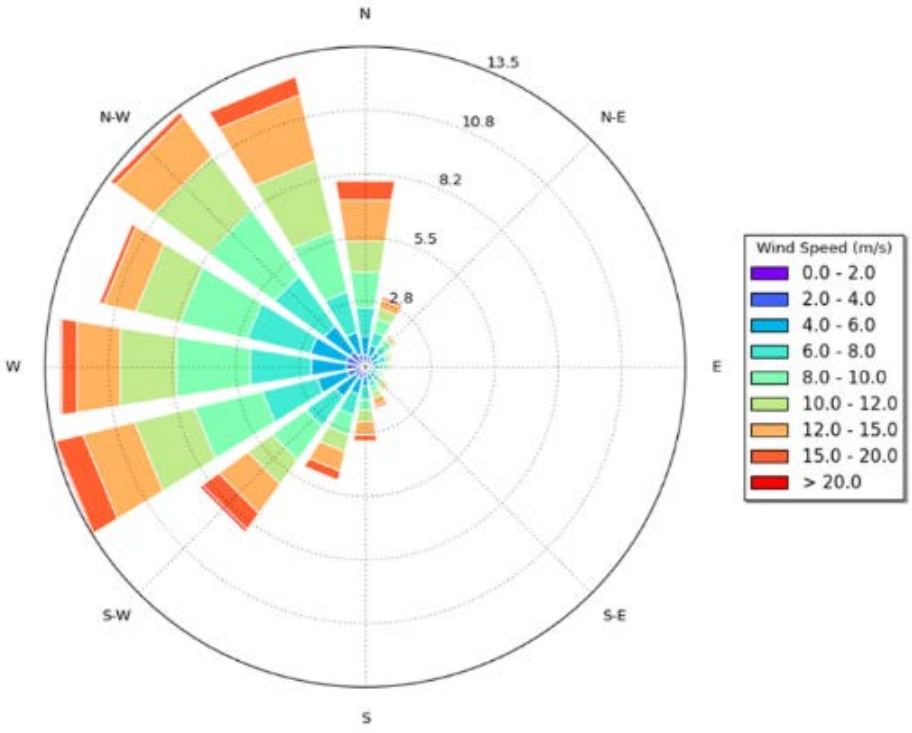


Figure 7-24: Distribution of winds at Sea Lion

7.3.5.4 Bathymetry data

The bathymetry data that has been used in this modelling study has been provided by BMT and was created by combining ETOPO2 (a global relief model of the Earth's surface that integrates land topography and ocean bathymetry) and General Bathymetric Chart of the Oceans (GEBCO) data. For areas in the vicinity of the Falkland Islands, BMT bathymetry was used. Particular attention was given to representation of features on the shelf edge to the north-east of the Falkland Islands, and also to Burdwood Bank to the south. Features were compared with Admiralty chart contours and, in some instances, local modifications were made by BMT.

The bathymetry data supplied by BMT is precisely the same data that was used in the hydrodynamic modelling to produce the ocean currents data sets discussed in Section 7.3.3. This is important since it results in a perfect match between bathymetry and seabed currents data. A mismatch in bathymetry and currents data can result in 'dead zones' near the seabed, which could adversely affect subsea discharge modelling.

The BMT bathymetry data was provided by BMT as irregularly spaced depth samples. This data was interpolated onto a regularly spaced grid in order to be compatible with the OSCAR model. The resulting interpolated bathymetry grid is depicted graphically in Figure 7-25.

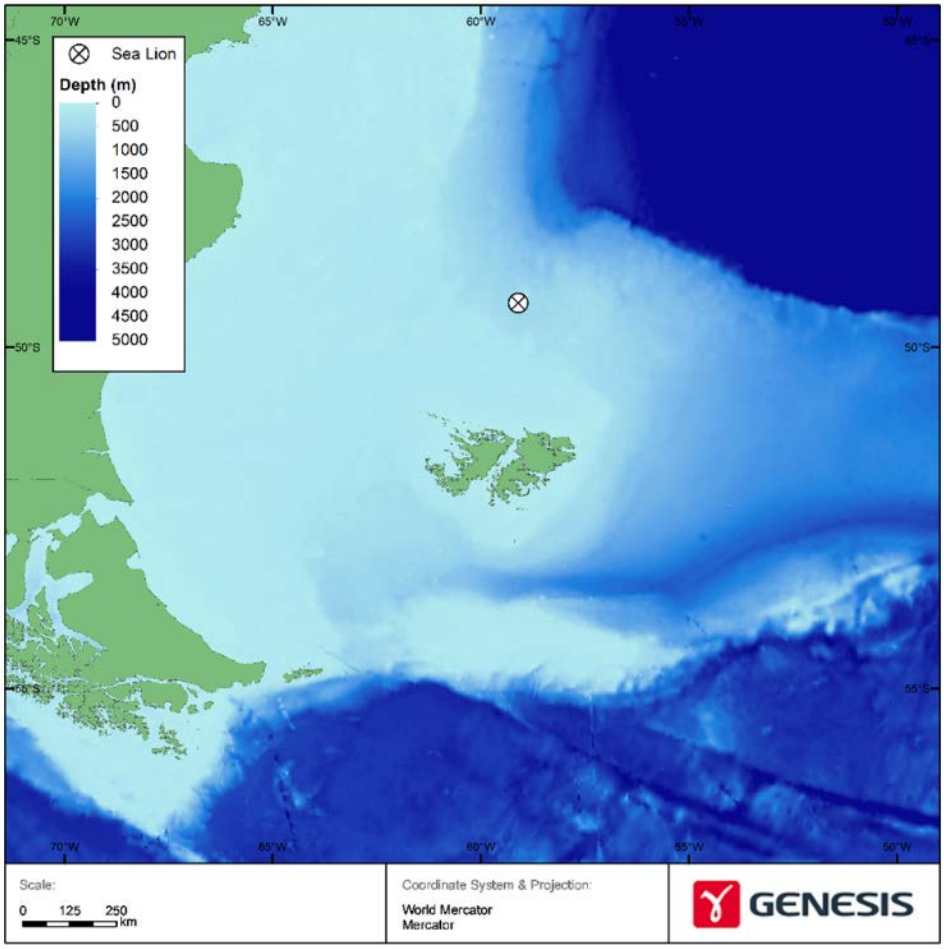


Figure 7-25: Bathymetry data used in the modelling

7.3.6 Geology and subsurface description

7.3.6.1 NFB and Sea Lion Field geology

The NFB is the name given to the set of sedimentary basins that lie to the north of the Falkland Islands (Richards and Fannin, 1997). It consists of two main sub-basins:

- A Northern Rift Basin (NRB) in which the predominant strike of the structural elements is north to south in orientation, and
- A Southern Rift Basin (SRB) in which the predominant strike of the main structural elements is north-west to south-east in orientation.

The main graben of the NRB is about 150 km long and 50 km wide at its northern end.

The Sea Lion Field is located on the north-east margin of the NRB. The Sea Lion Field was discovered in May 2010 by Rockhopper Exploration with well 14/10-2 which encountered oil reservoirs in good quality Lower Cretaceous turbidite sandstones that form a series of deepwater basin floor fans deposited into a stratified anoxic lake (Richards and Hillier, 2000; Holmes, *et al.,* 2015). Following discovery of the Sea Lion Field, the area was appraised by eight wells ikand two sidetracks), which helped delineate the extent of the Sea Lion accumulation and in addition proved the presence of

hydrocarbons in three younger fans (Casper, Casper South and Beverley). The main sediment source for the fans originated from flanking basement highs (primarily to the east), which connect into the main graben depo-centre *via* a series of feeder canyons or channels. Fans are highly sand-prone and were constructed by intrusive density flows. Deposition occurred from both turbidity currents and mass flows (for example, fluidised sediment-gravity flows).

7.3.6.2 Berkeley Sound geology

The geology of the Berkeley Sound area is principally sandstone and mudstone with overlying Quaternary sediments. The Quaternary sediments have been described as 'head deposits', comprising mainly gravels and sands, formed through a process called solifluction (Andersson, 1906; BSL 2015c; Solifluction is 'the gradual movement of wet soil or other material down a slope').

A number of rock outcrops occur within Berkeley Sound; those near the centre of the Sound, near the proposed LTV anchorage location are thought to be composed of sandstone and mudstone, originating from the Fox Bay and Philomel formations (Geological map of the Falkland Islands; British Geological Survey, reproduced in BSL, 2015a). The exposures observed along the northern and southern coasts of the Sound are thought to be formed of quartzite, with origins in the Port Stanley and Port Stephens formations (BSL, 2015a). These quartzite formations are more resistant to weathering and erosion.

7.3.7 Sediment characteristics

7.3.7.1 NFB and Sea Lion Field sediments

It is necessary to have an understanding of the baseline offshore sediment characteristics with regard to sediment types (grain size and organic matter content) and sediment chemistry in order to understand the potential impacts of discharges and disturbances associated with the Phase 1 & 2 Development.

The Falkland Islands are relatively immature in terms of O&G production and whilst 29 exploration wells have been drilled in the NFB to date there is currently no O&G production underway in the region (the Phase 1 & 2 Development is the first proposal for oil extraction). Therefore, typical background sediment types and chemistry datasets for the offshore and Berkeley Sound locations have not been formally characterised.

However, as described in Section 7.2.2 above, 20 offshore benthic surveys have been conducted between 1998 - 2016 within the three main Falklands basins. These surveys cover a range of depths from 140 m to 2,100 m and a range of metocean conditions, predominantly influenced by the East Falklands Current as it flows northwards to the east of the Falkland Islands.

The data provided indicate that Sea Lion sediments are comparable to those within the wider Falkland Islands waters (Gardline, 2013a & b).

7.3.7.1.1 Sediment type

7.3.7.1.1.1 Grain / Particle size

It is important to appreciate the baseline grain sizes of sediments (e.g., fine, medium, course) in the Sea Lion area as grain sizes directly affect the composition of benthic communities.

Sediments across the NFB typically exhibit a south-north gradient of decreasing mean particle size (Gardline, 1998a). The proportion of fine material, defined as material with a diameter <63 µm, generally increases with increasing depths. In the NFB, the sediment types range from 'very fine sand' in shallower waters (225 m depth) in the south-west, to 'coarse silt' in deeper waters (464 m depths) in the north-east (Gardline, 1998a).

During the area-wide 2012 environmental baseline survey in the Sea Lion area mean grain sizes ranging from 18 µm to 39 µm were recorded throughout the field, indicating that sediment types were generally homogenous (Gardline, 2013a). Sediments were predominantly classified as 'medium silt', with the exception of seven stations generally located in the northern part of the survey area that were classified as 'coarse silt'. The percentage of fine material (<63 µm) was high (61.6 – 79.7 %) at all stations across the Sea Lion area. These results were comparable to the sediment types recorded during the 1998 Falklands Offshore Sharing Agreement (FOSA) pre-drilling surveys conducted at 'B1' 14/05 and 'Little Blue' 14/09 wells (approximately 8.5 km and 16 km west of Sea Lion respectively) (Figure 7-5 above).

Post-drilling well site surveys carried out across the Drilling Campaign Areas contained similar proportions of fines, sands and gravels to those recorded in the Sea Lion area-wide survey (Gardline, 2013a & b). Whilst the highest variation was associated with the gravel fraction (>2 mm), which ranged between 0.1 % and 10.3 % contribution, this was attributed to natural variation across the area, and may originate from glacial drop-stones as found in the FOSA area. Analysis of other parameters did not indicate any disturbance from previous drilling activities. In the shallower waters of the southern NFB (140-285 m depths) the sediments were dominated by coarser sand particles, with a mean grain size of 156.5 µm (BSL, 2008b).

7.3.7.1.1.2 Total Organic Matter and Total Organic Carbon

Sources of organic matter in marine sediments include photosynthetic fixation of CO_2 by phytoplankton, decomposition of dead organisms, excretions from marine fauna, terrestrial inputs from rivers etc. and the excretion of extra-cellular products by algae which liberate appreciable proportions of the compounds produced by photosynthesis into the water (Lazar, *et al.,* 2012). Anthropogenic inputs to the marine environment can result in eutrophication which can enhance growth of phytoplankton and thus have the potential to upset the natural balance between organic matter deposition and the capacity of the sediment to 'recycle' the organic matter. The amount of organic matter in marine sediments is generally dominated by fluxes in the deposition of surface derived phytodetritus (decomposing phytoplankton and other plant material) to deeper water sediments.

Given that the level of organic matter in sediments can have a major influence on chemical and biological processes which occur within the sediments, as well as affecting the behaviour of other chemical components such as metals and organic pollutants (Lazar, *et al.,* 2012), it is important to understand the background levels of organic matter in order to determine whether or not anthropogenic activities may have an impact.

Total Organic Matter (TOM) and Total Organic Carbon (TOC) in sediment samples taken from the Sea Lion area were measured as a percentage of total sample weight. Both TOM and TOC levels were generally found to be homogeneous across the Sea Lion area with mean values of 5.6 % (±0.5 SD), and 0.9 % (±0.1 SD) respectively (Gardline, 2013b).

Both TOM and TOC were found to correlate with particle size, with higher proportions of organic matter recorded at stations with a higher percentage of fines ($P<0.001$). This relationship is linked to both the rate of sedimentation (detrital rain) from surface waters, and the hydrodynamic regime. Lower concentrations of organic matter are generally found in sandier sediments where surface sediments indicate some mobility and consequently have a lower percentage fines.

Values for TOM were similar to those recorded during the FOSA 1998 pre-drilling survey for the 'B1' 14/05 well and the 'Little Blue' 14/09 well (mean 5.7 % (±0.5 SD) and 4.3 % (±1.9 SD) respectively) (Gardline, 1998a & b). These samples were the closest to the Sea Lion Field and were located in comparable depths (415-482 m), further indicating the homogeneity of this area of the NFB. In the

southern NFB the level of total organic matter remained consistently low throughout the survey area (1.7 % (±0.4 SD)) perhaps reflecting the reduced proportion of fines and mobile sandy sediments of the shallower waters (BSL, 2008b).

7.3.7.1.2 Sediment chemistry

7.3.7.1.2.1 Sediment hydrocarbons

Total Hydrocarbon Concentrations (THC)

Hydrocarbons in marine surface sediments may have originated from a number of sources, including terrestrial run-off in coastal areas, vessel spills and discharges, plant origin, natural seeps and hydrocarbon extraction.

In the Sea Lion pre-development area-wide survey, the THC ranged from 4.7 - 15.5 $\mu g.g^{-1}$ (mean 9.7 $\mu g.g^{-1}$ (±2.7 SD)) across all stations. Samples collected during the post-drilling survey exhibited THC levels within a similar range as the area wide survey, ranging between 3.5 $\mu g.g^{-1}$ and 17.2 $\mu g.g^{-1}$ with a mean of 8.5 $\mu g.g^{-1}$ (±2.9 SD). Overall, no spatial trends were observed and THC levels were considered to be within natural ranges exhibited by background variation (Gardline, 2013a & b).

Generally, the results from all seven FOSA survey locations show low THC with the exception of the 'Minke' 14/13 well, located approximately 24 km south-west of Sea Lion, which recorded a mean THC 4.6 $\mu g.g^{-1}$ (±4.1 SD) (Gardline, 1998h). Similar levels were also recorded in shallower water depths (140-285 m) during the southern NFB survey in 2008 located >50 km south of Sea Lion (mean 4.3 $\mu g.g^{-1}$ (±1.4 SD)) (BSL, 2008b), although mean THC in both areas were low in comparison to Sea Lion.

Survey results suggest that levels of THC within the Sea Lion area were not above typical background levels for this region.

Hydrocarbon composition

Unresolved Complex Mixture (UCM) is a fraction of hydrocarbons, which are not fully separated during gas chromatography (GC) and appear as a 'hump' on the GC trace. This unresolved fraction consists of a number of individual components, which remain after substantial weathering and biodegradation of petrogenic inputs (Farrington, *et al.,* 1977), and can provide an indication of the origin of contamination or the natural source. At the majority of stations across the Sea Lion Area, UCM accounted for the majority of hydrocarbons within the sediments, which is indicative of well-weathered hydrocarbon sources and suggests that the majority of the material did not originate from fresh hydrocarbon inputs from drilling activities (Gardline, 2013a).

Sea Lion sediments exhibited a mixture of biogenic and petrogenic hydrocarbon inputs, with a predominance of biogenic inputs. These biogenic inputs were likely to be derived from marine organisms associated with the highly productive surface water in this area of the South Atlantic and diffuse terrestrial plant sources (Gardline, 2013a). Petrogenic hydrocarbons may have been derived from various anthropogenic activities, including the historic exploratory drilling activity in the area (Gardline, 2013b).

Polycyclic Aromatic Hydrocarbons (PAH)

Monitoring the aromatic hydrocarbon type and content is particularly important due to the toxic nature (mutagenic/carcinogenic) of several of Polycyclic Aromatic Hydrocarbons (PAHs) even at very low concentrations.

PAHs and their alkyl derivatives have been recorded in a wide range of marine sediments (Laflamme and Hites, 1978) with the majority of compounds produced from what is thought to be pyrogenic sources. These are the combustion of organic material such as forest fires (Youngblood and Blumer, 1975), the burning of fossil fuels and, in the case of offshore oilfields, flare stacks, etc. The resulting

PAHs, are normally transported to the sediments *via* atmospheric fallout or river runoff. Another PAH source is petroleum hydrocarbons, often associated with localised drilling activities. These are rich in the lighter, more volatile 2 and 3 ring PAHs (NPD; naphthalene, phenanthrene and dibenzothiophene).

Mean total PAH concentrations across the Sea Lion area were 0.12 $\mu g.g^{-1}$ (±0.02 SD), whilst mean PAH concentrations at the post-drilling survey stations ranged from 0.10 $\mu g.g^{-1}$ (±0.03 SD) to 0.15 $\mu g.g^{-1}$ (±0.01 SD). Mean total NPD concentrations across the Sea Lion area were 0.05 $\mu g.g^{-1}$ (±0.01 SD), compared to a range of 0.04 $\mu g.g^{-1}$ (±0.01 SD) to 0.065 $\mu g.g^{-1}$ (±0.01 SD) at the post-drilling survey stations.

When compared to the FOSA 1998 pre-drilling baseline survey, the maximum Sea Lion development area and post-drilling PAH and NPD concentrations were marginally higher than the FOSA stations, with the exception of the Minke well location, which exhibited mean PAH of 0.72 $\mu g.g^{-1}$ (±0.01 SD) and NDP of 0.2 $\mu g.g^{-1}$ (±0.01 SD). Comparison on a wider regional basis indicated that PAH and NPD levels from the SFB Burdwood Bank and Toroa surveys were approximately double the mean values recorded from the Sea Lion survey, whilst samples from the EFB were broadly comparable to those from the Sea Lion area.

Analysis of PAH composition in Sea Lion area sediments indicated that they predominantly originate from pyrogenic sources (Gardline, 2013a & b). Whilst there was no evidence of any point source contamination at any of the Sea Lion area stations, the presence of the lighter, more volatile 2-3 ring hydrocarbons is indicative of a minor source of petrogenic hydrocarbon, which may be associated with the relatively recent exploratory drilling activity, or natural diffuse hydrocarbon seeps (Gardline, 2013b).

Heavy metals

Metals occur naturally in the marine environment and are widely distributed in both dissolved and sedimentary forms. Anthropogenic inputs of metals to the marine environment are primarily as components of industrial and municipal wastes and of particular relevance to the offshore oil and gas industry are drilling discharges, which can contain substantial amounts of barium sulphate (barite) as a weighting agent (NRC, 1983). Barite also contains measurable concentrations of heavy metals as impurities, including cadmium, chromium, copper, lead, mercury and zinc (NRC, 1983).

Generally concentrations of heavy metals across the Sea Lion area and from the post-drilling survey were within background levels observed at other locations on the Falklands continental shelf and therefore considered to be within natural variability for this region. Lead (Pb) was the only exception where values from Sea Lion area were higher than those from the FOSA 1998 pre-drilling baseline survey, which were generally found to be below the levels of detectability.

When normalised to 5 % Aluminium (Al), several of the metals (Copper - Cu, Nickel - Ni, Lead - Pb and Zinc - Zn) recorded significant negative correlations with mean particle size and sand, and positive correlations with fines. This suggests the metal concentrations within the survey area were largely associated with natural variation in physical sediment characteristics and therefore should be considered as background in concentration for this area of the Southern Atlantic (Gardline, 2013a).

7.3.7.2 Berkeley Sound sediments

The sediments within Berkeley Sound are very variable, but three general seabed types have been identified: sand with gravel ribbons, mud with fine sands, and bedrock exposures. At the eastern, oceanic end of the Sound the seabed generally comprised sands interspersed with gravel ribbons and varying proportions of fragmented shell material. At the western end of Berkeley Sound and within the shallow bays, sediments were generally finer with muds and fine sands recorded. Bedrock exposures in the form of rocky escarpments were identified in the centre of the survey area, close to the proposed LTV anchorage location, and along the north and south coasts of the Sound. These

exposures consisted of rock faces in a predominantly north-south orientation. Numerous variations to these very general habitats were observed throughout Berkeley Sound; these are discussed in detail in BSL's Habitat Assessment (BSL, 2015b), and are described in Section 7.4.3.3.3.

Black gravels and coarse sands were present at a number of stations, possibly of volcanic origin (i.e., basalt), along with fragmented relic shell material. Other biogenic contributors to the sediments included, intact relic mussel and clam shells. Along with cobbles, these shells were often encrusted with both live and relic barnacles.

7.3.7.2.1 Sediment type

7.3.7.2.1.1 Grain / Particle size

The particle size interpretation of sediments from Berkeley Sound is based upon observations made from the acoustic and seabed photography, and from the analytical results acquired from the surface sediments at 46 locations (Figure 7-26). Material for particle size analysis was recovered from the surface 5 cm and was analysed by BSL upon return of the samples to the UK.

Particle size analysis indicated that the seabed was highly variable throughout Berkeley Sound, with varying levels of fines, sands and gravels (including pebbles). The average sediment composition was as follows:

- Fines (diameter <63 µm): mean 15.44 % ± 19.82 SD (SD = standard deviation),
- Sand (63 µm- 2 mm): mean 70.85 % ± 27.42 SD, and
- Gravel (> 2 mm): mean 13.71 % ± 20.55 SD.

The mean particle size recorded at each station is illustrated in Figure 7-26, and ranged from 40 µm to 15,540 µm (or, 15.54 mm), demonstrating the huge variability in sediment sizes based upon the proportions of silts, clays, sands and gravels recorded around a general sand profile in Berkeley Sound.

The relative proportion of sand, mud and gravel was used to classify the sediment type, using the Folk (1954) classification scheme. The dominant sediment type representing slightly gravelly sand and was recorded at 15 of the 46 stations sampled (Figure 7-27).

The geographical distribution of sandy sediments (>63 µm to 2 mm) is illustrated in Figure 7-28. This figure highlights the widespread distribution throughout the Sound with a general reduction in sands in the lower energy inshore region towards the west. Where sands were prevalent in the western inshore regions (Stations 10 and 25) they also contained a higher proportion of fines (13.49 % and 2.77 % fines, respectively) than the sands found in the east of the Sound.

The geographical distribution of sediment fines (i.e., silts and clays <63 µm), is illustrated below in Figure 7-29. This shows a distribution pattern of an increasing proportion of fines towards the western inshore regions of Berkeley Sound, with stations 02A and 40 showing the highest proportions of fine sediments with 69.2 % and 65.5 %, respectively. In addition to this, fines were also elevated in the trough of the large basin feature around station 34. Again, the percentage of fines here was mostly distributed based upon the hydrodynamic regime, with elevated levels generally located where the water flow is of a lower energy.

The spatial distribution of coarser gravel sediments (granules above 2 mm in size) is presented in Figure 7-30. Coarse sediments were recorded in all but 10 samples spread throughout the survey area; where present, they ranged from less than 0.1 % to 69.9 %, with a survey mean of 13.7 %.

Most of the coarse sediments recorded within Berkeley Sound were generally biogenic in origin, i.e., relating to shell material derived from bivalves and barnacles (including the gravel ribbons). However, at stations in closer proximity to bedrock exposures (e.g., Stations 07, 08, 11, 12, 28, 29, 41, 44), higher proportions of cobbles, pebbles and gravels, from glacial and peri-glacial deposits and from the eroded

rocks themselves, were found. Coarse sediments were often encrusted with biogenic material consisting primarily of molluscs, barnacles and bryozoans.

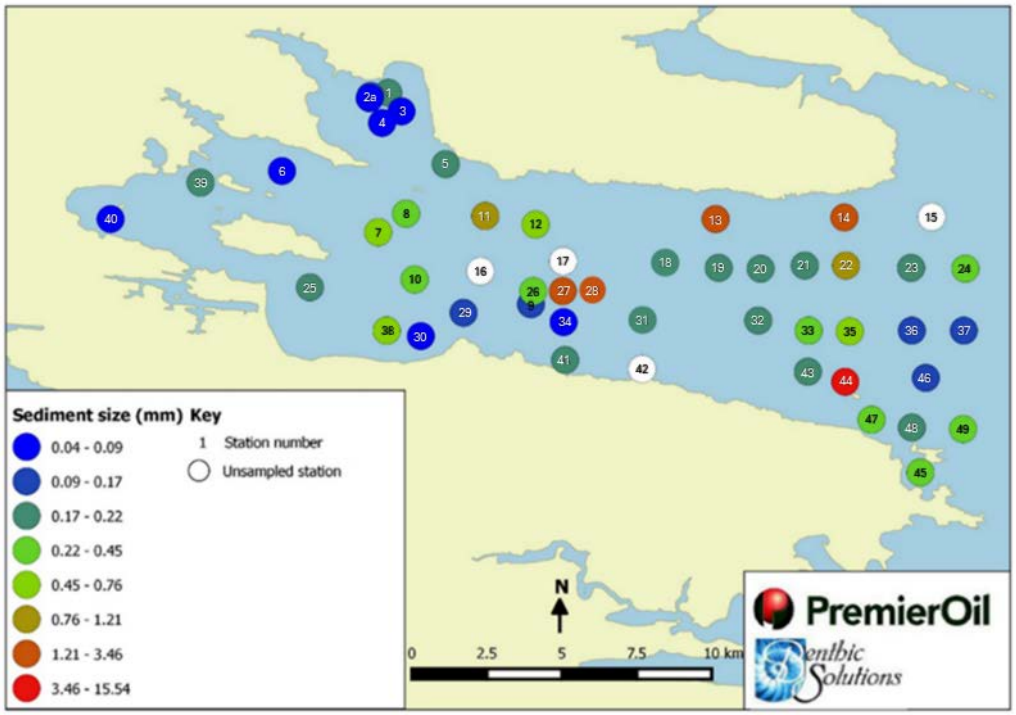


Figure 7-26: Mean particle size (mm) recorded at each of the 46 sites sampled ***(Source: BSL, 2015c)***

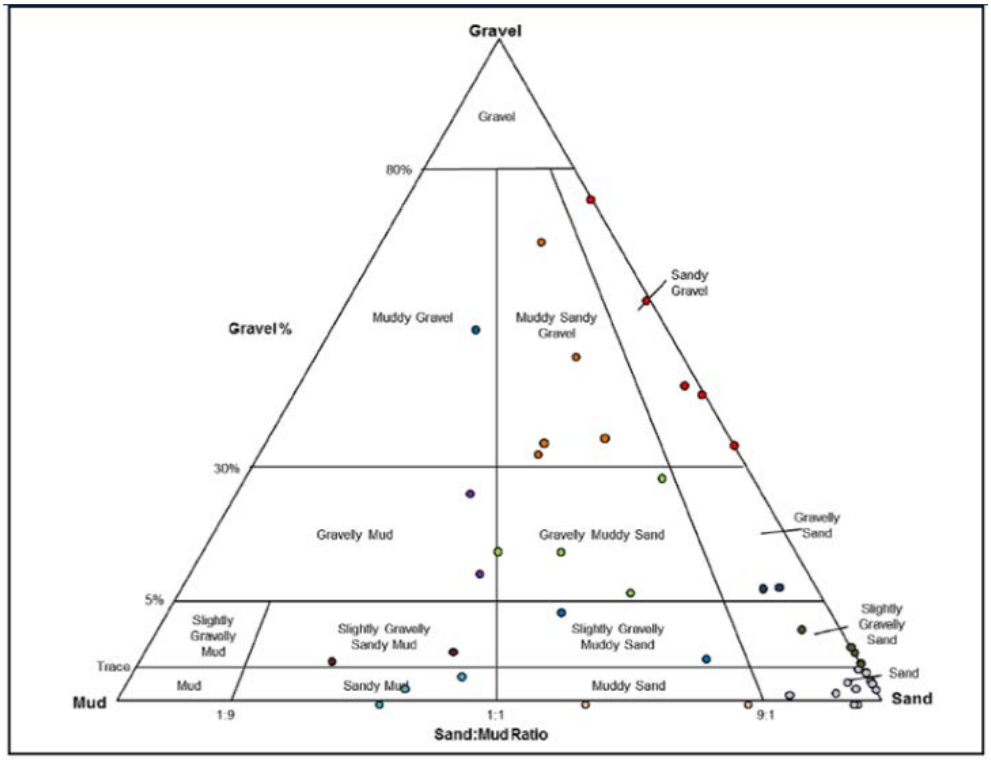


Figure 7-27: The position of the 46 stations sampled within Berkeley Sound within the Folk triangle ***(Source: BSL, 2015c)***

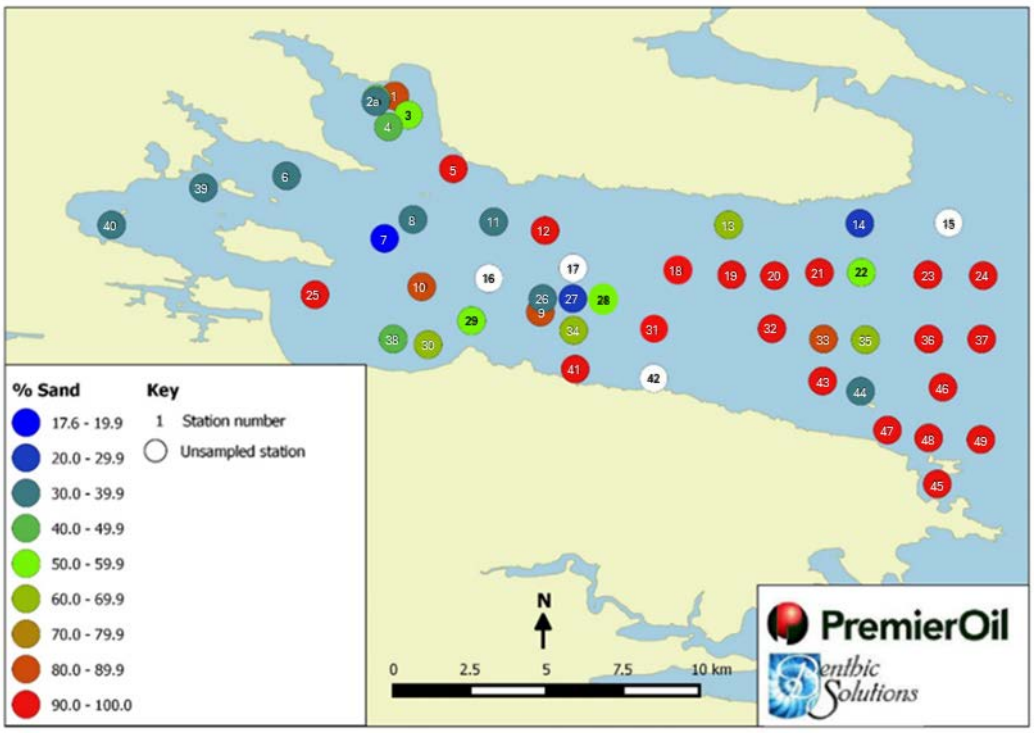


Figure 7-28: Percentage of sand recorded at each of the 46 sites sampled ***(Source: BSL, 2015c)***

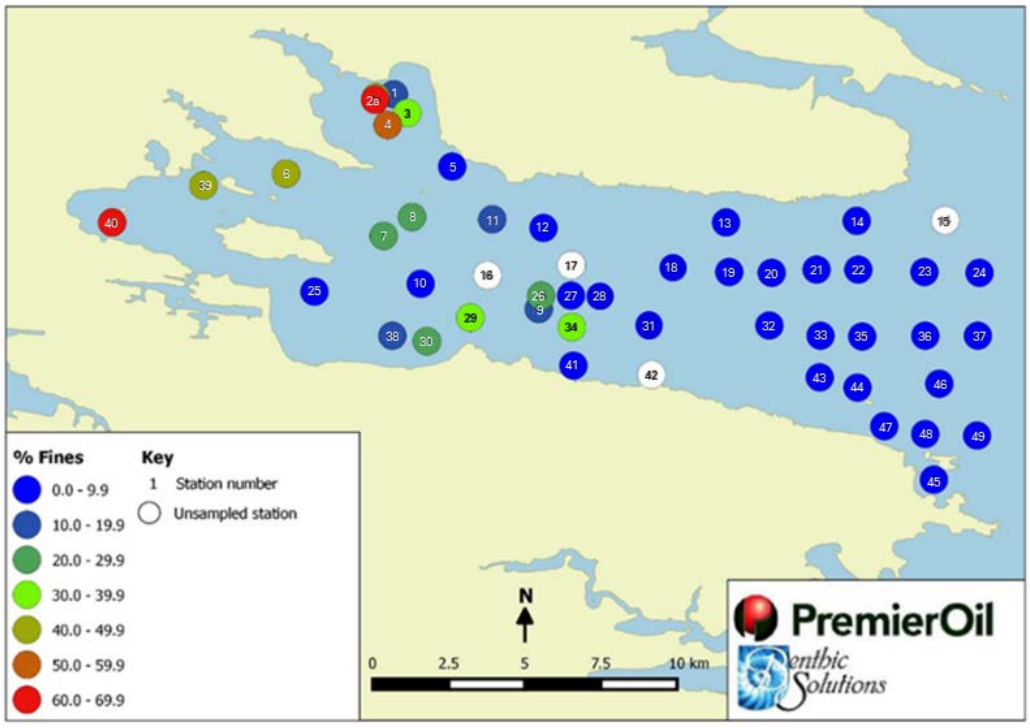


Figure 7-29: Percentage of fines recorded at each of the 46 sites sampled ***(Source: BSL, 2015c)***

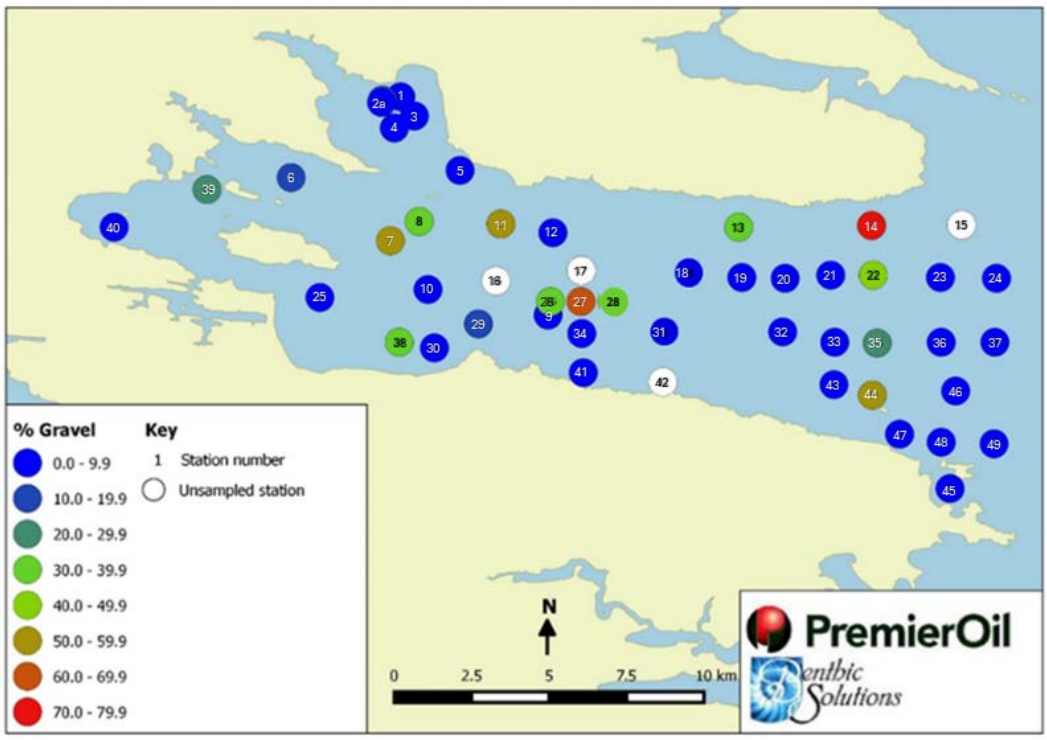


Figure 7-30: Percentage of gravel recorded at each of the 46 sites sampled ***(Source: BSL, 2015c)***

7.3.7.2.1.2 Total Organic Matter and Total Organic Carbon

Sediments were analysed for Total Organic Carbon (TOC), Total Inorganic Carbon (TIC), Total Organic Matter (TOM) and moisture content.

TOC represents the proportion of biological material and organic detritus within the substrates. In surface sediments, TOC is an important source of food for benthic fauna (Snelgrove and Butman, 1994), although an overabundance may lead to reductions in species richness and abundance due to oxygen depletion.

The TOC levels were variable throughout the survey area, ranging from <0.1 % in the sandy sediments up to 5.92 % at station 34, with a mean of 1.29 % ± 1.46 SD. The distribution generally follows a trend of increased organic enrichment with the percentage of fines. This is illustrated in Figure 7-31, showing an increase in TOC towards the western inshore region of Berkeley Sound, as well as in the large basin feature situated in the area of proposed LTV anchorage (Station 34). These variations are expected to be due to the increased sedimentation in these lower energy environments, compared with the higher energy mobile sands that are considered to be organically poor.

TOC levels could be considered a limiting factor within the substrate, influencing the distribution and abundance of some infaunal species such as deposit feeders. TOC within Berkeley Sound is expected to reflect both autochthonous (originating locally) and allochthonous (originated elsewhere) material. Primary production within Berkeley Sound in both phytoplankton and macroalgae form represent an important component of TOC, especially during summer blooming periods. TOC is expected to be strongly influenced by allochthonous material which includes fluvial transport (limited to small streams) as well as carbon sources entering the Sound from the surrounding sea.

As expected TOM levels followed the same trend as TOC levels which ranged from 0.45 % in sandy sediments (Station 21) to 14.94 % at Station 34, the survey mean was 3.15 % ± 3.73 SD.

TIC is the sum of inorganic carbon compounds such as carbon dioxide, carbonic acid, bicarbonate anions, and carbonate. In contrast to the TOC and TOM, the TIC correlated best with the percentage of gravel. Despite removing shell material from the samples, this correlation is likely due to epifaunal specimens such as bryozoans that contain carbonates in their exoskeletons and have colonised such gravels. Stations predominantly composed of sands and silts exhibited generally low TIC levels. TIC levels were variable and ranged from <0.1 % to 57.40 %, throughout the survey area, with a mean of 11.48 % ± 11.96 SD recorded.

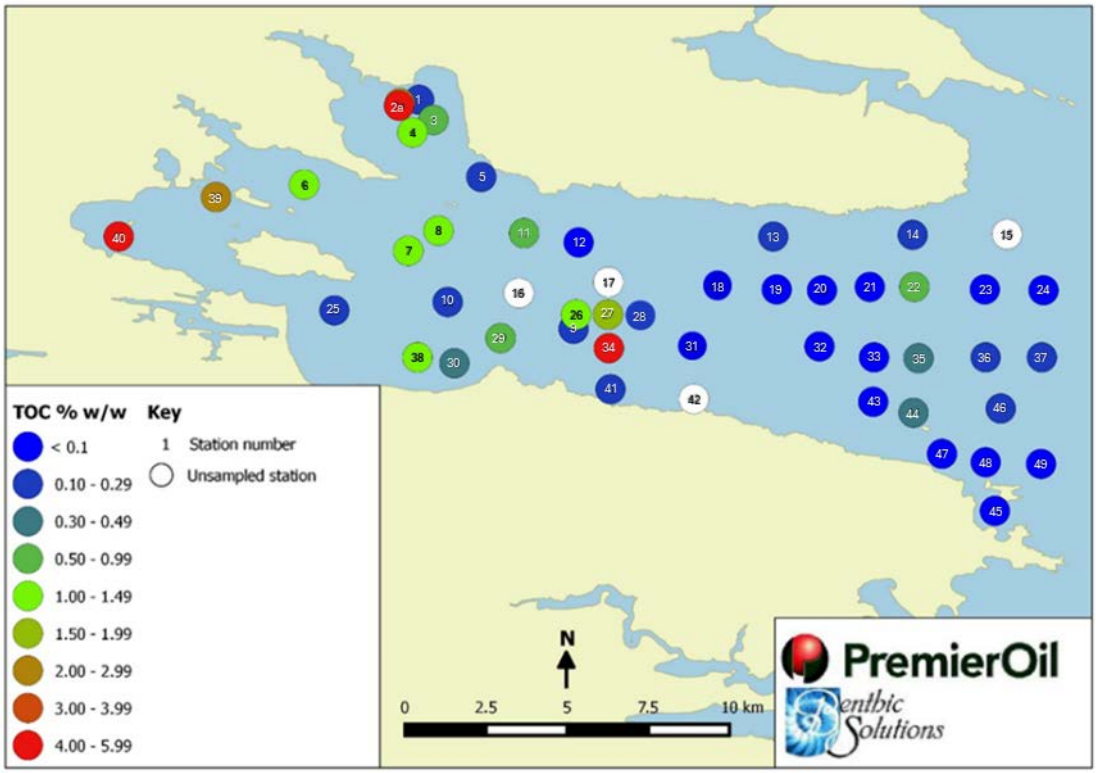


Figure 7-31: Total Organic Carbon (TOC) recorded at each of the 46 sites sampled ***(Source: BSL, 2015c)***

7.3.7.2.2 Sediment chemistry

7.3.7.2.2.1 Sediment hydrocarbons

It should be noted that Berkeley Sound cannot be considered a pristine environment with regards to hydrocarbons, with three significant oil spill events documented in the 20 years preceding this survey (SMSG 2012), along with constant use of the area as an anchorage for large ships and fishing vessels. Understanding of the baseline sediment chemistry is therefore necessary to provide a point of comparison for any future monitoring.

Results for hydrocarbon analyses are summarised and tabulated as total hydrocarbon concentrations, total Polycyclic Aromatic Hydrocarbons (PAH), and total n-alkane and homologue ratios.

Total Hydrocarbon Concentrations

The Total Hydrocarbon Content (THC) of the sediments showed concentrations ranging from 1.03 $\mu g.g^{-1}$ at Station 48 to 159.89 $\mu g.g^{-1}$ at Station 34 (Figure 7-32). The lowest THC values were recorded at the mouth of the Sound in the east, and around Kidney Island in the sandier sediments. Stations located inshore to the west of the Sound showed a general increase in THC, as did the basin feature sampled at station 34 which contained the highest THC (159.89 $\mu g.g^{-1}$), almost four times greater than the next

highest value. This can be compared with a central North Sea average of 9.51 µg.g^{-1} and a 95th percentile of 40.10 µg.g^{-1} (UKOOA 2001).

THC levels generally correlate with the proportions of fines, TOC and TOM. A general exception to this trend were the stations located to the east and north of Cochon Island, which although generally showing low concentrations, were above those expected for this sediment type. In 2005, a reefer grounded on Cochon Island. Although the vessel was refloated and able to anchor within the Sound, this incident resulted in a small oil spill (approximately 130 tonnes of intermediate fuel oil).

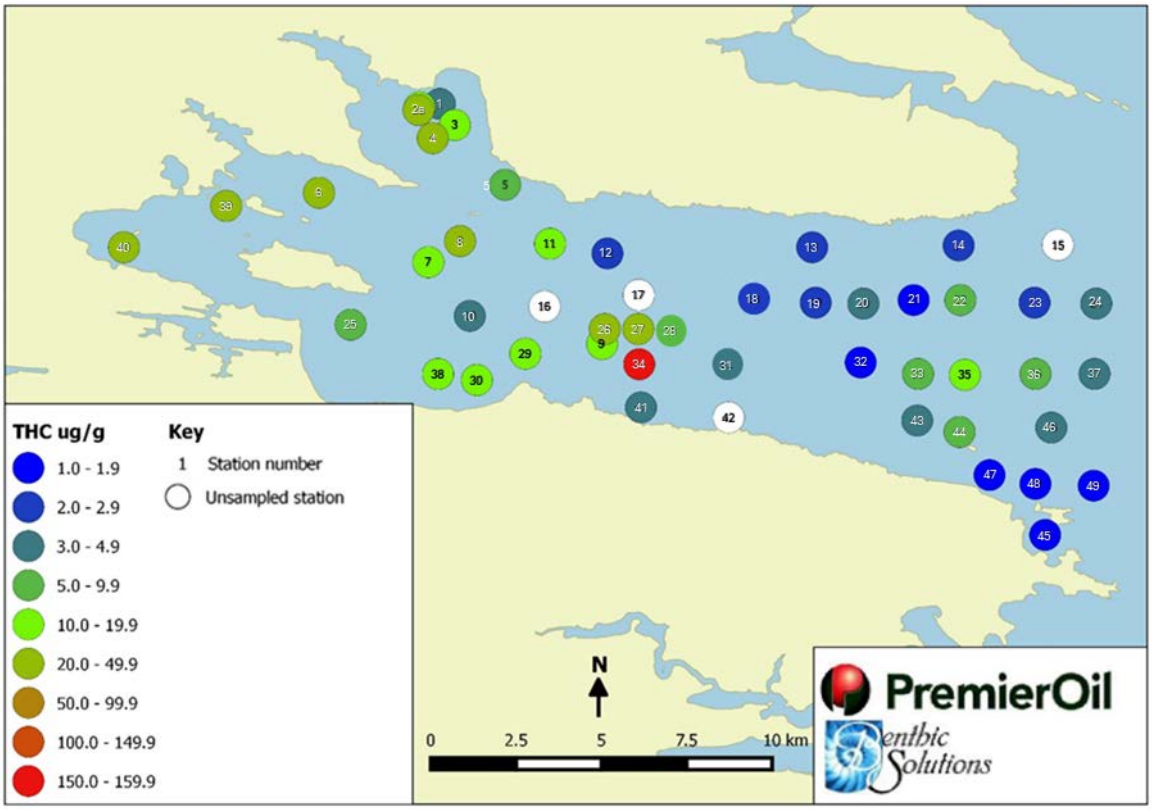


Figure 7-32: Total Hydrocarbon Concentrations (THC) recorded at each of the 46 sites sampled
(Source: BSL, 2015c)

Saturate / Aliphatic Hydrocarbons

All of the sampling stations were analysed for n-alkanes using Gas Chromatography with Flame Ionisation Detection (GC-FID). The total saturate alkane concentrations are illustrated in Figure 7-33.

The total n-alkane concentrations were again highly variable, ranging from 0.03 to 9.99 µg.g^{-1} with a mean of 0.72 ± 1.42 SD. The lowest n-alkane concentrations were found at Station 47 and the highest at Station 34, in line with the THC data. This correlates with the results obtained for fines, TOC and TOM.

The overall concentration of alkanes accounted for <10 % of the total THC recovered at each station (mean 4.22 ± 1.66 SD). This is quite low and is expected for uncontaminated marine sediments where background hydrocarbons are continuously replenished by a low but chronic source of alkanes.

Chromatograms were analysed in detail in order to identify the distribution of alkanes. All samples showed a peak at nC26 which is thought to be trans-squalene, in addition to this all samples except Stations 34, 37-39, 41 and 44-49, showed a peak at around 9.5 minutes which is thought to be Indole. Squalene is likely to have entered the marine environment through terrigenous plant material,

whereas indole occurs due to the breakdown of algal tryptophan by bacteria (Maruyama, *et al.,* 1989). This source is likely attributed to the breakdown of phytoplankton from the preceding summer months.

There were large Unresolved Complex Mixture (UCM) humps at Stations 02-04, 05-09, 26, 27, 29, 34, 35 and 38-40 (mainly western inshore stations). The UCM from nC10-25 is interpreted to relate to weathered diesel (this range is known as the diesel-range organics; DRO; Geosphere, Inc., 2006); whilst the heavier UCM from nC25-37, peaking at around nC33 is likely to represent terrigenous plant materials, which typically comprise the long-chain, odd carbon-number n-alkanes (nC25-33; Eglinton, *et al.,* 1962). Given the location of Berkeley Sound, sources of terrigenous plant matter include mosses and grassland from the surrounding hills.

The chromatogram at Station 40 showed numerous peaks throughout the nC10-37 range, however, a notable hump peaking around nC26 was also observed; this shaped hump was not present at any other station. The station is in close proximity to terrestrial run-off and therefore could be caused by unresolved terrigenous material. Alternatively, this could be resultant from anthropogenic activity at Green Patch Settlement where a livestock farm is located; although the modest TOC and heavy and trace metals concentrations suggests any such influx is not significant.

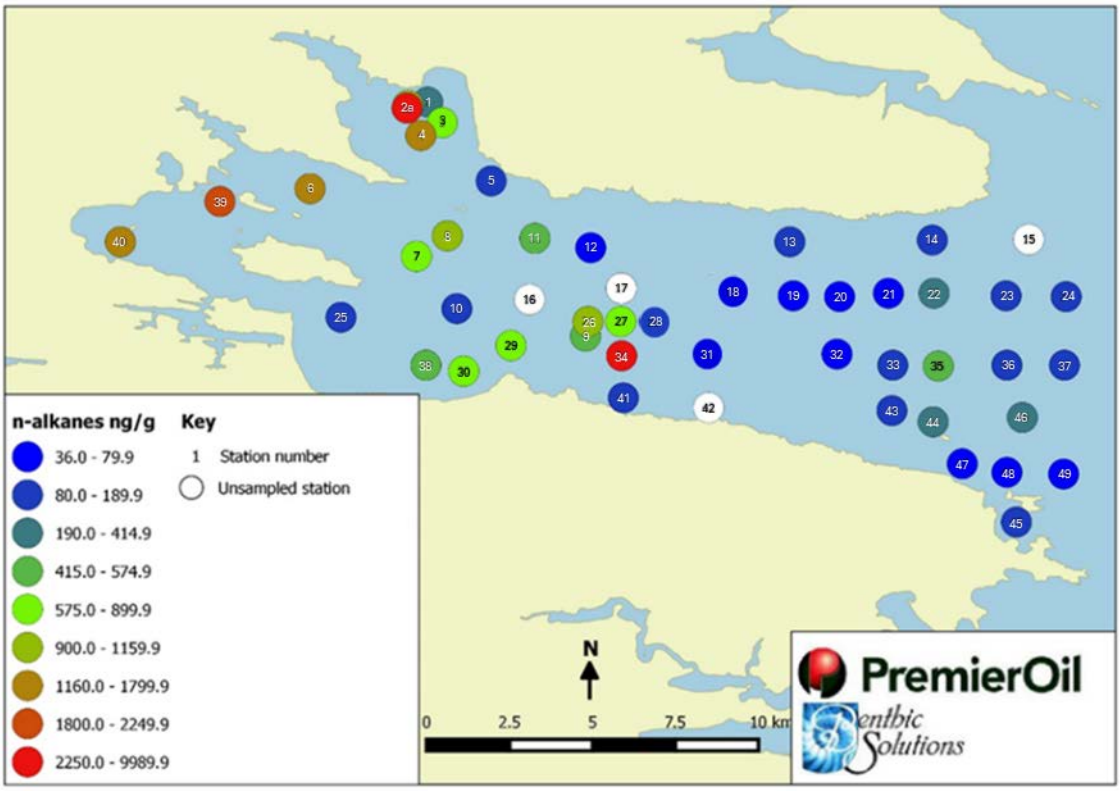


Figure 7-33: Total saturate alkanes recorded at each of the 46 sites sampled ***(Source: BSL, 2015c)***

Polycyclic Aromatic Hydrocarbons (PAH)

Polycyclic Aromatic Hydrocarbons (PAHs) and their alkyl derivatives have been recorded in a wide range of marine sediments (Laflamme and Hites, 1978) with the majority of compounds produced from what is thought to be pyrolytic sources. These include the combustion of organic material such as forest fires (Youngblood and Blumer, 1975), the burning of fossil fuels and, in the case of offshore oil fields, flare stacks. The resulting PAHs, rich in the heavier weight 4-6 ring aromatics, are normally transported to the sediments *via* atmospheric fallout or river runoff. Another PAH source is petroleum

hydrocarbon, often associated with localised drilling activities. These are rich in the lighter, more volatile 2 and 3 ring PAHs (NPD; naphthalene (128), phenanthrene, anthracene (178) and dibenzothiophene (DBT) with their alkyl derivatives.

Total PAH concentrations (2 to 6 ring compounds) were highly variable, ranging from <1 to 938.5 ng.g^{-1} (mean 48.48 ± 153.68 SD; Figure 7-34). Total PAHs showed a general increase in concentration with the percentage of fines; as expected, Station 34 contained the highest PAH level in line with results for THC and alkanes.

The naphthalene (NPD) fraction (2 and 3 ring aromatics) followed a very similar trend to total PAH, ranging from <1 to 372.28 ng.g^{-1} with a mean of 23.18 ± 58.91 SD. A higher proportion of NPD at many stations, ranging from 51.7 % to 100 %, suggest a petrogenic influence.

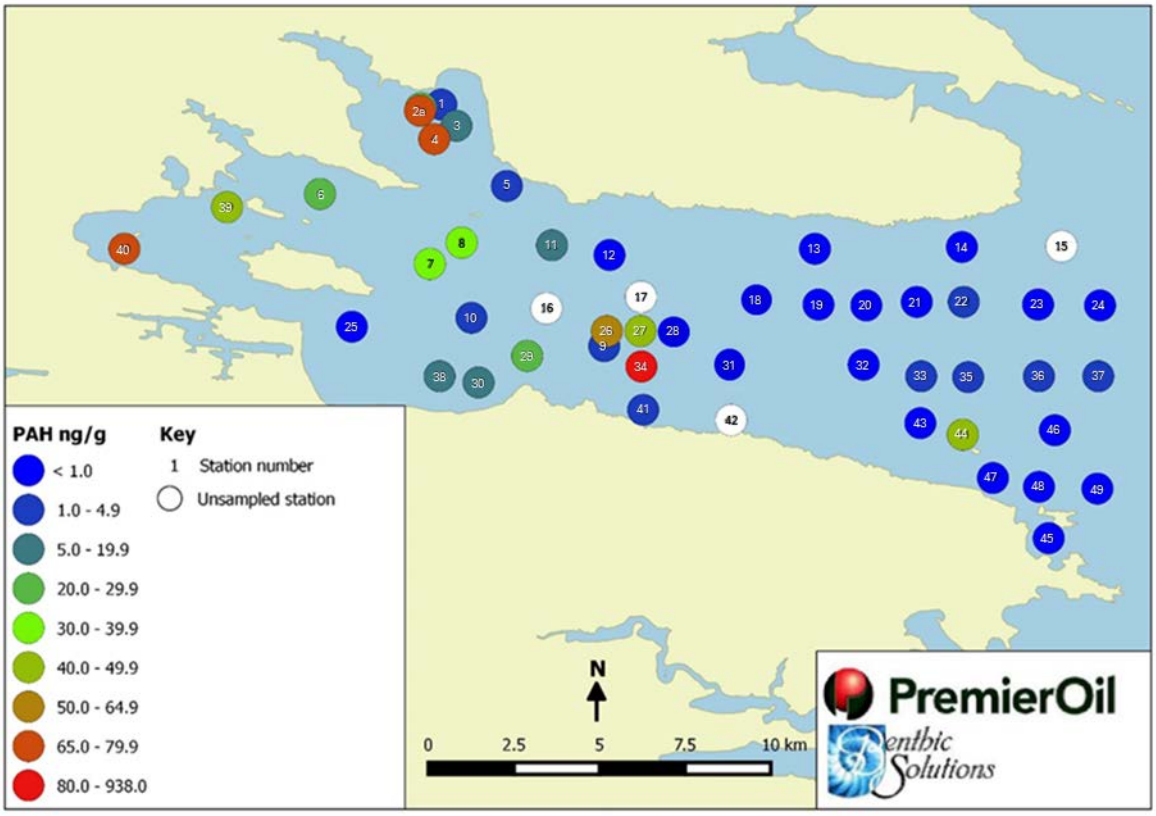


Figure 7-34: Total Polycyclic Aromatic Hydrocarbons (PAH; 2-6 Ring) recorded at each of the 46 sites sampled ***(Source: BSL, 2015c)***

7.3.7.2.2.2 Heavy and trace metal concentrations

Metals are generally not harmful to organisms at concentrations normally found in marine sediments and some, like zinc, may be essential for normal metabolism, although it can become toxic above a critical threshold. In order to assign a level of context for toxicity, an approach used by Long *et al.* (1995) to characterise contamination in sediments will be used here. These researchers reviewed field and laboratory studies and identified metals that were observed to have ecological or biological effects on organisms. They defined 'Effect Range Low' (ERL) values as the lowest concentration of a metal that produced adverse effects in 10 % of the data reviewed, while 'Effect Range Median' (ERM) values designate the level at which half of the studies reported harmful effects. Consequently, metal concentrations recorded below the ERL value are not expected to elicit adverse effects, while levels above the ERL and ERM values are likely to be toxic to some marine life, though with varying likelihood.

The results of heavy and trace metal analysis, with an indication of whether the mean recorded measurements exceeded the ERL are summarised in Table 7.2. Full results can be found in BSL (2015c).

In Berkeley Sound, cadmium (Cd) levels were variable but generally moderate in concentration (above the ERL) and were highest in areas containing a higher proportion of fine sediments. Results suggest a naturally high background concentration of cadmium in these areas. Nickel (Ni) levels exceeded the ERL at Station 47, and arsenic (As) at Stations 07, 13 and 40. Mercury (Hg) remained at trace concentrations at all stations sampled.

Moderate but variable concentrations of lead (Pb) were recorded, however, the highest value recorded at Station 18 fell below the ERL. As with all metals except copper, lead indicated a significant positive correlation with the percentage of fine sediments.

For this survey, natural barium (Ba) levels recorded were variable, reflecting the sediment changes across the Sound with a general positive correlation with the percentage of fines. The majority of barium is typically insoluble in the form of a non-toxic sulphate (Gerrard, *et al.,* 1999); this metal is rarely of toxicological concern to the marine fauna.

Of the other metals, chromium (Cr), nickel (Ni), copper (Cu), vanadium (V), tin (Sn) and zinc (Zn) all yielded relatively low concentrations. Vanadium is often associated with the oil and gas industry as it is present in relatively high concentrations in most crude oils (Khalaf, *et al.,* 1982). Most vanadium enters seawater in suspension or colloidal form, passing quickly out of the water column and into silt deposition (Cole, *et al.,* 1999). Consequently, as the natural background levels in this region were relatively low, possible impacts from anthropogenic activities are likely to be detected from future surveys.

The slight elevation of arsenic at Station 40 as well as containing the highest concentrations of chromium, vanadium and zinc could be due to its close proximity to a livestock farm located at the nearby Green Patch Settlement. However, as high aluminium levels were also recorded here it is most likely a factor of sediment type, which has incurred enrichment of heavy and trace metals. Further to this, based upon the general low concentrations at which heavy and trace metals are recorded at both this station and throughout the survey area, none are considered to be of ecotoxicological concern.

7.3.8 Summary of physical environment

A summary of the offshore and inshore physical environment is provided in Table 7.3 below.

Table 7.2: Summary of heavy and trace metal concentrations in Berkeley Sound (BSL, 2015c)

Measure	Trace metal concentrations (µg.g^{-1})												
	Arsenic	Cadmium[1]	Chromium	Copper	Lead	Mercury	Nickel[1]	Tin	Vanadium	Zinc	Aluminium	Barium	Iron
Max (St[2])	14.2 (40)	4.12 (34)	52.1 (40)	7.7 (18)	43.7 (18)	0.08 (44)	21.7 (47)	3.0 (31)	72.9 (40)	50.1 (40)	38,600 (40)	424 (30)	15,400 (39)
Mean	3.43	1.24	18.25	4.53	8.59	0.02	6.89	1.08	28.36	18.7	13,783	204.9	5,972
SD	2.72	1.44	12.33	1.52	6.88	0.02	4.66	0.54	15.18	12.67	9,677	112.4	3,955
Var (%)	79.3	116.0	67.5	33.5	80.1	92.7	67.7	50.09	53.5	67.76	70.21	54.8	66.2
ERL	8.2	1.2	81.0	34.0	47.0	0.15	21.0	n/a	n/a	150.0	n/a	n/a	n/a
Mean > ERL	No	Yes	No	No	No	No	No	n/a	n/a	No	n/a	n/a	n/a
ERM	70.0	9.6	370.0	270.0	220.0	0.71	52.0	n/a	n/a	410.0	n/a	n/a	n/a

[1] Cd and Ni Levels in Berkeley Sound are above acceptable levels. This is likely due to shipping activity associated with shipping, fishing and bunkering. The only Sea Lion Development activity anticipated in Berkeley Sound is vessel logistics operations and limited MGO bunkering for a duration of 13 non-consecutive months such that ongoing monitoring of Cd and Ni are not warranted from a Navitas point of view.
[2] St = Station number (see Station numbers in Figure 7-34 above).

Table 7.3: Summary of the offshore and inshore physical environment

Subject	Summary
NFB and the Sea Lion Field	
Meteorology	There is little meteorological data available from the location of the Sea Lion Field. A hindcast weather model has been developed, covering 20 years. The model produced wind and wave data for a wide area around the Falklands. The results were calibrated and verified against satellite and measured data, and confirmed previous wind and wave assumptions.
Oceanography and water quality	A detailed metocean model has been constructed to better understand the circulation and hydrodynamics of the Southern Patagonian Shelf. This area has a complex oceanography heavily influenced by the Falkland Current (off shoot of the Antarctic Circumpolar Current), tide and bottom topography. Of note, oceanography was recognised as a gap in the scoping stage but was not adopted as part of the scope for the GAP project (Section 7.2.4.2). For the purposes of the EIA, the oceanographic data available is considered sufficient and valid for the purposes of the modelling. However empirical field data will be required to inform, improve and ground truth modelled data.
Bathymetry	The area of the Sea Lion Field is situated on the Continental Shelf Slope in waters approximately 450 m in depth. The seabed in the NFB is characterised by numerous indentations, troughs and trenches. Bathymetric surveys conducted over the NFB indicated the presence of poorly preserved iceberg keel scars.

Subject	Summary
Sediment types	Sediments across the NFB typically exhibit a south-north gradient of decreasing mean particle size. The proportion of fine material, defined as material with a diameter less than 63 µm, generally increases with increasing depths, and the sediment types ranged from very fine sand in shallower waters (225 m depth) to the south-west, to coarse silt in deeper waters (464 m depths) to the north-east. Sediment types and TOM / TOC levels in the Sea Lion area are generally considered to be homogenous. The sediments are classified as 'medium silt' and, based on post-drilling surveys, appear to be unaffected by previous drilling campaigns.
Sediment chemistry	With regard to sediment chemistry, there was no direct evidence of seabed disturbance or elevated concentrations of hydrocarbons and metals associated with historical drilling activity within the Sea Lion area, although some fractions of hydrocarbon may have been derived from contamination associated with the previous drilling activity. Subtle differences between stations were evident that are thought to be associated with natural spatial variation across the area. Hydrocarbon, TOM, TOC and metal concentrations were considered typical of the medium and coarse silty sediments recorded in the Sea Lion survey area (Gardline, 2013b).
Berkeley Sound	
Meteorology	Over the course of the year, typical wind speeds vary from 2 m/s to 14 m/s (light breeze to strong breeze) and rarely exceed 18 m/s (gale). Westerly winds are the most common. The air temperature typically varies from 0° C to 15°C and precipitation is most likely in June and least likely in October
Oceanography and water quality	Water quality profiles indicate that the water column within Berkeley Sound is generally well mixed with a significant freshwater influence from the surrounding hills, particularly during the winter months. This is especially evident towards the western extent of the Sound, which is interpreted to have a lower energy hydrodynamic regime. The high wind speeds recorded during the survey, along with the influence from the Falkland Current and the gently shoaling bathymetry within Berkeley Sound are likely to be responsible for the well mixed water column.
Bathymetry	Bathymetrically the Sound deepened from the shallow waters in the west to approximately 55 m at the entrance to the Sound in the east. A basin feature dominates the central region of the Sound, around the LTV anchorage location; this depression is approximately 11 m below the level of the surrounding seabed and is expected to act as a sink, with higher deposition rates of finer sediments.
Sediment types	Environmental ground-truthing confirmed the presence of numerous subtle sediment changes throughout Berkeley Sound with differing proportions of coarse material in the form of fragmented shells, gravel, cobbles and boulders. Generally, the majority of sediments were dominated by sands; however the shallow embayments in the west of Berkeley Sound comprised higher proportions of fine materials, reflecting a weaker hydrodynamic regime. Mega-rippled sand and evidence of current turbulence was present at the eastern end of the survey area. Mobile linear gravel ribbons were recorded throughout the sand habitat to the east of the LTV anchorage location, comprising gravels, cobbles and relic bivalve shells (clams and mussels) heavily encrusted with relic and live barnacles and calcareous mats of pink coralline algae (*Corallina spp*.). Bedrock exposures were recorded in the area of the LTV anchorage location and along the north and south coasts of Berkeley Sound, forming large escarpments in some areas with erosional deposits often present around the base.
Sediment chemistry	Physio-chemical parameters generally showed similar trends throughout the survey area relating to sediment characteristics, and in particular to the proportion of sediment fines; this was the case for total organic content and hydrocarbon concentrations. Station 34, located within the basin feature, showed distinct elevations in organics and hydrocarbons including n-alkanes and PAHs. Despite such elevations, the proportions of n-alkanes and PAHs to total hydrocarbons were similar throughout, suggesting that the area does not reflect any significant variation above that dictated by the sediment

Subject	Summary
	type. Consequently, locations that were predominantly sand contained generally low-level hydrocarbon concentrations. Where hydrocarbons are present, these were thought to be largely terrigenous in origin, however, evidence for petrogenic sources was also recorded, with weathered diesel signatures observed in most samples within the central part of the Sound. Heavy and trace metals were variable, with general concentrations positively correlating with the percentage of fine sediments. All metals, with the exception of cadmium, were as expected for this region with Station 40 generally showing marginally higher metal concentrations, potentially attributable to its proximity to the Green Patch Settlement, where a livestock farm is present.

7.4 Biological Environment

The following sections provide data on the abundance and distribution of the key biological receptors identified within Paragraph 4 (2a-k) – Schedule 4 of the FIG Offshore Minerals Ordinance (Section 3.1.7.3.1) and listed in Section 8.4. Each section is separated into a description of the receptors offshore (the NFB and / or Sea Lion Field) and inshore (Berkeley Sound) and ends with a summary of the key life history characteristics. Where necessary, further details on the life history characteristics are provided within the environmental impact and risk assessment Chapters (10 and 12) as is relevant to the impact and / or risks being assessed.

7.4.1 Plankton

7.4.1.1 Introduction

The planktonic community is composed of a range of microscopic plants (phytoplankton) and animals (zooplankton) that drift with the oceanic currents. These organisms form the basis of marine ecosystem food chains and many species of larger animals such as fish, seabirds and cetaceans are dependent upon them. The movements of plankton therefore directly influence the movement and distribution of other marine species such that impacts upon plankton may impact upon other receptors. Therefore, it is important to understand the distribution of these organisms.

In general, it is understood that both the oceanography and topography of the southern Patagonian Shelf (Section 7.3.3) create an area of very high plankton productivity immediately to the north of the Islands.

7.4.1.2 Phytoplankton

The distribution and abundance of phytoplankton itself is heavily influenced by salinity and nutrient gradients, water depth, tidal mixing and thermal stratification within the water column (NSTF, 1993). The majority of phytoplankton occur in the photic zone (the upper tens of metres, which receives enough sunlight for photosynthesis to occur) and are unicellular organisms, such as diatoms and dinoflagellates.

7.4.1.2.1 Offshore phytoplankton

There may be as many as 5,000 species of marine phytoplankton with diatoms, cyanobacteria and dinoflagellates amongst the most prominent groups. Historic samples within the vicinity of the Falkland Islands indicate that there are relatively few phytoplankton species with high diatom abundance south of 44°S, whilst the northern waters were comparatively dominated by dinoflagellates and ciliates (Hendley, 1937; Rodhouse, *et al.,* 1992).

Shelf waters to the north of the Falklands are particularly rich in phytoplankton (Figure 7-35) in part because of the convergence of the Falkland and Brazil Currents (Section 7.3.3). The turbulent interactions of these currents bring nutrient-rich water to the ocean surface, allowing the phytoplankton to take full advantage of the long days and strong sunlight. The area of the shelf-break between the Falkland Islands and the Phase 1 & 2 Development is also an area of high phytoplankton production. It is thought that this is the result of upwelling of nutrient rich waters, created by the Falkland Current and seabed topography at the shelf-break.

Although phytoplankton is present year-round, blooms tend to appear in October and can persist throughout the austral spring and summer.

According to Gonçalves-Araujo *et al.* (2016) the spring phytoplankton community shows elevated biomass and is dominated by diatoms associated with a deeper and more weakly stratified upper mixed layer depth (UMLD) and relatively low nutrient concentrations. In contrast, the phytoplankton

community in summer is represented by lower biomass and is mainly dominated by haptophytes and dinoflagellates, associated with shallower and well-stratified upper mixed layers with higher nutrient concentrations, likely due to lateral advection of nutrient-rich waters from the Falkland Current.

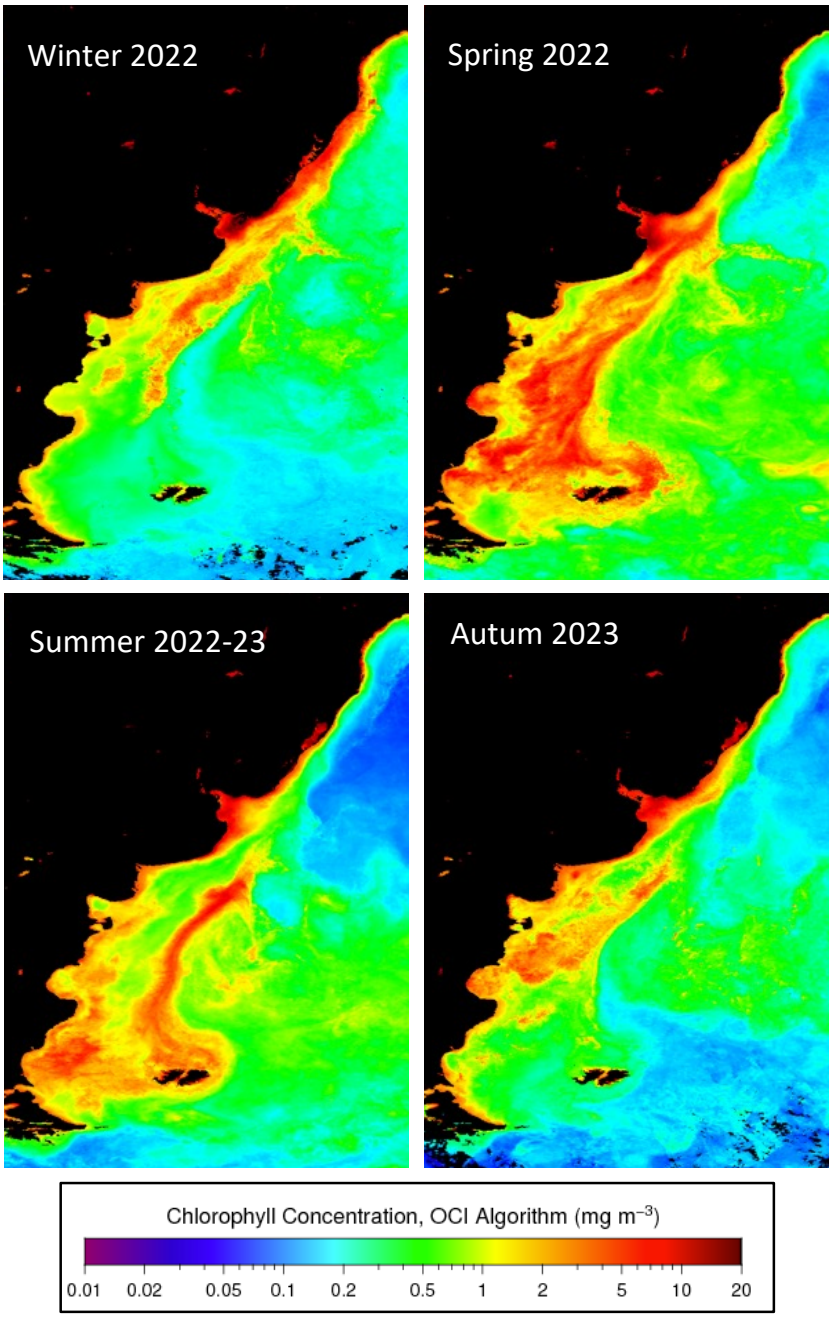


Figure 7-35: Example of Chlorophyll-a concentrations in the south-west Atlantic ***(Source: https://oceancolor.gsfc.nasa.gov)***

7.4.1.2.2 Inshore phytoplankton and Harmful Algal Blooms

Although Harmful Algal Blooms (HAB) of phytoplankton appear to be rare events in the Falklands, they are a common occurrence off the southern coast of Chile. While HABs have not been recorded in Berkeley Sound, in 2002, one occurred in the inshore waters to the west of the Falklands. HAB algae contain toxins that accumulate up the food chain poisoning higher predators or rendering filter-feeding

organisms toxic. The HAB in 2002 resulted in the death of many penguins (Baylis, *et al.,* 2013a & b) and other marine organisms.

7.4.1.3 Zooplankton

7.4.1.3.1 Offshore zooplankton

The high levels of phytoplankton in the NFB supports complex communities of zooplankton (Tarling, *et al.,* 1995; Boltovskoy, 2000), which in turn support complex pelagic and demersal ecosystems (Agnew, 2002).

The Falkland Current, an offshoot of the Antarctic Circumpolar Current, brings oxygen and nutrient rich water to the Falklands. The Islands split the Falkland Current into east and west branches, which sweep around the Islands to re-join to the north. This complex system of currents and bathymetry produces areas of upwelling and eddies, where there is little water movement. In turn, this influences primary production and the distribution of zooplankton. In the Falklands, the peak in total zooplankton abundance occurs between January and March, when an area of very high zooplankton density occurs at the shelf-break to the north of the Islands (Agnew, 2002). An area of high zooplankton density also occurs on the shelf-break to the north-east of the Falklands in winter.

A study by Padovani *et al.* (2012) examining the role of the hyperiid amphipod crustacean *Themisto gaudichaudii* on the Patagonian Shelf concluded that this species contributes greatly, both directly and indirectly, to supporting the fish community in the area. The study proposed that this amphipod plays a key role in the sub-Antarctic region, similar to that of Antarctic krill (*Euphausia superba*) in Antarctic waters, channelling the energy flow and enabling a short and efficient food chain.

Gelatinous zooplankton, such as jellyfish, are also considered an important component of the offshore ecosystem, occurring in the diets of at least seven species of fish. For two species in particular, namely the southern rock cod (*Patagonotothen ramsayi*) and spur dogs (*Squalus acanthias*), comb jellies (ctenophores) comprise more than 10 % of the diet (Arkhipkin and Laptikhovsky, 2013).

Other important components of the zooplankton community include the euphausiids *Thysanoessa gregaria*, *Euphausia vallentini* and *E. lucens* (Tarling, *et al.,* 1995; Boltovskoy, 2000). Together with *T. gaudichaudii*, these comprise important prey items some of the Falkland Islands most abundant finfish species (e.g., hoki (*Macruronus magellanicus*)) as well as Argentine shortfin squid (*Illex argentinus*) (Mouat, *et al.,* 2001; Agnew, 2002; Brickle, *et al.,* 2009). Similarly, lobster krill can be found in dense shoals on the shelf where they constitute important prey for higher predators (Harrison-Matthews, 1932; Arkhipkin, *et al.,* 2001; Arata and Xavier, 2003; Laptikhovsky and Arkhipkin, 2003; Laptikhovsky, 2004; Clausen, *et al.,* 2005; Brickle, *et al.,* 2009; Michalik, *et al.,* 2010; Quillfeldt, *et al.,* 2011 and P. Brickle, *pers. obs.*).

It should be noted that such baseline plankton / zooplankton surveys are not usually undertaken by Oil and Gas operations, so may be regarded as being beyond the reasonable requirement of Navitas to supply for this ES, given that such temporal data collection at such a distant field site would be costly and logistically difficult. Therefore, the baseline here was generated from extant literature.

7.4.1.3.2 Inshore zooplankton

In inshore waters, lobster krill (*Grimothea* spp.) is perhaps the most significant component of the zooplankton community and forms dense shoals inshore but is largely absent from more oceanic waters.

A recent study by Piontek *et al.* (2023) found that copepods, larval lobster krill and euphausiids dominate the local mesozooplankton community by biomass. All species showed seasonal patterns, including ontogenetic behaviour in lobster krill migrating to deeper waters as they develop. While

overall biomass significantly decreased with distance from shore, diversity was found to be highest at 30 km from shore.

There is a PhD studentship (SAERI and the University of Aberdeen) currently working on inshore zooplankton dynamics in Berkeley Sound. However, the results of this study are not expected to be available until mid-2025.

7.4.1.3.2.1 Lobster krill (Grimothea spp.*)*

The near-shore environment is dominated by two morphotypes of lobster krill:

- Gregarious lobster krill ('*gregaria*' type), and
- Short-eyed lobster krill ('*subrugosa*' type).

Once considered two species *G. gregaria* and *G. subrugosa*, however Perez-Barros *et al.* (2008), from analyses of DNA sequence analysis of three mitochondrial mtDNA gene fragments, conclude that they either represent a case of a dimorphic species, or a case of incomplete lineage sorting. Scientists at SAERI and SMSG continue to distinguish the two types until further phylogenetic work can be conducted.

Post-larval stages of these crustaceans (once thought to be a separate species and sometimes known as *Grimothea*) are pelagic and can form dense shoals, turning the water red. The adults are more commonly found on the seabed but also display shoaling behaviour. Shoals are most frequently encountered between November and May, but adult lobster krill can be found throughout the year. These are very abundant species in the Falkland Islands near-shore environment and are critical to this ecosystem (Agnew, 2002). The inshore distribution of this species and its importance as a component of the diets of many higher predators make it an important component of the inshore zooplankton. Evidence from animals examined during the early 20th century whaling, indicate that lobster krill were particularly important prey for sei, humpback and right whales (Harrison-Matthews, 1932). These animals are also important prey for seabirds, (Thompson, 1993; Quillfeldt, *et al.,* 2011; Clausen, *et al.,* 2005; Michalik, *et al.,* 2010; Arata and Xavier, 2003) fish (Arkhipkin, *et al.,* 2001; Laptikhovsky and Arkhipkin, 2003; Laptikhovsky, 2004; Brickle, *et al.,* 2009).

7.4.2 Marine and intertidal vegetation

7.4.2.1 Introduction

Understanding the marine and inshore vegetation of the Falkland Islands is important as algae are one of the major primary producers in the inshore marine environment. It is necessary to determine whether there are any species present that may be at risk from any oil-related activities or pollution.

7.4.2.2 Seaweeds and algae of the inshore environment

There are 253 seaweed taxa recorded from around the Falkland Islands (Brodie and Mrowicki, 2019), primarily in inshore waters. Seaweeds within the Falkland Islands, and elsewhere, fall into one of three categories:

- Brown algae (Phylum: Heterokontophyta),
- Green algae (Phylum: Chlorophyta), and
- Red algae (Phylum: Rhodophyta).

There have been several collections of seaweeds from around the Islands and samples of 400 and 350 specimens were collected by Vallentin (1909-11) and Clayton (2002-03) respectively (described in Wells, 2010). In 2013, two expeditions were conducted to collect further samples (*c.* 500) with the aim of producing the first-ever inventory of the macroalgal species of the Falkland Islands (Mystikou, 2015). Most recently, the Darwin Plus funded project 'Building foundations to monitor and conserve Falklands

marine forest habitats' (DPLUS068, 2017-2019) consolidated specimens from herbariums in Falklands Conservation and the Natural History Museum, London. There appear to be many similarities between the Falkland Islands and southern South America (Wells, 2010), with many new species and new records found recently (Brodie & Mrowicki, 2019). Recent work by Beaton (2020) show that the Falkland Islands has a greater intertidal diversity and taxonomic distinctness than the Straits of Magellan, Beagle Channel, Antarctic Peninsula and South Georgia.

The more conspicuous algal species found in the Falkland Islands are listed in Table 7.4 (Neely and Brickle, 2013).

7.4.2.2.1 Brown algae (Phylum: Phaeophyta)

Of the 58 species of brown algae recorded in the Falklands, the most visually dominant species are the giant kelp (*Macrocystis pyrifera*), the tree kelp (*Lessonia* spp.) and bull kelp (*Durvillaea antarctica*), all of which are classed as brown algae, and are common inshore, between 0.5 m to approximately 40 m depth.

7.4.2.2.1.1 Giant kelp (Macrocystis pyrifera)

The most characteristic seaweed of the Falkland Islands, and most likely to interact with oil and gas activity in Berkeley Sound, is the giant kelp, *Macrocystis pyrifera*. This species is one of the largest (growing up to 60 m in length) and most abundant of the brown algae found around the coast of the Falkland Islands (van Tussenbroek, 1989). Giant kelp forms extensive beds with large floating canopies (known as 'forests') in shallow coastal waters, although relatively sparse within Berkeley Sound when compared with the rest of the east coast of the Islands (Section 7.4.3). Giant kelp is a significant species within the shallow marine environment serving as a primary producer and as the foundation to a much more diverse habitat, which supports many species of invertebrate that in turn support higher predators (seabirds and marine mammals, White, *et al.,* 2002).

Giant kelp is found in more temperate climates, where sea temperatures are less than 20°C. It is found in areas with rocky, or hard, substrate, which the kelp is anchored to *via* a holdfast. The stipe grows out of the holdfast and this leads into the leaf-like fronds, which are buoyed by small gas-filled bladders. Research shows that giant kelp may grow at a rate of 60 cm per day (Neely & Brickle, 2013).

The waters of the Falkland Islands are particularly productive and nutrient rich and giant kelp flourishes in the area. Large kelp fronds may become detached from the seabed, as a result of grazing from benthic herbivores or during storm events, to form large rafts that float freely on the sea surface. The distribution of free-floating kelp patches in Falkland Islands waters was reported from the at-sea surveys carried out between February 1998 and January 2001 (White, *et al.,* 2002). Floating kelp patches were particularly important foraging habitat for grey-backed storm-petrels (*Garrodia nereis*) with an additional 21 seabird species also recorded as associating with free-floating patches of kelp (Gillon, *et al.,* 2001).

Bayley *et al.* (2021) evaluated the ecosystem services provided by kelp in the Falkland Islands. The study incorporated updated knowledge on the potential of kelp to sequester 'blue carbon' and used the extensive kelp forests of the Falkland Islands as a case study to assess the value of kelp forests to society through multiple associated ecosystem services. The analyses showed kelp forests provide a highly valuable range of direct and indirect services, which if managed correctly, will continue to benefit people, both now and in the future. The total estimated value of the Falkland Islands' kelp system was equivalent to *c.* £2.69 billion per year (or £3.24 million km year). However, the true value of the kelp forest surrounding the Falkland Islands is likely to be higher still, given that the estimate does not account for elements such as associated scientific research, tourism, and cultural services, due to the necessary data currently being unavailable. Similarly, the full value of these highly biodiverse ecosystems in supplying habitat and food to a large range of associated species is crucial,

yet extremely difficult to fully quantify. This study illustrates the importance of maintaining kelp ecosystems in a healthy state to ensure they continue to supply valuable ecological processes, functional roles, and ecosystem services, including their overlooked role as significant long-term carbon sinks.

7.4.2.2.1.2 Tree kelp (Lessonia spp.*)*

Tree kelp is often found intertwined with giant kelp. There are four species of tree kelp that have been identified within Falklands waters: *Lessonia flavicans* (Broad-blade tree kelp; the most common of the four), *L. nigrescens*, *L. frutescens* (although this is suspected to be a local form of *L. nigrescens* (Skottsberg, 1921)) and *L. vadosa* (shallow tree kelp). Tree Kelp, distributed at depths >20 - 100 m have an order of magnitude greater biomass than Giant Kelp (*Macrocystis pyrifera*). If confirmed, this will transform our understanding of deeper habitats, and their potential for carbon storage (P. Brickle *pers. comm.*).

Broad blade tree kelp inhabits slightly deeper waters than some of the other tree kelp species, from 2 - 20 m, inhabiting silty sediments and forms dense canopies. Conversely, the shallow tree kelp inhabits depths between 0.5 - 2 m and grows in areas of harder substrate.

Loligo squid, one of the most important marine resources in the Falklands, are known to use kelp beds (primarily *Lessonia* spp.) as spawning sites (Brown, *et al.,* 2010).

7.4.2.2.1.3 Bull kelp (Durvillaea antarctica)

Bull kelp (*Durvillaea antarctica*) has a circum-polar distribution in the Southern Ocean. It is extremely robust and found on exposed shores. Unlike many of the other large brown algae, bull kelp does not have air bladders, instead it floats due to a unique honeycomb structure within the alga's blades, which also helps this species to avoid being damaged by the strong waves.

Table 7.4: Conspicuous algae species found within Falkland Islands Waters[1]

Phylum	Common name[1]	Scientific names[1]
Brown algae (Heterokontophyta)	Giant kelp	*Macrocystis pyrifera*
	Shallow tree kelp	*Lessonia vadosa*
	Broad blade tree kelp	*Lessonia flavicans*
	Bull kelp	*Durvillaea antarctica*
	Creeping ring algae	*Herpodiscus durvillaea*
	Bladder algae	*Adenocystis utricularis*
	Sea potato	*Leathesia marine*
	Rope algae	*Desmarestia chordalis*
	Fur algae	*Desmarestia distans*
Green algae (Chlorophyta)	Cushion algae	*Codium effusum*
	Dead man's fingers	*Codium fragile*
	Sponge weed	*Spongomorpha arcta*
	Sea lettuce	*Ulva lactuca*
	Gutweed	*Ulva intestinalis*
	Ruffled sea lettuce	*Ulva linza*
Red algae (Rhodophyta)	Rock-leaf algae	*Lithophyllum falklandicum*
	Encrusting coralline algae	*Corallina* spp.
	Feathered coralline algae	*Corallina officinalis*
	Blood algae	*Hildenbrandia lecannellieri*
	Coiled algae	*Ahnfeltia plicata*
	Iridescent algae	*Iridaea* spp.
	Red sheet algae	*Gigartina skottsbergii*

[1] Source of data and nomenclature for the Latin names follows Neely and Brickle (2013). **Note:** the full species list provided by Brodie and Mrowicki is in progress and is currently unavailable.

7.4.2.2.2 Green algae (Phylum: Chlorophyta)

Most of the 45 species of green algae in the Falkland Islands are known from shallow waters and include the sea lettuces *Ulva* spp. and cushion algae such as the *Codium* spp. These are anecdotally highly diverse and will be subject to study on how refugia (like the Falkland Islands) in the last glacial maximum contributed to this diversity, at species and population levels, and indeed how they may have recolonised other glaciated areas as the ice retreated (Beaton, 2019).

7.4.2.2.3 Red algae (Phylum: Rhodophyta)

Red algae are the most diverse group of seaweeds, with 150 species recorded in the Falklands. Along with more typical fleshy species, the red algae include coralline, or encrusting, algae that secrete calcium carbonate. Only red algae are able to live and grow at greater depths than other seaweeds because their red pigmentation means they are able to absorb the blue light available at greater depths (maximum depth for most species is less than 100 m but coralline algae may grow in deeper waters).

7.4.2.3 Mapping of kelp beds

Coastal kelp was mapped utilising Land-Sat satellite imagery with a resolution of 30 m (Premier, 2014a). Imagery relates to kelp on the sea surface and may comprise giant kelp, tree kelp or bull kelp. Sub-surface tree-kelp and narrow fringes of bull kelp on rocks may not be visible and it was assumed that the greatest area relates to giant kelp and surface tree kelp. Coastal kelp images were taken in August 2013 (East Falkland) and June 2014 (West Falkland), and as such are representative of winter kelp coverage.

As part of the process of assessing the suitability of Berkeley Sound for LTV anchorage, kelp was mapped for the entire Falkland Islands coastline (Premier, 2014a). The spatial extent present within different sections of the coast was compared to the total island-wide coverage of kelp. The coast between MacBride Head and Cape Pembroke (encompassing Berkeley Sound) contained 19.5 km^2 of kelp, equivalent to about 2 % of all Falklands kelp.

Given the importance of kelp beds as an inshore habitat for a wide range of species assemblages and the unknown importance for kelp as a spawning ground for Loligo, the distribution of kelp is an important consideration regarding the possible impact and response to potential oil spills. Kelp may have the ability to retain oil and prevent effective oil spill response; however, when compared with the East Falkland coastline as a whole, Berkeley Sound has relatively low kelp coverage (Figure 7-36).

In 2016, further analysis of satellite images was conducted to map terrestrial, inter-tidal and shallow marine habitat types (EnvSys, 2016). Under good conditions, it is possible to map the seabed down to a depth of approximately 15 m. With the aid of the results of dive surveys at known locations it was possible to map kelp below the surface and distinguish between some of the most conspicuous species. Figure 7-37 shows the distribution of giant kelp (*Macrocystis pyrifera*) within Berkeley Sound. The most extensive patches of kelp are located in the relatively shallow, sheltered waters of the Inner Sound, around Cochon Island, Kidney Island and in the vicinity of Volunteer Point.

Through SAERI's Darwin Plus (DPLUS065, 2017-2020) project 'Mapping the Falklands & South Georgia coastal margins for spatial planning' broad-scale coast and terrestrial habitat maps have been produced using Sentinel satellite imagery (10 m resolution) imagery. Although finer resolution, this analysis showed similar patterns of kelp distribution at similar spatial scales around the Falklands compared to the POEPL (Premier, 2014a) study.

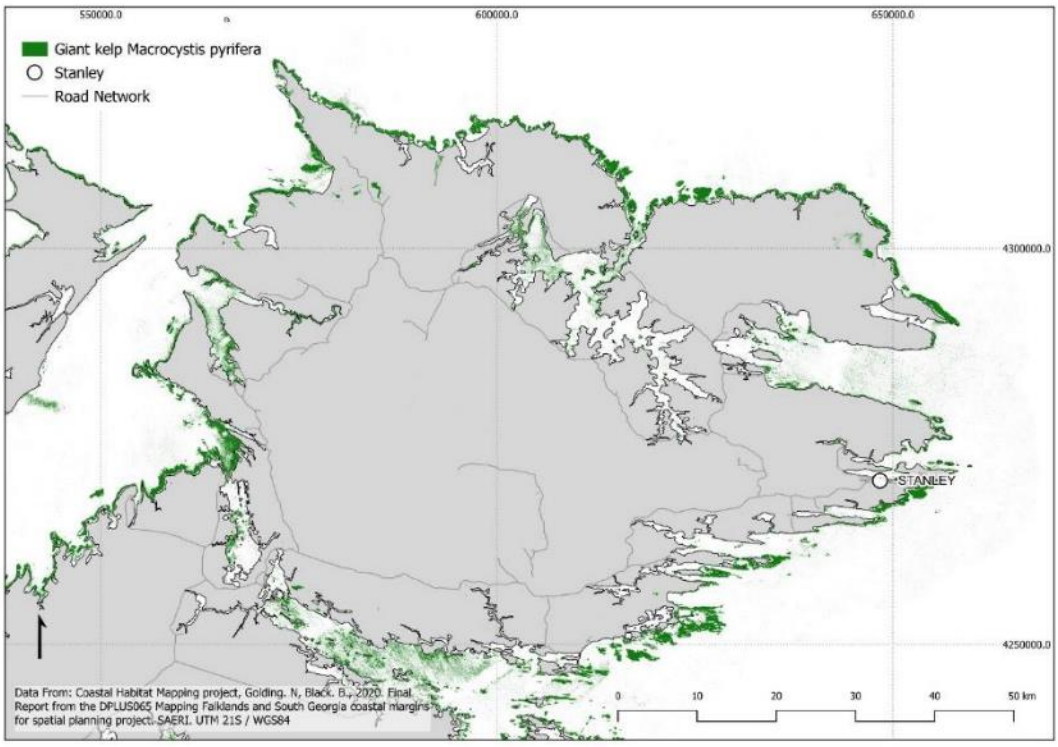


Figure 7-36: Kelp coverage around the East Falkland coastline ***(Source: Golding and Black, 2020)***

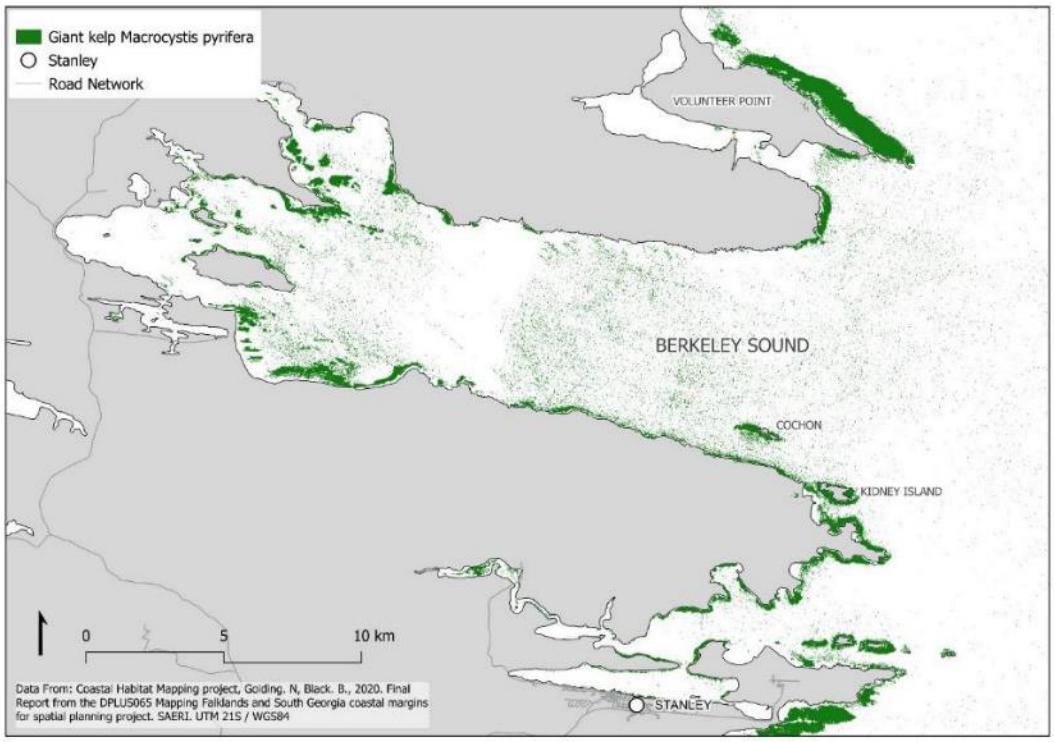


Figure 7-37: Map showing the distribution of giant kelp (*Macrocystis pyrifera*) in Berkeley Sound

7.4.3 Benthic environment

7.4.3.1 Introduction

Benthic organisms (or benthos) are the flora and fauna found on the bottom, or in the bottom sediments, of the sea.

7.4.3.2 NFB and Sea Lion Field benthos

A baseline understanding of the offshore benthic environment is required in order to inform the assessment of:

- Potential environmental impact of disturbance to the seabed from the placement of objects,
- Potential environmental impact of the discharge of drill cuttings and subsea operational discharges, and
- Potential environmental impact of underwater noise offshore and inshore.

Potential impacts of drilling activities would be of particular concern if there are any rare or protected species present within the area likely to be affected by drilling activities.

7.4.3.2.1 Offshore benthic flora and fauna

As described in Section 7.2.2, a number of baseline and post-drilling benthic surveys have been conducted in the Falkland Islands since 1998. Although the results from these surveys are useful in a broad sense, it is important to note that there have in many cases, and especially with the older surveys, been significant inaccuracies and inconsistencies with the survey design, sample processing, and species identification. This is an issue that was addressed by the GAP project (Section 7.2.4.2), which improved taxonomic resolution and quality control, and the design methodologies for future environmental baseline studies.

The pre-development and post-drilling surveys of the Sea Lion area were conducted in March and April 2012 in Licence Blocks PL032 and PL004 (Gardline, 2013a). In total, 90 stations were sampled: 54 in the environmental baseline survey, 28 (four of which were replicated from the Development survey) in areas where drilling had previously taken place, and eight random 'Quality Assurance / Quality Control' stations.

The results and analyses showed that the entire survey area was fairly homogeneous and the benthic community was typical of the sediments in the area (Section 7.3.7.1). The community structure was characterised as undisturbed and unpolluted by anthropogenic activity. In terms of the number of taxa present, polychaetes were the most abundant taxonomic group at most stations, making up 53 % of the taxa found throughout the survey area. Crustaceans were the next most abundant group, making up 23 % of the total taxa. Molluscs, echinoderms and 'other' taxonomic groups made up the remainder.

With respect to individual animals, overall crustaceans were the most abundant, making up 38 % of the total number of individuals; polychaetes made up 37 % of the total. There appeared to be a slight degree of spatial differentiation, with slightly more crustacean species found in the southern part of the survey area. The results of the post-drill survey found that the benthic community was typical of those found in undisturbed / unpolluted medium to coarse silt environments, with no evidence of anthropogenic disturbance as a result of drilling activities. Species diversity and abundance was relatively uniform across the survey area.

Although there are inconsistencies in methodology, analyses, and taxonomic resolution, the surveys generally show that the benthic community throughout the survey area can be characterised as a typical silt / mud benthic environment. The consistency in results between pre and post-drilling surveys, both in 1998 and 2012, suggest that the drill operations to date have had little or no effect on

the benthic community. The surveys have led to the identification of new species being identified within the Falkland Islands, highlighting the incomplete state of our knowledge on the deepwater benthic environment of the Falkland Islands.

7.4.3.2.2 Offshore benthic habitat assessments

At each station, a habitat assessment was conducted in order to identify:

- Sediment characteristics / benthic species which may indicate an area of environmental interest,
- The presence of any potentially sensitive habitats equivalent to those protected under Annex I of the EC Habitats Directive 92/43/EEC (as enacted by the UK's Offshore Marine Conservation (Natural Habitats) Regulations 2010 (as amended)), such as:
  - Biogenic, stony or bedrock reefs or any other habitats, and / or
  - Submarine structures made by leaking gases.
- Threatened and / or declining species or habitats which are on the OSPAR (2008) list in the UK Biodiversity Action Plan (JNCC, 2016).

Following this assessment, it was concluded that none of the above were within the surveyed area (Gardline, 2013a).

7.4.3.2.3 Deep water benthos predictive modeling

The deepwater benthic assemblages between 200 – 3000 m depth within the Falkland Conservation Zones were examined using a predictive modeling approach in a study done in support of the Falkland Islands toothfish fishery MSC certification of sustainability, commissioned by Consolidated Fisheries Ltd. Detailed methods and results of this analysis is found in SAERI (2023) Vulnerable Marine Ecosystems Project: Technical Document. Report prepared for Consolidated Fishing Ltd. July 2023.

Species predictive modeling (sometimes called species distribution modeling) compares a suite of physical variables with actual species observations, then uses the combination of physical variables that relate to the species location to predict the distribution of those species in areas that have not been sampled. In this sense, the analysis produces what is essentially a habitat suitability map for each species, and this is interpreted as the probability of a species distribution in those suitable habitats.

This study was particularly interested in those species considered to be Vulnerable Marine Ecosystem (VME) indicator taxa; that is those species that are particularly vulnerable to impacts, in this case, vulnerable to seabed fishing and bottom contact activities, due to their characteristics of having fragile structure, slow reproduction and growth rates, or rarity, to name a few. In this study, six groups of VME indicator taxa were examined: Porifera (sponges), Pennatulacea (sea pens), Alcyonacea (soft corals), Gorgonacea (bamboo corals, sea fans, bubblegum corals), Scleractinia (stony cup corals), and Stylasteridae (frame building hydrocoral). A seventh species, *Bathelia candida* (reef-forming coral, similar to *Lophelia* spp. reefs in the northern hemisphere) was examined separately from the Scleractinia due to its recognised importance in other deep-sea habitats. Physical factors used for habitat suitability included seabed depth, seabed terrain (slope, aspect, curvature, bathymetric position index, rugosity), sediment type (rock, gravel, sand, mud, carbonates), and oceanographic variables (temperature, salinity, chlorophyll, oxygen, nutrients, seabed current). Species occurrence data were gathered from a variety of locally held data gathered by FIG Fisheries and recorded in previous hydrocarbon exploration campaigns, as well as online data (e.g., OBIS). Physical data were collected from a range of online sources (see SAERI 2023 for details). The prediction algorithms used were an ensemble (average) of two methods; MaxEnt (Maximum Entropy) and RF (Random Forest)

models, which are both suitable for presence-only analysis in deep-sea environments. This analysis is used to provide predicted presence only, not abundance or aggregations.

The total number of VME indicator taxa with at least 50 % probability of being present in the Navitas production area can be seen in Figure 7-38. This indicates that are between 1 and 5 VME indicator taxa with at least 50 % likelihood of being present at any location within the PL032 license area, and 1 - 4 indicator taxa in the production area. The VME indicator groups that are predicted to be found are combinations of Pennatulacea (sea pens), Alcyonacea (soft corals), Scleractinia (stony cup corals), Gorgonacea (bamboo corals, sea fans, bubblegum corals) Stylasteridae (frame building hydrocoral), and Porifera (sponges). No *Bathelia candida* (reef-forming coral) is predicted to be present in the area.

Despite the VME groups predicted to be found in the area, early assessments of surveys by Gardline (2013a) concluded that there were no indications of sensitive habitats equivalent to those protected under Annex I of the EC Habitats Directive 92/43/EEC (as enacted by the UK's Offshore Marine Conservation (Natural Habitats) Regulations 2010 (as amended)) including Biogenic, stony or bedrock reefs or any other habitats, submarine structures made by leaking gases, or threatened and / or declining species or habitats which are on the OSPAR (2008) list in the UK Biodiversity Action Plan (JNCC, 2016). This suggests that of those taxa with a 50 % or greater predicted probability of being present in the area, these taxa are likely to be low density (not in aggregations) and / or rare, given that they went undetected in the Gardline (2013a) survey. The sediment regime in the area was classified as 'mud grading to sand', however glacial dropstones are found infrequently and these are often associated with encrusting VME species, which may result in a patchy distribution and low densities. Finally, it can be seen from the predicted distribution of VME indicator taxa that these species / habitats are widely distributed in the surrounding areas adjacent to PL032 and throughout the Falkland Conservation Zone.

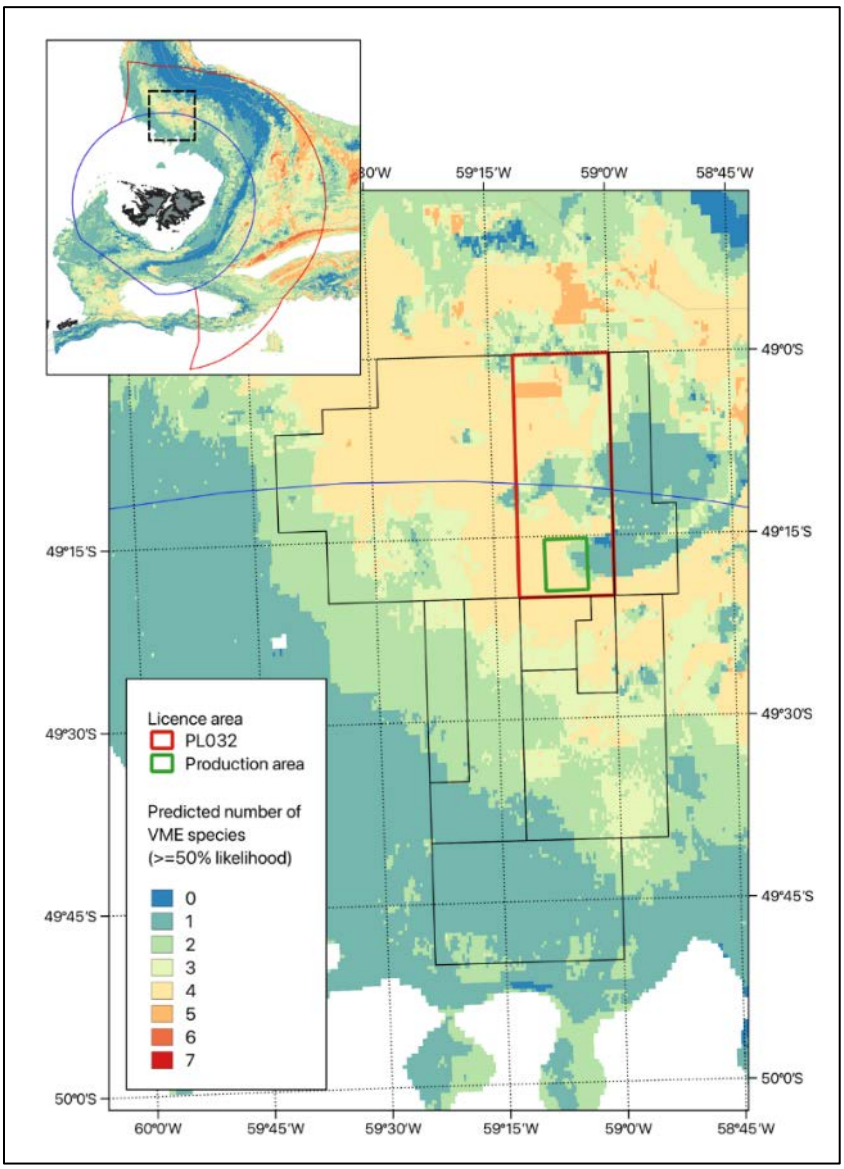


Figure 7-38: Number of VME indicator taxa predicted to be present in the Sea Lion field, licence area, and production area (redrawn from SAERI 2023)

7.4.3.3 Berkeley Sound benthos

A baseline understanding of the inshore benthic environment is important to:

- Inform the assessment of potential impact of disturbances to the seabed from the placement of objects,
- Inform the assessment of risks associated with inshore oil spills,
- Inform the assessment of potential impacts associated with underwater noise inshore, and
- Provide a point of comparison for any benthic monitoring.

The inshore marine environment of the Falkland Islands is poorly studied. Prior to the current ongoing studies by SMSG or those commissioned by POEPL, few surveys of significance have been conducted. Attempts to survey and categorise the inshore environment and marine habitats of the Falkland Islands are therefore relatively recent and are largely limited to studies undertaken by the SMSG.

There have been a number of SMSG expeditions to Berkeley Sound to describe the benthic communities (SMSG, 2009a; Neely, *et al.,* 2010b; SMSG, 2012; Davidson, 2016; EnvSys, 2016), which provide comprehensive coverage of the shallow marine environment, <20 m in depth (see Section 7.4.3.3.1.1). In the winter of 2015, Benthic Solutions, under contract to POEPL, surveyed the deeper waters of the Sound (generally >10 m) using grab samples and underwater photography. Section 7.4.3.3.3 describes the results of these surveys, further details can be found in (BSL, 2015a, b & c; EnvSys, 2016).

7.4.3.3.1 Berkeley Sound benthic flora and fauna

7.4.3.3.1.1 Inter-tidal and shallow marine benthos

Thus far, SMSG surveys have recorded a total of 530 species in the Falkland Islands intertidal and shallow waters (< 20 m water depth). A few species, particularly sponges, are newly identified and are still undergoing scientific description and naming (e.g., Goodwin, *et al.,* 2011; Goodwin, *et al.,* 2016).

In February 2016, SMSG were commissioned by POEPL to survey the shallow marine habitats within Berkeley Sound. In total, 27 stations were surveyed and results are presented in EnvSys (2016) and SAERI and SMSG (2016). Classifications of the subtidal habitats were based upon the habitat classification system created by SMSG in 2010. The survey showed that the main subtidal habitats within the survey area were Macrocystis pyrifera forest, and Sand, both being present at the same number of stations. Other habitats present at varying numbers of sites include: Mixed *Macrocystis* and *Lessonia* forest, Mud, Rock barren, Silty *Lessonia* forest, Fine sand, *Austromegabalanus psittacus* reef, Rock barren and gravel, and Drift algae and Algal litter.

The different habitat types were ranked as follows, according to the number of species found in each (note that the analyses were conducted using quadrat photography and represent epifaunal species only):

- *Macrocystis pyrifera* forest, with 94 species found,
- Rock barren habitat, with 47 different species,
- Mixed *Macrocystis pyrifera* and *Lessonia* forest, with 35 different species being present,
- Silty *Lessonia* forest habitat had 33 species present,
- *Austromegabalanus psittacus* reef habitat had 24 species,
- The Sand habitat had nine species,
- Rock barren and gravel habitat had eight species present,
- Mud had six species,
- Fine sand habitat had five species, and
- Drift Algae and algal litter habitat type had two species present.

A total of 139 species were observed and recorded, from the 27 dives, though not all were identified to species or even genus level. By phyla, Echinodermata: sea star (starfish) was the most prevalent grouping (10.04 %), in terms of relative abundance, followed by Chordata: ascidians (9.06 %), Arthropoda: crab (8.25 %), Porifera: sponges (8.16 %) and Echinodermata: sea urchins (7.62 %). Arthropoda: amphipoda and Mollusca: cephalopods were the least abundant representing 0.09 % of the total. By species, the Chilean red sea urchin (*Loxechinus albus*) had the highest overall relative abundance, followed by the blue-spotted rockcod (*Patagonotothen cornucola*), and giant kelp (*Macrocystis pyrifera*).

All of the subtidal habitats recorded are common within the Falkland Islands, and each has varying degrees of associated biodiversity. Berkeley Sound, itself, has different amounts of exposure and

openness, going from less exposed / more enclosed at the western end of the Sound, to more exposed / less enclosed towards the eastern end. This will have an impact on the habitat types and species present across the area.

7.4.3.3.1.2 Deeper water benthos

Macrofaunal analysis

Benthic Solutions carried out macrofaunal analysis on 138 grab sample replicates obtained at 46 baseline stations within Berkeley Sound (BSL, 2015c).

The analysis identified a total of 28,369 individuals from 350 taxa in all 138 samples analysed (taxa (singularly referred to as taxon) refers to any taxonomic group; species, genus etc.). Nomenclature follows Neely & Brickle (2013).

Of the 350 taxa recorded, 281 were infaunal (including solitary epifauna), consisting of:

- Annelids (segmented worms): 106 taxa (51.4 % of the total individuals),
- Crustaceans (barnacles, shrimps, crabs etc.): 79 taxa (34.6 % of total individuals),
- Molluscs (snails, bivalves and sea slugs): 56 taxa (7.8 % of total individuals),
- Echinoderms (sea urchins, starfish, brittle stars etc.): 16 taxa (1.7 % of total individuals),
- Solitary epifauna: 9 taxa (0.3% of total individuals), and
- Other groups: (Nemertea (ribbon worms), Nematoda (round worms), Sipuncula (Peanut worms), Turbellaria (flatworms), and Brachiopoda (lamp shells), Pycnogonida (sea spiders), Pisces (fish), Enteropneusta (acorn worms)), 15 taxa (4.2 % of individuals).

With the exception of species that were intentionally grouped into higher taxonomic levels (e.g., Nematoda, Nemertea), the majority of adult specimens were identified to genus level or lower. Approximately 60.7 % of specimens collected during this survey were identified to species level with 88.3 % identified to at least genus level.

Infaunal trends

The macrofauna throughout Berkeley Sound was highly variable in terms of abundance, richness and species composition, as would be expected given the highly variable nature of the sediment and the large scale of survey area. A total of 185 taxa were present with an average density of more than one individual per sample (0.1 m^2), while 58 of the 281 infaunal taxa recorded were represented by only a single specimen. Annelids (segmented worms) were found to dominate the infaunal community. This dominance is seen by overall rank, with six annelid polychaetes recorded in the top ten ranked taxa. This dominance was followed by crustacea which were also well represented, with four representatives in the top ten ranked taxa.

The results of further analysis generally indicate a wide variation in infaunal community diversity within Berkeley Sound with higher dominance and lower diversity at stations with impoverished fauna. Of particular note, Stations 02A, 04, 34 and 40 had particularly low species richness and diversity. These stations are all close to sites of human activity and also had elevated levels of pollutants (see Section 7.3.7.2.2; BSL, 2015c for full details). Station 31 is close to the LTV anchorage sites and has been frequently used as an anchoring site by other vessels. This site was made up of slightly gravelly sand, with lower species abundance and richness compared to adjacent areas, particularly with respect to sediment infauna (BSL, 2015b).

Epifaunal and other biological groups

The results show that 44 of the 46 macrofaunal samples recorded the presence of invertebrate species that are generally considered to be epifaunal and are not statistically assessed within the infauna

(discussed above). Analysis of the infaunal and epifaunal communities indicates that generally infauna are numerically dominant, with epifauna making up a small but nevertheless important part of the community. Solitary and colonial epifauna showed a general decrease in richness at stations containing uniform sands. Epifauna were surveyed by a combination of grab and photographic surveys.

Observations on epifauna recovered within the grab samples are as follows.

- Coelenterata (sea anemones, sea pens): The sessile epifauna was characterised by a scarcity of Coelenterata, with only a few small sea anemones, and a few fragmented specimens, mostly of the hydroid *Sertularella* sp.,
- Chordata (sea squirts): Tunicates were mostly represented by large specimens of the stalked solitary species, stalked piure (*Pyura legumen*), a few *Ascidia* sp. specimens and encrusting colonial lace tunicate (*Didemnidae* spp.),
- Bryozoa (bryozoan): The Bryozoa fauna was very rich and diverse within Berkeley Sound. Large numbers were found to inhabit almost any solid surface, including shells, the giant barnacle (*Austromegabalanus psittacus*), and larger species of seaweed. The general knowledge of Cyclopora (e.g., *Tubulipora* spp., *Lichenopora* sp. and *Disporella* sp.) is poor and the latter cannot be identified with certainty as it never been systematically assessed for Antarctic and sub-Antarctic waters. The upright branching genus *Cellaria* are habitat-forming in Northern Atlantic waters offshore but does not reach such importance here. Apart from a few species of what were formerly known as *Anasca* sp. these species are all encrusting, and
- Other: A solitary Entoproct (*Barentsia* sp.) specimen and a few species of Porifera (sponges) compose the rest of the epifauna.

It should be noted that grab sampling often fails to recover coarse material, especially larger pebbles and cobbles colonised by epifauna and samples cannot be taken over bedrock, therefore, it is important to not only assess epifauna through physical samples, but also to analyse photographic footage.

Photographic survey operations were carried out using a combined digital video and stills camera system deployed in a drop-down frame. This survey method is especially useful at stations over exposed bedrock where no samples were recovered, in order to determine what species are present. Seabed imagery indicated a wide variety of epifaunal groups and species throughout Berkeley Sound. Conspicuous species included:

- The fan worm *Perkinsiana antarctica*,
- Schythe-edged serolis *Acanthoserolis scythei*,
- Ornamented hermit crab *Pagurus comptus*,
- Lobster krill *Grimothea gregaria,*
- The spider crabs *Eurypodius* spp.,
- Ribbed mussel *Aulacomya atra*,
- Patagonian scallop *Zygochlamys patagonica*,
- Veined brachipod *Magellania venosa*,
- Snowflake bryozoan *Tubulipora* sp.,
- Beaded sea star *Cosmasterias lurida*,
- Sunstar *Labidiaster radiosus*,
- Chilean sea urchin *Loxechinus albus,* and

- Encrusting sponges:
  - Tedania species *Tedania* sp.,
  - Chalk sponge *Grantia* sp.,
  - Boring sponge *Cliona* sp.,
  - Warty tunicate *Asterocarpa humilis*,
  - Stalked piure *Pyura legumen*, and
  - Bubble tunicate *Styela* spp.

Sponges were extremely prevalent in areas of bedrock exposure, cobbles, boulders and other hard contacts. Urchins, brittlestars, sea cucumbers and hermit crabs were also commonly found in these areas. Starfish and tunicates were fairly common throughout, whereas lobster krill (*Grimothea gregaria*) and isopods dominated sand habitats. Other Crustacea, particularly crabs, were frequently observed at the transition zones between gravel ribbons and sands, and amongst mega-rippled bedforms. Bryozoans and hydroids were often observed attached to and encrusting upon bedrock, hard contacts and algae, and fish such as rockcod (*Patagonotothen* spp.) dominated the free-swimming megafauna. In addition, evidence of cephalopod spawning was recorded at Station 29, where a single egg cluster was found to be attached to a kelp stipe; these are of the commercially important Patagonian long-fin squid (*Doryteuthis gahi*; referred to as 'loligo' hereafter). It should be noted that the survey was conducted between the two main spawning seasons for the main loligo cohorts (Arkhipkin and Middleton, 2002a; 2002b). Nonetheless, this observation confirms that this species spawns within Berkeley Sound, although it is not possible to infer the intensity of the spawning ground.

Seabed photography confirmed the variable nature of the seabed within Berkeley Sound, as indicated by the bathymetric and side scan sonar datasets (see Section 7.3.6.2). Complex gravel ribbons were observed from sites close to the LTV anchorage sites eastwards to the mouth of the Sound, throughout the sand-dominated areas. Sparsely populated epifaunal communities were observed in areas of sand, although the interspersing gravel ribbons (gravels and relic clam shells and barnacles) were colonised by a diverse range of organisms.

7.4.3.3.2 Berkeley Sound inter-tidal and shallow marine habitat mapping and classification

7.4.3.3.2.1 Shallow marine surveys undertaken

Since 2006, SMSG have undertaken surveys at over 300 sites within several broad geographical areas of the Falkland Islands (Figure 7-39), and SAERI/SMSG have more recently collaborated on a number of surveys:

- Beauchêne Island (SMSG, 2009b),
- Jason Islands (SMSG, 2008),
- Adventure Sound (SMSG, 2009c),
- Port William,
- Stanley Harbour,
- Berkeley Sound (SMSG, 2009a; Neely, *et al.,* 2010b; SMSG, 2012),
- New Island,
- Falkland Sound,
- King George Bay,
- Hummock Island (ART/SMSG/SAERI),

- Bird Island (SAERI/SMSG),
- Shag Rock (SAERI/SMSG), and
- Port Stephens Harbour (SMSG/SAERI).

The distribution of these surveys throughout the Falklands archipelago helps to place the significance of the habitats found within Berkeley Sound in context. However, the Falkland Islands have an estimated 7,700 km of coastline and 750 offshore islands and thus large sections of the Falklands shorelines remain unsurveyed.

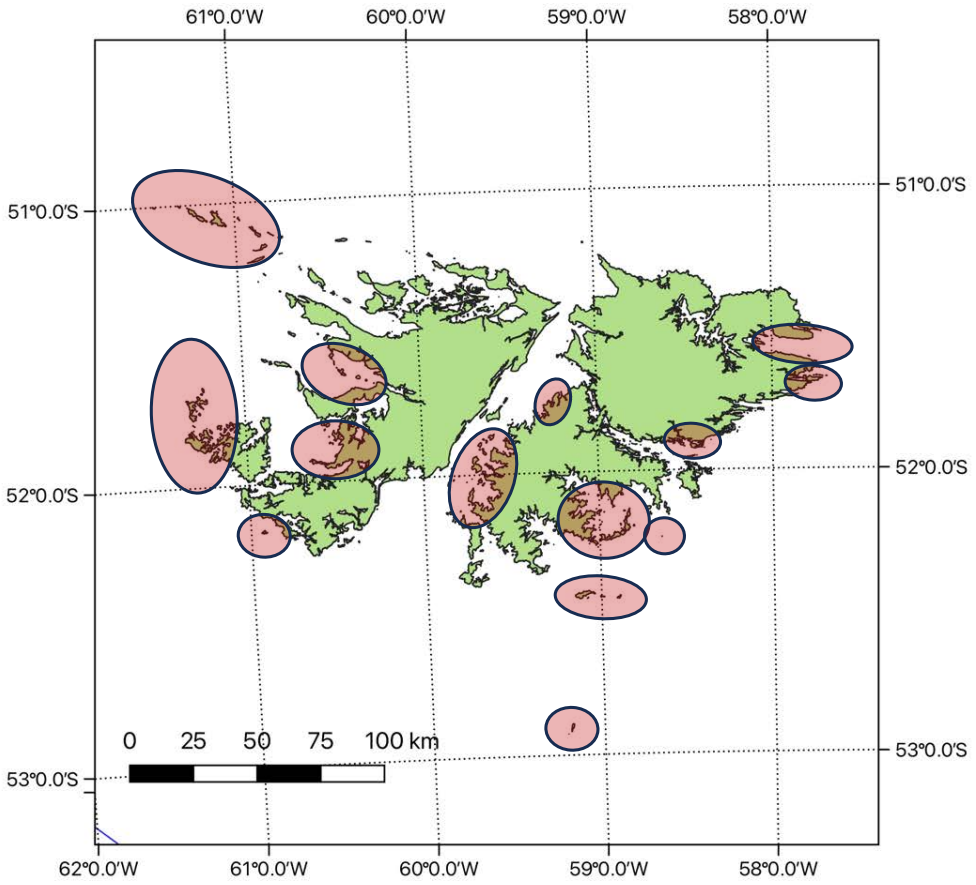


Figure 7-39: Distribution of SMSG dive survey sites across the Falklands archipelago

SMSG dive survey methodology

The survey methodology employed by SMSG consists of three parts:

- Mobile animal surveys,
- Photographic quadrats,
- ROV Surveys, and
- JNCC sublittoral habitat classification.

Full details of the methodology and expeditions can be found in Neely (2010).

Island-wide shallow marine survey coverage

The full spatial extent of each marine habitat type is unknown and has not been fully mapped for the Falkland Islands as a whole. Therefore, it is not yet possible to define spatially limited, rare or 'at risk' marine habitats for the Falkland Islands. While there are some habitats which may be environmentally

sensitive, or equivalent to those listed in Annex I of the EC Habitats Directive 92/43/EEC) (Section 7.4.3.2.2), and these areas have been subject to greater survey effort, thus far these appear to be 'rare' habitat types. Nonetheless, further surveys at other sites may identify additional occurrence of these habitats.

Berkeley Sound exhibits a high diversity of marine habitats, including some spatially limited reef habitats. It is likely that due to the range of coastline types and the projecting position to the north-east of the Falklands with oceanic currents close inshore that the area covering Cape Pembroke, Kidney Island and Berkeley Sound has higher diversity than elsewhere on East Falkland; however, due to unequal survey effort between sites it is not possible to be categorical.

Satellite imagery used for refining the habitat maps

In order to assist in comparative assessment of the Berkeley Sound coast, Environment Systems (EnvSys) was commissioned, in partnership with SAERI, to prepare shallow marine, inter-tidal and terrestrial habitat maps. This work builds on previous projects to map habitat types in the LTV anchorage sites. Background information concerning earlier phases of the mapping project can be found in Pike *et al.* (2014) and Marengo (2014b). The results from the preliminary analysis are presented in 'North Falklands Coastline Environmental Sensitivity for Oil Spill Response' (Premier, 2014a).

Due to the considerable extent of the marine and coastal area that needs to be mapped, a method was developed that combines the use of satellite imagery together with field data, including collection of species presence data, to provide updated detailed habitat maps (EnvSys, 2016).

The satellite imagery used to refine the shallow marine, inter-tidal and terrestrial habitat maps was:

- Three World View images (Figure 7-40) one from November 2011 and two from January 2012 collected in Part 1 of the project. The images were processed for use within a terrestrial and marine environment, as described in EnvSys, (2016), and
- A Sentinel-2 image acquired for this project (Part 2). The Sentinel-2 image used for this study was captured in January 2016. Technical details of this satellite system are described in EnvSys (2016).

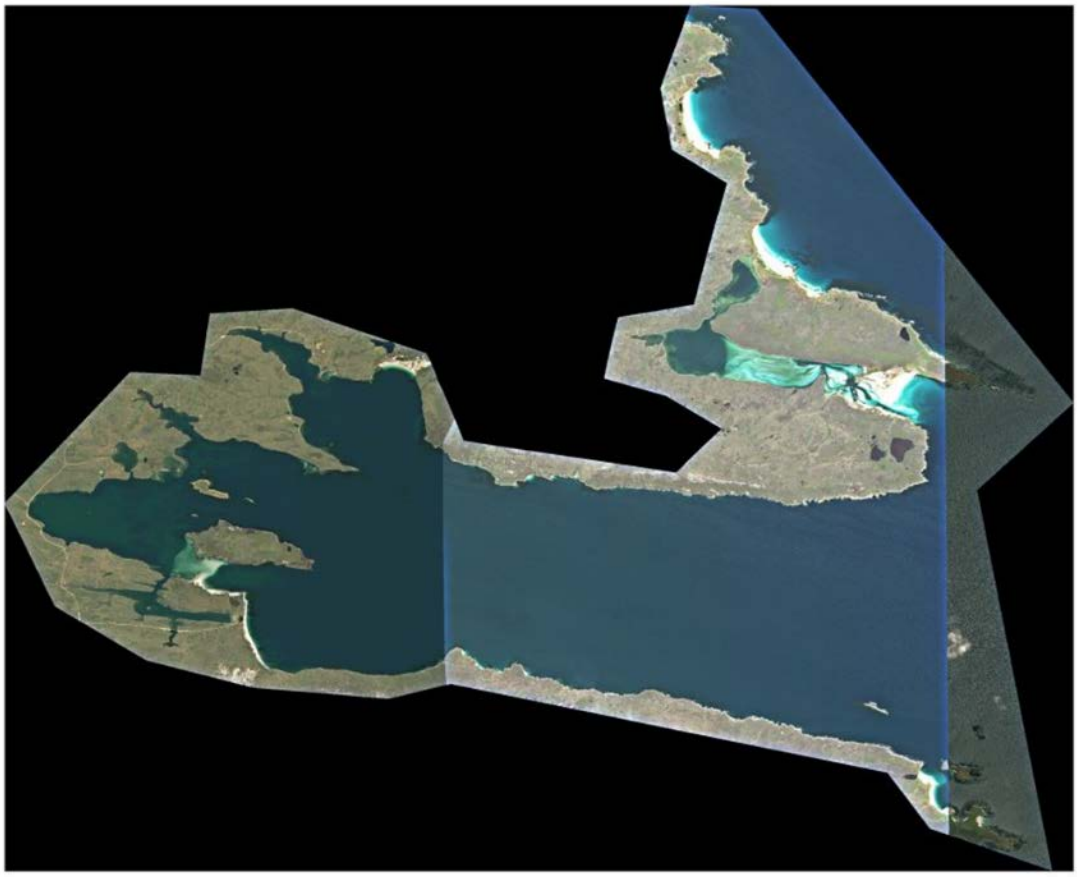


Figure 7-40: Satellite image of Berkeley Sound showing the extent of the three separate images

Using fieldwork to support mapping from satellite data

The fieldwork was undertaken to provide 'ground truth data' to support a detailed understanding of the variability of remote sensing characteristics of particular habitats and to support the selection of an accurate digital elevation model. The species data collected also provided more detailed habitat information on the marine, inter-tidal and terrestrial habitats.

7.4.3.3.2.2 Shallow marine habitat mapping

To date 19 habitats have been identified and full habitat descriptions are provided by Neely *et al.* (2010a) and are described briefly below (Table 7.5). It is likely that further study will identify additional habitat types (especially restricted habitats of limited spatial extent that may be missed with low survey effort) and that some hierarchical subdivision of existing habitat types will occur.

The 18 habitat types currently described are:

- *Macrocystis pyrifera* forest,
- *Macrocystis / Lessonia* mixed forest,
- Deep *Lessonia* forest,
- Silty *Lessonia* forest,
- Shallow *Lessonia* forest,
- Shallow *Lessonia* forest with high algal cover,
- Fleshy algae-covered substrate,
- *Durvillaea* forest,

- Mussel bed,
- *Austromegabalanus psittacus* reef,
- *Crepidula dilatata* reef,
- *Phragmatopoma virgini* reef,
- Rock barren,
- Cobbles,
- Sand,
- Fine sand,
- Mud,
- Sheltered artificial structures (Neely, *et al.,* 2010a), and
- Deep (40-50m) *Microporella* sp. (bryozoan) beds (SFL, 2022a).

WorldView 2 satellite has three bands which can penetrate water to between six and 15 metre depth and these bands were used to map the shallow water marine habitats with the aid of dive survey ground-truthing.

From the information gathered so far, there is some zonation of main cover forming species around the Sound. In particular, the western-most edge, being the most sheltered, tends to have the finest sediments and more *Lessonia* rather than *Macrocystis* kelp species. The proportion of each habitat mapped is shown in Table 7.6 and mapped in Figure 7-41.

Table 7.5: Habitat descriptions for the Falkland Islands shallow marine environment (Neely, *et al.,* 2010a) found in Berkeley Sound

Habitat type	Exposure	Substrate	Depth range	Characteristic species
Macrocystis pyrifera forest	Moderate to heavy	Solid bedrock occ. large boulders	3 – 18 m	Giant kelp, coralline algae, common sea star, pink pencil urchin and beaded brittle star.
Macrocystis / Lessonia mixed forest	Moderate to heavy	Solid bedrock occ. large boulders	2 – 20 m	Tree kelp, giant kelp, coralline algae, ornamented hermit crab, pink pencil urchin and common sea star.
Deep *Lessonia* forest	Moderate to heavy	Solid bedrock occ. large boulders	6 – 20+ m	Tree kelp, coralline algae, sponges, Atlantic purple sea urchin, flower-lobed anemone and common sea star.
Silty *Lessonia* forest	Minimal	Solid bedrock or boulders overlaid with a layer of silt	1 – 20 m	Tree kelp, saffron sea cucumber, Patagonian scallop and pink pencil urchin.
Shallow *Lessonia* forest	Moderate to heavy	Solid bedrock occ. large boulders	4 – 17 m	Tree kelp, coralline algae, sponges, common sea star, bryozoans, flower-lobed anemone and Atlantic purple sea urchin.
Shallow *Lessonia* forest with high algal cover	Moderate	Solid bedrock occ. large boulders with fleshy algae	6 – 8 m	Tree kelp and leafy / digitate algae.
Fleshy algae-covered substrate	Moderate	Solid bedrock occ. large boulders with fleshy algae	2 – 11 m	Leafy / digitate algae.
Durvillaea forest	Heavy, surge and swell	Solid bedrock or immobile boulders	0 – 4 m	Bull kelp, coralline algae and Magellanic copper limpet.

Habitat type	Exposure	Substrate	Depth range	Characteristic species
Mussel bed	Minimal to heavy	Solid bedrock, often abutting sand, mud or silt	0 – 20 m	Giant mussel, ribbed mussel, blue mussel and ornamented hermit crab, coralline algae.
Austromegabalanus psittacus reef	Moderate	Solid bedrock, often vertical faces	3 – 10 m	Giant barnacle, coralline algae, bubble tunicate and giant tunicate.
Crepidula dilatata reef	Moderate	Solid bedrock	1 – 5 m	Broad slipper limpet, coralline algae, digitate red algae and Chilean sea urchin.
Phragmatopoma virgini reef	Moderate	Solid bedrock or immobile boulders	0 – 7 m	Pink feather duster worm, piure and bryozoans.
Rock barren	Moderate	Solid bedrock or immobile boulders	3 – 10 m	Coralline algae, Chilean sea urchin and ornamented hermit crab.
Cobbles	Heavy, often high surge.	Mobile cobbles, 5 – 20 cm in diameter	5 – 20 m	Flaming limpet.
Sand	Moderate	Sand	0 – 20 m	Scythe-edged *Serolis*, purple backed crab and tessellated rock cod.
Fine sand	Minimal	Fine sand	0 – 5 m	Filamentous algae, sea lettuce, striped clam and short-spired volutid.
Mud	Minimal	Mud	0 – 15 m	Gregarious lobster krill.
Sheltered artificial structures	Minimal	Boats, pilings etc.	0 – 4 m	Giant tunicate, vase tunicate and parchment worm.

Table 7.6: The area and percentage cover of each of the habitat types mapped in Berkeley Sound (EnvSys, 2016)

Habitat	Area (ha)	Percentage cover
Open water (area of water outside of the kelp line)	21,613.9	87.24
Sand cobbles and pebbles (detected in the subtidal)	552.4	2.23
Kelp mosaic / other species	525.2	2.12
Sand with rock platforms, boulders and cobbles	491.4	1.98
Sand occasional mud where sheltered	475.5	1.92
Macrocystis kelp forest	442.1	1.78
Cobbles and rocks (with Algae growth)	140.8	0.57
Lessonia kelp forest	121.6	0.49
Sand rocks and mud at different depths – mud where sheltered	115.5	0.47
Boulders and cobbles with some rock ledges and finer sediments	95.2	0.38
Rocks and boulders – with dense algae	70.8	0.29
Mosaic of rocks, boulders and fine sediments (medium diversity) with algae	70.0	0.28
Rock platforms – occasional mussel beds and finer sediment	60.0	0.24
Total	24,774	100

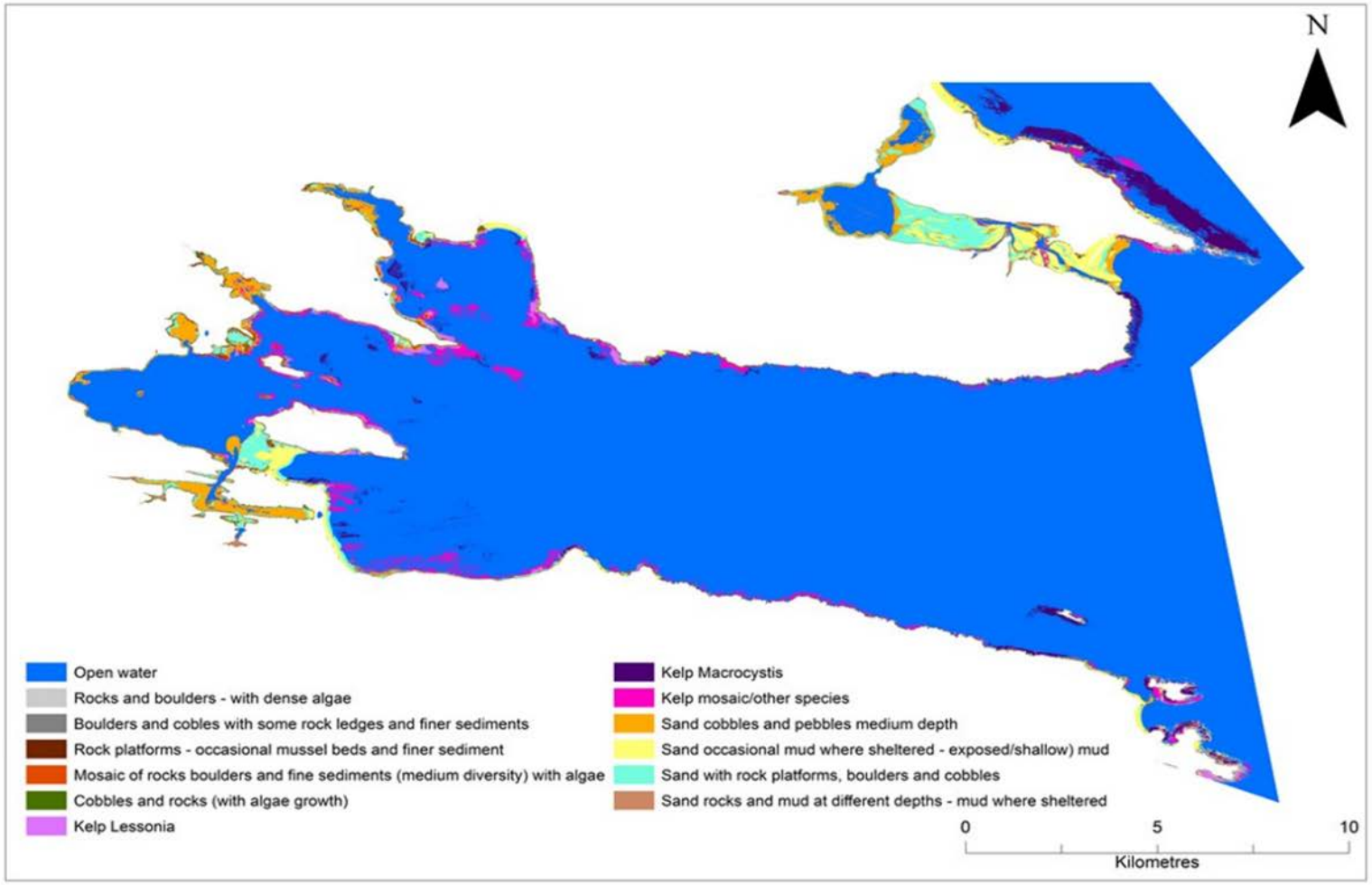


Figure 7-41: Shallow marine and intertidal habitat map for Berkeley Sound (EnvSys, 2016)

7.4.3.3.2.3 Inter-tidal habitat mapping

The inter-tidal zone is a very harsh environment and animals living there are exposed to extremes of temperature and salinity as the tides rise and fall. Intertidal habitats are characterised by vertical zonation with characteristic species present within each zone. Therefore, the same substrate type will support very different species assemblages across a relatively small distance. The species groups that are able to dominate each zone are well known from studies elsewhere in the world and reasonably predictable. However, there is currently no recognised habitat classification specifically for the intertidal habitats found in the Falkland Islands. Preliminary fieldwork to describe the inter-tidal habitats of the Falklands was conducted in February 2016, reported in EnvSys (2016). No formal, detailed habitat classification was obtained, as this would require a much more extensive survey and assessment than was afforded in this project; rather a general, qualitative description of type of substratum, species occurrences and degree of diversity has been generated.

The degree of species diversity was estimated based on the number of species occurring at each point of observation / quadrat and confirmed by visual estimation of the corresponding photos. Classes of species diversity were arbitrarily defined as 'low', 'medium', and 'high'. Anything less than 15 species was classed as 'low' and anything between 15 and 25 was classed as 'medium', while anything above 25 was classed as 'high'.

Following fieldwork, the characteristic of each of the intertidal field sites were examined against the spectral signatures of the imagery, in particular based on the sediment type and any algae or other species cover (e.g., mussel beds). Several other factors were considered in the image classification process including depth, the diversity of the communities and the substrates present. From this analysis, a look-up table (Table 7.7) was created to link the main classes from the field survey with features that could be observed in the remote sensing imagery.

Figure 7-42 and Figure 7-43 illustrate how the data collected during fieldwork was translated into the final habitat map. The map covering intertidal and shallow marine habitats for the whole of Berkeley Sound is shown in Figure 7-41 above. Note that Figure 7-43 shows the inter-tidal and shallow marine habitats combined.

Table 7.7: Look-up table linking fieldwork derived inter-tidal habitat classes and classes discernable in the remote sensing imagery

Fieldwork classes	Classes generated in the final map
Boulders	Boulders
Boulders and cobbles	Boulders and cobbles with some rock ledges and finer sediments
Boulders and pebbles	
Boulders and sand	
Cobbles	Cobbles / sparse vegetation
Cobbles and pebbles	Cobbles and rocks (with algae growth)
Gravel mud	Sand rocks and mud at different depths – mud where sheltered
Mosaic of cobbles, pebbles and gravel	Mosaic of rocks boulders and fine sediments (medium diversity) with algae spp.
Mosaic of platforms boulders and sand	
Mosaic of platforms, boulders and cobbles	
Mosaic of platforms, boulders and rocks	
Mosaic of platforms, boulders, cobbles and gravel	
Mosaic of platforms, cobbles and pebbles	
Mosaic of rocks, boulders and sand	
Mosaic of platforms, rocks, cobbles and sand	Sand with rock platforms, boulders and cobbles
Rock platforms	Rocks and boulders – with dense algae
Rock platforms and boulders	

Fieldwork classes	Classes generated in the final map
Rock platforms and cobbles	Brown rock platforms – occasional mussel beds and fine sediments
Rock platforms and sand	
Rocks	
Sand	Sand occasional mud where sheltered
Sand and boulders	Sand rocks and mud at different depths – mud where sheltered
Sand and cobbles	
Sand and dead shells	
Sand and rock escarpment	
Sand cobbles and pebbles	Sand cobbles and pebbles medium depth

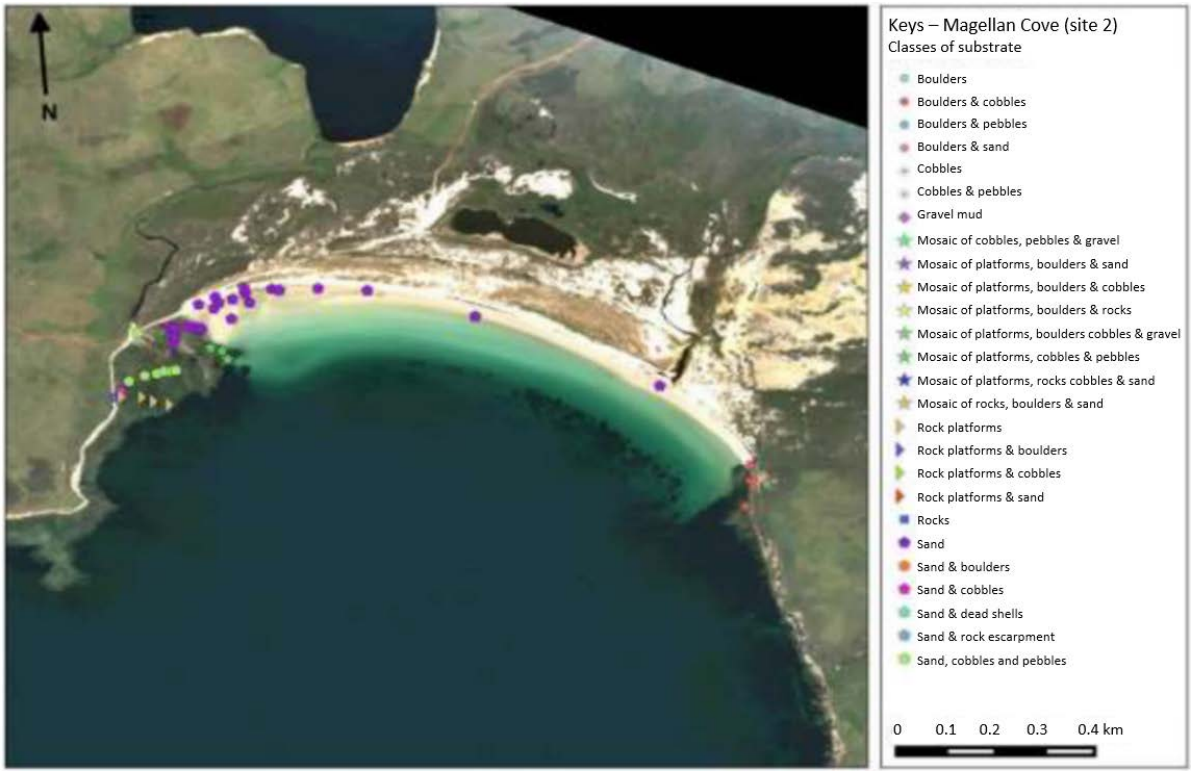


Figure 7-42: Sites and substrate classes recorded at Magellan Cove

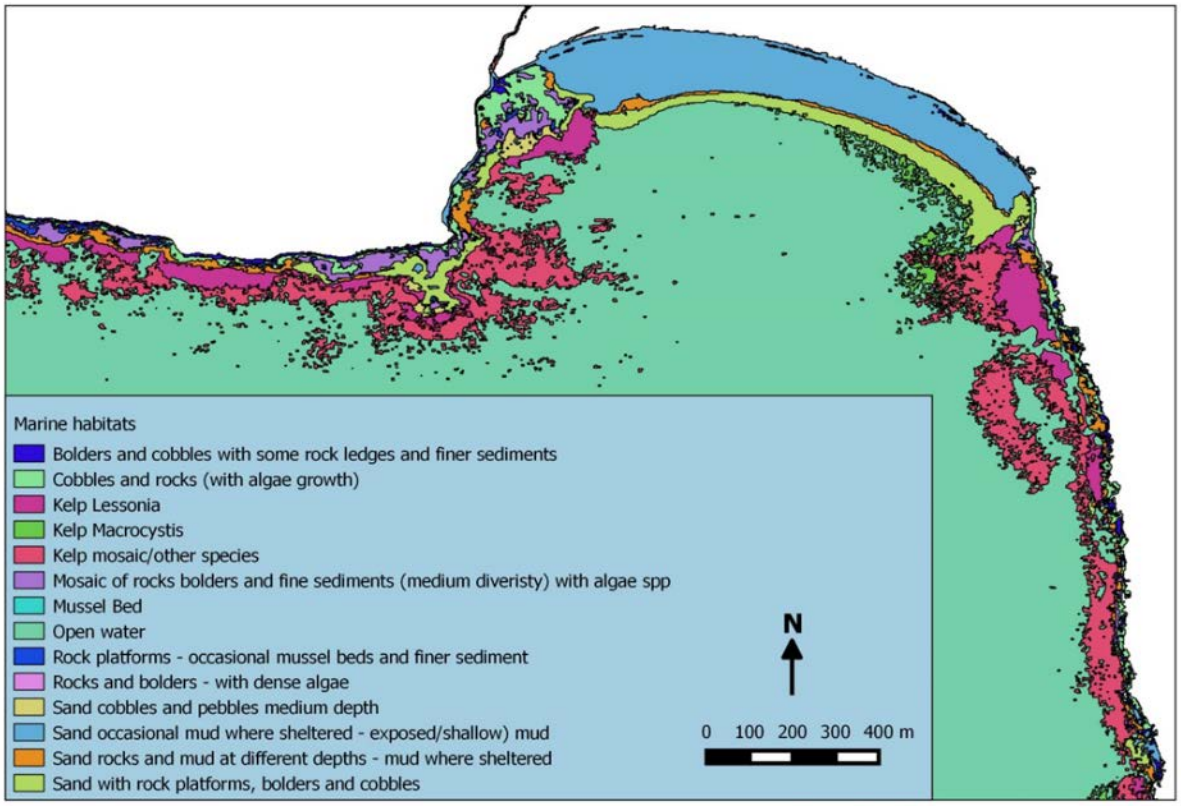


Figure 7-43: Inter-tidal and shallow marine habitats mapped at Magellan Cove

7.4.3.3.3 Berkeley Sound deeper water (>10m) habitat mapping and classification

The surveys carried out by Benthic Solutions recorded numerous subtle sediment changes throughout Berkeley Sound with differing proportions of coarser materials in the form of fragmented shells, gravel, cobbles and boulders. The distribution of habitat types within Berkeley Sound is shown in Figure 7-44 and Figure 7-45.

Due to differences in the depths surveyed, the habitat classification described by SMSG (Neely, *et al.,* 2010a) often only loosely conformed to those encountered by Benthic Solutions.

The six main habitats identified within Berkeley Sound are:

- Rock face and cobbles,
- Mud,
- Sand,
- Kelp forest,
- Mussel beds, and
- Gravels.

The habitat types listed above (and shown in Figure 7-44 and Figure 7-45), and anthropogenic habitats are all discussed in more detail below. Further to the main habitat designations, anthropogenic habitats are also discussed.

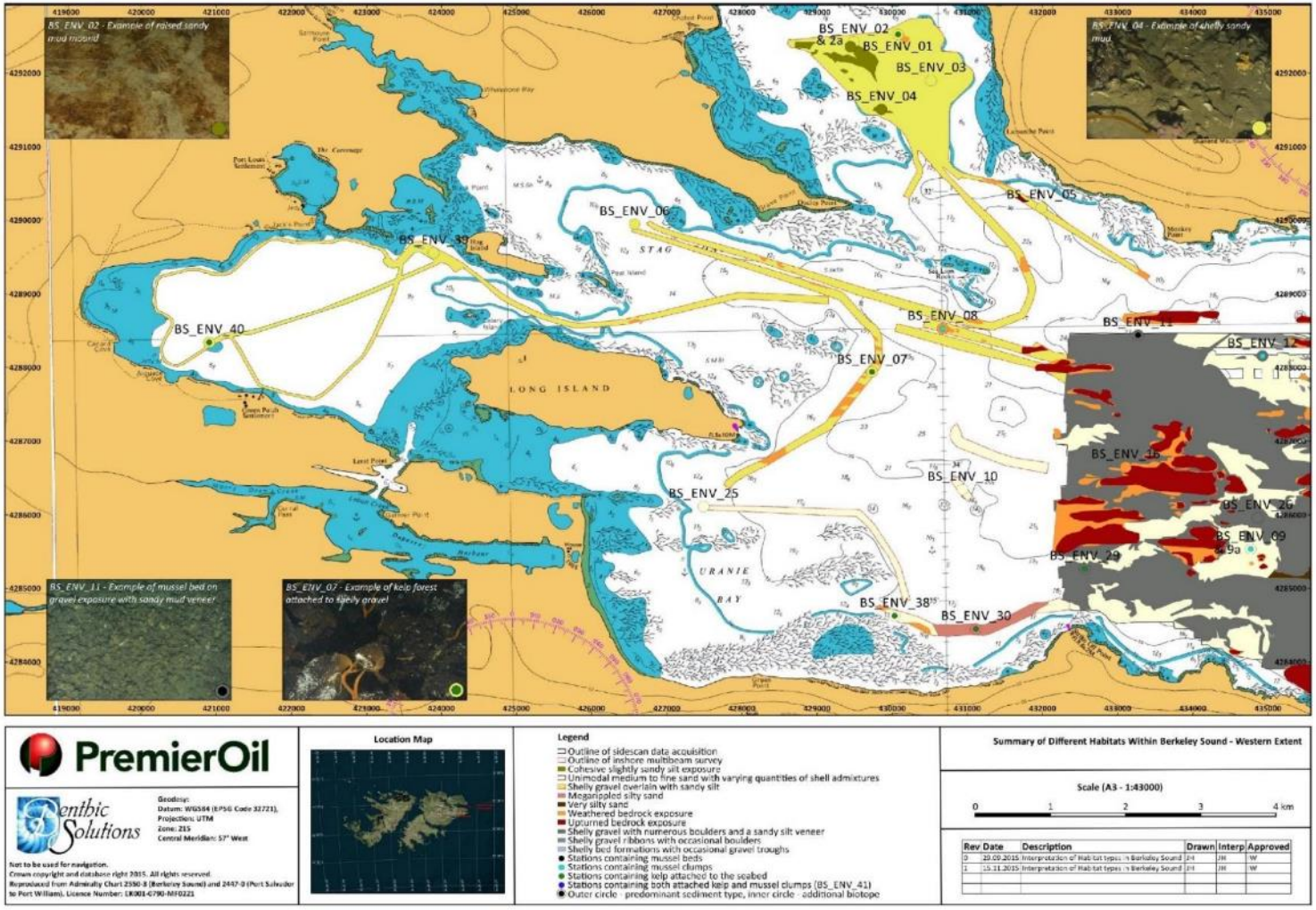


Figure 7-44: Habitats mapped within the inner Berkeley Sound (BSL, 2015b)

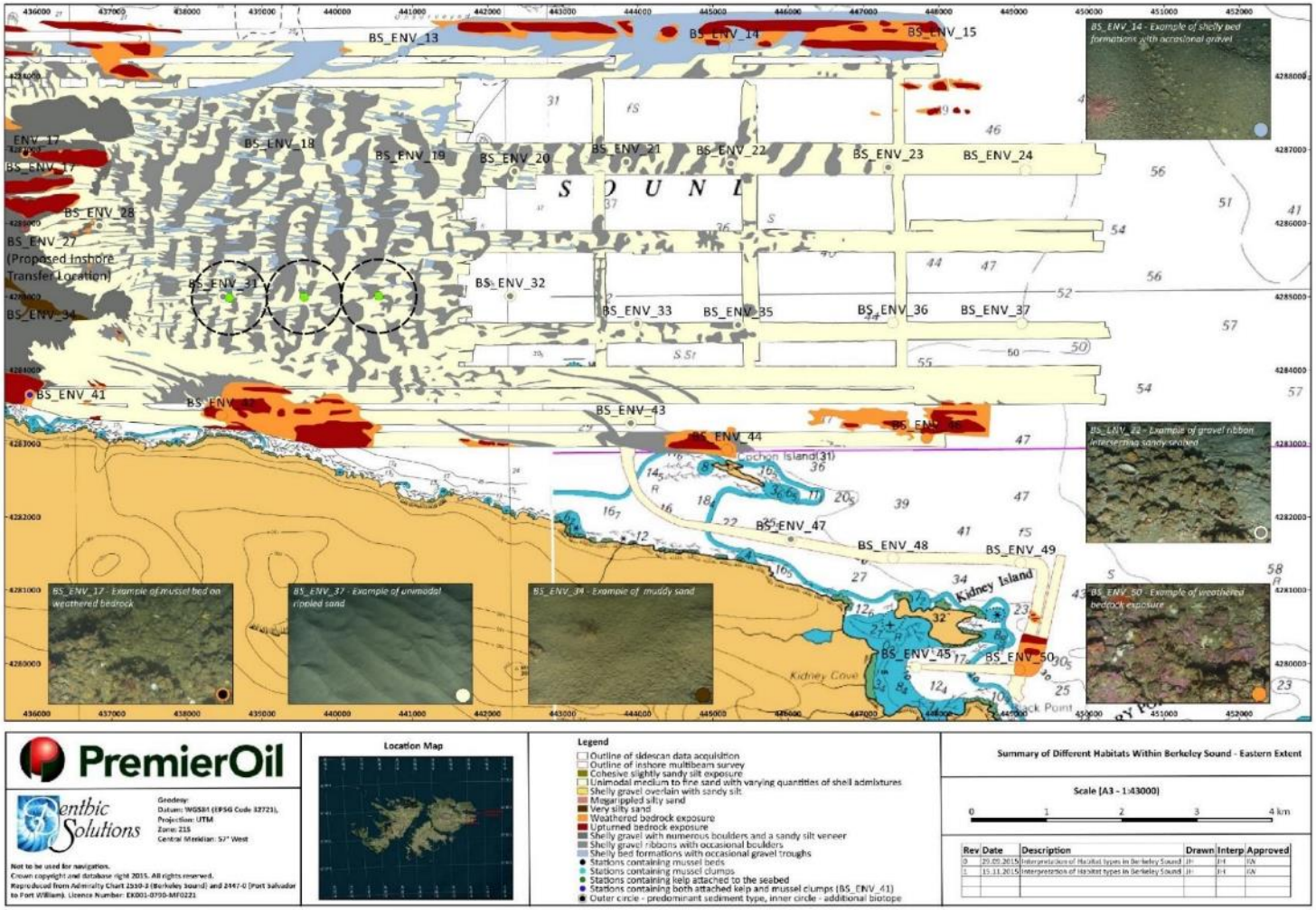


Figure 7-45: Habitats mapped in the outer Berkeley Sound (BSL, 2015b), showing the proposed LTV anchorage and exclusion zones

7.4.3.3.3.1 Rock face and cobbles

Bedrock exposures and escarpments were identified in the area of the LTV anchorage sites, and along the north and south coasts of Berkeley Sound. Around the LTV anchorage sites, the strata generally dipped vertically in a north-south orientation. The size of these exposures varied from localised boulder-sized formations to the most prominent bedrock exposure around site Station 16, which measured over two kilometres across by one kilometre wide. Erosion of these features often resulted in cobble sized deposits at the base and in the gullies of the formations.

Stations observed to conform to the rock face and cobbles habitat included Stations 42, 44 and 46 in the south of the survey area. Only rock face habitats were observed at Stations 16 and 50, and those that displayed further variations of this habitat type include Stations 08, 15, 17 and 41.

Rock features were generally very diverse, characterised by encrusting coralline algae (*Corallina* spp.), numerous sponges (including possibly boring sponge (*Cliona* sp.), lace sponge (*Clathrina* sp.), chalk sponge (*Grantia* sp. and *Tedania* spp.) and bryozoa (branched bryozoa, *Cellaria malvenensis*, *Reteporella* sp.). Further to this, solitary sessile epifauna included (but was not limited to) barnacles, tunicates (bubble tunicate, *Styela magalhaensis*, stalked piure, *Pyura legume*, warty tunicate, *Asterocarpus humilis* (possibly invasive) and flower tunicate, *Sycozoa gaimardi*), anemones (smooth anemone, *Actinostola chilensis*, flower-lobed anemone, *Antholoba achates*) and the invasive parchment worm, *Chaetopterus variopedatus*.

More mobile species were dominated by large numbers of limpets (often encrusted with coralline algae). Other mobile species included chitons, urchins (Chilean sea urchin), starfish (sunstar, *Labidiaster radiosus*, rough armed sea star, *Ganeria falklandica*, badge starfish, *Diplodontias singularis*), brittlestars (rough brittlestar, *Ophiactus asperula*), rock cod (*Patagonotothen* spp.), and various crustaceans (decorator crab, *Eurypodius latreilli*, Chilean snow crab, *Paralomis granulosa*), amongst numerous others. Detailed site-specific conspicuous fauna lists are provided in Appendix III of BSL, 2015b. It is of note that the mottled sea star, *Glabraster antarctica*, which is described as 'a primarily Antarctic and Sub-Antarctic species only rarely seen inshore in the Falklands' by SMSG (Neely and Brickle, 2013), was identified at Station 42 amongst the coralline algae encrusted bedrock exposures.

Bedrock-associated habitats were visually observed to harbour a huge array of encrusting and free-living biota. The biologically diverse nature of these bedrock exposures could be considered to conform to the designation of a geogenic reef, as per the EC Habitats Directive.

7.4.3.3.3.2 Mud

Muddy habitats, with varying levels of fragmented shell material, were encountered in the western part of the area surveyed, particularly within the Johnson's Harbour and Port Louis embayments. Muds also characterised the base of the depression feature around the LTV anchorage sites. Seabed photography recorded bioturbation in the form of burrows and other 'lebensspuren' (animal tracks and furrows) likely to be produced by echinoderms, gastropods, and isopods, including the scythe-edged serolis (*Acanthoserolis schythei*).

This habitat type showed considerable variation in the form of shell material, sand and cobbles. Ribbed mussel beds and silty Lessonia forest were also observed in areas characterised by fines.

Prevalent conspicuous fauna included the scythe-edged serolis isopod, crustaceans (lobster krill, purple backed crab (*Peltarion spinulosum*) and long-nosed spider crab (*Eurypodius longirostris*)), starfish (rough armed sea star, common sea star (*Anasterias antarctica*) and badge starfish), the veined brachiopod (*Magellania venosa*) and gastropods (Gever's trophon (*Trophon geversianus*)) and checkered murex (*Xymenopsis buccineus*)). In most areas, the seabed was generally featureless and absent of current related bedforms, indicating a sedimentary regime with limited hydrodynamic

reworking of the sediments. At the edges of the basin feature close to the LTV anchorage sites and at other locations nearby, patches of rippling were observed on the seabed surface, indicative of some level of current turbulence.

7.4.3.3.3.3 Sand

Sandy sediments were widely recorded within the fairway area to the east of the LTV anchorage sites, and around Kidney Island. Within the fairway the sonar data indicated a variable seabed, with linear patches of course materials separating areas of sand; these have been interpreted as mobile gravel ribbons after review of the seabed imagery and video footage.

Bioturbation and 'lebensspuren' ('life-traces') in the form of crustacean tracks was observed at a number of stations, particularly those with less shell material or fewer cobbles present, with burrows also occasionally recorded.

Sand megaripples with wavelengths of 0.5 m to 1.5 m (crest to crest) were observed at stations closest to the mouth of the Sound, indicative of current turbulence, with the orientation suggesting that the localised currents flow east / west in line with expectations based upon the tides flowing in and out of the Sound. Megarippled shelly bedforms were also identified along the north coast at Stations 13 and 14, and also at Stations 19 and 43 within the fairway and along the south coast, respectively. These were composed of very coarse materials and are indicative of current turbulence with little deposition from fine materials.

Lobster krill (*G. gregaria*) represented the most abundant epifauna inhabiting sandy substrates. Other crustaceans (Chilean snow crab, long-nosed spider crab), starfish (beaded sea star, sunstar, rough armed sea star) and rock cod (*Patagonotothen* spp.) were also noted in these areas, along with numerous relic polychaetae tubes.

7.4.3.3.3.4 Kelp forest

Kelp forests were encountered along the coast, and in shallow areas with exposed or shallow-buried bedrock (Section 7.4.2.2). Two kelp habitats were observed in the seabed video and photography: silty Lessonia forest and mixed *Lessonia* / *Macrocystis pyrifera* forest. In addition, during transits, large areas of giant kelp (*M. pyrifera*) were encountered frequently along the coast of the Sound, and around Cochon and Kidney Islands.

Large clusters of storm-rafted giant kelp were present at the surface throughout much of the Sound, with kelp debris also present on the seabed at a number of stations.

Conspicuous fauna included: Patagonian scallop (*Zygochlamys patagonica*), starfish (rough armed sea star, common sea star), tunicates (piure species., warty tunicate (*Asterocarpa humilis*; possibly invasive), bubble tunicate (*Styela* sp.)), ornamented hermit crab, ribbed mussel, nudibranchs, fur algae (*Desmarestia distans*), urchins and various encrusting sponges. Encrusting pink coralline algae (*Corallina* sp.) was recorded in low quantities at nine stations, and in addition, at Station 41 ribbed mussel densely populated the *Lessonia* holdfasts. It should be noted that this example of a silty Lessonia forest was composed of comparatively less silt than other examples further to the west of the site.

At Station 29, sparse kelp coverage was encountered, with fur algae attached to the shells of bivalves and other hard contacts. One cluster of squid eggs was photographed at this station; these eggs are thought to belong to the commercially exploited loligo squid.

7.4.3.3.3.5 Mussel beds

Mussel beds, mostly thought to comprise the ribbed mussel, were identified at two stations within the environmental survey area (Stations 17 and 11), with smaller patchy aggregations noted at a further four stations. Three species of mussel are known to form the majority of extensive beds in the Falkland

Islands: blue mussel, giant mussel (*Choromytilus chorus*) and ribbed mussel (Neely, *et al.,* 2010a). Blue mussel is thought to inhabit shallower waters, whereas both giant and ribbed mussels tend to be found in deeper areas. The majority of mussel beds were observed at stations characterised by silty sediments, and located on slope faces, and all mussel beds observed were found to be located in the western half of the survey area, where the silt content was visually interpreted to be higher.

Mussel beds provide a complex structure which creates a habitat within which small organisms are able to shelter, and a substrate for encrusting organisms to colonise. Mussel beds are included in the OSPAR List of threatened habitats (specifically horse mussel, *Modiolus modiolus*), and are recognised for creating biogenic reef structures, and are therefore included in the Annex I Reefs list in the EC Habitats Directive. The two large beds identified at Stations 11 and 17 could therefore be construed as biogenic reefs.

Ribbed mussel individuals were often found to be encrusted with calcareous coralline and other algae, barnacles, sponges and small tunicates, such as *Styela magalhaensis*. Starfish, such as rough armed sea star and beaded sea star, were common amongst the mussel beds, along with crustaceans (Chilean snow crab, ornamented hermit crab), veined brachiopods and various gastropods.

7.4.3.3.3.6 Other habitats

Gravel ribbons encompassed differing proportions of sand, silt, shell material, gravels and cobbles, and include the complex gravel ribbons and megarippled shelly bedforms mentioned previously. The presence of ribbed mussel beds and silty *Lessonia* forest were noted at Station 41 along the southern coast of Berkeley Sound.

Gravel ribbons comprised large patches of relic bivalve shells (likely the striped clam, *Eurhomalea exalbida*), gravels and cobbles. These materials were heavily encrusted with both relic and live barnacles and calcareous mats of *Corallina* spp.

Gravel ribbons were also found to support a diverse range of organisms, including numerous crustaceans (ornamented hermit crab, long-nosed spider crab and Chilean snow crab), the naked urchin and the white feather-duster worm (*Perkinsiana antarctica*), along with various sponges, tunicates, hydroids and bryozoans colonising the hard contacts. Relatively few conspicuous fauna were recorded in areas of shelly bedforms, with the mobile sunstar most frequently observed, followed by the long-nosed spider crab and the Chilean snow crab.

7.4.3.3.3.7 Anthropogenic habitat

Examples of anthropogenic structures were prevalent throughout the Berkeley Sound (see Section 7.7.6.2) and were mostly present in the form of localised sonar contacts. The shipwrecks of the Ocean 8 and Blakeney were also identified in the analogue data; however, no seabed photography was acquired at these locations. The introduction of anthropogenic structures such as wrecks into the marine environment can often be seen as a long-term benefit, providing a hard surface that is often an alternative substrate to natural rock. This can therefore benefit epifaunal species that are otherwise only present on rocky reefs (Hiscock, *et al.,* 2010).

While the addition of these vertical and horizontal hard surfaces could be considered to be ecologically beneficial to the region, other anthropogenic activities can have the opposite effect. Anchor scars were identified throughout the survey area. The physical dragging of the anchors disturbs benthic communities, stripping hard surfaces and overturning soft sediments.

Evidence of shipping activities in the region were observed at Station 09; these ranged from uncolonised aluminium cans, to a heavily colonised steel structure, as well as the aforementioned anchor scars. The presence of shipping debris throughout the area relates to Berkeley Sound's long history as an anchorage.

The steel structure at Station 09A was investigated using seabed photography (Figure 7-130 below under Section 7.7.6.2.3) and is thought to be an arm from a jigger. The structure was found to be densely populated, with bivalves (possibly mussels), gastropods (broad slipper limpet, Gever's trophon and checkered murex), decorator crab, giant tunicates (*Paramolgula gregaria*), starfish (common sea star, possibly badge starfish), naked urchin, painted shrimp (*Campylonotus vagans*), and encrusting sponge recorded.

Numerous rock cod (*Patagonotothen* spp.) were also present around the structure, likely belonging to more than one species. Sheltered structures are often used by mobile species as a nursery area; this is supported by the presence of numerous fish in the subsea video.

Seabed imagery indicated the possible presence of the filamentous bacteria *Beggiatoa* sp. within the anchor scars, visible as a white mat on the seabed. This bacteria species is generally only found in areas that interface aerobic and anaerobic conditions and is often found in areas of organic enrichment.

7.4.3.3.4 Berkeley Sound environmentally sensitive habitats

The classification of intertidal habitats is still in development, however, to date it appears that the range of intertidal habitats found are widespread.

However, during the Benthic Solutions' field programme (BSL, 2015b), several potentially environmentally sensitive habitats, or those of conservation significance recognised under the UK's Offshore Marine Conservation Regulations 2010 (which implements the EU Habitats Directive 92/43/EEC) were identified within Berkeley Sound. These include:

- Geogenic Reefs (rock faces and cobbles),
- Biogenic Reefs (mussel beds), and
- Kelp Forests.

7.4.3.3.4.1 Geogenic reefs

Geogenic reefs were interpreted to occur in areas of bedrock exposure. The biological diversity observed at these sites was considered to conform to the EC Habitats Directive designation of geogenic reefs. These areas were found to be colonised by a diverse array of biota, with numerous associated free-living species present too. Bedrock exposure was observed in the form of escarpment outcrops in the centre of the Sound and along the north and south coast.

7.4.3.3.4.2 Biogenic reefs

Biogenic reefs took the form of mussel beds and were predominantly thought to comprise the ribbed mussel (*Aulacomya atra*). Although examples of the small-ridged mussel (*Philobrya blakeana*) were also recorded, this species is not known to form the dense aggregations observed during the survey. Three further species of mussel are known to inhabit the Falkland Islands: purple shore mussel (*Perumytilus purpuratus*), giant mussel (*Choromytilus chorus*) and the blue mussel (*Mytilus chilensis*); the latter two of which are capable of aggregating to form extensive subtidal beds, as observed with *A. atra*. Mussel beds were identified at two stations: 11 and 17, with patchy aggregations observed at four further stations although these are not thought to constitute the dense aggregations that define this habitat type. Mussel beds (specifically horse mussel, *Modiolus modiolus* and intertidal blue mussel beds) are included in the OSPAR List of threatened habitats and are recognised for creating biogenic reef structures; they are also included in the Annex I Reefs list in the EC Habitats Directive. However, blue mussel beds are an extremely common feature in the Falklands coastal waters and it is questionable whether blue mussel beds represent a threatened habitat in the Falkland Islands.

Further biogenic reefs have been previously identified locally by the SMSG (Neely, *et al.,* 2010a) but were not recorded during this programme. The full spatial extent of each habitat type is unknown and has not been fully mapped. Therefore, it is not yet possible to define spatially limited rare or 'at risk'

marine habitats for the Falkland Islands. There are no designated species or habitats equivalent to those of conservation significance recognised under the UK's Offshore Marine Conservation Regulations 2010 (which implements the EC Habitats Directive 92/43/EEC) or listed as a priority habitat within the *Natura 2000* marine network.

The habitat types most likely to meet such criteria that have been recorded in the Falklands shallow marine environment are the following cold water reef forming species:

- Giant barnacle (*Austromegabalanus psittacus*) reef,
- Broad slipper limpet (*Crepipatella dilatata*) reef, and
- Purple-crowned feather duster worm (*Phragmatopoma virgini*) reef.

Giant barnacle reefs and broad-slipper limpet reefs have only been encountered within Berkeley Sound (in the region of Strike-off Point; Neely, *et al.,* 2010a) and a feather duster tubeworm reef has been observed at only one site within Port William, near to Cape Pembroke, these are likely to be rare and spatially limited habitat types. However, Berkeley Sound and Cape Pembroke have also been subject to the greatest survey effort and the identified species / habitat accumulation curve is more advanced. Further survey at other sites may yet identify additional occurrence of these habitats.

7.4.3.3.4.3 Kelp forests

Kelp forests are known to provide shelter for sometimes hundreds of species within their holdfasts (Chile; Ríos, *et al.,* 2007), illustrating their importance within biological communities. The sensitivities of kelp forests have been recognised elsewhere in the world, with an extensive *M. pyrifera* forest in Alaska currently undergoing consideration for red list status (Endangered to Critically Endangered; Keith *et al.,* 2013), however, no legislative protection is currently in place for this habitat type globally.

Marine algae and especially the species of kelp (Giant Kelp - *Macrocystis pyrifera*, Tree Kelp - *Lessonia* spp. and Bull Kelp - *Durvillaea antarctica*) form a significant component within 7 of the 18 coastal habitat types described by SMSG (Neely, *et al.,* 2010a) and dominate much of the coastline of the Falklands. While no index of diversity is available, it is likely that kelp forest forms the most diverse habitat with greatest range of faunal associations of the Falkland Islands marine habitat types. *Macrocystis* and *Lessonia* kelp in particular form a complex stratified 3-dimensional habitat matrix through the water column.

Kelp although relatively resistant to low-level oil accumulations, due to the protecting mucilaginous exudate on foliage, may be impacted by heavier accumulations due to:

- Reduced photosynthetic output,
- Breakage from increased foliar loading, and
- Inhibition of settlement and growth of new young plants due to sedimentation.

Furthermore, indirect impacts may result if faunal assemblages are impacted with a resultant increase in grazing fauna leading to defoliation. Kelp may also limit oil dispersal and retain oil in the near-shore environment.

Understanding the marine and inshore vegetation of the Falkland Islands is important as algae are one of the major primary producers in the marine environment. As with other components of the inshore marine environment the marine algal habitats and floral and faunal associations that exist within Falklands waters are poorly described and understood. See also Section 7.4.2 for detail on the mapping of kelp forest.

7.4.3.3.5 Marine non-native/invasive species

The introduction of invasive marine species has had environmental, and in many cases economic, impact across the globe. The first confirmed vessel landing in the Falklands occurred in 1690 (17th

century) and was likely carrying non-native species and this continues to the present day. The Falklands, like many other parts of the world, are perceived to be relatively pristine but may have already been significantly altered by invasive marine species. One of the major issues regarding the detection of marine invasives is the lack of baseline data regarding the native fauna. The surveys of SMSG are beginning to fill some of these gaps by conducting baseline surveys to record the species and habitat types present in the Islands (see Neely, *et al.,* 2010a; Neely, 2010). These surveys have identified two non-native species that are present; the vase tunicate (*Ciona intestinalis*) and the parchment worm (*Chaetopterus variopedatus*). These species are known to be problematic in other parts of the world, which sparked dedicated surveys to map the distribution of these species in Stanley and Mare Harbours (SMSG, 2011), the primary ports in the Falklands.

Vase tunicates are very competitive and can rapidly cover nearly 100 % of the available substrate, excluding almost all of the native species in that area. The results of surveys thus far indicate that this species is restricted to Stanley and Mare Harbour (i.e., not in Berkeley Sound), hinting at a relatively recent introduction (SMSG, 2011). This also highlights the risk of vessels visiting these Harbours having the potential to translocate this organism to other parts of the Falklands.

The parchment worm is more widespread throughout the Falkland Islands and it is likely that it was introduced some time ago, possibly during the era of wooden sailing vessels (SMSG, 2011).

In addition to the species above, several non-native species have been found recently that are considered to be invasive elsewhere but seem to be having little impact on the native Falklands floral and faunal assemblage at this time. These include:

- The cnidarian *Metridium* sp. (plumose anemone, SMSG, 2013),
- The ascidian *Asterocarpa humilis*,
- Nine species of algae (Brodie and Mrowicki, 2019), and
- The blue mussel *Mytilus edulis* (SFL, 2022b).

The effect of shipping on modern invasive species introductions in Stanley Harbour can be clearly evidenced by the recent discovery of a northern hemisphere clade of the blue mussel (*Mytilus edulis*) on FIPASS (SFL, 2022b). Here, a survey of the blue mussel assemblage in the top 5 m depths of the FIPASS hull showed that at least 12 % of the *Mytilus* sp. assemblage was the introduced *M. edulis*, with the remainder being the endemic species *M. chilensis*. Although it is not clear when this species was introduced, analysis shows that they are present in higher densities in areas frequented by vessels mooring along-side, suggesting they have not had time enough to spread widely. However, multiple cohorts of *M. edulis* were found, suggesting they are recruiting into the same locations.

There is potential for other non-native species to be present but yet to be discovered. The surveys of BSL (2015c) found several species within Berkeley Sound that were previously only known from the North Atlantic. As many of the vessels visiting the Falklands originate in Europe, it is plausible that these arrived in ballast water or as biofouling organisms.

To further address the lack of baseline, POEPL commissioned (in partnership with SMSG, SAERI, University of Aberdeen, and FIG-Biosecurity) a multi-year (2015-2018) monitoring program to test the effectiveness of methods for the monitoring and early detection of marine invasives in the Falklands (Premier, 2019a). Monitoring sites were located in Stanley Harbour at the Temporary Dock Facility, and at York Bay in Port William. Monthly visual inspections of species recruitment onto settlement plates was carried out, and periodic analysis of the whole settlement plate assemblage was done using metagenomic analyses (see Figure 7-46).

The results showed:

1) Natural species recruitment on settlement plates can vary significantly within and between sites, and temporally within and between years,
2) Whilst metagemonic methods can detect the total species present including cryptic and newly settled species, traditional taxonomic analysis of plate assemblages are required to confirm species' identity, and
3) Comparing gene sequences to GenBank showed that of the 51 unique species detected throughout the study, eight were confirmed to 100 % likelihood of a named identity, and 21 were confirmed to *c.* 90 % likelihood of a named identity, suggesting that *c.* 50 % of species found require formal identification and genetic bar-coding for detection in the future.

This study will inform a marine invasives species monitoring program, as recommended at the EMMP workshop. This will likely involve firstly, the establishment of a more comprehensive baseline of a species bar-coding library, as well as deploying settlement plates in Berkeley Sound and Stanley Harbour for monitoring pre-construction phase in advance of the first vessels arriving to the Falklands. Recommendations regarding new, highly portable technology to be potentially used in the Falklands were also made.

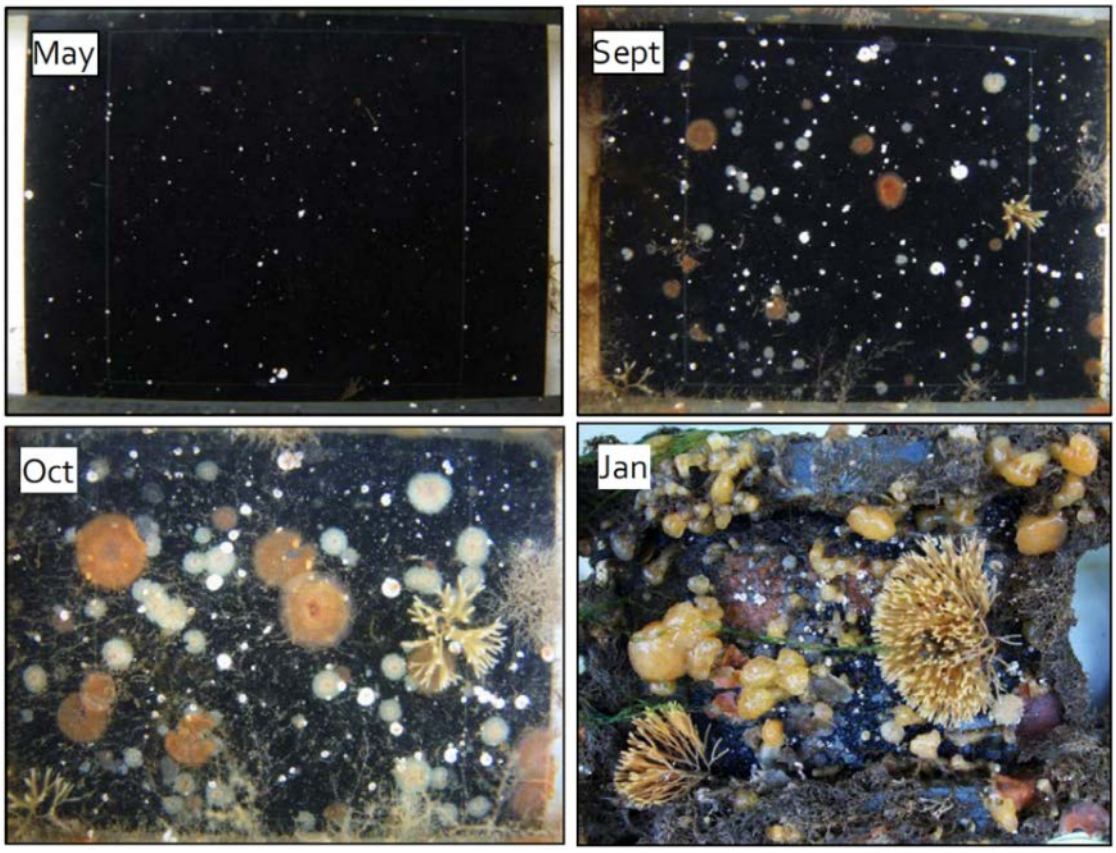


Figure 7-46: Example of progress in colonisation and growth of organisms on settlement plate over time (TDF site, May 2016 – Jan 2017)

7.4.3.4 Marine flora and fauna in Stanley Harbour and surrounding areas

The mud habitats in and around Stanley Harbour have been described as having a relatively high abundance of the saffron sea cucumber (*Cladodactyla crocea*), the tessellated rock cod (*Patagonotothen tessellata*), the invasive sea squirt, vase tunicate (*Ciona intestinalis*), the pencil urchin (*Austrocidaris canaliculata*) and the common starfish (*Anasterias antarctica*). Approximately 30 commonly occurring species were recorded during a broad survey of the wider extent of Stanley

Harbour conducted in 2011 by the Shallow Marine Surveys Group (SMSG; Brickle, *et al.,* 2011). These are all considered to be common and widespread species and are not considered to be restricted in distribution or of great ecological concern.

In 2013, a more detailed benthic grid survey of the immediate development area to the east of The Narrows was carried out by SMSG (SMSG, 2013). Findings of the 2013 survey were broadly similar to the 2011 SMSG study with the most common and widespread species being the saffron sea cucumber. The species assemblages suggested that the area was not rich in biodiversity and showed little variation between sites surveyed. The area in and around Stanley Harbour, and specifically the TDF development, has relatively low biological significance with similar habitats widely represented within the Falkland Islands. Further benthic studies carried out in Stanley Harbour in 2021 (Royal Haskoning unpublished data 2021, EIS document PB7829-RHD-ZZ-ZZ-RP-YE-0005.P01.01) in relation to FIPASS development recorded similar patterns for the epibenthic floral and faunal assemblage. However, this study differed from previous studies by including detailed sediment infaunal analysis. The infaunal assemblage, as defined by species retained on a 500 micron sieve, was highly diverse but also highly patchy in the eastern Stanley Harbour area. The final list species list comprised 233 species.

The most specious group were the Polychaetes with 94 species/putative species found. Of these, the most abundant species was *Aphelochaeta magellanica* (3,101 individuals) and another unidentified species of the same Genus (960 individuals). The Family Capitellidae (*Capitella* sp. 2 and *Mediomastus* sp. 1) were also particularly abundant, as was the Paronidae (*Paradoneis* sp.1). The Amphipoda were the next specious group with 27 species observed, with the Phoxocephalidae showing high abundance (*Proharpinia antipoda*, 422 individuals; *Paradexamine nana*, 389 individuals; *Proharpinia stephenseni*, 185 individuals). A total of 36 species/putative species of Gastropods were observed with relatively low abundances. The Gastropod fauna was dominated by the minute sea snail *Eatoniella* sp (481 individuals), and unidentified Bivalvia (293 individuals). Other dominant species were juvenile Mytildae bivalves (1,751 individuals), and A total of 29 Bryozoan (lace coral) species, however these are not considered infauna *per se*. Species accumulation curves for infaunal sampling did not reach asymptote in Stanley Harbour suggesting that further sampling would be required to understand the full infaunal species inventory, where the Chao2 richness estimator predicted 299 species.

7.4.3.5 Summary of the offshore and inshore benthic environment

Table 7.8 provides a summary of the offshore and inshore benthic environments.

Table 7.8: Provides a summary of the offshore and inshore benthic environments

Subject	Summary
NFB and the Sea Lion Field	
Offshore benthic flora and fauna	The epifaunal community was relatively uniform across the observed area, commonly including Polychaeta (Terebellidae (spaghetti worm)) Arthropoda (the isopod Serolidae, the crustacean Euphausiacea (krill)), Echinodermata (Ophiuroidea (brittle stars)), Sterechinus sp. (urchins), Chordata (Myctophidae (lantern fish)) and Cnidaria (*Primnoella* sp. (sea pen)). Epifaunal siphons were noted at most stations indicating the presence of the spoon worm, Echiura. There were many other less commonly observed fauna across the survey area. There were no species or habitats equivalent to those of conservation significance under the UK's Offshore Marine Conservation (Natural Habitats, & *c*.) (Amendment) Regulations 2010 (which implements the EC Habitats Directive 92/43/EEC observed within the surveyed area.
Offshore habitats	The habitat encountered in the NFB is relatively uniform in character due to the lack in diversity in substrate type. In places, erratic rocks are present a hard substrate for encrusting organisms such as sponges and deepwater corals. However, these features have not been encountered in the area of the Phase 1 & 2 Sea Lion Development.
Berkeley Sound	
Shallow marine and inter-tidal flora and fauna	The results of dive surveys show that the shallow marine environment of Berkeley Sound is numerically dominated by the phyla, Echinodermata: sea star (starfish) (10.04 %), followed by Chordata: ascidians (9.06 %), Arthropoda: crab (8.25 %), Porifera: sponges (8.16 %) and Echinodermata: sea urchins (7.62 %) Arthropoda: amphipoda and Mollusca: cephalopods were the least abundant representing 0.09 % of the total. By species, the Chilean red sea urchin (*Loxechinus albus*) had the highest overall relative abundance, followed by the blue-spotted rockcod (*Patagonotothen cornucola*), and giant kelp (*Macrocystis pyrifera*).
Deeper water flora and fauna	The macrofauna communities were dominated by Polychaeta (bristle worms) and Crustacea (shrimps) and reflected the very diverse habitats recorded throughout Berkeley Sound. A total of 281 infaunal taxa and 69 epifaunal species were identified during the seabed sampling campaign. The results were analysed using multivariate techniques which showed the community forming one main cluster with subtle variations within, generally separating out based on sediment type. Three statistically significant sub-clusters were evident, grouping together stations characterised by mud, gravel and sand sediments. A diverse epifaunal community was recorded throughout the Sound, constituting an important element of the ecosystem in this area. These conspicuous groups were represented by Porifera, Bryozoa, Cnidaria, Crustacea, Echinodermata, Mollusca and Tunicata. Sponges were prevalent in areas of bedrock exposure, mainly in encrusting form but with some solitary specimens also identified.
Shallow marine and inter-tidal habitats	Shallow marine habitats within Berkeley Sound are very diverse. Of note are kelp forests (which support a wide range of benthic organisms and are utilised by foraging higher predators) and biogenic reefs. Surveys near Strike-off Point have found reefs composed of slipper limpets and giant barnacles.
Deeper water habitats	The benthic communities in the deeper waters of Berkeley Sound are closely linked to the sediment type. Of note were, exposed areas of bedrock, which supported large numbers of encrusting epifaunal organisms (such as sponges). These were classified as meet the criteria necessary for geogenic reefs.

7.4.4 Fish and invertebrate ecology

7.4.4.1 Introduction

This section provides a summary of the most abundant fish and squid species within Falkland Islands waters, describes their seasonal abundance in relation to the Sea Lion Field, their seasonal spawning migrations and their principal diet. Note that, to inform the EIA of impacts to other users of the sea, indication is made as to which species are of commercial importance with catch statistics provided in Section 7.7.3.1.1.

7.4.4.2 NFB and Sea Lion Field fish and invertebrate ecology

The wider area of continental shelf and slope in the vicinity of the Sea Lion Field provides important feeding grounds for a number of species throughout all seasons of the year, with a slight decrease in the number of species present during the spring months. Whilst a number of these fish and squid species spawn within the Falkland Islands inner shelf and deep slope waters, none of the commercial species are known to have spawning grounds within the area of the Sea Lion Field and many species migrate outside of Falkland Islands waters to spawn (Arkhipkin, *et al.,* 2012a; Arkhipkin, *et al.,* 2023). A number of skate species are known to spawn in this area based on the evidence from the occurrence of hatchlings and reproductively active females (Pompert, 2011).

7.4.4.2.1 Patagonian Shelf habitats

The Patagonian Shelf and Slope are amongst the two most biologically productive areas in the south-west Atlantic. As the Falkland Current meets the continental slope it results in an area of strong upwelling of Sub-Antarctic Surface Water (SASW) that forms a highly productive frontal zone as it mixes with shelf waters (Section 7.3.3). Due to its high primary productivity, the Patagonian Shelf ecosystem is characterised by abundant pelagic and demersal organisms that support rich squid and fish resources. Many species of fish and squid within the Patagonian ecosystem, such as Argentine shortfin squid, common hake (*Merluccius hubbsi*) and hoki, migrate seasonally to the productive frontal zones to feed, and return to non-frontal zones during spawning periods, resulting in seasonal changes in the fish assemblages across the ecosystem. The convergence of the SASW and Patagonian Shelf waters at the Falkland Islands shelf break forms the transition between the temperate and sub-Antarctic ecosystems (Section 7.3.3), and consequently species belonging to both temperate and sub-Antarctic taxa are found within the area.

7.4.4.2.1.1 Conservation and management zones

The Falkland Islands Conservation and Management Zones (FICZ and FOCZ) delineate the extent of the Falkland Islands EEZ, and six main habitat zones have been identified within this area characterised by a combination of bottom topography, bathymetry, water structure and hydrodynamics. These zones are explained in detail by Arkhipkin *et al.* (2012a). These zones are represented by:

- The Inner Shelf (IS),
- The outer shelf (OS) is subdivided into two habitats:
  - North-Western Outer Shelf (NWOS), and
  - South-Eastern Outer Shelf (SEOS).
- The upper continental slope is partitioned at latitude 51° S into two habitats:
  - Northern Slope (NS),
  - Southern Slope (SS), and
  - Deepwater Slope (DS) at depths between 600 and 1,200 m.
- The Sea Lion Field sits in the Northern Slope area in the FICZ (Figure 7-47).

The NS covers an area of 50,686 km^2, with an average depth of greater than 400 m. This ecoregion was identified by bottom topography (most representative), bathymetry, water structure and hydrodynamics, however, the bottom topography is not homogeneous. The shallow-water area (250–350 m) of NS is mainly flat with sandy or muddy bottom topography and parts are heavily trawled throughout the year for finfish and skates (**note:** the skate specific Individual Transferable Quota (ITQ[29]) has not been used for several years now but they are regularly caught as bycatch). In the NS, in waters of > 350 m there is little to no fisheries activity. The deepwater area to the north-east of the NS has rough bottom topography and is covered with corals to the north and is therefore difficult to work by trawlers Figure 7-47).

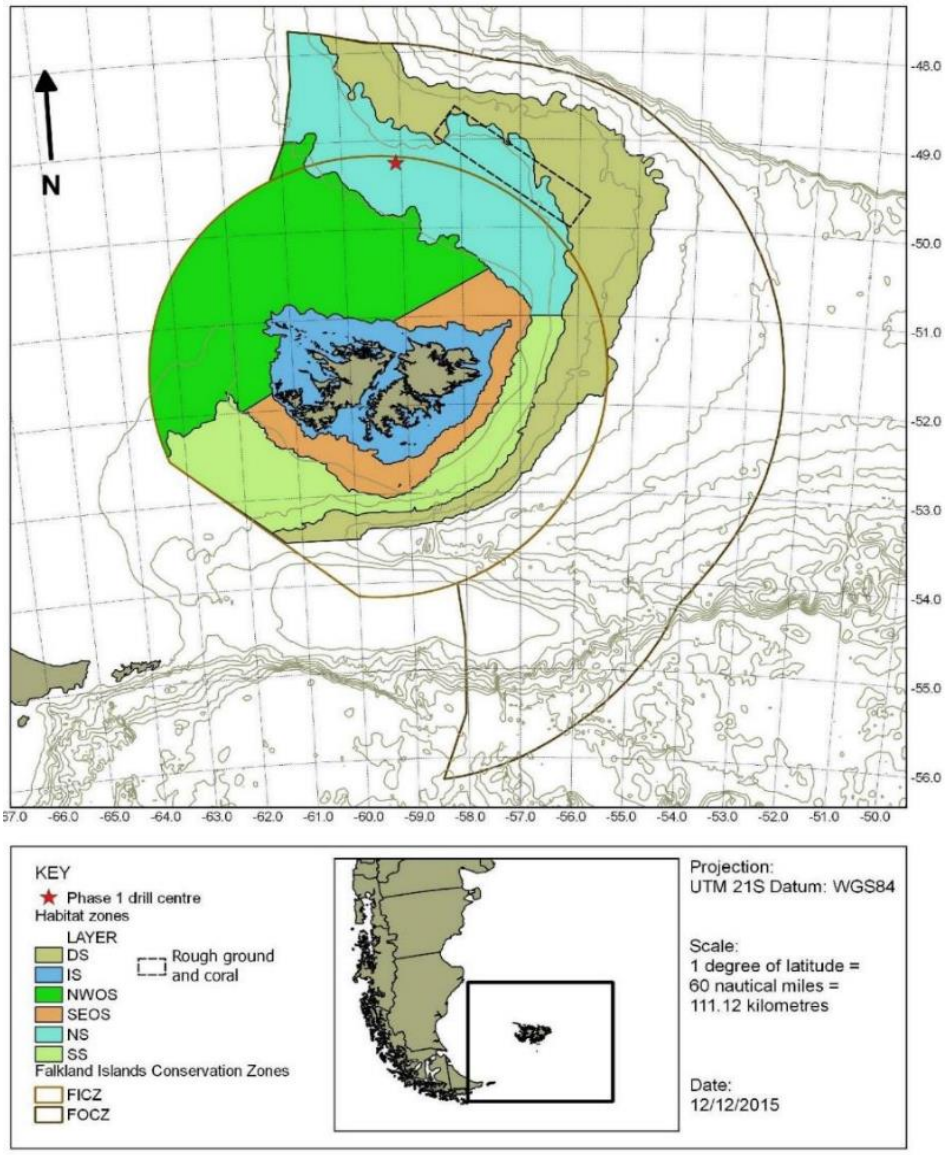


Figure 7-47: Map delineating habitat zones within Falkland Islands waters. Rectangle illustrates the area of rough ground and corals ***(Source: Arkhipkin, et al., 2012a. Inner shelf (IS), north-western outer shelf (NWOS), south-eastern outer shelf (SEOS), northern (NS) and southern slope (SS) and deep water slope (DS))***

[29] Individual Transferable Quota: a quota that limits the amount of fish a fisher can catch or the amount of fishing effort they can use. ITQs are often specific to a type of fish and are used to manage fish stocks and prevent overfishing.

7.4.4.2.2 Seasonal abundances around the Falkland Islands

Despite the biological productivity of the Falkland Islands waters only a small number of predators (fish and squid) spend all year around the eastern Patagonian Shelf and only consume a relatively small proportion of this bounty. Most of the productivity is exploited by non-resident migrating species that move to the area from distant spawning grounds to take advantage of the highly productive waters (Arkhipkin, *et al.,* 2012b). Sharks, skates, squid, tunas and gadoids migrate to the area at different times of the year to feed. A number of deepwater species of fish and squid feed within the area as juveniles and move to deeper waters as they mature and become adults.

7.4.4.2.2.1 Seasonal abundances on the Northern Slope

The six sub-Antarctic and seven temperate fish and squid species found in abundance in Falkland Islands waters primarily utilise these areas as productive feeding grounds, migrating within and out of these waters as food availability changes and to follow seasonal spawning migrations. The Northern Slope (NS) area, where the Sea Lion Field is located, is an important feeding area for a number of species, whose abundance in the NS varies seasonally. Table 7.9 summarises the relative abundance of the main fish species throughout the six main habitat zones over the four seasons. Within the table, high abundances are highlighted in turquoise, moderate abundance is highlighted in light blue and low abundance is white. Note however that cell highlights relate only to the relative abundance within the NS.

The NS provides an important foraging area for some species throughout the year, with the spring season showing lowest species abundance with only hoki and yellownose skate found in higher abundances (Table 7.9 below). Most species have relatively wide distributions being present in several habitat areas within each season, suggesting that no species is solely reliant on the NS area as a feeding ground. However, during the autumn and spring more than 50 % of the hoki population inhabit the NS over other areas (Arkhipkin, *et al.,* 2012b).

Although the productive waters of the Falkland Islands support the foraging of a diverse and abundant assemblage of fish and squid, an unusual aspect of Falklands fish ecology is the migration of the majority of higher trophic species, such as southern and common hake, hoki and kingclip, to spawn elsewhere. Only a few large predators such as red cod (SEOS), several skates, loligo (IS) and greater hooked squid (DS), spend their entire life cycle in the shelf ecosystem (Arkhipkin, *et al.,* 2012b).

7.4.4.2.2.2 Other commercial and non-commercial fish species on the Northern Slope

Although not currently commercially harvested, grenadiers, particularly the Ridge scaled rattail (*Macrourus carinatus*), are abundant in the NS and may be subject to a future fishery (Payá, 2009). Other species not mentioned above include a number of skate species, morid cods and psychrolutid fish. Lantern fishes (Myctophidae), black smelts (bathylagids) and other bentho-pelagic fish also contribute to the fish community on the NS. Little is known about their biology and life history in the Falkland Islands but they likely play a significant role in the ecology, through the consumption of primary consumers and vertical migrations, which could play a major role in exporting carbon from the surface layers to deeper water. These are important features of the ecosystem on the North Slope (P. Brickle *pers. obs.*), that were evident in many of the drop-down camera surveys undertaken in the Sea Lion area (Gardline, 2013a).

Table 7.9: Summary of seasonal abundance of fish species in the six FOCZ/FOCZ habitat zones, indicating abundance on the Northern Slope habitat zone (which contains the Sea Lion Field)[1]

Species	Spring (Oct – Dec)[2]	Summer (Jan – Mar)[2]	Autumn (Apr – Jun)[2]	Winter (Jul – Sept)[2]
Sub-Antarctic species				
Southern blue whiting[3]	SEOS / SS / NWOS	NS/ SS/ NWOS/ SEOS	NS / SS / DS	SEOS / SS / NWOS
Southern hake[3]	SS/ NWOS/ NS/ DS	NWOS / SS / DS	SS / NWOS	SS / NWOS / NS
Hoki (whiptail hake) [3]	NS/ NWOS/ SS/ SEOS			SS / NS / NWOS
Patagonian toothfish[3]	DS/ SS / SEOS/ NS/ NWOS	NWOS/ NS/ DS/ SS	NS/ DS/ SS/ NWOS	DS/ SS/ NS/ NWOS/ SEOS
Greater hooked squid	DS / NS / SS	DS/ NWOS/ NS/ SS/ SEOS	DS/ SS/ NWOS/ SEOS/ NS	DS / SS / NS
Loligo squid[3]	IS / SS	IS / SEOS / SS	SEOS / IS	SS / SEOS / NS
Temperate species				
Common hake[3]	NWOS / NS	NWOS / NS	NWOS / NS	NWOS / NS
Kingclip[3]	NWOS/ SS/ NS/ SEOS	NWOS / SS / NS	NWOS / SS / NS	NWOS / NS / SS
Southern rock cod[3]	NWOS / SEOS / NS	NWOS/ NS/ SS/ SEOS	NWOS / NS / SS	NWOS/ SS/ NS/ SEOS
Argentine shortfin squid[3]	Absent	NWOS / NS	NWOS / NS	NS
Yellownose skate	NS/ NWOS/ SS/ SEOS	NWOS	NS / SS / NWOS	NS / NWOS / SS
Spur dog	NWOS / NS / IS	NWOS	NWOS	NWOS / NS
Slender tuna	Absent	IS / SEOS / NWOS	NS / NWOS / SEOS	Absent

[1] The habitats are identified in order of abundance for each species, and cell highlights relate only to the relative abundance within the NS. Habitat Zones: IS - Inner Shelf, NWOS - North-Western Outer Shelf, SEOS - South-Eastern Outer Shelf, NS - Northern Slope, SS - Southern Slope and DS - Deepwater Slope.

[2] Turquoise = High abundances in the NS. Light blue = Moderate abundances in NS White = Low abundances.

[3] Commercially important species.

(Source: based on data from Arkhipkin, et al., 2012b)

7.4.4.2.3 Species-specific summary of fish migration patterns, diet and life-cycle characteristics

Information on the migration patterns of fish around the Falkland Islands has been summarised from Arkhipkin *et al.* (2012b), based on data collected from 13,044 commercial bottom and pelagic trawls between 2000 and 2010 and from 1,272 research trawls between 1999 and 2011. See Table 7.10 below for a summary of the data below and life history and behavioural characteristic. Unless specifically stated, the International Union for the Conservation of Nature (IUCN) status of the species listed below has not been evaluated.

7.4.4.2.3.1 Sub-Antarctic fish and squid

Southern blue whiting

Southern blue whiting (*Micromesistius australis*) was until recently an abundant pelagic migratory species associated with south-west Atlantic waters. Since 1990 (total catch of 71,876t), catches within Falklands waters have been declining to all time low in 2023 (total catch of 15t). Targeted licenced

fishing for southern blue whiting ceased in 2017 and since then, the only catch is bycaught in other finfish fisheries (FIG, 2024b). Recent data show signs of stronger recruitment to the stock (FIG, 2024b). It is unclear what caused the decline but over-fishing is likely to be a contributing factor. Its spawning grounds are to the south-west of the Falkland Islands where it congregates during the spring. Once spawning is complete, the Southern blue whiting migrate onto the South-Eastern Outer Shelf (SEOS), and to a lesser extent in the Southern Slope (SS), where they feed on the abundant plankton resources (Brickle, *et al.,* 2009). During the summer (Dec-Feb), the main proportion of southern blue whiting migrates to the NS, and then further north with the Falkland Current beyond the southern Patagonian Shelf.

Southern hake

Southern hake (*Merluccius australis*) is a large bentho-pelagic predator consuming prey both in the water column and near the seabed, particularly smaller fish. Its greatest abundance observed in Falkland Islands waters is found during the austral summer when it migrates to forage in the SEOS, NWOS and SS. In autumn they almost disappear from the NWOS but remain abundant in the SS. The lowest biomass is observed during winter when they migrate into Chilean waters to spawn (Arkhipkin, *et al.,* 2003; Payá and Ehrhardt, 2005; Bustos, *et al.,* 2007; Brickle, *et al.,* 2016).

Hoki (whiptail hake)

Hoki or whiptail hake (*Macruronus magellanicus*) is one of the most abundant fish in the seas around southern South America. Spawning typically occurs during the winter months in areas outside of southern Patagonian Shelf waters. During spring hoki migrate to their feeding areas on the Falklands continental slope where it occurs in significant numbers in the NS and also in the SS and NWOS. Hoki is an opportunistic predator primarily consuming zooplankton, small fish and squid (Brickle, *et al.,* 2009). It has been suggested that approximately 20-25 % of the population migrate to the warm waters of the NWOS during the spring and summer. During autumn, the majority of hoki return to the upper slope and are found in large numbers over the NS. In winter, most of the population migrates outside the southern Patagonian Shelf to spawn with low numbers remaining on the SS. Unlike southern blue whiting, hoki appear both in shallow waters of IS and deep waters of the slope (DS); especially in autumn.

Patagonian toothfish

Patagonian toothfish (*Dissostichus eleginoides*) is a near bottom predator that has a wide distribution around the sub-Antarctic. The overall seasonal distribution of toothfish does not change significantly between the various habitat zones. In winter toothfish stay mainly in deepwater (DS) and slope region (NS) and start to migrate to shallower waters of the NWOS, SS and SEOS in spring. In summer, toothfish migrate to the warmer waters of NWOS and NS to forage on southern rock cod and other species, moving back to the slope regions (mainly NS) in autumn (Arkhipkin, *et al.,* 2012a). For the population as a whole a small percentage undertake large scale movements including towards the spawning grounds in the south. However, a significant proportion are resident (Brown, *et al.,* 2013; Troccoli, *et al.,* 2020; Lee, *et al.,* 2022; Kim, *et al.,* 2024) and this pattern will likely be similar for the NS.

Greater hooked squid

The greater hooked squid (*Moroteuthopsis ingens*) is an abundant species throughout the Southern Ocean and feeds predominantly on fish species (Arkhipkin, *et al.,* 2012b). The IUCN status of this species has been assessed as 'Least Concern' (Barratt and Allcock, 2014a). It is a relatively large squid (maximum reported mantle (body/tube) length of 61 cm) found from the surface to the deep waters (at 1,100 m; Jackson, 1993). Although abundant, this species is not commercial due to the high concentrations of ammonia in its flesh. However, it is one of the main prey items for shelf and slope cetaceans (Clarke, 1980). Following the winter spawning period the adults die, and in spring the juveniles move from the deepwater spawning area to shallower waters on the NS and SS. In summer,

the maturing juveniles forage mainly on the NWOS, NS and SS to depredate on southern rock cod. By autumn, the now fully mature greater hooked squid make their migration back to deep waters to spawn, gradually disappearing from shelf and upper slope areas, and reaching their highest abundance in DS (Arkhipkin, *et al.,* 2012a).

Red cod

Red cod (*Salilota australis*) is a relatively large demersal fish. On the Falkland Islands Shelf red cod's abundance is highest in spring in the SEOS, SS and NWOS, during their spawning and post spawning period. In the summer they disperse mostly over the NWOS to feed (Arkhipkin, *et al.,* 2001). In autumn they are mainly dispersed across the shelf and then in winter adult fish start to migrate back to the SEOS to spawn (Arkhipkin, *et al.,* 2010 and 2012b; Brickle, *et al.,* 2011).

Patagonian long-finned squid (loligo)

Patagonian long-finned squid, known locally as loligo, is an important domestic commercial species that spends its whole life cycle in the waters of the Falkland Islands (Arkhipkin, *et al.,* 2012b). The loligo population comprises two different spawning groups, the first spawning during spring and the second spawning during the autumn season. Their abundance on the NFB is high in winter, when pre-spawning animals forage for zooplankton in SS, SEOS and less significantly on the NS. During the spring the abundance is very low as many animals move to inshore areas to spawn and die (Section 7.4.4.3.2.1). The population increases again during summer as the newly hatched juveniles move from inshore waters to the SEOS and SS to feed on the abundant zooplankton, whilst avoiding depredation pressure from the larger fish (Arkhipkin, *et al.,* 2012b). During August the second spawning group migrates into inshore waters to spawn, whilst the maturing juveniles from the spring spawning group replace them on the SEOS feeding grounds.

7.4.4.2.3.2 Temperate fish and squid

Common hake

Common hake (*Merluccius hubbsi*), like the austral hake, is a near bottom predator that inhabits the temperate waters of the Patagonian Shelf and slope (Cohen, *et al.,* 1990). During autumn and winter, common hake migrate to their main foraging grounds in the NWOS, and to a lesser extent to the NS, to feed on southern rock cod. During spring and summer common hake abundance decreases significantly in the FICZ as they migrate north-west to their spawning grounds on the northern Patagonian Shelf (Arkhipkin, *et al.,* 2003; Arkhipkin, *et al.,* 2012a).

Kingclip

Kingclip, also known as the pink cusk eel (*Genypterus blacodes*), is a large eel-like benthic predator that occurs in the temperate shelf and slope waters of southern South America (Renzi, 1986). The greatest abundances are found in the NWOS, SS and SEOS, which are the main foraging areas for this species. During the summer approximately 60 % of the adult population migrate to their spawning grounds in the northern Patagonian Shelf outside Falkland Islands waters. In autumn, their abundance is at a minimum with remaining individuals possibly skipping spawning in the NWOS and SS. In winter, kingclip migrates back to the Falkland Islands to forage primarily on southern rock cod with increased abundances in NWOS, NS and SS. They then move from the NS further south to SS to continue feeding during spring (Arkhipkin, *et al.,* 2012b).

Southern rock cod

The southern rock cod (*Patagonotothen ramsayi*) is a bentho-pelagic species consuming prey both in the water column and near the seabed on the shelf and upper slope (50-500 m depths). The abundance of southern rock cod had increased several-fold since 2005 with the coincident decline in southern blue whiting catches in the Falkland Islands, however its importance as a fishery has been replaced by common hake since 2012 (FIG, 2013c). It is hypothesised that the regional decline in southern blue

whiting is a factor in rock cod's increased abundance (Laptikhovsky, *et al.,* 2013). Southern rock cod is itself an important prey species for all predatory fish (Laptikhovsky, *et al.,* 2013) and juvenile phases of loligo squid. This temperate species has a flexible diet with the ability to switch between main food sources as their abundance varies with the seasons (Arkhipkin and Laptikhovsky, 2013). During the spring and summer months, rock cod feed primarily on zooplankton crustaceans and benthic organisms in the NWOS and NS coinciding with peak zooplankton production during these months (Arkhipkin, *et al.,* 2012b). During the late summer and autumn months gelatinous plankton form an important part of their diet reflecting their overall seasonal abundance in the oceans (Arkhipkin and Laptikhovsky, 2013). The abundance of rock cod decreases particularly in the upper slope areas (NS and SS) during autumn, due to a migration out of Falkland Islands waters in preparation for the winter spawning period. A small proportion of the stock remains on the SS during the winter months.

Argentine shortfin squid

The Argentine shortfin squid has an annual life cycle (Hatanaka, 1986) and is the most abundant squid species in the south-west Atlantic, IUCN status 'Least Concern' (Barratt and Allcock, 2014b). It is closely associated with the temperate waters of the Patagonian Shelf and highest abundances are recorded on the NWOS and NS during summer where it migrates to the southern part of its range to forage on zooplankton, in particular krill (e.g., *Thysanoessa gregaria*, *Euphausia vallentini* and *E. lucens*) and pelagic amphipods (such as *Themisto gaudichaudii*). In autumn, they make their way north along the slope as part of their pre-spawning migration and abundances in the NWOS and NS decreases. During the rest of the year this species is largely absent from the Patagonian Shelf and slope (Arkhipkin, *et al.,* 2012b; Chemshirova, *et al.,* 2023).

Yellownose skate

The yellownose skate (*Dipturus chilensis*) is a relatively large skate that is moderately abundant in water depths between 100 and 300 m on the temperate shelves around southern South America (Nakamura *et al.,* 1986) but rarely found in depths >500 m. A migratory species, the yellownose skate makes long spawning migrations out of Falkland Islands waters to warmer waters in the summer (Arkhipkin, *et al.,* 2013). The skate returns in autumn during their feeding migration to prey on other fish and squid, which are abundant in Falkland Islands waters. The yellownose skate reaches maximum abundance around the Falkland Islands in austral winter (July to September) primarily on the NWOS (Arkhipkin, *et al.,* 2013). Throughout the spring, their abundance gradually decreases in the northern regions with some movement likely to the southern slope. This species has been assessed as 'Vulnerable' on the IUCN Red List and the population is thought to be in decline and subject to commercial fishing pressure (Kyne, *et al.,* 2007). The yellownose skate is one of the four species dominating the multispecies skate fishery in the Falkland Islands, which is currently managed by limiting the fishing effort and numbers of licences. The late maturation of females at 14 years old and low reproductive capacity makes this species vulnerable to overfishing and other factors that contribute to mortality.

Spur dog

The spur dog (*Squalus acanthias*) is a small shark that is associated with temperate waters of the Patagonian Shelf (Nakamura, *et al.,* 1986). It reaches its maximum abundance in Falkland Islands waters in the NWOS during spring, with smaller aggregations in the NS. In summer through to autumn this species migrates out of Falkland Islands waters onto the Argentine Shelf and into international waters (Arkhipkin, *et al.,* 2012b). This species has been assessed as 'Vulnerable' on the IUCN Red List and the population is thought to be in decline (Fordham, *et al.,* 2016). Although naturally abundant, it is vulnerable to over-exploitation by fisheries due to its late maturity, low reproductive capacity, longevity, long generation time (25 to 40 years) and hence a very low rate of population increase (2-7 % per year).

Slender tuna

The slender tuna (*Allothunnus fallai*) is a medium sized tuna growing to a maximum total length of approximately 100 cm. This species is widespread and locally abundant in the Southern Ocean and is assessed as Least Concern by IUCN (Collette, *et al.,* 2011). Slender tuna has the most southerly distribution of tunas in the South Atlantic, and feeds predominantly on zooplankton and is recorded in the IS in summer with the greatest abundance appearing in autumn in the NS. During the winter and spring months the slender tuna is completely absent from the Falkland Islands waters (Arkhipkin, *et al.,* 2012b).

7.4.4.2.4 Summary of offshore fish and invertebrate ecology

A summary of the abundance and behaviour of offshore fish and invertebrate species in provided in Table 7.10.

Table 7.10: Summary of offshore fish and invertebrate species around the Falkland Islands

Species	Domain	Migratory[1]	High abundance on NS	Behaviour on NS	Diet	Commercially targeted
Sub-Antarctic species						
Southern blue whiting	Pelagic	✓	Summer	Feeding	Zooplankton	✓
Southern hake	Bentho-pelagic	✓	-	n/a	Fish, squid	✓
Hoki (whiptail hake)	Pelagic	✓	Spring - Autumn	Feeding	Zooplankton fish and squid	✓
Patagonian toothfish	Demersal	X	All year	Feeding	Fish, squid, crustaceans	✓
Greater hooked squid	Pelagic	X	Summer	Feeding	Zooplankton, squid, fish	X
Loligo squid	Pelagic	X	Winter	Feeding	Zooplankton, squid, fish	✓
Temperate species						
Common hake	Bentho-pelagic	✓	Autumn - Winter	Feeding	Fish, squid	✓
Kingclip	Demersal	X	Winter	Feeding	Fish, Squid crustaceans	✓
Southern rock cod	Demersal	X	Summer	Feeding	Zooplankton, benthic invertebrates and gelatinous plankton	✓
Argentine shortfin squid	Pelagic	✓	Summer	Feeding	Zooplankton, squid, fish	✓
Yellownose skate	Demersal	✓	Spring	Feeding	Fish, crustaceans	✓
Spur dog	Demersal	✓	-	Feeding	Fish, squid and benthic invertebrates	X
Slender tuna	Pelagic	✓	Autumn	Feeding	Zooplankton, squid	X

[1] In and out of the Falkland Islands EEZ.

7.4.4.3 Berkeley Sound fish and invertebrate ecology

Commercial fishing is not permitted within coastal waters around the Falkland Islands (within three miles of the coastline, Section 7.5.1.2). Nonetheless, commercial species may utilise inshore waters for feeding or spawning. Additionally, there are numerous inshore species (20 species, mostly crustaceans and molluscs) that, although currently not heavily exploited in the Falklands, have the potential for commercial exploitation (Neely, *et al.,* 2010b; Davidson, 2016). All species contribute to the diverse inshore community however.

This section provides a description of the most abundant species of fish and invertebrates off the east coast of the Falkland Islands and in Berkeley Sound. For each, a summary of their ecology is provided in terms of:

- Their seasonal abundances in relation to the Berkeley Sound area,
- Their seasonal spawning migrations, and
- Their principal diet.

7.4.4.3.1 Fish species

There are relatively few fish species found within inshore waters in and around Berkeley Sound. The exceptions being, rock cod, mullet, smelt and sprat.

7.4.4.3.1.1 Southern rock cod

Detail on the offshore distribution and abundance of this species is provided in Section 7.4.4.2.3.2 above.

The genus *Patagonotothen* contains 14 species in the waters off southern South America of which *P. ramsayi* is the most abundant (Ekau, 1982; Norman, 1937; Hart, 1946; Brickle, 2005c). Little is known about the biology and ecology of these species. Bargelloni *et al.* (2000) estimated that the divergence time of Subantarctic *P. tessellata* from Antarctic *Lepidonotothen nudifrons* at 9 million years. Stankovic *et al.* (2002) added *P. brevicauda* to their analysis and estimated that the divergence time of *Patagonotothen* from its Antarctic sister is approximately seven million years well after the formation of the Antarctic Polar Front, which formed 20 – 25 million years ago.

Inshore, eight species of rock cod (*Patagonotothen*) have been recorded (Neely and Brickle, 2013). The have very different niches and include the abundant *Patagonotothen tessellata* which inhabit open water outside of the kelp line. Within kelp forests, *P. cornucola* inhabit the benthic environment particularly in algal litter (i.e., algal detritus and drift algae), *P. squamiceps* inhabits the kelp canopy and *P. sima* inhabits the intertidal. The inshore species range in size from 5 to 6 cm (*P. sima*) to 40 cm (*P. wiltoni*) in total length (P. Brickle, *pers. obs.*). These species are important prey for a number of inshore predators. In late summer huge shoals of post larval *P. tessallata* are prey for sei whales, dolphins, seals and slender tuna (P. Brickle, *pers. obs.*).

7.4.4.3.1.2 Falklands mullet

The Falkland Islands mullet (*Eleginops maclovinus*) belongs to the primitive monotypic notothenioid family Eleginopidae (Balushkin, 1992). Unlike most other notothenioids, *Eleginops* never became associated with the margins of the Antarctic plate (Eastman, 1993). It is the only notothenioid fish (apart from the Australian freshwater Pseudaphritidae), in which its entire evolution occurred in temperate nearshore environments (Balushkin, 1994) away from Antarctic waters.

The Falklands mullet is one of the most unusual notothenioids, only one of two euryhaline species (adapted to live in a range of salinities) in the entire suborder. The fish lives in coastal waters around the Falkland Islands (Boulenger, 1900; Hart, 1946) and in estuaries and rivers along the South American coast as far north as Uruguay on the east coast and Talcahuano, Chile on the west coast (Regan, 1913;

Norman, 1937; Andriashev, 1964). DeWitt *et al.* (1990) reported that a specimen had also been recorded from Tristan da Cunha in the Atlantic Ocean.

The Falkland mullet is an important component of Falkland Islands inshore ichthyofauna and preys on smelt, larval notothenioids, echiurid worms, polychaetes and crustaceans including *Grimothea* spp. Mullet are prey to sea lions and inshore dolphins (see Brickle, *et al.,* 2003; 2005a; 2005b; Brickle and MacKenzie, 2007 for more detail on mullet biology and ecology in the Falkland Islands).

The local mullet has been subject to a small inshore fishery in the Falkland Islands which continues. Catches vary and have been up to 15 tonnes per year (Brickle, *et al.,* 2003). Note that there is no large scale commercial (bottom trawl and longline) fishing allowed within three miles of the Falkland Islands baseline.

7.4.4.3.1.3 Smelt

There are two species of smelt or silversides (family Atherinopsidae) *Odontesthes smitti* and *Odontesthes nigicans* that inhabit the coastal waters of the Falkland Islands. Their biology and ecology are not well known and are taken occasionally as bycatch in beach seine nets for mullet (P. Brickle, *pers. comm.*).

7.4.4.3.1.4 Falklands sprat

Sprattus fuegensis is an abundant near shore and shelf herring like fish in the family Clupeidae. Falkland sprat was subject to a trawl fishery in the late 90s and is an important prey item for inshore predators and migrating predatory fish, mammals and seabirds in the Falklands Islands (P. Brickle, *pers. obs.*). This is particularly the case in mid to late summer when young fish of the year are plentiful and preyed upon by many species of higher predator including large baleen whales.

7.4.4.3.2 Invertebrate species

7.4.4.3.2.1 Loligo (Patagonian long-finned squid (Doryteuthis gahi))

Loligo is a demersal cold-water squid, which forms the basis of a substantial fishery on the Patagonian Shelf to the south, east and north-east of the Falkland Islands, with highest catches concentrated on the shelf break in waters between 150 and 200 m in depth.

Loligo is a key species in the Falkland Islands ecosystem (van der Grient, 2023; Büring, *et al.,* 2024) and therefore important to the functioning of the nearshore and shelf environment. Loligo routinely cannibalise themselves, eat krill, *Themisto*, arrowworms, copepods, many other zooplankton and fish species (Brickle *et al.*, 2001).

A small squid species (typical mantle length of 13–17 cm), loligo is an important domestic commercial species that spends its whole life cycle in Falkland Islands waters (Arkhipkin, *et al.,* 2012b) staying offshore to feed and coming inshore to spawn and die. The loligo population comprises two different spawning cohorts, the first spawning during spring and the second spawning during the autumn. Detail on the loligo distribution and abundance in the NFB is provided in Section 7.4.4.2.3.1 above. During August the second spawning group migrates into inshore waters to spawn, while the maturing juveniles from the spring spawning group replace them on the feeding grounds.

Despite being of great commercial significance, little is known about the breeding behaviour of Falklands' loligo. However, it was believed that unlike other loliginid squid they do not lay their eggs directly on the substrate, instead the eggs are attached to kelp stipes and likely on rocky outcrops. This is believed to be an adaptation to reduce the predatory pressure from benthic invertebrates. Also curious is the observation that although egg masses can be encountered anywhere in the kelp year-round (Tingley, *et al.,* 1996), they are never seen in great numbers at a single site. It is believed that each female lays clusters of eggs in many different locations. This appears to be an adaptation to the unpredictable inshore marine environment and may also reduce the predatory pressure from the

abundant populations of seabirds and marine mammals in the region (Brown, *et al.,* 2010). It is acknowledged that the distribution of loligo spawning grounds is poorly known in the Falkland Islands. Despite regular observations of *D. gahi* egg masses among kelp forests around the Falkland Islands (Arkhipkin, *et al.,* 2000; P. Brickle, *pers. obs.*), they have never been found in numbers required to support the large fishery that currently exists for this species around the Falklands. This fishery is one of the most important loliginid fisheries in the world and yields some 82 -99 % of the catch of the species in Atlantic Ocean (Arkhipkin, *et al.,* 2006).

Therefore, the question remains: are kelp forests the only spawning grounds for this species? First doubts appeared when a loligo egg mass was found attached to the tube of the polychaete *Chaetopterus variegatus* collected by bottom trawl at the depth range 68-71 m (Laptikhovsky, 2008). Investigation of Loligo sp. egg masses in Argentine waters revealed the existence of two types of clusters; those allocated to *D. gahi* (based on egg size) were found attached to the ropes with artificial egg clusters to attract females (demonstrating possible confusion with kelp stipes), and also a few were found attached to (artificial) hard substrata (Barón, *et al.,* 2001). Although spawning in this species on rocky ground is plausible, the prevalence of these bottom–attached masses remains unclear. On 11 January 2011 during a benthic SCUBA survey, undertaken by SMSG, off Tussac Island, Port William (54°40'496 S 057°43'689 W, depth 9.8 m) a loligo egg mass was observed attached to the bedrock. It is likely that loligo spawn on rocky outcrops in deeper water outside of the kelp zone. Further surveys are required to establish the spatial / bathymetric distribution and habitat characterisation of these spawning grounds.

7.4.4.3.2.2 Other commercially exploitable invertebrates

The Inshore Fisheries Research Project was initiated to investigate the distribution and abundance of 20 potentially exploitable inshore invertebrate species (Neely, *et al.,* 2010b). As part of this collaborative project between SAERI, the Falkland Islands Fisheries Department and SMSG, dive surveys have been conducted within the eastern half of Berkeley Sound (Davidson, 2016).

Of the potentially commercial species, only the Chilean sea urchin, ribbed mussel (*Aulacomya atra*), blue mussel (*Mytilus chilensis*), keyhole limpets (*Fissurella* spp.), and piure (*Pyura chilensis*) were found in any appreciable numbers and in several locations.

Chilean sea urchin

Chilean sea urchins (*Loxechinus albus*) were found at all 10 of the dive sites. The recorded density ranged between 36 and 940 urchins per 60 m^2. The higher densities were found in the eastern half of the survey area, with lower densities in the west.

Ribbed mussel

The ribbed mussel (*Aulacomya atra*) was present at eight of the 10 dive sites. The recorded density ranged between 6 and 1,350 mussels / 60 m^2. The densities were higher further towards the west of the survey area, with lower abundances in the east.

Blue mussel

Blue mussels (*Mytilus chilensis*) were only found at three of the 10 dive sites. The density, at the sites where they were found, ranged from 12 to 280 mussels per 60 m^2.

Keyhole limpet

Keyhole limpet species (*Fissurella* spp.) were found at three of the 10 sites. The density, at the sites where they were found, ranged from 5 to 29 limpets per 60 m^2. The distribution of keyhole limpets was skewed to the east of the area surveyed.

Piure

Piure (*Pyura chilensis*) were found at four stations but was not found in high densities anywhere. The highest density recorded was 20 piure per 60 m^2.

7.4.4.4 Fish and squid in Stanley Harbour and surrounding areas

Five fish species were recorded during recent surveys (Brickle, *et al.,* 2011; SMSG, 2013); the tessellated rock cod (*Patagonotothen tessellata*) was the most common with blue-spotted rock cod (*P. cornucola*), kelp rock cod (*P. squamiceps*), humped rock cod (*P. sima*), and orange fin rock cod (*P. brevicauda*) occurring less frequently. Mullet (*Eleginops maclovinus*) is also caught by recreational fishers at the western end of Stanley Harbour.

Commercial fishing is an important industry within the Falkland Islands and a number of commercial species of fish and squid are exploited. In general, it is considered that commercial species are not found in Stanley Harbour in significant numbers, although there is the potential for them to be present in low numbers.

A number of inshore non-commercial cephalopod species are potentially present with *Enteroctupus megalocyathus* and *Muusoctopus eureka* occurring in similar environments to the TDF development such as Mare Harbour (Brickle, *et al.,* 2011). Spawning of Patagonian Longfin Squid or loligo (*Doryteuthis gahi*), the main cold water commercial squid species in the Falkland Islands is known to occur within relatively shallow near-shore waters. Egg masses are known to occur in algal beds (Arkhipkin, *et al.,* 2000). However, there is no evidence to suggest that there are spawning grounds within the area of the TDF development or Stanley Harbour more widely.

7.4.4.5 Summary of inshore fish and invertebrate species

A summary of the abundance and behaviour of inshore invertebrate and fish species in provided in Table 7.11.

Table 7.11: Summary of inshore fish and invertebrate species around the Falkland Islands

Species	Domain	Migratory	High abundance in BS	Behaviour in BS	Diet	Commercially targeted
Invertebrate species						
Loligo	Demersal	✓	✓	Spawning	Zooplankton, squid, fish	✓
Ribbed mussel	Benthic	X	✓	Resident	Filter feeder	X
Chilean sea urchin	Benthic	X	✓	Resident	Algae	X
Blue mussel	Benthic	X	✓	Resident	Filter feeder	X
Keyhole limpet	Benthic	X	X	Resident	Algae	X
Piure	Benthic	X	X	Resident	Filter feeder	X
Fish species						
Mullet	Demersal	X	✓	Resident	Zooplankton, benthic invertebrates	X
Rock cod	Demersal	X	✓	Resident	Zooplankton, benthic invertebrates and gelatinous plankton	✓
Sprat	Pelagic	X	✓	Resident	Zooplankton	X
Smelt	Pelagic	X	✓	Resident	Zooplankton	X

7.4.5 At sea surveys, seabird vulnerability and tracking

7.4.5.1 Introduction

The productive waters around the Falkland Islands provide globally important feeding areas for significant aggregations of seabirds (White, *et al.,* 2002). The Islands themselves hold internationally important breeding populations of a number of seabird species, and coastal and offshore waters support numerous species of non-breeding visitors (BirdLife International, 2014a). Of the 82 seabird species recorded in the Falkland Islands, 22 / 23 breed in the archipelago, 24 are annual non-breeding visitors and the remainder rare visitors or vagrants. (White, *et al.,* 2002; Woods and Woods, 2006).

Three species of albatross and petrel covered by the Agreement on the Conservation of Albatrosses and Petrels (ACAP) breed on the Falkland Islands. Over 70 % of the global population of black-browed albatross (*Thalassarche melanophris*), and 43 % of the global population of southern giant petrels (*Macronectes giganteus*) breed on the Islands (Wolfaardt, 2012; Stanworth and Crofts, 2017; Crofts, 2020).

After New Zealand, the Falkland Islands support more penguin species than any other region in the world. For most of these species, the populations breeding on the Falkland Islands represent a significant proportion of the global total. Approximately 34 % and 36 % of the global populations of gentoo (*Pygoscelis papua*) and rockhopper penguins (*Eudyptes chrysocome*), respectively, breed in the Falkland Islands (Baylis, *et al.,* 2013a & b). Furthermore, a significant proportion (possibly 10 %) of the global population of Magellanic penguins (*Spheniscus magellanicus*) breed on the Islands (Woods and Woods, 1997). The small breeding population of king penguins (*Aptenodytes patagonicus*) on the Falkland Islands, is almost entirely confined to a single colony on the east coast of East Falkland, adjacent to Berkeley Sound at Volunteer Point.

In addition to the large number of seabirds that breed on the Islands, many non-breeding seabirds have been observed (White, *et al.,* 2002) or tracked migrating into the waters of the Falkland Islands from elsewhere, particularly South Georgia (Croxall and Woods, 2002; Phillips, *et al.,* 2006).

The avifauna of the Patagonian Shelf region is well studied and documented, and seabird distribution, breeding and foraging patterns are relatively well understood in comparison to other species (Croxall, *et al.,* 1984; Woods, 1988; Woods and Woods, 1997; Strange, 1992; White, *et al.,* 2001 & 2002; FIG, 2008a; BirdLife International, 2015; Baylis, *et al.,* 2019a). However, it is acknowledged that there are data gaps.

This section provides a summary of the seabird species found in the Falkland Islands, their abundance, distribution, feeding and breeding ecology, conservation status and sensitivities. Throughout, the nomenclature and IUCN status follow BirdLife International's datazone (BirdLife International, 2020a). A list of all the bird species mentioned in the text with current (October 2024) IUCN status can be found in Appendix 1.

Note: The baseline for seabirds was constructed from a large number of datasets using different methodologies and represents a large volume of data. Seabirds are considered amongst the most sensitive of receptors so presenting the detail here was considered necessary. Synthesising and rationalising this further would require a significant reduction in important detail.

7.4.5.2 Seabirds in the NFB and Sea Lion Field

7.4.5.2.1 Seabird abundance and distribution surveys and tracking

Numerous surveys have been conducted since the late 1990s in an effort to determine the distribution and abundance of seabirds in the Falkland Islands. In particular, the JNCC Seabirds At Sea Team (SAST)

was commissioned to conduct seabird and marine mammal surveys in advance of the first exploratory round of drilling for oil within Falkland Islands waters.

In addition to the SAST surveys, seabird abundance and distribution within the Sea Lion area has been informed by at-sea surveys conducted by Rockhopper Exploration and Desire Petroleum during seismic survey campaigns in the PL001 licence area (Geomotive and MRAG, 2011) and the wider NFB licence blocks (Polarcus, 2011) and numerous satellite tracking projects (Baylis, *et al.,* 2019a; Baylis, *et al.,* 2021a) conducted through the GAP project and subsequent projects like the Darwin Plus 'Improving Falklands marine management effectiveness for marine higher predators (DPLUS139)' project.

It is important to acknowledge that the GAP project established a tracking programme filling in spatial and life history gaps for vulnerable birds (such as penguins) and fur seals (and only for Falkland Islands breeding species). GAP also assimilated and consolidated *c.* 20 years of tracking data from a variety of collaborators as part of this process and this has resulted in one of the largest datasets of its sort in the South Atlantic. However, some gaps still remain.

Although the JNCC Seabirds At Sea Team (SAST) surveys are 24 years old, it is unlikely that broad-scale animal distribution and movement patterns have changed significantly. Baylis, *et al.* (2019a) highlights that for nine-species tracked, the probability of occurrence is highest on the Patagonian Shelf, shelf slope and the Burdwood Bank (Figure 7-53). These findings are similar to the at-sea distribution presented for the same species (White, *et al.,* 2002). This is likely to reflect productivity on the Patagonian Shelf as a whole, being linked to the Patagonian Shelf, slope and Burdwood Bank (static features, associated with predictable areas of enhanced productivity) (e.g., Figure 7-53). Based on the predictive models, and knowledge of local oceanography, the importance of the Patagonian Shelf around the Falkland Islands is unlikely to have changed over the past 24 years, hence animal distribution is still likely to be associated with the Patagonian Shelf. Hence, the SAST data remains useful to characterise occurrence of species, particularly where no tracking data exists. The SAST data set is also useful in that it includes species that do breed in the Falkland Islands but use its waters for foraging or as migrations corridors. Given the GAP project focused on Falkland Islands breeding species, these data sets complement each other and make for the basis of a more informed assessment process.

It is acknowledged that previously some stakeholders have indicated that they would prefer that additional data acquisition to replicate and update the SAST data acquisition programme be undertaken before the project is approved. However, for a single operator this is not considered financially or logistically practicable. Acquisition of data on this scale would require an FIG / pan-industry collaborative approach.

Given this, data gaps remain and it is accepted that the assessments should deal with these in a rigorous and precautionary way (FIG, 2016e)[30], by highlighting and integrating gaps in data and understanding through the assessment process. It is also important to note here that the EMMP (Chapter 15) aims to collect further data in the field, specifically using Seabird and Marine Mammal Observers on two vessels for the initial years of the project (post sanction, pre-First-Oil and post-First-Oil).

[30] Schedule 4 of the Offshore Minerals Ordinance requires the EIS to describe the project and the environmental features likely to be affected by it *'to the extent that the applicant might reasonably be required to compile the information (having regard to current knowledge and methods of assessment). In other words, the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they address the gaps in the risk assessment. Therefore, the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained. When carrying out the risk assessment data gaps can be taken into account*.'

7.4.5.2.1.1 JNCC Seabirds At Sea Team (SAST) surveys

In advance of the first exploratory round of drilling for oil within Falkland Islands waters, the JNCC were commissioned to conduct seabird and marine mammal surveys. Surveys commenced in 1998 and continued for three years, with three dedicated observers employed throughout the project. The surveys covered an area of over 20,900 km^2 and recorded over 399,700 individual birds of 57 species. These data were published in the form of distribution maps; to display the seasonal dispersion of all species recorded (White, *et al.,* 2002). Over a two year period between 2003 and 2005, additional data was collected by one of the original SAST observers using the same methodology *en route* between the Falkland Islands and South Georgia (Black, 2005b). This work represents the most comprehensive survey of the at-sea distributions of seabirds within Falkland Islands waters and is considered here as the baseline to which additional information has been added, and should continue to be in the future. It is acknowledged that the age of the Seabirds-at-Sea dataset (collected over 24years ago), and inherent limitations of the survey method, mean that there are some questions regarding how representative the data are of present-day populations. Consequently, information relating to each species described below has been supplemented by more recent references on a species-by-species basis.

The SAST distribution atlas (White, *et al.,* 2002) and associated database remain the most useful description of seabird distributions within Falkland Islands waters, in terms of broad scale spatial and temporal patterns of distribution of breeding and non-breeding birds. There remain gaps in the SAST coverage but it is possible to infer the species assemblages that are likely to be found in these areas with the data available, therefore, White, *et al.* (2002) has been used as a reference in the EIS. Questions have been raised about the age of the SAST data. In order to ensure that the JNCC SAST data provided an appropriate dataset on which to base the environmental impact assessment, POEPL commissioned Genesis to undertake a review of the data (Genesis, 2017).

The review assesses the adequacy of the existing seabird data presented in the EIS for the purposes of impact assessment, i.e., is the quality and quantity of seabird data presented in the EIS fit for purpose?

The review concluded that the survey methods used, the coverage and the age of the data are comparable with existing datasets used to inform similar impact assessments undertaken in the UK. As a whole, the volume of data collected in the waters off the Falkland Islands is significantly smaller than the equivalent European Seabirds At-Sea (ESAS) data set, being based on three years of survey effort as opposed to over 30 years for the ESAS data. However, the survey effort is not dissimilar to the level of effort from the Atlantic Frontier waters located off the north and west coast of Scotland, where O&G exploration is also relatively new and developing. It is important to note that, in addition to the SAST data, a significant amount of recent tracking data was collected and synthesised through the GAP process, which is also utilised in the impact assessment. These data represent the largest of its type for southern South America and specifically the Patagonian Shelf. Hence, the SAST data are considered to be complementary to more recent occurrence data when undertaking the assessments in this ES. Limitations of the SAST data are described in the section below.

The EMMP (Chapter 15) will collect further data in the field, specifically using SMMOs on two vessels for the first three years of the project (post sanction, pre-First-Oil and post-First-Oil). Data collected here will allow of a comparison of the SAST data going forward'.

With permission from Falklands Conservation (FC) and JNCC, the SAST survey data was re-examined in 2020 to highlight the species recorded in the vicinity of the Sea Lion area. An imaginary 'box' (between 49-50°S and 58.5-59.5°W) was used for this purpose. The number of birds recorded per kilometre of survey track, on a seasonal basis, was calculated to indicate relative abundance in the immediate area around the Sea Lion Field and is presented in Table 7.12 (the highlights in shades of blue indicate relatively High, Medium and Low abundance). For the purposes of this analysis, the months of March,

April and May are considered to be autumn, June, July and August are winter, September, October and November are spring and December, January and February are summer. As in White *et al.* (2002), clear seasonal patterns of abundance, and therefore risk from O&G related activity, were identified for most species recorded in the region.

In total, over 2,050 km of survey track were observed over Sea Lion Field waters. Effort was spread across all months with a high of 504 km achieved in July and a low of 41 km in May.

Over 4,880 seabirds of at least 27 species, were recorded and are summarised on a seasonal basis in Table 7.12.

Table 7.12: Relative seasonal abundance of seabird species recorded in the vicinity of the Sea Lion Field during JNCC surveys (JNCC data)[1,2]

Rank	Autumn (M,A,M)		Winter (J,J,A)		Spring (S,O,N)		Summer (D,J,F)	
	Species[3]	Birds/km	Species[3]	Birds/km	Species[3]	Birds/km	Species c	Birds/km
1	BBA	1.172	Pr	1.417	BBA	0.415	Pr	0.940
2	GS	0.576	BBA	0.315	Pr	0.252	GS	0.440
3	WCP	0.342	AF	0.239	SS	0.126	BBA	0.379
4	CP	0.168	CP	0.124	CP	0.098	WP	0.124
5	WP	0.108	SRA	0.031	R/M	0.059	WCP	0.083
6	AF	0.054	GHA	0.030	WP	0.054	MP	0.079
7	GBsp	0.045	SGP	0.019	WCP	0.049	GBsp	0.077
8	SPP	0.045	NGP	0.013	GBsp	0.031	SS	0.053
9	SS	0.042	NRA	0.011	AF	0.031	SGP	0.022
10	Pr	0.039	KP	0.011	SGP	0.018	LTS	0.020
11	SRA	0.033	DP	0.010	DP	0.018	SRA	0.010
12	SGP	0.030	WP	0.008	MP	0.013	SPP	0.010
13	MP	0.030	KG	0.008	NGP	0.013	WA	0.008
14	GHA	0.027	GPsp	0.007	GPsp	0.010	GPsp	0.008
15	LTS	0.024	MDP	0.002	AS	0.010	AS	0.008
16	WA	0.018	SS	0.002	NRA	0.005	DP	0.006
17	AS	0.018	Dio Alb	0.001	WA	0.003	NRA	0.002
18	NRA	0.009	WCP	0.001	SRA	0.003	CP	0.002
19	AtP	0.009			KG	0.003	RP	0.002
20	GPsp	0.009					BBSP	0.002
21	DP	0.009						
22	R/M	0.009						
23	MDP	0.006						
24	NGP	0.006						
25	LS	0.003						
26	RP	0.003						
27	BBSP	0.003						

[1] Survey effort: Autumn 333.5 km, Winter 829.7 km, Spring 388.1 km, Summer 508.6 km

[2] Highlights in shades of blue indicate relatively Very High, High, Medium and Low abundance

[3] The species names relating to the species codes are found in the subheaders of Section 7.4.5.2.2 below and Appendix 1.

Data limitations with seabird distribution and vulnerability information

There are a number of limitations associated with the SAST surveys which are described by White, *et al.* (2001 and 2002) and must be taken into consideration when interpreting the data. The SAST surveys

were conducted opportunistically. Therefore, the distribution of survey effort was closely linked to the activity of patrol vessels. Occasionally, some vessel time was dedicated to covering the NFB but there remain some gaps in coverage. As a result, coverage within some of the key Licence Blocks was not as high as had been hoped at the outset of the project (White, *et al.,* 2001; 2002). In particular, the Drilling Campaign Area was not covered during April, May and September.

The detection and identification of cryptic species, such as penguins and diving-petrels (*Pelecanoides* spp.), at-sea was highlighted as one of the most significant challenges for observers, as these birds can be difficult to spot from vessels (White, *et al.,* 2002). However, simultaneous projects to satellite track penguins were conducted, to complement at-sea observations and fill any gaps. The recorded distribution of penguins during SAST surveys are supported by satellite tracking data (for example Pütz, *et al.,* 2000; 2002a & b). Additional tracking has been carried out in subsequent years, and as part of the GAP project (Section 7.2.4.2), which is summarised in Baylis, *et al.* (2019a & b; 2021). Preliminary results showing the range of each species, as derived from probability of occurrence data, support the known distributions of the species concerned. The seabird tracking database in the Falklands Islands is always evolving and therefore further data and analyses could complement the baseline in future years.

Visual surveys also rely on good conditions for observing. When conditions are too rough or dark to continue, surveys stop. Therefore, the activity of birds at night is not recorded. Some species are known to return to colonies at dusk, this behaviour is well known from observations from land and can be observed at sea when close to land late in the day. With sufficient survey effort, the movements of birds to and from colonies will be captured in the data.

The SAST data were collected over 24 years ago. Whether this influences the validity of the data is a matter for debate. During the three years of the project major inter-annual variations in species distribution were not identified, perhaps because the study covered a relatively short time frame.

Recent studies suggest that there may be significant inter-annual and spatial variation in foraging and migration patterns, for individuals of the same species breeding on the same island (Masello, *et al.,* 2010) and on island breeding sites that are in close proximity (Granadeiro, *et al.,* 2011; Catry, *et al.,* 2013). However, these were over small spatial scales. This is likely to be the case for individual birds but whether this is reflected in the foraging ranges of populations as a whole remains to be seen and future data would of course help clarify this. The three years of SAST surveys did detect some inter-annual variation but most of these concerned non-breeding visitors to Falkland Islands waters. Species such as great shearwater (*Ardenna gravis*) and soft-plumaged petrel (*Pterodroma mollis*) are likely to show greater inter-annual variation than those breeding at the Falklands. This suggests that a combination of satellite tracking and at-sea observations is likely to provide the best overview of seabird distribution within the waters of the Falklands Islands. Substantial tracking datasets now exist to support more detailed analysis of movements - particularly during the breeding season. However, limitations associated with tracking data are discussed in Section 7.4.5.3.1.3.

It is important to note that data from the extensive tracking database collected for the Falkland Islands (Baylis, *et al*., 2019), at larger geographic scales, show findings are similar to the at-sea distribution presented for the same species (White, *et al*., 2002). This is likely to reflect productivity on the Patagonian Shelf as a whole, being linked to the Patagonian Shelf, slope and Burdwood Bank (static features, associated with predictable areas of enhanced productivity) (Section 7.4.5.2.1).

Despite limitations, one of the great advantages of at-sea surveys is that all species are recorded. Therefore, it is possible to assess the risk to species that have not been tracked. For example, many of the smaller species of petrels are vulnerable to oiling and light-induced bird strikes, but little tracking

data exists. An example the availability of tracking data for individual species is provided in Table 7.13, highlighting the SAST data is the only baseline for numerous small petrel and prion species.

7.4.5.2.1.2 Seabird surveys from seismic vessels in NFB during 2011

A total of 242 seabird surveys were conducted from January until May 2011 during a 3D seismic survey in the licence area PL001, which is adjacent to the block containing the Sea Lion Field (Geomotive and MRAG, 2011). In addition, 226 individual seabird surveys were conducted over a larger area covering many of the NFB licence blocks from the end of November 2010 to May 2011 (Polarcus, 2011). Survey methods were based on standardised protocols developed by the JNCC and used by SAST in the Falklands. Additionally, a mixture of line transect and point surveys were conducted in March and April 2012 as part of the Sea Lion Field environmental baseline survey (Gardline, 2013a). The objective of these surveys was to add to the knowledge of seabird abundance and distribution within the PL001 licence area during the summer season. However, the activity of the vessels, towing seismic gear at slow speed (4.5 knots), is likely to have resulted in some biases due to birds persistently associating with the vessels. It is difficult to directly compare the data presented in Geomotive and MRAG (2011) and Polarcus (2011) with that in White *et al.* (2002) as it is presented in a different format. Nonetheless, there are similarities in the ranks of species abundance from all three datasets. Table 7.13 lists the 27 most abundant seabird 'species' recorded during the PL001 survey and the corresponding rank of abundance of those species in the NFB survey.

The most abundant families of seabirds recorded during the surveys were albatrosses, shearwaters, petrels, skuas and fulmars (Table 7.13). Three species of penguin (Magellanic, gentoo and rockhopper) were recorded in low numbers during both surveys. However, it must be noted that penguins are more difficult to detect because of their diving behaviour. Black-browed albatross, great shearwaters, soft-plumaged petrels, white-chinned petrels (*Procellaria aequinoctialis*) and giant petrel species (*Macronectes* spp.) were all ranked highly in both surveys, and are all known to follow and be attracted to vessels (Polarcus, 2011).

Table 7.13: Number of seabird sightings during the PL001 and NFB Surveys

Bird species common name	PL001[1]		NFB[2]		Seabird tracking data (within FCZs)[3]	Origin of birds tracked
	Rank	No. of birds	Rank	No. of birds		
Black-browed albatross	1	3,118	1	5,043	Yes	Falkland Islands
Great shearwater	2	2,106	3	1,004	Yes	Gough and Tristan
Soft-plumaged petrel	3	1,257	6	318	Yes	Antipodes and Auckland Island
White-chinned petrel	4	1,100	2	1,633	Yes	Crozet, Kerguelen, South Georgia
Prion spp. (inc. Blue petrel)	5	552	5	488	-	-
Giant petrel species	6	411	4	574	-	-
Sooty shearwater	7	338	11	17	Yes	Falkland Islands
Wilson's storm-petrel	8	229	7	262	Yes	Falkland Islands

Bird species common name	PL001[1]		NFB[2]		Seabird tracking data (within FCZs)[3]	Origin of birds tracked
	Rank	No. of birds	Rank	No. of birds		
Atlantic petrel	9	173	23	2	Yes	Gough Island
Southern royal albatross	10	172	12	16	-	-
Cape petrel	11	170	20	4	-	-
Manx shearwater	12	158	NR[4]	NR	-	-
Southern giant petrel	13	132	NR	NR	Yes	Prince Edward and South Georgia
Northern giant petrel	14	125	NR	NR	Yes	Prince Edward and South Georgia
Falkland Islands skua	15	78	NR	NR	No	-
Large albatross species	16	65	13	14	-	-
Large skua	17	64	16	7	-	-
Wandering albatross	18	59	10	20	Yes	Crozet, Kerguelen, Prince Edward, South Georgia
Antarctic fulmar	19	52	9	22	Yes	Antarctica
Grey-backed storm petrel	20	44	NR	NR	No	-
Magellanic penguin	21	42	8	70	Yes	Falkland Islands
Diving-petrel species	26	6	13	14	-	-
Rockhopper penguin	30	2	15	11	Yes	Falkland Islands
Black-bellied storm-petrel	NR3	NR	19	3	No	-
Northern royal albatross	23	14	20	2	Yes	Chatham Islands
Gentoo penguin	30	2	20	2	Yes	Falkland Islands
'Shy' type albatross	NR	NR	23	1	-	-

[1] Geomotive and MRAG 2011. 11/01/11 - 02/05/11.
[2] Polarcus 2011. 25/11/10 - 05/05/11.
[3] Metadata from https://data.seabirdtracking.org/dataset. Data are not freely available, and not necessarily relevant to PL001 and NFB.
[4] NR = not recorded.

7.4.5.2.1.3 Satellite tracking studies

At about the same time that the SAST surveys were being initiated in the Falklands, a number of seabird satellite tracking studies of seabirds commenced. These focused on a range of species, including black-browed albatross (Huin, 2002), Magellanic (Pütz, *et al.,* 2000; 2002a), rockhopper (Pütz, *et al.,* 2002b) and gentoo penguins (Clausen and Pütz, 2003). In subsequent years, tracking projects have continued

on a number of species at various sites around the Islands (see Blockley and Tierney, 2016). Indeed, tracking studies formed a major part of the GAP Project, which collated existing tracking data, and undertook further tracking to fill gaps (see Section 7.2.4.2). The initial results of the GAP project are presented in Blockley and Tierney (2016) and Baylis, *et al.* (2019a & b). However, further work could potentially be undertaken to interpret this data with the aim of producing vulnerability maps.

Tracking data for different age-classes, breeding stages and breeding colonies are limited for most species. This is particularly the case for immature / juvenile birds, periods outside of the breeding season and species that breed elsewhere (noting that most of the IUCN Endangered, Vulnerable and Near Threatened species encountered within Falklands waters do not breed on the Islands). So, although there has been a considerable research effort on tracking seabirds in recent years, there remain substantial data gaps. Generally, small sample sizes and data gaps limit the ability to assess vulnerability for all age-classes, breeding stages and in some instances, species. Further work is required to address priority tracking data gaps in the Falklands (Section 7.2.4.2), so that these data can be used in future assessments. Notable additions to seabird tracking data since the GAP project, include a recent SAERI led tracking project (DPLUS139) that included six species and 5 breeding colonies (Table 7.14). Combined with the GAP project data, this yields over 360,000 at-sea locations from 10 species (Figure 7-48). This data is yet to be formally analysed but could be integrated into future assessments.

In addition, the Falkland Islands provides important foraging habitat for seabird species that breed elsewhere, particularly at South Georgia (e.g., Berrow, *et al.,* 2000; Phillips, *et al.,* 2006; Ratcliffe, *et al.,* 2014). BirdLife International manages the Global Procellariiform Tracking Database (BirdLife International, 2004), which serves as a central repository for albatross and petrel tracking data from all over the world. The Global Procellariiform Tracking Database model has recently been extended to penguins (and other seabirds). Work is currently underway in the Falklands to collate, and determine how best to use, the tracking data available for seabirds breeding and visiting the Falkland Islands (Section 7.2.4).

Where possible the published accounts of tracking projects have been used to describe the distribution of species and their foraging ecology. However, for some species there is little information in the published literature that adequately describes the distribution of the populations involved.

Table 7.14: Summary of deployments from a recent multi-colony tracking project[1]

Species	Colony	Year	Individuals	Trips	Duration (days)	Duration (SD)	Max distance (km)
BBA	Bird	2021	24	63	2.9	2.7	589.9
RHP	Bird	2021	26	96	0.9	1.5	235.9
RHP	Steeple Jason	2021	30	35	3.1	2.1	143.2
SAFS	Flat Jason	2021	10	13	48.5	38.1	1498.1
TBPR	Bird	2021	9	9	7.7	0.9	697.5
BBA	Grand Jason	2022	27	31	4.8	3.1	930.9
IMSH	Grand Jason	2022	15	102	0.3	0.1	22.3
IMSH	Steeple Jason	2022	17	150	0.2	0.1	31.5
IMSH	White Rock	2022	5	32	0.1	0.1	21.7
RHP	Grand Jason	2022	27	78	1.6	2.6	234.0
SAFS	Flat Jason	2022	18	18	91.5	51.9	2039.6
WISP	Grand Jason	2022	3	3	5.5	1.4	641.3
Total			211	630	-	-	-

[1] BBA = Black-browed albatross, RHP = Rockhopper penguins, SAFS = South American fur seal, TBPR = Thin Billed Prion, WISP = Wilsons Storm Petrel, IMSH = Imperial shag.

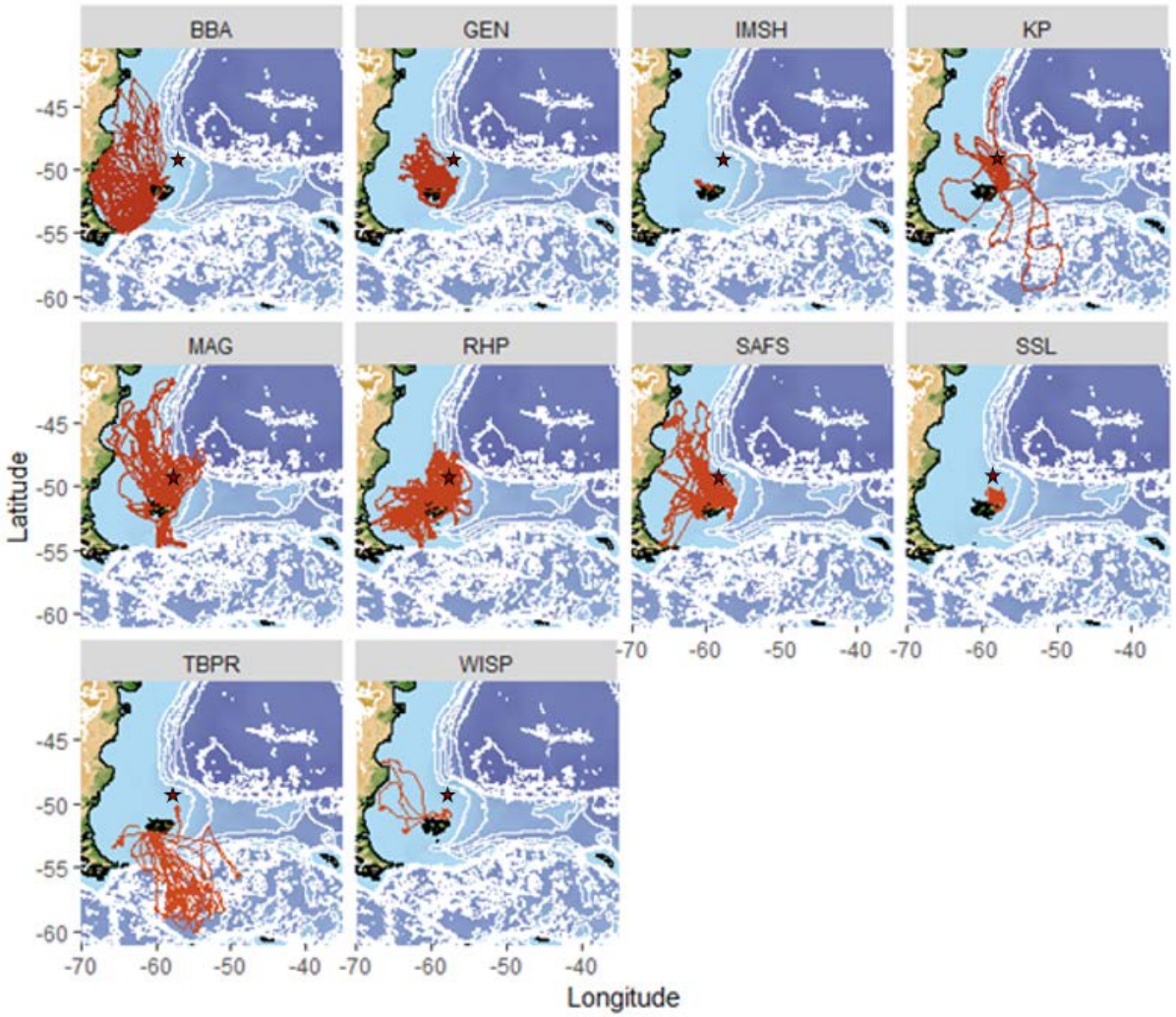


Figure 7-48: Combined data, from both satellite (PTT) and GPS tags, spanning over 20 years and for ten species – includes data collected during DPLUS139. The star indicates the Sea Lion Field location. The red lines represent foraging trips, which are individual plots are different species. BBA = Black-browed albatross, GEN = Gentoo penguin, IMSH = Imperial shag, KP = King Penguin, MAG = Magellanic Penguin, RHP = Rockhopper penguin, SAFS = South American fur seal, SSL = Southern sea lion, TBPR = Thin Billed Prion, WISP = Wilsons Storm Petrel

7.4.5.2.1.4 GAP project overview and data availability

The recommendations of the GAP analyses group were to initiate further tracking work to fill the obvious and highest priority taxon gaps. Briefly, the main priority gaps were:

- Seabirds: those species most susceptible to oil contamination, such as penguins, should be afforded the highest priority, particularly Gentoo, Magellanic and Rockhopper penguins,
- Pinnipeds: fur seals and sea lions were considered a priority for immediate tracking work given their breeding distribution in the north of the Falklands and given that little was known about their at-sea distribution (Section 7.4.6.3.2.3), and
- Collate existing tracking data.

The GAP analysis integrated data from four types of biologging tags - geolocator tags (GLS), satellite tags (PTT), Fastloc-GPS tags and GPS tags. The type of biologging tag selected was a compromise

between tag size, battery life, cost, and location accuracy. A detailed description of differences between biologging tags are described in the GAP Phase I report (Blockley and Tierney, 2016). However, in brief:

GLS tags record light levels and time. Light levels allow sunrise and sunset to be estimated, which can be used to calculate longitude. Time provides a measure of day length, which can be used to calculate latitude. Locations derived from GLS tags have errors of hundreds of kilometres. However, their small size makes them ideal to track migratory movements of seabirds.

Satellite tags (PTTs) are one of the most widely used tags because they provide real-time location data remotely *via* Argos satellites anywhere in the world. Locations are estimated using the Doppler-shift in frequencies between the tag and polar-orbiting satellites. Satellite tags transmit data when the animal is at the surface. The number of satellite links influences the error associated with the estimated position (error ranges from hundreds of meters to kilometres). For species that do not spend a long time at the surface, location quality can be consistently poor.

Fastloc-GPS tags are a compromise between satellite tags and GPS tags. Fastloc-GPS tags (Wildtrack Telemetry System Limited, Leeds, UK) require only seconds at the surface to take a snapshot of the radio signals produced by GPS satellites. Fastloc GPS tags process these signals onboard the tag (identifies satellites and their pseudo-ranges), and then transmits data *via* the Argos satellite system and final locations are post-processed. The location accuracy of Fastloc-GPS tags is typically less than 100 m (Costa, *et al.,* 2010).

GPS tags utilise a constellation of satellites that orbit the earth and transmit navigational data. Due to the time required for a GPS tag to be at the surface to obtain a satellite fix and maintain the almanac, they are typically best suited to flying seabirds. The location accuracy of GPS tags is typically less than 50 m. Data processing steps varied depending on the type of tag used, but in general involved three main steps:

- Identification of foraging trips,
- Use of a speed filter to remove obviously erroneous locations, and
- Implementation of a movement model to account for location error and produce a best-fit/most likely track.

Given GLS tags are associated with a very large location error (> 150 km), here we focus on data derived from other tags (satellite tags, Fastloc-GPS tags and GPS tags). For a detailed overview of how telemetry data was analysed, please refer to Baylis and Tierney, 2018 and Baylis, *et al.,* 2019.

GAP Results - Telemetry data (all species)

In total, 687 individuals were tracked, with 1,891 foraging trips identified, from 21 colonies (listed in Table 7.15). To summarise the observed distribution of individuals at-sea, telemetry data was split into groups according to species, sex, season and breeding status / stage Table 7.16 and Figure 7-49 provide an overview of the data available from satellite tags, Fastloc-GPS tags and GPS tags, and the various groups that were defined.

Individual species maps, showing the animals' tracks, are presented in Figure 7-50, Figure 7-51 and Figure 7-52. Maximum foraging trip distance ranged from 79 km for chick-rearing gentoo penguins to 1,325 km for incubating black-browed albatross (Table 7.16). Over 60 % of sampled colonies (13 of 21) were in the north-east of the Falkland Islands (Figure 7-49). The proportion of colonies from which animals were tracked for each species ranged from <10 % for South American sea lions and gentoo penguins (4 of 71 and 6 of 81 colonies, respectively) to 30 % for black-browed albatross (4 of 12 colonies).

Figure 7-49 represents the core foraging areas (50 % utilisation distributions) for the animals tracked (refer to Table 7.16). Core foraging areas extended as far north as 42 °S, 1,000 km to the north of the Falkland Islands, and as far south as 56°S, 360 km to the south. Foraging trips were, however, predominantly confined to the Patagonian Shelf, including the Burdwood Bank (Figure 7-49).

The highest overlap of core areas, both among groups and species was on the Patagonian Shelf to the north of the Falkland Islands (Figure 7-49). In total, 83 % of locations (species range was 67 – 99 % of locations) were associated with bathymetric depths less than 400 m, which highlighted a preference for the Patagonian Shelf and Burdwood Bank for most species. The exceptions were southern elephant seals, where 68 % of foraging trip locations were associated with water depths between 400 m and 800 m (i.e., shelf-slope waters; Figure 7-52), and a small proportion of rockhopper penguins, which foraged beyond the Patagonian Shelf and slope during incubation, in water > 600 m deep (Figure 7-50). Most foraging trip locations (74 %) were within the Falkland Islands Conservation Zones. The remaining locations were within the Argentine Exclusive Economic Zone (23 %), and the high seas (3 %).

Predictive models

Tracking data was not available for all breeding colonies at the Falkland Islands. For example, gentoo penguins and South American sea lions breed at over 70 sites around the Falkland Islands, but were tracked from only six and three sites, respectively. It is unlikely that the existing telemetry data accurately depicts the space use of animals from other colonies, especially distant colonies; however, it is impractical to track all breeding colonies. To predict the space use from colonies not tracked, Baylis, *et al.* (2019) modelled habitat selection using Generalised Additive Models (GAMs).

In brief, space use was modelled as a function of dynamic and static environmental indices that described habitat. The seven environmental indices used were sea surface temperature, sea level anomaly, eddy kinetic energy, bathymetry, slope and distance from colony. Predicting from GAMs, the predicted distribution of animals was mapped from both sampled and unsampled colonies. Note that male fur seals and sea lions roam widely and use multiple colonies. Therefore, predictive models were not developed for male seals. For a detailed overview of how models were developed and details on the environmental indices used, please refer to Baylis *et al.* (2019a & b).

Model results are presented below (Figure 7-53) as an overview, and in the species accounts in Section 7.4.5.2.2 for seabirds and Section 7.4.6.2.2.1 for pinnipeds. The results depict the probability of occurrence, proportional to the likelihood of absences – perhaps best interpreted simply as predicted presence and absence. Results from both tracking data and predictive models demonstrated that the shelf area around the Falkland Islands (which includes parts of the North Falkland Basin) was important habitat for marine higher predators breeding at the Falkland Islands. The large area of shelf used by marine predators reflects the ubiquitous breeding distribution of some species, combined with the long-distance movements of most species tracked.

Limitations of telemetry data

Telemetry data were collected over different years, and for some species and some breeding colonies, available telemetry data was unlikely to fully represent core areas used based on the representativeness analysis detailed in Baylis *et al.* (2019a & b). Given data collection was opportunistic rather than systematic, inconsistencies in the temporal coverage of data between species could obscure potentially important areas of use. Ultimately, it would be ideal to track species at the same time, stratifying data collection across colonies within species, such that good geographical coverage was achieved, with more data collected from larger colonies. However, the resources required to undertake simultaneous tag deployments on multiple predator species from multiple colonies is typically not feasible.

Limitations of predictive models

Although the predictive models generally performed well (see Baylis, *et al.,* 2019 a & b), caveats and constraints exist with the predictive modelling approach. For example, the models developed by Baylis, *et al.,* 2019 could have been extended by including additional terms to account for correlation structures inherent in telemetry data, including (1) individual and colony-level slopes (random effects); (2) a term to model temporal / serial autocorrelation and (3) terms to describe spatial autocorrelation. However, including these terms has so far proved impracticable in studies that have analysed datasets of similar size due to computational constraints and lack of convergence (Raymond, *et al.,* 2015; Arthur, *et al.,* 2017; Trathan, *et al.,* 2018; Warwick-Evans, *et al.,* 2018).

Table 7.15: Colony location abbreviations used in Table 7.16 and Figure 7-49 below

Colony	Abbreviation	Colony	Abbreviation
Bird Island	BIRD	Volunteer Point	VPT
New Island	NEW	Volunteer Rocks	VRK
Steeple Jason	SJI	Rugged Hill	RHL
North Fur Island	NFUR	Diamond Cove	DC
Saunders Island	SAU	Kidney Island	KDI
Pebble Island	PBI	Kelp Island	KELP
Cape Dolphin	CD	Bertha's Beach	BB
Cape Bougainville	CBG	Bleaker Island	BLK
Big Shag Island	BSI	Sea Lion Island	SLI
Seal Bay	SEALB	Beauchêne Island	BCI
Cow Bay	CB		

Table 7.16: Data derived from tags other than GLS tags, includes six seabird and three pinniped species[1]

Species	Migra-tory	Season	Breeding stage (group)	Colonies tracked [% tracked]	Individuals	Foraging trips	Trip distance (km) max [mean ± SD]
Seabirds							
Gentoo penguin (*Pygoscelis papua*)	N	Winter	Non-breeding	BB, BLK, CB, CD, PBI [6 %]	25	155	479 [109 ± 80]
		Summer	Incubation / Chick rearing	NEW, CB [2 %]	45	74	79 [21 ± 16]
Magellanic penguin (*Spheniscus magellanicus*)	Y	Summer	Incubation / Chick rearing	BLK, CB, CD, PBI, SEALB, NEW [7 %]	63	140	1,115 [298 ± 298]
King penguin (*Aptenodytes patagonicus*)	N	Winter	Chick rearing	VPT	8	32	971 [295 ± 215]
Rockhopper penguin (*Eudyptes chrysocome*)	Y	Summer	Incubation	CBG, PBI, SEALB, SOP [11 %]	27	27	514 [216 ± 127]
		Summer	Chick rearing	BIRD, NEW, PBI, SEALB [11 %]	116	185	540 [139 ± 109]
Black-browed albatross[2] (*Thalassarche melanophris*)	Y	Summer	Incubation	NEW, SJI, BCI, SAU [33 %]	70	92	1,325 [507 ± 339]
		Summer	Chick rearing	NEW, SJI, BCI, SAU [33 %]	256	699	1,235 [131 ± 147]
Sooty shearwater (*Ardenna grisea*)	Y	Summer	Incubation	KDI	20	43	438 [185 ± 87]
Pinnipeds							

Species	Migra-tory	Season	Breeding stage (group)	Colonies tracked [% tracked]	Individuals	Foraging trips	Trip distance (km) max [mean ± SD]
South American fur seal (*Arctocephalus australis*)	N	Winter - female	Lactation	NFUR, VRK [20 %]	9	108	674 [310 ± 216]
		Spring - female	Lactation	NFUR, VRK [20 %]		42	940 [425 ± 295]
		Winter - male	Non-breeding	NFUR [10 %]	4	34	992 [229 ± 206]
South American sea lion (*Otaria flavescens*)	N	Summer - female	Lactation	CD, BSI, KELP [4 %]	25	93	173 [63 ± 34]
		Winter-male	Non-breeding	CD, BSI [3 %]	21	157	157 [88 ± 36]
Southern Elephant seal (*Mirounga leonine*)	Y	Summer - female	Post-breeding	SLI	10	10	497 [120 ± 42]

[1] Baylis, *et al.,* 2019a.
[2] Total number of black-browed albatross tracked was 319, but some birds were tracked over both incubation and chick rearing periods.

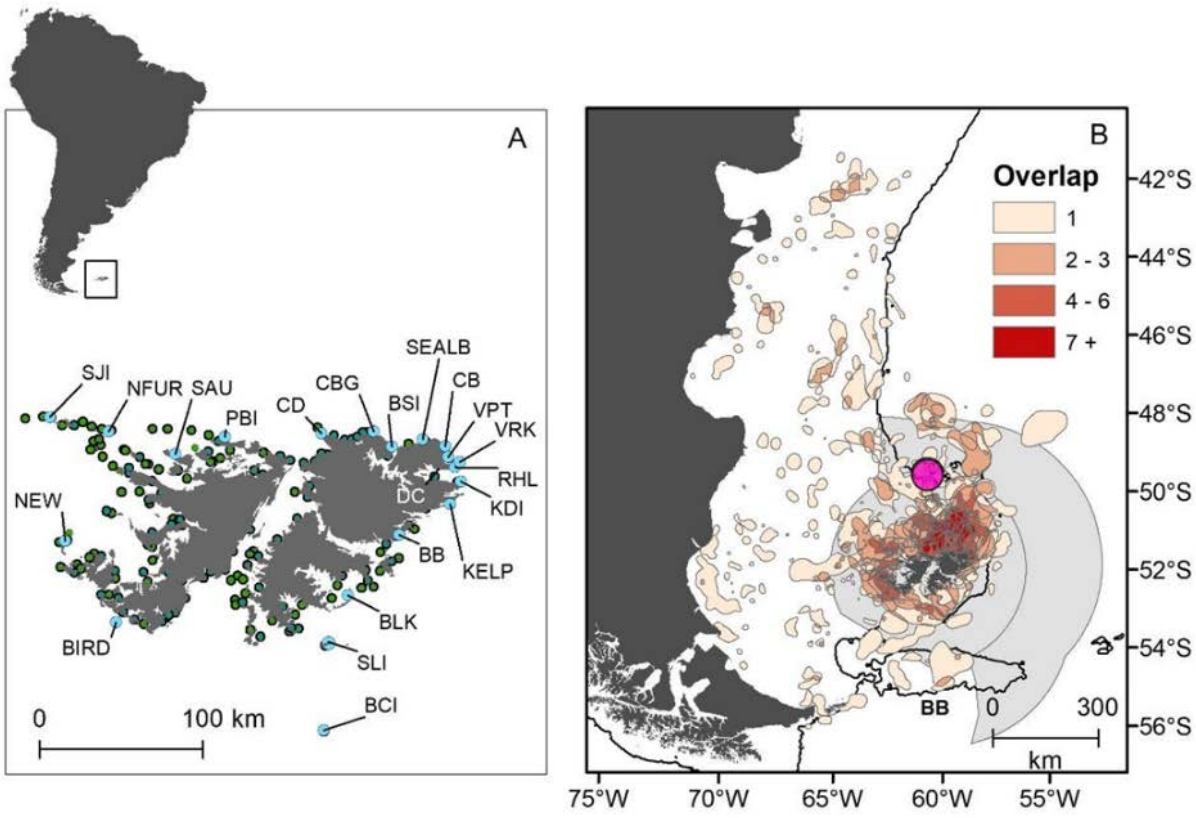
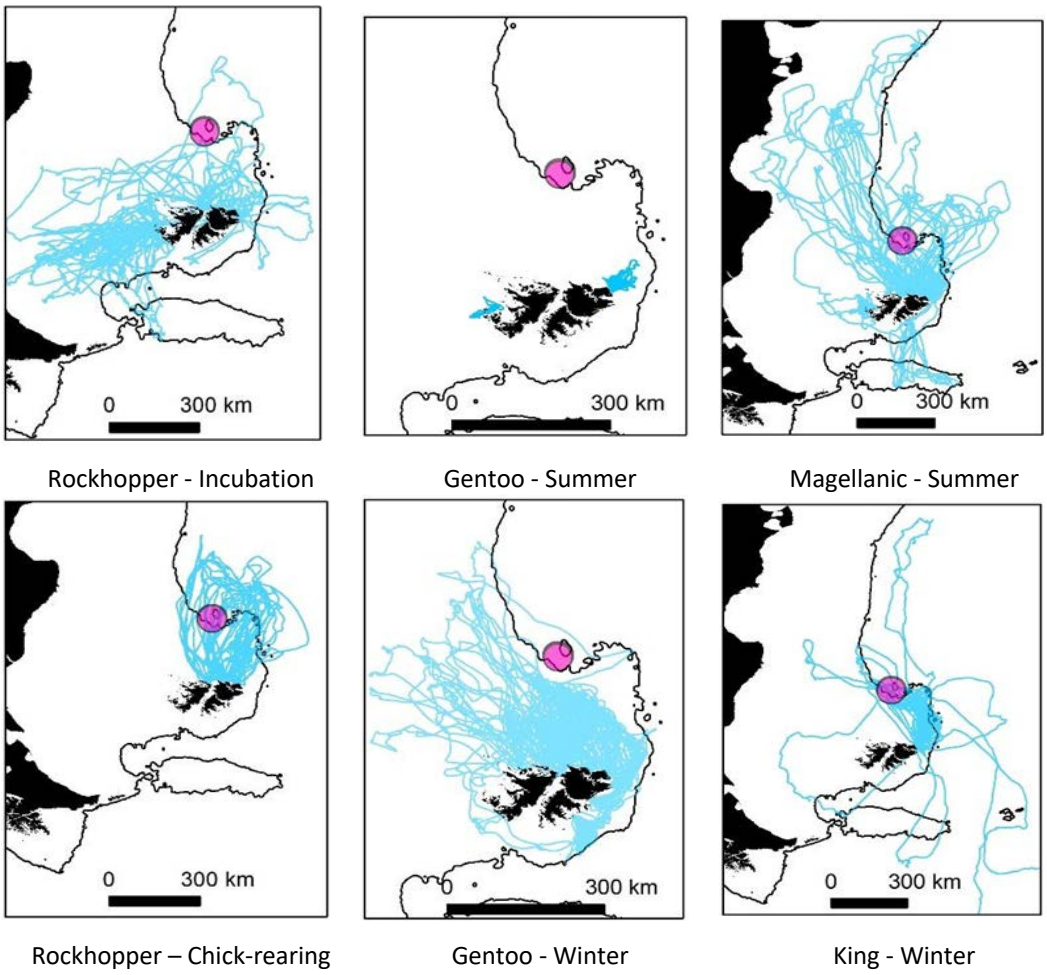


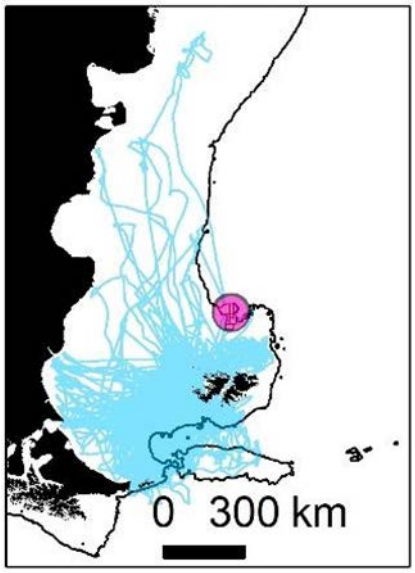
Figure 7-49: Panel A = locations of the 21 tracked breeding colonies (blue dots) and untracked colonies (green dots). Panel B = important areas identified by overlap of 50 % utilisation distributions, derived from the tracking data presented in Table 7.16. Thin black line is the 400 m isobath that marks the edge of the Patagonian Shelf, as well as the Burdwood Bank (BB). Grey shading is the Falkland Islands Interim and Outer Conservation Zones. The pink dot represents the drill centre *(adapted from Baylis et al., 2019a)*



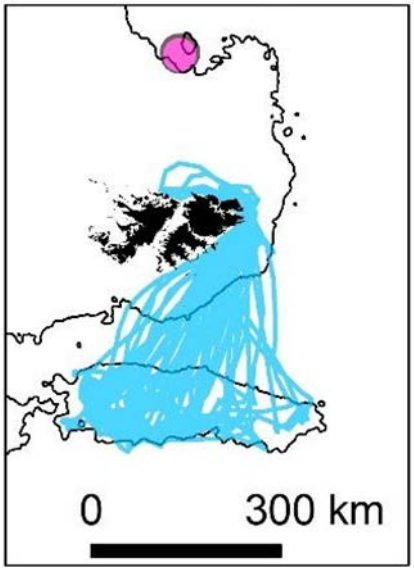
Rockhopper - Incubation | Gentoo - Summer | Magellanic - Summer

Rockhopper – Chick-rearing | Gentoo - Winter | King - Winter

Figure 7-50: Penguin telemetry data, by species and where available, season or breeding stage. The pink dot represents the drill centre



Black-browed albatross - Incubation

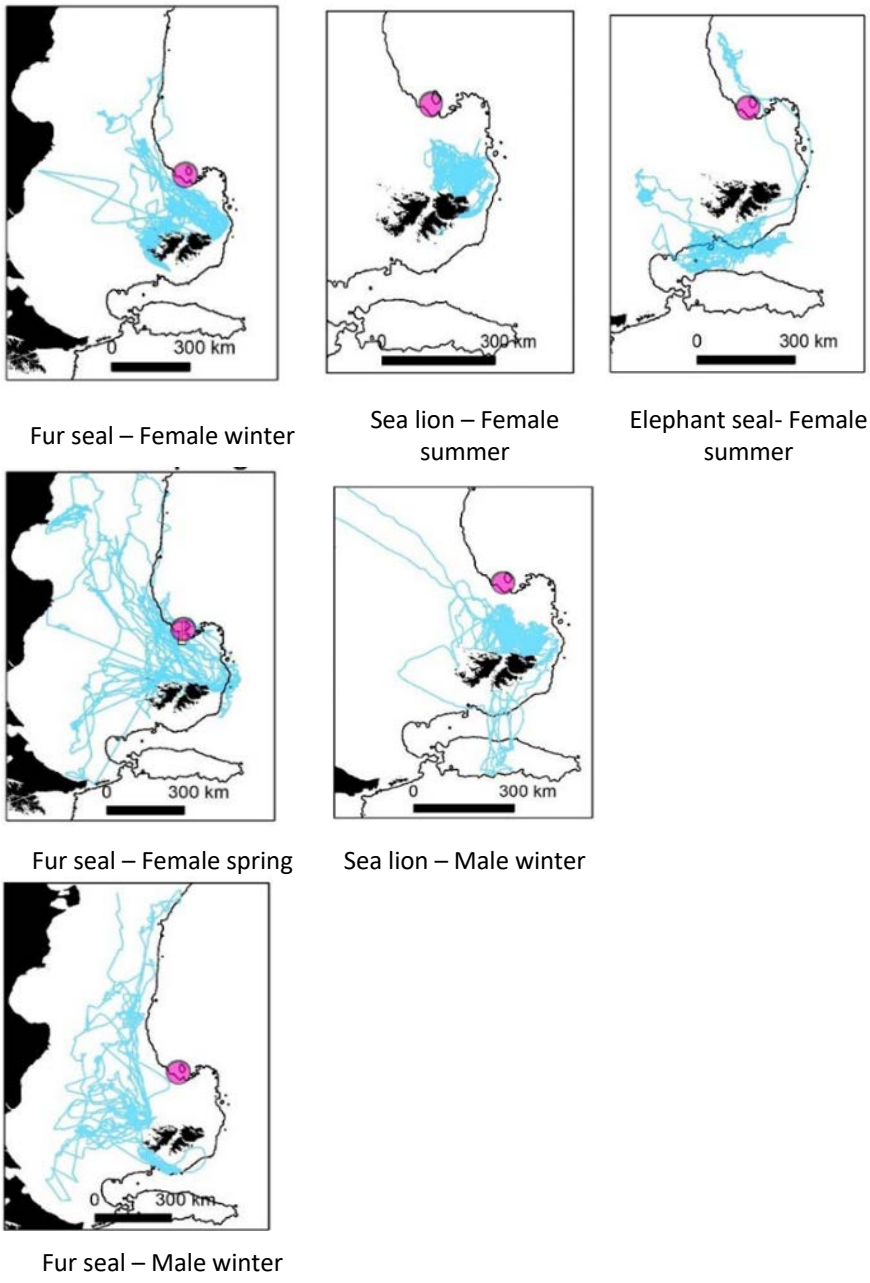


Sooty shearwater - Summer



Chick rearing

Figure 7-51: Flying seabird telemetry data, by species and where available, breeding stage. The pink dot represents the drill centre



Fur seal – Female winter

Sea lion – Female summer

Elephant seal- Female summer

Fur seal – Female spring

Sea lion – Male winter

Fur seal – Male winter

Figure 7-52: Pinniped telemetry data, by species and where available, sex and season. The pink dot represents the drill centre

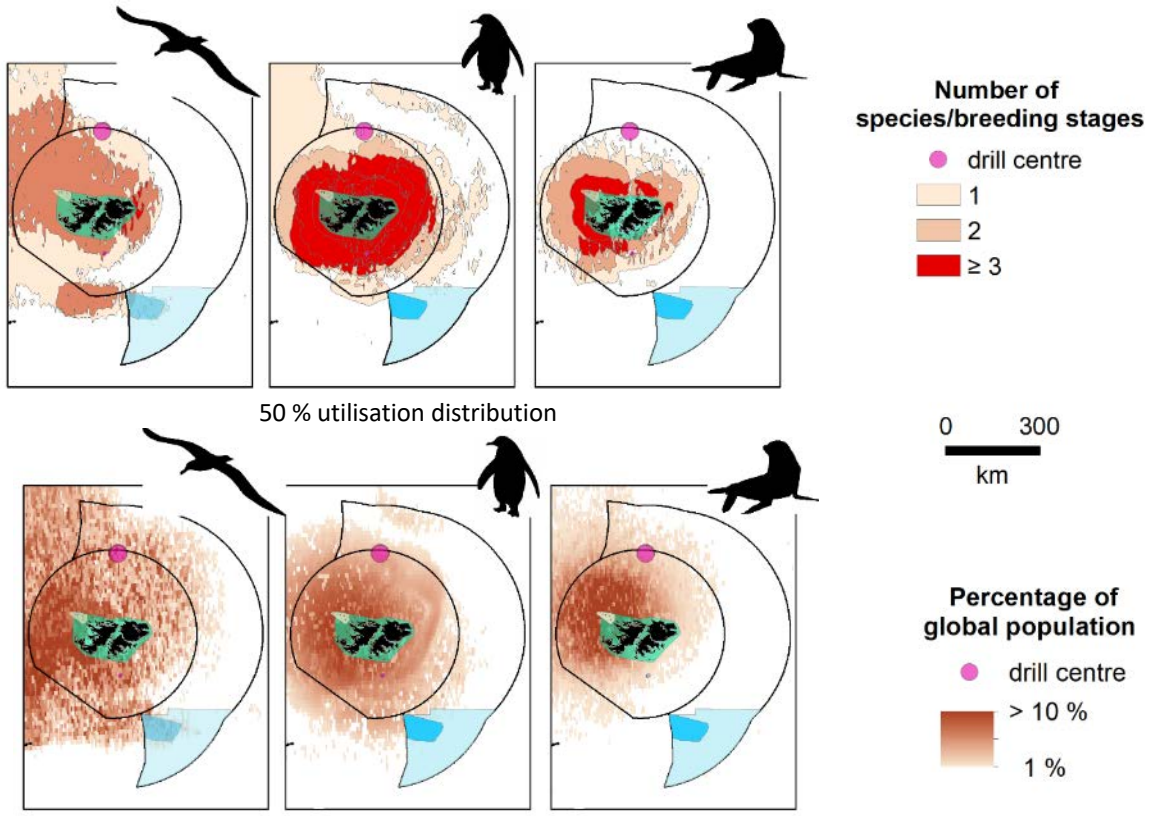


Figure 7-53: An overview of the GAP data from Baylis, *et al.,* 2019 and Baylis, *et al.,* 2021a. Predicted distribution (red shading relates to overlap in species/stages) and proposed Marine Managed Areas (MMAs) for flying seabirds (Black-browed Albatross and Sooty Shearwaters), penguins (Gentoo, King, Magellanic and Rockhopper Penguins) and pinnipeds (Southern elephant seals, Southern sea lions and South American fur seals). Upper panels, 50 % utilisation distribution; lower panels, percentage of global population. The lower panels exclude Southern elephant seals, Southern sea lions, Magellanic Penguins, and King Penguins, given these species did not meet IUCN Key Biodiversity Area (KBA) criterion D1a (demographic aggregations ≥1 % of the global population size). Green, inshore MMA, yellow, Jason Islands group MMA; blue, Burdwood Bank MMA. Thin black lines are the Falkland Islands Inner and Outer Conservation Zones. Also shown is the location of Phase 1 & 2 Development drill centre

7.4.5.2.2 Species-specific distribution and abundance

In this section, a brief account is provided of the abundance and distribution for each species, listed in order of autumn abundance (Table 7.12 above). This information is based primarily on the results of the SAST surveys (White, *et al.,* 2002) but is also informed by additional at-sea surveys and tracking data.

The population size of species are given where data are available, however, it should be noted that accurate population estimates and trends are only available for a few species. In the Falklands, the populations of penguins and ACAP species (black-browed albatross and southern giant petrel) are relatively well known, thanks to several island-wide censuses (Baylis, 2012; Baylis, *et al.,* 2013a & b; Stanworth and Crofts, 2017) and Falklands Conservation's Seabird Monitoring Programme (Crofts and

Stanworth, 2019). The populations and breeding sites of most other species of seabird are less well known and this is acknowledged as a data gap.

Table 7.17 provides a summary of the key ecological characteristics of the most abundant seabird species within the NFB and particularly the Sea Lion area to help understand how O&G operations may pose a threat to these species, and how the potential impacts may be avoided or mitigated.

Black-browed albatross (BBA)

The Falkland Islands are home to the world's largest breeding population of black-browed albatrosses (*Thalassarche melanophris*). The most recent census, in 2010, estimated the breeding population to comprise approximately 500,000 breeding pairs, which represents approximately 75 % of the global population (Wolfaardt, 2012).

During SAST surveys, black-browed albatross were regularly recorded throughout the year in the vicinity of the Sea Lion area (Table 7.12 above) and were ranked in the top three species recorded in all seasons. In the autumn (March to May), the number of birds recorded per kilometre travelled was substantially greater than in other seasons. Black-browed albatross were also the most numerous species recorded during seismic surveys (Table 7.13).

Black-browed albatrosses were tracked from four Falklands colonies. The results were used to produce the predicted distribution shown in Figure 7-54. The data indicates that birds forage predominantly over the Patagonian Shelf. During chick rearing the range of adult birds is more restricted than during the incubation period, when birds are likely to be away from the colonies for longer periods of time. SAST surveys recorded a similar overall distribution but recorded differences in the abundance of black-browed albatrosses across the Patagonian Shelf.

Of note, besides the local breeding population of black-browed albatross, the South Georgia population also occurs in the Falkland Islands (Frankish, *et al*., 2020a). The black-browed albatross from South Georgia is an ACAP Priority Population (i.e., where the territory has >10 % of the global total for each species and / or the population is declining at a rate of >3 % per annum) (GSGSSI, 2016).

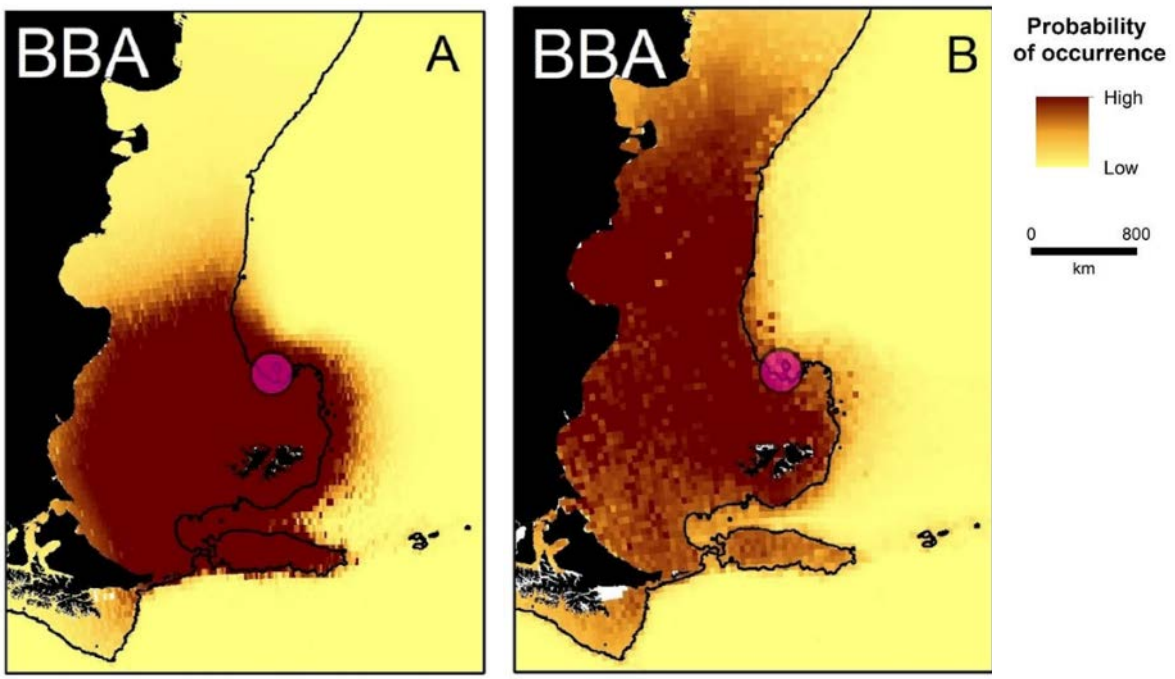


Figure 7-54: Black-browed albatross predicted habitat use (predicted presence) for birds breeding on the Falklands from the available biotelemetry and biologging data (A = chick rearing, B = incubation). The pink dot represents the drill centre *(adapted from Baylis et al., 2019a)*

Great shearwater (GS)

Great shearwaters (*Ardenna gravis*) are largely non-breeding visitors to Falkland Islands waters, although there is a very small local breeding population (50 -100 pairs, Woods and Woods, 1997). Virtually the entire global population of five million pairs breed on the Tristan da Cunha group of islands (BirdLife International, 2016). After breeding, the population embarks on a clockwise circum-Atlantic migration.

Great shearwater was the second most numerous species recorded in the summer and autumn (Table 7.12 and Table 7.13). The seasonal presence of this species within Falklands waters was consistent from year-to-year, although the number of birds can vary inter-annually (White, *et al.,* 2002).

White-chinned petrel (WCP)

There is a very small breeding population of white-chinned petrels (*Procellaria aequinoctialis*) in the Falkland Islands, estimated at 55-100 pairs (Reid, *et al.,* 2007). The small numbers of breeding pairs include 331 (95 % CI: 52 – 1043) and 199 (95 % CI: 33 – 594) at Kidney Island and Top Island respectively (Kuepfer, *et al.,* 2024). Most of the birds present within Falkland Islands waters come from the much larger breeding population at South Georgia (Berrow, *et al.,* 2000; Phillips, *et al.,* 2006), which is in decline and estimated to comprise approximately 900,000 pairs (Martin, *et al.,* 2009).

White-chinned petrels were one of the most regularly recorded species throughout most of the year in the vicinity of the Sea Lion area, except for the winter months when their numbers are considerably reduced (Table 7.12).

Of note, a recent tracking study demonstrated movements of the South Georgia white-chinned petrel population to Falkland Islands waters (Frankish, *et al*., 2020b).

Cape petrel (CP)

Cape petrels (*Daption capense*) are non-breeding visitors to Falkland Islands waters from their Antarctic breeding grounds. Although recorded in every season, Cape petrels do not arrive in large numbers until May. Numbers start to decline in September and are virtually absent during the summer months (Table 7.12; White, *et al.,* 2002).

Wilson's storm-petrel (WP)

Wilson's storm-petrels (*Oceanites oceanicus*) are extremely widespread and abundant in the southern hemisphere. The Falklands are thought to support a modest breeding population of something in excess of 5,000 pairs (Woods and Woods, 1997).

Although present throughout the year, numbers of Wilson's storm petrels were greatly reduced during the winter months. In the summer months, high densities of Wilson's storm-petrel were found over the Patagonian Shelf to the north-east of East Falkland, close to the Sea Lion area (White, *et al.,* 2002).

Antarctic fulmar (AF)

Like Cape petrels, Antarctic fulmars (*Fulmarus glacialoides*) are non-breeding visitors to Falkland Islands waters from their Antarctic breeding grounds. Antarctic fulmars were one of the most common species recorded during the winter months but were almost entirely absent during the summer (Table 7.12).

Grey-backed storm-petrel (GBSP)

Like Wilson's storm-petrel, the Falklands support what is thought to be a small breeding population (1,000-5,000 pairs) of grey-backed storm-petrels (*Garrodia nereis*) (Woods and Woods, 1997). During the summer months, high densities of this species were encountered over the shelf break to the north-east of the Islands, which extends close to the Sea Lion area. Although recorded in all seasons, fewer grey-backed storm-petrels were recorded in the winter (Table 7.12).

Grey-backed storm-petrels were the most frequently recorded species feeding in association with patches of free-floating kelp (Gillon, *et al.,* 2001).

Soft-plumaged petrel (SPP)

Soft-plumaged petrels (*Pterodroma mollis*) are regarded as summer and early autumn visitors to Falklands waters (Table 7.12; White, *et al.,* 2002). The nearest breeding location of this species to the Falklands is on the Tristan da Cunha group. Soft-plumaged petrels were one of the few species recorded by White, *et al.* (2002) that showed inter-annual variation in the number of birds recorded within Falklands waters. Like several other species with breeding populations in the Tristan da Cunha group, the majority of soft-plumaged petrels recorded were encountered over oceanic waters to the north-east of the Falklands.

Sooty shearwaters (SS)

The best known and probably largest colony of sooty shearwaters (*Ardenna griseus*) is found on Kidney Island, in the mouth of Berkeley Sound, which is estimated to comprise 139,000 pairs (Wakefield, *et al.,* 2017; Clarke, *et al.,* 2019). Sooty shearwaters are known to breed elsewhere in the Falklands but very little is known about the size and location of many breeding sites. Although present throughout the year, the majority of the breeding population are absent from Falklands waters from April to August (Table 7.12; White, *et al.,* 2002). Generally, the highest densities of sooty shearwaters were recorded over inshore waters, where large flocks raft on waters adjacent to breeding colonies.

Twenty sooty shearwaters were tracked from Kidney Island during the summer months. Results indicate that the birds were largely restricted to the east coast of the Falklands and Burdwood Bank (Figure 7-51 and Figure 7-55). SAST surveys also recorded the highest densities of sooty shearwaters over inshore waters off the east coast of the Islands, but they were also encountered throughout

inshore waters around the Falklands. Sooty shearwaters were present in lower number over the wider Patagonian Shelf (White, *et al.,* 2002).

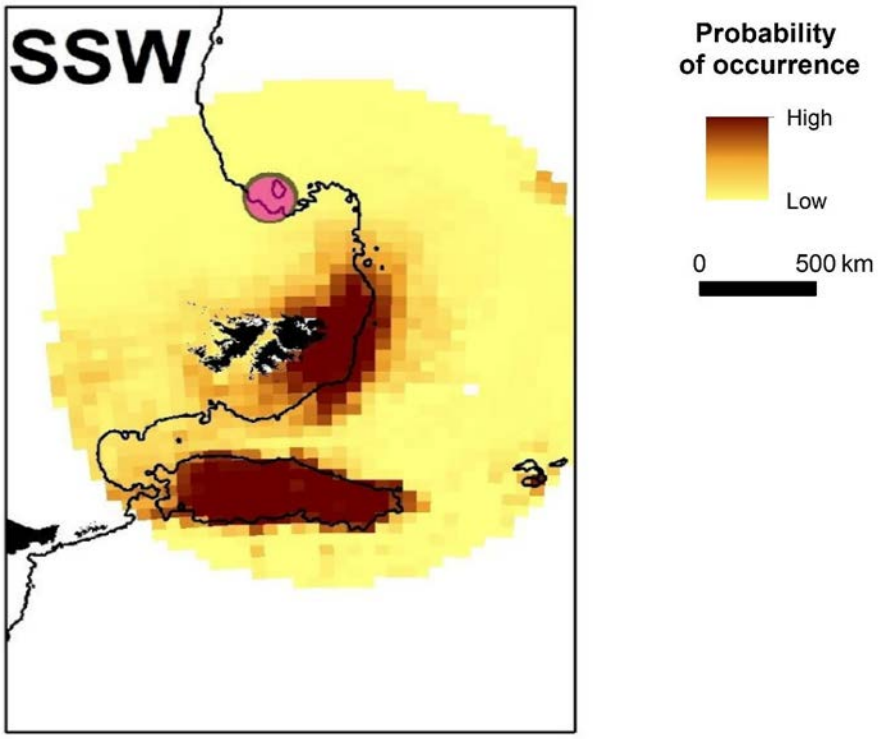


Figure 7-55: Sooty shearwater predicted habitat use (predicted presence) for birds breeding on Kidney Island from the available biotelemetry and biologging data. The pink dot represents the drill centre *(adapted from Baylis et al., 2019a)*

Prion species (Pr)

Several species of prion (*Pachyptila* spp.) are known to frequent Falkland Islands waters. However, they are difficult to identify to species level at-sea and therefore most prions were recorded as 'prion species'. Throughout most of the year, prions are one of the most numerous 'species' encountered within Falklands waters; however, there is a distinct decline in numbers during the autumn (Table 7.12; White, *et al.,* 2002).

Two species of prion breed within the Falkland Islands: thin-billed (*P. belcheri*) and fairy prions (*P. turtur*). The population of thin-billed prions is estimated to comprise approximately two million pairs on New Island alone (Catry, *et al.,* 2003) with other smaller colonies elsewhere in the Islands, making thin-billed prion the most numerous breeding seabird in the Falklands. Fairy prions have a far smaller breeding population at one confirmed breeding site, on Beauchêne Island (Woods and Woods, 1997). In addition, Antarctic prions (*P. desolata*) are likely to visit Falkland Islands waters.

Locally high densities of prions can be found close to the Sea Lion area in the summer months but densities of this 'species' are generally much higher elsewhere within Falklands waters, notably to the west and south-west of the Islands (White, *et al.,* 2002).

Southern (SRA) and Northern royal albatrosses (NRA)

Southern and northern royal albatrosses (*Diomedea epomophora* and *D. sanfordi*) are both non-breeding visitors to the south-west Atlantic from their breeding sites in New Zealand and have been observed in Falkland Island waters (Nicholls, *et al*., 2002; 2005; Bose, *et al*., 2023). They are classified

as Vulnerable and Endangered, respectively, under the IUCN Red List framework. Both species are recorded throughout the year in Falklands waters, with the largest numbers of birds recorded between March and June (Table 7.12; White, *et al.,* 2002). However, southern royal albatross are considerably more numerous than the northern species (White, *et al.,* 2002). During this period, royal albatrosses were found in highest densities over Patagonian Shelf waters to the west of the Falklands. At other times, royal albatrosses appear to disperse throughout Falklands waters.

Southern giant petrels (SGP)

The Falklands support the largest breeding population of southern giant petrels (*Macronectes giganteus*) in the world, with approximately 20,970 breeding pairs (Stanworth and Crofts, 2017) or approximately 40 % of the global population. The presence of white morph birds (white plumaged birds) during the winter months indicates that some birds that breed in higher latitudes move to Falklands waters during the winter (White, *et al.,* 2002).

Southern giant petrels were recorded in all seasons (Table 7.12) and were noted for being extremely persistent followers of vessels. The true density of birds within Falklands waters is likely to have been underestimated as birds in close attendance to fishing vessels were not recorded (White, *et al.,* 2002). This species was not recorded in high numbers in the vicinity of the Sea Lion area but the presence of an oil rig, platform or supply vessels may attract these scavenging birds, and consequently increase their presence in the area.

Magellanic penguin (MP)

Magellanic penguins (*Spheniscus magellanicus*) are regarded as summer breeding visitors to the Falkland Islands, which support approximately 10 % of the global population (Woods and Woods, 1997). During their breeding season, highest densities of Magellanic penguins were recorded in inshore waters but patches of locally high density were also encountered over Patagonian Shelf and shelf-break waters. Following the post-breeding moult, Magellanic penguins migrate northwards in the autumn to over-winter on the northern Patagonian Shelf (Pütz, *et al.,* 2000; Blockley and Tierney, 2017). They do not start to return to the Falklands until September. It is during these migrations that many birds will pass through the NFB.

Sixty-three Magellanic penguins were tracked from six locations during the summer months. The results of the predictive model indicate the presence of this species throughout Patagonian Shelf waters but also an area of relatively high probability of occurrence in shelf-slope waters to the north of the Sea Lion Field (Figure 7-56, Baylis, *et al.,* 2019a). This reflects the data collected during SAST surveys (White, *et al.,* 2002).

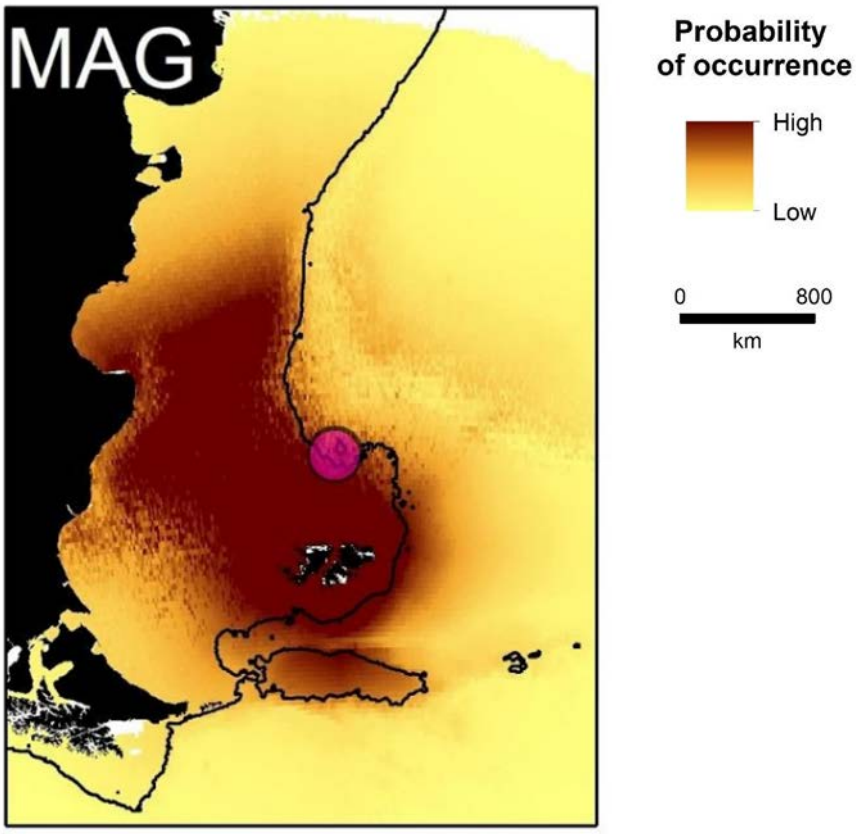


Figure 7-56: Magellanic penguin, predicted habitat use (predicted presence) for birds breeding on the Falklands from the available biotelemetry and biologging data. The pink dot represents the drill centre *(adapted from Baylis, et al., 2019a)*

Grey-headed albatross (GHA)

Grey-headed albatrosses (*Thalassarche chrysostoma*) are non-breeding visitors to Falkland Islands waters (Clay, *et al.,* 2016). The closest breeding populations are on islands off the southern coast of Chile and South Georgia, with approximately 50 % of the global population of this Endangered species breeding on the latter (Poncet, *et al.,* 2017).

The presence of this species within Falklands waters is highly seasonal, with the majority of birds recorded between May and September (White, *et al.,* 2002). During this period, most of the birds recorded were encountered over the shelf-break to the south and east of the Islands (White, *et al.,* 2002).

In addition to being IUCN-Endangered, since 2011 the grey-headed albatross from South Georgia is an ACAP Priority Population (GSGSSI, 2016).

Long-tailed skua (LTS)

Long-tailed skua (*Stercorarius longicaudus*) breed in the Arctic during the boreal summer and spend the non-breeding season in the South Atlantic and South Pacific. The vast majority of birds observed in the vicinity of the Falklands were recorded between December and March (Table 7.12). The Falklands lie towards the southern limit of this species' range, and the majority of sightings were recorded over oceanic and shelf-break waters to the north of the Islands. Like several other non-breeding summer visitors to the Falkland Islands, considerable inter-annual variations in the number of this species were recorded (White, *et al.,* 2002).

Wandering albatross (WA)

Wandering albatrosses (*Diomedea exulans*) are classified globally as Vulnerable under the IUCN Red List and are non-breeding visitors to Falkland Islands waters. The closest breeding site is at South Georgia where the population is in decline, with approximately 1,278 pairs breeding in 2014 / 15 (Poncet, *et al.,* 2017). Indeed, the wandering albatross from South Georgia is considered locally to be Endangered, at high risk from pelagic long-line fisheries (Jiménez, *et al*., 2016) and is an ACAP Priority Population (GSGSSI, 2016). Observations of banded individuals at-sea indicate that a large proportion of the South Georgia population utilise Falklands waters at some point during the year (Croxall, *et al.,* 1999; Otley, *et al.,* 2007; Carneiro, *et al*., 2022).

Wandering albatrosses are found in low numbers throughout the year, primarily over the shelf-break waters surrounding the Falkland Islands. Few birds were recorded in the vicinity of the Sea Lion area (Table 7.12) but it is likely that many birds pass through this area during the course of a year.

Antarctic skua (AS)

The presence of Antarctic skuas (*Stercorarius antarctica*) within the study area is highly seasonal, with the vast majority of birds recorded between November and April (Table 7.12). The density of birds recorded was highest over inshore waters, close to breeding sites. However, locally high densities were encountered at-sea throughout the remainder of the Falklands Conservation Zones (White, *et al.,* 2002).

Atlantic petrel (AtP)

The large breeding population of Atlantic petrels (*Pterodroma incerta*) is restricted almost entirely to Gough Island, in the Tristan da Cunha group, where the population of 1.8 million pairs is in decline due to mouse depredation (BirdLife International, 2015). Atlantic petrel is currently classified as Endangered according to the IUCN Red List.

Although not recorded in the vicinity of the Sea Lion Field, this species will be infrequently present in the area. Atlantic petrels have been recorded in every month but there was a distinct peak in numbers during spring, which corresponds with the post-breeding period of this winter breeding species. Most Atlantic petrels were recorded in oceanic waters to the north-east of the Falklands (White, *et al.,* 2002).

Diving-petrel species (DP)

Two species of diving-petrel (*Pelecanoides species*) are regularly encountered within Falkland Islands waters: common diving-petrel *Pelecanoides urinatrix* and Magellan diving-petrel *P. magellanicus*; Georgian diving-petrel *P. georgicus* has also been recorded. Given reasonable views, Magellan diving-petrels can be readily identified at-sea but the other species are difficult to separate and therefore most birds were recorded as 'diving-petrel species'.

In general, far more diving-petrels are recorded during the spring and summer than during the autumn and winter months. The highest densities of birds were recorded to the west and south of the Falklands (White, *et al.,* 2002). Diving-petrels were only recorded in low numbers in the vicinity of the Sea Lion area (Table 7.12).

Southern rockhopper (RP) and Macaroni penguins (MAC) (R/M)

The Falklands support approximately 40 % of the global population of southern rockhopper penguins (*Eudyptes chrysocome*) (Baylis, *et al.,* 2013b). Outside the breeding and moulting periods, between May and August, these birds were only encountered in low numbers within Falklands waters. During the spring, rockhopper penguins were dispersed throughout Falklands waters (White, *et al.,* 2002), during which time the highest number of birds were recorded in the vicinity of the Sea Lion area (Table 7.12). During the austral summer months, the distribution of rockhopper penguins was linked to the shallower waters of the Patagonian Shelf.

Tracking of rockhopper penguins at several sites around the Falklands during incubation and chick-rearing indicates distinctive patterns of distribution in these two periods. During incubation, birds disperse more widely and are present in the relatively deep waters of the shelf-slope. During chick-rearing, the model predicts that the area of high probability of occurrence is concentrated over the Patagonian Shelf (Figure 7-57). The distribution predicted from the tracking data reflects the distribution pattern recorded during SAST surveys (White, *et al.,* 2002).

During the non-breeding period, rockhopper penguins were tracked to an area of the Brazil – Falklands Confluence Zone, off the coast of northern Argentina (*c.f*. Magellanic penguins; Blockley and Tierney, 2017). It is during the migration between winter grounds and breeding sites (September and October) that many rockhopper penguins breeding on East Falkland pass close to the Sea Lion Field.

During the austral winter months, some macaroni penguins (*E. chrysolophus*) from the breeding population on South Georgia move into the oceanic waters of the Falklands Conservation Zones (White, *et al.,* 2002). These observations are supported by satellite tracking of birds from South Georgia (Ratcliffe, *et al.,* 2014). It was not always possible to be certain of the identity of *Eudyptes* penguins when encountered at-sea and therefore many birds were recorded as rockhopper / macaroni penguins. It is likely that some of these birds were in fact macaroni penguins.

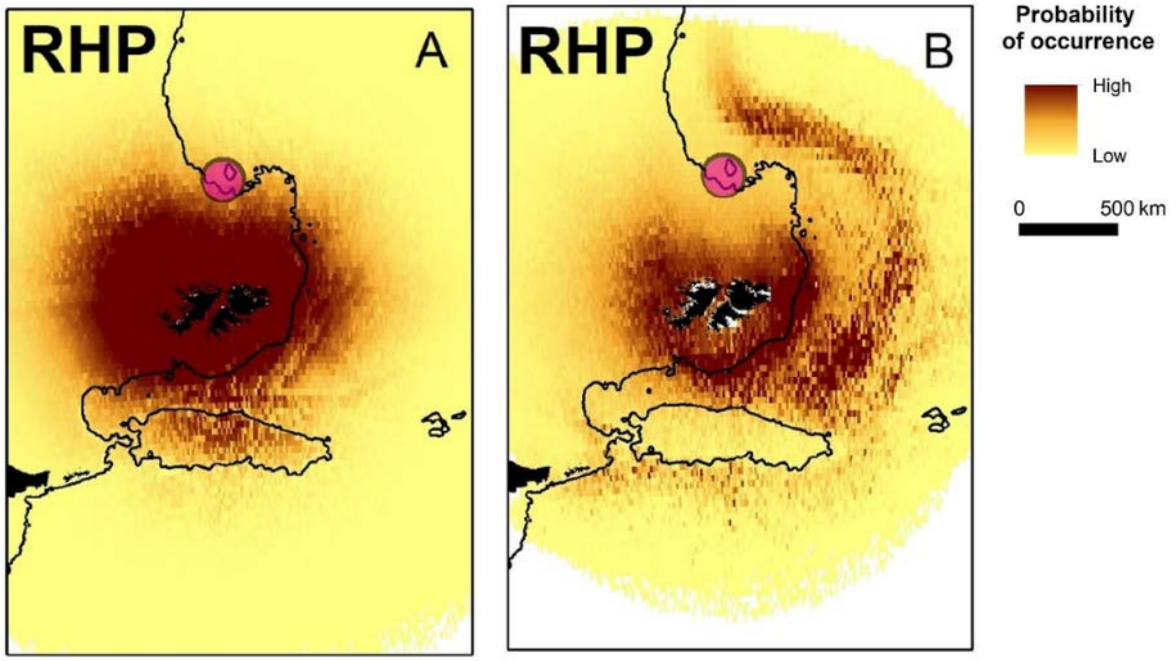


Figure 7-57: Rockhopper penguins, predicted habitat use (predicted presence) for birds breeding on the Falklands from the available biotelemetry and biologging data (A = Chick rearing, B = Incubation). The pink dot represents the drill centre *(adapted from Baylis, et al., 2019a)*

Northern giant petrel (NGP)

Northern giant petrels (*Macronectes halli*) are non-breeding visitors to Falkland Islands waters. The closest breeding sites are found on South Georgia, which supports the world's largest breeding population of this species (15,398 pairs or 71 % of the global population, Poncet, *et al.,* 2019). Satellite tracking during the breeding season indicates that these birds visit the Patagonian Shelf on foraging trips (González-Solís, *et al.,* 2000). Like southern giant petrels, this species was recorded in all months but in lower numbers. During the autumn and winter months, highest densities of this species were

recorded over the Patagonian Shelf. In the spring and summer, birds were dispersed throughout the waters surveyed (White, *et al.,* 2002).

Little shearwater (LS)

Little shearwaters (*Puffinus assimilis*) are rare non-breeding visitors to Falkland Islands waters, the nearest breeding population being found on the Tristan da Cunha group. White *et al.* (2002) only recorded this species during the summer and autumn months with a peak in sightings during March. The majority of records were of birds in the waters to the north of the Islands.

Black-bellied storm-petrel (BBSP)

Black-bellied storm-petrels (*Fregetta tropica*) are non-breeding visitors to Falklands waters. The presence of this species is almost entirely restricted to the summer months, when they are most frequently sighted over oceanic waters to the north of the Islands (White, *et al.,* 2002). Very few birds were recorded in the vicinity of the Sea Lion area (Table 7.12).

Two additional species were recorded during austral winter and spring surveys but not during the austral autumn.

King penguin (KP)

Although there is a small resident breeding population of king penguins (*Aptenodytes patagonicus*) in the Falkland Islands, encounters with king penguins at-sea were highly seasonal. Virtually all of the birds recorded were seen between June and September (White, *et al.,* 2002). The timing of these sightings and the number of birds encountered suggest that many of the king penguins present within Falklands waters originated from South Georgia. This is supported by data from birds tracked from South Georgia in the winter.

Most of the king penguin records within Falklands waters come from oceanic and shelf-break waters to the north of the Islands (White, *et al.,* 2002).

Eight king penguins from Volunteer Point were tracked during the winter. The tracks indicate that for most of the time the birds' activity was concentrated over the shelf-break to the north of the Falklands with some birds travelling further afield, mostly into deep, oceanic waters (Figure 7-50). The predictive model suggests high probability of occurrence over a wider area of the Patagonian Shelf (Figure 7-58).

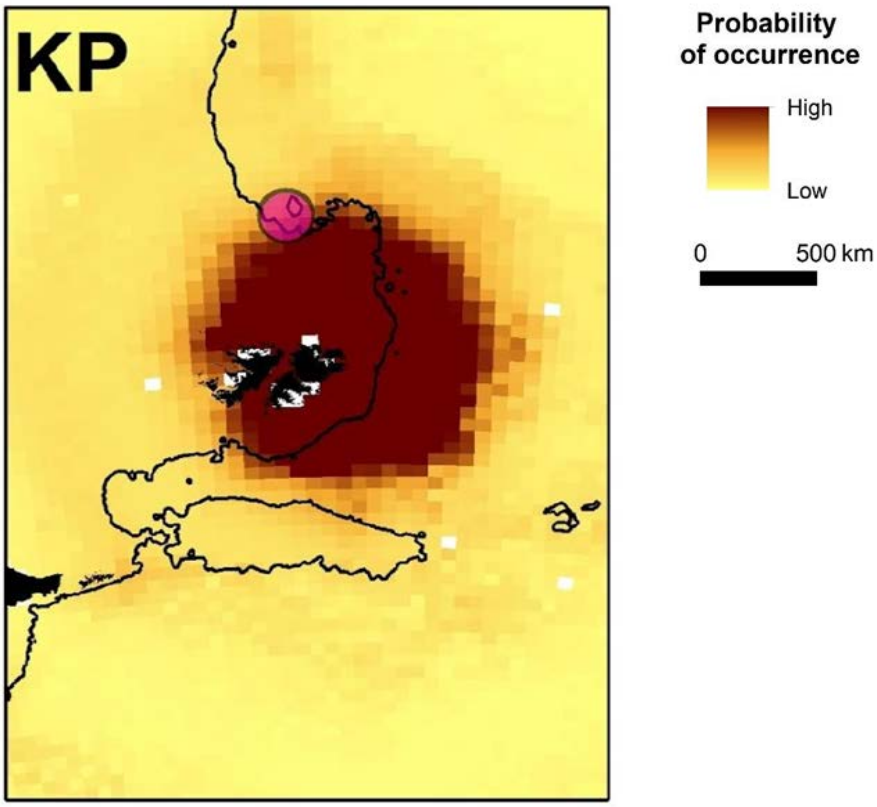


Figure 7-58: King penguin, predicted habitat use (predicted presence) for birds breeding at Volunteer Point from the available biotelemetry and biologging data. The pink dot represents the drill centre *(adapted from Baylis, et al., 2019a)*

Kelp gull (KG)

Kelp gulls (*Larus dominicanus*) are resident breeders in the Falkland Islands. During the austral summer (November to April), kelp gulls are confined to inshore waters. In the austral winter (May to October), kelp gulls were recorded in far higher numbers, but the majority of sightings still occur over inshore waters. However, birds also range much further offshore; it is at this time that they are recorded in the vicinity of the Sea Lion area (Table 7.12).

Gentoo penguin

The Falkland Islands are home to a globally important population of gentoo penguins (*Pygoscelis papua*). Although present throughout the year, returning to shore regularly during the winter, JNCC surveys recorded clear seasonal trends in the distribution of this species. Between December and March, all records were within 100 km of the nearest land, while between April and November gentoo penguins were recorded at greater distance, up to 316 km, from land. However, despite their wider distribution, gentoo penguins were rarely observed in waters greater than 200 m in depth (White, *et al.,* 2002).

Over the winter and early summer periods (June-November), Gentoo penguins tracked during the GAP project typically stayed relatively close to the Falkland Islands, not travelling more than 200 km offshore. However, there was considerable individual variation in foraging trip distances and some individuals traveled further afield, reaching distances of over 450 km, foraging in the north-west of the Islands (Figure 7-59; Blockley and Tierney, 2017). Gentoo penguins were not recorded near the Sea Lion Field.

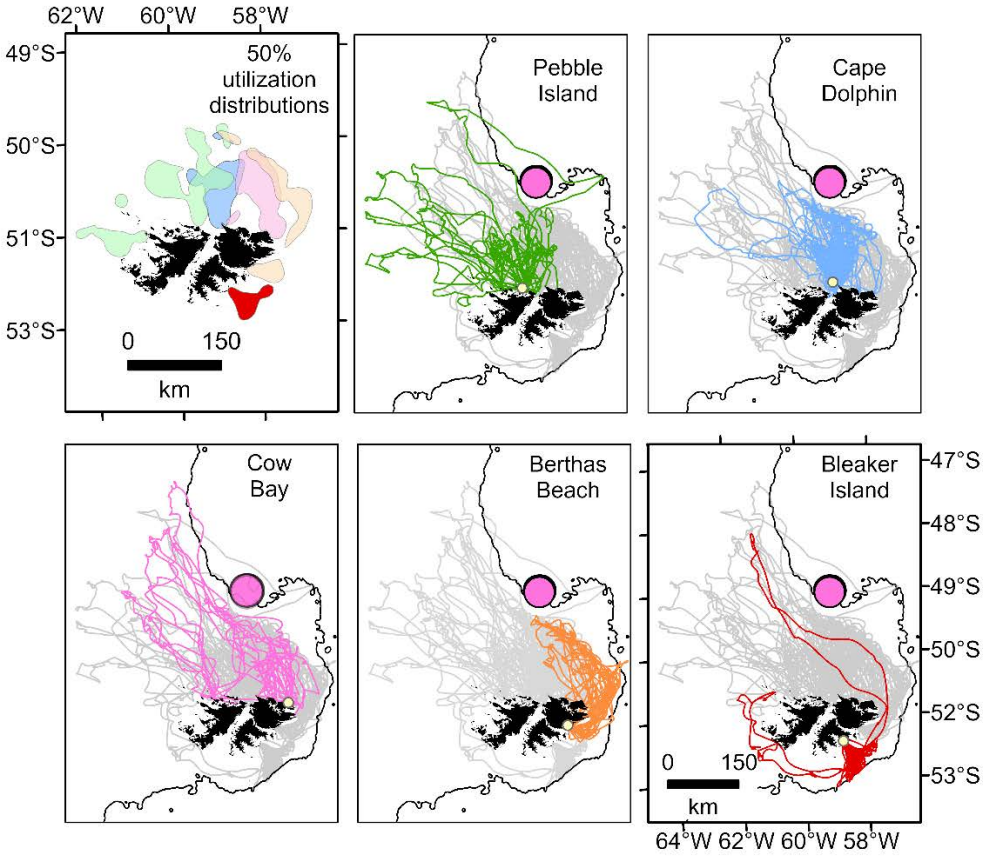


Figure 7-59: The locations of 25 gentoo penguins tracked during the winter and early summer from five locations. Utilisation distributions show areas where penguins spent most (>50 %) of their time (Blockley and Tierney, 2017). The pink dot represents the area of the drill centres *(Source: Baylis, et al., 2021b)*

Kerguelen petrel

Kerguelen petrels (*Aphrodroma brevirostris*) are non-breeding visitors to the waters of the Falkland Islands, with the majority of sightings occurring between May and November (White, *et al.,* 2002). A small population was recently discovered breeding on South Georgia (Black, *et al.,* 2012) but the nearest substantial population is found on Gough Island in the Tristan da Cunha group. Kerguelen petrels can be encountered throughout Falklands waters during the winter months, but they are more frequently seen over offshore / oceanic waters.

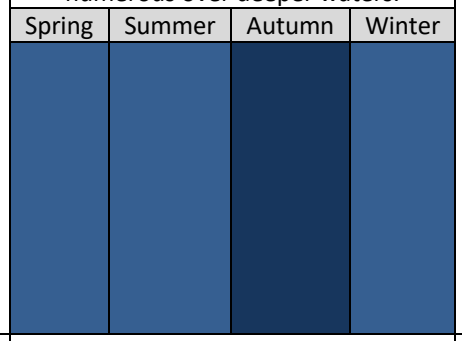
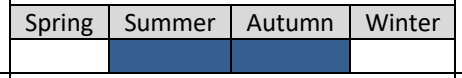
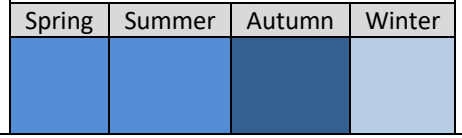
Blue petrel

Like Kerguelen petrels, blue petrels (*Halobeana caerulea*) are seasonal non-breeding visitors to Falklands waters, with the majority of sightings between May and November (White, *et al.,* 2002). This species is rarely encountered over Patagonian Shelf waters, most records come from oceanic waters to the east and south-east of the Islands. The nearest breeding colonies of blue petrels are found on islands off the southern coast of Chile and South Georgia, the origin of birds seen in the Falklands is unknown.

7.4.5.2.3 Summary of offshore bird abundance, distribution, life-cycle and behavioural characteristics

Table 7.17 provides a summary of bird abundance, distribution, life-cycle and behavioural characteristics in the NFB and around the Sea Lion Field.

Table 7.17: Summary of offshore bird abundance, distribution, life-cycle and behavioural characteristics

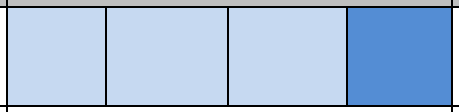
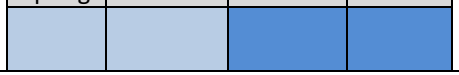
Species	IUCN status	ACAP species[1]	FI priority species[2]	Seasonal occurrence and distribution	Breeding cycle	Feeding mode	Persistent ship associate[3]	Breeding sites	Falklands population	Global population and trend[4]
Black-browed albatross (*Thalassarche melanophris*)	LC	✓[5]	✓	Present year-round in high numbers across the Patagonian Shelf, less numerous over deeper waters. 	Annual breeder. First breeding at 7 yrs. 1 egg laid mid Oct. Chicks fledge Apr/May.	Surface seizing and shallow dives (to *c.* 19 m) from the surface	✓	In the Falklands, 17 breeding sites, very large colonies on Jason Islands and Beauchêne Island, and South Georgia	c. 500,000 pairs. *c.* 75 % global population	700,000 pairs Stable
Great shearwater (*Ardenna gravis*)	LC	X	X	Widespread over waters to the north of the Falklands between Dec – Apr, absent in the winter and spring. Vast majority of birds observed are non-breeders. 	Adults return Sept. 1 egg laid end Oct. Chicks and adults depart late April.	Surface seizing and pursuit diving (to *c.* 20 m)	✓	Kidney Island only known site in the Falklands	20 pairs <0.1 % global population	5 million pairs Stable
White-chinned petrel (*Procellaria aequinoctialis*)	VU	✓	✓	Widespread over shelf and oceanic waters in winter, shallower waters in spring summer. Most birds present are non-breeding visitors. 	Adults return Sept. 1 egg laid Oct/Nov. Chicks and adults depart Apr/May.	Surface seizing and pursuit diving (to *c.* 20 m)	✓	Kidney Island, New Island, Bottom Island, South Georgia	55-100 pairs <0.1 % global population	1.2 million pairs Decreasing

Species	IUCN status	ACAP species[1]	FI priority species[2]	Seasonal occurrence and distribution	Breeding cycle	Feeding mode	Persistent ship associate[3]	Breeding sites	Falklands population	Global population and trend[4]
Cape petrel (*Daption capense*)	LC	X	X	Common winter visitor to Falklands waters, few present in the summer months. Spring / Summer / Autumn / Winter	Single egg laid Nov/Dec. Fledge Feb/Mar.	Surface seizing and shallow dives	✓	Antarctica	Non-breeder	2 million individuals Stable
Wilson's storm-petrel (*Oceanites oceanicus*)	LC	X	X	Present throughout the year but abundance far higher during the summer months. Spring / Summer / Autumn / Winter	Adults return Nov. 1 egg laid Nov-Jan. Chicks fledge Feb/Mar.	Foot paddling (surface seizing)	✓	Rat free tussock islands e.g., Beauchêne and Jason Islands	5,000+ pairs	4 – 10 million pairs Stable
Antarctic fulmar (*Fulmarus glacialoides*)	LC	X	X	Common autumn and winter visitor. Highest densities found over Patagonian Shelf waters but found throughout Falklands waters. Spring / Summer / Autumn / Winter	Single egg laid Nov/Dec. Fledge Mar/Apr.	Surface seizing	✓	Antarctica	Non-breeder	4 million individuals Stable
Grey-backed storm-petrel (*Garrodia nereis*)	LC	X	X	Present throughout the year but abundance highest between Sep – Mar. Spring / Summer / Autumn / Winter	Adults return Oct/Nov. Egg dates Nov/Dec. Fledging Feb/Apr.	Foot paddling (surface seizing)	X	Rat free tussock islands; e.g., Beauchêne and Kidney Islands	1-5,000 pairs	200,000 individuals Decreasing
Soft-plumaged petrel (*Pterodroma mollis*)	LC	X	X	Primarily in deep waters north of the Falkland Islands (Nov–Apr, peak Jan). Spring / Summer / Autumn / Winter	Egg laid Nov/Dec. Fledge May.	Surface seizing and shallow dives	X	Tristan da Cunha, Gough Island	Non-breeder	5 million individuals Stable

Species	IUCN status	ACAP species[1]	FI priority species[2]	Seasonal occurrence and distribution	Breeding cycle	Feeding mode	Persistent ship associate[3]	Breeding sites	Falklands population	Global population and trend[4]
Sooty shearwater (*Ardenna griseus*)	NT	X	✓	Present throughout the year but most of the population depart between Apr – Aug. Spring | Summer | Autumn | Winter	Start breeding at 4 yrs. Adults return Sept. 1 egg laid late Nov. Adults depart Mar. Chicks fledge April.	Surface seizing and pursuit diving (to *c.* 50 m)	X	Tussock islands notably Kidney Island	139,000 pairs 0.1 % global population[5]	20 million individuals (*c.* 4.4 million breeding pairs)[5] Decreasing
Prion species (*Pachyptila* spp.)	LC	X	X	Most numerous 'species' of seabird in Falklands waters, recorded throughout the year. Spring | Summer | Autumn | Winter	Return Sept. Egg dates Oct/Nov. Fledge Feb/Mar.	Picking at the surface on the wing and shallow dives	X	e.g., New Island, Jason Islands	2 million + pairs of thin-billed prion	20+ million pairs Stable
Southern royal albatross (*Diomedea epomophora*)	VU	✓	X	Present throughout the year. Highest density found over Patagonian Shelf north-west of Islands between March and June. Spring | Summer | Autumn | Winter	Biennial breeder. Age at first breeding 6-12 years. Single egg laid Nov/Dec. Fledge Oct to Dec.	Surface seizing	✓	New Zealand	Non-breeder	7,900 pairs Stable
Northern royal albatross (*Diomedea sanfordi*)	EN	✓	X	Present throughout the year. Highest density found over Patagonian Shelf north-west of Islands between March and June. Spring | Summer | Autumn | Winter	Biennial breeder. Mean age at first breeding 8 years. Single egg laid in Nov. Fledging Sept / Oct.	Surface seizing	✓	New Zealand	Non-breeder	17,000 individuals Decreasing

Species	IUCN status	ACAP species[1]	FI priority species[2]	Seasonal occurrence and distribution	Breeding cycle	Feeding mode	Persistent ship associate[3]	Breeding sites	Falklands population	Global population and trend[4]
Southern giant petrel (*Macronectes giganteus*)	LC	✓	✓	Recorded in all months, highest densities March-June over Patagonian Shelf waters, west and south of Falkland Islands. Spring / Summer / Autumn / Winter	Annual breeder. Age at first breeding 5-11 years. Adults return Sept. 1 egg laid Oct/Nov. Chicks fledge Mar.	Surface seizing	✓	38 locations, primarily islands in Falkland Sound	20,970 breeding pairs 41 % global population	50,819 pairs Increasing
Magellanic penguin (*Spheniscus magellanicus*)	LC	X	✓	Majority recorded between Nov and Mar, absent during winter, feeding Patagonian Shelf and shelf break, Argentine coast. Spring / Summer / Autumn / Winter	Adults arrive Sept. 2 eggs laid Oct. Chicks fledge Mar. Adults depart Apr.	Dive to depths of 140 m	X	Over 90 locations on the Falkland Islands	c.140,000 pairs 10 % global population	1.3 million pairs Decreasing
Grey-headed albatross (*Thalassarche chrysostoma*)	EN	✓[6]	X	Present year-round but highest abundance from May to Sept, when found over the shelf edge and deeper waters. Spring / Summer / Autumn / Winter	Biennial breeder. Age at first breeding 12 yrs on South Georgia. Single egg laid in Oct. Fledge Apr/May.	Plunge diving, Surface seizing and surface dives	✓	Southern Chile and South Georgia	Non-breeder	250,000 individuals Decreasing
Wandering albatross (*Diomedea exulans*)	VU	✓[6]	X	Non-breeding visitor present throughout, mostly over waters >200 m in depth. A high proportion of the South Georgia population are recorded within Falklands waters during the course of the year. Spring / Summer / Autumn / Winter	Biennial breeder. Age at first breeding 8+ years. Single egg laid Dec/Jan. Fledge following Dec.	Surface seizing	✓	South Georgia	Non-breeder	6,100 pairs Decreasing

Species	IUCN status	ACAP species[1]	FI priority species[2]	Seasonal occurrence and distribution	Breeding cycle	Feeding mode	Persistent ship associate[3]	Breeding sites	Falklands population	Global population and trend[4]
Atlantic petrel (*Pterodroma incerta*)	EN	X	X	Recorded in all months, majority Oct to Mar during post-breeding dispersal. Most numerous over deep waters to north-east, and south-east.	Single egg laid Jun/Jul.	Surface seizing and shallow dives	X	Tristan da Cunha, Gough Island	Non-breeder	1.8 million pairs Decreasing
Diving-petrel species (*Pelecanoides* spp.)	LC	X	X	Present in all months, greater number between Sept and Feb to the west of the Falklands.	Returns Sept. Egg date Oct.	Pursuit diving to *c.* 60 m	X	Tussock Islands, e.g., Beauchêne Kidney and Jason Islands	5-10,000 pairs	16 + million individuals
Northern giant petrel (*Macronectes halli*)	LC	✓	X	Recorded in all months with slightly higher density recorded from March to August, over Patagonian Shelf waters.	Annual breeder. Age at first breeding 4-11 years. Single egg laid Aug to Oct. Fledge Mar/Apr.	Surface seizing Persistent ship associate	✓	South Georgia	Non-breeder	21,682 pairs Increasing
Rockhopper penguin (*Eudyptes chrysocome*)	VU	X	✓	Winter foraging between Straits of Magellan and 39°N (1,400km).	Mating Oct 2 eggs laid mid Nov Chicks fledge Mar Adults depart April	Pursuit diving to *c.* 100 m	X	Primarily outer islands of West Falkland	320,000 pairs 36 % global population	1.23 million pairs Decreasing
	LC	X	X	May-June migrate south of Polar Front.	12 month - Mating Oct		X	Primarily Volunteer	<1,000 pairs 0.04 %	2 million pairs

Species	IUCN status	ACAP species[1]	FI priority species[2]	Seasonal occurrence and distribution	Breeding cycle	Feeding mode	Persistent ship associate[3]	Breeding sites	Falklands population	Global population and trend[4]
King penguin (*Aptenodytes patagonicus*)					1 egg laid Nov-Mar 55 day incubation	Pursuit diving to *c.* 350 m		Point in the Falklands	global population	Increasing
Gentoo penguin (*Pygoscelis papua*)	LC	X	✓	Resident, primarily within 10 km up to 300 km in winter. Spring Summer Autumn Winter 	Nest building Sept 1-2 eggs laid late Oct 34 day incubation	Pursuit diving to *c.* 100 m	X	79 locations throughout the Falklands	121,500 pairs, 34 % global population	387,000 pairs Stable

[1] See Section 7.4.5.5.2

[2] See Section 7.5.3

[3] Indicates species that are attracted to vessels, as a potential source of food, and can form large flocks in the wake of ships.

[4] From BirdLife International, 2024.

[5] **Post-consultation footnote (July 2025):** the global population of sooty shearwaters is now recorded as 8.8 million mature individuals such that the stable Falkland Islands population, as a percentage of the global population, is estimated to be 3.2 % (BirdLife International, 2025).

[6] Note that the South Georgia Population is an ACAP Priority Population.

Key: Relative abundance of seabirds within Falklands waters

Not recorded	Low	Moderate	High	Very High

(Source: Woods, 1988; Nicholls, et al., 2002; White, et al., 2002; Nicholls, et al., 2005; Reid and Huin, 2005; Reid, et al., 2007; FIG, 2008a; Baylis, 2012; Wolfaardt., 2012; Clay, et al., 2016; GSGSSI, 2016; Poncet, et al., 2017; Stanworth and Crofts, 2017; Poncet, et al., 2019; BirdLife International, 2020a; Carneiro, et al., 2022; Bose, et al., 2023, Frankish et al., 2020a, Frankish et al., 2020b and Phillips et al., 2023, Otley et al., 2006)

7.4.5.3 Birdlife of Berkeley Sound

Although the largest seabird colonies in the Falklands are found on offshore islands in the south and west of the Falklands archipelago, the area of Berkeley Sound does support some significant colonies of seabirds; particularly sooty shearwater, white-chinned petrel, rockhopper, gentoo and king penguins (see Section 7.5.2.3.1.1).

Total island-wide censuses have been undertaken by Falklands Conservation for a number of seabird species including gentoo (Baylis, *et al.,* 2013a), rockhopper (Baylis, *et al.,* 2013b), macaroni and king penguins (Pistorius, *et al.,* 2012), black-browed albatross (*Thalassarche melanophris*; Baylis, 2012), southern giant petrel (*Macronectes giganteus*; Reid and Huin, 2005), and white-chinned petrel (Reid, *et al.,* 2007). A small number of colonies are monitored annually as part of Falklands Conservation's Seabird Monitoring Programme (e.g., Crofts and Stanworth, 2017). The results of this work provide vital baseline data and help to put the importance of Berkeley Sound colonies into the context of the wider Falkland Islands.

This section provides a summary of the distribution of birds in Berkeley Sound (and adjacent waters), their abundance, distribution, feeding and breeding ecology and sensitivities.

7.4.5.3.1 Seabird distribution and abundance surveys

Data from numerous surveys and studies have been used to identify the distribution of birds in Berkeley Sound. The surveys include:

- Four seasonal coastal bird surveys carried out between 2016 and 2019 by SAERI (SMSG and SAERI, 2016; SAERI, 2019),
- The JNCC SAST data, each trip commenced from Stanley and therefore significant effort was directed at coastal waters adjacent to Berkeley Sound,
- Satellite tracking of penguin species, and
- Annual Seabird Monitoring Programme carried out by Falklands Conservation.

The relevant results from the above are summarised below with the data collated into species-specific summaries in Section 7.4.5.3.2.

7.4.5.3.1.1 Berkeley Sound coastal bird survey, summer 2016

Under contract to POEPL, the South Atlantic Environmental Research Institute (SAERI), conducted a series of seasonal coastal bird surveys summer 2016, winter 2017, spring 2018 and autumn 2019 to determine the distribution of potentially sensitive receptors around the Berkeley Sound coast. The methodology used during the 2016 coastal bird survey was adapted from that described in Tabak *et al.* (2015) and Neely (2010). The aim of each survey was to record the distribution of birds and marine mammals along the entire coastline of Berkeley Sound. In order to achieve this, two approaches were taken: one land-based and one boat-based. These two approaches were required to obtain the best available coverage given issues of boat access and steep terrain (as cliffs are difficult to survey from land). Land and boat surveys both recorded all birds and marine mammals sighted within a strip transect, which extended 100 m seaward and 25 m landward of the high tide line. The distribution of survey effort achieved in each survey is shown in Figure 7-60.

Berkeley Sound contains a wide range of habitat types; from rat free tussock islands, exposed rocky coasts, cliffs, gently sloping farmland, sheltered bays and mud flats. As is supported by this survey, each habitat type is expected to support a distinct assemblage of birds. The distribution of all birds recorded in each survey is shown in Figure 7-61. The results of these surveys indicate that there are clear differences in the species and abundance of birds found along the coasts of the outer and inner Sounds. The outer Sound is numerically dominated by imperial shag, rock shag, rockhopper and gentoo

penguins in the spring and summer. During the winter and autumn surveys the coasts of the outer Sound supported relatively few birds. The inner Sound supported lower numbers of birds but a greater diversity of species, which was numerically dominated by Falkland steamer duck, rock shag, kelp gull, Magellanic penguin and upland goose. The distribution of individual species are described in Section 7.4.5.3.2.

The species and number of individuals recorded during the survey are shown in Table 7.18.

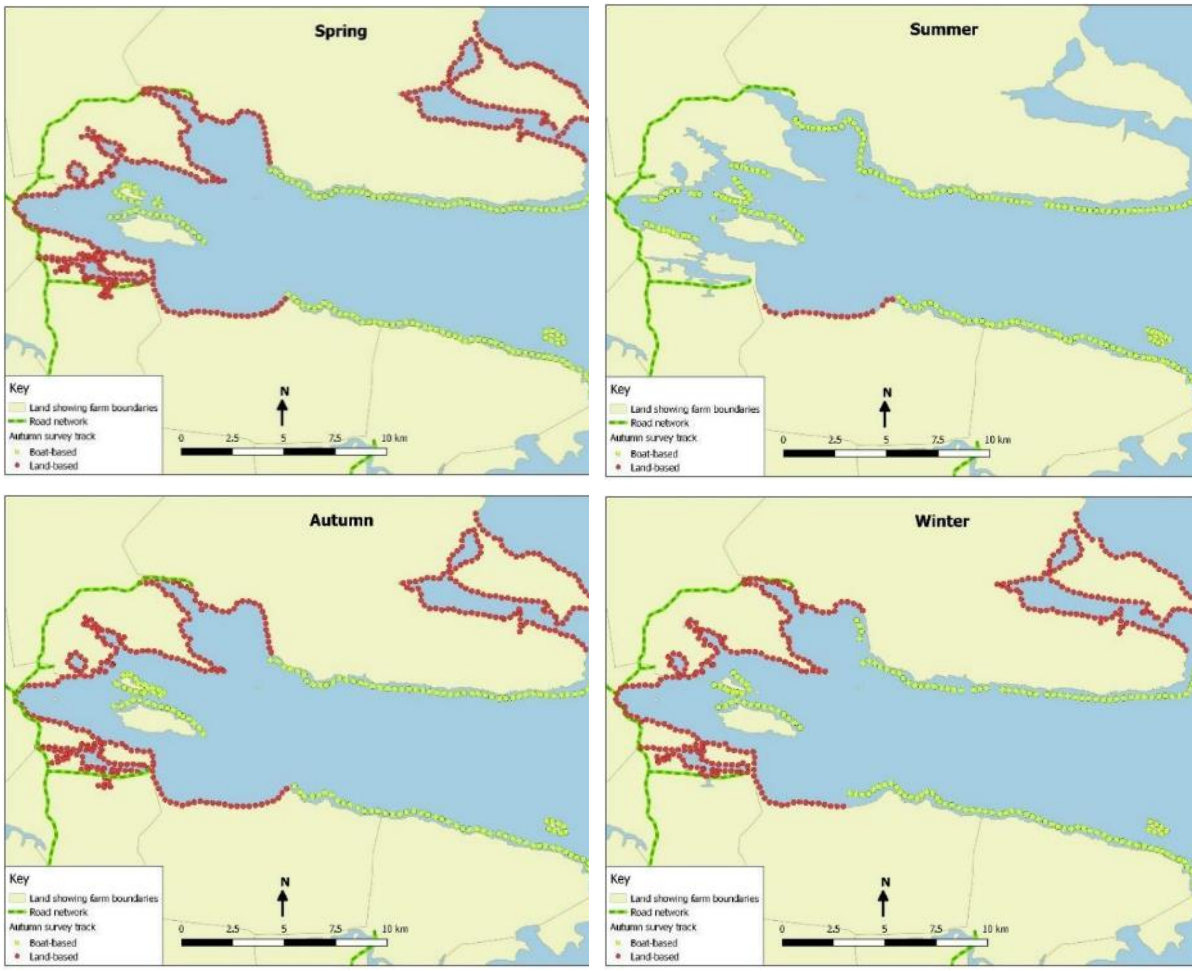


Figure 7-60: Distribution of coastal bird survey effort achieved in each season

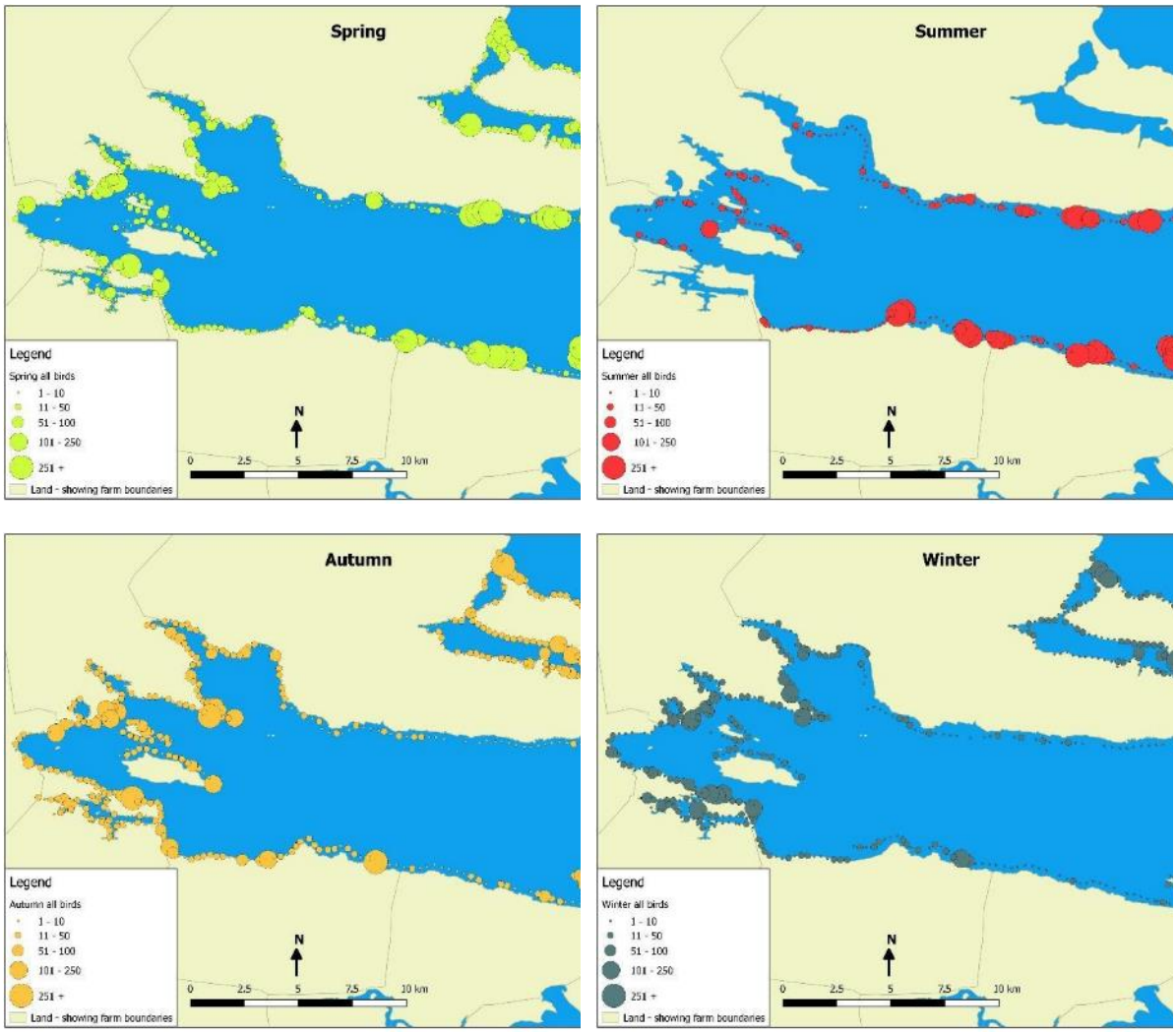


Figure 7-61: The distribution of all bird records in each season

Table 7.18: Summary of the number of individuals of each bird species recorded by season

Common name	Scientific name	Spring	Summer	Autumn	Winter	Total
Rockhopper penguin	*Eudyptes chrysocome*	6,018	2,773	2	0	8,793
Rock shag	*Leucocarbo magellanicus*	1,523	1,670	2,720	1,695	7,608
Imperial shag	*Leucocarbo atriceps*	1,350	4,457	567	396	6,770
Falkland steamer duck	*Tachyeres brachydactyla*	1,583	485	1,700	2,006	5,774
Gentoo penguin	*Pygoscelis papua*	417	1,700	1,005	939	4,061
Kelp gull	*Larus dominicanus*	934	342	1,829	776	3,881
Upland goose	*Chloephaga picta*	496	109	794	603	2,002
Two-banded plover	*Charadrius falklandicus*	214	0	769	995	1,978
Kelp goose	*Chloephaga hybrida*	568	142	668	528	1,906
Patagonian crested duck	*Lophonetta specularoides*	500	21	701	555	1,777
Magellanic oystercatcher	*Haematopus leucopodus*	368	7	603	359	1,337
Magellanic penguin	*Spheniscus magellanicus*	733	465	3	0	1,201
White-rumped sandpiper	*Calidris fuscicollis*	1,030	0	0	0	1,030
Sheathbill	*Chionis albus*	185	0	364	425	974

Common name	Scientific name	Spring	Summer	Autumn	Winter	Total
Giant petrel species	*Macronectes* spp.	153	32	474	152	811
Dolphin gull	*Larus scoresbii*	227	20	267	223	737
King penguin	*Aptenodytes patagonicus*	511	0	29	150	690
Brown-hooded gull	*Larus maculipennis*	425	0	70	50	545
Speckled teal	*Anas flavirostris*	39	0	350	131	520
Dark-faced ground-tyrant	*Muscisaxicola maclovianus*	54	7	323	133	517
Blackish oystercatcher	*Haematopus ater*	103	21	162	99	385
Turkey vulture	*Cathartes aura*	90	14	176	52	332
Long-tailed meadow lark	*Sturnella loyca*	66	2	150	103	321
Black-throated finch	*Melanodera melanodera*	31	0	216	67	314
Falklands thrush	*Turdus falklandii*	75	5	117	74	271
Ruddy-headed goose	*Chloephaga rubidiceps*	52	12	86	117	267
South American tern	*Sterna hirundinacea*	219	0	0	0	219
Rufous-chested dotterel	*Charadrius modestus*	0	0	45	59	104
Falkland pipit	*Anthus correndera*	33	0	31	23	87
White-tufted grebe	*Rollandia rolland*	8	0	51	21	80
South American tern	*Sterna hirundinacea*	0	76	0	0	76
Dark-crowned night heron	*Nycticorax nycticorax*	26	5	29	8	68
Tussac bird	*Cinclodes antarcticus*	4	30	1	5	40
Sooty shearwater	*Ardenna griseus*	27a	1a	0	0	28
Crested caracara	*Caracara plancus*	2	0	24	0	26
Black-chinned siskin	*Spinus barbatus*	6	0	13	0	19
Antarctic skua	*Catharacta antarctica*	3	12	0	0	15
Silver teal	*Anas versicolor*	0	0	12	1	13
Red-backed hawk	*Buteo polyosoma*	1	0	3	4	8
Grass wren	*Cistothorus platensis*	1	0	0	5	6
Cobb's wren	*Troglodytes aedon*	0	4	0	0	4
Yellow-billed pintail	*Anas georgica*	0	0	4	0	4
Chiloe widgeon	*Anas silbilatrix*	3	0	0	0	3
Peregrine falcon	*Falco peregrinus*	3	0	0	0	3
Least seed snipe	*Thinocorus rumicivorus*	0	0	2	0	2
Wilson's storm-petrel	*Oceanites oceanicus*	0	0	2	0	2
White-chinned petrel	*Procellaria aequinoctialis*	0	0	1	1	2
Antarctic fulmar	*Glacialoides antarctica*	0	0	0	1	1
House sparrow	*Passer domesticus*	1	0	0	0	1
Magellanic snipe	*Gallinago magellanica*	0	0	1	0	1
Sanderling	*Calidris alba*	0	0	1	0	1

JNCC SAST surveys

JNCC SAST surveys started and ended in Stanley and therefore contribute to our knowledge of seabird and marine mammal distributions over inshore waters near Berkeley Sound.

In total, over 2,688 km of survey track were observed, within the area shown in Figure 7-62, over the seven year life of SAST surveys. Each observation made is linked to one of the point locations shown

in Figure 7-62, which each represent approximately 3 km of survey track. Effort was spread across all months with a high of 329 km achieved in July and a low of 152 km in May.

Over 26,800 seabirds were recorded within the area adjacent to Berkeley Sound, seasonal relative abundance for all the species recorded is shown in Table 7.19.

Many of the species recorded displayed clear temporal and spatial patterns of distribution, which are described below.

The majority of the most numerous species shown in Table 7.19 are Falkland Islands breeding species but some abundant visiting species; include great shearwaters (*Puffinus gravis*), Antarctic fulmars and Cape petrel, also feature. From a conservation perspective, some of the most significant species are those covered under the Agreement for the Conservation of Albatrosses and Petrels (ACAP) (Section 7.4.5.3.2). Eight ACAP species were recorded; black-browed albatross, southern giant petrel, white-chinned petrel, northern giant petrel, southern royal albatross, grey-headed albatross, wandering albatross and northern royal albatross.

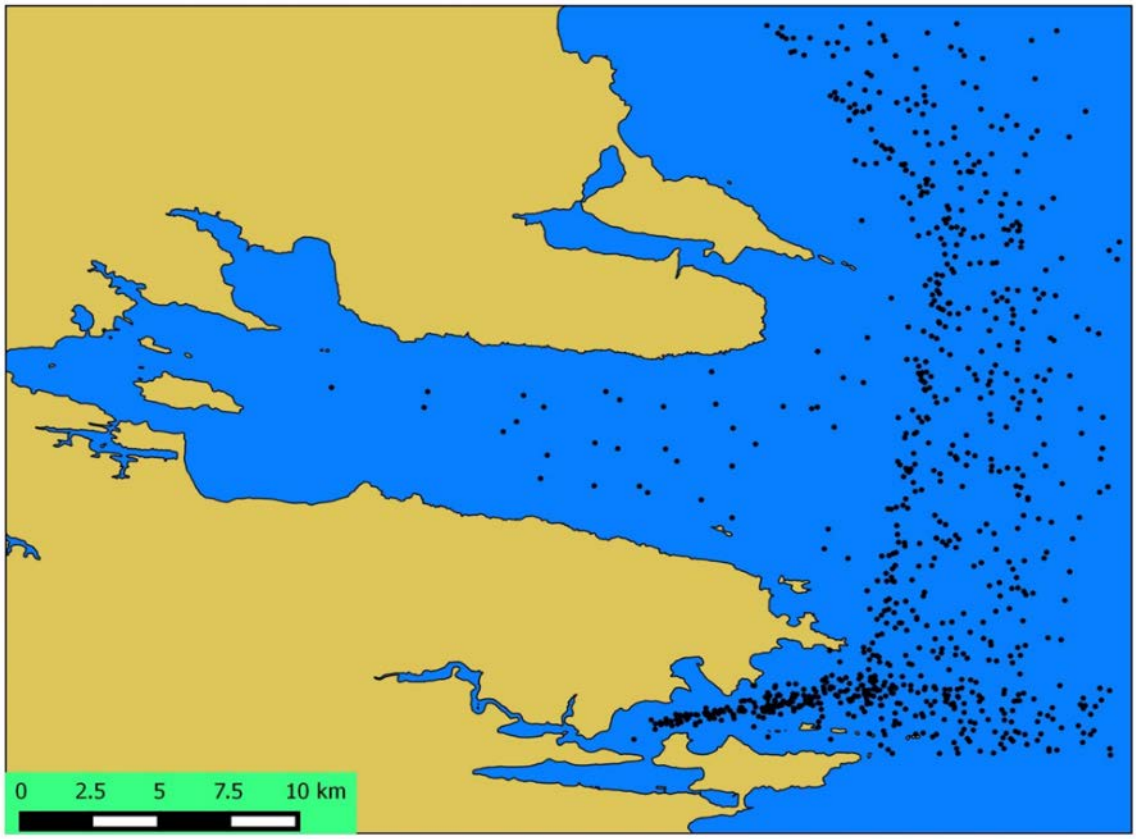


Figure 7-62: Total survey effort achieved during JNCC surveys in coastal waters near Berkeley Sound, each point represents a 10-minute observation period (or approximately three km of survey track)

Table 7.19: Relative seasonal abundance of seabirds recorded in the waters adjacent to and within Berkeley Sound during JNCC surveys (JNCC data) [1,2]

Rank	Autumn (M,A,M)		Winter (J,J,A)		Spring (S,O,N)		Summer (D,J,F)	
	Species[3]	Birds/ km	Species[3]	Birds/ km	Species[3]	Birds/ km	Species[3]	Birds/ km
1	IS	2.994	IS	2.220	SS	10.177	MP	4.131
2	SS	2.482	BBA	0.294	IS	2.830	SS	3.936
3	BBA	0.968	AF	0.234	MP	0.870	IS	1.419
4	MP	0.691	KG	0.221	BBA	0.536	BBA	1.279
5	GS	0.665	RS	0.184	AF	0.184	RP	0.424
6	FFSD	0.554	GP	0.102	WP	0.174	WP	0.265
7	GP	0.458	SGP	0.099	KG	0.148	SAT	0.255
8	AF	0.194	FFSD	0.085	SAT	0.095	KG	0.247
9	WCP	0.151	SS	0.045	GP	0.071	WCP	0.242
10	KG	0.146	CP	0.038	SGP	0.068	FFSD	0.236
11	SGP	0.128	NGP	0.011	CP	0.053	GS	0.219
12	SAT	0.118	MP	0.010	DP	0.052	GP	0.159
13	CP	0.050	DG	0.009	RS	0.050	SGP	0.098
14	RP	0.036	BHG	0.008	WCP	0.044	Pr	0.092
15	AS	0.036	GHA	0.003	RP	0.029	AS	0.038
16	RS	0.029	KeP	0.003	AS	0.014	SRA	0.033
17	NGP	0.014	Pr	0.002	DG	0.012	RS	0.031
18	DP	0.012	MDP	0.002	NGP	0.010	DP	0.015
19	GHA	0.009	WP	0.001	FFSD	0.005	NGP	0.013
20	Pr	0.007	RP	0.001	GS	0.005	BHG	0.013
21	DG	0.005	DP	0.001	BHG	0.004	AF	0.012
22	BHG	0.005	SRA	0.001	MDP	0.004	CP	0.006
23	SRA	0.004	WA	0.001	GBSP	0.004	DG	0.002
24	LTS	0.004	BP	0.001	SRA	0.001	MDP	0.002
25	KeP	0.002			NRA	0.001	WA	0.002
26	WA	0.002			BP	0.001	SPP	0.002
27	NRA	0.002						
28	SPP	0.002						

[1] Survey effort: Autumn 561.2 km, Winter 870.7 km, Spring 735.4 km, Summer 521.4 km

[2] Highlights in shades of blue indicate relatively Very High, High, Medium and Low abundance

[3] The species names relating to the species codes are found in the species accounts subheaders in Section 7.4.5.3.2 and in Appendix 1.

7.4.5.3.1.2 Falklands Conservation annual monitoring programme

On behalf of the Falkland Islands Government, Falklands Conservation undertake an annual Seabird Monitoring Programme across the Falkland Islands and currently monitor gentoo penguins at 11 breeding sites (16 colonies), Magellanic penguins at one site (single colony) and rockhopper penguins at five sites (13 colonies). King penguins and black-browed albatross are monitored at single but key sites in terms of colony size, in relation to the Falklands population, southern giant petrels are monitored at one site (three colonies), imperial shag at three sites and brown skua at one site (Crofts and Stanworth, 2019). Data from these monitoring sites give information on the breeding success and population trends over a number of years, indicating the current status of the populations.

Within Berkeley Sound, three rockhopper colonies on the north coast of the Sound (Diamond Cove, Rugged Hill and Eagle Hill; Figure 7-63) are monitored annually (Crofts and Stanworth, 2018). Island wide-censuses were undertaken every five years until 2010, but no subsequent island-wide census has occured since 2010. Gentoo and king penguins are monitored annually at Volunteer Point (Figure 7-63). In recent years, monitoring has commenced at the imperial shag colony at Rugged Hill.

The number of pairs of seabirds breeding at each of these colonies is compared with the Falkland Islands population as a whole in Table 7.20. Annual monitoring at selected sites by Falklands Conservation has recorded high variability in the number of breeding pairs and breeding success in gentoo and rockhopper penguins between and within monitored sites (Crofts and Stanworth, 2019). However, monitoring during the 2016 / 17 breeding season recorded dramatic reductions in the number of breeding pairs of gentoo and rockhopper penguins recorded across virtually all sites (declines of 35 % and 31 % respectively since 2015), including those in Berkeley Sound. There is some evidence that food availability has been poor in the 2015/16 season, evident from below average breeding success and starvation in moulting adult penguins (Crofts and Stanworth, 2017). Seabirds in poor physical condition are likely to defer breeding, which may account for the apparent crash in the breeding populations. However, adult mortality may also be a contributing factor. Local factors such as food supply or stochastic events, such as toxic algal blooms, can have dramatic influence at a regional level within the Falklands archipelago. However, the archipelago wide decline in the number of breeding birds hints at a more significant environmental perturbation. There is evidence that the seawater temperature around the Falklands was lower than usual in 2016 (Crofts and Stanworth, 2017), which may have resulted in reduced food availability to adults preparing to moult in early 2016 and breed in 2016 / 17. The most recent 2022 census indicates that rockhopper and gentoo penguin breeding pairs have not recovered from the decline in breeding pairs reported in 2015/16 – although there is considerable variability in the number of breeding pairs over time (Kuepfer and Stanworth, 2023).

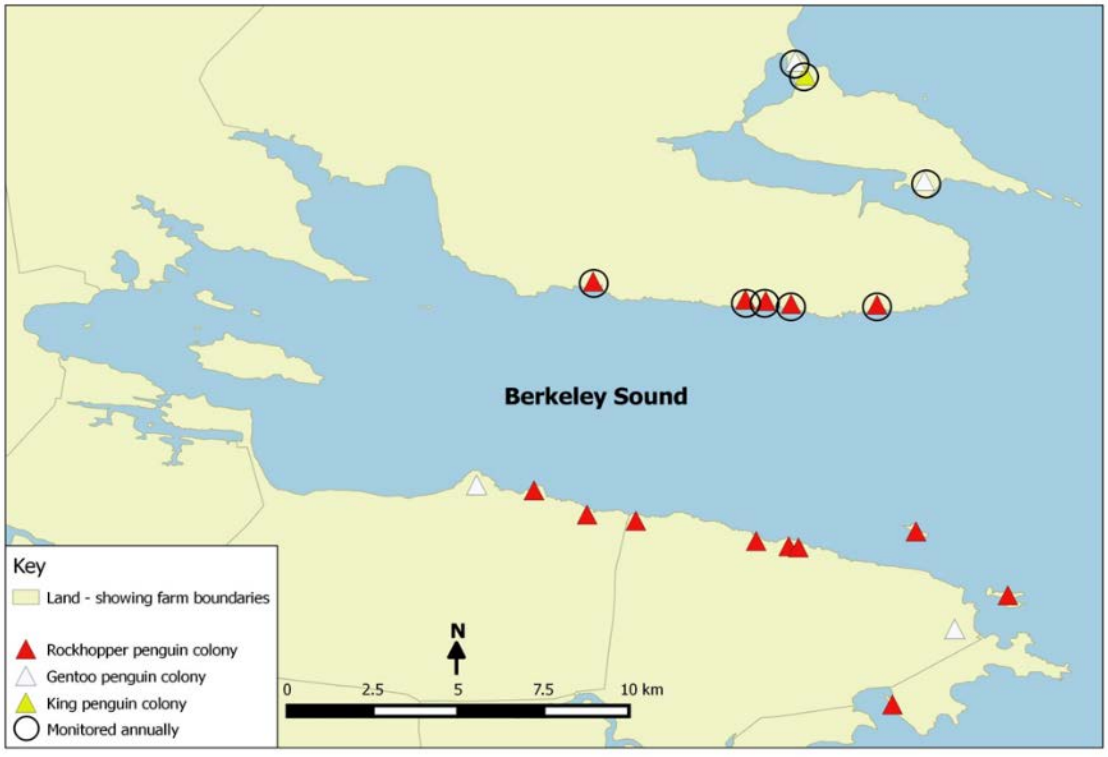


Figure 7-63: Locations of penguin colonies within Berkeley Sound

Table 7.20: The size of seabird colonies within Berkeley Sound[1,2]

Colony	Annual monitoring site	2010 count (pairs)	2022 count (pairs)	2010 FI population (pairs)	2010 % of FI population	Long-term population trend (since 1995)	Short-term population trend (since 2010)
Gentoo penguin[2]							
Cow Bay	✓	1,599	1,620	132,321 + 2,015	1.21	↑	↓[3]
Volunteer Point	✓	3,529	1,920		2.67	↔	↔
Strike-off Point	X	146			0.11	↔	Unknown
Kidney Cove	X	1,227			0.93	↓	Unknown
BS Gentoo total	-	6,501			4.9	↑	Unknown
Rockhopper penguin[4]							
BS north coast	✓	2,648	2,409	319,163 + 18,503	0.83	↔	↔
Diamond Cove	✓	167	108		0.05	↔	↔
BS south coast	X	2,131			0.67	↔	Unknown
Cochon Island	X	552			0.17	↑	Unknown
Kidney Island	X	297			0.09	↑	Unknown
BS Rockhopper total	-	5,795			1.8	↔	Unknown
King penguin[5]							
Volunteer Point	✓	c. 720 chicks	c. 940 chicks	c. 720 chicks	c.100 %	↑	↔
Imperial shag[5]							
Eagle Hill	✓	283 nests	Approx. 550 (Eagle Hill (*c.* 350) + Rugged Hill (*c.* 200)	Unknown	Unknown	Unknown	Unknown
Southern giant petrel[6]							
Volunteer Lagoon	X	9 (2004 count)		19,810 (2004 count)	0.045	Unknown	Unknown

[1] Kuepfer and Stanworth, 2023.
[2] The table shows the long-term trend (1995-2022) and short-term trend (2010-2022). The 2010 versus 2022 counts, may appear to contradict the population trend in the table (stable, increase or decline). However, comparing two years (e.g., 2010 versus 2022), is not the same as a trend over time (e.g., 12 years between 2010 and 2022).
[3] Short-term decline due to a dramatic crash in the number of breeding pairs since 2015 (Crofts and Stanworth, 2019), prior to 2015 the number of breeding pairs was increasing.
[4] Baylis, 2012.
[5] Stanworth, 2014.
[6] Reid and Huin, 2005.

7.4.5.3.1.3 Bird distribution data gaps and limitations

Coastal bird surveys have been conducted on a seasonal basis, which gives an indication of seasonal changes in bird presence and abundance. However, additional surveys would give greater confidence in the results and help to determine inter-annual variation in bird distribution.

There are a number of advantages and disadvantages associated with each of the survey methods described above. However, when interest is focused on a relatively small area; such as Berkeley Sound, it is likely that visual surveys along fixed transects will provide the most useful data for future monitoring. Nonetheless, further survey work is required to better understand baseline bird distributions within the Sound.

7.4.5.3.2 Species-specific distribution and abundance

The following collates the data from the surveys above to provide a species-specific summary of the distribution and abundance of the most significant bird species encountered within Berkeley Sound. A summary of the abundance, distribution, life-cycle and behavioral characteristics is provided in Section 7.4.5.3.3.

Southern rockhopper penguin (RP)

In total, 8,793 rockhopper penguins were recorded during the course of all four coastal bird surveys, making this the most numerous species recorded during the project. Points of high density were associated with known colonies on the coasts of the outer Sound, Cochon and Kidney Islands. Few rockhopper penguins were recorded in the inner Sound (Figure 7-64).

During the spring, far more rockhopper penguins were recorded than at any other time (Table 7.18 above). The summer survey coincided with the start of the moult period in this species and adult birds were congregating in colonies ashore but it was thought that many were still at-sea.

Very few rockhopper penguins were recorded during the autumn survey and none was recorded in the winter survey.

Satellite tags have been deployed on rockhopper penguins breeding at a number of colonies around the Falklands, including two on the south side of Berkeley Sound. The tracks obtained indicate that birds breeding in Berkeley Sound tend to forage over the shelf and shelf-slope to the north of the Falklands (Pütz, *et al.,* 2003). However, trip length (and range) may vary throughout the breeding season, depending on the energy demands of chicks and adults. Nevertheless, rockhopper penguins breeding within Berkeley Sound will be departing from and returning to their colonies throughout the breeding season and are therefore potentially at risk over this entire period.

The GAP project fitted rockhopper penguins from Berkeley Sound with geolocators over the winter period. The results indicate that these birds depart from Falklands waters and overwinter off the coast of South America (Blockley and Tierney, 2017).

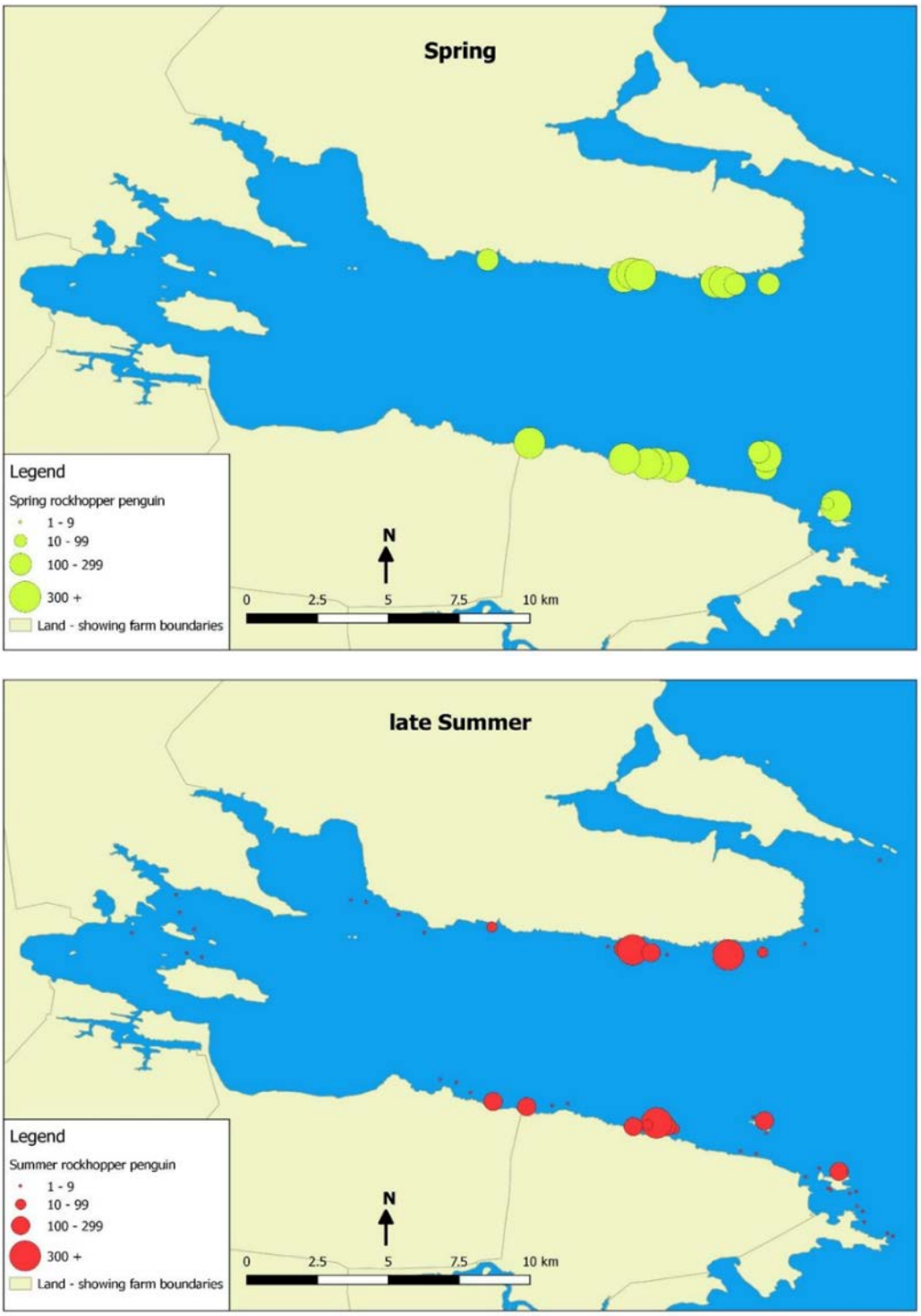


Figure 7-64: Distribution of rockhopper penguins recorded during coastal bird surveys (Note: very few rockhopper penguins were recorded in the autumn survey and none in the winter)

Rock shag (RS)

Rock shags were the second most numerous species recorded during the coastal bird survey project, with 7,608 birds recorded (Table 7.18). The distribution of rock shag records from each survey is illustrated in Figure 7-65. Although recorded throughout the areas surveyed, rock shags show seasonal shifts in distribution. In spring and summer, more rock shags were recorded in the outer than the inner

Sound. In the autumn, rock shags apparently disperse and relatively fewer were recorded in the outer Sound. During the winter, the number of rock shags present in the outer Sound was greatly reduced. Of note, a stretch of cliff on the south coast of the outer Sound supported higher numbers than elsewhere (Figure 7-65).

Rock shags have a coastal distribution and were infrequently recorded during JNCC surveys, which were rarely conducted within this species' range. Tracking in Argentina suggests that this species forages in water less than 10 m in depth, with a gravelly sand bottom within 5 km of the colony (Birdlife International, 2020b). Although there is likely to be some inter colony differences in foraging range, all the available evidence suggests that rock shags are restricted to coastal waters.

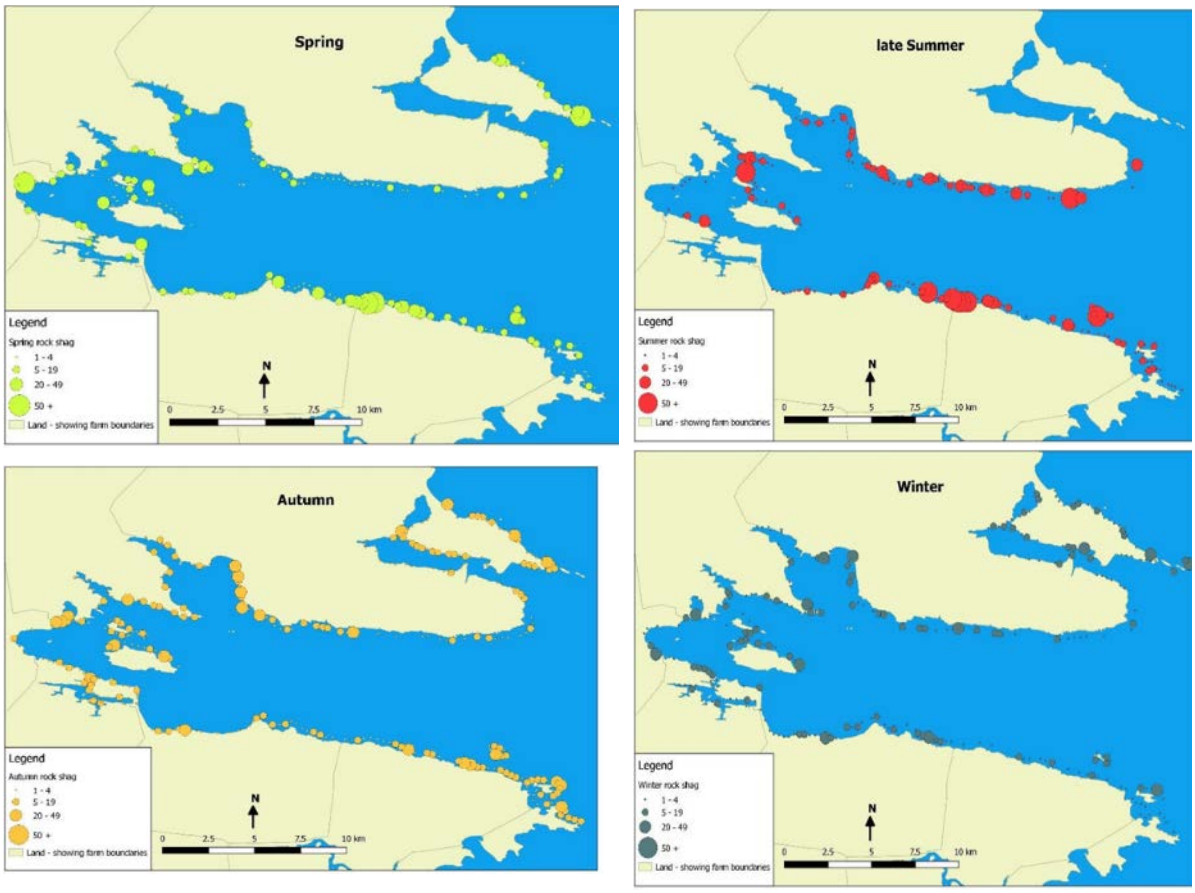


Figure 7-65: Distribution of rock shags recorded in each season

Imperial shag (IS)

Imperial shag was the third most numerous species recorded during the series of coastal bird surveys, with 6,770 birds recorded (Table 7.18). During the spring and summer, Cochon Island supports a large population of this species and the highest density was observed on the cliffs of the north coast of this island. Other smaller colonies were recorded on the north coast of Kidney Island, Volunteer Point and the north and south coasts of the outer Sound (east of Strike-off Point). Elsewhere, imperial shags were only recorded as single birds or small groups (Figure 7-66). During the survey, large groups of imperial shags (likely to be feeding aggregations) were observed on the waters of the outer Sound. These birds were not recorded as they fell outwith the coastal survey transect.

By contrast, during the autumn and winter, imperial shags were only recorded in low numbers within Berkeley Sound (Figure 7-66). The only large group observed was seen roosting on the north coast of Volunteer Rocks, however these birds fell outwith the survey transect.

Perhaps surprisingly, imperial shag was the second most numerous species of seabird recorded by the SAST in the vicinity of Berkeley Sound (Section 7.4.5.3.1.1) and were consistently recorded as one of the most numerous species present in all months of the year (Table 7.18). Although imperial shags were not observed on the shoreline in the winter, they are still abundant within inshore waters during the winter months. Like several other species distributions described here, large groups of imperial shags were recorded in the waters off Mengeary and Volunteer Points, which suggests that these are important foraging areas for numerous species of seabirds.

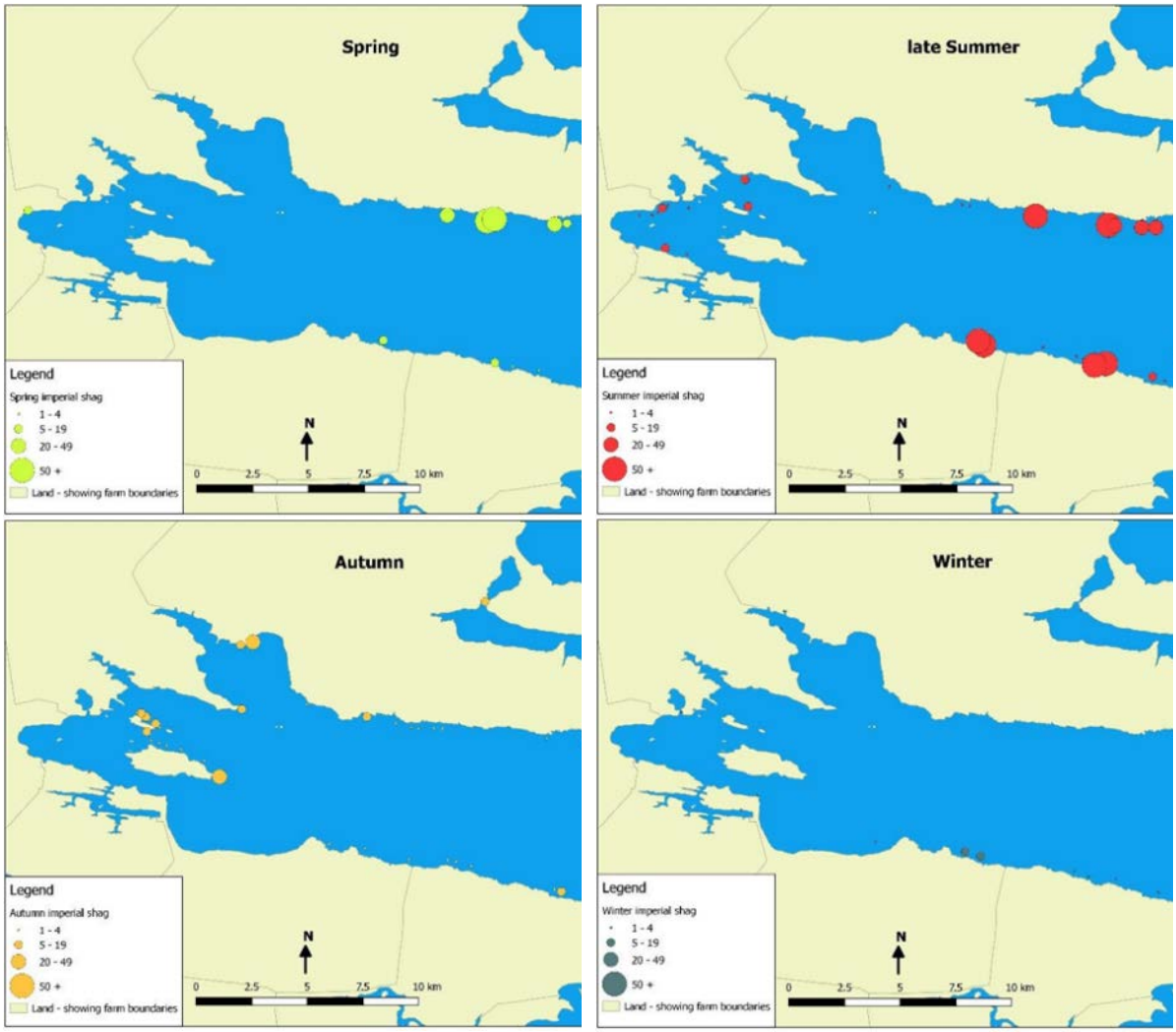


Figure 7-66: The distribution of all imperial shag recorded in each season

Falkland steamer duck (FSD)

The Falkland steamer duck is one of only three endemic bird species in the Falklands (the others being Cobb's wren and Tussac bird). Overall, Falkland steamer duck was the fourth most numerous species recorded during the coastal bird surveys (Table 7.18). Throughout the year, steamer ducks were the most numerous species recorded in the inner Sound during the coastal bird surveys, and were also recorded around the coast of Kidney Island, but appeared to be largely absent from the more exposed coasts of the outer Sound (Figure 7-67). Adult steamer ducks occupy territories throughout the year and pairs are recorded at regular intervals around the entire coast of the inner Sound and Volunteer Lagoon. Larger aggregations of young or non-breeding birds were encountered in all seasons but the group size recorded was larger in the spring than at other times.

This species was the fifth most numerous species recorded by the SAST although the distribution of records was restricted exclusively to the inshore waters of Port William. The lack of records in Berkeley Sound however, reflects the distribution of survey effort which was rarely within 2 km of the coast.

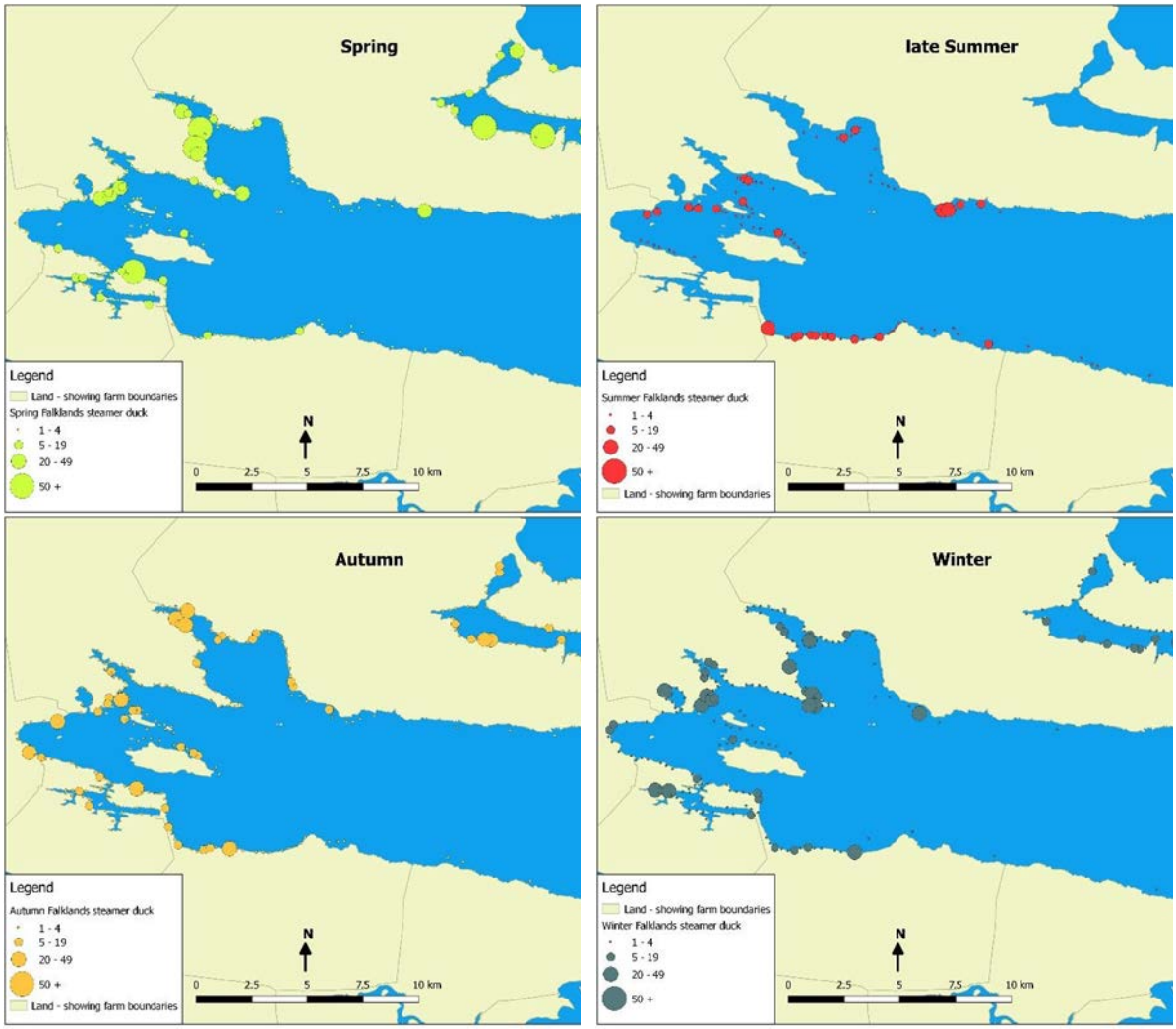


Figure 7-67: The distribution of all Falkland steamer duck records in each season

Gentoo penguin (GP)

Gentoo penguins are resident in the Falklands and regularly return to shore throughout the year. Gentoo penguin were consistently one of the most numerous species in each coastal bird survey (Table 7.18). However, they were only recorded in association with known breeding sites; primarily Kidney Cove and Lagoon Sands.

Satellite tags have been deployed on gentoo penguins breeding at a number of colonies around the Falklands, including Kidney Cove. It is generally regarded that during the breeding period (September to February) gentoo penguins forage inshore and return to colonies on a daily basis. Although not derived from tracking, detailed observations of birds breeding at Volunteer Point recorded mean minimum and maximum foraging trip lengths were between 2.0 - 3.0 days and 0.7 - 1.8 days during the incubation and brood periods respectively (Otley, *et al.,* 2005). Comparable foraging trips were longer at other sites studied in the South Atlantic (Otley, *et al.,* 2005).

During the winter, tracking from Kidney Cove has shown that birds may disperse away from the breeding colony but still return regularly to land elsewhere in the Falklands (Clausen and Pütz, 2003).

Foraging trips were more variable in length and range during the winter, when compared with the breeding birds. Although gentoo penguins are present at Berkeley Sound colonies throughout the winter, they may not be the same birds that breed there during the summer.

Magellanic penguin (MP)

Generally, Magellanic penguins favour relatively sheltered vegetated areas that have access to the open sea. During coastal bird surveys, the area with the highest density of breeding Magellanic penguins recorded was on the greens behind Volunteer Beach. Magellanic penguins were apparently absent from the study area during the autumn and winter surveys (Table 7.18).

Magellanic penguins were recorded in low numbers throughout the waters surveyed by the SAST; however, large groups were encountered within Port William and across the entrance of Berkeley Sound (Figure 7-68). Tracking and at-sea observations indicate that the majority of Magellanic penguins migrate northwards following moulting and overwinter outwith the waters of the Falkland Islands (Pütz, *et al.,* 2000). This is reflected in the number of birds recorded in each season (Table 7.19 above), which indicates that very few Magellanic penguins are present between May and September.

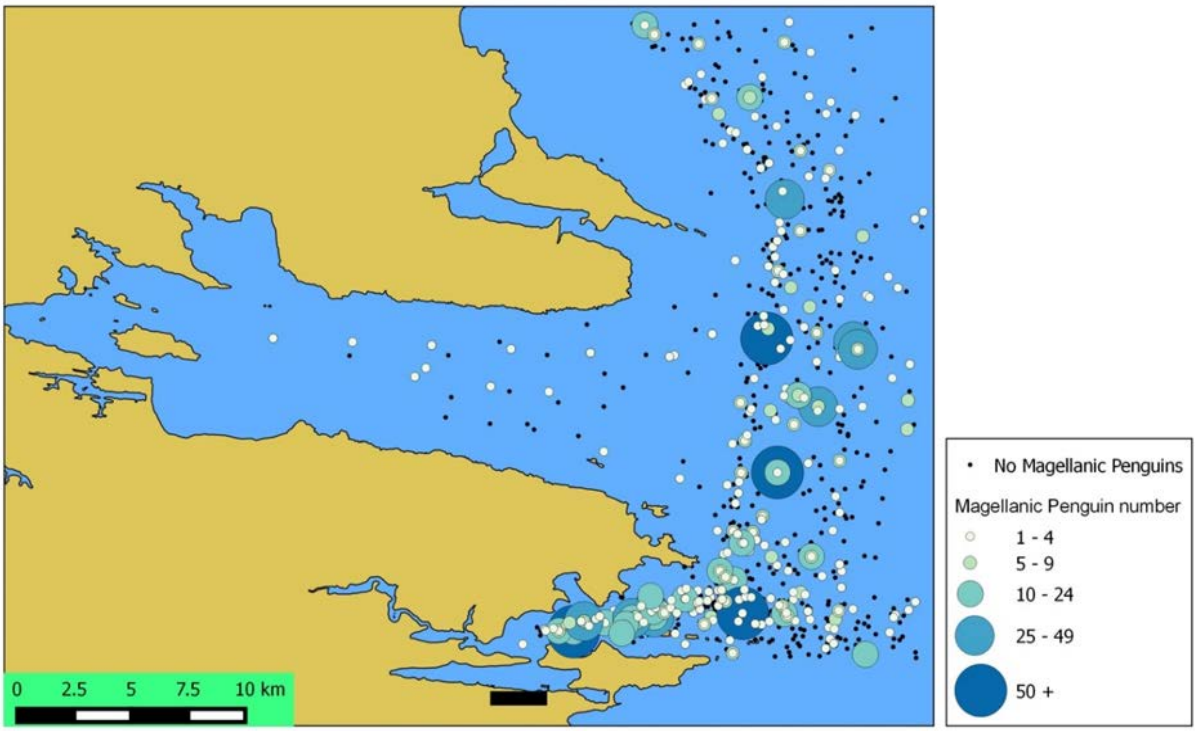


Figure 7-68: The distribution of all Magellanic penguin records in the vicinity of Berkeley Sound

King penguin (KP)

Unlike the other species of penguin breeding in the Falklands, king penguins raise chicks throughout the year, therefore, colonies are occupied throughout the year. The largest king penguin colony in the Falklands is located close to Berkeley Sound, behind Volunteer Beach. The majority of the king penguins recorded during coastal bird surveys were recorded close to this site or the far smaller colony at Volunteer Sands. The fact that no king penguins were observed during the summer coastal survey (Table 7.18) was due to the lack of survey effort near these colonies (Figure 7-20).

Several tracking studies have been conducted on king penguins (*Aptenodytes patagonicus*) breeding at Volunteer Point, which have identified seasonal shifts in distribution associated with phases of the breeding cycle (Pütz, 2002; Pütz and Cherel, 2005; Baylis, *et al.,* 2014; summarised in Table 7.21.

Although the distribution may change during the course of the year (Pütz, 2002), king penguins are generally found offshore over the continental slope. The recorded distribution is thought to be closely linked to the distribution of the primary prey species, myctophids or lantern fish (Cherel, *et al.,* 2002). While these offshore foraging areas are likely to be beyond the influence of activities within Berkeley Sound, breeding birds return regularly to shore and it is here (in inshore waters) that they are at greatest risk. It is likely that the length of foraging trips and therefore the frequency of visits to the colony are of greater interest when assessing the impact of inshore activity than the location of feeding grounds.

Table 7.21: Summary of king penguin foraging trips from Volunteer Point

Season	Months	Duration (days)			Min distance travelled (km)			Maximum distance from colony (km)		
		Mean	SD	Median	Mean	SD	Median	Mean	SD	Median
Early winter[1]	Mar, Apr, May	19.8	15.5	15	2,014.5	1,279	1,370	664.6	419.7	485
Late winter[1]	Jun, Jul, Aug	28.1	29	33.5	2,787.7	3,081.9	3,419	510.2	392.8	778
Early summer[1]	Oct	5.2	3.9	15	595.1	554.5	1,685	158.5	150.4	352
Early summer[2]	Nov	15.1	5.5	-	861.7	785.3	-	257.5	124.9	-
Early winter[3]	Apr	7.6	2.1	-	191	16	-	-	-	-
	May	16.4	14.7	-	277	222	-	-	-	-
	Jun	29.0	22.7	-	393	329	-	-	-	-

[1] Pütz, 2002.
[2] Pütz and Cherel, 2005.
[3] Baylis, *et al.,* 2014.

Black-browed albatross (BBA)

Although seen throughout the year by the SAST, the number of black-browed albatrosses recorded was generally lower during the winter months (Table 7.19 above). Usually recorded individually or in small numbers, larger groups were occasionally encountered (Figure 7-69).

Black-browed albatrosses have been tracked from a number of colonies in the Falklands; Beauchêne, Saunders Island, New Island and Steeple Jason (BirdLife International, 2004; Baylis, *et al.,* 2019a). Results have confirmed that this species forage primarily over Patagonian Shelf waters. Birds tracked from Beauchêne are of especial interest as this is the second largest colony in the Islands and the closest to Berkeley Sound. To date, tracking indicates that the east coast of the Falklands is not a core foraging area for this species (BirdLife International, 2004).

As stated above, besides the local breeding population of black-browed albatross, the South Georgia population also occurs in the Falkland Islands (Frankish, *et al*., 2020a). The black-browed albatross from South Georgia is an ACAP Priority Population (GSGSSI, 2016).

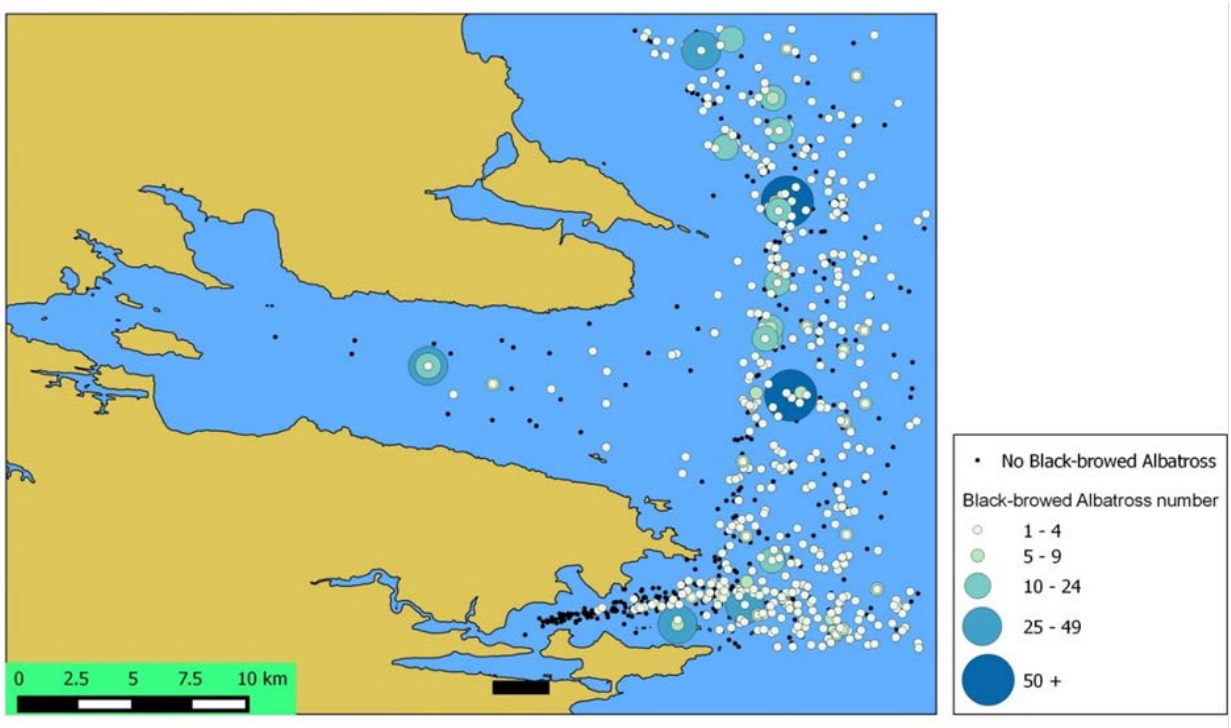


Figure 7-69: The distribution of all black-browed albatross records in the vicinity of Berkeley Sound

Southern giant petrel (SGP)

Southern giant petrels were present throughout Berkeley Sound in low numbers. Most sightings were of single birds flying along the coast but several larger aggregations (mostly associated with Kidney Island) and breeding colonies were recorded. The presence of a small breeding colony near the entrance to Volunteer Lagoon was confirmed and a potentially 'new' breeding site was identified on Peat Island, to the east of Hog Island (Figure 7-3 above). The first site is close to a known breeding site at Black Rincon within Volunteer Lagoon, this colony consisted of nine nests in the 2004 / 05 season (Reid and Huin, 2005). However, the present colony appears to have moved to the opposite side of the Lagoon and is on the point to the west of Lagoon Sands. At the second site, birds were seen on nests but the presence of eggs was not confirmed.

White-chinned petrel (WCP)

Although only two white-chinned petrels were recorded during the coastal bird surveys, the Falkland Islands largest known colony of this species is found on Kidney Island (Reid, *et al.,* 2007) which supports 331 (95 % CI: 52 – 1043) breeding pairs (Kuepfer, *et al*., 2024). Breeding takes place between September and May and this is when the number of white-chinned petrels visiting the Island will be highest. JNCC surveys in inshore waters adjacent to Berkeley Sound recorded white-chinned petrels at moderate to high densities from spring to autumn with fewer observed during the winter. Like many other species of petrel, rafts of white-chinned petrels congregate in inshore waters near breeding colonies.

White-chinned petrels are classed as 'Vulnerable' by the IUCN and therefore represent one of the most sensitive of the Falklands breeding species.

As stated above, a recent tracking study demonstrated movements of the South Georgia white-chinned petrel population to Falkland Islands waters (Frankish, *et al*., 2020b).

Sooty shearwater (SS)

As was evident during the SAST surveys (Section 7.4.5.3.1.1), the sooty shearwater is the most numerous breeding seabird species in the vicinity of Berkeley Sound with a population estimate of 139,000 pairs) breeding on Kidney Island (Wakefield, *et al.,* 2017). Although the behaviour was never recorded during SAST surveys, huge rafts of sooty shearwaters gather off Kidney Island at the entrance to Berkeley Sound during the breeding season, where they wait until dusk before returning to their nesting burrows ashore. This behaviour makes sooty shearwaters vulnerable to the effects of any surface pollutants and / or the effects of artificial light.

Figure 7-70 shows the distribution of all sooty shearwater records in the vicinity of Berkeley Sound during JNCC surveys with very high abundance recorded at the entrance to Port William. This reflects the proximity to the breeding site on Kidney Island but also, to some extent, reflects the route taken by the SAST survey vessels. Despite this species' diurnal habit of dispersing to feed during the day before returning to breeding colonies in the evening, very high densities of sooty shearwaters were recorded throughout the day in waters adjacent to Berkeley Sound, within Berkeley Sound and off Volunteer Point.

Between May and August, the number of sooty shearwaters recorded is greatly reduced (Table 7.19 above) as many birds migrate to the northern hemisphere at this time (Hedd, *et al.,* 2014).

Contrary to the SAST surveys, very few sooty shearwaters were recorded during the coastal bird surveys. Although sooty shearwater was the most numerous species observed, virtually all of the birds seen were outwith the transect. For instance, while surveying the coast of Kidney Island (known to be an important breeding site) on 26th October a raft of approximately 15,000 sooty shearwaters was observed to the north of the island. A large number of sooty shearwaters was also observed passing off the coast of Johnsons Rincon on 22nd October. The presence of these birds deep within the Sound may have been related to the wind direction on the day (south-easterly), as they were not present in the same area on the 26th.

In 2007, 44 sooty shearwaters from Kidney Island were fitted with geolocator tags (Hedd, *et al.,* 2014) (Section 7.4.5.3.1.3). The results allow information regarding at-sea distribution, foraging trip length and activity (time spent on the water) to be collected. For instance, differences in the foraging strategies of male and female birds were found. The greatest differences between the sexes occur in the early stages of breeding, before the egg is laid (in late November). At this time, males forage closer to, and spend significantly more time at, the breeding sites than females. Key results of the tracking studies are summarised in Table 7.22.

The results of further tracking of sooty shearwaters from Kidney Island during the GAP programme are shown in Figure 7-70.

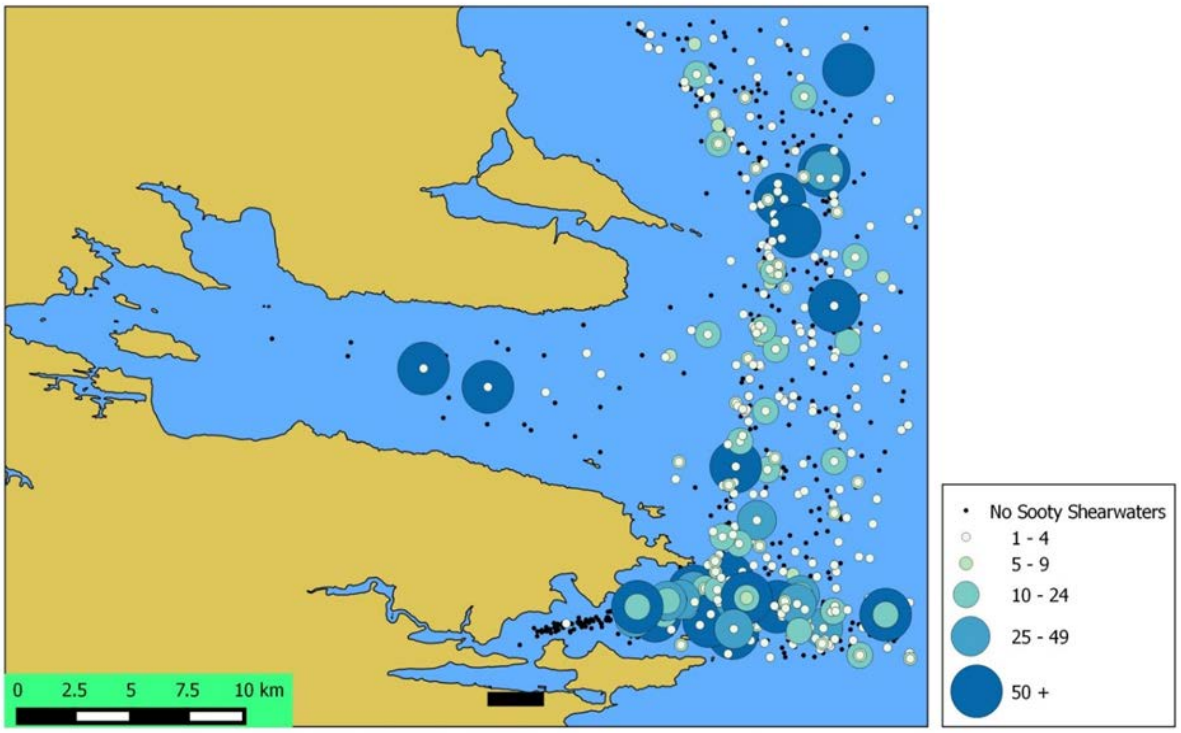


Figure 7-70: The distribution of sooty shearwater records in the vicinity of Berkeley Sound (held on the SAST database)

Table 7.22: Sooty shearwater behaviour derived from geolocator tags ***(Source: Hedd, et al., 2014)***

Period	Date	Trip length		Range / distance		Overlap in distribution
		Male	Female	Male	Female	
Pre-Breeding	Return late Sept	Daily	Variable	-	-	Low
Pre-laying exodus	Leave early Nov	12 + 8.7 days	22.4 + 3.5 days	2,830 + 1.997 km	5,906 + 1,412 km	Low
Incubation	Lay 22 Nov	7.6 + 2.7 days		Range 491 + 273 km		High
Chick rearing	Hatch 18 Jan	1.4 + 1.3 days		Max. 410 km		High

Kelp gull (KGu)

Kelp gulls were recorded throughout the areas covered by all of the coastal bird surveys; however, highest numbers were recorded in the inner Sound. Several notable concentrations were recorded in the summer on Long Island or the adjacent mainland. During the winter, kelp gulls appeared to be more dispersed.

Dolphin gull (DG)

Dolphin gulls were recorded in low numbers during all of the coastal surveys, always associated with groups of shags or penguins. The Falklands are the global stronghold of this species with approximately 85 % of the world's population breeding in the Islands.

Brown-hooded gull

Brown-hooded gulls were infrequently encountered; however, when sighted they were usually in groups. Brown-hooded gulls were most frequently encountered in the inner Sound.

South American tern (SAT)

All of the South American terns recorded during the summer 2016 coastal survey were sighted close to Kidney Island. It appeared that there may be a colony of this species on a small island off the north-west tip of Kidney Island. South American terns were not recorded during the winter 2017 survey.

South American terns were recorded at moderate to high densities in coastal waters near Berkeley Sound from the spring to autumn.

Antarctic skua (AS)

Antarctic skuas were occasionally observed during the summer 2016 coastal survey (Section 7.4.5.3.1.1) but there was no discernible pattern to the distribution of this species. This species was absent during the winter of 2017.

Tussac bird (TB) (Blackish cinclodes)

Tussac bird was recently given endemic status, having been split from the blackish cincloides found on mainland South America. During the coastal surveys, tussac birds were recorded around three islands within the Sound: Cochon, Kidney and Hog Islands. Tussac birds only thrive on islands without rats, although they can be seen in adjacent rat-infested areas. Cochon and Kidney Islands are known to be rat-free, however, the status of Hog Island is unknown.

Cobb's wren (CW)

Although rarely recorded during the summer 2016 coastal bird surveys, Cobb's wren is one of the most sensitive species found in the Berkeley Sound area. This species is endemic to the Falkland Islands and has restricted distribution within the Islands due to being extremely vulnerable to predation by introduced rats and cats. The distribution of these birds is therefore extremely patchy and largely restricted to small rat free tussock islands, such as Cochon and Kidney Islands. The small range and susceptibility to rat invasions means that the species is classified as 'Vulnerable'[31] by the International Union for the Conservation of Nature (IUCN). A species action plan has been written for Cobb's wren by Falklands Conservation and FIG (2008c).

The behaviour of Cobb's wrens, favouring dense coastal tussock backing boulder beaches, not only makes them susceptible to rats. The small size and habitat preferences of these birds also make them impossible to survey accurately from a moving boat. Eggs are laid between early October and December, and there are probably two broods per season (Woods, 1988; Woods and Woods, 1997).

Although Cobb's wrens were not recorded during the winter 2017 survey, they are known to be present on Cochon and Kidney Islands at this time.

Kelp goose (KGo)

Kelp geese were recorded throughout the areas surveyed during the summer 2016 coastal survey. This species is territorial and therefore was only recorded in pairs, or small family groups. During the winter 2017 survey, kelp geese were recorded more frequently in the sheltered waters of the inner Sound.

All other species

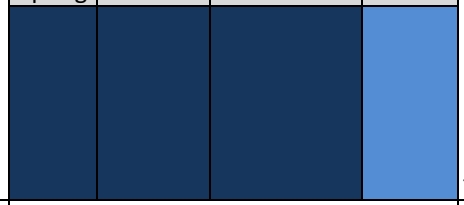
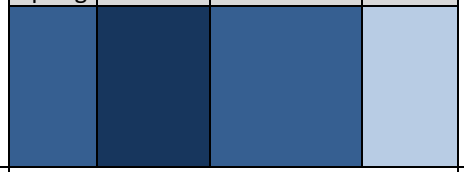
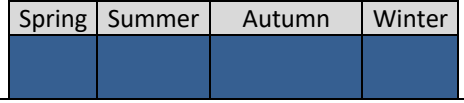
A number of other species of duck, shorebirds and land birds were recorded opportunistically during both coastal surveys (Table 7.18 above). However, due to difficulties in seeing these species from a moving boat, the results of this survey are not reliable enough to map the distribution of these species.

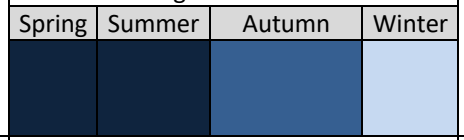
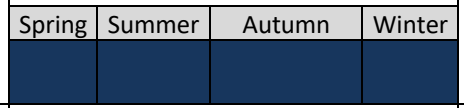
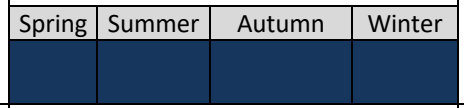
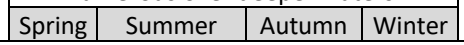
[31] **Post-consultation note (July 2025):** The Cobb's wren is now listed as IUCN 'Least Concern' as surveys indicate the endemic species is now present on more than 120 islands within the archipelago. While it is only found on predator-free islands, rat eradication programmes appear to have helped this species and the population trend appears to have been stable for some time (BirdLife International, 2025).

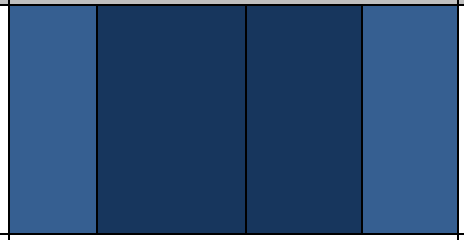
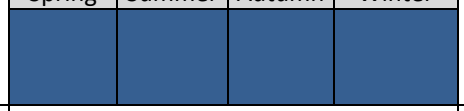
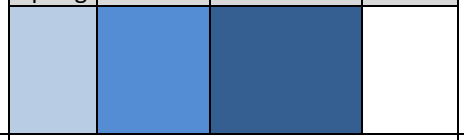
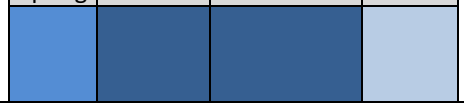
7.4.5.3.3 Summary of inshore bird abundance, distribution, life-cycle and behavioural characteristics

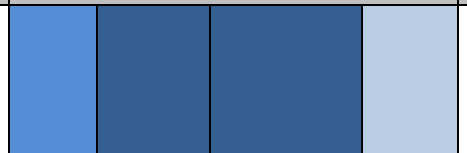
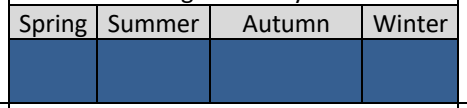
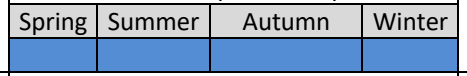
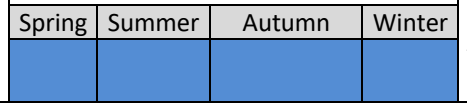
Table 7.23 provides a summary of inshore bird abundance, distribution, life-cycle and behavioural characteristics.

Table 7.23: Summary of inshore bird abundance, distribution, life-cycle and behavioural characteristics

Species	IUCN status	ACAP species[1]	FI priority species[2]	Seasonal occurrence and distribution[1]	Breeding cycle	Feeding mode	Persistent ship associate[3]	Berkeley Sound breeding sites	Falklands population	Global population and trend[4]
Sooty shearwater (*Ardenna griseus*)	NT	X	X	Present throughout the year but most of the population depart between Apr – Aug. Spring | Summer | Autumn | Winter 	Start breeding at 4 yrs. Adults return Sept. 1 egg laid late Nov. Adults depart Mar. Chicks fledge April.	Surface seizing and pursuit diving (to *c.* 50 m)	X	Kidney Island	139,000 pairs 0.1 % global population[5]	*c.* 20 million individuals (*c.* 4.4 million breeding pairs)[5] Decreasing
Imperial shag (*Leucocarbo atriceps*)	LC	X	X	Present throughout the year in high numbers, distribution restricted to inshore waters. Spring | Summer | Autumn | Winter 	2-4 eggs laid Nov. Chicks fledge mid-Feb.	Pursuit diving	X	Cochon and Kidney Islands Outer Sound cliffs	*c.* 45,000 – 84,000 pairs	Unknown
Rockhopper penguin (*Eudyptes chrysocome*)	VU	X	✓	Winter foraging between Straits of Magellan and 39°N (1,400km). Spring | Summer | Autumn | Winter 	Mating Oct 2 eggs laid mid Nov. Chicks fledge Mar. Adults depart April.	Pursuit diving to *c.* 100 m	X	Cochon and Kidney Islands Outer Sound cliffs	320,000 pairs 36 % global population	1.23 million pairs Decreasing
Gentoo penguin (*Pygoscelis papua*)	LC	X	✓	Resident, primarily within 10 km up to 300 km in winter. Spring | Summer | Autumn | Winter 	Nest building Sept. 1-2 eggs laid late	Pursuit diving to *c.* 100 m	X	Strike-off Point, Kidney Cove and	121,500 pairs, 34 % global population	387,000 pairs Stable

Species	IUCN status	ACAP species[1]	FI priority species[2]	Seasonal occurrence and distribution[1]	Breeding cycle	Feeding mode	Persistent ship associate[3]	Berkeley Sound breeding sites	Falklands population	Global population and trend[4]
					Oct. 34 day incubation.			Volunteer Point		
Magellanic penguin (*Spheniscus magellanicus*)	LC	X	✓	Majority recorded between Nov and Mar, absent during winter, feeding Patagonian Shelf and shelf break, Argentine coast 	Adults arrive Sept. 2 eggs laid Oct. Chicks fledge Mar. Adults depart Apr.	Dive to depths of 140 m	X	Relatively sheltered low lying coasts; e.g., Kidney, Long Island and Volunteer Point	*c.*140,000 pairs 10 % global population	1.3 million pairs Decreasing
Rock shag (*Leucocarbo magellanicus*)	LC	X	X	Present year-round, forages in coastal waters, often amongst kelp forests, returning to shore to roost on a daily basis. 	2-5 eggs laid in Nov to mid Dec. Chicks fledge mid-Jan to late Feb.	Pursuit diver	X	Rocky coastlines throughout;	*c.* 32,000 – 59,000 pairs	Unknown
Falkland steamer duck (*Tachyeres brachydactyla*)	LC	X	X	Endemic to the Falklands, maintain territories year-round. Forage in coastal waters, regularly returning to land to rest. 	5-10 eggs laid mid-Sept to Dec. Chicks fledge at 15-16 weeks old.	Upending and diving for molluscs and crustaceans	X	Relatively sheltered coast of the inner Sound	*c.* 9,000 – 16,000 pairs, common and widespread, endemic	N/A (endemic species)
Black-browed albatross (*Thalassarche melanophris*)	LC	✓[7]	✓	Present year-round in high numbers across the Patagonian Shelf, less numerous over deeper waters. 	Annual breeder. First breeding at	Surface seizing and shallow dives (to *c.* 19 m)	✓	In the Falklands, 17 breeding sites, very	*c.* 500,000 pairs.	700,000 pairs Stable

Species	IUCN status	ACAP species[1]	FI priority species[2]	Seasonal occurrence and distribution[1]	Breeding cycle	Feeding mode	Persistent ship associate[3]	Berkeley Sound breeding sites	Falklands population	Global population and trend[4]
					7 yrs. 1 egg laid mid Oct. Chicks fledge Apr/May.	from the surface		large colonies on Jason Islands and Beauchêne Island, South Georgia	76 % global population	
Kelp gull (*Larus dominicanus*)	LC	X	X	Resident species, disperse in the winter to exploit foraging opportunities. Spring / Summer / Autumn / Winter 	2-3 eggs laid Dec. Chicks fledge Mar.	Predators of young birds and eggs, marine inverts but also scavengers	✓	Long Island	*c.*24,000 – 44,000 pairs	3.3 to 4.3 million individuals
Great shearwater (*Ardenna gravis*)	LC	X	X	Widespread over waters to the north of the Falklands between Dec – Apr, absent in the winter and spring. Vast majority observed are non-breeders. Spring / Summer / Autumn / Winter 	Adults return Sept. 1 egg laid end Oct. Chicks and adults depart late April.	Surface seizing and pursuit diving (to *c.* 20 m)	✓	Kidney Island only known site in the Falklands	20 pairs <0.1 % global population	5 million pairs Stable
White-chinned petrel (*Procellaria aequinoctialis*)	VU	✓	✓	Widespread over shelf and oceanic waters in winter, shallower waters in spring summer. Most birds present are non-breeding visitors. Spring / Summer / Autumn / Winter 	Adults return Sept. 1 egg laid Oct/Nov. Chicks and adults depart Apr/May.	Surface seizing and pursuit diving (to *c.* 20 m)	✓	Kidney Island, New Island, Bottom Island, South Georgia	*c.* 331 breeding pairs on Kidney Island, Falklands population as a whole	1.2 million pairs Decreasing

Species	IUCN status	ACAP species[1]	FI priority species[2]	Seasonal occurrence and distribution[1]	Breeding cycle	Feeding mode	Persistent ship associate[3]	Berkeley Sound breeding sites	Falklands population	Global population and trend[4]
									unknown but expected to be <0.1 % global population	
Antarctic fulmar (*Fulmarus glacialoides*)	LC	X	X	Common autumn and winter visitor. Highest densities found over Patagonian Shelf waters but found throughout Falklands waters. 	Single egg laid Nov/Dec. Fledge Mar/Apr.	Surface seizing	✓	None	Non-breeder	4 million individuals Stable
King penguin (*Aptenodytes patagonicus*)	LC	X	X	Breeding cycle takes an entire year; therefore, adults visit colonies throughout the year. 	Mating Oct. 1 egg laid Nov-Mar 55 day incubation	Pursuit diving to *c.* 350 m	✗	Volunteer Point	<1,000 pairs 0.04 % global population	2 million pairs Increasing
Kelp goose (*Chloephaga hybrida*)	LC	X	X	Common resident species throughout the Falklands on rocky coasts. May move to overwinter in more sheltered areas between April and September. 	4-6 eggs laid Oct / Nov.	Grazes algae in the intertidal zone and coastal grasses	✗	Breeds in the areas including exposed outer Sound	*c.* 10,000 – 18,000 pairs	Unknown
Cobb's wren (*Troglodytes cobbi*)	LC	X	✓	Widespread but fragmented population, only found on predator (rat and cat) free tussock islands. 	3-4 eggs laid Oct – Dec. May have two broods per year.	Invertebrates often forages in the beach	✗	Cochon and Kidney Islands	Endemic, 6,000 breeding pairs over 120 islands	N/A (endemic species)

Species	IUCN status	ACAP species[1]	FI priority species[2]	Seasonal occurrence and distribution[1]	Breeding cycle	Feeding mode	Persistent ship associate[3]	Berkeley Sound breeding sites	Falklands population	Global population and trend[4]
Tussac bird (*Cinclodes antarcticus*)	NT	X	X	Widespread but fragmented population, only breeds on predator (rat and cat) free islands.	1-3 eggs laid Oct-Dec. May have two broods per year.	Invertebrates often forages in the beach	X	Cochon and Kidney Islands	*c.* 15,000 – 28,000 pairs common and widespread, endemic	N/A (endemic species)

Spring	Summer	Autumn	Winter

[1] See Section 7.4.5.5.2
[2] See Section 7.5.3
[3] Indicates species that are attracted to vessels, as a potential source of food, and can form large flocks in the wake of ships.
[4] From BirdLife International, 2024.
[5] **Post-consultation footnote (July 2025):** the global population of sooty shearwaters is now recorded as 8.8 million mature individuals such that the stable Falkland Islands population, as a percentage of the global population, is estimated to be 3.2 % (BirdLife International, 2025).
[6] Note that populations on South Georgia are an ACAP Priority Population.

Key: Relative abundance of seabirds within Falklands waters.

Not recorded	Low	Moderate	High	Very High

(Sources: Woods, 1988; Woods and Woods, 1997; FIG, 2008a; White, et al., 2002; Reid and Huin, 2005; Reid, et al., 2007; Baylis, 2012; Wolfaardt, 2012; BirdLife International, 2019; Frankish et al., 2020a, Frankish et al., 2020b and Phillips et al., 2023; Kuepfer, et al., 2024)

7.4.5.4 Birds in Stanley Harbour and surrounding areas

Many of the common species of land birds of the Falklands can be found breeding around the coast of Stanley Harbour. Of these, species of duck (such as Patagonian crested ducks; *Lophonetta specularoides*) and kelp geese (*Chloephaga hybrida*) rely on the marine environment for food and are therefore susceptible to marine pollution. There are relatively few seabirds found within the Harbour, when compared with other inshore waters of the Falkland Islands. However, a number of breeding pairs of endemic Falkland steamer ducks have been recorded, and small breeding colonies of Magellanic penguins and rock shags. In 2013, two coastal bird surveys, one in the winter (August) and the other in the summer (December), were conducted along the entire coastline of Stanley Harbour (Poncet, 2014). More recent surveys were initiated in 2020 and are at-present, ongoing (Poncet, 2021). The more recent surveys were carried out in summer and winter and cover over 40 km of coastline (22 km within Stanley Harbour and 21 km along Port William and Cape Pembroke Peninsula). The results of these surveys form the basis of this baseline description of birdlife within Stanley Harbour.

The coastline was divided into 14 transects, which varied from 1 to 6.46 km in length (Poncet, 2021) (Figure 7-71). All birds within 100 m to seaward and 25 m inland of the coast were recorded as surveyors walked each transect. The results of the surveys are summarised in Table 7.24 below. The results of the survey data indicate that both Stanley Harbour and Cape Pembroke host a high number of bird species in both summer and winter (number of species > 20).

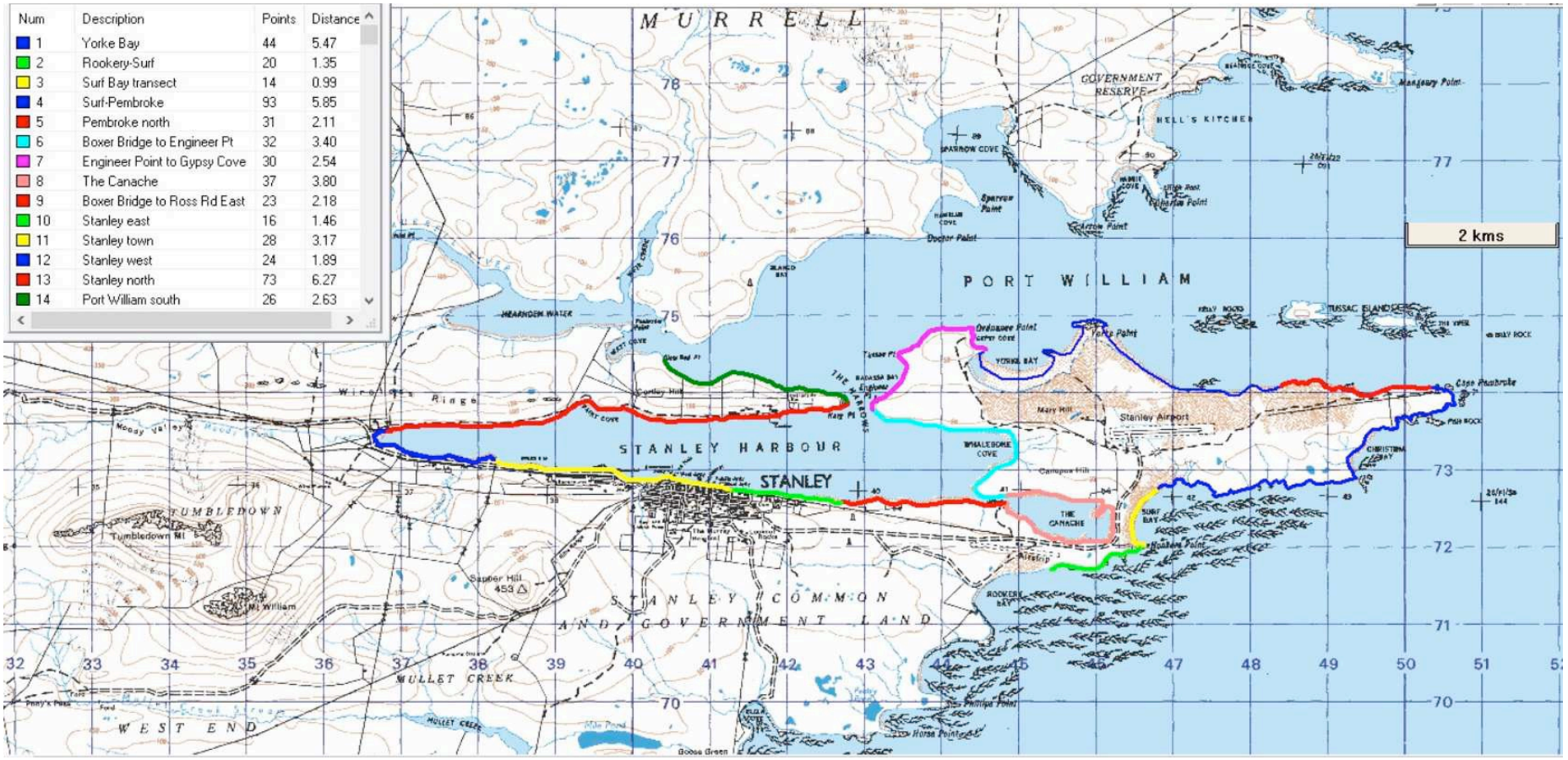


Figure 7-71: The Stanley Harbour coastline showing the coastal bird survey transects ***(Source: Poncet, 2021)***

7.4.5.4.1 Falkland steamer duck

Overall, Falkland steamer ducks were the most numerous coastal bird in summer and winter within Stanley Harbour (max count was n=215 in summer). The summer survey recorded steamer duck breeding territories at regular intervals around much of the Stanley Harbour coastline, with the exception of the coastline along the Stanley waterfront and the Canache where this species was relatively scarce. Breeding territories are occupied by the same pair throughout the year. At least 28 breeding pairs were reported in Stanley Harbour during summer (Poncet, 2021). In addition, aggregations of non-breeding steamer ducks were recorded at 'traditional' sites around the coast, mostly in the western end of the Harbour but also near the entrance to the Canache.

7.4.5.4.2 Kelp goose

Very few kelp geese appear to breed within Stanley Harbour and the number of birds present during the summer is relatively low within Stanley Harbour. However, during the winter kelp geese disperse and more birds can be found feeding in the sheltered waters of Stanley Harbour. Kelp geese were more numerous outside of Stanley Harbour, on outer coasts, being the most frequently recorded coastal bird during summer Cape Pembroke surveys (Poncet, 2021).

7.4.5.4.3 Passerines

Seven species of passerine (perching birds such as: Falkland thrush, black-chinned siskin, black-throated finch, long-tailed meadowlark, grass wren, Falkland pipit and house sparrow) were recorded along all coastlines. The town of Stanley with its trees, shrubs and buildings provide good habitat for passerine birds.

7.4.5.4.4 Waders

Although found in low numbers elsewhere, The Canache proved to be a local hot-spot for waders. This shallow embayment reveals inter-tidal mudflats at low tide, which attracts feeding waders. Although present year-round, the number of waders within The Canache is higher during the winter than the summer.

7.4.5.5 Seabird population and conservation status

Most seabird species are highly mobile, travelling thousands of kilometres across international waters and multiple Exclusive Economic Zones and generally only return to land to breed and moult. They face many serious conservation challenges throughout their migratory range and across all phases of the lifecycle, and are currently considered the most threatened group of birds (BirdLife International, 2014b). The species accounts in the previous section include the IUCN Red List threat categories for each species. It is important to note that these threat categories refer to the status of the global population, and not specifically the Falklands population. It is also useful to note that there are often regional differences in population trends. For example, on the basis of the most recent archipelago-wide census, the population trend for the black-browed albatross population in the Falklands is positive (Wolfaardt, 2012; Crofts, 2020), whereas the South Georgia population continues to decline (Poncet, *et al.,* 2006).

The population status of many of the abundant breeding seabirds in the Falkland Islands is relatively well understood thanks to a number of long-term monitoring projects conducted by Falklands Conservation and other research institutions, especially those conducting research at New Island. The 2010 archipelago-wide surveys of seabirds breeding in the Falkland Islands revealed that, black-browed albatrosses, rockhopper and gentoo penguins had increased since 2005. More recent archipelago-wide censuses have been undertaken, but the results are yet to be published. Archipelago-wide censuses are complemented by a number of annual monitoring studies, which highlight that the number of gentoo and rockhopper penguin breeding pairs have, overall, declined at annually

monitored sites over the past 10 years. However, a high degree of inter-annual and inter-site variability in population numbers and breeding productivity over the past 10 years exists. The king penguin population in the Falkland Islands, which is arguably insignificant in global terms, but is one of the islands' most important tourist attractions, has also been increasing since annual monitoring began in 1991 (Pistorius, *et al.,* 2012, Crofts and Stanworth, 2018). However, these increases should not be taken to mean that the seabird populations in question are not susceptible and vulnerable to current and future threats, and indeed to the effects of multiple threats.

It is important to note that the population sizes and trends of the majority of Falklands breeding species are poorly known.

7.4.5.5.1 Threats to seabirds

Seabirds face threats both at sea and on land, at their breeding sites. Arguably one of the greatest threats to seabirds, particularly albatrosses and petrels, is the incidental mortality associated with fisheries (bycatch). Fisheries bycatch has been recognised as a critical threat to seabirds in the waters of the Falkland Islands (Sullivan, *et al.,* 2003; Reid, *et al.,* 2004). Following the introduction of effective mitigation measures and the adoption of a National Plan of Action for Reducing Incidental Catch of Seabirds in Capture Fisheries (NPOA-S, Longline), seabird bycatch associated with longline fishing in the Falkland Islands has been significantly reduced. Since 2007, there have been no reported seabird mortalities in the longline fishery (FIG, 2024b).

Significant levels of seabird mortality have also been recorded in the finfish and loligo trawl fishery in the Falkland Islands (Sullivan, *et al.,* 2003). Although mitigation measures, and a NPOA-S (Trawl), have been adopted, and have contributed to a substantial reduction in mortality, seabirds are still killed incidentally in the trawl fisheries of the Falklands Islands. The estimated number of birds killed in trawl fisheries (mostly black-browed albatrosses) varies considerably from year-to-year (Figure 7-72; FIG, 2017b; 2019a), with the lowest extrapolated mortalities since 2004 recorded in 2018. Mortalities have remained relatively low since then, with 195 and 99 mortalities estimated in 2019 and 2020 respectively, which were solely from the loligo fleet, and 875 estimated mortalities in 2022 from both fleets (no estimates were reported in 2021) (FIG, 2019a; 2020; 2021b; 2022a; 2023n). Inter-annual differences in estimated mortality are due to fluctuations in the recorded mortality rate rather than fishing effort (FIG, 2015a). Note that in 2019 observer seabird dedicated effort was <2% and no seabird mortality was observed; in this case minor injury contacts were used as a mortality proxy (Parker, *et al.,* 2013). Seabird mortalities were reported as summarised in Table 7.25.

The use of the 3:1 rule for estimating mortalities from heavy contacts has meant that extrapolated mortalities has increased back to pre-2017 level. However, it should be noted that this new rule has not been tested since first published in 2013. It remains that inter-annual differences in estimated mortality are likely due to fluctuations in the recorded mortality rate rather than fishing effort (FIG, 2015a; 2016b).

Other potential threats to seabirds include competition with commercial fisheries for food, habitat modification, introduced predators, disease and contamination from various forms of pollution. Research conducted in the early years of commercial fisheries in the Falklands found that although a number of seabirds utilise species that are commercially harvested, there was no conclusive evidence that competition with fisheries was having a negative impact on seabird populations (Thompson, 1992; Thompson and Riddy, 1995). Incidents of disease and harmful algal blooms have been recorded for several seabirds in the Falklands, but these tend to be isolated, rather than persistent factors. Although a number of seabird species have been found oiled in the Falkland Islands, to date, the numbers recorded have been relatively low, especially in relation to possible population level impacts.

Table 7.24: A summary of the results of the Stanley Harbour coastal bird survey *(Source: Poncet, 2021)*

Area	Transect	Length (km)	No. species		Total no. birds		Birds/km	
			Summer	Winter	Summer	Winter	Summer	Winter
Cape Pembroke Peninsula & Port William	Rookery Bay to Surf Bay	1.35	11	9	41	118	31	87
	Surf Bay	1	7	7	63	75	63	75
	Surf Bay to Cape Pembroke	5.85	17	17	215	196	37	34
	Pembroke north[1]	2.11	n/s	d/a	n/s	d/a	n/s	d/a
	Yorke Bay[1]	5.47	n/s	d/a	n/s	d/a	n/s	d/a
	Gypsy Cove to Engineer Pt	2.54	12	11	119	90	47	35
	Port William	2.63	13	8	67	35	25	13
Totals for Cape Pembroke Peninsula and Port William		**20.95**	**25[1]**	**21[1]**	**505[1]**	**514[1]**	**34[1]**	**33[1]**
Stanley Harbour & the Canache	Engineer Point to Boxer Bridge	3.4	15	16	95	178	28	52
	Boxer Bridge to Ross Road	2.18	15	21	101	342	49	167
	Stanley east	1.46	8	11	80	117	50	73
	Stanley town	3.17	15	19	183	241	58	76
	Stanley west	1.7	15	15	110	98	65	58
	Stanley north	6.46	19	21	222	268	34	41
	The Canache	3.8	15	13	75	240	20	63
Totals for Stanley Harbour and the Canache		**22.17**	**26**	**26**	**866**	**1,484**	**39**	**67**

[1] Note: the survey data for transects in Pembroke north and Yorke Bay are not included in the total counts for birds, species and birds / km presented in this table.

[2] Note: n/s = not surveyed, d/a = data unavailable.

Table 7.25: Seabird mortalities based on Fisheries Statistics Bulletin methodology

Fleet	No. of heavy contacts	No. of observed mortalities	Extrapolated mortalities	Total
Fisheries Statistics Bulletin (24), 2019				
Finfish	75	0	1523	1,718
Loligo		65	195	
Fisheries Statistics Bulletin (25), 2020				
Finfish	48	0	825	858
Loligo		33	99	
Fisheries Statistics Bulletin (26), 2021 - No report was made regarding bycatch				
-	-	-	-	-
Fisheries Statistics Bulletin (27), 2022				
Finfish	Not reported	5	572	875
Loligo		101	303	

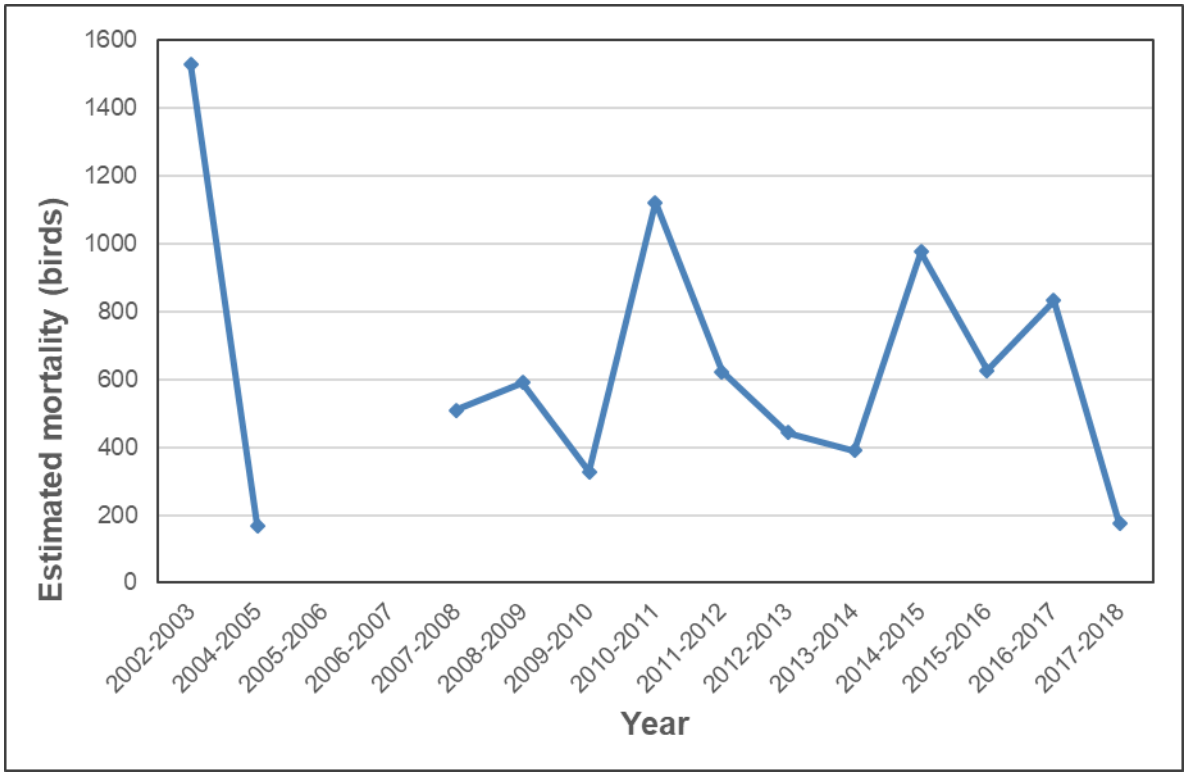


Figure 7-72: Annual estimates of seabird bycatch in the Falkland Islands trawl fishery ***(Source: FIG, 2017b)***

7.4.5.5.2 Agreement for the Conservation of Albatrosses and Petrels (ACAP)

In recognition of the threat of fisheries related mortality and land-based threats at breeding sites a multilateral Agreement for the Conservation of Albatrosses and Petrels (ACAP, 2019) was established in 2004, which seeks to conserve albatrosses and petrels by coordinating international activity to mitigate known threats to their populations. ACAP is a daughter agreement to the Convention on the Conservation of Migratory Species of Wild (CMS) (also known as the Bonn Convention) which is an environmental treaty of the United Nations that provides a global platform for the conservation and sustainable use of terrestrial, aquatic and avian migratory animals and their habitats. All of the UK Overseas Territories and Crown Dependencies are covered by the CMS, with the exception of Anguilla and British Antarctic Territory[32]. The CMS's primary objective is to conserve migratory birds throughout their range; it identifies migratory species threatened with extinction (CMS, Appendix I) and strives to strictly protect these species. CMS also acts as a framework Convention for other regional agreements for migratory species that need international co-operation (CMS, Appendix II) to conserve them over their entire range, such as ACAP.

ACAP aims to stop or reverse population declines by co-ordinating action between States within migratory ranges to mitigate known threats to albatross and petrel populations. To achieve this ACAP promotes an Action Plan which describes a number of conservation measures including research and monitoring, reducing incidental mortality in fisheries, eradicating non-native species at breeding sites and reducing disturbances, habitat loss and pollution.

Currently, ACAP covers 31 species, which comprise 22 albatrosses, seven petrels and two shearwaters. Of these species, eight were recorded over the waters within or adjacent to Berkeley Sound during JNCC surveys (White, *et al.,* 2002; Black, 2005b). Two of these eight species have breeding populations

[32] Oversea Territories Conservation UK: https://www.ukotcf.org.uk/conventions/cms-2/.

within Berkeley Sound; a small but nationally important breeding population of white-chinned petrels on Kidney Island and two small colonies of southern giant petrels, one at the entrance to Volunteer Lagoon and the other on Peat Island. Table 7.26 shows the species listed under ACAP that occur within Falkland Island waters.

Of importance, in 2011, ACAP identified nine seabird Priority Populations (i.e., populations which represent >10 % of the total global population and / or are declining at a rate of >3 % per annum) for conservation. The wandering albatross is a non-breeding visitor to Falkland Islands waters and individuals from the South Georgia populations of grey-headed and black browed albatross are also known to forage in Falkland Islands waters. All three of these South Georgia populations are considered to be ACAP priority populations (GSGSSI, 2016).

Table 7.26: ACAP species (ACAP, 2016) that have been recorded within the waters of the Falkland Islands

Common name	Scientific name	Local status	IUCN status
Black-browed albatross	*Thalassarche melanophris*	Common breeder	LC
Grey-headed albatross	*Thalassarche chrysostoma*	Regular visitor	EN
Grey petrel	*Procellaria cinerea*	Regular seasonal visitor	NT
Light-mantled sooty albatross	*Phoebetria palpebrata*	Regular visitor	NT
Northern giant petrel	*Macronectes halli*	Common visitor	LC
Northern royal albatross	*Diomedea sanfordi*	Regular visitor	EN
Sooty albatross	*Phoebetria fusca*	Rare visitor	EN
Southern giant petrel	*Macronectes giganteus*	Common breeder	LC
Southern royal albatross	*Diomedea epomophora*	Common visitor	VU
Wandering albatross	*Diomedea exulans*	Common visitor	VU
White-capped albatross	*Thalassarche steadii*	Rare seasonal visitor	NT
White-chinned petrel	*Procellaria aequinoctialis*	Rare breeder/Common visitor	VU

7.4.5.6 Seabird vulnerability to oil spill

One of the potential threats that need to be considered in relation to hydrocarbon developments is the impact of oil pollution. To date, reports of oiled seabirds in the Falkland Islands concern a small number of birds. However, millions of seabirds have been killed globally by oil pollution (García-Borboroglu, *et al.,* 2006 and 2008; Wolfaardt, *et al.,* 2009). With the development of the O&G industry in the Falkland Islands, the risk posed to seabirds is an important consideration, especially given the global importance of this area for seabirds and the logistical challenges associated with responding to oil spill events.

Birds are vulnerable to oiling from surface oil pollution, which can cause direct toxicity through ingestion, and hypothermia as a result of a bird's inability to waterproof its feathers. Oil pollution can also impact birds indirectly through contamination of their prey (NRC, 2003). Seabird species vary greatly in their responses and vulnerability to surface pollution, therefore in assessing their vulnerability it is important to consider species-specific aspects of their feeding, breeding and population ecology (White, *et al.,* 2001). Species that spend a greater proportion of their time on the sea surface are considered to be at greatest risk from the effects of surface pollution. Penguins are therefore more likely to be affected than the highly aerial petrels. Species that are wholly dependent on the marine environment for feeding and resting are considered more vulnerable to the effects of surface pollution than species that use offshore areas only seasonally or move offshore only to rest or roost. In addition, the potential reproductive rate of a species will influence the time taken for a

population to recover following impacts. Other factors such as natural mortality rate, migratory behaviour, species abundance and conservation status (e.g., IUCN global Red List status) will also determine the effects of an oil spill on seabird populations.

7.4.5.6.1 JNCC Oil Vulnerability Index (OVI)

To assess the relative risk to different species, the JNCC developed an index to assess the vulnerability of bird species to the threat of oil pollution (Williams, *et al.,* 1994). One of the main outputs of the SAST surveys in the Falkland Islands was the production of an Oil Vulnerability Atlas (White, *et al.,* 2001)[33]. This analysis scored each species on four factors to produce an Oil Vulnerability Index (OVI)[34]. Recently, JNCC have updated the OVI to include recent survey data and using a new method, which has been named the Seabird Oil Sensitivity Index (SOSI). The OVI method is described below as this is the one that has been applied here. The OVI was applied to the density of that species recorded within each ¼ ICES square (an area measuring approximately 15 x 17 nautical miles), this data is summed to give the Area Vulnerability Score (AVS) for each ¼ ICES square. The AVS's for each square were plotted on a monthly basis to highlight areas that support vulnerable assemblages of seabirds throughout the Falklands Conservation Zones (White, *et al.,* 2001). The results of the original analysis were published in White *et al.* (2001) and the vulnerability maps for each month are presented in Figure 7-73 to Figure 7-76. These maps place the Sea Lion Field and Berkeley Sound into the wider context of Falkland Islands waters and generally, seabird density and consequently AVSs decreased with increasing water depth.

7.4.5.6.1.1 AVS in the Sea Lion Field

During the austral summer (December to February; Figure 7-73), the vulnerability of the area in the immediate vicinity of the Sea Lion Field increased, from low in December to high in February. The species contributing most to this relatively high score were prion species, black-browed albatrosses, Magellanic penguins, Wilson's and grey-backed storm-petrels and great shearwaters. Areas to the north and west of the Field were low and moderate respectively. However, an area of very high vulnerability was identified to the south-east in January.

In the austral autumn (March to May; Figure 7-74), the immediate area around the Sea Lion Field received relatively low survey effort. In March, the area was regarded as moderate to high vulnerability, due to the presence of high densities of black-browed albatrosses, Magellanic penguins and great shearwaters with lower densities of rockhopper penguins, Wilson's and grey-backed storm-petrels and white-chinned petrels. In April and May, the area received lower survey coverage. At this time, low to moderate densities of Cape petrels and black-browed albatrosses were recorded with lower numbers of grey-headed albatrosses, Antarctic fulmars and prions also present.

During the austral winter months (June to August; Figure 7-75), the area of the Sea Lion Field is classed as an area of moderate vulnerability, at which time a patchy distribution of species typical of the Patagonian Shelf in winter, was recorded. The most numerous species in this area at this time were; prion species, black-browed albatross, Antarctic fulmar and Cape petrel.

Surveys during the austral spring (September to November; Figure 7-76) recorded relatively lower densities of seabirds than at other times of the year. The area of the Sea Lion Field is therefore classed as moderately vulnerable. The seabirds present during this period include: rockhopper/macaroni penguins, prion species, Wilson's storm-petrels, black-browed albatrosses and Magellanic penguins.

[33] Note that the Vulnerability Atlas was based on two years' worth of data. Ideally data from multiple years should be utilised to account for variability in the distribution of abundance.

[34] Note: Seabird Oil Sensitivity index (SOSI) has not been used as this would require new data acquisition. SOSI would be an appropriate approach should new data be available in the future.

7.4.5.6.1.2 AVS in Berkeley Sound

The JNCC analysis has not been performed specifically for coastal waters due to the lack of dedicated survey effort close inshore. Vulnerable areas within Berkeley Sound, for seabirds, are linked to the location of colonies and aggregations associated with these colonies. This information has been used to indicate the areas of greatest concern regarding seabird interactions with Oil and Gas activity within the Sound and Figure 7-73 to Figure 7-76 show high or very high vulnerability throughout the year. The data available regarding known breeding populations allows some inferences regarding seasonal oil spill vulnerability within Berkeley Sound. High densities of resident species, such as gentoo penguin, rock and imperial shags (*Phalacrocorax magellanicus* and *P. atriceps*) and black-browed albatrosses are found in coastal waters year-round. During the summer, these are joined by large breeding populations of seabirds that spend the winter elsewhere, which results in the very high vulnerabilities.

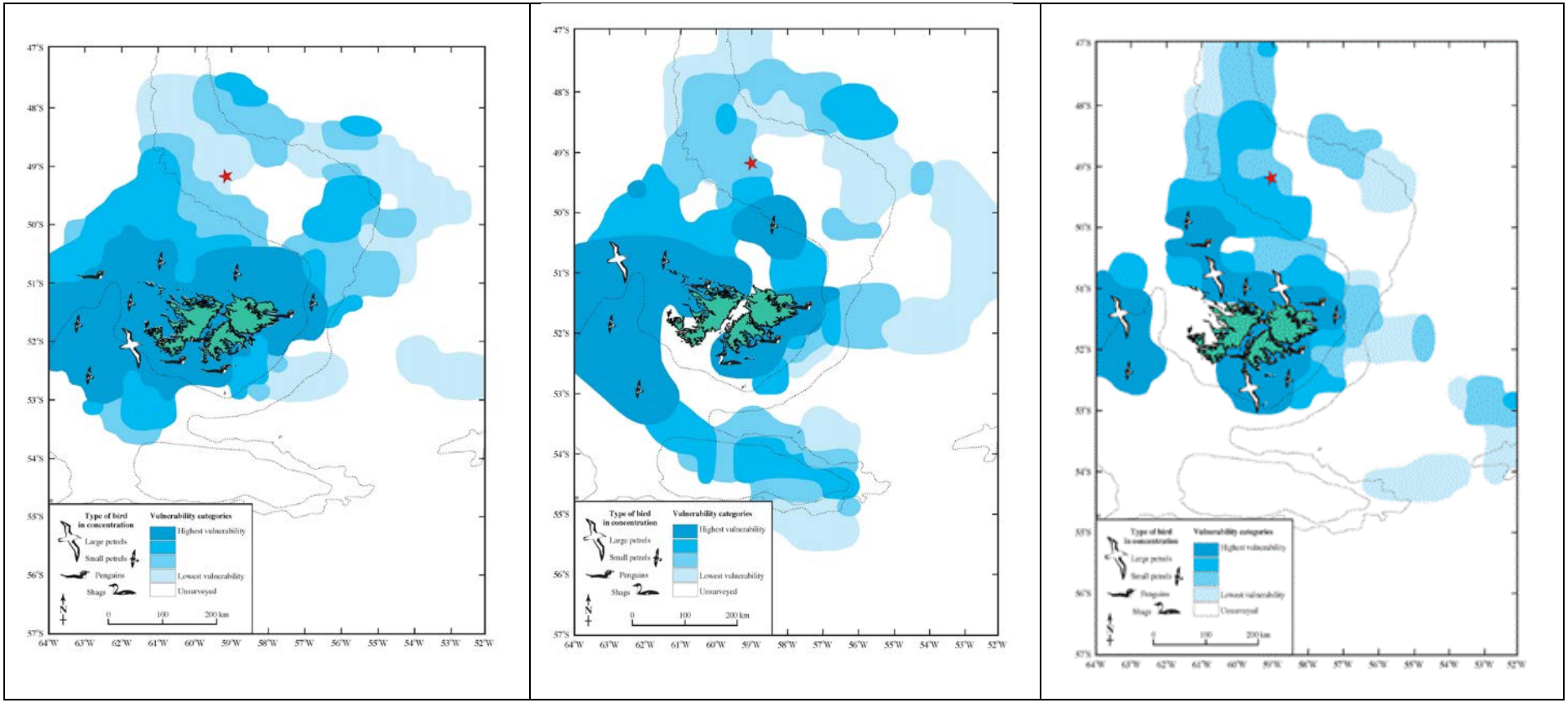


Figure 7-73: Seabird Vulnerability Maps for summer months; December (left), January (centre) and February (right) (the red star indicates the location of the Sea Lion Development) ***(source: White, et al., 2001)***

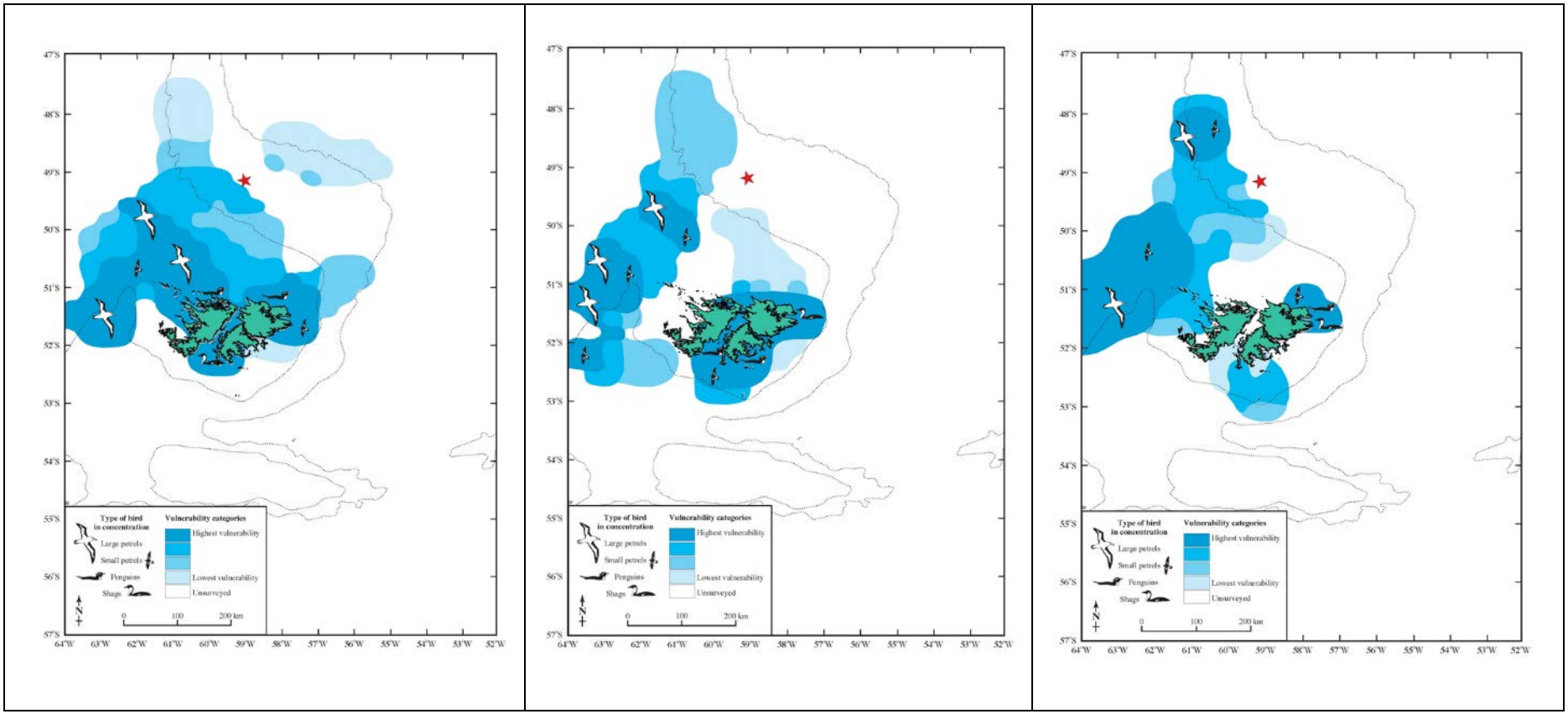


Figure 7-74: Seabird Vulnerability Maps for autumn months; March (left), April (centre) and May (right) (the red star indicates the location of the Sea Lion Development) ***(source: White, et al., 2001)***

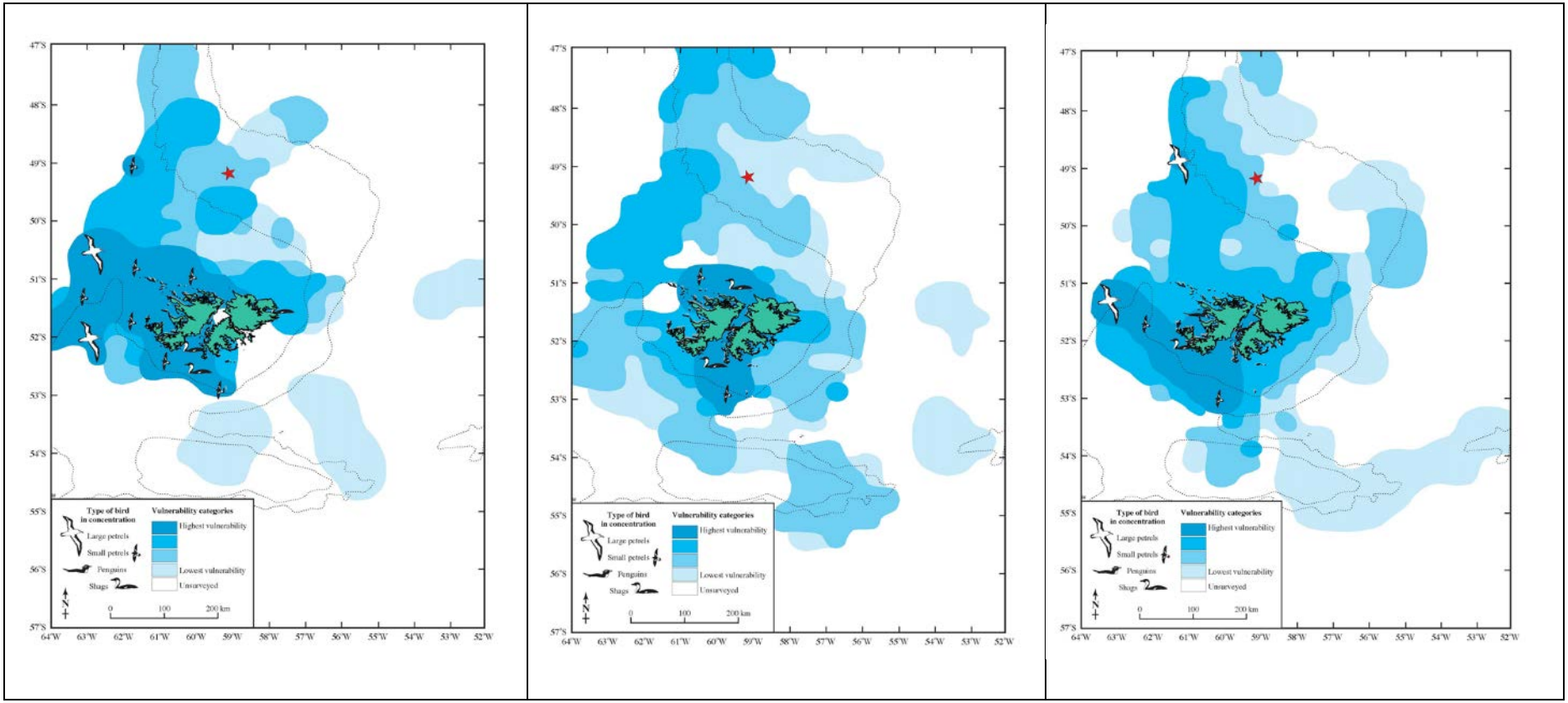


Figure 7-75: Seabird Vulnerability Maps for winter months; June (left), July (centre) and August (right) (the red star indicates the location of the Sea Lion Development) ***(source: White, et al., 2001)***

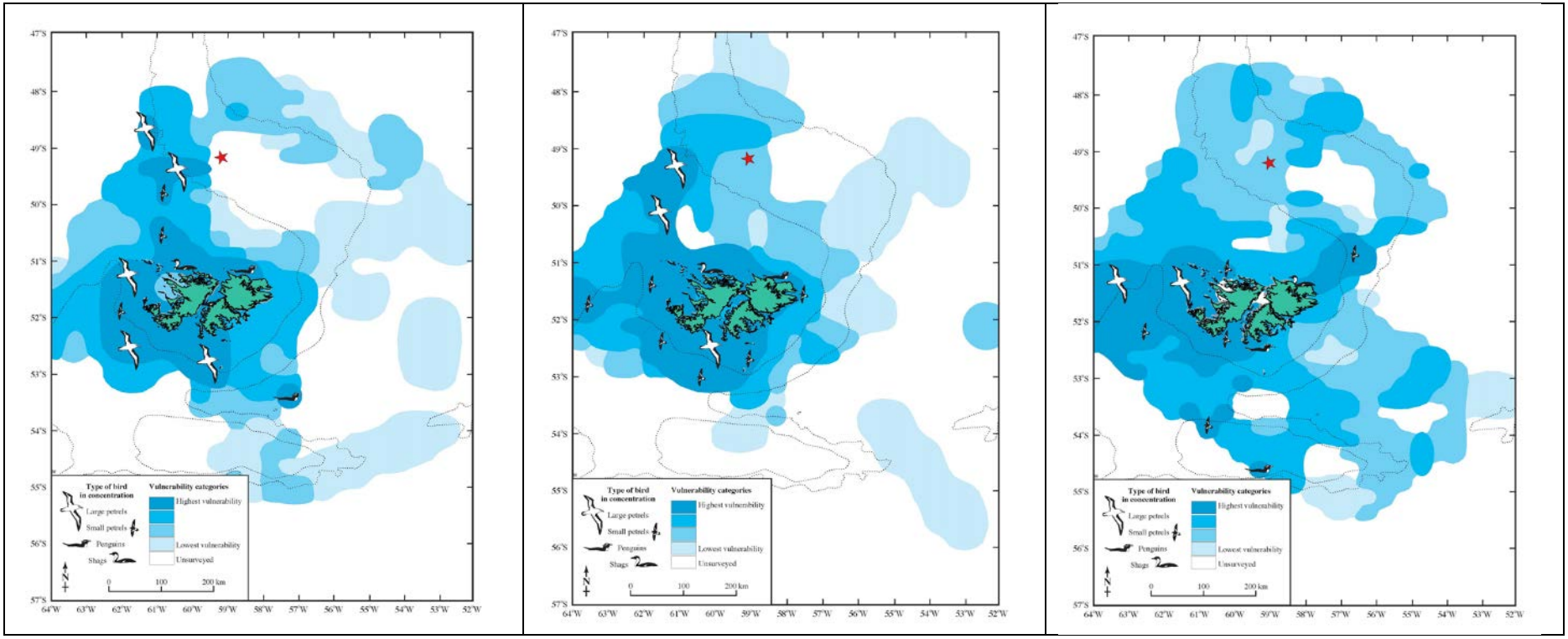


Figure 7-76: Seabird Vulnerability Maps for spring months; September (left), October (centre) and November (right) (the red star indicates the location of the Sea Lion Development) ***(source: White, et al., 2001)***

7.4.6 Marine Mammals

7.4.6.1 Introduction

Marine mammals can be divided into two main categories:

- Cetaceans (whales, dolphins and porpoises) which can be further divided into:
  - Baleen whales (Mysticeti) such as the humpback whale, sei whale and right whale, which feed by extruding plankton and small schooling fish from seawater which is filtered through baleen plates, and
  - Toothed whales and dolphins (Odontoceti) such as killer whales, sperm whales, dolphins and porpoises which all have teeth for prey capture.
- Pinnipeds (seals, sea lions and fur seals):
  - Fin-footed, semi-aquatic marine mammals that spend part of their time hauled out on land to rest, moult and breed.

The following describes the cetacea and pinnipeds known to be present in the NFB and in, and around, Berkeley Sound.

7.4.6.1.1 Cetaceans

Although cetaceans are not tied to land to breed, many species return to specific areas to calve, reproduce or feed each year. During the non-breeding period, many of the larger species make ocean-wide migrations to exploit specific feeding grounds, often at high latitudes. It is believed that many of the baleen whales recorded offshore within Falkland Islands waters are on passage through the area to and from these feeding / breeding grounds including Falklands inshore waters (e.g., Weir, *et al.,* 2019; Weir, *et al.,* 2024).

The relative abundance and availability of prey, including plankton, fish and squid, can, therefore, be of prime importance in determining the number and distribution of marine mammals and it is thought that the productive inshore waters around the Falkland Islands (including Berkeley Sound) are of importance as feeding areas for visiting and resident species (Weir, 2017; Segre, *et al*., 2021).

Confirmed sightings and stranding records indicate that at least 25 species of cetacean occur within Falkland Islands waters. Many of these species are locally rare and / or inconspicuous with some only known from stranded animals (Otley, 2012). It is generally considered that there are insufficient data available to describe the foraging and breeding areas, seasonal distribution and abundance, and diet of most marine mammal species in the Falklands (FIG, 2008a). However, two recent projects studying dolphins and sei whales in inshore waters have increased our knowledge of these animals. Therefore, the dispersion of marine mammals within Berkeley Sound is reasonably well known, but there is greater uncertainty more widely around the Falkland Islands and offshore. Nonetheless, the available data is sufficient to indicate likely species presence on a seasonal basis. Both the visual and acoustic survey methods described below have recognised limitations which need to be acknowledged. However, the datasets have been used in a complementary manner to provide a better overall picture.

7.4.6.1.2 Pinnipeds

At least, six pinniped species have been recorded in the Falkland Islands in recent years, three of which are known to breed on the islands. These are the:

- South American fur seal (*Arctocephalus australis*),
- South American sea lion (*Otaria flavescens*) (also referred to as the southern sea lion), and
- Southern elephant seal (*Mirounga leonina*).

Two of the species listed above, the fur seal and the sea lion, are known to breed within Berkeley Sound (Thompson *et al.,* 2005; Strange, 1992).

In addition to this, seasonal and vagrant visitors include:

- The Antarctic fur seal (*Arctocephalus gazella*) - seasonal visitor,
- The leopard seal (*Hydrurga leptonyx*) - seasonal visitor, and
- The Ross seal (*Ommatophoca rossii*) - vagrant.

It is possible that other species from the Antarctic or sub-tropics occur as rare visitors or vagrants also, for instance sub-Antarctic fur seal, (*Arctocephalus tropicalis*).

Fur seals and sea lion are eared seals (Otariidae), while the elephant, leopard and Ross seals are earless or 'true seals' (Phocids), which are less agile on land than eared seals, due to their less flexible hind limbs.

7.4.6.2 Marine mammals in the NFB and Sea Lion Field

7.4.6.2.1 Cetacean relative abundance and distribution surveys in the NFB and Sea Lion Field

The Falkland Islands support a diverse range of marine mammal species. Much of the information regarding the status of marine mammals in the Falklands comes from anecdotal reports and records of stranded animals (Otley, 2012; Augé, *et al.,* 2016). However, there have also been a number of at-sea surveys that have collected information on the abundance and distribution of marine mammals. From February 1998 to January 2001, a team of Joint Nature Conservation Committee (JNCC) observers systematically conducted at-sea surveys of seabirds in the waters of the Falkland Islands (White, *et al.,* 2002). Although these surveys and the methodology used were designed specifically to map seabird distribution, all marine mammals observed were recorded.

The results of these surveys have been used to map and describe the distribution of marine mammals in the Falkland Islands (White, *et al.,* 2002). However, the age of the dataset, and inherent limitations associated with at-sea surveys, raise uncertainty as to how representative it is of present-day populations. In recent years, the collection of data by marine mammal observers on seismic vessels (Polarcus, 2011; Geomotive and MRAG, 2011) and the deployment of acoustic monitoring devices (Hipsey, *et al.,* 2013) have added to our knowledge of the distribution and abundance of marine mammals in the region.

Key outcomes from the following surveys are described below:

- Marine mammals recorded during JNCC seabirds at-sea team (SAST) surveys,
- Acoustic monitoring survey of marine mammals in the vicinity of the Sea Lion Field (including a description of the acoustic baseline determined during the survey), and
- Marine mammal observations during seismic surveys in the NFB.

7.4.6.2.1.1 Marine mammals recorded during JNCC SAST survey

Visual surveys were conducted during 91 cruises covering a total area of 20,907 km^2. Figure 7-77 shows the area covered and the total survey effort between 1998 and 2001 in relation to the Sea Lion Development area. Since the end of the JNCC supported project, some additional seabird and marine mammal surveys have been conducted within Falkland Islands waters, using the same methodology. However, these datasets have yet to be collated and analysed as a whole. There is evidence that the number of large cetaceans present around the Falkland Islands (Augé, *et al.,* 2016) and more generally within the South Atlantic (e.g., Zerbini, *et al.,* 2019) have increased since the time of the JNCC surveys.

The JNCC surveys documented 6,550 individuals, comprising 17 species of marine mammal, including 14 species of cetacean and three pinniped 'species'.

Survey effort was generally greatest during the summer months due to longer daylight hours. Survey effort was lowest during the autumn months when the survey bases (Fishery Patrol Vessels, FPVs) were required elsewhere. Figure 7-78 shows the relative occurrence of sightings for each species throughout the year. These data are adjusted to account for the differences in monthly survey effort. Although several species appear to be present throughout the year (for example, sperm whales and Peale's dolphins), others exhibited a marked seasonality (for instance, hourglass dolphin (*Lagenorhynchus cruciger*) and southern bottlenose whale (*Hyperoodon planifrons*)). Baleen whale sightings were relatively infrequent between May and September, which is likely due to the migratory behaviour of these species.

It is possible to broadly describe the seasonal occurrence and general distribution of most species of cetacean. Combined with more recent survey data, a better understanding of Falkland Islands cetacean populations is developing but much remains to be learnt regarding the rarer species.

The three commonest species recorded during the JNCC surveys were all dolphins and accounted for 68.4 % of all cetacean records. The most commonly recorded species was Peale's (644 sightings) with hourglass (150 sightings) and Commerson's dolphins (*Cephalorhynchus commersonii*) (84 sightings) also regularly recorded. Southern right whale dolphins (*Lissodelphis peronii*) were only observed on five occasions. The three most frequently recorded dolphin species each exhibited a distinct spatial pattern of dispersion with very restricted overlap in their ranges (see species accounts below). However, there was evidence of seasonal variation in the dispersion pattern of hourglass dolphin.

The JNCC surveys did not record all cetacean species that are known or believed to occur around the Falkland Islands. A number of species have been found stranded in the Falkland Islands (Otley, *et al.,* 2012; Otley, 2012; Augé, *et al.,* 2016) but were not observed during the JNCC surveys (White, *et al.,* 2002). In addition to seven beaked whale species (Otley, *et al.,* 2012), dusky (*Lagenorhynchus obscurus*) and bottlenose dolphins (*Tursiops truncatus*), spectacled porpoise (*Phocoena dioptrica*), and pigmy right whale (*Caperea marginata*) each have between 1-4 stranding records in the Islands (Otley, *et al.,* 2012). The majority of the stranded species that were not recorded during JNCC surveys were beaked whales which are notoriously difficult to observe at-sea and even more difficult to identify to species level. Apart from southern bottlenose whale, which is reasonably easy to identify, the majority of beaked whales sighted were recorded as 'beaked whale species'. None-the-less, Gray's (*Mesoplodon grayi*) and strap-toothed beaked whales (*M. layardii*) have been positively identified during at-sea surveys in the south-west Atlantic, outside Falkland Islands waters. All 17 of the 'unidentified beaked whales' recorded within Falkland Islands waters during the JNCC surveys were encountered in waters greater than 1,000 m deep to the east of the Islands.

There are a number of limitations of visual surveys, which should be considered whenever using these data. Experienced and skilled observers are required as many species spend considerable periods of time below the surface, where they are undetectable. Sea state and visibility will also affect the reliability of visual surveys. The use of multiple observers and distance sampling survey techniques can increase the reliability of the data collected during dedicated marine mammal surveys, but these techniques were not applied during JNCC surveys. Acoustic methods may help to quantify the abundance of marine mammals, but these methods also have limitations. The vocal range of many of the species encountered within Falkland Islands waters is unknown. The combination of visual and static acoustic monitoring can provide a more rigorous survey methodology through amalgamation of both datasets.

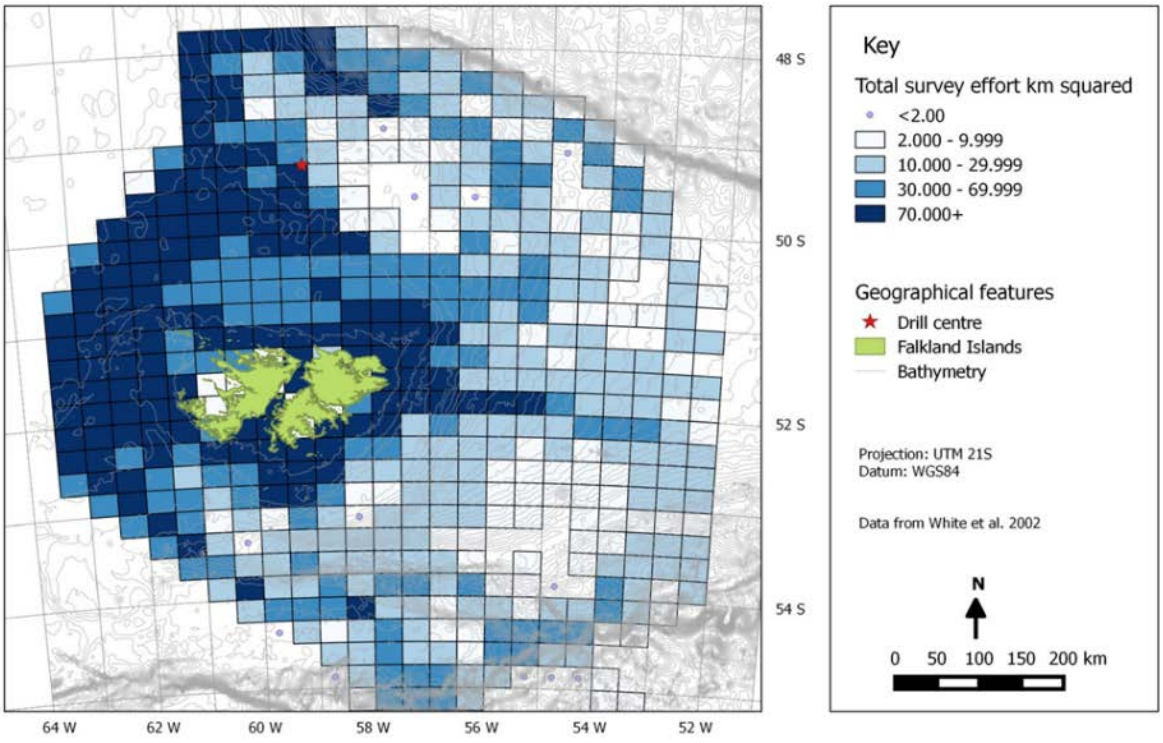


Figure 7-77: Total survey effort achieved during JNCC surveys between February 1998 and January 2001 (White, *et al.*, 2002)

Species	Month											
	Jan	Feb	Mar	Apr	Mar	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Southern Right Whale												
Humpback Whale												
Fin Whale												
Minke Whale												
Sei Whale												
Large Whale Species												
Sperm Whale												
Southern Bottlenose Whale												
Beaked Whale species												
Long-finned Pilot Whale												
Killer Whale												
Commerson's Dolphin												
Peale's Dolphin												
Hourglass Dolphin												
Southern Rightwhale Dolphin												
Fur Seal Species												
South American Sea Lion												
Southern Elephant Seal												

Key: Temporal distribution of marine mammal sightings (standardised for effort), percentage of sightings in each month (Data from White et al. 2002)

Not observed	1-5%	6-10%	11-15%	16-20%	21-25%	26-30%	30-40%	40+ %

Figure 7-78: Relative incidence of marine mammal sightings, by species, adjusted for monthly survey effort. Note that this is based on percentages of sightings for each month *(adapted from White, et al., 2002)*

7.4.6.2.1.2 Acoustic monitoring surveys of marine mammals in the vicinity of Sea Lion Field

From 2012 to 2013, Rockhopper Exploration conducted a one-year static acoustic monitoring programme in the Sea Lion Field, using wideband acoustic recordings to examine the spatial and temporal distribution of resident and transitory marine mammal populations from their vocalisations. Full details of the monitoring survey and results are described in Hipsey *et al.* (2013). The aim of the acoustic survey was to enhance the existing marine mammal dataset collected during the three-year JNCC SAST surveys and more recent seismic surveys, to provide a more comprehensive dataset for assessing potential impacts from future hydrocarbon related development of the area. A persistent, autonomous passive acoustic monitoring programme was selected as it provides an almost continuous survey methodology, which is not hampered by factors restricting the effectiveness of visual surveys, (such as, nightfall, poor visibility due to rain and fog, and long mammal dive periods) and the approach does not require the permanent presence of vessels with trained human observers. Additionally, since sound can travel significant distances underwater, the spatial coverage of a static recording programme typically extends much further than the visual horizon. Acoustic detection ranges vary by species, but low-frequency cetaceans (mostly baleen whales) can be detected tens to hundreds of kilometres away from a suitably sensitive recording instrument (Stafford, *et al.,* 2007). Signals from species vocalising and echolocating at higher frequencies may also be detected but usually at shorter ranges of hundreds to thousands of metres (Zimmer, *et al.,* 2008; Kyhn, *et al.,* 2009).

The one-year acoustic monitoring programme was split into three, four month recording phases, with mooring and recording equipment deployed at the beginning and retrieved at the end of each phase. During each of the three recording phases, five moorings were laid in 413 to 423 m of water, two moorings deployed a deepwater Autonomous Multichannel Acoustic Recorder (AMAR, JASCO Applied Sciences) and three a deepwater variant C-POD cetacean click detector (Chelonia Ltd.).

Although acoustic monitoring provides a number of advantages for marine mammal detection over visual surveys, there are also some limitations. The results of the survey record the number of vocalisations, which implies relative abundance but do not indicate the location or number of animals present. There is no assessment of inter-species, seasonal, sexual or age-related differences in vocalisations, which are likely in species such as baleen whales that rely more on sound for communication than navigation or prey detection. Additionally, there is limited knowledge regarding the range of vocalisations produced by each species. For example, Hipsey, *et al.* (2013) did not record any sei whales, although they are known to be regularly sighted during visual surveys. Since the data was analysed in 2013, the known range of vocalisations produced by Antarctic minke whales has been extended to include what are known as 'bioduck sounds' (Risch, *et al.,* 2014b). Therefore, the acoustic data may contain records of this, and other, species that were previously overlooked. Additionally, the survey only covered a period of one year and further data is required to gain a better understanding of inter-annual variation in cetacean presence / abundance.

The acoustic surveys recorded six species of marine mammal; a summary of the results is presented below in Figure 7-79 to Figure 7-84 and Table 7.27. Presented here is the combined hourly distribution of sound files with marine mammal call detections based on the manual analysis of 5 % of the acoustic data recorded 31 July 2012 to 24 July 2013 within the Sea Lion Development Area for both Autonomous Multichannel Acoustic Recorders (AMARs). Note that AMAR 1 was not operational after 19 March 2013. Grey areas represent hours of darkness.

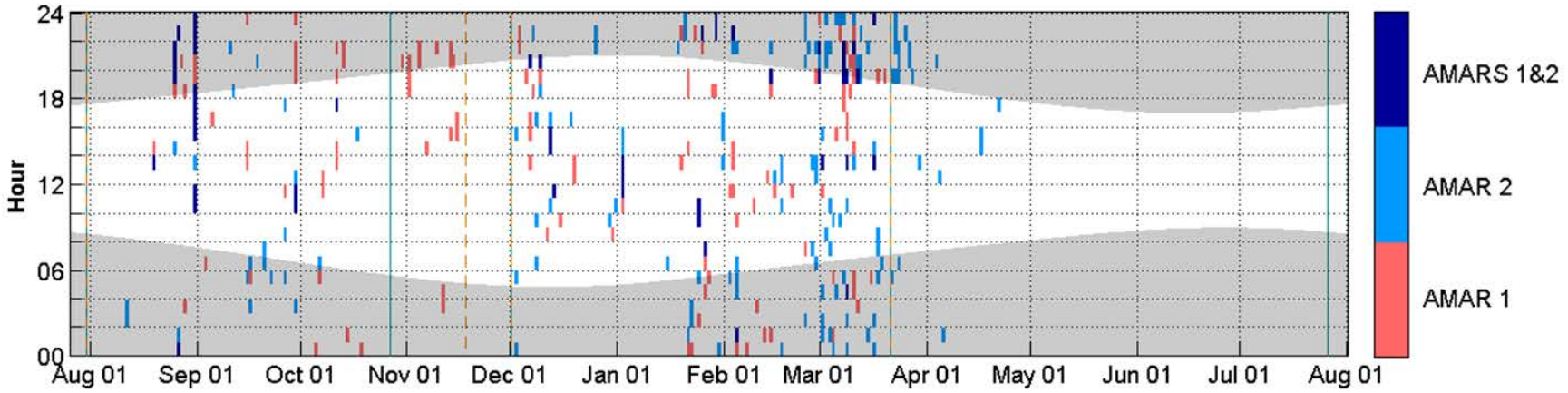


Figure 7-79: Fin whale call detections ***(source: Hipsey, et al., 2013)***

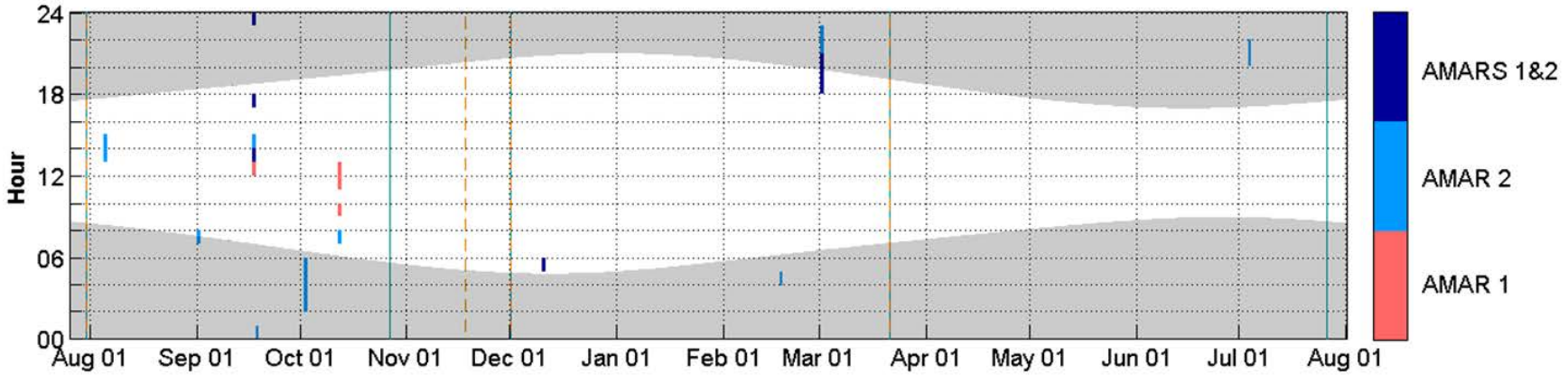


Figure 7-80: Killer whale call detections ***(source: Hipsey, et al., 2013)***

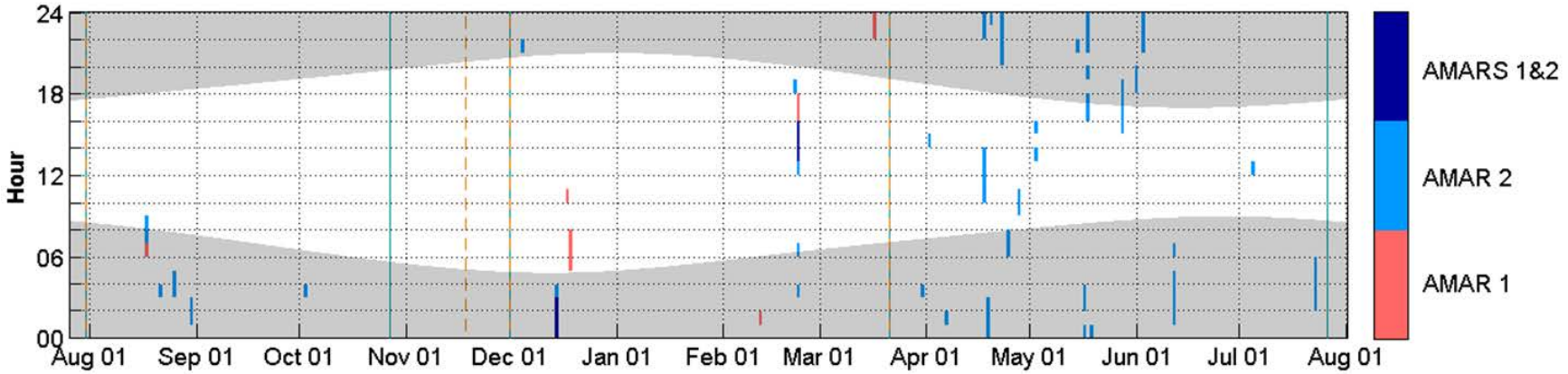


Figure 7-81: Pilot whale call detections ***(source: Hipsey, et al., 2013)***

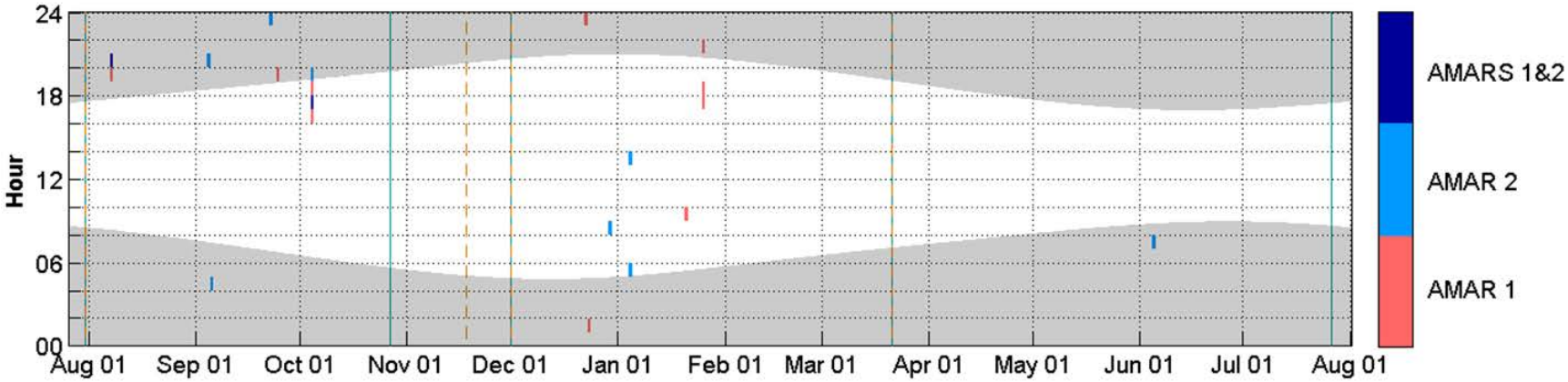


Figure 7-82: Southern right whale call detections ***(source: Hipsey, et al., 2013)***

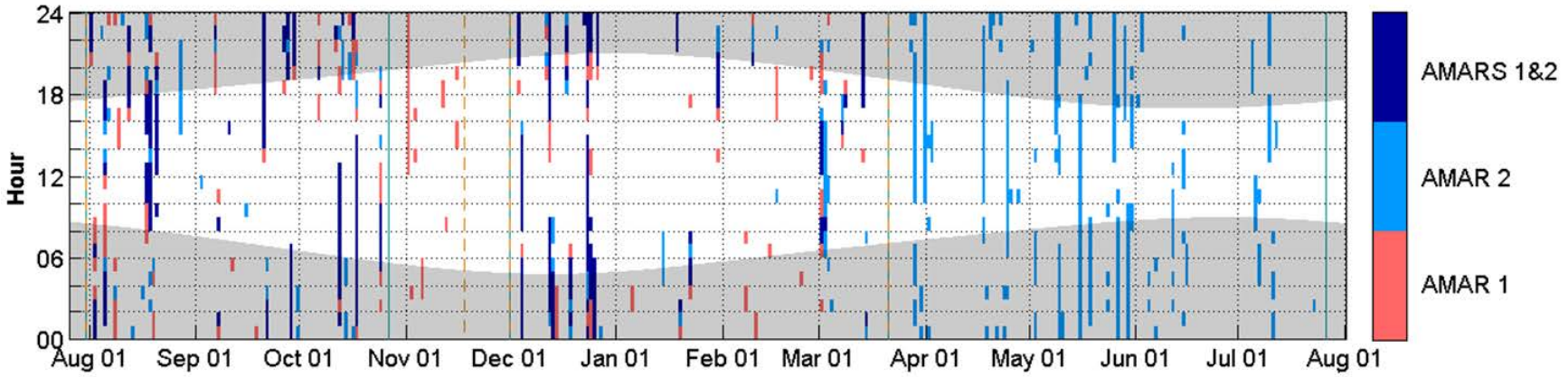


Figure 7-83: Sperm whale call detections ***(source: Hipsey, et al., 2013)***

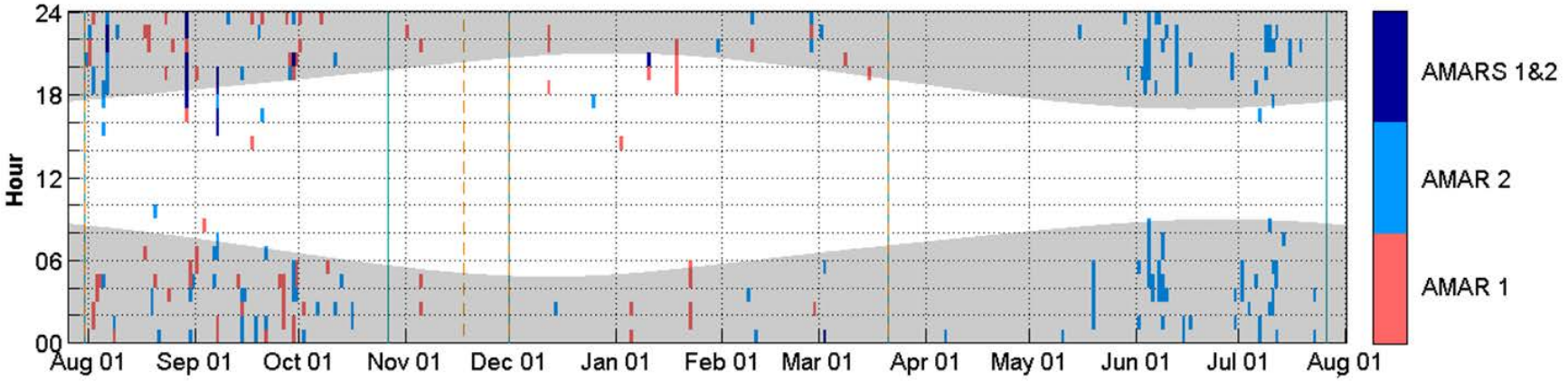


Figure 7-84: Unidentified odontocete (toothed whale) call detections ***(source: Hipsey, et al., 2013)***

Table 7.27: Summary of the number of AMAR detections in vicinity of Sea Lion Field from July 2012 to July 2013

Species	Winter - Spring 31 July - 18 Nov 2012		Austral Summer 1 Dec 2012 - 21 Mar 2013		Autumn - Winter 21 Mar - 24 Jul 2013	
	AMAR 1	AMAR 2	AMAR 1	AMAR 2	AMAR 1[1]	AMAR 2
Leopard seal	0	0	685	744	-	632
Sperm whale	297	208	364	333	-	577
Fin whale	84	48	111	169	-	21
Killer whale	10	15	11	17	-	7
Pilot whale	2	10	30	33	-	100
Southern right whale	9	6	6	4	-	1
Unidentified odontocetes	519	301	165	123	-	245

[1] The AMAR 1 data was compromised and not analysed.
(Source: Hipsey, et al., 2013)

Baseline underwater sound levels from acoustic monitoring

Ambient noise levels from each AMAR were examined to document baseline underwater sound conditions in the Sea Lion area. Recorded ambient noise levels were generally consistent with a remote, deep continental shelf location in a temperate climate with occasional fishing activity but little or no regular mercantile shipping traffic (Hipsey, *et al.,* 2013). The results from the analysis of both AMARs were generally very similar throughout the recording period, which would be expected given the generally homogenous environmental and bathymetric conditions across the Sea Lion area.

The spectral distribution of sound levels recorded at both AMAR sites suggested a general absence of anthropogenic noise, and that the ambient noise spectrum was heavily influenced by weather conditions. Noise events such as vessels were infrequent and sporadic, except during the second half of February. During this period an increased but small number of detections were made at both AMAR sites (Hipsey, *et al.,* 2013).

7.4.6.2.1.3 Marine mammal observations during seismic surveys in the NFB

In addition to the year-long acoustic monitoring programme in the Sea Lion Field, Marine Mammal Observations (MMO) were conducted as mitigation to minimise the potential impacts of seismic surveys being conducted in the NFB. Seismic surveys were conducted between January 2011 and May 2011 in the NFB (Geomotive and MRAG, 2011), and between v in Licence Block PL001 (Polarcus, 2011), which is adjacent to PL032 (Figure 7-1).

Marine mammal observations by MRAG observers, totalling 1,310 hours and 11 minutes, recorded 142 encounters of 12 different marine mammal species in the NFB (Geomotive and MRAG, 2011).

The concurrent survey within Licence Block PL001 was conducted over a period of 109 days, totalling 794.5 hours of observations. Marine mammals were sighted on 109 occasions, corresponding to 462 individuals, and representing 11 species (Polarcus, 2011).

The MMO data from the seismic surveys provides additional information relating to the presence of marine mammals in the NFB during the austral summer and autumn, which complement the acoustic monitoring data for the Sea Lion Field.

7.4.6.2.1.4 Species-specific summary of cetacean distribution offshore

The following section collates the data from above to provide species-specific accounts of distribution within Falklands waters. A summary of the abundance, distribution, life-cycle and behavioural characteristics of cetacea offshore is provided in Table 7.28 below.

Southern right whale

There is evidence that the population of southern right whales (*Eubalaena australis*) that breed off Peninsula Valdes, Argentina, was increasing, with a doubling time of 10-12 years (Reilly, *et al.,* 2013). However, since 2005 a high calf mortality rate has been observed, which has slowed the population growth and may lead to a decline in the future (IWC, 2014a). The cause of calf deaths is unknown but several factors; including, a decrease in food availability, biotoxins, disease and kelp gull attacks, have been proposed (IWC, 2014a). The migratory behaviour of southern right whales suggests that animals may travel through Falklands waters on passage between their Patagonian spring breeding grounds and summer feeding grounds near South Georgia and Antarctica. However, whaling catches and satellite tracking show that southern right whales utilise the entire SW Atlantic region. They likely forage in pelagic Falkland Islands waters year-round as well as using the area during migrations and, especially, as a wintering destination (for breeding and socialising) in nearshore waters. Satellite telemetry indicated the spatial and temporal extent to which southern right whales aggregate in Falkland Islands waters during winter and supports growing evidence that the region is key habitat for breeding behaviour (Weir, *et al.,* 2024).

The JNCC surveys recorded southern right whales on four occasions over the three-year survey period (White, *et al.,* 2002). Southern right whale up-calls were recorded in the Sea Lion area on 11 different days during the year-long monitoring period (Hipsey, *et al.,* 2013). Individual southern right whales were also recorded by the MMO during seismic surveys, with 10 individuals sighted in PL001 and four individuals during the wider NFB survey (Geomotive and MRAG, 2011; Polarcus, 2011). These results suggest that this species may be more common now than recorded by JNCC visual surveys, with animals present within the NFB in low numbers throughout most of the year. The migratory behaviour of southern right whales suggests that there will be peaks in numbers as these animals travel between their Patagonian spring breeding grounds and summer feeding grounds near South Georgia and Antarctica.

During the winter of 2017, an unusually high number of southern right whales was recorded in coastal waters around East Falkland (Section 7.4.6.3.1.1). Though it should be noted that this is when empirical data collection started, which may account for some bias in the numbers recorded.

Blue whale

Historically, blue whales (*Balaenoptera musculus*) would have been present within Falkland Islands waters. At present they are sighted extremely rarely (Augé, *et al.,* 2016; Costa and Cazzola, 2018) within Falklands waters. Whaling in the Atlantic sector of the Southern Ocean killed many thousands of blue whales (Moore, *et al.,* 1999). Although there is anecdotal evidence that the number of encounters with blue whales are increasing, the paucity of blue whale sightings in the wider Scotia Sea indicates that the population of these animals has not yet recovered.

Fin whale

Acoustic monitoring recorded fin whales (*B. physalus*) in the Sea Lion area during late August 2012, and consistently in late winter and early spring (August and September) (Hipsey, *et al.,* 2013). Detections stopped abruptly in April and did not resume before the end of the monitoring in July. Fin whales were not sighted in August and October during the JNCC surveys (White, *et al.,* 2002). Five individuals were observed in September but most sightings occurred from November to January (White, *et al.,* 2002). Fin whales were sighted by MMOs during both of the seismic surveys in the NFB, with largest numbers (12 individuals) recorded in waters adjacent to but west of the Sea Lion area (Geomotive and MRAG, 2011).

The acoustic monitoring programme recorded fin whales as present in the Sea Lion area from September until March, suggesting that past visual surveys (White, *et al.,* 2002) underestimated their occurrence north of the Falkland Islands, or, that there is inter-annual variation in the occurrence of

fin whales in this area, or, that the number of animals present has increased since 2002. In the nearby waters of the Scotia Sea (south-east of the Falkland Islands), large numbers of fin whales have been observed in recent years (A. Black, *pers. obs.*). However, most of these sightings are offshore and the exact location of these animals can show considerable inter-annual variation, which is likely to be linked to the distribution of food resources. Fin whales have been detected acoustically in the Scotia Sea and off the western Antarctic Peninsula starting in February and peaking in late summer and the autumn (Širović, *et al.,* 2009). Large aggregations of feeding fin whales were also observed in the autumn (March–April 2012) off Elephant Island at the tip of the Antarctic Peninsula (Burkhardt and Lanfredi, 2012; Herr, *et al.,* 2022).

The presence of these animals in waters to the south of the Falklands is seasonal and therefore it is reasonable to assume that many migrating animals will pass through Falkland Islands waters. The peak in Falklands recordings in March followed by the cessation of all detections could therefore indicate a pulse of migrating whales from those feeding grounds.

Fin whales have recently been downgraded to 'Vulnerable' on the IUCN Red List, due to increasing population size, and are also afforded conservation status and management under the Convention on International Trade in Endangered Species (CITES) and the Convention on the Conservation of Migratory Species of Wild Animals (CMS).

Sei whale

JNCC surveys recorded 45 sei whales (*B. borealis*). Most of these were off the east coast of the Islands in relatively shallow inshore waters (White, *et al.,* 2002). Sei whale was the most frequently sighted, and third most abundant, species recorded by the MMO during the PL001 seismic survey with 67 individuals recorded (Geomotive and MRAG, 2011). During the NFB seismic survey, they were the third most frequently sighted and fourth most abundant, species recorded (Polarcus, 2011). Conversely, analysis of the acoustic data from the Sea Lion area did not contain any confirmed sei whale calls. However, it is believed that this is due to the potential overlap in calls from sei and fin whales (Watkins, 1981; Baumgartner, *et al.,* 2008) and it is possible that the fin whale detection records included some sei whale calls (Hipsey, *et al.,* 2013). With the recent PAM work conducted in Berkeley Sound by Cerchio and Weir (2022) these data could be used to determine whether sei whales were detected in the NFB Hipsey *et al.* (2013) study.

For many years large numbers of sei, and possibly fin, whales have been observed in inshore waters around the Falkland Islands (White, *et al.,* 2002; Otley, 2012; Augé *et al.,* 2016; Cerchio and Weir, 2022). These animals are only present on a seasonal basis and are likely to pass through the NFB during their migration. Recent projects have surveyed the distribution of sei whales, and other cetaceans, in inshore waters (Thomson and Munro, 2014; Weir, 2017; Costa and Cazzola, 2018; Weir, *et al.,* 2018; Weir, *et al.,* 2021). The preliminary results and anecdotal observations indicate that sei whales are frequently encountered in inshore waters during the summer and autumn months (see Section 7.4.6.3.1 for further details). Sei whales are listed as 'Endangered' on the IUCN Red List and are also afforded conservation status and management under CITES and CMS.

Minke whale

Antarctic minke whales (*B. bonaerensis*) were encountered widely within Falklands waters and recorded throughout the year, although most animals were recorded between September and April (White, *et al.,* 2002). Minke whales were recorded during both of the marine mammal surveys conducted during seismic operations in the NFB (Geomotive and MRAG, 2011; Polarcus, 2011) but were not detected by acoustic surveys (Hipsey, *et al.,* 2013). The lack of minke whales in the acoustic record is unexpected but could be due to poor knowledge of the vocal range of this species in the South Atlantic at the time of the analysis. This interesting as Risch *et al.* (2014a) regularly detected minke whales on PAM as they migrate in the north Atlantic. In addition, at least one stranding in the

Falklands has been genetically attributed to *B. acutorostrata* (common minke whale) (C. Weir, *pers. comm*.) and it is likely that both species utilise Falklands waters.

Humpback whales

Humpback whales (*Megaptera novaeangliae*) have been infrequently recorded within Falklands waters. JNCC surveys encountered seven animals in Patagonian Shelf waters, all between October and March. Acoustic monitoring and marine mammal observations from seismic vessels did not record humpback whales in the NFB.

Satellite tracking (Zerbini, *et al.,* 2006) and photo-identification indicate that animals from the population breeding off the coast of Brazil migrate to feed off South Georgia and the South Sandwich Islands in the summer months. Satellite tracks and the lack of sightings of these animals suggest that few of these whales pass through Falklands waters during this migration.

Sperm whale

Sperm whales (*Physeter macrocephalus*) were observed on 21 occasions in the JNCC surveys, the highest number of sightings occurring in October. About half of the sightings occurred in an area just north of the Sea Lion area. Although this seems to be a small number of sightings over a three-year survey, the distribution of the records indicates that animals are present in the deeper waters of the FOCZ year-round. A single sperm whale was observed during the MMO in PL001, and four individuals were observed during MMO in the NFB seismic survey (Geomotive and MRAG, 2011; Polarcus, 2011). The low number of sightings is likely to be due to the behaviour of the animals, which spend much of their time below the surface, and the limited survey effort in their preferred habitat type. Nevertheless, because sperm whales echolocate almost continuously while diving, and dive for extended periods of time, acoustic monitoring is a powerful survey method for this species (Whitehead, 2003). Indeed, Hipsey *et al.* (2013) found sperm whales were the most commonly recorded species during their year-long study. Detections occurred throughout the acoustic monitoring period without any obvious seasonal trend.

Sperm whales are notorious for depredating Patagonian toothfish in the local longline fishery (Yates and Brickle, 2007). All the available evidence suggests that sperm whales, likely to be mature males, are present within the deeper waters of the Falklands Conservation Zones throughout the year.

Southern bottlenose whale (beaked whale)

The JNCC surveys recorded southern bottlenose whales (*Hyperoodon planifrons*) between September and February. All encounters occurred in waters over 1,000 m deep. This species was apparently absent from Falklands waters in the winter months. It was not detected during acoustic monitoring and only a single animal was observed during seismic operations (Geomotive and MRAG, 2011).

Nonetheless, sightings of *Hyperoodon* have occurred in waters to the north, northeast and east of the Falkland Islands (White, *et al*., 2002).

Other (unidentified) beaked whales

Beaked whales (namely *Mesoplodon, Ziphius and Berardius* spp.) are notoriously difficult to identify at-sea and none of the 15 animals recorded during JNCC surveys were specifically identified. Nonetheless, stranding records indicate that a number of beaked whale species could be present within Falkland Islands waters (Otley, *et al.,* 2011). All sightings during the JNCC surveys occurred in waters over 1,000 m deep, with the majority coming from the region of the Falkland Trench to the south-east of the Islands. However, Otley (2012) suggests that in the Falkland Islands, beaked whales also use shallower waters while Filatova *et al.* (2024) suggest that beaked whales can specialise in the use of coastal habitat (e.g., depths <300m).

Killer whale

The JNCC surveys recorded seven killer whale (*Orcinus orca*) sightings over three years, primarily on the Patagonian Shelf, (White, *et al.,* 2002). Killer whales were detected in the Sea Lion area on ten different days during the year-long acoustic monitoring period, with seven of the records occurring between July and mid-October (Hipsey, *et al.,* 2013). Killer whales were observed during the PL001 and NFB seismic surveys on two and one occasion respectively (Geomotive and MRAG, 2011; Polarcus, 2011). Killer whales are known to regularly depredate longlines in the Falkland's Patagonian toothfish fishery when vessels are fishing in the north of the FOCZ, relatively close to the Licence Blocks (Yates and Brickle, 2007). Observers on fishing vessels recorded killer whales only to the north-east of the Islands despite a considerable amount of fishing in other areas throughout the year (Yates and Brickle, 2007). The evidence suggests that a small resident population of killer whales may occur in the region of the shelf-break to the north of the Falkland Islands.

Satellite tracking indicates that Type B killer whales migrate just east of the Falkland Islands when travelling between the Antarctic Peninsula and sub-tropical waters of the South Atlantic (Durban and Pitman, 2012). These animals appear to travel rapidly through the region, but they could account for some of the acoustic detections and sightings.

Long-finned pilot whale

Long-finned pilot whale (*Globicephala melas*) sightings occurred primarily between February and September during the JNCC surveys (White, *et al.,* 2002). Acoustic detections from the Sea Lion area also indicated the presence of pilot whales during the austral autumn and winter, with the majority of detections occurring from mid-February until late August (Hipsey, *et al.,* 2013). Pilot whales were recorded on approximately 35 days throughout the year-long monitoring period (Hipsey, *et al.,* 2013). Several small groups of pilot whales were also observed during the seismic survey MMO, with a total of 88 individuals over three sightings in PL001 and 75 individuals over four sighting occasions in the NFB survey (Geomotive and MRAG, 2011; Polarcus, 2011). In contradiction to most survey results, while observing on fishing vessels working in the deeper waters of the FOCZ, pilot whales were observed on a daily basis in large numbers during the summer but rarely during the winter months (A. Black, *pers. obs.*).

The large number of pilot whale strandings on the Falkland Islands (Otley, 2012) suggests that there is a sizeable population associated with Falklands waters. This species is regularly sighted in large groups from fishing vessels operating over the continental slope (A. Black, *pers. obs.*). White, *et al.* (2002) often recorded other species of cetacean in association with pilot whales, especially hourglass dolphins and to a lesser extent southern right whale dolphins.

Peale's dolphin

Peale's dolphin (*Lagenorhynchus australis*) was the most commonly recorded marine mammal species during the JNCC survey period with 1,952 animals recorded during 644 encounters. Peale's dolphins were almost exclusively restricted to Patagonian Shelf waters and were only regularly recorded in waters deeper than 200 m to the south-west of the Falkland Islands (Figure 7-85). Peale's dolphins were regularly recorded at the western boundary of the Falklands EEZ, a strong indication that the distribution of the species is continuous between the Falkland Islands and mainland South America. However, genetic sampling from inshore waters indicates little genetic mixing between the Falklands and South American populations (Costa and Cazzola, 2018). There was no clear evidence of any seasonal changes in the abundance, distribution or behaviour of these animals.

Peale's dolphin was also the most frequently recorded marine mammal on both seismic vessel surveys (Geomotive and MRAG, 2011; Polarcus, 2011).

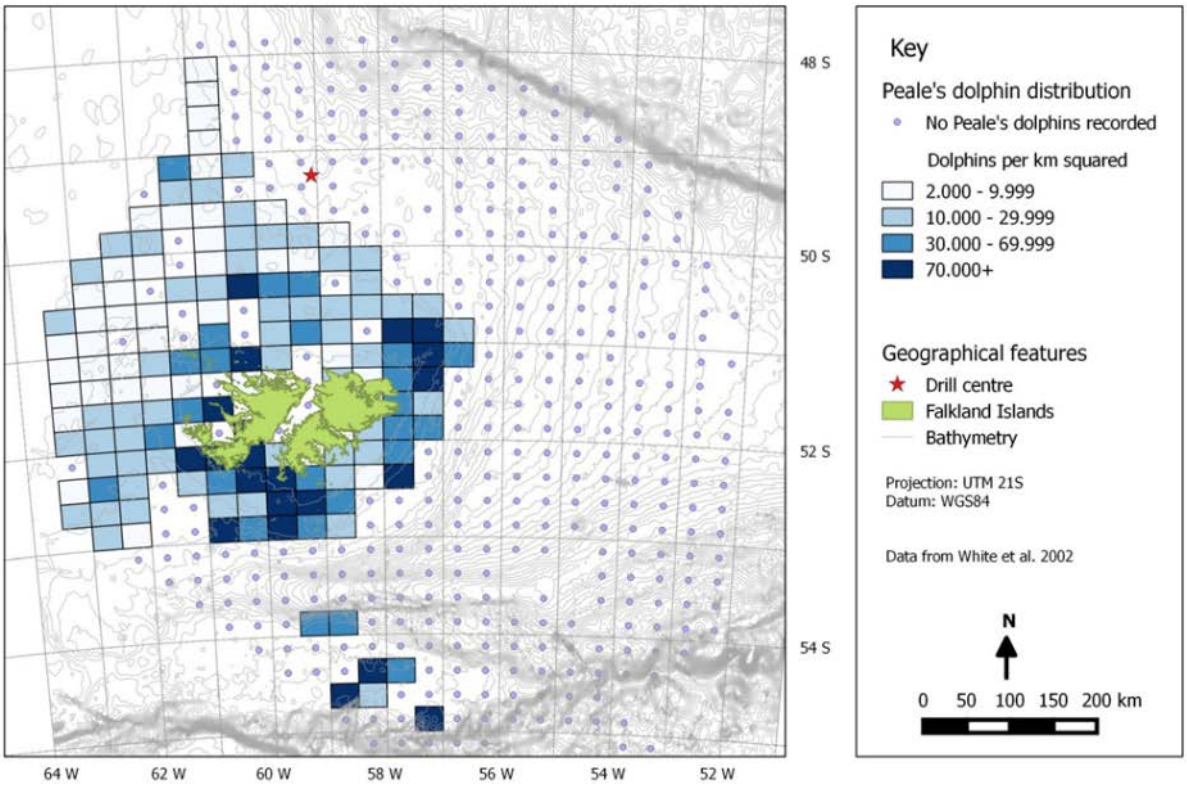


Figure 7-85: Peale's dolphin distribution recorded during JNCC surveys, all months

Hourglass dolphin

A total of 150 sightings of 792 hourglass dolphins (*L. cruciger*) was recorded during the JNCC surveys. Between September and February, hourglass dolphins were recorded frequently during surveys in oceanic waters. Outside this period, hourglass dolphins were only rarely recorded, suggesting that they occur seasonally within Falklands waters. The majority of hourglass dolphin records were in continental shelf slope and oceanic waters (Figure 7-86). The JNCC surveys clearly identified spatial segregation between Peale's and hourglass dolphins, with virtually no overlap in the ranges of these two species (White, *et al.,* 2002). Hourglass dolphins were also one of the most frequently recorded species from seismic vessels (Geomotive and MRAG, 2011; Polarcus, 2011).

The acoustic monitoring survey recorded an unidentified odontocete species (toothed whales, killer whales and dolphins), which could not be definitively identified to species level (Hipsey, *et al.,* 2013). The occurrence of the odontocete calls closely matched the dolphin C-POD detections and the click characteristics and habitat preferences suggest the hourglass dolphin as the potential source (Hipsey, *et al.,* 2013).

It is likely that hourglass dolphins would occur in the deeper waters surrounding the Sea Lion area.

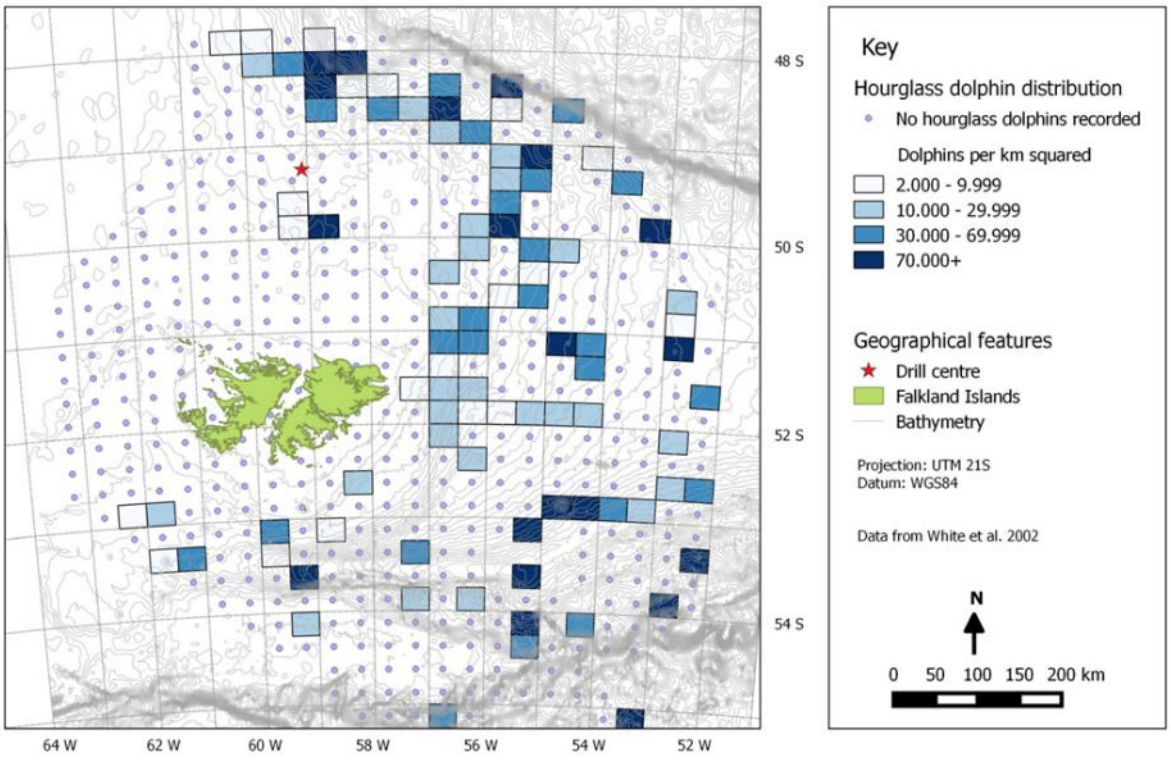


Figure 7-86: Hourglass dolphin distribution recorded during JNCC surveys, all months

Commerson's dolphin

Commerson's dolphins (*Cephalorhynchus commersonii*) were recorded during JNCC surveys in every month of the year except May. A total of 276 animals was recorded in 84 encounters. All records of Commerson's dolphins were from either partially enclosed or coastal waters in the immediate vicinity of the Falkland Islands (Section 7.4.6.3.1.5).

Southern right whale dolphin

Southern right whale dolphins (*Lessodelphis peronii*) were only recorded on five occasions during JNCC surveys, all in waters over 200 m deep. However, the tendency for this species to occur in large groups resulted in a total of 231 animals recorded. Over half of these were in a single group of 120 animals, the largest group of any dolphin species recorded during surveys. On all five occasions when southern right whale dolphins were recorded they were in the company of long-finned pilot whales.

7.4.6.2.2 Pinniped abundance and distribution surveys in the NFB

The presence of pinnipeds in the NFB was recorded during:

- The JNCC SAST surveys described above,
- Acoustic monitoring within the Sea Lion Field, and
- Using satellite tracking studies.

7.4.6.2.2.1 Species-specific pinniped distribution and abundance in the NFB

The following describes the distribution and abundance of pinniped species in the NFB.

South American sea lion

Sea lions (*Otaria flavescens*) were recorded in all months but the majority of records came from inshore waters (White, *et al.,* 2002). Sea lions were also recorded in low numbers during surveys from seismic vessels (Geomotive and MRAG, 2011; Polarcus, 2011).

Tracking of adult female sea lions indicates a high degree of specialisation regarding foraging strategy, which is consistent over a number of years. Although largely restricted to Patagonian Shelf waters, adult female sea lions displayed either inshore or offshore strategies, with offshore foragers consistently tracked to the edge of the Patagonian Shelf (waters of approximately 200 m depth). Telemetry and diet data indicate a further specialisation in animals foraging offshore, with individuals displaying either benthic foraging or a mixture of benthic and pelagic foraging (Baylis, *et al.,* 2015).

The predicted distribution, from tracking data, is shown in Figure 7-87, which supports earlier results of tracking and at-sea observations.

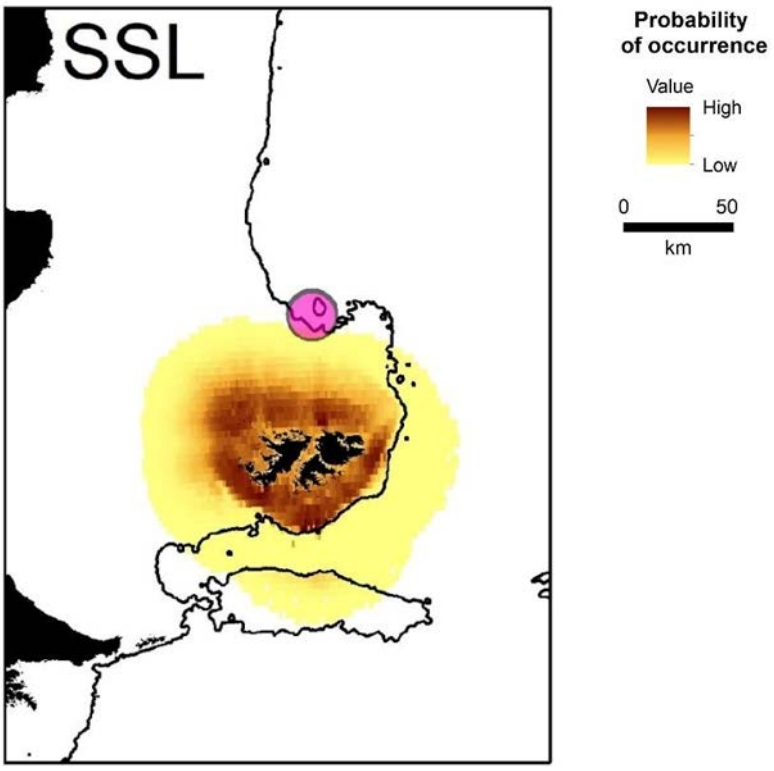


Figure 7-87: South American sea lion, predicted habitat use (predicted presence) for sea lions breeding on the Falklands from the available biotelemetry and biologging data. The pink dot represents the drill centre *(adapted from Baylis, et al., 2019a)*

Fur seal species

Fur seals (*Arctocephalus gazella and A. australis*) were the most numerous pinniped species recorded during JNCC surveys. Although the observers were aware that South American and Antarctic fur seals were both present, it was not possible at sea to reliably identify all fur seals to species level and therefore all fur seals were recorded as 'fur seal species'. They were recorded in all months but there was a distinct peak in the number recorded during the winter. It is thought that this marked an influx of Antarctic fur seals into Falklands waters from the South Georgia breeding population, a hypothesis that is supported by tracking data (Staniland, *et al.,* 2012).

Adult female fur seals from North Fur Island, Volunteer Rocks and Bird Island have been tracked during mid to late lactation (winter and spring) when females regularly alternate between foraging at sea and provisioning dependent offspring onshore (Figure 7-88a & b respectively). Throughout the tracking studies, fur seals rarely travelled beyond the edge of the Patagonian Shelf. During late lactation female fur seals appear to disperse more widely, travelling as far as the South American coast, but remain over the Patagonian Shelf (Baylis, *et al.,* 2018).

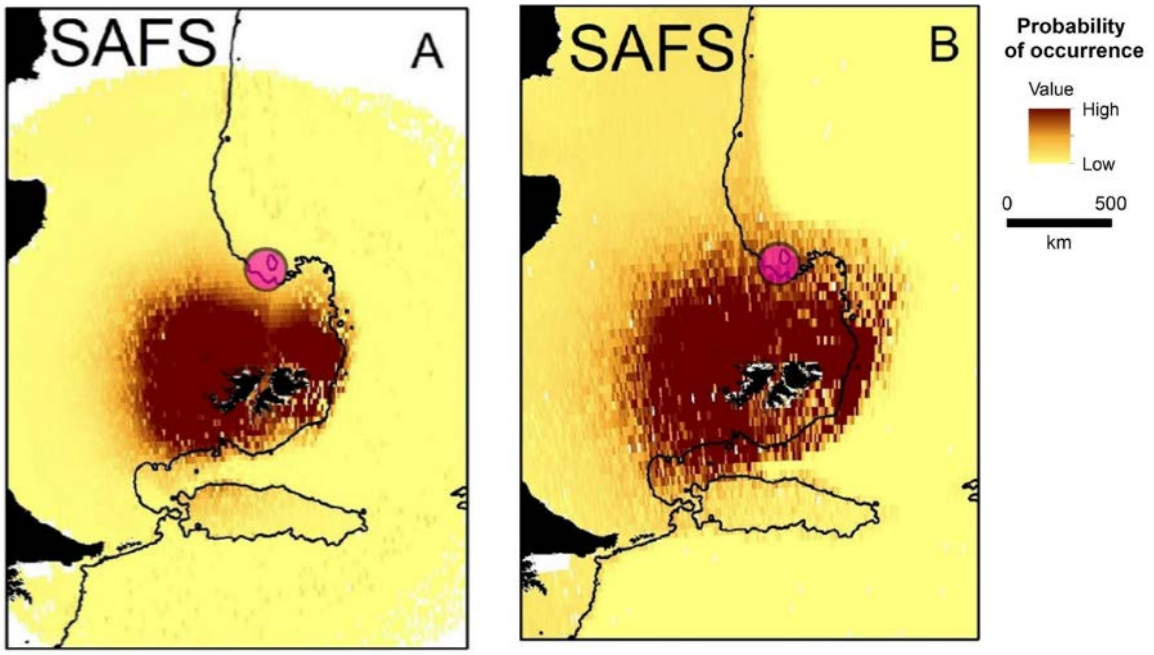


Figure 7-88: South American fur seal, predicted habitat use for breeding on the Falklands from the available biotelemetry and biologging data. A = winter and B = spring. The pink dot represents the area of the drill centres *(adapted from Baylis, et al., 2019b)*

Southern elephant seal

Southern elephant seals (*Mirounga leonina*) spend the majority of the time below the surface, and therefore visual surveys are unlikely to accurately record the distribution of the species. White *et al.* (2002) recorded 13 southern elephant seals and no other visual or acoustic surveys have recorded this species. Most of the records were clustered along the shelf-break to the north of the Islands.

Between 2009 and 2011, 23 female elephant seals were satellite tracked from Sea Lion Island (Galimberti and Sanvito, 2012), the main breeding location for elephant seals in the Falkland Islands. The resulting tracks indicate that the majority of foraging trips of the animals tracked are to the south of the Falklands (some extending into the South Pacific), although three animals were tracked to the shelf-break to the north of the Falkland Islands (Figure 7-89).

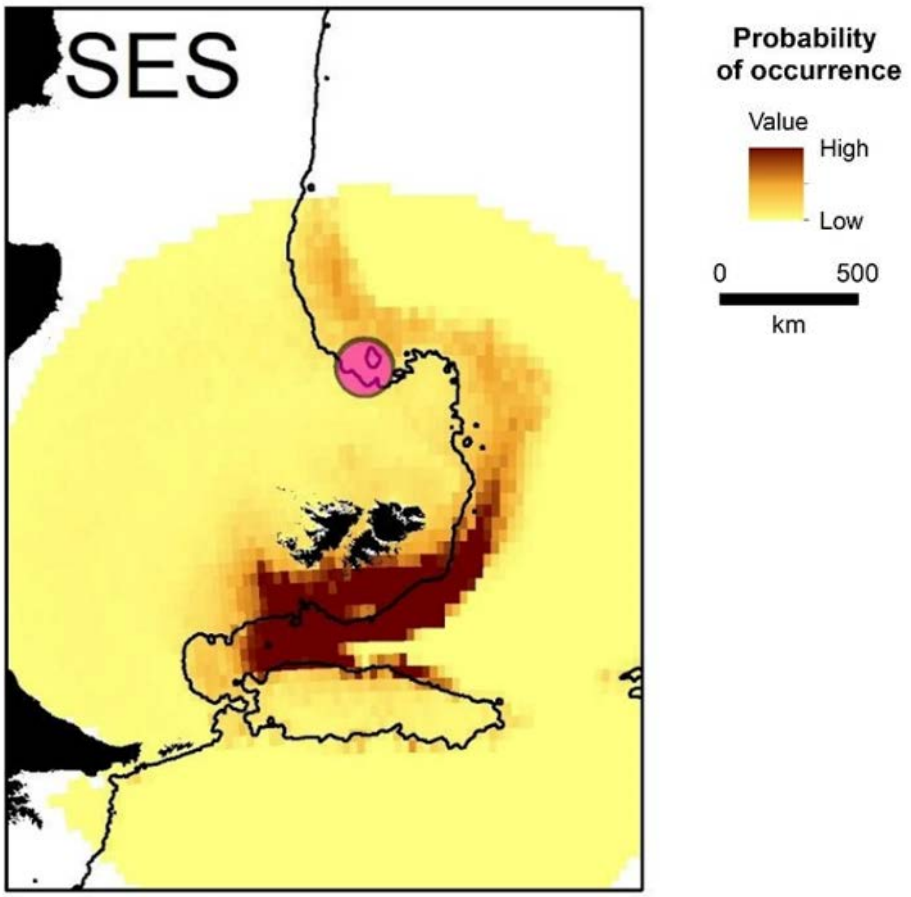


Figure 7-89: Southern elephant seal, predicted habitat use for breeding on the Falklands from the available biotelemetry and biologging data. The pink dot represents the area of the drill centres ***(adapted from Baylis, et al., 2019b)***

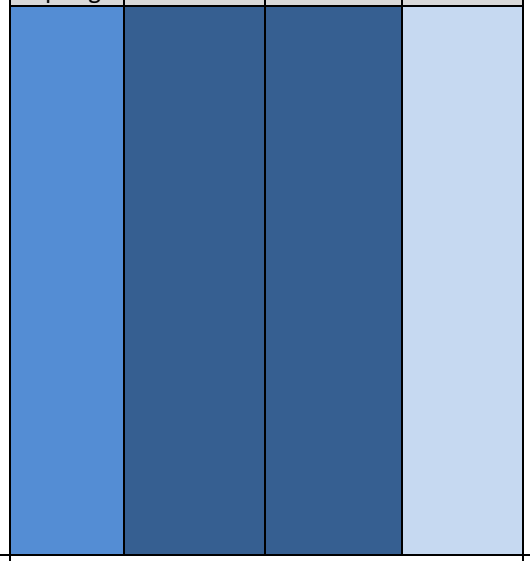
Leopard seal

Leopard seals (*Hydrurga leptonyx*) accounted for the greatest number of detections throughout the acoustic monitoring study with the majority of leopard seal detections occurring in March and April, and all detections concentrated in late austral summer and autumn (Hipsey, *et al.,* 2013). In contrast, there were no sightings of this species during the JNCC surveys or by the MMO on the seismic vessels in the NFB (White, *et al.,* 2002; Geomotive and MRAG, 2011; Polarcus, 2011). The characteristics of the recorded calls indicate the calling animals were sexually immature males (Hipsey, *et al.,* 2013). During the summer, leopard seals occur in the Antarctic pack ice and disperse northward with the advancing pack during the winter. Leopard seals are known to be more numerous around sub-Antarctic islands, such as South Georgia, in the winter months (Walker, *et al.,* 1998; Rodríguez, *et al.,* 2003). In the Falklands, individual leopard seals are seen from time-to-time but they are not regarded as anything more than occasional visitors (Strange, 1992). Records elsewhere in the world indicate that this species, particularly young males, have a tendency to wander far from their Antarctic breeding grounds (Aguayo-Lobo, *et al.,* 2011; Rodríguez, *et al.,* 2003; Hamilton, 1939). Cerchio and Weir (2022) suggest that the sounds recorded and attributed to leopard seals could be sei whales based on their passive accoutic monitoring work in Berkeley Sound. However this will warrants further investigation.

7.4.6.2.3 Summary of cetaceans in the NFB

Table 7.28 provides a summary of cetacean abundance in the NFB, distribution, life-cycle and behavioural characteristics.

Table 7.28: Summary of cetaceans in the NFB and Sea Lion Field

Species	IUCN status	Present in the Sea Lion area	Global distribution	Foraging strategy	Auditory type	Behaviour
Southern right whale	LC	✓ Spring | Summer | Autumn | Winter 	Circumpolar in the southern hemisphere[1]	Surface skim-feeding	Low frequency	Slow lumbering swimmers but can be acrobatic, breaching clear of the water or lifting the tail clear of the water. The southern right whale breeds between July-November in Península Valdés (Argentina) and Santa Catarina (Brazil) (Danilewicz, *et al*., 2016; Mandiola, *et al*., 2019; Renault-Braga, *et al*., 2022) and migrates south in the summer. In recent decades, high calf mortality has been reported in Argentina (Cooke and Zerbini, 2018). In the Falkland Islands, regionally important aggregations of southern right whales (including for mating) occur during winter in coastal waters (Weir and Stanworth, 2020). Recently, satellite tags have been deployed on Southern right whales in the Falkland Islands e.g., (Weir, 2022).
Blue whale	EN	✓ Although not recorded in the Sea Lion area during surveys, blue whales are known to be present in very low numbers in the region.	Found in all oceans in low numbers	Lunge feeding	Low frequency	Migrate between low latitude wintering grounds and high latitude feeding grounds in summer
Fin whale	VU	✓ Spring | Summer | Autumn | Winter 	Found in all oceans of the world	Lunge feeding	Low frequency	Capable of swimming at speeds of 19 knots. Movements poorly understood but most frequently encountered offshore or where deep water is found near the coast (White, *et al.,* 2002). Seen in small groups many of

Species	IUCN status	Present in the Sea Lion area	Global distribution	Foraging strategy	Auditory type	Behaviour
						which may be present within a small area (tens of km^2)
Antarctic minke whale	NT	✓ Spring / Summer / Autumn / Winter	Southern Hemisphere distribution	Lunge feeding	Low frequency	Movements poorly known but some populations appear to be resident year-round. It is acknowledged that common Minke whales likely utilise Falklands waters too
Sei whale	EN	✓ The most abundant large whale seen in inshore waters also frequently sighted offshore. Spring / Summer / Autumn / Winter	Found in all oceans, sub-Antarctic waters are favoured feeding grounds in summer[2]	Lunge feeding	Low frequency	Dives more regularly than most large whales, surfacing at approximately one-minute intervals. One of the fastest of the great whales, sei whales swim a few metres below the surface. As with all whale species, progress can be followed by 'fluke prints' left on the surface in the animal's wake. Recently, satellite tags have been deployed on Sei whales in the Falkland Islands and highlights the importance of coastal nearshore waters (https://falklandsconservation.com/sei-whale-tracking/).
Humpback whale	LC	✓ Although not recorded in the Sea Lion area during surveys, humpback whales are known to be present in low numbers in the region. Spring / Summer / Autumn / Winter	Found in all oceans of the world	Lunge feeding	Low frequency	A population breeding off the coast of Brazil is thought to migrate to feed off the South Sandwich Islands in the summer months. Recent boat-based surveys in the Falkland Islands highlight annual variability in occurrence of Humpback whales (Weir, 2022).
Sperm whale	VU	✓ Spring / Summer / Autumn / Winter	Found from the Arctic to the Antarctic	Deep diving	Mid frequency	Sperm whales are encountered in the deeper water of the Falkland Islands throughout the year (White, *et al.,* 2002). All the animals present are males that

Species	IUCN status	Present in the Sea Lion area	Global distribution	Foraging strategy	Auditory type	Behaviour
						periodically migrate to warmer waters to breed; however, these movements are not coordinated.
Beaked whales (Southern bottlenose whale)	LC	✓ Spring / Summer / Autumn / Winter	Found throughout the Southern Ocean	Deep diving (some evidence for shallow water too)	Mid frequency	Present in the deeper waters of the Falklands during the spring and summer months (White, *et al.,* 2002). A number of other species of beaked whale are present on the basis of stranding data, but these animals are rarely seen (Otley, *et al.,* 2011).
Long-finned pilot whale	LC	✓ Spring / Summer / Autumn / Winter	High latitudes in the northern and southern hemisphere	Deep diving	Mid frequency	Can be encountered in large groups (100 + animals). There appears to be seasonal changes in distribution within Falklands waters, but movements poorly understood (White, *et al.,* 2002).
Killer whale	DD	✓ Spring / Summer / Autumn / Winter	Found in all oceans of the world.	Shallow / deep dives	Mid frequency	Killer whales are known to pass through Falklands waters on rapid transit from Antarctic Peninsula to sub-tropical waters (Durban and Pitman, 2012). Additionally, there are likely to be resident populations. Seen year-round from longline vessels fishing to the north-east of the Sea Lion Field.
Commerson's dolphin	LC	X	Only southern South America, the Falklands and Kerguelen	Shallow dives	High frequency	Only observed in coastal waters (Franchini, *et al.,* 2020).
Peale's dolphin	LC	✓ Largely restricted to the Patagonian Shelf (waters <200 m).	Restricted to southern South America and	Shallow dives	High frequency	Thought to be resident with no discernible seasonal movements detected in the survey data. More numerous inshore but found

Species	IUCN status	Present in the Sea Lion area				Global distribution	Foraging strategy	Auditory type	Behaviour
		Spring	Summer	Autumn	Winter	the Falkland Islands			across the Patagonian Shelf (waters <200 m) (Franchini, *et al.,* 2020). Very enthusiastic bow-riders.
Hourglass dolphin	LC	✓ Most likely dolphin species to be encountered in the Sea Lion Field.				Found throughout the Southern Ocean	Shallow dives	High frequency	Thought to undergo seasonal movements, migrating northwards in winter and south in summer. Often seen accompanying other cetaceans, especially long-finned pilot whales.
		Spring	Summer	Autumn	Winter				

[1] **Post-consultation note (July 2025):** Studies carried out by Falklands Conservation between 2017 and 2025 (and ongoing) indicate that regionally important aggregations of southern right whale are now documented during winter in coastal waters, particularly along the north and northeast coast of East Falkland (Weir and Stanworth, 2020; Weir, 2024). These surveys indicate that this population comprises >1% of the global population (Weir, 2024).

[2] **Post-consultation note (July 2025):** Studies carried out by Falklands Conservation between 2017 and 2025 (and ongoing) indicate that aggregations of sei whales in the Falkland Islands nearshore waters comprise >0.1% of the global population.

Key: Relative abundance of marine mammals within Falklands waters

Not recorded	Low	Moderate	High	Very High

7.4.6.3 Marine mammals in and around Berkeley Sound

7.4.6.3.1 Cetacean abundance and distribution surveys in and around Berkeley Sound

In recent years, several projects have focused on studying inshore cetaceans.

- A series of coastal bird surveys within Berkeley Sound also recorded marine mammals (SAERI, 2016; 2017; 2018; 2019),
- Anecdotal observations of cetaceans around the Falklands have been collated to give an indication of trends in species abundance.
- Falklands Conservation surveys:
  - BEST sei whale survey (Weir, 2017), and
  - Dedicated surveys of sei whales, and other cetaceans, in Berkeley Sound (Franchini, *et al.,* 2020; Weir and Stanworth, 2020).
- The 'Dolphins of the kelp' (DOKE) project focused on Commerson's and Peale's dolphins but also recorded other cetaceans within Berkeley Sound and elsewhere around the Falklands (Costa and Cazzola, 2018), and
- Tracking of fur seals from Volunteer Rocks and sea lions from colonies to the north and south of Berkeley Sound (Baylis, *et al.,* 2015), which help to determine the use of inshore waters by these animals.

These sources supersede the marine mammal data collected in or adjacent to Berkeley Sound by JNCC SAST surveys (1998 - 2004), although this data still helps to provide historical perspective with detail provided below.

The relevant results from the above are summarised below with the data collated into species-specific summaries in Section 7.4.6.3.1.5.

7.4.6.3.1.1 Cetaceans recorded during Berkeley Sound coastal bird surveys

The Berkeley Sound coastal surveys are designed to record animals along the coastal fringe, within 100 m of the shoreline, and therefore are not specifically designed to record cetaceans. Although Commerson's dolphin, Peale's dolphin and sei whales were recorded, these sightings add little to the findings of dedicated cetacean projects (see Sections 7.4.6.3.1.3 and 7.4.6.3.1.4 below). The exception, however, was the winter of 2017, which saw an influx of southern right whales into coastal waters off the east coast of the Falklands. Animals had been present for a number of weeks prior to the survey in late July and were recorded on several different days in the outer Sound (Figure 7-90). Southern right whales have also been recorded by several other independent surveys during the winter of 2017. It is important to note that empirical data on whales started in 2017 (see Sections 7.4.6.3.1.3 and 7.4.6.3.1.4 below). It is acknowledged that whale populations have increased over time since the cessation of whaling. However, it is not possible to determine whether abundances were similar prior to the commencement of the BEST Sei whale project that commenced in 2017 (Weir, 2017).

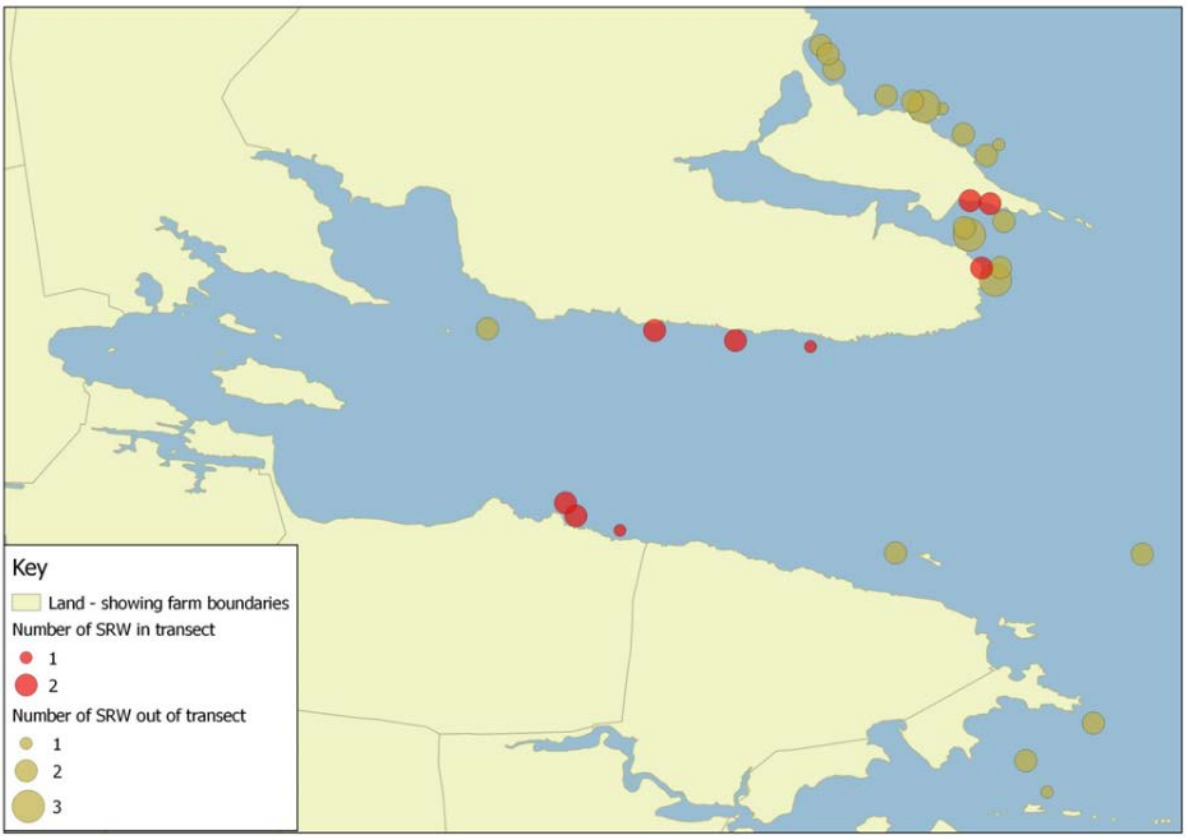


Figure 7-90: The distribution of southern right whale records during the winter 2017 survey

7.4.6.3.1.2 Anecdotal inshore cetacean sightings

In order to inform the development of the Falkland Islands Marine Spatial Plan, a project to record local ecological knowledge regarding large cetacean sightings culminated in 2016 (Frans and Augé, 2016). The results highlight a clear increase in numbers of whales sighted, from no observations in the 1970s to 350 observations between 2010 and 2015 (mostly of IUCN 'Endangered' sei whales and IUCN 'Vulnerable' fin whales) for similar observer effort.

Although seen throughout the inshore waters of the Falklands (see Thomson and Munro, 2014; Costa and Cazzola, 2018; Weir, 2018), several areas of high sighting density in recent years (since the 1990s) were identified, including Berkeley Sound (Figure 7-91a). There is some indication however, that some areas of high sighting density reflect the distribution of observers rather than the absolute density of the cetaceans in these areas. For example, the hotspot in the middle of Falkland Sound is on the route of the ferry between East and West Falklands; the area near Stanley is adjacent to the only major centre of human habitation and the focus of shipping activity.

It is difficult to attribute observer effort to anecdotal observations. Frans and Auge (2016) asked contributors to the frequency of visits to an area on a decadal basis, which were scored from 1 to 5 (Once to Frequent; see Table 7.29). These scores were then averaged for all observers, which has produced some unusual results as areas of high activity have lower average frequency scores than anticipated (Figure 7-91b).

Table 7.29: Descriptions of visits and sightings categories ***(Source: Frans and Auge, 2016)***

Frequency	Effort Value	Category	Description
Of visits (per decade)	1	Once	One instance or specific event per decade
	2	Few	2 - 5 visits per decade
	3	Occasional	One or a few visits per year
	4	Often	Visiting over long periods (<6 months) per year
	5	Frequent	Residing or passing through the location >6 months per year
Of sightings (across visits)	-	Once	One sighting in a given decade, or for a specific visit
		Seldom	Rare sightings (e.g., 2-3 sightings across visits)
		Occasional	Seen for <1/2 the visit frequency
		Often	Sighting for >1/2 the visit frequency
		Always	Sighting at almost each visit

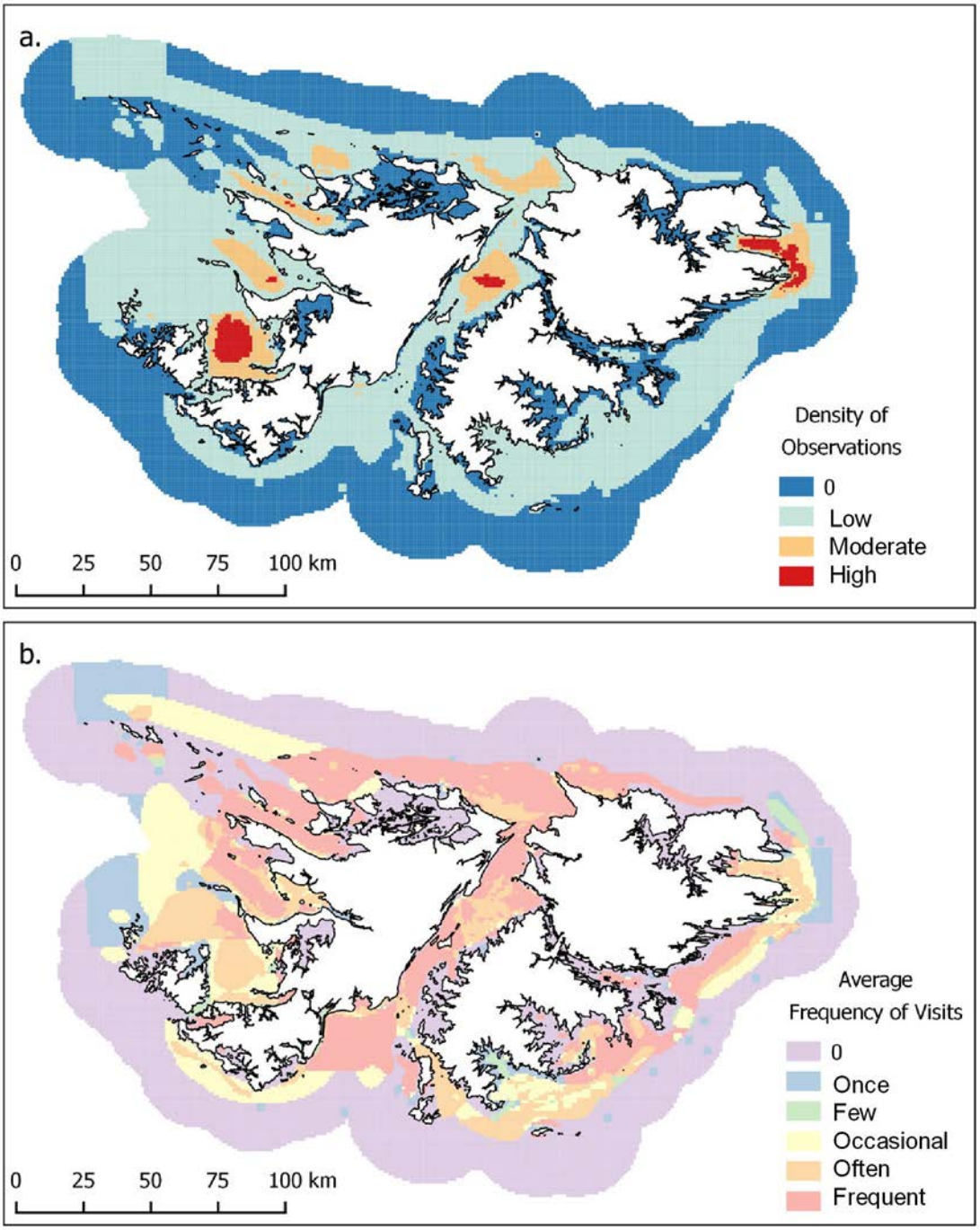


Figure 7-91: Distribution of anecdotal large cetacean records around the Falkland Islands ***(Source: Frans and Augé, 2016)***

7.4.6.3.1.3 Falklands Conservation cetacean surveys in Berkeley Sound

During early 2017, Falklands Conservation initiated a project entitled 'Developing a site-based conservation approach for sei whales (*Balaenoptera borealis*) at Berkeley Sound, Falkland Islands'. The project aims to improve knowledge of sei whales in the Falkland Islands, increase awareness and provide information on the potential for interaction between whales and human activities. The results are presented in Weir (2017).

Surveys were conducted between January and June, utilising land-based, aerial and boat-based techniques. All species of cetacean were recorded but the project focused on sei whales and the initial locations of sightings are shown in Figure 7-92. Data collected indicate that sei whales occur throughout Berkeley Sound (east of Long Island) and adjacent coastal waters, including the approaches to Port William. Although surveys were only undertaken during the first half of the year, the results support previous reports of seasonal presence of sei whales, with all sightings occurring between January and May. The majority of animals observed were seen in water depths of 20 – 50 m, with relatively few in water less than 15 m in depth. Behavioural observations indicate that the area is used as a feeding ground and analysis of faecal material confirmed that lobster krill are the primary prey species.

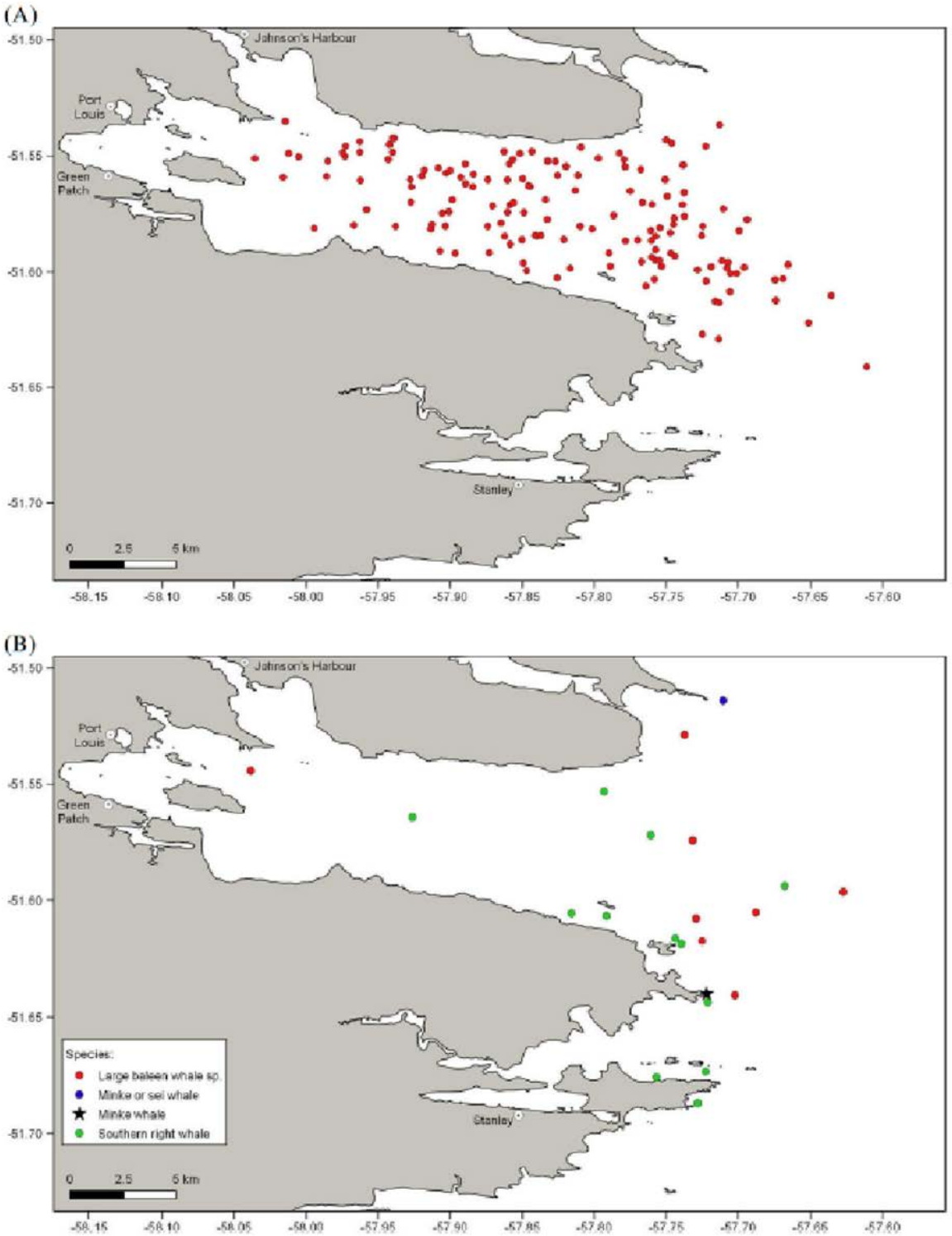
Between February and May 2017, 26 boat-based surveys resulted in 2,841.6 km of survey effort and 149 sightings of sei whales (300 individuals). In total, 87 individual sei whales were recognised by photo-identification with the number of identifiable animals recorded on any one day ranging between 0 – 20 individuals. This is a minimum indication of the number of animals using Berkeley Sound as many animals could not be photographed or would pass through the area between surveys. Most (64.6 %) of the sei whales that were photo-identified in Berkeley Sound were captured on one survey date only and the most frequently recorded individual was recorded on eight dates. The available evidence suggests that the majority of individuals are present within Berkeley Sound for brief periods but some remain for longer periods or return after a period of absence.

Observers also recorded blow rates and dive times (Weir, 2017), which could eventually be used to correct abundance estimates and develop ship-strike models. Over 20 observation periods, a mean breathing rate of 32.2 blows / hr was recorded, which equates to a mean dive cycle of 112 seconds. The maximum dive time recorded within Berkeley Sound was 13.5 minutes. The recorded swimming speed in Berkeley Sound averaged 6 km / hr with the maximum observed speed of 22 km / hr (12 knots). It is clear that dive profiles and swimming speed will vary depending on an animal's activity; however, observations indicate that movements of sei whales in and out of Berkeley Sound are likely to occur rapidly.

In 2018, visual and photographic surveys were conducted on the sei whale population in Queen Charlotte and King George Bays, to the west of the Falklands (Weir, 2018). The results indicate that sei whales are present in considerable number around the Falklands coastline. Two individuals that were identified in Berkeley Sound during 2017 were resighted to the west of the Falklands, indicating repeat visits to the Falklands in different years and hints that animals may move around the entire Falklands coastline. This was subsequently supported by satellite tagging efforts by Falklands Conservation, which although preliminary (see https://falklandsconservation.com/sei-whale-tracking/), revealed long-distance movements of sei whales around the Falkland Islands. A mark recapture study (photo identification) revealed movement of a single sei whale between Brazil and the Falkland Islands (Weir, *et al.,* 2019).

Predictive models are a useful tool to explore probable distribution of sei whales over larger areas. Sei Whale abundance was predicted to be highest in the Falkland Sound and over much of the northern coastline of the Falkland Islands, and Queen Charlotte Bay, West Falklands (Figure 7-93) (Baines and Weir, 2020). This is also seen in the sightings data shown in Figure 7-94 and is further supported by hotspots indicated from 350 opportunistic observations collated between 2010 and 2015 (Frans and Augé, 2016) (Figure 7-95).

Of note, marine mammal work conducted by Falklands Conservation has resulted in two Important Marine Mammal Areas (IMMAs) which are further described in Section 7.5.2.3.5.


(A)
Johnson's Harbour
Port Louis
Green Patch
Stanley
0 2.5 5 km
-51.50
-51.55
-51.60
-51.65
-51.70
-58.15
-58.10
-58.05
-58.00
-57.95
-57.90
-57.85
-57.80
-57.75
-57.70
-57.65
-57.60
(B)
Johnson's Harbour
Port Louis
Green Patch
Stanley
Species:
Large baleen whale sp.
Minke or sei whale
Minke whale
Southern right whale
0 2.5 5 km

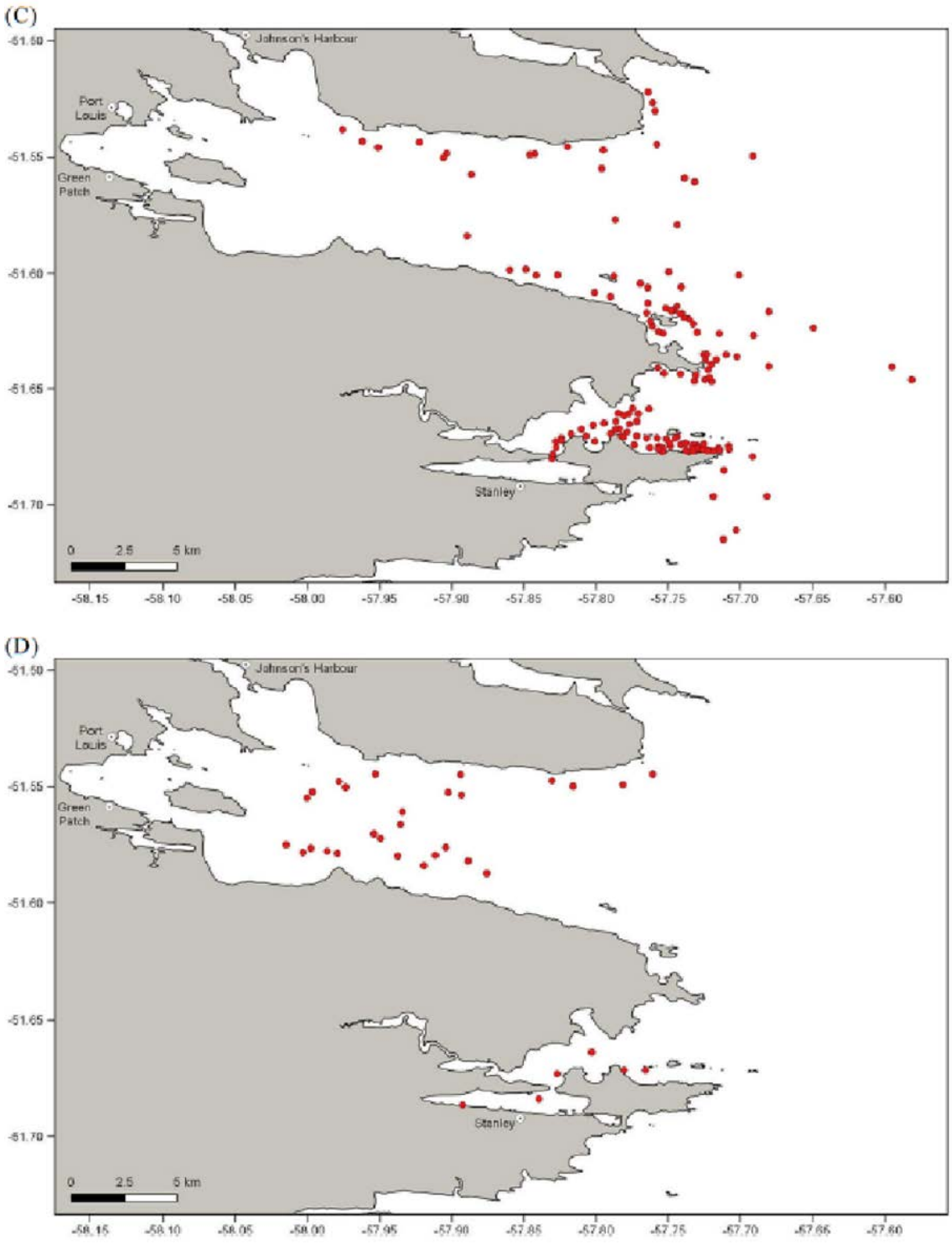


Figure 7-92: The spatial distribution of cetacean sightings recorded during boat-based surveys in Berkeley Sound (A) sei whale; (B) other baleen whales; (C) Peale's dolphin and (D) Commerson's dolphin ***(Source: Weir, 2017)***

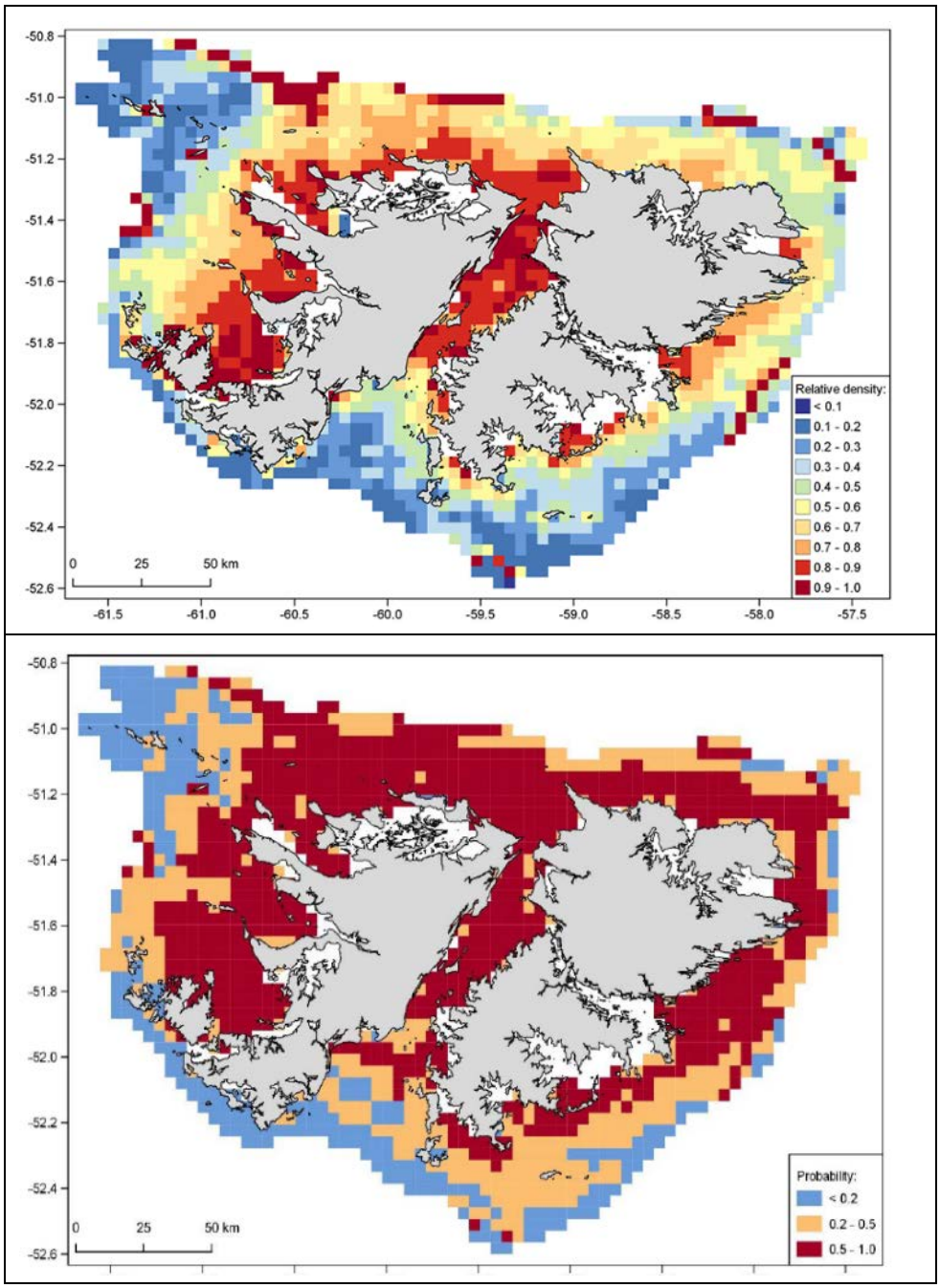


Figure 7-93: Predictive models for sei whales, depicting the probability of occurrence and density – both highlighting the potential importance of nearshore waters to sei whales. Upper panel is modelled using a MaxEnt model (Maximum Entropy). Lower panel is the combined Generalised Additive Model (GAM) and a MaxEnt model. Note the difference in scale (relative density and probability) between the upper and lower panel ***(Source: Baines and Weir, 2020; Weir, et al., 2021)***

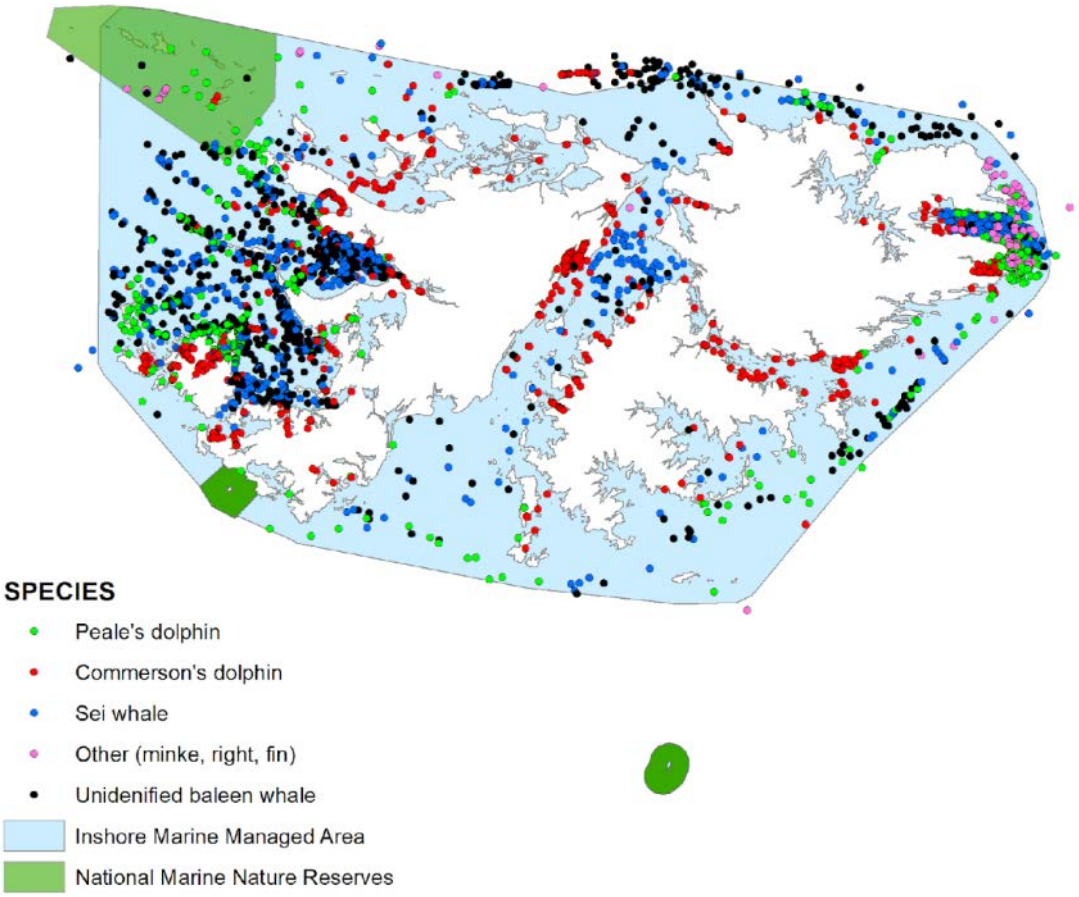


Figure 7-94: Cetacean survey efforts by SAERI and Falklands Conservation between 2016-2018 have rarely ventured beyond 5 km from the Falkland Islands coastline. Also shown are proposed Marine Managed Areas ***(Source: Costa and Garcia, 2017; Costa and Cazzola, 2018; Baines and Weir, 2020)***

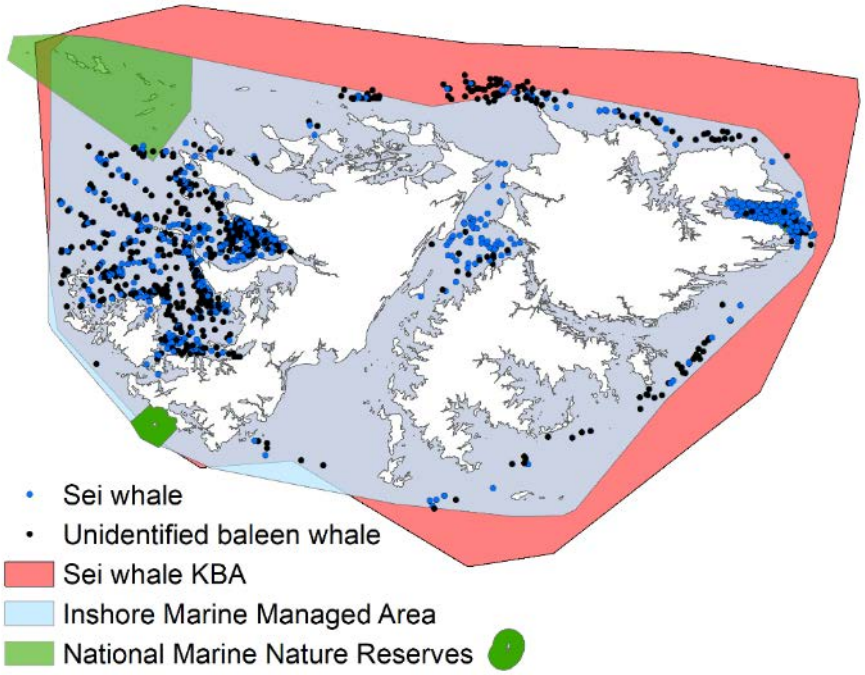


Figure 7-95: Sei whale hotspots derived from 350 opportunistic observations collated between 2010 and 2015. Also shown is the Sei whale KBA (see Section 7.5.2.3.4)

7.4.6.3.1.4 Dolphins of the Kelp (DOKE)

The 'Dolphins of the Kelp' (DOKE) project ran between 2016 and 2018 under the auspices of SAERI. The projects aimed to establish baseline data on the abundance, distribution, natural history and genetic diversity of the Falklands inshore cetacean populations to provide a scientific basis for conservation and ecosystem-based marine management initiatives (Costa and Cazzola, 2018).

The project was broadly split into three phases:

- A Falklands-wide aerial transect survey to map the distribution of all cetaceans within 10 km of the coast,
- Focused studies on Commerson's and Peale's dolphins at three sites to investigate seasonal site fidelity, local abundance and movements which included:
  - Repeat boat-based transect surveys,
  - Photo-ID, and
  - Passive Acoustic Monitoring.
- Tissue sampling to determine genetic diversity and relatedness with other South American populations.

Island wide aerial transect survey

In total, 217 transects running perpendicular to the coast, spaced 5 to 6 km apart, were superimposed over the inshore waters (Figure 7-96). These transects were followed by a Falkland Islands Government Air Service (FIGAS) plane at an altitude of 150 m and speed of 90 knots between March 18th and May 8th 2017. Observers recorded all animals sighted using distance sampling techniques. On completion of the survey, the total length of survey track was 4,317 km and 454 sightings, of seven species, were made (Table 7.30). The abundances are a function of sightings and submergence times. This relationship is different for each species. Figure 7-97 shows the distribution of Commerson's and Peale's dolphins recorded and Figure 7-98 shows the distribution of baleen whales recorded.

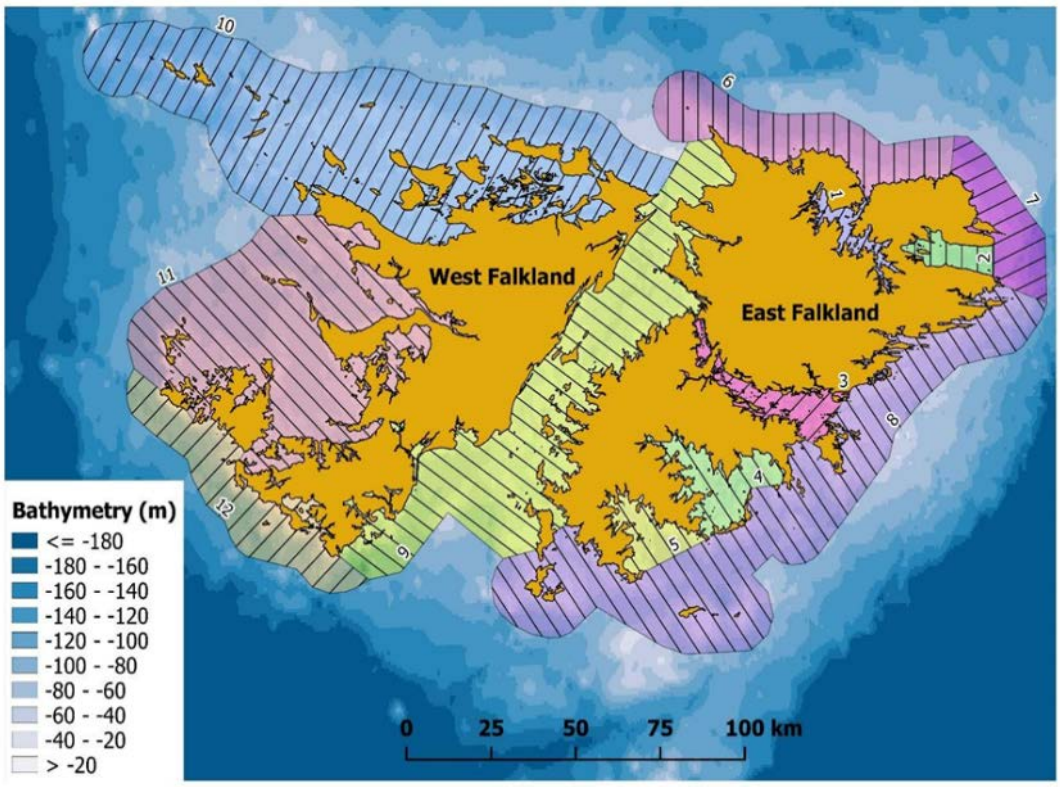


Figure 7-96: Map of the inshore waters of the Falkland Islands showing the positions of aerial survey transects ***(Source: Costa and Cazzola, 2018)***

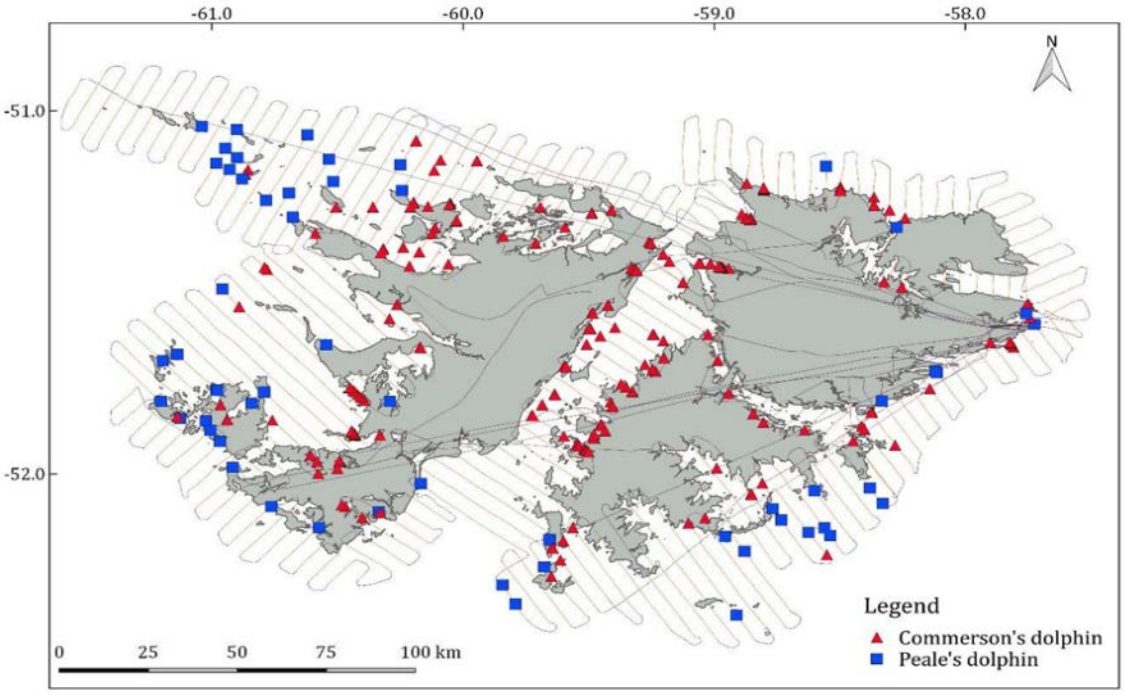


Figure 7-97: Locations of Commerson's (red triangles) and Peale's dolphin (blue squares) recorded during aerial surveys from March to May 2017 ***(Source: Costa and Cazzola, 2018)***

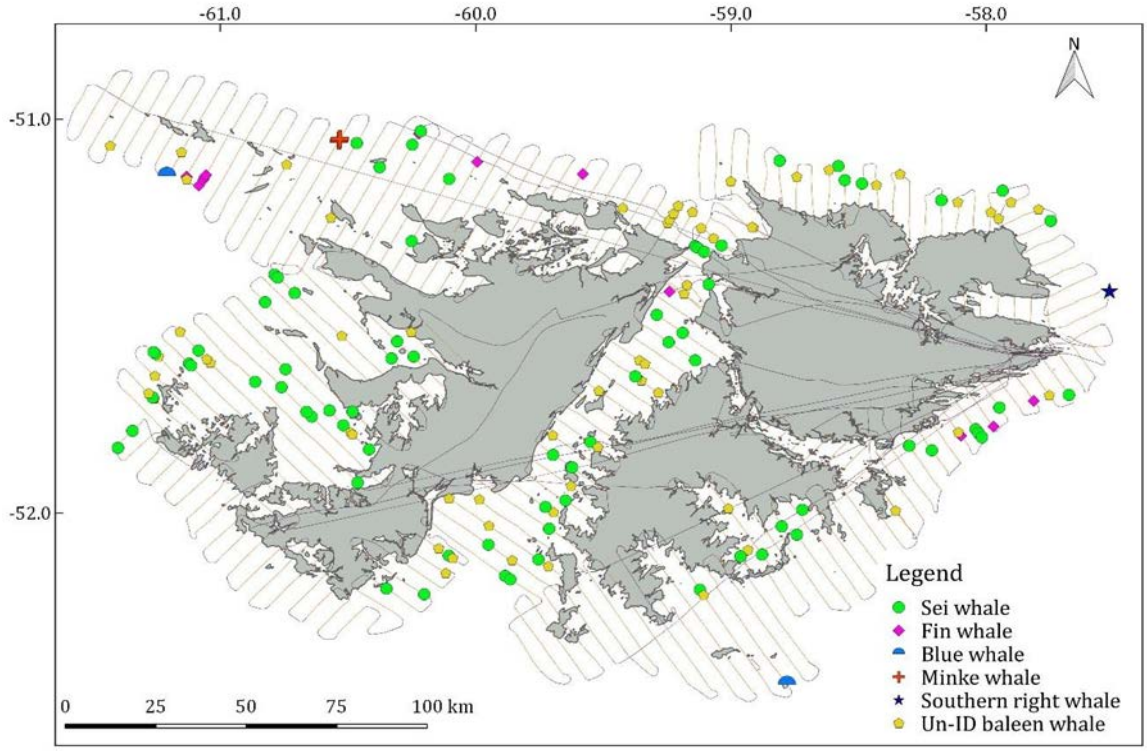


Figure 7-98: Locations of baleen whales sighted from March to May 2017 ***(Source: Costa and Cazzola, 2018)***

Table 7.30: Summary of cetacean sightings made during the Dolphins of the Kelp aerial survey

Species	Number of sightings[1]	Estimated population[1]
Commerson's dolphin	238	5,789
Peale's dolphin	60	1,896
Sei whale	74	341
Fin whale	12	64
Minke whale	2	13
Blue whale	2	N/A
Southern right whale	1	N/A
Unidentified baleen whale	65	N/A

[1] Population is estimated using a ratio between the number of sightings, dive (submergence) times. The ratio is different for each species.

Focused studies on Commerson's and Peale's dolphins

Repeated boat-based transect surveys were designed to determine the habitat types favoured and seasonal movements by Commerson's and Peale's dolphins. Six surveys were completed at each of the three sites between November 2016 and July 2018 (Figure 7-99). In total, 5,417 km of survey effort was achieved, which produced 348 Commerson's dolphins, 162 Peale's dolphin, 23 southern right whale, 20 sei whale, three minke whale and one killer whale sightings.

Preliminary results suggest that:

- Commerson's dolphins are present all along the coastline but where 'hotspots' exist the number of animals present was higher in summer than winter:
- Peale's dolphins showed a restricted distribution (Port William seems to be a 'hotspot' for this species), although recorded in summer and winter more animals were sighted in the winter, and

- Where the two species overlap, Commerson's occupied the inner part of the bay and Peale's the outer.

Passive acoustic monitoring devices (C-PODs) were deployed in Many Branch Harbour to further investigate the behaviour of Commerson's dolphins, in particular diurnal patterns of behaviour. It was found that activity within the most sheltered areas peaked during daylight hours in February and March, the calving period for this species in the Falklands.

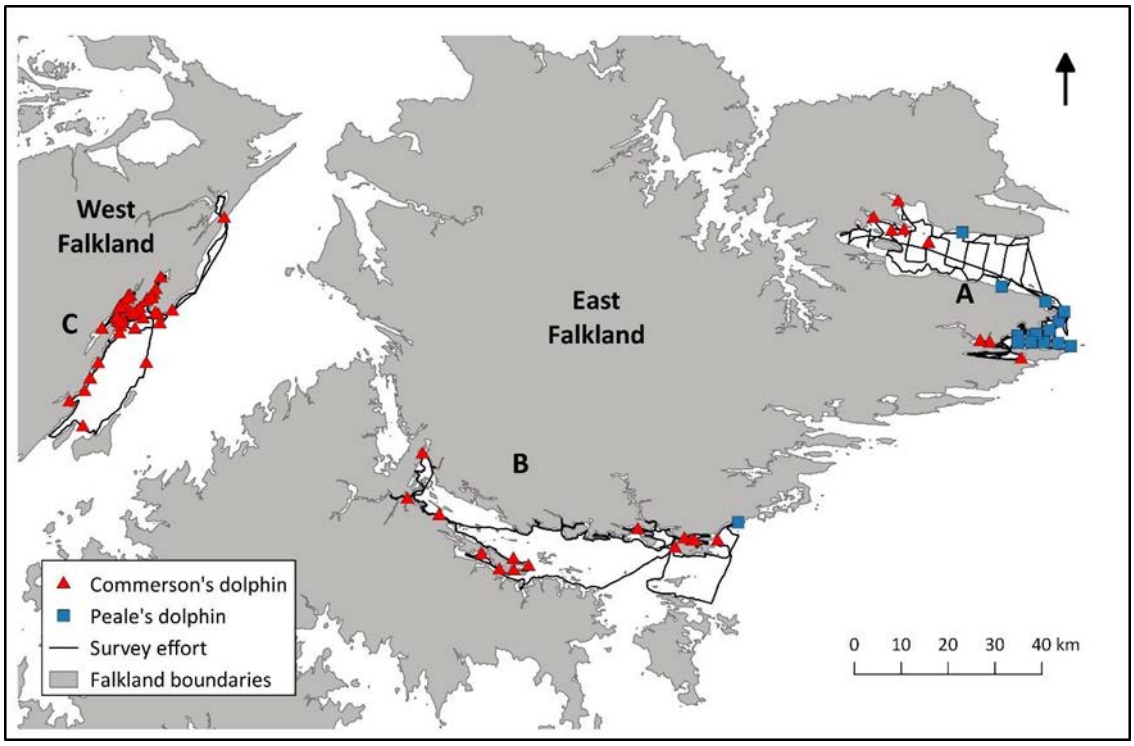


Figure 7-99: Survey effort and dolphin sightings between 21st November and 22nd December 2016, in the three focal areas; A, Port William and Berkeley Sound; B, Choiseul Sound and Bertha's Beach; C. Port Howard and many Branch Harbour ***(Source: Costa and Cazzola, 2018)***

Genetic diversity

Tissue samples were collected from Commerson's and Peale's dolphins at the sites shown in Figure 7-100. Primary results suggest:

- There are highly significant differences between Peale's dolphins sampled in the west and east of the Falklands,
- Commerson's dolphins did not show evidence of population differentiation between sampling locations, and
- Both species have limited sharing of haplotypes with mainland South American populations.

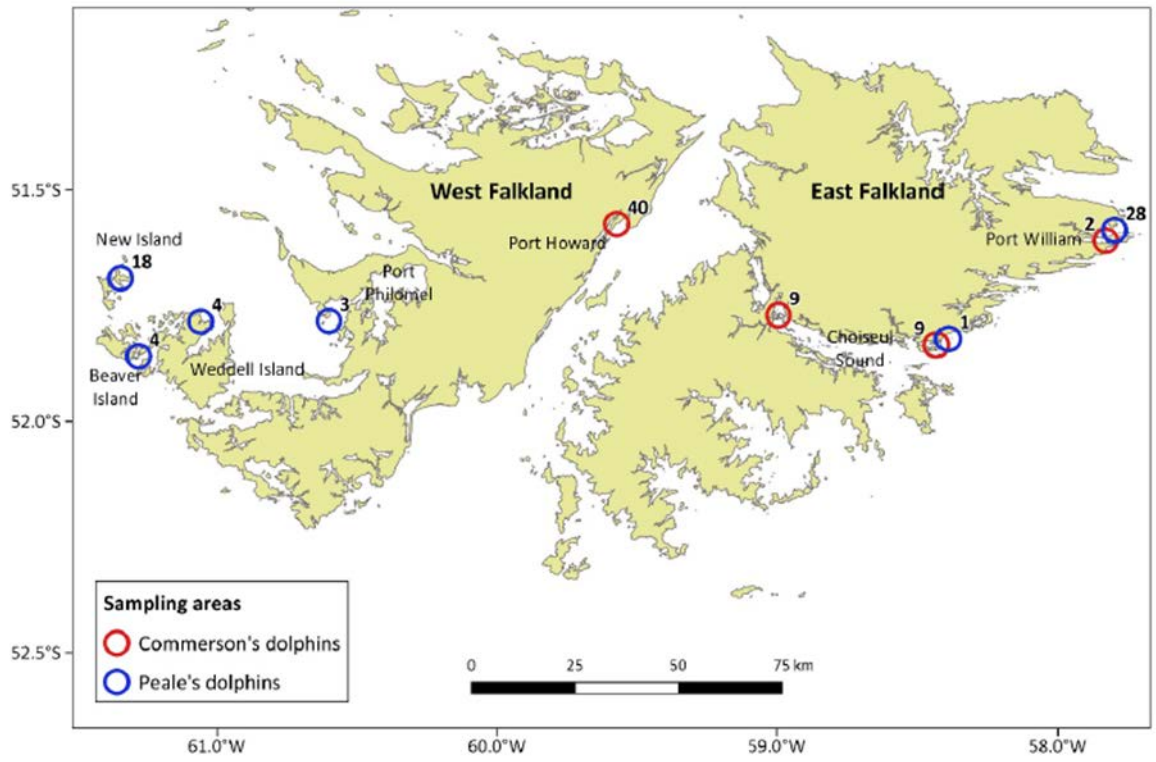


Figure 7-100: The location and number of tissue samples collected from Commerson's and Peale's dolphins for genetic analysis

7.4.6.3.1.5 Seal tracking studies

South American fur seals tracked at Volunteer Rocks in 2015 typically undertook extended foraging trips to the Patagonian Shelf slope to the north of the Falkland Islands. The mean foraging trip duration was 15.2 ± 2.7 days, with a mean trip distance of 314 ± 70 km over the 188 days they were tracked. Key foraging areas were on the Patagonian Shelf slope to the north and east of the Falkland Islands. Inshore waters around Volunteer Rocks were found to be important for commuting to and from the breeding colony. However, in 2015, fur seal foraging effort appeared to be over deeper waters associated with the shelf slope (mean foraging trip bathymetric depth was 263 ± 28 m), suggesting that the use of inshore waters for foraging was limited. This differs to behaviours seen at other fur seal breeding colonies, such as North Fur Island, seals from which were tracked at the same time. These had shorter foraging trip distances and durations, with more time spent within inshore waters. However, it is important to highlight study caveats, in particular the small sample size of only four fur seals tracked from Volunteer Rocks. Hence, a larger sample size and longer temporal tracking data set is required to establish the importance of inshore waters around Volunteer Rocks as foraging habitat for fur seals.

Of note, sea lion tracking was unsuccessful such that no tracking data exist for sea lions from Berkeley Sound.

7.4.6.3.1.6 Cetaceans recorded during JNCC SAST survey

Observations of marine mammals were made and recorded during JNCC SAST surveys between 1998 and 2004, described in Section 7.4.5.2.1.1. Although the methodology used was not specifically designed to survey the distribution of marine mammals, all animals sighted were recorded and White *et al.* (2002), remains the most comprehensive account of the at-sea distribution of marine mammals within Falkland Islands' waters.

It should be noted, however, that the survey vessels rarely entered Berkeley Sound or coastal waters (i.e., those less than 2 km from shore). An examination of the data collected in waters adjacent to Berkeley Sound gives a hint at the seasonal abundance of marine mammals in this restricted area; however, little dedicated survey effort was achieved within Berkeley Sound during the JNCC surveys, most effort is associated with the route taken in and out of Port William. Table 7.31 shows the number of individuals of each marine mammal species recorded on a monthly basis. Figure 7-101 shows the distribution of cetaceans in the waters adjacent to Berkeley Sound and shows an apparent association between many of the cetacean records and headlands, namely Volunteer Point, Mengeary Point and Cape Pembroke. It is possible that mixing created by currents and bottom topography make these areas particularly productive.

Table 7.31: Cetacean observations in waters adjacent to Berkeley Sound

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Peale's Dolphin	16	34	19	41	70	34	22	10	5	12	9	9	**281**
Sei Whale			4	2	1		4						**11**
Minke Whale				8		1				1			**10**
Commerson's Dolphin									3	4			**7**
Large, (unidentified) whale species			1				1						**2**
Southern Right Whale												1	**1**

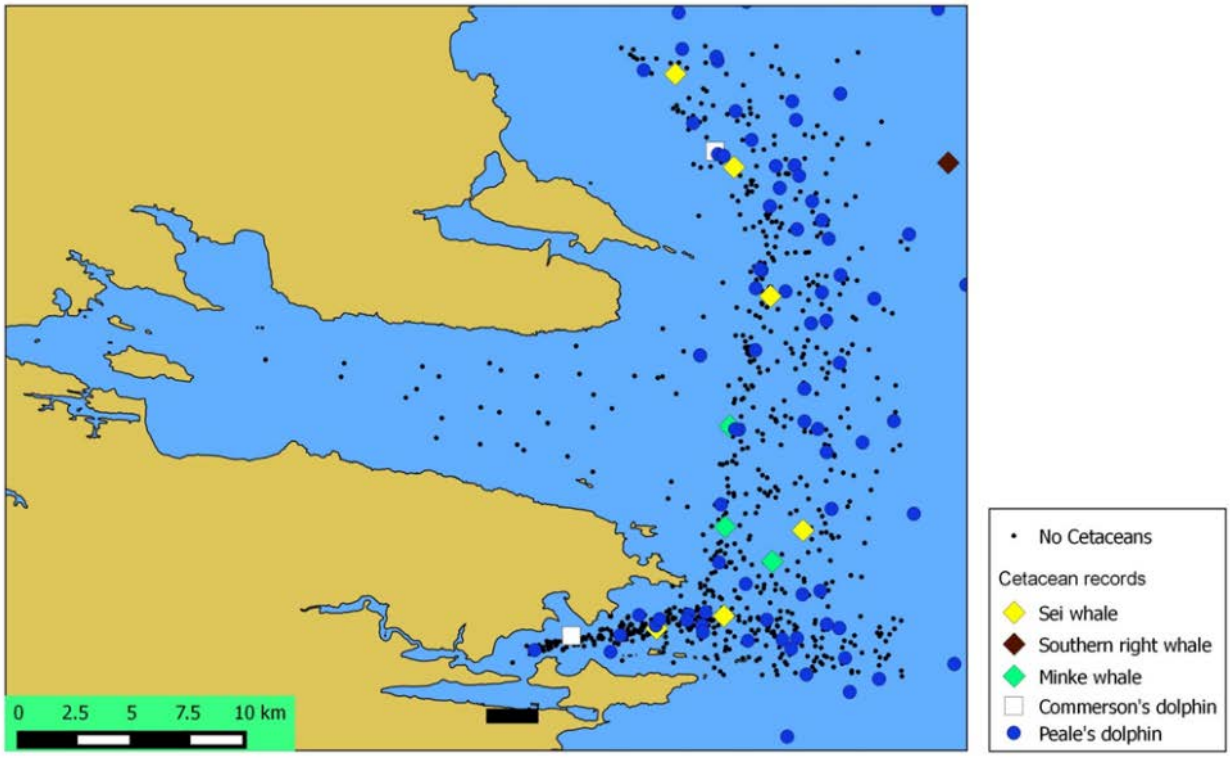


Figure 7-101: The distribution of all cetacean records in the waters adjacent to Berkeley Sound from SAST JNCC data

7.4.6.3.1.7 Species-specific summary of cetacean distribution inshore

In addition to the many cetacean species that have been recorded in the wider NFB and near the Sea Lion Field (Section 7.4.6.2), a number of species have been recorded specifically within and around Berkeley Sound, as recorded in the surveys described above.

Notably, of the species that are regularly observed within Berkeley Sound, sei whales are listed as 'Endangered' on the IUCN Red List. Further, two species of dolphin, Peale's and Commerson's dolphins, are regularly observed within Berkeley Sound and these species, and all other cetaceans, are listed as species of conservation priority and are the subject of a Falkland Islands Cetacean Action Plan[35].

[35] The 2008 Cetacean Species Action Plan expired in 2018 and the new version is currently in draft.

The following provides a species-specific account of the collated survey results. Further, a general summary of the abundance, distribution, life-cycle and behavioural characteristics is provided in Table 7.32 below.

Sei whale

For many years large numbers of sei whales (*B. borealis*) have been observed in inshore waters around the Falkland Islands (White, *et al.,* 2002; Frans and Augé, 2016). Although they can be seen throughout much of the year, their abundance is far higher during the summer and autumn (November to April), peaking in March such that their presence is considered to be seasonal.

The results of inshore surveys (Thomson and Munro, 2014; Costa and Cazzola, 2018; Weir, 2018) and anecdotal observations by Frans and Augé (2016) indicate that, during the summer and autumn months, sei whales are encountered throughout most of the inshore waters of the Falklands. Interviews with local residents indicate several hotspots of sightings including Berkeley Sound (Frans and Augé, 2016). Further, the anecdotal observations hint that sei whales are now more numerous within Falklands waters than they were at the time of the JNCC's at-sea surveys (Frans and Augé, 2016).

The results of Falklands Conservation's 2017 project (Weir, 2017) support much of the existing knowledge of sei whales but add considerably to our understanding of sei whale movements and behaviour within Berkeley Sound. There is clearly a large number of sei whales using the inshore waters of the Falkland Islands, such as Berkeley Sound, as a late summer / autumn feeding ground. However, photo-identification within Berkeley Sound indicates that the animals are transitory with most animals spending a short period of time within Berkeley Sound (Weir, 2017) and some remaining for longer (Weir, 2022). Return visits by individuals in different years was confirmed and more evidence of large-scale movements by individuals within Falklands waters was achieved in 2018 (Weir, 2018). Therefore, it is assumed that a high proportion of the overall population of sei whales could be exposed to any human induced environmental change if it were to coincide with the seasonal presence of these animals.

Cerchio and Weir (2022) isolated more than 2,000 low-frequency sei whale calls for manual classification. Five categories of stereotyped call types in the 15–230 Hz range were described. Acoustic properties and behavioural characteristics indicate that this is likely a male breeding display similar to songs and singing of other balaenopterids.

Sei whales are listed as 'Endangered' on the IUCN Red List and have priority conservation status in the Falkland Islands.

Fin whale

Fin whales (*Balaenoptera physalus*) are known to seasonally occur in the offshore waters around the Falkland Islands (Section 7.4.6.2.1.4) and there are fewer confirmed sightings from inshore waters (Weir, 2017; Costa and Cazzola, 2018). Local knowledge indicates however that fin whales have been seen inshore throughout the year with a definite peak in numbers in March (Frans and Augé, 2016). There are two apparent hotspots of fin whale sightings in inshore waters; one to the west of the Islands and the other in Berkeley Sound (Frans and Augé, 2016). However, Weir (2017) did not record fin whales within Berkeley Sound and suggests that the sightings reported in Frans and Augé (2016) could be misidentified. Like all large whales, there is a perception that the number of fin whales present in the waters around the Falklands has increased over the past twenty years or so.

Fin whales are listed as Vulnerable on the IUCN Red List and also have priority conservation status in the Falkland Islands.

Antarctic minke whale

Antarctic minke whales (*B. bonarensis*) were encountered widely within Falklands waters with most animals recorded between September and April (White, *et al.,* 2002). Inshore, sightings have predominantly occurred during the summer and autumn months (Frans and Augé, 2016). Anecdotally, minke whales are frequently sighted off the eastern coast of Kidney Island (A. Black, *pers. obs.*; Frans and Augé, 2016). Dedicated inshore cetacean surveys conducted during 2017 recorded minke whales in low numbers (Weir, 2017; Costa and Cazzola, 2018).

Southern right whale

Once they arrive in the Falklands Islands, southern right whales (*Eubalanus australis*) tend to be found in coastal or inshore waters (*c.f.* Black, 2005b). Several right whales have been sighted within Stanley Harbour (A. Black, *pers. obs.*; Frans and Augé, 2016) and one was sighted in Berkeley Sound during July 2015 (BSL, 2015). Interviews conducted by Frans and Augé (2016) however, indicate that southern right whales are rarely sighted and their presence in Falklands waters is very seasonal (late summer / early autumn). Although more sightings occur to the west of the Falklands (Frans and Augé, 2016), until 2017 the available evidence suggests that southern right whales are periodically present within Berkeley Sound sometimes recorded using it for socialising.

During the winter of 2017 (May to August), a large influx of southern right whales occurred (see Section 7.4.6.3.1.1 and Weir, 2017). Regionally important aggregations of southern right whales (including for mating) are now documented during winter in coastal waters, particularly to the north of the Falkland Islands (Weir and Stanworth, 2020).

Humpback whales

Humpback whales accounted for approximately 12 % of the whales processed at the New Island shore station in the early 1900s (Weir, 2017). While humpback whales (*Megaptera novaeangliae*) have been recorded within Falklands waters (White, *et al.,* 2002), acoustic monitoring and marine mammal observations from seismic vessels did not record humpback whales in the North Falkland Basin and interviews with local residents did not produce many additional records of humpback whales inshore (Frans and Augé, 2016). An intense period of dedicated inshore cetacean surveys in 2017 /18 did not produce any sightings of humpback whales (Weir, 2017; 2018; Costa and Cazzola, 2018). Despite their historical presence and apparent increase in numbers elsewhere, the available evidence suggests that humpback whales are infrequently encountered within Falklands waters.

Killer whale

The JNCC surveys recorded seven killer whale (*Orcinus orca*) sightings (18 animals in total) over three years, (White, *et al.,* 2002). Killer whales are regularly sighted inshore around Sea Lion Island, to the south of East Falkland (Sanvito and Galimberti, 2018) and occasionally elsewhere inshore. Although there are no official records from Berkeley Sound, killer whales do visit the area and have anecdotally been observed within the Sound and around Volunteer Point.

Satellite tracking indicates that Type B killer whales follow a migration route to the east of the Falkland Islands when travelling between the Antarctic Peninsula and sub-tropical waters of the South Atlantic (Durban and Pitman, 2012). These animals appear to travel rapidly through the region but they could account for some of the acoustic detections and sightings within Falkland waters.

Long-finned pilot whale

Long-finned pilot whale (*Globicephala melas*) strandings have been regularly recorded on the Falkland Islands since 1866 (Otley, 2012). Since 1984, pilot whale strandings have been recorded as a near annual event, with 43 recorded incidents ranging in number from less than ten individuals to up to 500 animals. The mean number of animals involved in each event is 105 (Otley, 2012). There appears to be a seasonal component to the strandings with 50 % occurring during the autumn, 32 % in winter, 12 %

in summer and 6 % in spring. It is unclear what causes these strandings, but the seasonal component suggests that there may be seasonal movements of these animals both inshore and offshore. This is supported by surveys and observations offshore (White, *et al.,* 2002).

The high number of pilot whale strandings on the Falkland Islands (Otley, 2012) hints that there is a sizable population associated with Falklands waters. However, this species is generally regarded as a deepwater species and are not regularly sighted inshore. Pilot whales were not sighted during a period of intense inshore cetacean surveys in 2017/18.

Peale's dolphin

Five groups of Peale's dolphin (*Lagenorhynchus australis*) were recorded during the 2016 coastal survey (Section 7.4.6.3.1.1). There was a cluster of three records close to Monkey Point but this species could be encountered anywhere within Berkeley Sound. Peale's dolphin was recorded both inshore and offshore during the JNCC surveys and was by far the most abundant species of cetacean recorded near the entrance to Berkeley Sound (Figure 7-101 above) and offshore on the Patagonian Shelf (Figure 7-85). There was no clear evidence of any seasonal changes in the abundance, distribution or behaviour of these animals. Little is known about the biology of Peale's dolphins, but these animals are thought to be largely resident and to calve between October and April (Shirihai, 2006).

The results of the DOKE project and Falklands Conservation sei whale project indicate that Peale's dolphins are present within Berkeley Sound but in relatively low numbers and are far more numerous in Port William (Weir, 2017; Costa and Cazzola, 2018; Weir, 2018; Baines and Weir, 2020). The results of genetic analysis indicate significant differences in the genetics between animals sampled in the east and west of the Islands, which hints that these animals do not travel widely.

Dusky dolphin

There have been few confirmed sightings of dusky dolphin (*L. obscurus*) within Falklands waters (Weir and Black, 2018). During inshore cetacean surveys in 2017 and 2018, a single dusky dolphin (identifiable by a large nick in its dorsal fin) was repeatedly observed in Port William and at the entrance to Berkeley Sound (Costa and Cazzola, 2018; Weir and Black, 2018). This animal was always recorded in association with Peale's dolphins, it is believed that this association is unusual. The lack of other confirmed sightings during a period of intensive inshore cetacean surveys in 2017 and 2018 indicates that dusky dolphins are rare visitors to inshore Falklands waters.

Commerson's dolphin

During the JNCC surveys, Commerson's dolphins were recorded in every month except May (Figure 7-78) although very few animals were actually recorded. The number of these animals is very likely to have been underestimated due to their preference for coastal waters and the JNCC surveys were rarely conducted in the core habitats used by this species. Of the observations made, all were in partially enclosed or coastal waters and sightings were most frequently recorded from the waters within, or close to, the north and south entrances to Falkland Sound (Figure 7-102). These results are supported by the pilot inshore cetacean survey, which recorded more Commerson's dolphins between islands than towards open waters (Thomsen and Munro, 2014).

There was no evidence of seasonal variation in the distribution or abundance of Commerson's dolphin and the apparent decreases in some months, for example May, are, again, believed to be due to variation in the distribution of JNCC survey coverage rather than changes in the distribution of the dolphins. Anecdotally, highest densities of Commerson's dolphins are most frequently observed in enclosed coastal waters; such as settlement harbours (A. Black, *pers. obs.*) which were rarely visited on any of the previous boat-based surveys.

The results of the DOKE surveys and Falklands Conservation sei whale project support previous observations (Figure 7-97) and provide evidence of seasonal and diurnal movements within inshore

waters. The results of an Islands-wide survey indicate that Commerson's dolphins are by far the most numerous cetaceans found in waters within 10 km of the coast (Table 7.29, Weir, 2017; Costa and Cazzola, 2018; Weir, 2018; Baines and Weir, 2020).

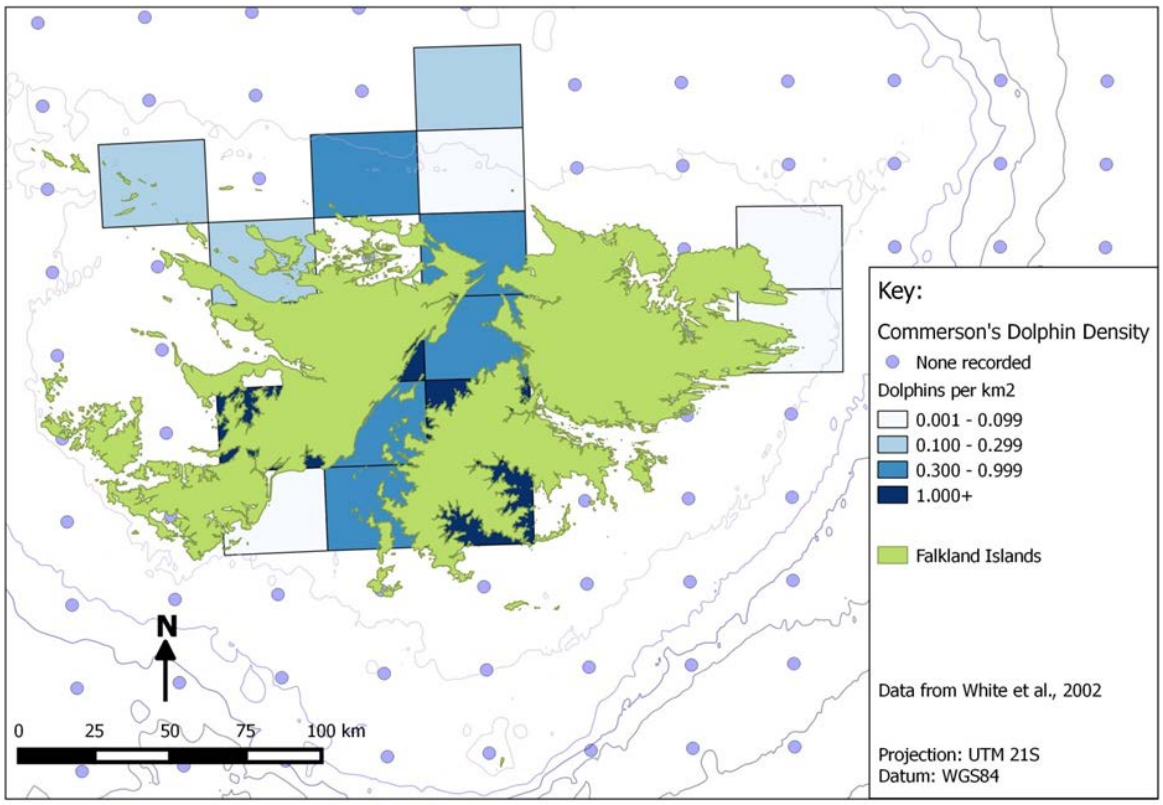


Figure 7-102: Commerson's dolphin distribution recorded during JNCC surveys, all months

7.4.6.3.2 Pinniped abundance and distribution surveys in and around Berkeley Sound

In understanding the baseline distribution and abundance of pinnipeds in Berkeley Sound, data from the following surveys and studies have been used.

These surveys include:

- Coastal bird surveys carried out by SAERI under contract to POEPL,
- The JNCC SAST survey, and
- Tracking studies.

7.4.6.3.2.1 Pinnipeds recorded during the 2016 and 2017 coastal survey

The coastal bird surveys undertaken between 2016 and 2019 (described in Section 7.4.5.3.1) also recorded all pinnipeds observed hauled-out or in coastal waters.

7.4.6.3.2.2 Pinnipeds recorded during JNCC SAST survey

While the SAST did not carry out dedicated marine mammal observations, marine mammals were recorded regularly in low numbers in inshore waters near Berkeley Sound.

7.4.6.3.2.3 Tracking Studies

There has been some limited tracking of fur seals breeding at Bird Island (off the south coast of West Falkland; Thompson *et al.,* 2003). Female sea lions from three locations on East Falkland have also been tracked (Baylis, *et al.,* 2015). The results of tracking associated with the GAP programme are summarised in Baylis, *et al.* (2019a).

7.4.6.3.2.4 Species-specific summary of pinniped distribution inshore

The following species-specific summaries draw on data taken during the surveys described above. A summary of the abundance, distribution, life-cycle and behavioural characteristics is provided in Table 7.32 below.

South American fur seal

Volunteer Rocks at the northern entrance to Berkeley Sound (Figure 7-103) is known to be a breeding site for South American fur seals (*Arctocephalus australis*); where approximately 230 pups are born each year. This represents approximately 0.6 % of the known Falkland Islands population (based on a population of 36,500 animals; Baylis, *et al.,* 2019). Reflecting this, most of the fur seals recorded during the summer and winter coastal surveys were close to this site. Fur seals were the most numerous pinniped recorded during JNCC at-sea surveys (White, *et al.,* 2002).

The results of tracking studies indicate distinct seasonal differences in the distribution of female fur seals breeding at the Bird Island location. South American fur seals commence breeding in early November with the establishment of territories by the dominant bulls. Pups are born around mid-December and are suckled for about 11 months. In the early part of the breeding season, females make short, nocturnal foraging trips. During mid-lactation, the duration of foraging trips increased but the distribution remained close to the breeding site. By the autumn, the duration and range of foraging trips had increased (Thompson, *et al.,* 2003). Along with seasonal differences in food requirements, fur seal foraging strategies are likely to be influenced by local conditions and may therefore vary considerably between colonies.

South American sea lion

Infrequent surveys of the breeding population of South American sea lions (*Otaria flavescens*) have been conducted in the past, which recorded a single breeding site on the north coast of Berkeley Sound (Thompson, *et al.,* 2005). Although pup counts for all colonies are not presented in Thompson, *et al.* (2005), it is estimated that close to 2 % of the Falklands breeding population (2,747 pups produced in 2003) are found at this site. In support of this, during the 2016 coastal survey, most of the 60 South American sea lions recorded were in two groups; one at a haul-out site on Hog Island and the other at the colony on the northern coast of the outer Sound (often referred to as Diamond Cove; Figure 7-103). Sea lions were also observed on Cochon and Kidney Islands (Figure 7-103). During the winter 2017 survey, sea lions were recorded in low numbers throughout the Sound. At-sea, sea lions were recorded in all months during the JNCC surveys with the majority of records came from inshore waters (White, *et al.,* 2002).

Contrary to the accepted view that South American sea lions are generalists, satellite tracking of female South American sea lions has identified that individuals have specialised foraging strategies; in terms of location (inshore *vs.* offshore) and prey type (benthic or pelagic) (Baylis, *et al.,* 2015).

South American sea lions are known to return to land at favoured haul-out sites throughout the year and therefore all animals are susceptible to impacts in inshore waters throughout the year. However, those that specialise as inshore foragers are at greatest risk.

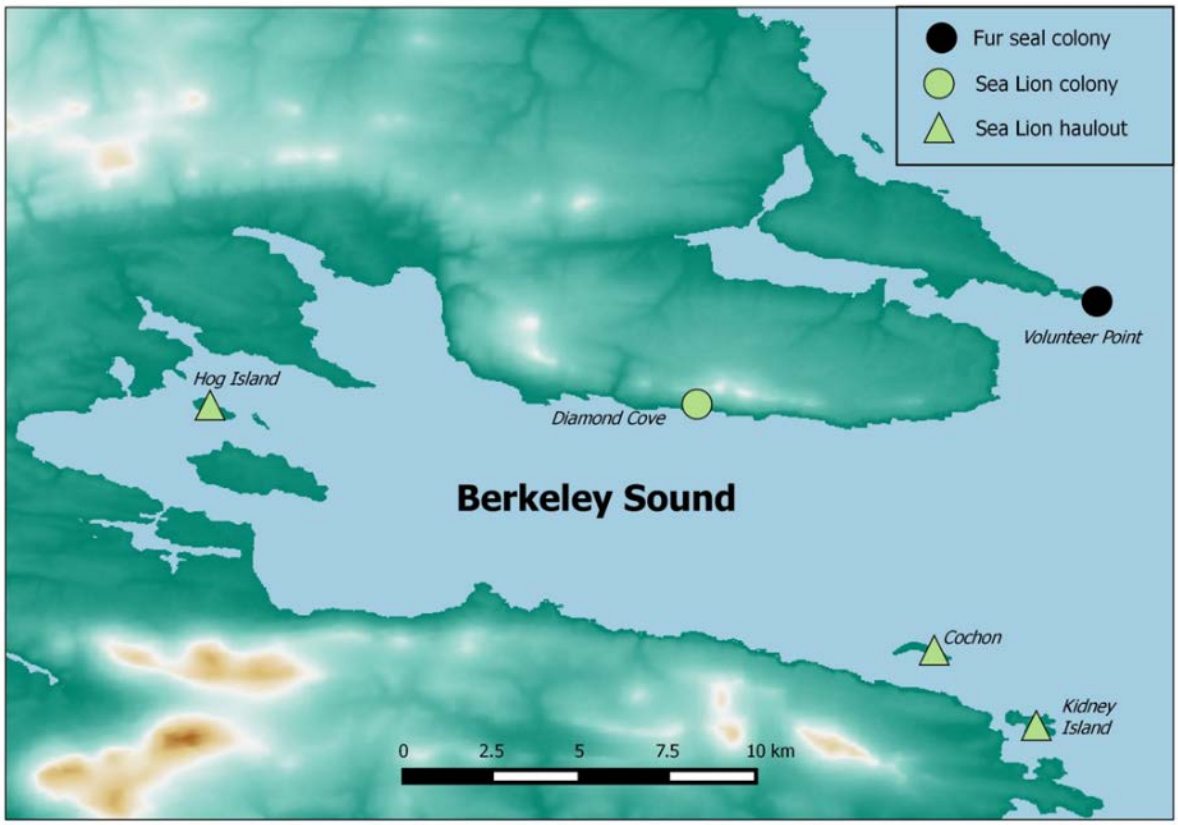
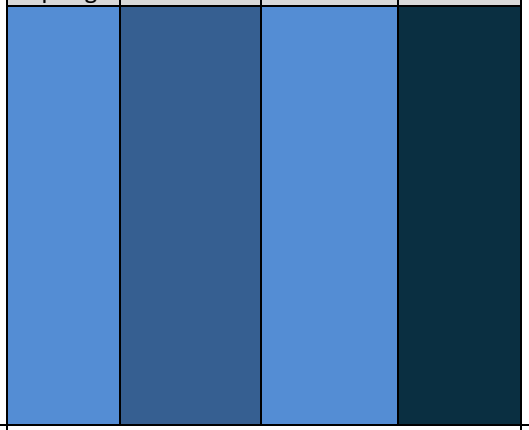
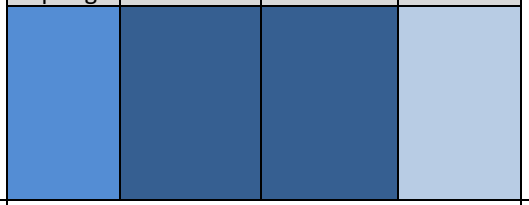


Figure 7-103: Sea Lion and fur seal colonies in Berkeley Sound

7.4.6.3.3 Summary of marine mammals in and around Berkeley Sound

Table 7.32 provides a summary of marine mammal abundance in Berkeley Sound, distribution, life-cycle and behavioural characteristics.

Table 7.32: Summary of marine mammals found inshore around the Falkland Islands

Species	IUCN status	Presence in Berkeley Sound	Global distribution	Foraging strategy	Auditory type	Behaviour
Cetaceans						
Southern right whale (*Eubalaena australis*)	LC	✓ Rarely sighted before 2017 but confirmed to be present in Berkeley Sound and other inshore waters (A. Black *pers. obs.*). Influx of a large number of whales during winter 2017. Spring / Summer / Autumn / Winter 	Circumpolar in the southern hemisphere[1]	Surface skim-feeding	Low frequency	Slow lumbering swimmers but can be acrobatic, breaching clear of the water or lifting the tail clear of the water. The southern right whale breeds between July-November in Península Valdés (Argentina) and Santa Catarina (Brazil) (Danilewicz, *et al*., 2016; Mandiola, *et al*., 2019; Renault-Braga, *et al*., 2022) and migrates south in the summer. In recent decades, high calf mortality has been reported in Argentina (Cooke and Zerbini, 2018). In the Falkland Islands, regionally important aggregations of southern right whales (including for mating) occur during winter in coastal waters (Weir and Stanworth, 2020). Recently, satellite tags have been deployed on Southern right whales in the Falkland Islands e.g., (Weir, 2022).
Fin whale (*Balaenoptera physalus*)	VU	Rarely sighted inshore Spring / Summer / Autumn / Winter 	Found in all oceans of the world	Lunge feeding	Low frequency	Capable of swimming at speeds of 19 knots. Movements poorly understood but most frequently encountered offshore or where deep water is found near the coast (White, *et al.,* 2002). Seen in small groups many of which may be present within a small area (tens of km^2)
	NT	✓				

Species	IUCN status	Presence in Berkeley Sound	Global distribution	Foraging strategy	Auditory type	Behaviour
Antarctic minke whale (*Balaenoptera bonarensis*)		Regularly sighted within Berkeley Sound Spring | Summer | Autumn | Winter	Globally, the most common of the rorquals	Lunge feeding	Low frequency	Movements around the Falkland Islands and South Atlantic region, are currently poorly known, but minke whales appear to be resident year-round (White, *et al.,* 2002).
Sei whale (*Balaenoptera borealis*)	EN	✓ The most abundant large whale seen in inshore waters (including Berkeley Sound) also frequently sighted offshore. Spring | Summer | Autumn | Winter	Found in all oceans, sub-Antarctic waters are favoured feeding grounds in summer[2]	Lunge feeding	Low frequency	Dives more regularly than most large whales, surfacing at approximately minute intervals. One of the fastest of the great whales, sei whales swim a few metres below the surface and progress can be followed by 'fluke prints' left on the surface in the animal's wake. Recently, satellite tags have been deployed on Sei whales in the Falkland Islands and highlights the importance of coastal nearshore waters (https://falklandsconservation.com/sei-whale-tracking/).
Humpback whale (*Megaptera novaeangliae*)	LC	Although not recorded in Berkeley Sound, humpback whales are known to be present in low numbers in the region. Spring | Summer | Autumn | Winter	Found in all oceans of the world	Lunge feeding	Low frequency	A population breeding off the coast of Brazil is thought to migrate to feed off the South Sandwich Islands in the summer months. Recent boat-based surveys in the Falkland Islands highlights annual variability in occurrence of Humpback whales (Weir, 2022).
Long-finned pilot whale (*Globicephalus melas*)	LC	Known to strand regularly (annually) in the Falklands but not within Berkeley Sound Spring | Summer | Autumn | Winter	High latitudes in the northern and southern hemisphere	Deep divers	Mid frequency	Can be encountered in large groups (100 + animals). There appears to be seasonal changes in distribution within Falklands waters, but movements poorly understood (White, *et al.,* 2002).

Species	IUCN status	Presence in Berkeley Sound	Global distribution	Foraging strategy	Auditory type	Behaviour
Killer whale (*Orcinus orca*)	DD	Regularly sighted inshore around Sea Lion Island, off the south coast of East Falkland but no known sightings in Berkeley Sound Spring | Summer | Autumn | Winter	Found in all oceans of the world.	Shallow dives	Mid frequency	Killer whales are known to pass through Falklands waters on rapid transit from Antarctic Peninsula to sub-tropical waters (Durban and Pitman, 2012). Additionally, there are likely to be resident populations. Seen year-round from longline vessels fishing to the north-east of the Sea Lion Field.
Commerson's dolphin (*Cephalorhynchus commersonii*)	LC	✓ Frequently sighted in coastal waters of the Sound Spring | Summer | Autumn | Winter	Only southern South America, the Falklands and Kerguelen	Shallow diving	High frequency	Observed throughout the Falklands in coastal waters (Franchini, *et al.,* 2020).
Peale's dolphin (*Lagenorhynchus australis*)	LC	✓ Frequently sighted throughout the Sound Spring | Summer | Autumn | Winter	Restricted to southern South America and the Falkland Islands	Shallow dives	High frequency	Thought to be resident with no discernible seasonal movements detected in the Falklands population. More numerous inshore but found across the Patagonian Shelf (waters <200 m) (Franchini, *et al.,* 2020). Very enthusiastic bow-riders.
Pinnipeds						
South American fur seal (*Arctocephalus australis*)	LC	✓ Breed on Volunteer Rocks at the northern entrance to the Sound. Spring | Summer | Autumn | Winter	Restricted to southern South America and the Falkland Islands	Shallow dives	Otariid	The Falkland Islands has one of the largest breeding populations of South American fur seals in the South Atlantic (Baylis, *et al.,* 2018). Most breeding sites found off the north-west and south-west of the Falklands. Volunteer Rocks are the only known breeding site off the east coast of the Islands (Baylis, *et al.,* 2018). Adults frequently travel between the Falkland Islands and

Species	IUCN status	Presence in Berkeley Sound				Global distribution	Foraging strategy	Auditory type	Behaviour
									coastline of South America during foraging trips (Riaz, *et al.,* 2024). South American fur seals are non-migratory.
South American sea lion (*Otaria flavescens*)	LC	✓ A small breeding colony is located on the north coast of the Sound. Haul-out sites on Kidney, Cochon and Hog Islands.				Restricted to southern South America and the Falkland Islands	Shallow dives	Otariid	There are 68 breeding sites spread throughout the Falklands. The population has suffered a drastic long-term decline. In 2003, the population was reduced to 3.4 % of the 1937 estimated population. The Falkland Islands population is slowly increasing, with approximately 4,500 pups born annually (Baylis, *et al.,* 2015)
		Spring	Summer	Autumn	Winter				

[1] **Post-consultation note (July 2025):** Studies carried out by Falklands Conservation between 2017 and 2025 (and ongoing) indicate that regionally important aggregations of southern right whale are now documented during winter in coastal waters, particularly along the north and northeast coast of East Falkland (Weir and Stanworth, 2020; Weir, 2024). These surveys indicate that this population comprises >1% of the global population (Weir, 2024).

[2] **Post-consultation note (July 2025):** Studies carried out by Falklands Conservation between 2017 and 2025 (and ongoing) indicate that aggregations of sei whales in the Falkland Islands nearshore waters comprise >0.1% of the global population.

Key: Relative abundance of marine mammals within Falklands waters

Not recorded	Low	Moderate	High	Very High

7.4.6.4 Marine mammals in Stanley Harbour and surrounding areas

Commerson's dolphin (*Cephalorhynchus commersonii*) and Peale's dolphin (*Lagenorhynchus australis*) have frequently been recorded within Stanley Harbour (Falklands Conservation Cetacean Watch records; MMO surveys misc.). Due to their limited range Commerson's dolphin has a greater potential to be impacted by operations than Peale's dolphin. The Peale's dolphin has a greater range of mobility and may move between more sheltered waters, kelp forests, exposed coastlines and shelf waters (White, *et al.,* 2002). However, no quantitative data on density or site fidelity is available.

Female South American sea lions (*Otaria flavescens*) are regularly sighted within the Harbour and hauled-out on existing jetties.

Overall, anecdotal evidence suggests that Commerson's dolphins and sea lions are the main sensitivities within the Harbour and other sighted species, such as southern right whales, are far less common[36].

7.4.6.5 Terrestrial habitats surrounding Berkeley Sound

7.4.6.5.1 Terrestrial habitat mapping and classification

Satellite images (see Figure 7-40 above) were used to map the terrestrial surrounding Berkeley Sound, details of the methodology used can be found in EnvSys (2016).

Using the information from fieldwork the remote sensing data was reanalysed and the terrestrial habitats mapped. A small section of the final map where fieldwork points had been used to guide the classification is provided in Figure 7-104.

The full map of the terrestrial vegetation surrounding the Sound can be seen in Figure 7-105, with the Magellan Cove area highlighted ('boxed'). The proportion of each habitat mapped is shown in Table 7.33.

In the coves and valleys where streams run into the Sound the vegetation comprises a mixture of flushes and marshy grassland close to the stream with species rich or semi-improved grassland in the valley bottoms. Away from the streams, the ground is not marshy but there is more available water than on the slopes and cliff edges and more palatable grass species occur, which flourish under these conditions. These areas attract grazing sheep which tends to lead to a cycle of nutrient enrichment as the sheep gather there; this leads to the semi-improved nature of many of these grasslands. Adjacent to the sandy beach, and in patches on the lower cliffs, are maritime grasslands, which contain a wide range of species.

Only on the low lying peaty and wetter land near Long Island, do the blanket bog and modified bogs reach within the 200 m zone of influence around the Sound, although these habitats are common further inland where the cliff edges flatten out. Cushion forming species generally occur in mosaics with acid grassland; they occur on shallower slopes throughout the Sound but generally in fairly small patches. The vegetation is also modified by penguin colonies which create swaths of bare ground which are often first colonised by sheep's sorrel (*Rumex acetosa*). The nutrient enrichment of these areas generally results in the establishment of the more productive unimproved acid grassland after the penguins move on. The most significant habitats around the Sound are the flushes, which contain a range of less common species, and the areas of tussock grass found on some of the islands.

[36] **Post consultation note (July 2025):** In June 2025 Falklands Conservation commenced data acquisition on the occurrence of dolphins in Stanley Harbour (Falklands Conservation, 2025). This will better inform environmental impact assessments relating to activities in Stanley Harbour. Once available this data will be considered through the EMMP process (Chapter 15) and any identified adaptive management action will be taken as required.

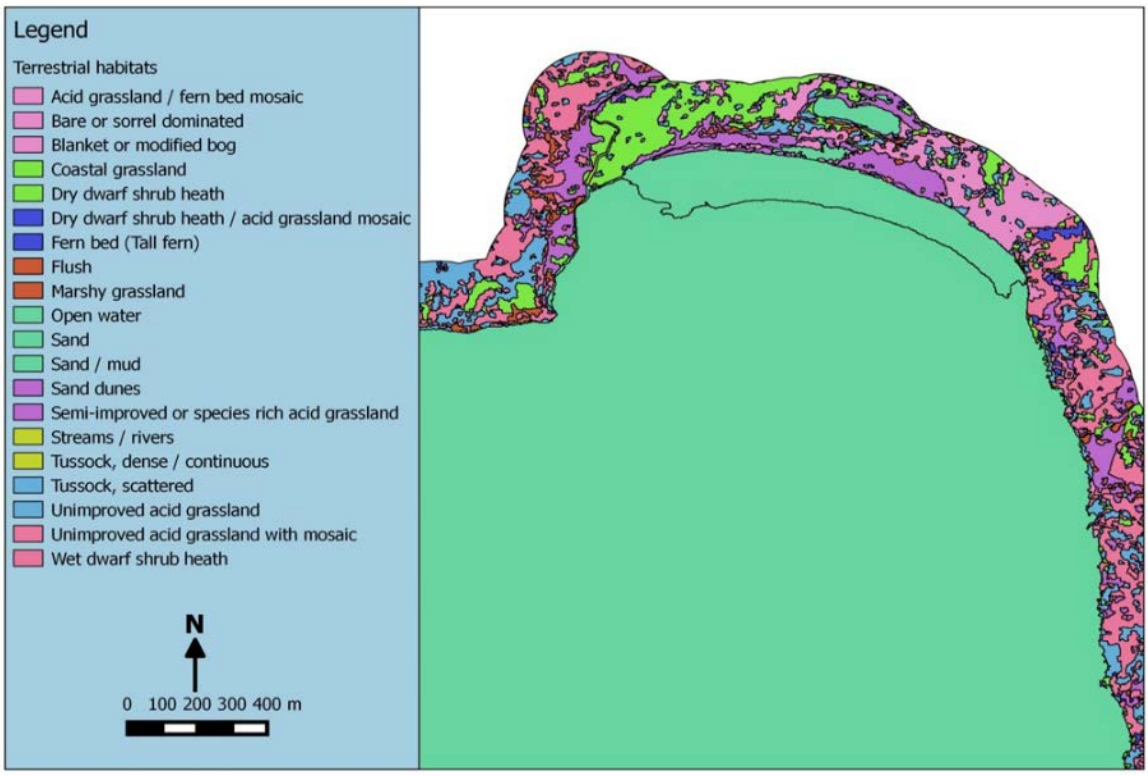


Figure 7-104: Terrestrial habitat mapping: Magellan Cove

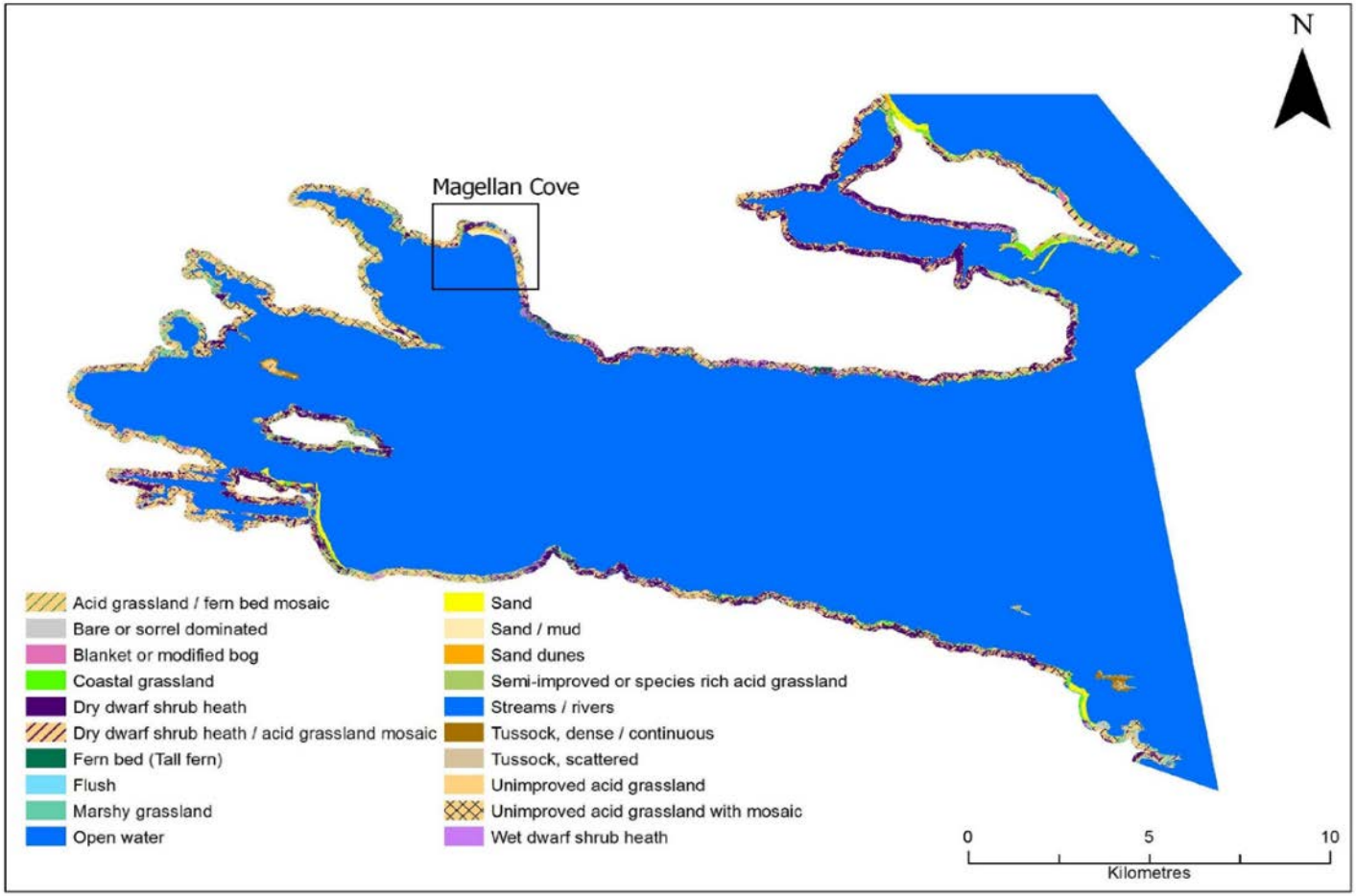


Figure 7-105: Terrestrial habitat map for Berkeley Sound ***(Source: EnvSys, 2016)***

Table 7.33: The area and percentage composition of terrestrial habitat types within 200 m of the Berkeley Sound shore

Habitat	Area (ha)	%
Unimproved acid grassland with mosaic including fern bed	869.07	25.05
Dry dwarf shrub heath	851.49	24.55
Unimproved acid grassland	571.34	16.47
Semi-improved or species rich acid grassland	269.97	7.78
Dry dwarf shrub heath / acid grassland mosaic	197.01	5.68
Wet dwarf shrub heath	138.41	3.99
Marshy grassland	120.15	3.46
Coastal grassland	110.33	3.18
Sand	83.34	2.40
Bare or sorrel dominated	80.00	2.31
Fern bed (tall fern)	40.48	1.17
Flush	33.65	0.97
Tussac grass, dense / continuous	30.72	0.89
Sand / mud	29.66	0.86
Sand dunes	19.72	0.57
Streams / rivers	7.63	0.22
Tussac grass scattered	7.30	0.21
Blanket or modified bog	7.05	0.20
Acid grassland / fern bed mosaic	1.34	0.04
Total	**3,468.66**	**100**

7.4.6.6 Environmental sensitive terrestrial habitats

In terms of the potential impact of oil and gas related activity within Berkeley Sound, any pollutants released or spilt will be marine in origin and therefore have greatest potential of impacting the coastal (littoral) environment. Low lying coastal areas may be at risk of being inundated by the sea and thus height above sea level is an important consideration. Figure 7-106 shows the terrain coloured up according to what might be considered 'risk' zones with the:

- Red areas being within 1 m above the mean high-water line,
- Orange areas within 5 m above the mean high-water line, and,
- Yellow areas being within 20 m above the mean high-water line.

This map clearly shows the low-lying areas where the streams output into the Sound as being most at risk of being impacted by any potential spill and strong winds / high tides. These areas also have some of the most significant vegetation, in terms of the diversity and uncommon species that they support. Although Important Plant Areas (Section 7.5.2.3.2) or Threatened Terrestrial Habitats (Section 7.5.2.4) are not known to occur around the coast of Berkeley Sound, three priority conservation species do occur (Section 7.5.3).

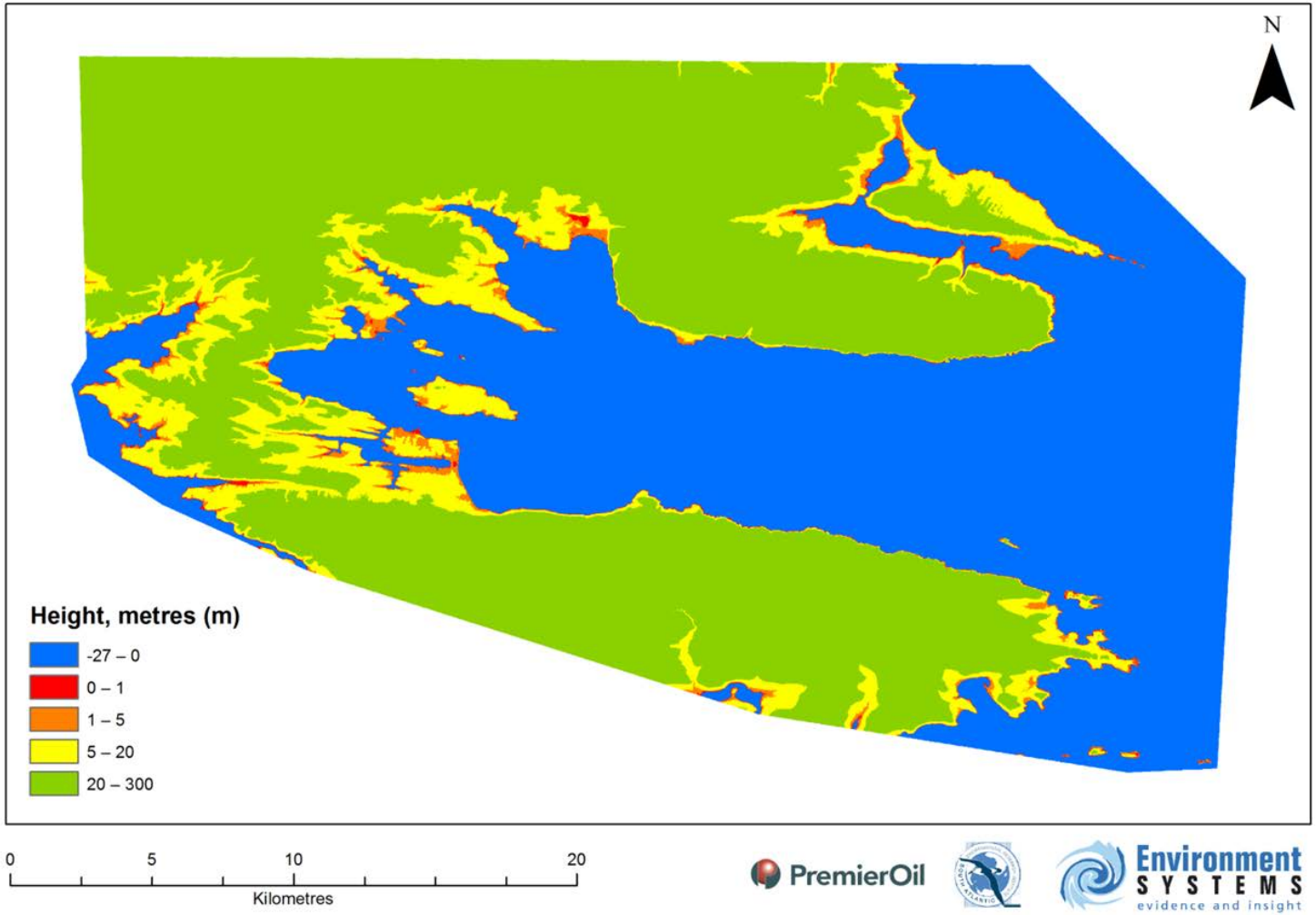


Figure 7-106: Terrain model data coloured to show low-lying land liable to marine inundation

7.5 Conservation Designations for sites, species and habitats

7.5.1 Protected species and sites

7.5.1.1 Benthic marine species

There is little specific protection for benthic marine species (or indeed marine habitats) within the waters of the Falkland Islands. This is partly because the marine environment and species assemblages are relatively poorly described.

Work was carried out to address these data gaps (Section 7.2.4.2). Marine Protected Areas (MPAs) or Marine Managed Areas (MMAs) (Section 7.5.2.2) will be designated in the near future, with some aimed at directly protecting seabed species and habitats among other vulnerable species.

7.5.1.2 Fish species

Fish species in their own right do not have specific protection. However, the Fisheries Ordinance 2005 (Section 3.1.7.3.9) caters for the use of closed areas (for protecting spawning sites). This comprises a combination of closed areas and a three-mile (from the baseline) no-take zone around the entire coastline (Figure 7-107 below).

Therefore, coastal waters, including Berkeley Sound, are not subject to commercial fishing. It should be noted that there was recently a small-scale sea cage growing facility for sea trout (currently not operating), and a small-scale harvesting operation for snow crab (now closed with some recent interest to restart crab fishing) within coastal waters elsewhere in the Islands. However, while there are potentially exploitable resources within Berkeley Sound (Davidson, 2016) these are currently unexploited.

7.5.1.3 Wild bird species

The majority of native wild birds are protected under the Conservation of Wildlife and Nature Ordinance, which was enacted in 1999 (Section 3.1.7.3.8).

The ordinance protects all bird species, except for the:

- Upland goose (*Chloephaga picta*) and feral domestic goose, which may be hunted and killed at any time of the year, and
- Patagonian crested duck (*Lophonetta specularoides*) and yellow-billed (speckled) teal (*Anus flavirostris*), both of which cannot be killed during the closed season (1 July to 31 March) and are therefore protected for part of the year.

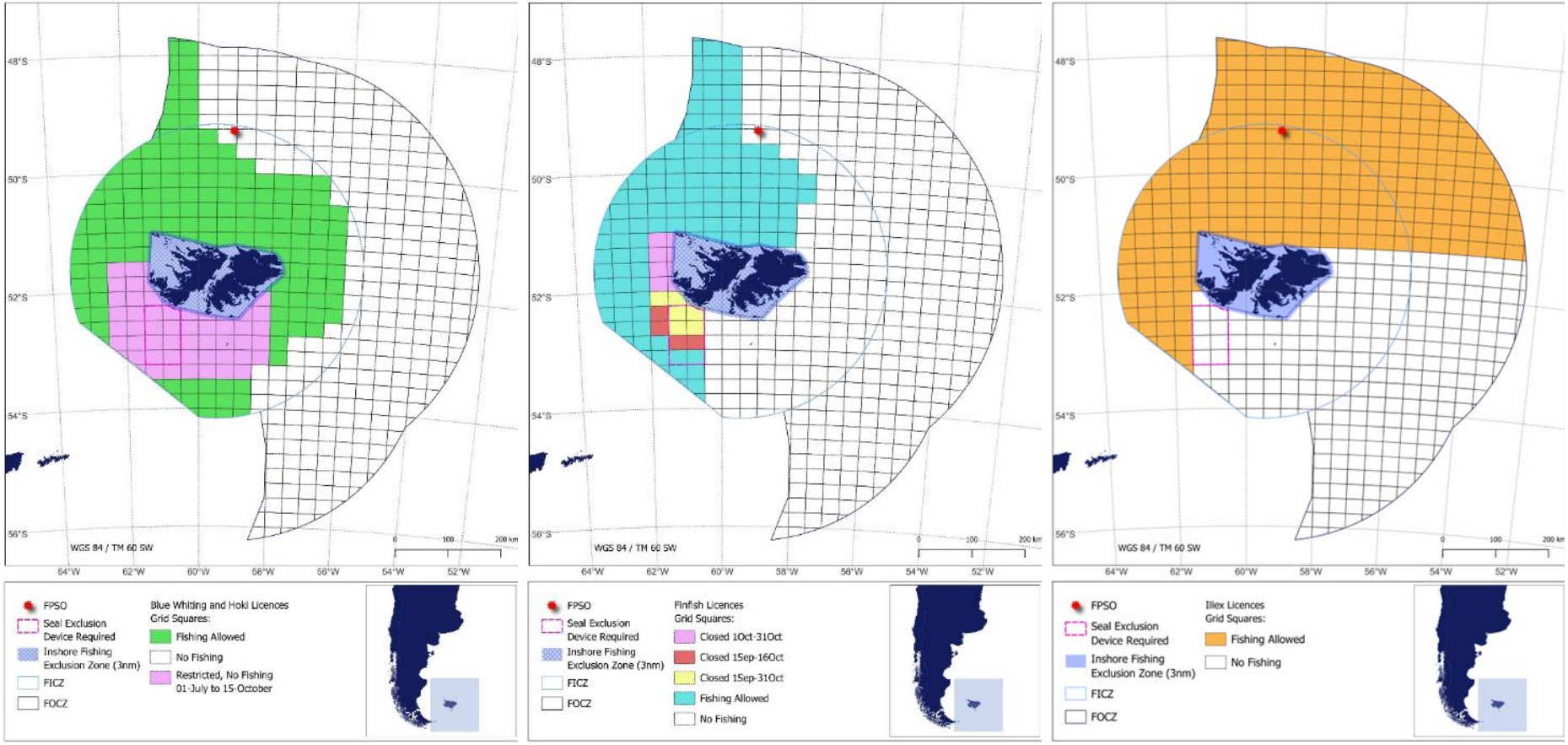
Further, the Ordinance bans the collection of eggs, birds and animals; however, a permit holder may still collect eggs from some species, including Magellanic and gentoo penguins. More recent amendments to the Ordinance forbid the collection of black-browed albatross and rockhopper penguin eggs. The Ordinance extends to cover the territorial waters of the Falklands (up to 12 nm offshore).

Note that the Fisheries Ordinance 2005 (Section 3.1.7.3.9) also requires the use of mitigation measures to prevent the incidental capture of seabirds in longline and trawl fisheries.

7.5.1.4 Marine mammals

The Marine Mammal Ordinance 1992 (Section 3.1.7.3.7) protects all marine mammals within Falkland Islands waters. It is an offence to take, wound or kill any marine mammal. According to the IUCN Red List, which assesses the conservation status of all species, there are four cetacean species that occur within Falkland Islands waters that are formally threatened. Sei and blue whales are 'Endangered' and

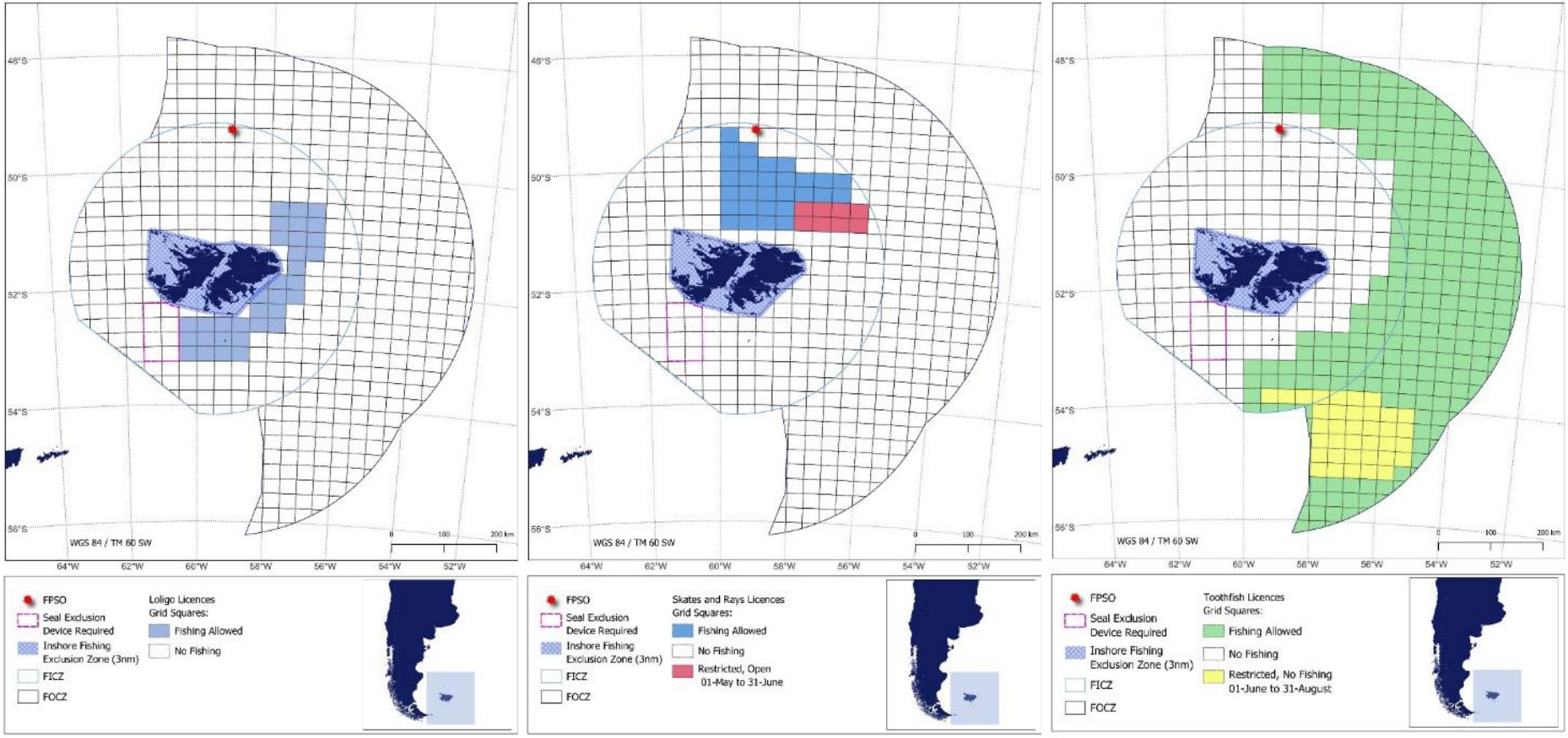
fin and sperm whales are classified as ‘Vulnerable’. Sei whales are regularly sighted within Berkeley Sound (Section 7.4.6.3).



a) Blue whiting and hoki

b) Finfish

c) Argentine shortfin squid (*Illex*)



d) Patagonian squid (loligo) e) Skates and rays f) Patagonian toothfish

Figure 7-107: The Falkland Islands Conservation Zones showing permanent and seasonal no-take zones

7.5.1.5 Terrestrial plants species

The Important Plant Area (IPA) directory for the Falkland Islands (Upson, 2012) identifies a number of endemic plant species and habitats that are of international conservation importance within the Falkland Islands. There are 178 vascular plant species native to the Falkland Islands including 14 endemic species, with 19 species currently protected under the Conservation of Wildlife and Nature Ordinance 1999. Six endemic species, listed below, are categorised as of global conservation concern, mostly due to their small population sizes and restricted ranges (Upson, 2012):

- Antarctic cudweed (*Gamochaeta antarctica*) – IUCN 'Endangered',
- Falkland false-plantain (*Nastanthus falklandicus*) – IUCN 'Endangered',
- Hairy daisy (*Erigeron incertus*) – IUCN 'Endangered',
- Moore's plantain (*Plantago moorei*) – IUCN 'Endangered',
- Falkland rock-cress (*Phlebolobium maclovianum*) – IUCN 'Vulnerable', and
- Falkland nassauvia (*Nassauvia falklandica*) – IUCN 'Unlisted'.

Upson and Lewis (2014) collate all the available information regarding plant distribution in the Falkland Islands into a distribution atlas. The distribution of the six species listed above are described as follows:

- Atlantic cudweed was only found in approximately six locations over the entire Falkland Islands,
- Falkland rock-cress is distributed across the Islands, although none have yet been found in the south of East Falkland,
- False plantain has only been found in the south of West Falkland,
- Hairy daisy is found in several locations along the west of West Falkland and in four locations on East Falkland,
- Falkland nassauvia and its distribution is still being studied, and
- Moore's plantain is also only found at a few locations in the south of West Falkland (Upson, 2012).

Antarctic Cudweed, Falkland Rock Cress and Hairy Daisy are all found in coastal environments and have been confirmed to occur in Port Louis Harbour within Berkeley Sound (Upson and Lewis, 2014). They may occur more widely in the Berkeley Sound area but detailed surveys have not been conducted in all areas. These species could be impacted by beach stranded oil or by vehicular and personnel access for response operations. The remaining three species (False Plantain, Moore's Plantain and Falkland nassauvia) occur only on West Falkland (Upson and Lewis, 2014) and are not significant to the current assessment.

7.5.2 Protected habitats

There are currently three categories of environmental and wildlife protection which are applicable within the Falkland Islands:

- Terrestrial National Nature Reserves (through the Conservation of Wildlife and Nature Ordinance (1999)),
- Marine Protected Areas (MPAs - none in place to date), however there are a number of proposed MMAs (Section 7.5.2.2),
- Scientific designations for globally important habitats:
  - Important Bird Areas (IBAs),
  - Important Plant Areas (IPAs),

- Ramsar sites
- Key Biodiversity Areas (KBAs), and
- Important Marine Mammal Areas (IMMAs).

Note: it is not possible to assess the overall health of the local designated sites without dedicated monitoring and management plans for each site. The development of such plans is the responsibility of the landowners e.g., FIG, private ownership etc., (Section 7.7.2.3).

7.5.2.1 Terrestrial National Nature Reserves (NNR)

National Nature Reserves (NNRs) are established under the Conservation of Wildlife and Nature Ordinance (1999). There are currently 19 NNRs within the Falkland Islands (Table 7.34, Figure 7-108), which are either owned by FIG, private landowners, or organisations, such as Falklands Conservation. There are two NNRs within Berkeley Sound; Cochon and Kidney Islands and Volunteer Point and Cow Bay (Table 7.34, Figure 7-108).

Although the protection of these NNRs is underpinned by legislation, the main mechanism used to facilitate protection and management of these sites is the development and implementation of management plans by both FIG and landowners/stakeholders. FIG can designate marine NNRs (also referred to as Marine Managed Areas (Section 7.5.2.2 below)). Although marine NNRs have yet to be proclaimed, there are some sites currently under review. Terrestrial NNRs may also be extended by 15 miles offshore from the coast.

Table 7.34: National Nature Reserves in the Falkland Islands and Berkeley Sound in particular

Date	Order	Designated Area	Landowner	IBA/IPA Ramsar Status	Distance from Sea Lion Licence block (km)
Falkland Islands overall					
1973	Jason Islands	Flat Jason 51º 06'S 60º 53'W (Designated separately, 1966) Elephant Jason 51º 09'S 60º 51'W South Jason 51º 12'S 60º 53'W North Fur Is. 51º 08'S 60º 44'W South Fur Is. 51º 15'S 60º 51'W Jason East Cay 51º 00'S 61º 18'W Jason West Cay 50º 58'S 61º 25'W The Fridays 51º 03'S 60º 58'W White Rock 51º 17'S 60º 53'W Seal Rocks 51º 07'S 60º 48'W	FIG	IBA	224
1964	The Twins Islands	51º 15'S 60º 38'W North-west of Carcass Island	Falklands Conservation	IBA	230
1964	Low Island	51º 19'S 60º 27'W South-east of Carcass Island	Private	IBA	235
1966	Middle Island	51º 38'S 60º 20'W King George Bay, West Falkland	FIG	IBA	263
2009	Chartres Horse Paddock (Patricia Luxton National Nature Reserve)	51º42'S 60º 03' W East of Chartres Farm Settlement, West Falkland	Private	IPA	265

Date	Order	Designated Area	Landowner	IBA/IPA Ramsar Status	Distance from Sea Lion Licence block (km)
1998	Narrows	51º 41'S 60º 19'W Narrows Farm, West Falkland	Private	-	267
1998	East Bay	51º 48'S 60º 13'W East Bay Farm, West Falkland	Private	-	277
1993	New Island	51º 43'S 61º 18'W	Falklands Conservation	IBA	302
1978	Sea Dog Island	Sea Dog Island 52 00'S 61 06'W	FIG	-	321
1969	Bird Island	Bird Island 52º 10'S 60º 54'W	FIG	IBA	333
1978	Arch Islands	Big Arch Island 52 13'S 60 27'W Natural Arch Clump Island Tussac Island Pyramid Rock Last Rock and Albemarle Rock	FIG	-	325
1964	Beauchêne Island	52º 54'S 59º 11'W	FIG	IBA	390
1970	Bleaker Island	52º 18'S 58º 51'W Bleaker Island north of Long Gulch	Private	IBA	310
2012	Sea Lion Island	Sea Lion Island 52º25'S 59º 05'W	Private	IBA Ramsar	338
1973	Stanley Common	51º 43'S 57º 49'W	FIG	IPA (Cape Pembroke)	269
1968	Cape Dolphin	51º 15'S 58º 51'W	Private	-	208
1996	Moss Side	51º 23'S 58º 49'W, Pond and sand-grass flats behind Elephant Beach	Private	-	222
Berkeley Sound					
1964	Cochon and Kidney Islands (Berkeley Sound)	Kidney Island 51º 38'S 57º 45'W Cochon Island 51º 36'S 57º 47'W	FIG	IBA / KBA	262
1968	Volunteer and Cow Bay (Berkeley Sound)	51º 29'S 57º 50'W East Falkland	Private	IBA	260

(Source: UKOTCF, 2025.)

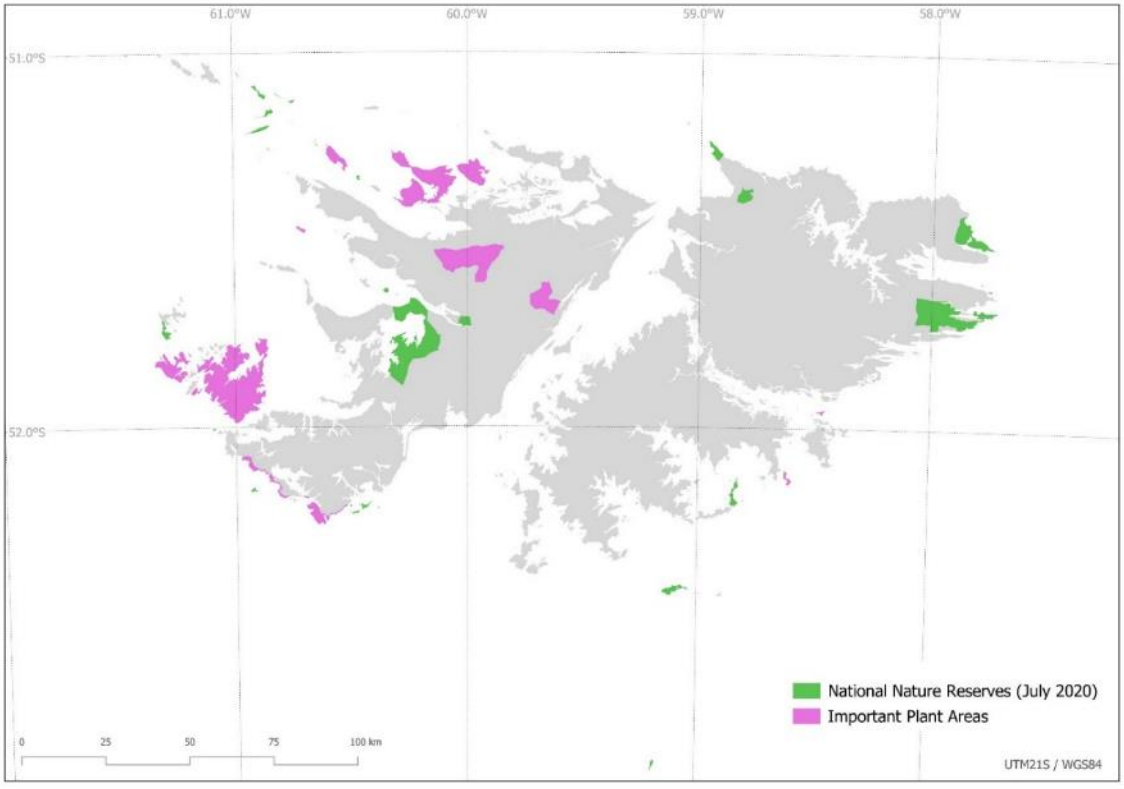


Figure 7-108: Falkland Islands National Nature Reserves and Important Plant Areas

7.5.2.2 Marine Protected Areas (MPAs) / Marine Managed Areas (MMAs)

The Falkland Islands EEZ is rich in marine biodiversity, including globally threatened seabirds and marine mammals. The Fisheries Ordinance 2005 does afford protection to the marine environment and designates a number of no-take zones. However, to date no MPA's have been officially designated in the seas surrounding the Falkland Islands. There is already risk to the Falkland Islands marine environment from resource extraction and such pressures are likely to intensify and include new developments and related changes to coastal land-use. Existing practice and legislation need to be improved to manage current and potential future threats, to protect threatened species, sites and habitats.

The Falkland Islands Biodiversity Framework 2016-30 (FIG, 2016a) sets out the Falkland Islands Government vision with regards to:

> *'Biodiversity namely to 'conserve and enhance the natural diversity, ecological processes and heritage of the Falkland Islands, in harmony with sustainable economic development.'*

The lack of integrated land / sea zoning and management was identified as one of the highest priorities that need addressing in the Falkland Islands in the 2012 workshop report from the FCO/JNCC funded project 'Environmental Mainstreaming' (JNCC, 2012).

The need for a holistic marine management approach across all sectors that promotes sustainable use of Falkland Islands marine resources and that safeguards its biodiversity is recognised. Therefore, a long-term process of Marine Spatial Planning (MSP) began in 2014 with the 'MSP in the Falkland Islands (DPLUS027) project. Following the successful conclusion of DPLUS027, a second MSP phase covered, among other things, the Assessment of Fishing Closure Areas as Sites for wider management (AFCAS) as potential MMAs, using criteria for Marine Protected Areas (MPA's) to help guide the areas selected.

A consultation and post-consultation workshop concluded further data were required to inform the process and this was the genesis of DPLUS071 (Fine scaling the design of Falkland Islands MMAs). Several proposed MMAs are being taken forward by FIG through finer scale policy design and subsequent legislative drafting.

The currently proposed Falkland Island MMAs are showed in Figure 7-109. The proposed MMAs include marine Sustainable Multi-Use zones (SMZs) and National Marine Nature Reserves (NMNRs). The SMZs and NMNRs will have different MMA management levels, if designated.

The MSP/MMA process in the Falklands encapsulates the requirements for both multiple sustainable economic use of the marine environment, and marine conservation and protection. The requirement for a robust evidence-base to make designation of MMAs meaningful from an ecological perspective is also core to this process.

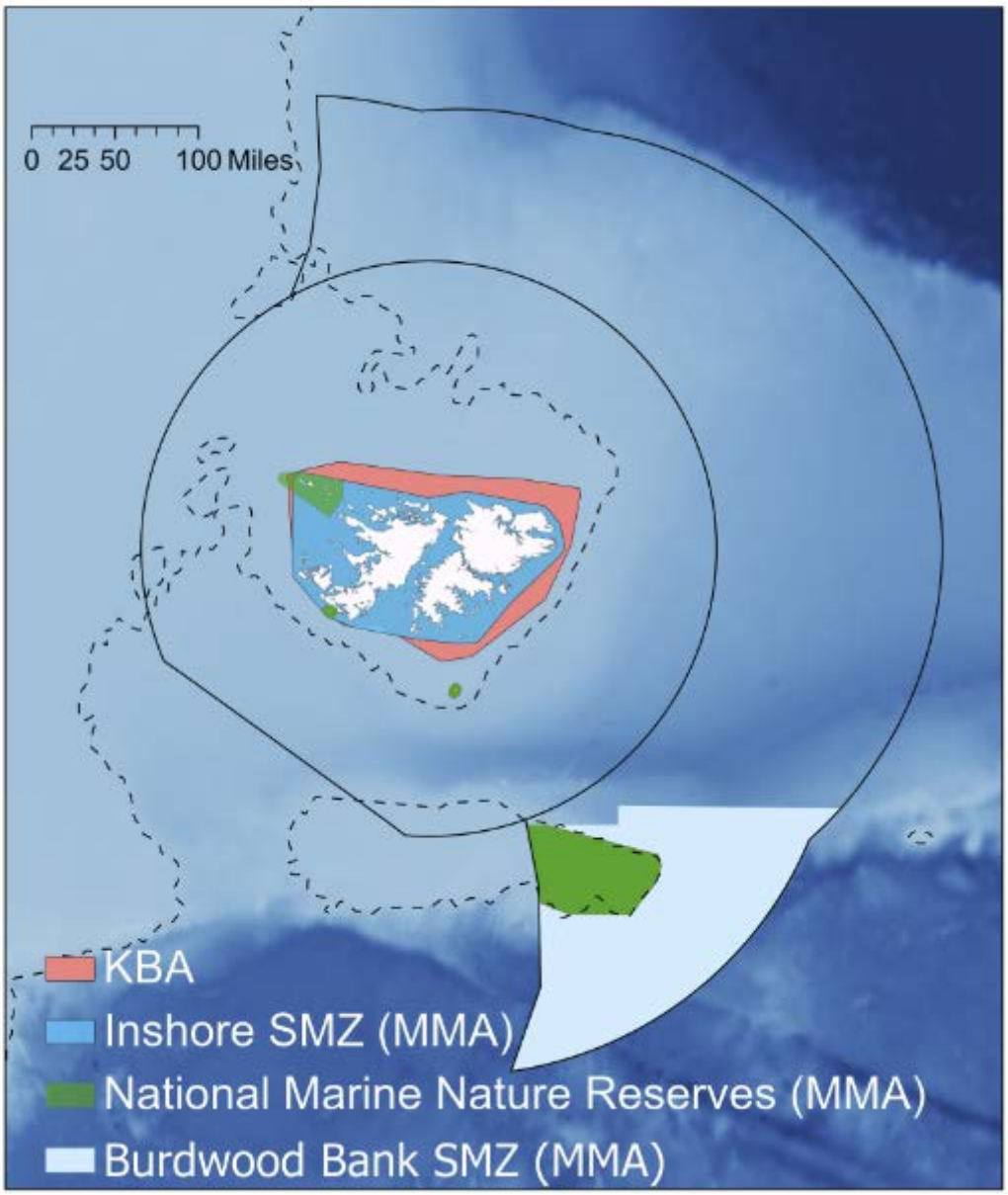


Figure 7-109: The location of currently proposed Marine Managed Areas (MMAs). MMAs include proposed Sustainable Multi-use Zones (SMZ) and National Marine Nature Reserves. Also shown are the non-statutory marine Key Biodiversity Areas (KBA)

7.5.2.3 Scientific designations for globally important habitats and sites

In addition to the NNR system, there are a number of scientific designations that serve to recognise the globally important nature of sites within the Falkland Islands. Important Bird Areas (IBAs) and Important Plant Areas (IPAs) use a set of internationally agreed criteria and regionally defined thresholds to determine whether a particular site meets the requirements. In the Falkland Islands, IBA and IPA status does not provide legal protection *per se*, but should be considered as important informants to forward planning (e.g., Protected Area establishment) and risk assessment initiatives. Ramsar sites are also designated on the basis of meeting a set of criteria, but are slightly different to IBAs and IPAs in that the Falklands are included in the UK ratification of the Ramsar Convention, and have certain responsibilities under the ratification.

7.5.2.3.1 Important Birds Areas (IBAs)

The IBA system was developed by BirdLife International as a means of recognising globally important sites for birds, to inform the protection and conservation of bird species. Within the Falkland Islands, Falklands Conservation is responsible for administering the IBA programme. There are currently 22 IBAs in the Falkland Islands, 17 of which are islands or island groups, and the other five are found on the mainland of East or West Falkland (Table 7.35; Figure 7-110). Any terrestrial based IBA may be extended by 15 miles into the offshore environment. Although there are currently no marine IBAs established, work is ongoing to determine candidate areas. The level of legal protection associated with IBAs varies from country to country. In the Falklands, IBA status does not infer any legal protection but they are useful for informing management decisions.

Table 7.35: Confirmed Important Bird Areas for breeding sites in the Falkland Islands and Berkeley Sound in particular[1]

IBA Code	Site Name	Area (km^2)	IBA trigger seabird Species, life-cycle	Distance from Sea Lion Field (km)
Confirmed IBA – Terrestrial breeding areas (Falkland Islands overall)				
FK001	Beauchêne Island	1.7	MC, GP, RP, BBA, FP, SS: breeding	291
FK002	Beaver Island Group	59.6	GP, MP, SGP: breeding	303
FK022	Bertha's Beach, East Falkland	33.0	GP, MP: breeding	274
FK003	Bird Island	1.2	RP, BBA, TBP, SS - breeding	331
FK004	Bleaker Island Group	21.5	GP, RP, MP, SGP, IS – breeding	305
FK018	Bull Point, East Falkland	15.0	GP, MP - breeding	324
FK005	Elephant Cays Group	2.5	MP, SGP – breeding	293
FK019	Hope Harbour, West Falkland	17.6	GP, RP, MP, BBA – breeding	241
FK006	Hummock Island Group	6.7	RP, IS – breeding	257
FK007	Jason Islands Group	33.7	MC, RP, MP, BBA, SGP – breeding	223
FK008	Keppel Island	36.3	GP, RP, MP, BBA – breeding	218
FK010	Lively Island Group	67.9	GP, MP, SGP - breeding	288
FK011	New Island Group	25.5	GP, RP, MP, BBA, TBP, WCP, IS - breeding	290
FK012	Passage Islands Group	8.8	GP, RP, SGP – breeding	268
FK013	Pebble Island Group	109.6	MC, GP, RP, MP, SGP, SS – breeding	208
FK014	Saunders Island	124.0	GP, RP, MP, BBA – breeding	222
FK015	Sea Lion Islands Group	10.3	GP, RP, MP, SGP, SS – breeding	337

IBA Code	Site Name	Area (km^2)	IBA trigger seabird Species, life-cycle	Distance from Sea Lion Field (km)
FK020	Seal Bay, East Falkland	31.0	GP, RP, MP, SS – breeding	230
FK016	Speedwell Island Group	0.9	GP, MP, SGP, SS – breeding	308
FK017	West Point Island Group	35.0	GP, RP, MP, BBA - breeding	229
FK009	Kidney Island Group	0.4	MP, WCP, SS - breeding	262
FK021	Volunteer Point, East Falkland	40.6	GP, MP – breeding	240

[1] IBA trigger species: BBA – black-browed albatross, FP – fairy prion, , GP – gentoo penguin, IS – imperial shag, MC – Macaroni penguin, MP – Magellanic penguin, RP – rockhopper penguin, SGP – southern giant petrel, SS – sooty shearwater, TBP – thin-billed prion, WCP – white-chinned petrel *(Source: BirdLife International, 2014a).*

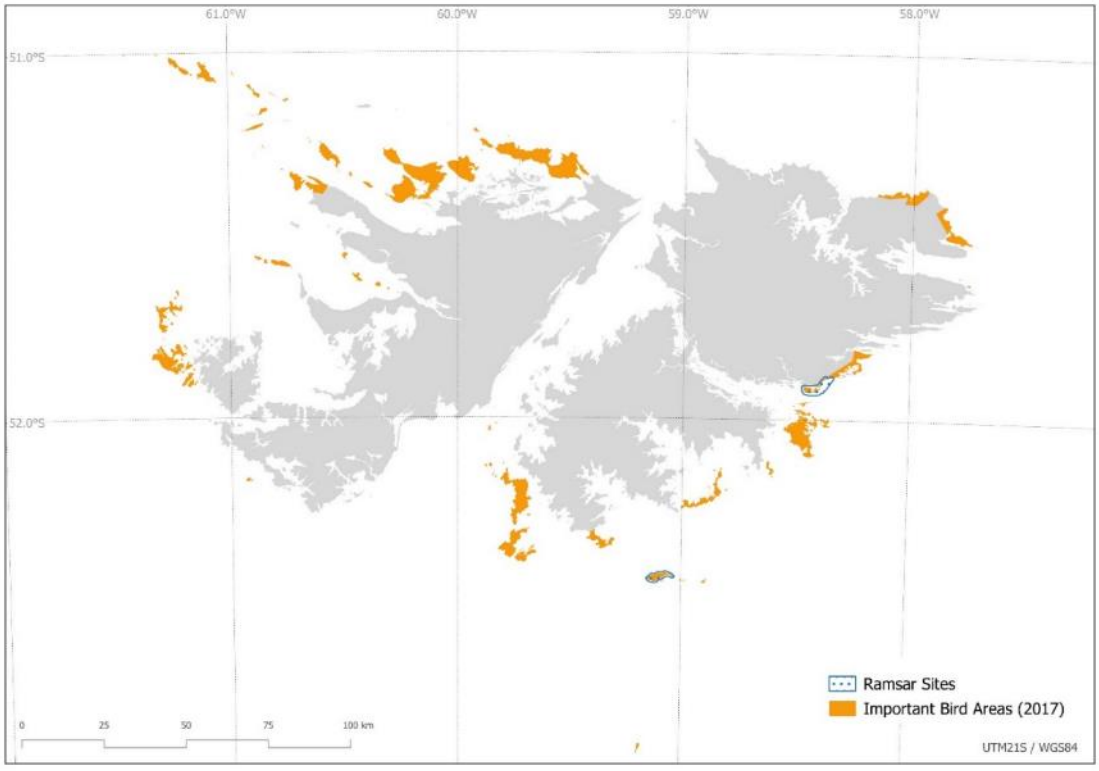


Figure 7-110: Current Important Bird Areas (IBAs) and Ramsar Sites (Bertha's Beach and Sea Lion Island) around the Falkland Islands *(Source: BirdLife International, 2014a)*

7.5.2.3.1.1 IBAs in Berkeley Sound

Kidney Island Group

The Kidney Island Group is composed of two small islands off the southern coast of Berkeley Sound; Kidney and Cochon Islands. Kidney Island lies approximately 400 m off the coast of East Falkland at the mouth of Berkeley Sound, near Mengeary Point, and is 32 hectares (ha) in area. Cochon Island is situated approximately 1,330 m to the north-west of Kidney Island, about one kilometre off the coast of East Falkland, and is eight hectares in area. The Group is owned by the FIG and is designated as a NNR and an IBA.

Kidney Island is low lying and dominated by mature tussac (*Poa flagellata*), which grows to over 2.5 m in height. Tussac grass forms habitat for a number of burrowing seabird species, with sooty shearwaters being the most numerous breeding species on the Island. The population has increased

in size since the 1960s and is now believed to number 139,000 pairs (Wakefield, *et al.,* 2017). Other burrowing seabirds that are known to breed on the Island include: Magellanic penguin, white-chinned petrel, great shearwater, grey-backed storm-petrel and common diving-petrel. The northern coast is fringed by cliffs (18 m in height) and is home to breeding rockhopper penguins, rock and imperial shags.

Kidney Island remains rat-free and is home to breeding populations of the Falklands' three endemic bird species: Cobb's wren, tussac bird and Falkland steamer duck.

The sub-littoral waters around Kidney Island support a diverse range of habitats and species (SMSG, 2012).

Cochon Island largely consists of steep-sided slabs of rock, which rise to 30 m above sea level. There is little soil on the Island and vegetation is largely restricted to patchy tussac grass. The diversity of breeding birds on Cochon Island is not as great as that on Kidney but it does support a small population (250 pairs) of rockhopper penguins and a large colony of imperial shags.

Both Islands are used as haul-out sites for South American sea lions, although they are not known to breed on the Kidney Island Group.

The proximity of these Islands to shipping routes and anchorages in Berkeley Sound mean that there is a risk of impact from accidental oil spills or the introduction of non-native species such as rats. A management plan has been written to address the management issues that affect both of these Islands (FIG, 2013a).

The Kidney Island Group is designated as an Important Bird Area (Falklands Conservation, 2006). The most significant species contributing to the IBA status are shown in Table 7.36.

Kidney Island also has Key Biodiversity Area (KBA) designation. Kidney, Top and Bottom Islands also represent ACAP breeding sites No. 80 and 81 for white-chinned petrels.

Along with the species listed in Table 7.36, Kidney Island is the only confirmed breeding site for great shearwater outside of the Tristan da Cunha Group (Woods, 1970). A very small population, estimated at no more than 15 pairs (Woods and Woods, 1997), breed at the western end of the Island. The sooty shearwater colony on Kidney Island is believed to be the largest in the Falkland Islands.

Table 7.36: Kidney Island Group IBA criteria ***(Source: Falklands Conservation, 2006)***

Species	IBA Criteria	Population estimate	Comment
White-chinned petrel	A1: Vulnerable species	Approx. 1,000	Kidney population mainly along southern coastal slopes
Rockhopper penguin	A1: Vulnerable	512	Kidney (257) increasing slowly, but historic decline since 1930s (c.3,500 pairs), Cochon (264) declining
Magellanic penguin[1]	A1: Near Threatened[1]	unknown	Numerous Kidney, not counted
Sooty shearwater	A1, A4ii: Near Threatened, > 1 % of the global population	>100,000	Kidney population has increased since 1960s, possibly two burrows per square metre
Cobb's wren	A1, A2: Vulnerable, Restricted range	unknown	Widespread and numerous on Kidney not counted
Tussac bird	A2: Restricted range	unknown	Numerous on Kidney beaches not counted
Falkland steamer duck	A2: Restricted range	15	Fluctuates from 6 - 15 pairs
Combined seabirds	A4iii: Supports >10,000 pairs of seabirds	>102,000	-

[1] Note that since the IBA designation, the Magellanic penguin IUCN Red List status has been downgraded to Least Concern (most recently assessed in 2020).

Volunteer Point and Cow Bay

Volunteer Point is a lowland peninsula on the northern coast of Berkeley Sound and marks the northern entrance to the Sound. North of Volunteer Point, lies Cow Bay, which combined represent an NNR and IBA covering 4,060 ha. The land is privately owned by Jan Cheek and is a popular tourist visitor site.

The northern coast of Volunteer Point includes a range of low cliffs, sandy and boulder beaches with extensive kelp beds offshore. The southern side of the peninsula borders Volunteer Lagoon and includes the extensive sand flats and dunes of Lagoon Bar.

Volunteer Green supports the largest colony of king penguins in the Falklands but also supports breeding gentoo and Magellanic penguins. Beyond the penguin colonies on the green, Volunteer Lagoon supports a variety of waterfowl. The species that contribute to the IBA status are shown in Table 7.37.

Table 7.37: Volunteer Point IBA criteria ***(Source: Falklands Conservation, 2006)***

Species	Criteria	Breeding pairs	Comment
Gentoo penguin	A1: Near threatened	1,368	2001 Volunteer Green 766, Lagoon Bar 325, Cow Bay 277
Magellanic penguin[1]	A1: Near threatened[1]	>2,000	2003, extensive coastal colony
Ruddy-headed goose	A2: Restricted range species	>100	Scattered throughout site
Black-throated finch	A2: Restricted range species	Unknown	Breeding in heathland and coastal vegetation, no counts
Falkland steamer duck	A2: Restricted range species	About 75	Volunteer Point 60 along coast, Cow Bay 10

[1] Note that since the IBA designation, the Magellanic penguin IUCN Red List status has been downgraded to Least Concern (most recently assessed in 2020).

7.5.2.3.2 Important Plant Areas (IPAs)

IPAs were established by Plantlife International and the IUCN with a view to identifying locations that will allow the best protection of threatened plant species. The IPAs are chosen based on whether the location has one or more species that are of global conservation concern, or has a rich population of regional flora (Upson, 2012). There are currently 17 IPAs within the Falkland Islands, none are close to Berkeley Sound (Upson, 2012).

7.5.2.3.3 Ramsar sites

The Ramsar convention was established in 1971. It provides for the protection of all habitats that fall under the umbrella description ‘wetlands’, which includes marshes, peat bogs, oases, ponds, lakes and the marine inshore environment. There are currently two Ramsar sites within the Falkland Islands: Sea Lion Island and Bertha’s Beach (Figure 7-110 above), both of which are also designated as IBAs; Sea Lion is also an NNR. There are currently 18 further sites which are being considered for Ramsar designation.

7.5.2.3.4 Key Biodiversity Areas

Key Biodiversity Areas (KBAs) are widely used to help inform conservation planning (IUCN, 2016). KBAs are sites that ‘contribute significantly to the persistence of global biodiversity’. They are one of several conservation prioritisation tools (others include Important Marine Mammal Areas and Ecologically or Biologically Significant Marine Areas). The global KBA program is administered by the KBA partnership, which is comprised of 12 international NGOs. KBAs are non-statutory.

The vision of the KBA Programme is:

> *'a comprehensive network of sites that contribute significantly to the global persistence of biodiversity is appropriately identified, correctly documented, effectively managed, sufficiently resourced and adequately safeguarded.'*

Recently, two marine KBAs have been designated in the Falkland Islands. These are the Falkland Islands Inshore (to 100 m depth) KBA and Beauchene Island. The data underpinning the Inshore KBA assessment and designation were for sei whales (IUCN 'Endangered') and seabirds[37]. The sei whale assessment was based on population estimates using photo-identification, predictive modelling and extrapolations of data from aerial surveys and line transects (Weir, 2021). These data indicated that the seasonal nearshore population of sei whales was >0.1 % of the global population. The Inshore KBA designation for sei whales was therefore based upon the lower KBA threshold (A1c) provided for species which have been assessed as IUCN 'Endangered' 'due only to population size reduction in the past or present'. The seabird KBA triggers were a marine extension of globally important seabird colonies (buffers around colonies) (Weir 2021; Handley, *et al*., 2023).

Overall the KBA assessments concluded that the following 10 species have populations which trigger global KBA criteria:

- Sei Whales (EN),
- Black-browed Albatross (LC),
- Southern Giant Petrel (LC),
- Sooty Shearwater (NT),
- Slender-billed Prion (LC),
- Brown Skua (LC),
- Dolphin Gull (LC),
- Gentoo Penguin (LC),
- Southern-Rockhopper Penguin (VU), and
- Falkland Steamer Duck (LC).

For full details about the assessments for sei whales and seabirds, please see: Weir (2020; 2021) and Handley *et al.* (2023). In addition, marine KBAs were also assessed using the GAP tracking data, which revealed the majority of the Falkland Islands EEZ (over 70 %) qualifies as a KBA (Baylis, *et al.,* 2021a).

However, like many datasets described within this EIS, there are limitations associated with KBA data. For example, while KBA criteria and thresholds are indeed standardised, the methods used to identify areas to assess against these criteria, are not standardised. This means that KBA boundaries could differ by orders of magnitude, depending on the approach used to delineate boundaries. For an in-depth review of KBA methods and challenges in the context of tracking data, see Baylis, *et al.* (2021).

The Falkland Island KBAs are shown in Figure 7-109 above.

7.5.2.3.5 Important Marine Mammal Areas (IMMAs)

IMMAs are areas identified as important habitat for marine mammals, and are defined as:

[37] **Post-consultation note (July 2025):** In 2024, a wintering southern right whale (IUCN 'Least Concern') candidate KBA was proposed as the right whale populations exceeded 1% of the global population (Weir, 2024), thus triggering the KBA designation under Criterion D1a. This KBA was designated but given the overlap in the areas covered, was subsequently subsumed into the existing Inshore KBA (Weir, 2024) which is now designated for the sei whales, seabirds *and* the southern right whale.

'A discrete portion of habitat, important for one or more marine mammal species, that has the potential to be delineated for conservation'.

IMMA designation can be based on both quantitative and qualitative criteria. However, IMMAs are non-statutory, have no legal standing, and do not take into account socio-economic and political concerns. IMMAs are one of several conservation planning and prioritisation tools, and complement and support existing tools such as IBAs, KBAs, and EBSAs and much of the Patagonian Shelf has been designated an IMMA.

Recent marine mammal work conducted by Falklands Conservation has resulted in two Important Marine Mammal Areas (IMMAs) as follows:

- The Falkland Islands Inner Shelf Waters IMMA from the coast to 100 m water depth. It supports a globally-significant and annually-persistent seasonal feeding aggregation of IUCN 'Endangered' sei whales (*Balaenoptera borealis schlegelii*), and provides important year-round habitat used for calving and feeding by Peale's dolphins (*Lagenorhynchus australis*) and Commerson's dolphins (*Cephalorhynchus commersonii*). The coastline provides breeding habitat for a globally-significant South American fur seal (*Arctocephalus australis*) population, and for the post-sealing recoveries of local breeding populations of southern elephant seal (*Mirounga leonina*) and South American sea lion (*Otaria byronia*). It also hosts an important moulting and resting aggregation of southern elephant seals from breeding populations of the South Georgia Stock.
- The North-east Falklands right whale wintering area IMMA which supports a regionally important wintering aggregation of southern right whales (*Eubalaena australis*), which use the region as a mating, socialising and resting area (Weir and Stanworth, 2020; Weir, 2022; Cerchio, *et al.,* 2022). Systematic research of baleen whales in the Islands only commenced in 2017, providing the first indication of the winter presence of right whale aggregations in nearshore areas (Weir, 2017). Since then, full winter seasons of coastal boat surveys to target the species have been carried out during 2019, 2020 and 2022 to assess its ecology and occurrence in the region (Weir and Stanworth, 2020; Weir 2022).

7.5.2.4 Threatened terrestrial Habitats

Under the Falkland Islands Biodiversity Framework, four terrestrial habitats have been identified as vulnerable, these are:

- Mainland tussac,
- Whitegrass-fachine acid grassland,
- Fachine scrub, and
- Boxwood scrub (framework still in draft)

However, this list of threatened habitats is only preliminary as it is based on the current, limited knowledge of these habitats and the extent and degree of threat that they face. A variety of wetland sites may also be under threat, but this requires further investigation. The main threat to terrestrial habitats has been through degradation associated with the introduction of grazing herbivorous animals for farming (RPS Energy, 2009; Upson, 2012).

7.5.3 Priority conservation species and habitats

A number of species and habitat types have been identified through criteria associated with listings under international conventions, global and national conservation status and changes in population, distribution and risk from specific threats as a priority for conservation efforts in the Falklands (FIG,

2008a). The species and habitats concerned are listed in Table 7.38. Specific action plans have been prepared for some, but not all, of these.

Many of these priority species are marine or coastal in distribution and are therefore vulnerable to O&G industry related impacts. Additionally, these species are likely to be the focus of inshore monitoring efforts. However, to date no sub-littoral species or habitats have been identified as a priority for conservation.

Table 7.38: Species and habitats of conservation concern in the Falklands and their action plan status

Comprehensive Action Plan required		Basic Action Plan required	
Mainland tussac grass	-	Endemic plants (13 species)	-
Whitegrass-fachine acid grassland	-	Californian club-rush stands	-
Fachine scrub	-	Mountain bluegrass	-
Boxwood scrub	-	Falklands steamer duck	-
Threatened plant species (22 species)	-	Cetaceans	✓
Black-browed albatross	✓	Peale's and Commerson's dolphins	✓
Striated caracara	-	Seals and sea lions	✓
Southern rockhopper penguin	✓	Southern giant petrel	✓
Cobb's wren	✓	Gentoo penguin	-
Zebra trout	-	Magellanic penguin	-
-	-	Falkland fritillary	-
-	-	Ruddy-headed goose	-
-	-	White-chinned petrel	✓

7.6 Coastal Sensitivity to Oil Spills

7.6.1 Environmental Sensitivity Index (ESI)

IPIECA (2016) provides a framework for coastal sensitivity mapping for oil spill response based upon coastal habitat type and the associated Environmental Sensitivity Index (ESI) developed from Gunlach and Hayes (1978) Oil Sensitivity Index. The ESI is a ranking system whereby different coastal zones with varying characteristics are ranked according to their environmental sensitivity. The ESI ranks habitats, assessed qualitatively, on the ease of cleaning, the rate of natural oil degradation (high / low energy) and the likely probability that an impact will be observed, rather than attempt to quantify the actual absolute impact.

The ESI (Table 7.39), ranging from 1 (low sensitivity) to 10 (very high sensitivity), can be adapted for a range of habitat types and integrates the:

- Shoreline type (grain size, slope) which determines the capacity of oil penetration and / or burial on the shore, and movement,
- Exposure to wave (and tidal energy) which determines the natural persistence time of oil on the shoreline,
- Shoreline slope,
- Ease of clean-up, and
- Ease of restoration.

The assessment was predominantly based upon shoreline type derived from Google Earth imagery and local knowledge along with a subjective assessment of exposure given predominant wind directions. A full breakdown of the methodology and results is given in Marengo (2014a).

Table 7.39: Environmental Sensitivity Index (ESI) definitions

ESI	Estuarine	Riverine
1A	Exposed rocky shores	Exposed rocky banks
1C	Exposed rocky cliffs with boulder talus base	Exposed rocky cliffs with boulder talus base
2A	Exposed wave-cut platform in bedrock / mud / clay	Rocky shoals, bedrock ledges
2B	Exposed scarps and steep slopes in clay (unconsolidated sediment)	-
3A	Fine to medium-grained sand beaches	-
3B	Scarps and steep slopes in sand (unconsolidated sediment)	Exposed, eroding banks in unconsolidated sediments
3D	Scarps / steep slopes in bedrock or flat rocks	-
4	Course-grained sand beaches	Sandy bars and gently sloping banks
5	Mixed sand and gravel beaches	Mixed sand / gravel bars and gently sloping banks
6A	Gravel beaches (granules and pebbles)	Gravel bars and gently sloping banks
7	Exposed tidal flats	-
8A	Sheltered scarps in bedrock, mud or clay. Sheltered rocky shores (impermeable)	-
8B	Sheltered solid man-made structures. Sheltered rocky shores (impermeable)	Sheltered, solid man-made structures
8D	Sheltered rocky rubble shores	-
8E	Peat shorelines	-
8F	-	Vegetated, steeply-sloping bluffs
9A	Sheltered tidal flats	-
9B	Vegetated low banks	Vegetated low banks
9	Hyper-saline tidal flats	-
10A	Salt- and brackish-water marshes	-
10B	Freshwater marshes	Freshwater marshes

7.6.2 Sensitivity of north Falklands coastline to offshore oil (crude/MGO) spills

In 2014, POEPL (now Navitas, Section 2.1.1) conducted an assessment of the environmental sensitivity of the north Falklands coastline to a spill of hydrocarbons from the proposed Sea Lion Development (Premier, 2014a). This sensitivity assessment was carried out using industry developed techniques and was informed by conceptual oil spill modelling studies which predicted the potential distribution of oil, and the risk of oil beaching along the north Falklands coastline, in the unlikely event of a worst-case oil spill from the proposed Development location.

The Falklands Coastline Environmental Sensitivity study (Premier, 2014a) remains relevant to this EIA as it highlights the most sensitive sites along the north Falklands coastline, which will inform management decisions in the unlikely event that an MGO spill response operation needs to be initiated.

During the 2018 coastal bird surveys in Berkeley Sound, observations of typical Falkland Islands shoreline types were recorded and given a classification index for the purposes of oil spill planning that parallels the IPIECA (2011) system of Environmental Sensitivity Index. While this does not affect the assessment, it improves the mitigation in terms of the detailed oil spill contingency plans that will follow approval of the project.

7.6.2.1 Coastal sensitivity assessment outputs

Modelling of an offshore oil spill (Section 12.1) shows that while the likelihood of oil reaching the shoreline is very low, there is a higher probability of oil 'waxlets' beaching on East Falkland than on islands to the west.

The sensitivity study highlighted that the north Falklands coastline is exposed and rocky with wave cut platforms and deep scarps which are considered to be of low sensitivity (ESI 1-3) to oil impacts. High sensitivity areas (ESI 8 – 10) include inland tidal creeks, and sheltered tidal flats and were identified as: Volunteer Lagoon, Swan Pond (Port Louis), Salvador Waters, Brazo del Mar, Limpet Creek, Little Creek, Smylie's Inlet, Inner White Rock Bay, Inner Tamar Pass (North and South), Inner Port Purvis, Victor Creek (Pebble Island), Justice Inlet (Keppel), NE Bay Saunders, Brett Harbour (Saunders), Penguin Island (Saunders) (Figure 7-111 and Figure 7-112). In addition to the general sensitivity of the coastline, there is a range of IBAs, IPAs, NNRs and Ramsar Sites that were considered along with sites of known environmental importance with significant concentrations of wildlife (Section 7.5). While a range of taxa may be impacted by an oil spill, the assessment was predominantly based upon colonial seabirds for which census data are available.

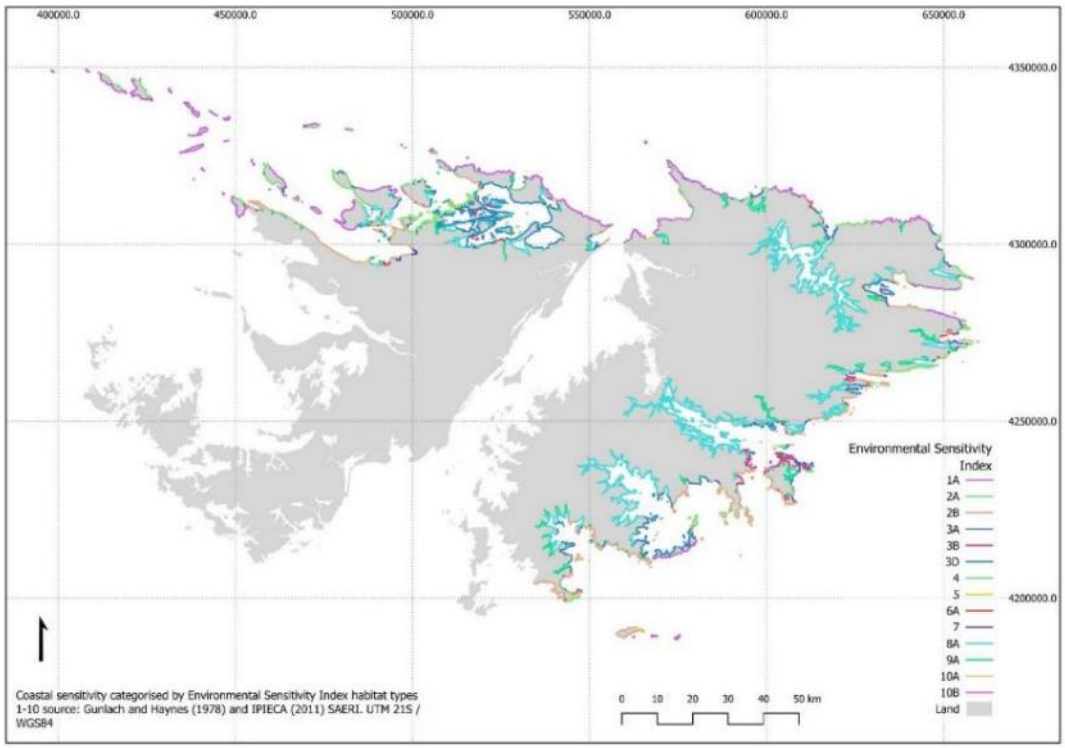


Figure 7-111: ESI North Falklands Coastline. Coastal sensitivity categorised by Environmental Sensitivity Index habitat types 1-10 ***(Source: Gunlach and Hayes, 1978; IPIECA, 2011)***

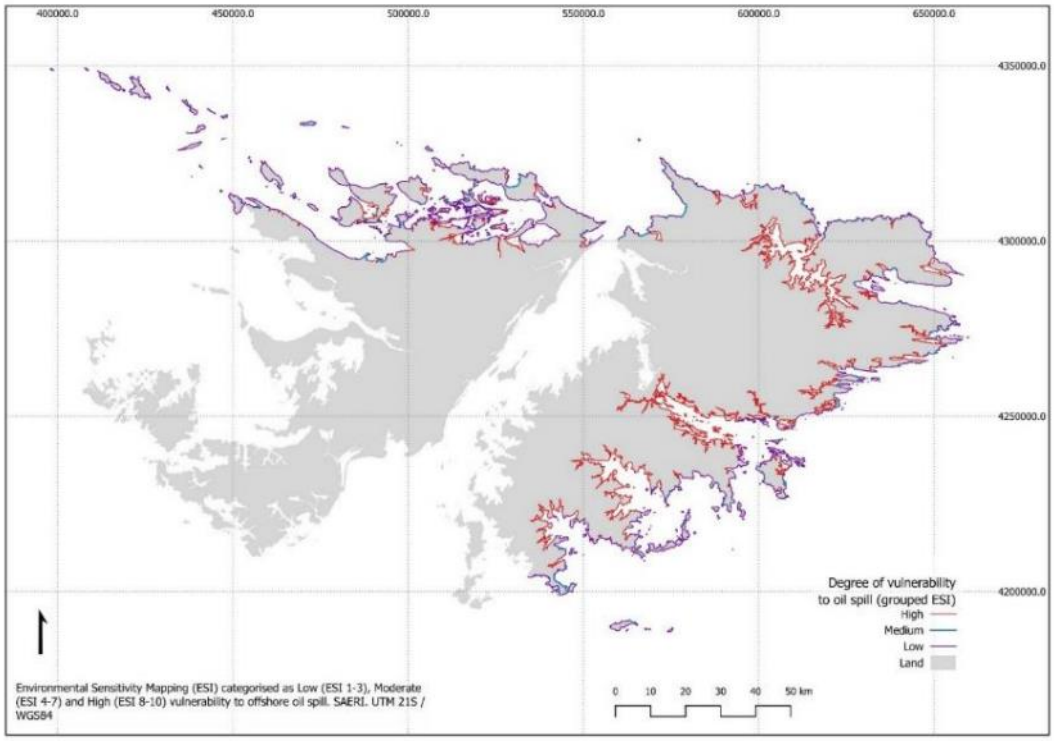


Figure 7-112: North Falklands Coastline. Environmental Sensitivity Mapping (ESI) categorised as Low (ESI 1-3), Moderate (ESI 4-7) and High (ESI 8-10) vulnerability to offshore oil spill

7.6.2.1.1 Environmental sensitivity to offshore oil spill

A review of the seabird colony locations with respect to coastline type, the seasonality of occurrence and the Oil Vulnerability Index (OVI) of the species (Section 7.4.5.6.1) suggest that gentoo penguins may be the most vulnerable to impacts and would be suitable to use as a ranking proxy. Gentoo penguins showed the greatest overlap with sensitive coastline types (ESI), associate with breeding colonies through-out the year, and have a high OVI.

The conservation importance of black-browed albatross and rockhopper penguins was recognised. Due to the tendency of these species to utilise more exposed rocky coastlines of low sensitivity, sites were not prioritised in the first instance. Real-time monitoring during an incident should determine the need for any subsequent re-prioritisation or response intervention on site.

Additional species and taxa were not considered either due to a lack of quantitative data that could be extrapolated to un-surveyed coastlines or to a widespread distribution across the coastal habitat types, which gave little differentiation between coastlines for ranking purposes.

7.6.2.1.2 Socio-economic sensitivity to offshore oil spill

Socio-economic factors were considered and the relative level of tourism utilised to further differentiate the environmental and socio-economic sensitivity of sites. The occurrence of fine-grained sand beaches in proximity to penguin colonies was identified as an important tourism resource, albeit that these sites are of relatively low sensitivity (Figure 7-111 above, ESI 3).

The study also mapped the location of infrastructure that might assist a response and mobilisation to the northern coastline. For example, the location of road, tracks, jetties (and slipways), ports, airstrips, settlements and shanties was detailed and mapped, along with their condition where appropriate. This will enable Navitas to define the level of resources required to mount an appropriate response.

7.6.2.1.3 Prioritisation and management of offshore oil spill response

Due to the spatial extent of the north Falklands coastline and the associated issues with regards to access and response time, it is evident that some prioritisation will be required. Prioritisation should focus response on those areas where capacity can be best deployed to tackle the maximum extent of sites, which are most at risk of biologically significant or socio-economic impacts.

A pragmatic compromise will need to be reached that balances the importance of a site with the level of resources that are required. This may mean that some important sites may not be tackled in favour of other more accessible sites where remedial actions will be able to be conducted over a greater spatial area.

The final long-listing of sites utilised the coastal ESI, location of notable scenic beaches, the occurrence of gentoo penguins, overlap with an environmental land designation and relative level of tourism activity.

The highest ranked sites for response are located at:

- Volunteer Point,
- Pebble Island,
- Saunders Island, and
- Carcass Island.

Important and secondary ranked sites for response are located at:

- Swan Pond and Seal Bay coastline,
- Brazo del Mar and entrance to Salvador Waters,
- Bougainville, Concordia and Limpet Creek coastline,
- Cape Dolphin Swan Pond Beach,
- Smylie's Inlet and Paloma Beach,
- Grave Cove, Dunbar, and
- Steeple Jason.

The grouping of sites into geographical areas will assist in the mobilisation of resources and may permit some secondary ranked sites to be tackled with adjacent higher priority sites. Geographic groupings with multiple sites would include:

- Volunteer Point and Cow Bay,
- Swan Pond and Seal Bay,
- Entrance to Salvador Waters,
- Limpet Creek and Concordia,
- Cape Dolphin and Elephant Beach,
- Paloma Beach, Smylie's and Race Point,
- Pebble Island, and
- Saunders Island.

The ESI classification and location of significant wildlife sites provides the background and basis for prioritising sites for oil spill response. It is however recognised by IPIECA (2011) that the relative importance of ranking criteria will be influenced by local perceptions and that ranking should not rely solely upon a quantitative analysis. A consultative approach incorporating local stakeholders into the planning process and final prioritisation should be conducted.

7.6.3 Sensitivity of Berkeley Sound coastline to inshore oil (MGO) spills

The inshore coastal sensitivity assessment was predominantly based upon shoreline types identified using Google Earth imagery and local knowledge along with a subjective assessment of exposure given predominant wind directions. A full breakdown of the methodology and results is given in Marengo (2014a).

Figure 7-113 maps the coastline of Berkeley Sound to show the distribution of ESI category habitats. Within Berkeley Sound sensitive coastlines are limited to the upper reaches of the Sound to the west of the LTV anchorages and would be less at risk of oil contamination given the prevailing westerly winds. The coastlines of the outer Sound are largely composed of steep-slopes or cliffs, which have low ESI scores (Figure 7-113). To the north of Berkeley Sound, the adjacent Volunteer Lagoon represents an area of higher sensitivity.

Berkeley Sound, and associated coastline (see Figure 7-113), has a total length of 295 km. Of this, 34 % (101 km) was classed as high sensitivity, 10 km (3 %) is moderate sensitivity and 184 km (62 %) is classed as low sensitivity.

In addition, it is important to understand and map the location of internationally recognised sites and nationally designated sites of environmental importance to identify sensitive ecosystems, critical habitats and endangered species. Therefore to highlight environmentally sensitive areas within the coastal zones adjacent to Berkeley Sound, the occurrence of nationally protected areas and the known locations of key faunal and floral species have been mapped throughout this baseline chapter.

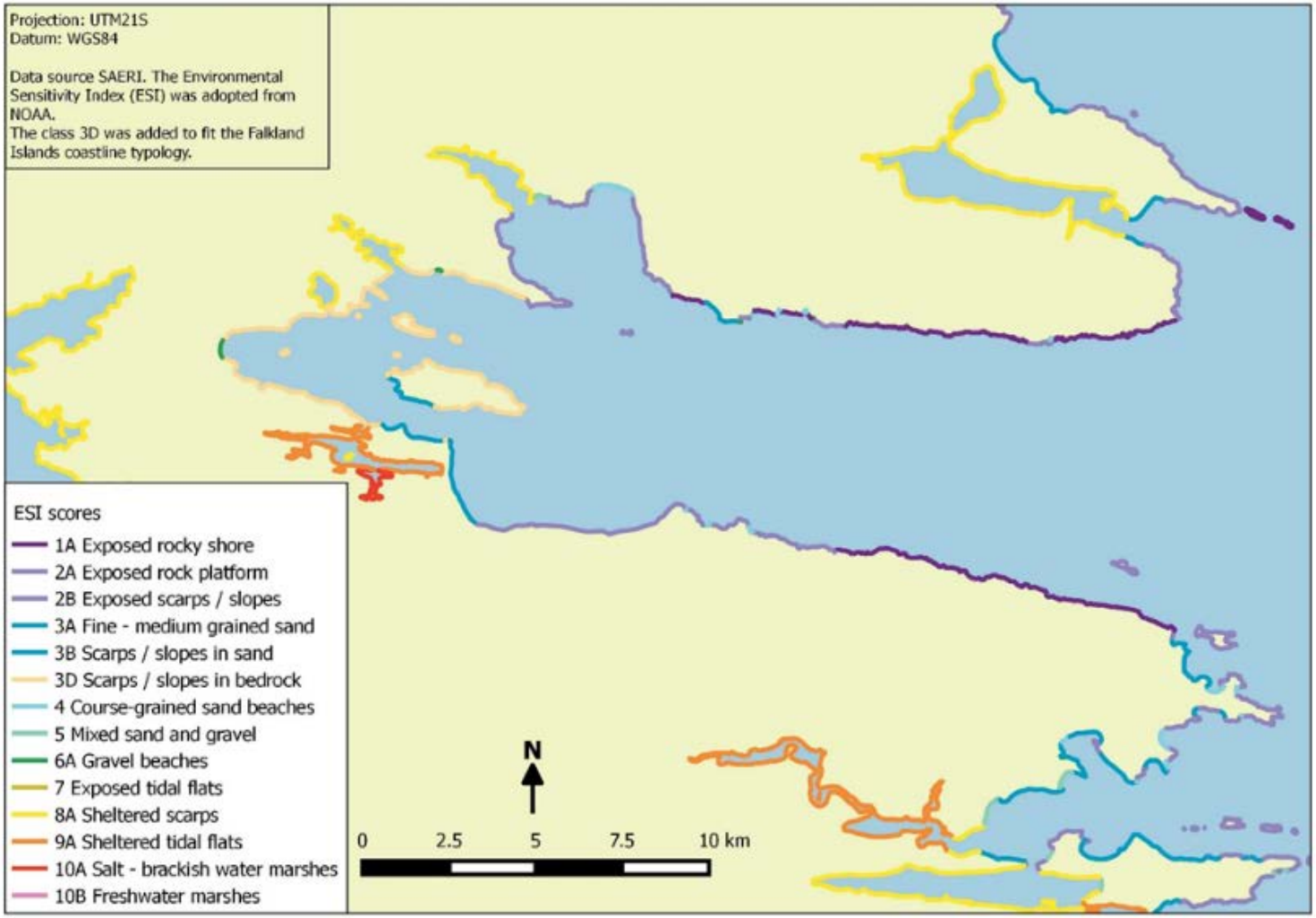


Figure 7-113: ESI Berkeley Sound. Coastal sensitivity categorised by Environmental Sensitivity Index habitat types 1-10

7.6.4 Oil spill history

Eighteen minor oil spills have occurred within Stanley Harbour and Berkeley Sound since the year 2000, all of which involved losses of fuel oil from vessels. The following record of spills was provided by FIMA (February, 2025), however detail on the incidents themselves, the size of the spill and associated fuel oil type were redacted:

- Berkeley Sound – one incident involving a trawler,
- Stanley Harbour (17):
  - FIPASS - 11 separate incidents involving trawlers, long-line fishing vessels, factory vessels, tankers and jiggers,
  - East jetty - Three separate incidents involving ferries, and
  - Stanley Harbour general – three separate incidents involving jiggers and tankers.

7.7 Social Environment

7.7.1 Introduction

In 2012, Rockhopper Exploration commissioned an independent socioeconomic impact assessment to identify potential impacts and mitigation measures to minimise any negative impacts from O&G developments that could be associated with the project (Plexus Energy, 2012). FIG also commissioned an independent socio-economic study of O&G development in the Falkland Islands (Regeneris, 2013). With support from the O&G industry, FIG developed a Social and Economic Monitoring Programme (SEMP), which relies on extensive public consultation. Initial results were published in the Social Economic Monitoring Programme (SEMP report) (Regeneris, 2015). POEPL updated the Sea Lion Socio-economic Impact Assessment in 2019 (Maplecroft, 2019), and FIG published a study on the socio-economic impacts of O&G development in the Falklands looking at a wider perspective, also in 2019 (Simsovic and Ranghetti, 2019).

Navitas are currently working on an update to the Sea Lion socio-economic impact assessment to cover any changes to the project plan and any changes to the socio-economic environment of the Falklands. This section outlines the current social baseline for the Falkland Islands and draws on all of the above reports as well as FIG data, including the recent 2021 Falklands Census. Much of the information presented here is to provide background reference. The EIS focuses on environmental impacts and risks not socio-economic impacts; however, where environmental impacts have the potential for wider socio-economic impact, these are discussed further in the relevant sections.

7.7.2 Human population

7.7.2.1 National identity

The culture of the Falkland Islands is a blend of British culture and elements that have emerged given the Islands' history, location and geopolitical relationships. There is a strong sense of allegiance to Great Britain.

The 2021 Census asked people to state their national identity: 54 % of residents considered themselves Falkland Islanders, 22 % British, 8 % St. Helenian and 5 % Filipino (FIG, 2023l).

There is a strong sense of local community and cohesion due to the small population. High levels of familiarity encourage a safe and welcoming community. While the majority of the population is based in Stanley, the rural life is an important part of Falklands culture. Areas outside Stanley are referred to as 'Camp'.

7.7.2.2 Population size and main settlements

The total usually resident population of the Falkland Islands was recorded at 3,142 (2,818 excluding residents at the Mount Pleasant Complex (MPC)) during the 2021 Population Census (FIG, 2023l). In recent years the economic pull of Stanley, the capital and only city, has attracted people away from Camp (Table 7.40). In 2021, 2,538 people, about 69 % of the total population, resided in Stanley, 8 % in Camp and 9 % (non-military personnel) at MPC, the joint army, air force and navy complex operated by the UK Ministry of Defence (MoD) at Mount Pleasant.

After Stanley the next most populous settlement in the Falkland Islands is Mount Pleasant some 36 miles south-west of Stanley. In 2021, the population in Camp declined since the last census in 2016 from 381 to 280. Goose Green, Fitzroy and North Arm are the most populated settlements on the East; Fox Bay, Port Howard and Hill Cove are the largest on the West (FIG, 2021c). Figure 7-114 shows the main islands in the Falklands archipelago and the locations of the main settlements and connecting roads.

The population of the Falkland Islands is ageing with 33 % of the population in Camp being over 60 years of age and 17 % in Stanley in 2021 (FIG, 2023l).

Alongside the populations of Camp and Stanley there are an estimated 324 civilian contractors who work and reside at MPC. Serving members of the armed forces are not counted in census statistics. The MPC is a largely self-contained community and provides the main airport for international flights to and from the Falkland Islands.

At the last census, 456 work permit holders were recorded in Stanley (FIG, 2023l); work permit holders are those working in the islands on a temporary contract, and they are employed in all sectors in the Falklands. The number of work permit holders is significant to the EIA as accommodation has to be found for all of these people. It is difficult for work permit holders to find affordable accommodation in the private rental sector (A. Black, *pers. obs.*).

In Stanley, just under one third of people in work (487 people) are employed by FIG. Ninety-six percent (96 %) of all employees in the professional, scientific and technical sector have temporary immigration status; other sectors that are reliant on this category of employees are hospitality (85 % of employees), retail (71 %) and tourism services (93 %).

Throughout the Islands, the largest proportion of all workers were employed by FIG (33 %). The next largest primary employment sector was construction (11 %), then agriculture, crop and animal production (10 %). The number recorded as working in the other major economic sectors; fishing and tourism, were lower at 4 and 3 % respectively.

Table 7.40: Location of population, excluding MPC

Location of population present on census night	1991	1996	2001	2006	2012	2016	2021
Stanley	1,557	1,636	1,989	2,115	2,120	2,460	2,538
East Falkland (outside Stanley)	245	233	208	194	202	190	149
West Falkland	196	174	144	127	127	151	95
Outer Islands	52	38	38	42	22	40	36
Total usual resident population	**2,050**	**2,081**	**2,379**	**2,478**	**2,471**	**2,841**	**2,818**
Stanley population	**76 %**	**79 %**	**84 %**	**85 %**	**86 %**	**87 %**	**90 %**

(Source: FIG, 2023l)

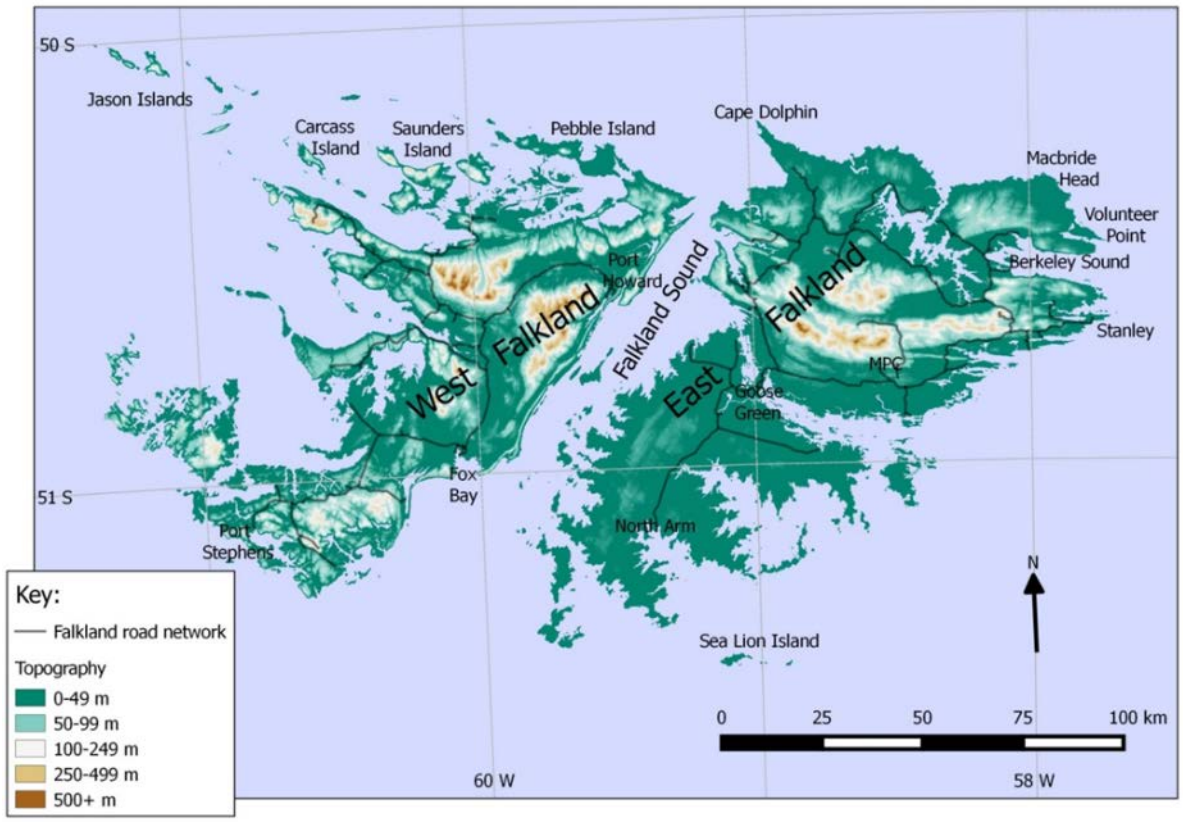


Figure 7-114: Prominent geographic features, major settlements and roads within the Falkland Islands

7.7.2.3 Berkeley Sound residents

The land surrounding Berkeley Sound is divided between six private landowners / farms (Figure 7-115 below) and is primarily used for grazing sheep. However, several farms also run tourism-based businesses, which are described in Section 7.7.4.6.1. Kidney and Cochon islands, at the mouth of Berkeley Sound, are owned by FIG and are both National Nature Reserves.

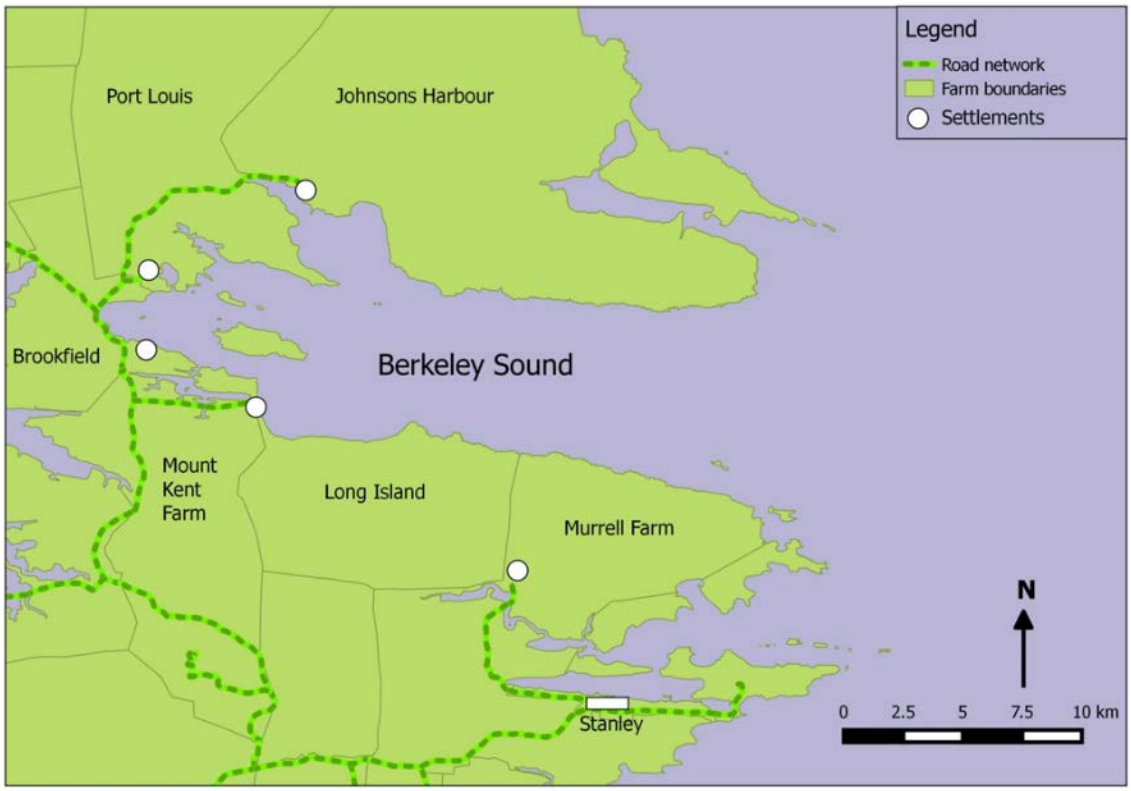


Figure 7-115: Farms with land bordering Berkeley Sound

7.7.2.4 The Falkland Islands economy

Prior to the mid-1980s, the Falkland Islands economy was almost completely based on agriculture, mainly sheep farming and the export of wool for income. Since the late 1970s, the seas around the Falkland Islands have also been an important area for commercial fisheries, with multinational fleets operating in the waters around the Islands. Following the establishment of the Falklands Interim Conservation Zone (FICZ) in 1986 for fishery purposes, and the creation of the Falkland Outer Conservation Zone (FOCZ), the 200 nautical mile Exclusive Economic Zone (EEZ), in 1990, the bulk economic activity shifted to the sale of fishing licences to foreign vessels operating within the Falkland Islands EEZ (Plexus Energy, 2012). The creation of the EEZ was critical in transforming the post-1982 Falklands' economy. The income from license fees fluctuates but currently makes up 25-30 % of the Government's revenue (FIG, 2023l). The other main contributors to the Falkland Islands economy are tourism, wholesale and retail trade, transportation and storage, and accommodation and food services.

It is important to understand current fishing activity within the area of the Sea Lion Field and Berkeley Sound in order to determine to what extent the potential future development of the area might interfere with fishing activities and 'other users of the sea' (Section 11.1 and 11.2). For example, whether or not exclusion of fishing vessels from 500 m radius around the FPSO could translate into loss of revenue for the fishing fleet or FIG as a result of licence sales.

7.7.3 Other users of the sea

7.7.3.1 Other users of the NFB

7.7.3.1.1 Fishing industry

This review is based on the 'Summary Report of Fishing Activity over the Sea Lion Development Area', conducted by Pale Maiden Consulting (April 2013), and the FIG Fisheries Department Catch Report Database from 2013 to 2022 (FIG, 2023n). Some information is also taken from the Fishing and Trawling Risk Study conducted by Jee (2013) on behalf of POEPL.

The Falkland Islands EEZ contains rich fishing grounds, particularly for the two important squid species, Argentine shortfin squid and loligo (Falklands calamari). Table 7.41 presents total catch (tonnes) data for the main target species in the Falkland Islands fishery between 2013 and 2022 (FIG, 2023c). The most notable feature of the data is the considerable inter-annual variation in the catch of a number of species. In particular, if catches between 2013 and 2022 are averaged, Argentine shortfin squid represents the largest catch by weight. However, from one year to the next, the catch of this species varies greatly, from over 357,000 tonnes in 2015 to virtually nothing in 2016. Loligo squid catches are more consistent from year-to-year and steadily increasing, and account for 25.1 % of the total fishery catch by weight between 2013 and 2022.

Patagonian rock cod has previously been an important commercial species but has decreased in importance since the drop in catches in 2015-16. From 2016 the catches of this species have decreased significantly and represented only 5.2 % of the reported catch between 2013 and 2022.

A number of other finfish species are caught but these account for a far smaller percentage of the total catch. Commercially caught finfish species include:

- Whiptail hake (hoki) (2.7 %),
- Hake (12.9 %),
- Skates and rays (1.3 %),
- Red cod (0.9 %),
- Blue whiting (0.7 %),
- Kingclip (0.8 %), and
- Patagonian toothfish (0.5 %) (Table 7.41).

The relative importance of finfish is skewed by inter-annual variation in *Illex* catch.

The Argentine shortfin squid is primarily fished by jiggers from the Far East, whereas the smaller inshore squid species loligo, and other finfish species, particularly hake, have been the target of the European bottom trawling fleet (FIG, 2023n).

For fisheries licensing and management purposes, the FICZ is divided into grid squares. Each grid square is 15' of Latitude by 30' of Longitude, or approximately 15 nautical miles by 17 nautical miles in size. These grid squares are the same as those used for seabird data (Section 7.4.5.6.1) and are referred to as the ¼ ICES squares. Each square can be referred to by a four-letter code (the first two letters denote the latitude and the second two the longitude). FIG Fisheries Department (FIFD) fisheries statistics from 2013 to 2022 indicate that the most important fishing areas corresponding to the highest catch (tonnes) per grid square are concentrated around the 200 m depth contour surrounding the Falkland Islands. The Patagonian toothfish is fished in depths greater than 600 m with the best catch per unit effort achieved off Burdwood Bank to the south and on the Deep Slope area to the north-east (FIG, 2023n).

Table 7.41: Annual fishing catch by target species in the FICZ / FOCZ

Target species	Catch (tonnes)										
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	% Catch 2013-2022
Argentine shortfin squid	142,619	306,111	357,722	2,360	67,445	54,405	43,449	62,663	172,537	73,053	49.5
Loligo squid	40,168	48,702	30,317	46,447	64,676	79,996	81,908	60,732	95,627	101,166	25.1
Patagonian rock cod	32,435	56,693	29,086	7,039	2,520	2,213	950	737	1,279	1,245	5.2
Hake	12,308	14,875	21,054	23,363	15,589	27,021	53,378	43,327	59,177	62,821	12.9
Hoki	16,849	7,392	6,845	11,562	4,053	4,438	7,407	7,643	1,914	2,326	2.7
Skates and Rays	5,932	5,555	6,393	5,906	3,189	1,994	1,504	1,397	1,574	1,203	1.3
Red cod	5,164	3,467	3,340	3,143	1,379	1,654	1,768	1,418	1,189	750	0.9
Southern blue whiting	2,698	3,612	2,790	5,415	2,309	992	518	69	86	273	0.7
Kingclip	3,977	2,881	2,983	1,612	1,632	1,445	1,711	1,625	1,708	1,340	0.8
Patagonian toothfish	1,422	1,297	1,227	1,499	1,579	1,259	1,317	1,246	1,095	1,140	0.5
Others	1,023	372	729	813	588	728	1,930	1,006	469	520	0.3
Total annual catch	**264,595**	**450,957**	**462,486**	**109,159**	**164,959**	**176,145**	**195,840**	**181,863**	**336,655**	**245,837**	-

(Source: FIG, 2023n)

7.7.3.1.1.1 Fisheries operating within vicinity of the Sea Lion Field

This section provides a description of the fishing activity and catches in the region of the proposed Phase 1 & 2 Development.

The FPSO and drill centres for the Phase 1 & 2 Sea Lion Field Development are located within FIFD grid square XFAK, approximately 20 to 37 nautical miles north-east of the 200 m depth contour line, in water approximately 450 m deep. This grid square has been rarely fished by any licensed vessels in recent years and is currently only open to vessels with a B Licence (*pers. comm.* FIG, 2023). The B licence allows vessels (jiggers) to fish for Argentine shortfin squid and, rarely, for the sevenstar flying squid (*Martialia hyadesii*). Data extracted from the Fisheries department database in 2023 (Table 7.42) indicate that both jiggers and trawlers have fished the area (although B licences for trawlers were removed in 2023), but there is considerable inter-annual variation in fishing effort and catch in the area. In the past some trawlers targeted *Illex*, however the B licences for trawlers were removed in 2023 (P. Brickle, *pers. comm.).* Jiggers fish at sea anchor and deploy light weight lines and therefore do not pose a great risk to subsea infrastructure.

However, further analysis of Vessel Monitoring System (VMS) data indicates that most of the vessels reporting catch in this square were in fact fishing elsewhere. Catches and fishing effort in the grid square occupied by the Sea Lion Field (XFAK) are relatively low (FIG, 2023n). This said, exceptionally high catches of *Illex* squid were made in 2014, 2017, and 2022 reflecting high catches throughout the zone during these seasons. Overall however, these data indicate that generally the area of the Sea Lion Field is rarely fished.

It is clear that the vast majority of fishing effort and catch comes from waters shallower than the Sea Lion Field. However, this is largely due to the distribution of target species, rather than technical difficulty, and trawlers have explored the area, with limited success, in the past.

Table 7.42: Total annual catch and effort in grid square XFAK 2013 – 2022

Species	2013		2014		2015		2016		2017		2018		2019		2020		2021		2022	
	J[1]	T[2]	J	T	J	T	J	T	J	T	J	T	J	T	J	T	J	T	J	T
	Catch (rounded to nearest tons)																			
Argentine shortfin squid	-	-	1,173	<1	-	-	-	-	209	262	38	-	158	-	-	-	91	-	199	-
Loligo squid	-	-	-	1	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-	-
Patagonian rock cod	-	-	-	3	-	6	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Hake	-	-	-	7	-	-	-	-	-	128	-	-	-	-	-	-	-	-	-	-
Hoki	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Skates and rays	-	-	-	132	-	2	-	-	-	<1	-	-	-	-	-	-	-	-	-	-
Red cod	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-
Southern blue whiting	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Kingclip	-	-	-	-	-	-	-	-	-	54	-	-	-	-	-	-	-	-	-	-
Patagonian toothfish	-	-	-	-	-	<1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Others	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Effort (hrs)	**0**	**0**	**55**	**100**	**0**	**14**	**0**	**0**	**11**	**190**	**23**	**0**	**11**	**0**	**0**	**0**	**24**	**0**	**19**	**0**

[1] Jigger

[2] Trawler
(Source: FIFD daily catch reports and commercial catch data)

7.7.3.2 Other users of Berkeley Sound and the east coast

It is important to be aware of other users of the east coast and Berkeley Sound, and whether the inshore activities (LTV and installation vessel activity for a non-consecutive period of up to 13 months) will have the potential to interact with fisheries, tourism and / or areas used for military exercises. For example, in March 2024 there were as many as seven reefers, two tankers and >30 fishing vessels in the Sound on a daily basis (*pers. comm*., FIMA 2024).

7.7.3.2.1 Fisheries

7.7.3.2.1.1 Fisheries operating in the approaches to Berkeley Sound

The Falkland Islands EEZ contains rich fishing grounds, particularly for the two important squid species, Argentine shortfin squid and loligo (Falklands calamari). The majority of fishing effort takes place to the north and west of the Falklands with the exception of the loligo fleet, which operates over the continental shelf to the east of the Islands (FIG, 2023n). As an example, Figure 7-117 shows the distribution of loligo catch over the two fishing seasons in 2022. Two areas; one to the north-east and the other to the south of East Falkland, consistently produce the highest catches. Although there is no fishing within Berkeley Sound itself, activity within the Sound could impact this fishery.

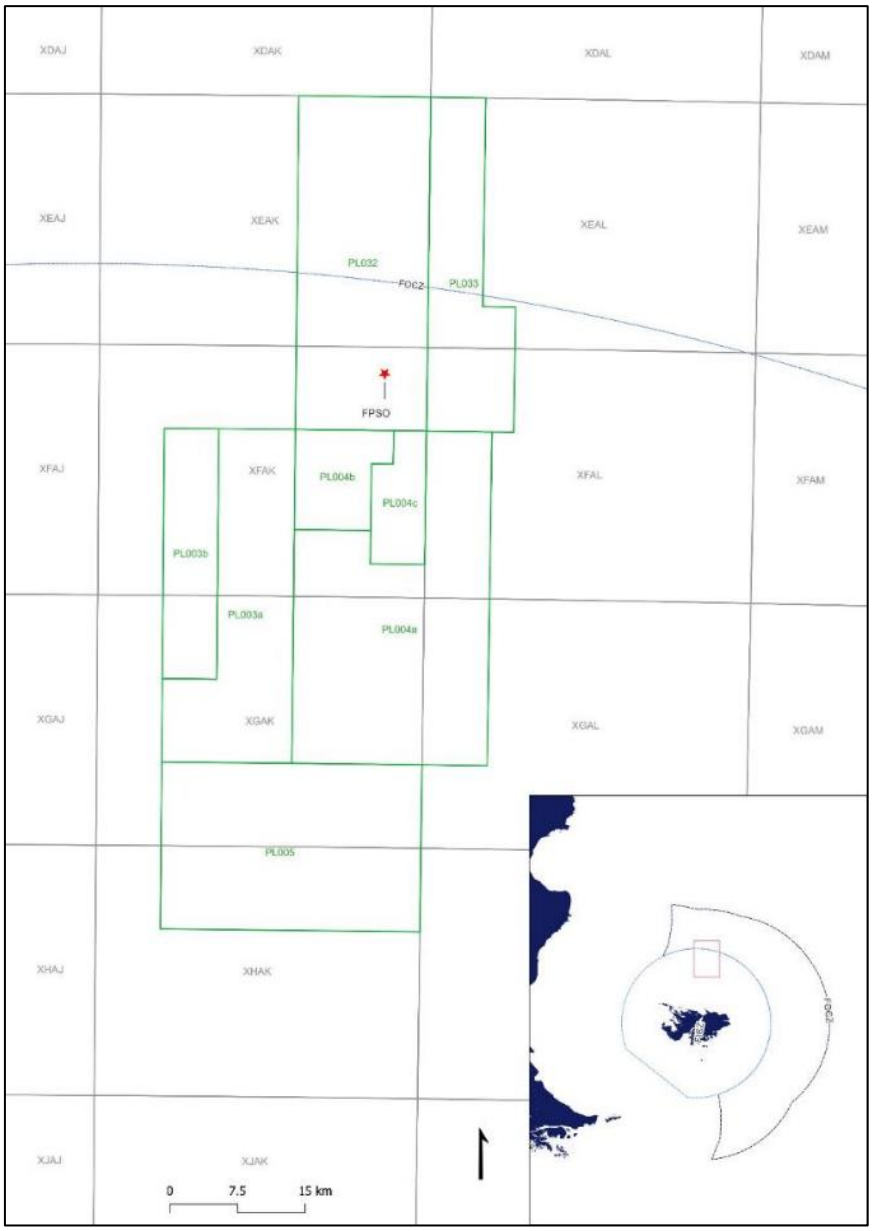


Figure 7-116: Fisheries squares and licences in the Sea Lion Field area

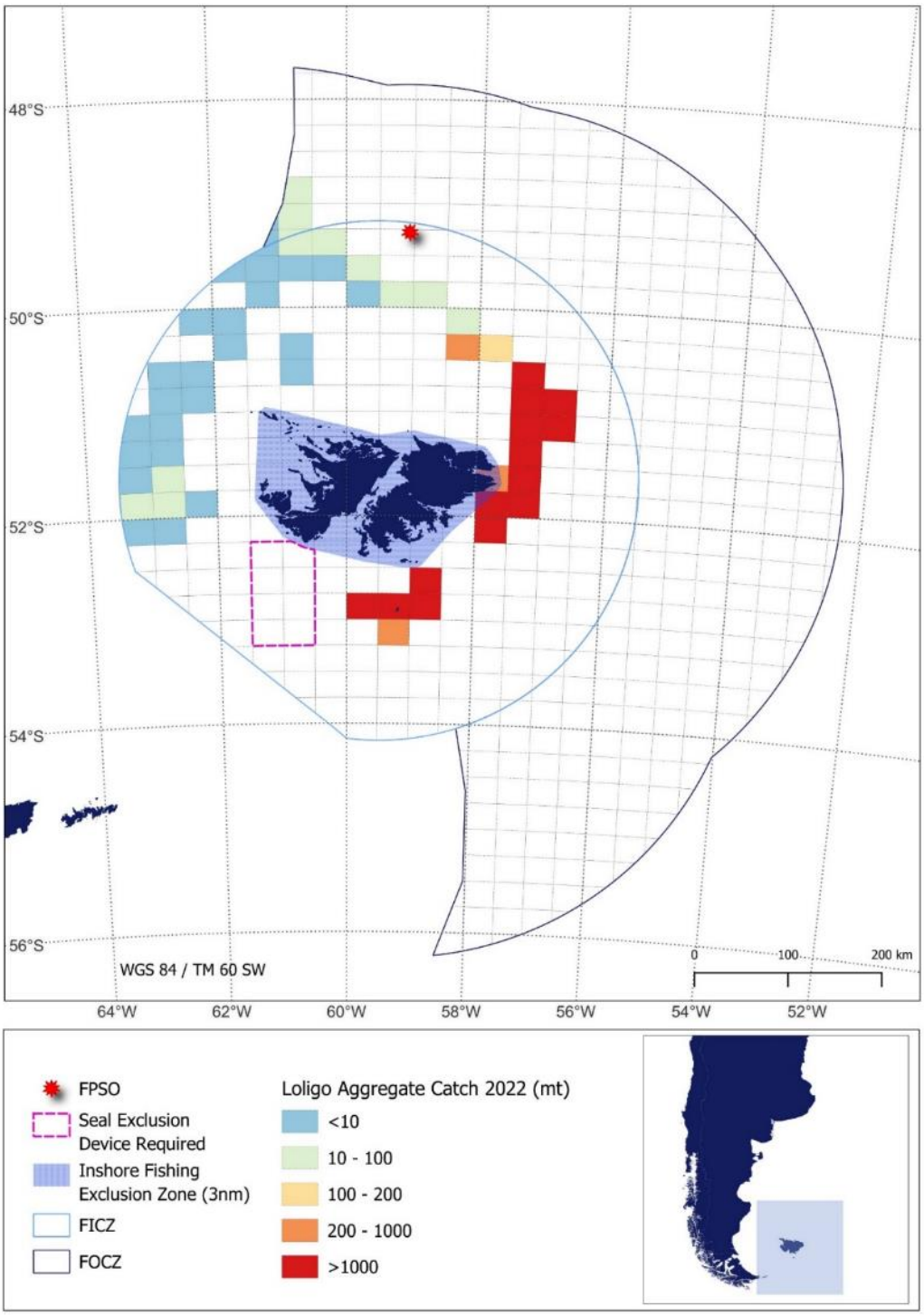


Figure 7-117: *Loligo* catch statistics from 2022 ***(Source: FIG, 2023n)***

7.7.3.2.1.2 Fisheries related activity within Berkeley Sound

Berkeley Sound is used as an anchorage for vessels engaged in the transshipment of fish. Reefer vessels (refrigerated cargo vessels) anchor in the Sound and are visited by fishing vessels to offload their catch. Once full, reefers transport the catch to market. There can also be a number of tanker vessels present within the Sound to bunker vessels with fuel oil.

In a 'normal' fishing year (when *Illex* catches are good) vessel use of Berkeley Sound is highly seasonal, with peak activity between March and June. The different types of vessel vary in size, which is summarised (expressed as vessel length) in Table 7.43. The vessels tend to occupy the area of relatively deep waters in the centre of the Sound. Figure 7-118 below shows vessel positions (both stationary and moving) as derived from AIS data recorded between May 2014 and May 2015. As well as seasonal fluctuation, the degree of activity can vary from year-to-year depending on the amount of fish (squid) caught in any one year. A summary of all vessel use in Berkeley Sound is provided in Section 7.7.3.2.5.

Note: The latest catch data presented in Table 7.41 above confirms that 2014-2015 represent the most significant fishing years in recent times and so have been used as a worst-case benchmark for the assessments herein.

Table 7.43: Summary of size (length) of vessels using Berkeley Sound (May 2014 to May 2015)

Vessel type	Mean length (m)	Standard Deviation	Minimum length (m)	Maximum length (m)
Fishing	62.5	12.1	45	114
Reefer	142.5	15.5	95	195
Tanker	111.5	22.1	98	151

7.7.3.2.2 Tourism service providers and Berkeley Sound

While a few cruise vessels visit Berkeley Sound, many pass the entrance to the Sound *en route* to and from Stanley.

During the cruise ship season many people take time off from their regular work to drive tourists to see wildlife around the Islands. In Camp, tourism accounts for a greater share of income than in Stanley. According to FIG figures, tourism accounts for an estimated 17 % of whole farm income, with the outer islands experiencing a greater share of tourism income at 41 % of the total. A summary of all vessel use in Berkeley Sound is provided in Section 7.7.3.2.5.

7.7.3.2.3 Military uses of Berkeley Sound

There has been a substantial military presence in the Falkland Islands since 1982, which provides air, land, and sea coverage.

There is very limited use of Berkeley Sound by military vessels.

7.7.3.2.4 Other vessels and uses of Berkeley Sound

Research vessels, such as the British Antarctic Survey (BAS) vessel the Sir David Attenborough, often transit through Falklands waters *en route* to South Georgia, Antarctica or other areas within the South Atlantic. It is possible that these vessels, and other commercial shipping, may use Berkeley Sound as an anchorage from time-to-time (see Section 7.7.3.2.5).

All types of vessels may also use Berkeley Sound to shelter during adverse weather.

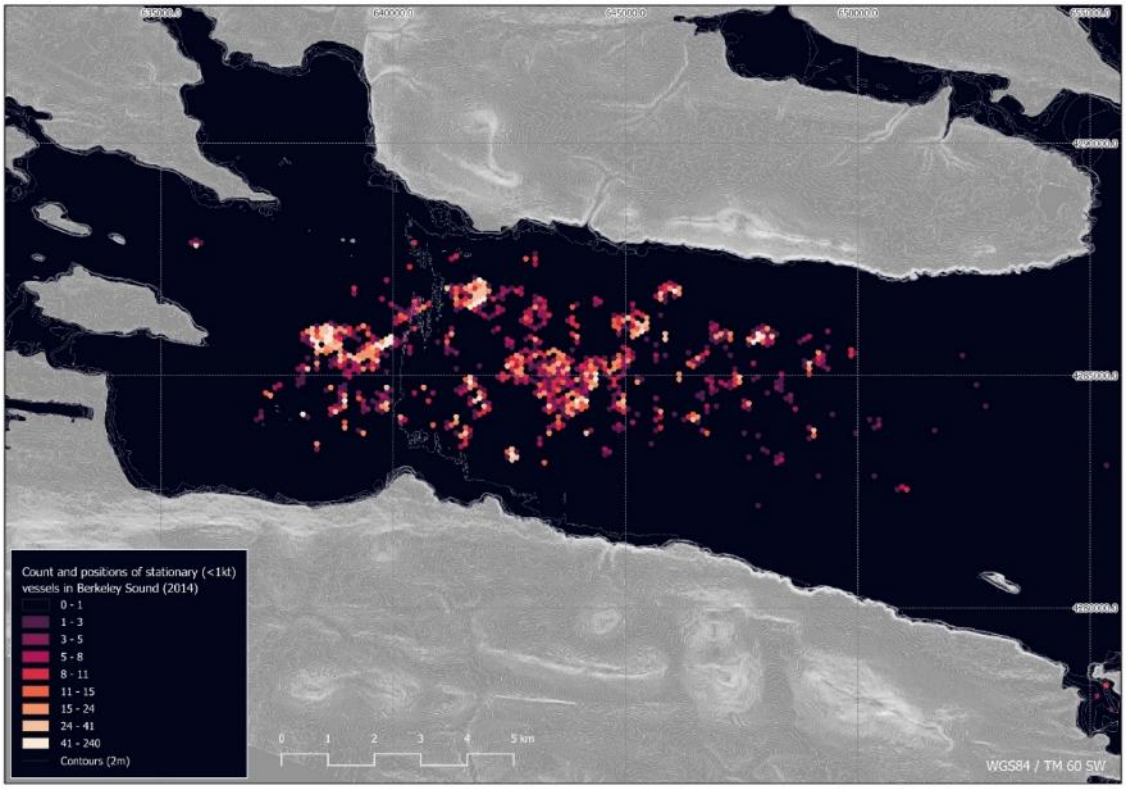


Figure 7-118: Positions of vessels within Berkeley Sound, May 2014 to May 2015

7.7.3.2.5 Summary of vessel numbers and position in Berkeley Sound

A summary of all the above vessel uses in Berkeley Sound for the period 2014 to 2022 is provided in Figure 7-119. The 2014 - 2015 period represents the most significant fishing period in recent times. The positions of vessels for this peak period (2014-2015) are provided in Figure 7-118 and these years have been used as a worst-case benchmark for the baseline and assessments herein.

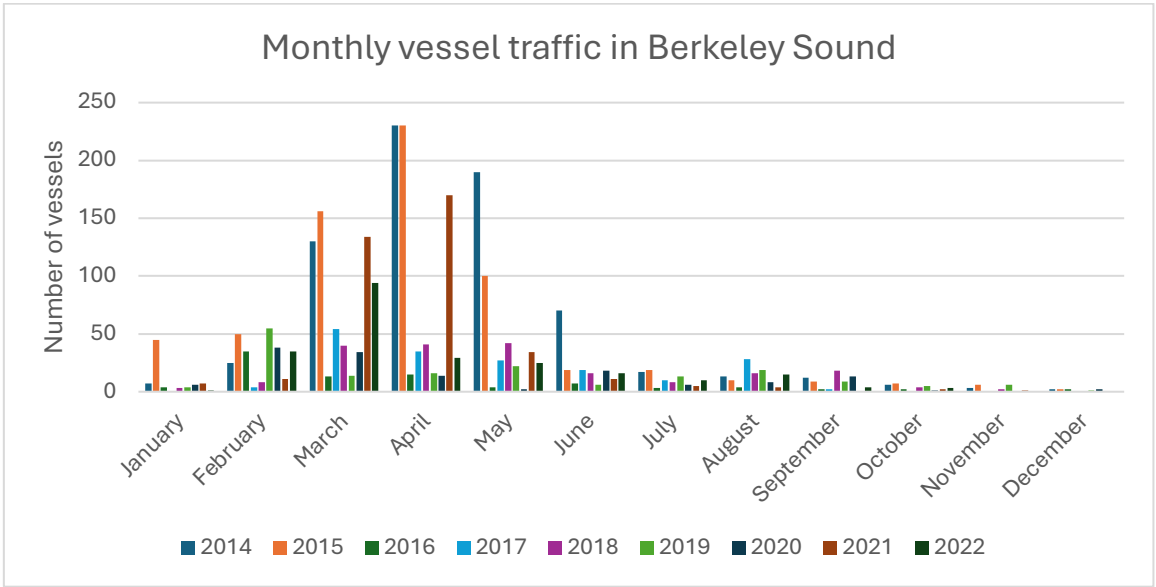


Figure 7-119: Vessel traffic in Berkeley Sound 2014-2022 (FIG Maritime Vessel Visits Data, 2023)

7.7.4 Tangible property

7.7.4.1 Port facilities

The Falkland Islands have port facilities at Mare Harbour and Stanley, including the Falklands Interim Port and Storage System (FIPASS) and the Temporary Dock Facility (TDF).

7.7.4.1.1 Mare Harbour (East Cove Military Port)

Mare Harbour is a deepwater port in Choiseul Sound, East Falklands, operated by the MoD. Mare Harbour is primarily used by the UK Royal Navy vessels patrolling the South Atlantic but also cargo vessels. It is the port facility and depot for MPC and is approximately 36 miles south-west of Stanley by road.

7.7.4.1.2 Stanley Harbour – jetties and FIPASS

Harbour operations in Stanley are currently managed by the Falkland Islands Government Maritime Authority, which sits within the Department of Emergency Services and Island Security (DESIS), with support from other Government Agencies.

There are several jetties within Stanley Harbour:

- East Jetty - 45 m berthing face with approximately 3.7 m of water clearance at its head. This jetty is used by a variety of vessels from privately owned visiting yachts to commercial trawlers up to 75 m in length, and can also be used to land passengers from launches,
- Public Jetty - used only for landing passengers from launches and other small craft. This jetty has approximately 3 m of water clearance at its head,
- The Camber – is located on the opposite side of the Harbour to Stanley but is used as a winter lay-up for charter yachts or trawlers (FIG, 2024a),
- The Temporary Dock facility (TDF) - is situated in the east end of the Harbour and was constructed to support O&G exploration in the NFB (see Section 7.7.4.1.2.1 below), and
- FIPASS (Falklands Interim Port and Storage System) - was constructed in 1984 and consists of flexi-port pontoon structures (Figure 7-120) which, to date, have provided suitable port facilities. FIPASS consists of seven permanently moored barges giving no more than 220 m of berthing face; the north-west barge is now closed (N. Port, *pers. comm.*, 2023). Depth of water clearance ranges from 5.7 - 7 m depending on the berth (FIG, 2023d). FIPASS is managed under contract from FIG by Atlink Ltd. who is responsible for the maintenance and manning of the facility and collect berthing, hard-standing, warehouse and utilities fees and charges on FIG's behalf. At times, there is not enough berthing space at FIPASS to meet demand, which represents the most significant potential conflict between users of the Harbour. Vessels can take bunkers of freshwater and fuel at FIPASS, at a rate of 25 and 35-40 tonnes per hour respectively.

A number of different types of vessel use the facilities in Stanley Harbour and each vessel type has specific requirements. The number of vessels visiting Stanley on a monthly basis is shown in Table 7.44. Descriptions are provided in Section 7.7.4.1.4 below.

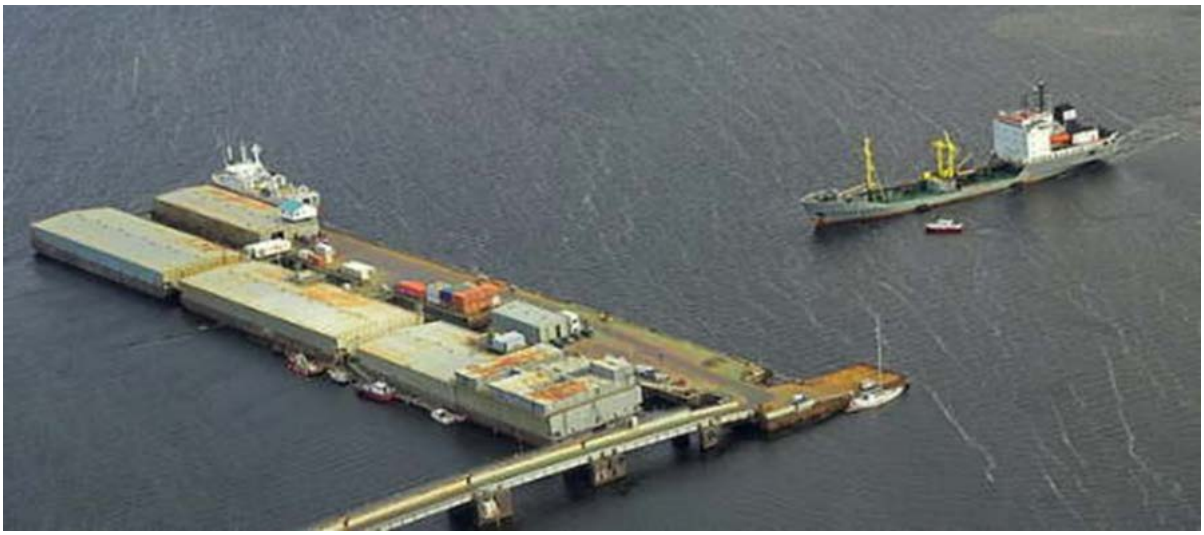


Figure 7-120: FIPASS, ***(Source: FIG, 2023d)***

Table 7.44: Vessels entering Stanley Harbour[1] (during 2014, 2018, 2022[2] and 2023)

Vessel Type	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Cargo	2014	4	2	5	5	3	2	5	4	1	2	2	3	38
	2018	2	2	3	3	2	3	2	5	4	3	5	3	37
	2022	0	0	0	0	0	0	1	0	0	0	0	0	1
Cruise ship	2014	9	12	8	1	0	0	0	0	0	6	14	14	64
	2018	21	5	9	1	0	0	0	0	0	5	18	12	71
	2022	3	1	1	0	0	0	0	0	1	6	12	13	37
Jigger	2014	0	92	15	3	1	0	0	0	0	0	0	0	111
	2018	0	103	4	6	1	0	0	0	0	0	0	0	114
	2022	1	89	0	0	0	0	0	0	0	0	0	0	90
Longliner	2014	1	4	5	3	1	5	7	9	3	4	4	1	47
	2018	3	3	4	6	3	3	3	6	4	2	3	1	41
	2022	1	0	1	0	1	1	0	0	8	0	0	0	12
Naval vessel	2014	0	3	0	2	0	3	0	0	0	1	1	2	12
	2018	0	2	0	0	1	1	0	0	0	0	0	1	5
	2022	0	0	0	0	0	0	0	0	0	0	0	0	0
Patrol vessel	2014	1	4	2	3	3	4	4	5	3	3	3	8	43
	2018	3	5	5	5	4	3	2	3	3	3	8	4	48
	2022	0	0	0	1	0	2	0	0	1	2	0	1	7
Research	2014	1	2	1	1	0	0	0	0	0	0	1	1	7
	2018	1	1	4	3	3	2	0	0	0	0	1	1	16
	2022	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanker	2014	2	1	1	3	3	1	2	1	1	1	1	0	17
	2018	1	0	1	1	1	2	0	1	2	1	0	1	11
	2022	0	0	0	0	0	0	0	0	0	0	0	0	0
Trawler	2014	3	17	13	14	12	3	16	11	6	16	6	0	117
	2018	4	14	14	8	16	3	10	12	15	10	3	2	111
	2022	0	5	0	1	0	0	5	1	1	0	0	0	13
Tug	2014	0	0	3	2	0	1	0	0	0	3	5	2	16
	2018	0	1	0	0	0	1	0	0	0	0	0	2	4
	2022	0	0	0	0	0	0	0	0	0	0	0	0	0
Yacht	2014	8	6	11	7	1	0	1	1	3	6	4	13	61

Vessel Type	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	2018	9	7	13	6	2	2	0	1	3	6	14	8	71
	2022	0	1	1	0	0	0	0	0	1	1	1	0	5
Total	**2014**	**38**	**149**	**68**	**46**	**26**	**19**	**35**	**31**	**17**	**44**	**46**	**47**	**566**
	2018	**51**	**146**	**59**	**42**	**33**	**20**	**17**	**28**	**31**	**31**	**55**	**38**	**551**
	2022	**5**	**96**	**3**	**2**	**1**	**3**	**6**	**1**	**12**	**9**	**13**	**14**	**165**
	2023	**40**	**102**	**21**	**20**	**2**	**0**	**10**	**12**	**17**	**11**	**24**	**19**	**278**

[1] The data collated by FIMA records only the final destination of vessels, so if a vessel comes to FIPASS (see Table 7.45), although it will have passed through Stanley Harbour, it is only recorded as visiting FIPASS.
[2] Note 2022 was a COVID year so vessel numbers are lower than would be expected in a normal year.
[3] 2023 data was not available by vessel type but a total for the month is included at the bottom for comparison with other years.
(Source: FIG fisheries department data (FIG, 2015b), Vessel Movements Database (DNR, 2019) and FIMA data (FIMA, 2023; 2024)

7.7.4.1.2.1 Temporary Dock Facility (TDF)

The Temporary Dock Facility (TDF), a floating barge, was installed in 2014 to support the 2015 oil exploration campaign. It is proposed that the TDF will continue to support the activities of Navitas during the Sea Lion Northern Development Area Phase 1 & 2 Development. The initial planning consent for the TDF was granted for three years for exploration and appraisal only. In March 2018, the conditions of the initial planning consent were varied to permit the use of the TDF for the Sea Lion development and production operations. Any upgrades to the TDF will be subject to separate planning applications/consents (Section 5.11.1.1.1).

7.7.4.1.3 Port facilities in Berkeley Sound

Berkeley Sound is a deepwater Harbour used for the transhipment of frozen fish and squid and is a designated port. The Sound is also used for licensed bunkering operations from tankers or reefers. However, only those vessels that have been licensed by Stanley Services Ltd. (SSL) can provide bunkers to other vessels within Falkland Islands territorial waters. The Sound is also regularly used by vessels of all kinds for shelter in adverse weather conditions.

While there are no shore facilities in Berkeley Sound, several companies in Stanley service the Sound (moving people and goods) by harbour launch.

All vessels crossing the reporting line into Berkeley Sound report to Stanley Port Control *via* VHF radio. The Reporting Line stretches between Volunteer Point (51° 31'S; 57° 44'W) and Cape Pembroke (51° 41'S; 57° 43'W). This line forms the outer limit of Berkeley Sound and Port William.

7.7.4.1.4 Vessel visits

7.7.4.1.4.1 Fishing vessels

Fishing vessels are regular visitors to Stanley Harbour throughout the year, where they undergo licence inspections, crew changes and catch transfers. The degree to which Stanley Harbour is utilised by fishing vessels varies considerably between vessel types and target species.

Jiggers visit Stanley Harbour for licence inspections and customs clearance prior to commencing fishing and the number of vessel visits peaks in February. However, most jiggers anchor with very few visits to FIPASS recorded (Table 7.45), (FIG, 2023n).

Trawlers are licensed to target finfish and loligo squid, during two fishing seasons (approximately February to May and August to November) and are regular visits to Stanley Harbour throughout the year. Although fewer trawlers than jiggers are licensed to fish within Falklands waters, trawlers make greater use of the facilities at FIPASS (Table 7.45).

While there is generally only one longliner licensed to fish within Falklands waters at any time, vessels that fish at South Georgia are regular visitors to Stanley Harbour as they all have to undergo catch verification at the end of the fishing season.

Note: 2015 fishing vessel data are presented in Figure 7-118 as it represents a good *Illex* year and correspondingly high vessel numbers.

Table 7.45: Vessel visits to FIPASS[1] (during 2014, 2018, 2022[2] and 2023[3])

Month	Year	Cargo	Cruise ship	Jigger	Longliner	Naval vessel	Oil related	Patrol vessel	Research	Tanker	Trawler	Tug	Yacht	Total
Jan	2014	4	3	0	1	0	6	1	1	2	3	0	0	21
	2018	2	8	0	2	0	0	3	1	1	4	0	6	27
	2022	2	0	0	6	0	0	2	0	1	0	0	1	12
	2023[3]	-	-	-	-	-	-	-	-	-	-	-	-	20
Feb	2014	2	5	3	4	1	5	3	1	1	15	0	0	40
	2018	2	1	0	3	0	0	4	1	0	10	1	1	23
	2022	1	2	1	1	0	0	3	0	1	15	0	0	24
	2023	-	-	-	-	-	-	-	-	-	-	-	-	37
Mar	2014	5	3	0	3	0	4	2	1	1	12	2	2	35
	2018	3	4	0	4	0	0	4	3	1	12	0	2	33
	2022	3	2	5	3	0	0	1	0	1	15	0	0	30
	2023	-	-	-	-	-	-	-	-	-	-	-	-	37
Apr	2014	4	0	0	2	1	2	3	1	3	10	0	1	27
	2018	3	1	2	4	0	0	3	2	1	7	0	1	24
	2022	3	0	3	1	0	0	2	0	1	13	0	0	23
	2023	-	-	-	-	-	-	-	-	-	-	-	-	29
May	2014	3	0	1	1	0	2	3	0	3	10	0	0	23
	2018	2	0	0	3	0	0	2	3	1	11	0	0	22
	2022	2	0	3	1	0	0	3	1	1	5	0	0	16
	2023	-	-	-	-	-	-	-	-	-	-	-	-	22
Jun	2014	2	0	0	3	2	0	3	0	1	2	1	0	14
	2018	3	0	0	3	1	0	3	1	2	3	1	0	17
	2022	1	0	0	5	1	0	3	0	1	1	1	0	13
	2023	-	-	-	-	-	-	-	-	-	-	-	-	10
Jul	2014	5	0	0	5	0	0	3	0	2	13	0	0	28
	2018	2	0	0	1	0	0	2	0	0	9	0	0	14
	2022	1	0	0	3	0	0	3	0	0	14	0	0	21
	2023	-	-	-	-	-	-	-	-	-	-	-	-	29
Aug	2014	4	0	0	6	0	0	3	0	1	10	0	0	24
	2018	3	0	0	4	0	0	3	0	1	11	0	0	22
	2022	2	0	0	2	0	0	0	0	2	15	0	0	21
	2023	-	-	-	-	-	-	-	-	-	-	-	-	32
Sep	2014	1	0	0	2	0	0	3	0	1	5	0	1	13
	2018	4	0	0	1	0	0	3	0	2	15	0	0	25
	2022	2	0	0	8	0	0	2	0	2	18	0	0	32
	2023	-	-	-	-	-	-	-	-	-	-	-	-	18
Oct	2014	2	3	0	2	1	2	3	0	1	14	3	2	33
	2018	2	3	0	2	0	0	2	0	1	8	0	0	18
	2022	3	4	0	1	0	0	4	0	2	8	0	0	22
	2023	-	-	-	-	-	-	-	-	-	-	-	-	20

Month	Year	Cargo	Cruise ship	Jigger	Longliner	Naval vessel	Oil related	Patrol vessel	Research	Tanker	Trawler	Tug	Yacht	Total
Nov	2014	2	5	0	4	0	4	3	1	1	5	3	0	28
	2018	3	9	0	3	0	0	4	1	0	2	0	3	25
	2022	3	5	0	1	0	0	1	0	1	0	0	0	11
	2023	-	-	-	-	-	-	-	-	-	-	-	-	21
Dec	2014	3	6	0	1	2	2	7	1	0	0	2	5	29
	2018	3	5	0	1	1	0	1	1	1	2	1	3	19
	2022	2	5	0	1	0	0	4	0	0	0	0	1	13
	2023	-	-	-	-	-	-	-	-	-	-	-	-	10
Total	**2014**	**37**	**25**	**4**	**34**	**7**	**27**	**37**	**6**	**17**	**99**	**11**	**11**	**315**
	2018	**32**	**31**	**2**	**31**	**3**	**0**	**34**	**13**	**11**	**94**	**3**	**8**	**262**
	2022	**25**	**18**	**12**	**33**	**1**	**0**	**28**	**1**	**13**	**104**	**1**	**2**	**238**
	2023	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**285**

[1] The data, collated by FIMA, records only the final destination of vessels, so if a vessel comes to FIPASS, although it will have passed through Stanley Harbour (see Table 7.44), it is only recorded as visiting FIPASS.
[2] Note 2022 was a COVID year so vessel numbers are lower than would be expected in a normal year.
[3] 2023 data available was given as a monthly total and is included for comparison with other years.
(Source: FIG fisheries department data (FIG, 2015b), Vessel Movements Database (DNR, 2019), FIMA data (FIMA, 2023; 2024 and pers. comm. Atlink, 2024).

7.7.4.1.4.2 Fisheries Patrol Vessels (FPVs)

The Falkland Islands and South Georgia and the South Sandwich Islands Governments' Fishery Patrol Vessels (FPVs) are regular visitors to Stanley Harbour throughout the year and go alongside FIPASS or East Jetty when space is available. The number of FPV visits to FIPASS is variable, as indicated by the following:

- 2014 - 37 visits,
- 2018 - 34 visits, and
- 2022 (COVID year) - 28 visits (Table 7.45).

7.7.4.1.4.3 Cargo vessels

Cargo vessels visit Stanley on a regular basis and require a berth at FIPASS to transfer cargo onshore. In 2014, 37 cargo vessels visited FIPASS. In 2018 cargo vessel visits to FIPASS were slightly less at only 32, and less again in 2022 (COVID year), visiting on 25 occasions (Table 7.45).

7.7.4.1.4.4 Cruise ships

The majority of cruise ships visiting Stanley anchor in the Harbour or Port William, from where they ferry passengers onshore to the Public Jetty or East Jetty in tenders. The vast majority of cruise ship visits occur between October and April. Some of the smaller cruise vessels will go alongside FIPASS. In 2018 there were 31 cruise ships alongside FIPASS reducing to 18 in 2022, due to COVID (Table 7.45).

7.7.4.1.4.5 Reefers

Reefers are refrigerated vessels that transship catch from fishing vessels for delivery to market. They usually anchor in Port William or Berkeley Sound and rarely enter Stanley Harbour.Table 7.44

7.7.4.1.4.6 Tankers

Up to 20 tankers visit FIPASS annually to transfer fuel, with 13 tanker visits to FIPASS in 2022 (COVID year) (Table 7.45). The supply of fuel has to meet demand, if demand increases due to O&G activity the supply will have to increase proportionately.

7.7.4.1.4.7 Yachts

In 2014, 61 yachts came into Stanley Harbour with 71 yachts in 2018. This number had reduced greatly by 2022 due to COVID with only seven yachts entering the harbour. These vessels usually moor at the Public Jetty, the East Jetty or anchor in the Harbour.

7.7.4.1.4.8 Royal Navy vessels

A Royal Naval (River Class) patrol vessel is permanently based in the Falkland Islands, to conduct the South Atlantic Patrol around the Falklands and South Georgia. The HMS Protector (or an equivalent alternative vessel), an Ice Patrol Ship, is on station close to in the waters of Antarctica and the southern hemisphere for 330 days a year (Royal Navy, 2019).

7.7.4.1.4.9 Research vessels

The British Antarctic Survey (BAS) operates three research stations in the Antarctic and two on South Georgia, (BAS, 2023). BAS operates one vessel to support these stations and conduct research at-sea. Throughout the summer season (September/October to May/June) this vessel may come into Berkeley Sound or Port William to resupply, change crew and scientists, but it is not able to come into Stanley Harbour due to insufficient navigable waters (N. Port, *pers. comm.*, 2023).

7.7.4.2 Road network

Until the 1980s, there were only tracks in the Falkland Islands outside of Stanley. By 2008, the road network in the Falkland Islands covered 862 km, with 489 km on East Falkland and 373 km on West Falkland. The road network has increased slightly since 2008, mainly on the west (C. Summers, *pers. comm.*).

However, the majority of the road network remains unpaved, consisting of a consolidated gravel surface with drainage ditches on both sides. The only asphalted roads are those within Stanley, those within the Mount Pleasant Complex (MPC) and the main road between Stanley and MPC.

Though regularly regraded ('ploughed' and rolled), the surface becomes badly potholed and rutted from vehicle wear. A constant programme of maintenance is required to keep the road network in a useable condition.

Over the years the number of vehicles, the weight of vehicles and the number of heavy vehicles has increased significantly having a bearing on the condition of the roads, particularly during winter months.

In April 2010, over a 19 day period, 5,484 vehicles (of which 2 % were Heavy Goods Vehicles (HGVs)) used the road between Stanley and Mount Pleasant. This represents a 170 % increase over the previous 10 years for all vehicles (FIG, 2012a). Although it is the heavier traffic which causes the greatest damage to any road, sealed or unsealed, road usage for all types of vehicles has increased disproportionately for a number of reasons, including:

- Cargoes from the UK now arrive at Mare Harbour and are delivered to Stanley by road,
- Movements to and from New Haven ferry terminal, including a significant increase in stock movements to the Abattoir,
- General increase in Islands wide movements by land rather than sea, and
- Increased localisation of posts for workers at MPC.

Between 2011 and 2015, the FIG Public Works Department (PWD) Roads section deployed pressure activated vehicle loggers at a number of sites to determine the number of vehicle passes as well as the class, weight and speed of the vehicles.

Average daily usage on the MPC road over the three sampled periods (at two locations) averaged 483 vehicle passes / day. The majority of these vehicles were cars, 4x4, minibuses or Light Goods Vehicles (LGV) with these groups accounting for 87.2 % of transit in 2015.

Daily usage on the Airport Road (measured between the Chandlery and Stanley Growers Market Garden), over a single sampled period, averaged at 1,755 vehicle passes / day. Again the majority of vehicles were cars, 4x4s, minibuses or LGVs with these groups accounting for 92.2 % of transit in 2015.

There has not been a detailed road usage survey since 2015. However, FIG (C. Summers, *pers. comm.*)

notes that:

- There has been an increase in the use of the South American Atlantic Service (SAAS) shipping service and therefore there has been an increase in heavy vehicle movements to and from the SAAS yard,
- With increased construction activity in the Stanley area there has been an increase in activity to the Mary Hill spoil dumping area,
- Road transportation of wool is steadily increasing, although numbers are not believed to be particularly significant, and
- The proposed site for the municipal waste transfer facility (Section 7.7.4.5.6) is at the east end of Megabid and will significantly increase the traffic movements in the area.

MPC Road usage has generally increased significantly year on year, however exact recent trends are not certain and road usage may have stabilised.

In 2012, the FIG introduced a Highways Asset Management Plan, which categorises the Islands' road network on the basis of its strategic importance and prioritises maintenance in respect of this (Table 7.46 and Figure 7-121).

Table 7.46: Road classification ***(Source: FIG, 2012a)***

Road Classification	Definition
Class A Road	Primary link road between major national assets
	Greatest traffic use by volume and weight
Class B Road	Link road between all Class A and C roads
	Major tourist destinations
	Major supply route to abattoir
Class C Road	All other roads
MoD Road	Roads linking MoD facilities with the national road network

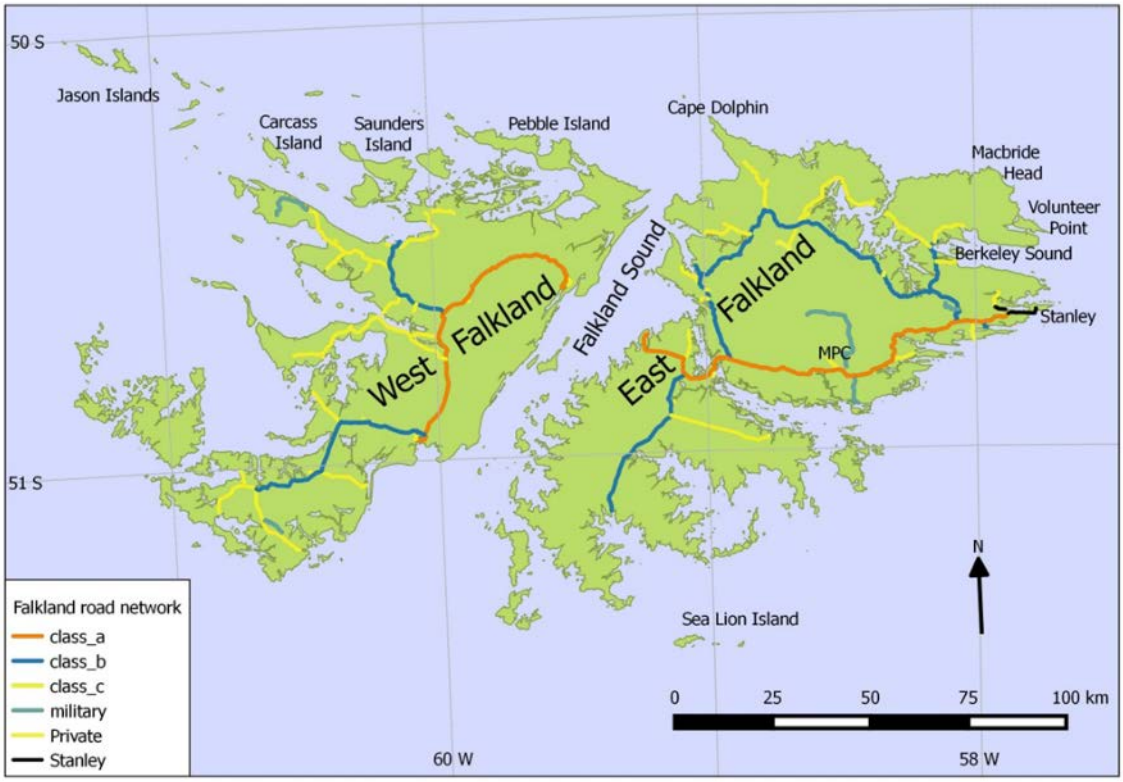


Figure 7-121: Road map of the Falkland Islands, indicating road class

7.7.4.2.1 Roads supporting Berkeley Sound

The settlements and farms at the head of Berkeley Sound are linked to the rest of the Islands by unpaved, gravel roads, as shown in Figure 7-121 above. The land surrounding the remainder of the Sound is only accessible by 4x4 vehicle during the summer months. During the winter, the land is wet and boggy, which increases the risk of becoming stuck in the mud ('bogged'). Access to tracks, such as the one leading to Volunteer Point, is closed to the public during the winter months.

7.7.4.3 Airport and air-links

There are two main paved runways in the Falkland Islands, one at Mount Pleasant International Airport and one at Stanley Airport.

7.7.4.3.1 Mount Pleasant International Airport

The Falkland Islands are currently serviced by two international air-links:

- The MoD air-bridge link to the UK, and

- The LATAM commercial service to Santiago, Chile.

The MoD operates a chartered aircraft between RAF Mount Pleasant and RAF Brize Norton (UK) twice weekly. The current charter service is fulfilled by AirTanker under contract. An agreement with FIG provides for a fixed civilian seat allocation on each flight. At present 31 seats are allocated for civilian use on each flight. In 2018 the average seat utilisation was 20 seats per flight and the number of airbridge flights per annum that were at full capacity was approximately 8-10 flights on both the south and the northbound legs. After the Covid-19 pandemic lowering seat occupancy considerably between 2019 and 2022, numbers are now considered to be back to pre-Covid levels (R. Clark, *pers. comm.*). Average figures should be treated with some caution as there is high seasonality in flight occupancy rates with August and Christmas periods showing the highest demands linked to school holidays. Medical flights are also routinely scheduled with accompanied medical teams for referrals from King Edward Memorial Hospital to the UK NHS for treatment. This may at times reduce capacity on individual flights.

LATAM operates a commercial flight once weekly to Punta Arenas and onwards to Santiago, Chile from where international connections can be made. Once per month the flight makes a brief stop-over in Rio Gallegos, Argentina.

The LATAM service currently utilises an Airbus 320 - 200 with 168 seats (although the plane can be configured for 174 passengers this is not done regularly). Occupancy is variable through the year and ranges from 12 - 100 % seat occupancy with an annual average of 54 % occupancy (2016-2018 data) reducing to an average occupancy of 44 % in 2022-23. For 2022/23 this would provides an average weekly spare capacity of approximately 94 seats (R. King, *pers. comm.*). The peak season is through the summer tourist season between the months of November to March when flights may be fully booked for cruise-vessel passenger exchanges (five flights were fully booked in 2023). A secondary peak occurs during August corresponding with the winter school holidays. This route is increasingly popular with travellers and passenger numbers continue to rise; figures for the duration of 2013 - 2018 showed an annual increase of 7 % but the flight was suspended during the Covid-19 pandemic, returning to normal service in July 2022. Flights can be fully booked, often due to cruise-vessel passenger exchanges and advance provisional block booking of flights.

Some of the key statistical information regarding air links to the Falkland Islands are summarised in Table 7.47 below.

Table 7.47: Summary of flights to and from the Falkland Islands[1]

Statistic	MoD Airbridge	LATAM Airlines (Santiago Route)
Route	Mount Pleasant, Falkland Islands – Brize Norton, UK	Mount Pleasant, Falkland Islands – Punta Arenas, Chile
Aircraft	Airbus A330 variant KC2 Voyager	Airbus 320 - 200
Frequency of flights	Twice per week	Once per week
No. flights per year	104	52
Commercially available seats	31	168
Average Occupancy seats	27 (86 %)	74 (44 %)
No. flights per annum which are at full capacity	8 - 10	5
Peak season	August and Christmas (school holidays)	November – March (cruise vessels and tourism) August (school holidays)
Average spare capacity	9	94

[1] Summary of restricted commercial data provided by FIG in 2018 and 2024 (LATAM) and for 2023 (MoD Airbridge).

7.7.4.3.2 Stanley airport

Stanley Airport has for many years primarily been operated for the domestic inter-island Falkland Islands Government Air Service (FIGAS). It was also used as a heli-base for the 2010-12 and 2015 exploration drilling campaigns. FIGAS currently has a fleet of five Britten-Norman BN2-B Islander aircraft.

7.7.4.4 Importers of supplies / goods to and from the Falkland Islands

The majority of goods are shipped into the Falklands. There are two main routes: direct from the UK or *via* South America.

7.7.4.4.1 Falkland Islands Resupply Service (FIRS)

The Falkland Islands Resupply Service (FIRS) is a service contracted by, and provided to, the Ministry of Defence (MoD), primarily to carry military freight to re-supply MPC. The Ro-Ro container vessel from the UK arrives in the Falklands every 6-12 weeks and operates between Marchwood, Southampton, in UK, and Mare Harbour on the Falkland Islands. This carries commercial freight as well as bringing in some the food imports and other civilian supplies.

7.7.4.4.2 South American Atlantic Service (SAAS)

The South American Atlantic Service (SAAS) also provides a container shipping link between the Falkland Islands and the UK *via* Montevideo, Uruguay.

7.7.4.4.3 Air freight

No specific civilian / private-sector allowance is made for commercial air-freight. Availability of commercial freight is limited by size and weight which is, in turn, limited by the air-frame of the aircraft available. Furthermore, freight capacity is dependent upon passenger numbers and thus spare air-frame load. On high occupancy flights, air freight is not available.

7.7.4.5 Existing resource infrastructure and use

7.7.4.5.1 Accommodation

7.7.4.5.1.1 Existing housing

The 2021 Census (FIG, 2023l) indicates that the overall civilian population of the Falkland Islands has decreased slightly from 3,200 to 3,142 (including those living at MPC) since 2016.

However, Stanley with 2,538 inhabitants, which accounts for 80 % of the total number of residents island-wide (including MPC residents), has shown a population growth of around 3 % since 2016.

The number of households in Stanley continues to grow and it is considered that, overall, there is an ongoing shortage of affordable housing for purchase and rental in Stanley, this is acknowledged as a critical constraint (Regeneris, 2013; Maplecroft, 2019).

The 2021 Census recorded a total of 1,600 resident households, of which, 1,148 (72 %) are located in Stanley (Table 7.48).

In 2021, the majority of houses in Stanley were mortgaged or owned outright (54 %) (Table 7.48). Approximately 40 % of Stanley households were held under rental, while a further 5 % were provided rent free as part of an employment package (FIG Policy Department, *pers. comm*.) (Table 7.48). Currently, only residents with a Permanent Resident Permit (PRP) or full Falkland Islands Status are able to own property in the Falklands. ExCo can grant permission to Non-Permanent Residents (NPR) and work-permit holders, however, most commonly NPR are excluded from owning property. Therefore, NPR form a large part of the rental market, both within FIG housing and the private sector.

In 2012, 87 properties were built in the six years leading up to the census. This number doubled in 2016 to 177 and reflects the increased rate of construction of both public and private housing in recent years (FIG, 2021c). Since then, around 30 new dwellings per year have been developed by FIG (O. Mathers, *pers. comm.* 2023).

Table 7.48: The number and proportion of Stanley households owned outright, owned under mortgage, rented or provided rent free[1]

Household Ownership Class	2006		2012		2016		2021	
	No.	%	No.	%	No.	%	No.	%
Rent Free	57	6	62	6	109	9	65	5
Rental	288	31	322	32	378	32	481	40
Mortgage	270	29	263	26	291	24	268	22
Owned	315	34	355	35	389	33	382	32
Unknown	-	-	-	-	22	2	-	-
Total	**930**	**-**	**1,002**	**-**	**1,189**	**-**	**1,196**	**-**

[1] Data provided by the FIG Policy Department (previously the Policy Unit) (*pers. comm*.). Note that these data cover Stanley housing only.

7.7.4.5.1.2 Future developments and town planning

The Stanley Town Plan (FIG, 2015d) recognises the need to plan for increased housing if future economic development is not to be impeded. The plan, which is based upon Regeneris (2013) projections of need, provides for a target of an additional 450 units over the 17 year duration of the plan from 2013 – 2030. This amounts to a housing target of approximately 26 units per annum.

In order to meet these future demands, the Stanley Town Plan has nominally identified and zoned areas for residential housing. These zones incorporate both FIG land that would be available for phased land release and private land that could be developed through market forces. A total plot capacity of 768 building plots was identified, with 362 plots considered to be potentially viable for development within the duration of the plan. FIG have averaged around 30 new dwellings per annum since 2016 (O. Mathers, *pers comm.*). In addition to residential zoning within the plan, proposals for permanent structures to provide transitory accommodation (e.g., short-term accommodation for offshore workers) would be supported within land identified for light industrial uses.

The development of some sites may be impeded by the location and current capacity of FIG to provide utility services such as water, power and sewage to the site. Nonetheless, the Planning Ordinance 1991 includes provision for the production of Developer Contribution Regulations. This would provide a mechanism to allow developers to fund 3rd party activity on land which is outside the developers' control to address the infrastructure needs or impacts of the Development. This could allow for the fast tracking of development if infrastructure servicing is met by 3rd parties or remunerated for.

7.7.4.5.1.3 Hotels and guest houses

The main hotel in Stanley is the Malvina House Hotel which has 70 rooms, followed by the Waterfront Hotel (six rooms) and Shorty's Motel (six rooms).

Additionally, there are several small Bed & Breakfast establishments in Stanley, and additional hostel style rooms at Lookout Lodge (60 rooms).

7.7.4.5.2 Fresh (potable) water supply

Freshwater in Stanley is a finite resource and, under present operating procedures, water availability and Stanley usage are largely balanced. In order to assess the impact of the additional freshwater requirements of the Phase 1 & 2 Development, it is necessary to quantify the baseline water availability. Therefore, it is necessary to understand:

- Freshwater required by Stanley, and

- Freshwater available to Stanley and the factors which may limit this supply:
  - The number of water catchment sources (i.e., the means of capturing rainwater),
  - Untreated water supply (i.e., how fast is the rainwater carried from the catchment source to the Dairy Paddock Reservoir and for how long in each day),
  - Water treatment (i.e., how fast can the water be treated, and the duration of pumping each day, so it can be supplied to the consumer as needed), and
  - Treated water storage capacities (i.e., where is the treated water held prior to use by the consumer).

7.7.4.5.2.1 Freshwater required by Stanley

Forecasts conducted in 2004 showed that there had been an upward trend in annual water consumption of approximately 3 % per annum over the previous 24 year period from 1980. More recent water forecasts have been difficult to determine due to leaks in the system (Z. Stephenson, *pers. comm.*). However, the year-on-year increase in Stanley consumption has continued into the present with increases of *c.* 2- 3 % p.a. resulting in a baseline maximum annual water use of 335,070 m^3 (i.e., 918 m^3/day) in 2023. Of note, this was a year without the additional demand of oil exploration. Additional use during phases of oil exploration caused spikes in water usage over and above this baseline increase. In 2015 during an oil exploration campaign, a maximum consumption of 346,087 m^3 was recorded, which related to an increase of 23 % upon the previous year of 2014 with no oil exploration. While it is noted from the above that the current basic Stanley water usage levels (2023) have increased almost to the levels of usage during the last exploration campaign (2015), it is clear that oil exploration and production will significantly increase the demand.

7.7.4.5.2.2 Freshwater available to Stanley and the factors which may limit supply

Water sources

Potable water is supplied to Stanley by the FIG Public Works Department water filtration plant.

As shown in Figure 7-122, untreated water (rainwater) is supplied *via* two catchment sources:

- The Moody Brook catchment, and
- The Upper Murrell River catchment which was brought on-line in 2016 and was developed owing to:
  - The increase in residential households in Stanley,
  - Increasing demand (including from new industries e.g., the abattoir, fishing, cruise vessels, and oil exploration activities), and
  - The observed drying of the Falkland Islands climate that limits catchment recharge (FIG, 2008a).

The Murrell catchment area has increased the rainwater catchment for Stanley by over 60 % and will safeguard the continuity of supply. With the commissioning of the Murrell River catchment, supply continuity is no longer considered a limiting factor for current water needs. However, whilst the dual catchments have increased the security of supply they have not increased the volume of supply to Stanley, which is still limited to a single water pipeline with a fixed capacity from the Moody Brook pump station.

Outside of Stanley, the quarry and abattoir are supplied from the Stanley structure through a pump system to augmented pressure. The Mount Pleasant military base operates independently and has a small reservoir and filtration system whilst small camp settlements and farms are served by private groundwater springs without processing.

Untreated water supply (filtration rates and duration) and treatment

Rainfall catchment is pumped from the Moody Brook and the Murrell River catchments to the Dairy Paddock Storage Reservoir (DPR) at a rate of 60 m^3/hr (Figure 7-122) through a single pipeline. Over the current 14.5 hour operating day, this relates to a capacity of 870 m^3/day of water pumping into the DPR which has a capacity of 1,500 m^3.

From the DPR water is processed through the PWD water filtration plant. The water is filtered through clarifiers and treated to ensure it is fit for human consumption. The theoretical maximum filtration rate is 77 m^3/hr. However, this rate cannot be sustained in the long-term as it exceeds the rate at which the DPR fills (60 m^3/hr). Filtration rates that exceed 60 m^3/hr can only be achieved in the short-term if the DPR is used as an additional buffer supply and run down through the filtration plant working day, to be recharged overnight by leaving the catchment water feed running and the DPR to refill unattended. The DPR is an integral component of the Stanley two-day contingency water supply storage and hence draw down of the reservoir is not taken as standard current procedure except in extenuating circumstances of critical demand.

With a total of 870 m^3/day supplied to the DPR over a 14.5 hr day, the water demand during the most recent oil exploration campaign in 2015 passed the supply capacity for the first time and thus required extended pumping times.

In summary, the water availability is affected by the:

- Supply of water from Moody Brook and Murrell River to the DPR (60 m^3/hr),
- Filtration rates at the filtration plant (theoretical maximum of 77 m^3/hr),
- Operational hours of the Moody Brook and Murrell River pumps (usually 14.5 hrs/day, but can be left on overnight to recharge the DPR in extenuating circumstances), and
- Operational hours of the filtration plant which are restricted by staffing and maintenance requirements.

Potable water storage and supply

Following filtration, potable water is pumped to interim storage header tanks to provide a pressure head to the mains system. Two separate systems are utilised:

- Murray Heights Low Level System: Storage of 1,232 m^3 which supplies central ‘old’ Stanley, and harbour frontage to FIPASS and TDF, and
- Sappers Hill High Level System: Storage of 2,874 m^3 which supplies new development areas and the by-pass / airport road. A pressure booster system supplies the abattoir and quarry.

Whilst the tanks can provide some degree of buffer storage, in practice it is not possible to fully draw down the tanks because:

- Excessive draw down of tanks can cause in-line system debris sedimentation, (which does not affect potability, but can lead to discolouration and may cause issues to some consumers), and
- The remit is to maintain two days’ worth of potable water to ensure supply to Stanley at all times.

The two days’ buffer of potable water would be prioritised to Stanley and emergency service usage in the event of shortfalls. In the event of water shortfall, there is a hierarchy of users that would be restricted and ultimately disconnected if required and subject to emergency provision. At present the TDF is classified as of lowest priority and restriction would likely be conducted as follows, TDF, FIPASS, PWD Megabid, and FIGAS, before restrictions were applied to Stanley.

FIG note that with capital funding commitments there will be significant changes to the water provision by 2025/26 (C. Summers, *pers. comm.*).

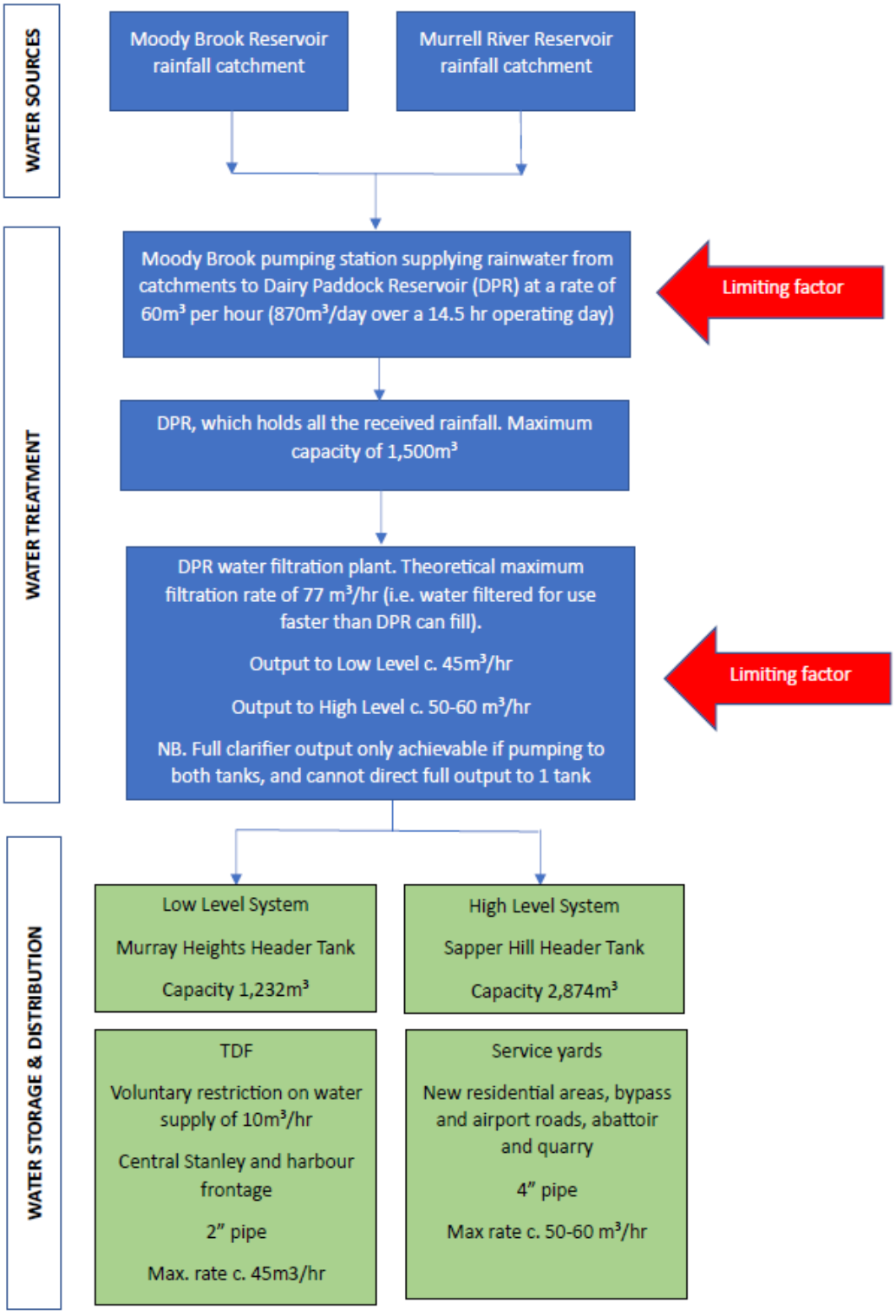


Figure 7-122: The Stanley filtration and water supply system with the limiting capacity of each stage

7.7.4.5.3 Non-potable process water

At present, it is not possible to supply lower quality non-potable water as this would lead to contamination of sections of the potable water supply. In addition, the full capacity of the existing catchment supply pipeline is utilised by the filtration plant excluding the possibility of a take-off from this pipeline.

7.7.4.5.4 Fuel and bunkering

Stanley Services Limited (SSL) was founded in 1987 and operates under an exclusive licence from FIG to provide all domestic fuels and a bunkering service to all vessels within territorial waters (12 nautical miles).

SSL stocks fuel according to demand. The SSL contract with FIG for supply to the local population requires SSL to have three months' worth of supply of each grade of product.

SSL operates a terminal with a capacity of 7,500 m^3 of Marine Gas Oil (MGO) in Stanley and can supply fuel to vessels moored at FIPASS in Stanley (via the ex-pipe alongside the wharf). When there are no O&G vessels operating, SSL only issue minimal amounts to local vessels, several fishing vessels and on occasion to small cruise ships. If there are more vessels operating, the tanks are replenished more regularly. SSL has room in their terminal to build further tank storage if required (L.Yon, *pers. comm.*).

Additionally, bunkering operations can take place in the open sea or in the relative safety of the natural harbour of Berkeley Sound. Together with joint shareholder Lavinia Corporation, SSL provides bunkering coverage to the fishing fleet on the high seas as well as in Berkeley Sound, supplying both MGO and 180 centistokes (cST) Bunker Fuel (i.e., Intermediate Fuel Oil (IFO)). There are two tankers in operation and during the height of the fishing season there are also numerous reefer vessels with large fuel capacities operating on the high seas fishing grounds in the South Atlantic.

With regard to aviation grades of fuel, SSL stocks one grade for the local Islander aircraft and also stocks jet fuel which is generally only supplied to helicopters supporting O&G operations. The SSL terminal in Stanley can stock about five weeks' worth of jet fuel. Jet fuel is replenished from the military base tank farm, 60 kms away by road (L. Yon, *pers. comm.*).

7.7.4.5.5 Electricity

In order to assess the impact of power use by the Phase 1 & 2 Development, it is necessary to understand the baseline electrical capacity to enable comparison between supply and demand. When quantifying the baseline it is necessary to consider the overall amount of power available, as well as the amount available at any given time. Therefore, electrical capacity needs to be considered in terms of the:

- Power required by Stanley:
  - Power consumption (in kiloWatt hours (kWh)) (i.e., the total power used over a unit of time), and
  - Peak power demand (in kiloWatts (kW)) (i.e., the instantaneous power available for use at any given moment in time).
- Power available in Stanley, and
- Future power output.

7.7.4.5.5.1 Power required by Stanley

Current Stanley energy use in 2022/23 amounts to 19,520,590 kWh per annum with an average daily use of 53,481 kWh (Table 7.49). This figure is considered typical of current baseline usage and trends. Within the two year period 2013/14 to 2015/16, i.e., the last time exploration drilling took place in the Falklands, electrical energy use increased from the previous year by 16 %. To be conservative within

the assessment, it is assumed that this increase was a result of the oil exploration activity conducted in 2015. However, as can be seen from Table 7.49, usage figures did not drop back down to pre-exploration figures in subsequent years, remaining at 10 % (2016/17) and 6 % (2017/18) above the 2013/14 figures. In 2021/22 usage was at similar levels to those seen during previous exploration rounds at 15 % above 2013/14 (pre-exploration) figures (J. Greenland, *pers. comm.*). Therefore, it is not entirely possible to accurately determine what the direct and indirect effects of oil exploration were, against a general increase in electrical usage.

The instantaneous power output is limited by the capacity of the generators. Stanley peak power output is currently around 3,200 kW depending upon which of the generators are under-going deep services or are on stand-by. Power generation output must be matched to demand load and sudden peak loading can cause failure or drop out in the system.

Table 7.49: Electrical power use (kWh = one unit in domestic usage) over a ten year period (each period covering July - June)

Year	Usage (kWh)										
	2012/13[1]	2013/14	2014/15[2]	2015/16[3]	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23
Total Annual Units	16,387,386	16,172,330	16,826,545	18,725,371	17,873,420	17,168,730	17,608,162	17,865,220	18,179,906	18,556,500	19,520,590
% Production from windfarm	32	32	32	32	30	32	30	30	30	30	30
Average Daily Units	44,897	44,308	46,100	51,162	48,968	47,038	48,241	48,946	49,808	50,840	53,481
Average Weekly Units	315,142	311,006	323,587	360,103	337,234	337,188	345,941	343,562	349,614	356,856	375,396
% Production Increase from 2013/14 base-year	-	Base Year No Exploration	+4	+16	+11	+6	+9	+10	+12	+15	+21

[1] Drilling operations with support from the supply base for 5 months.
[2] Drilling operations with support from the supply base for 4 months.
[3] Drilling operations with support from the supply base for 8 months.

7.7.4.5.5.2 Power available in Stanley

Within Stanley, the FIG Power Station is the electrical distribution hub and balances supply from the generators and the Sand Bay wind farm.

Stanley Power Station uses eight in-house diesel generators (seven online as of January 2024) and three high speed sets (a newer type of diesel generator) and supplies over 99 % of the electrical usage within Stanley. The highspeed sets make up the "Interim Power Station" and have been on-line since March/April 2020. They have been contributing roughly 20 % of total generation since that date. Once the new Power Station is operational the intention is for the high-speed sets to either be decommissioned or kept as a form of Standby Power Station (J. Greenland, *pers.comm.*). Outside of Stanley there is no central power grid with settlements and farms serviced by their own independent systems. Mount Pleasant Complex was, until recently, entirely serviced by diesel generators but a wind farm has now been constructed at Mare Harbour to supplement the generators.

The Sand Bay wind farm comprises six turbines and meets, on average, *c.*30 % of demand (C. Summers, *pers. comm.*). This use of a renewable resource has reduced diesel consumption at the Stanley Power Station by approximately 35 – 40 %. However, since this source is reliant on meteorological conditions and output cannot be modified to balance demand, the power needs of Stanley must be considered in the context of the diesel generators alone in order to take a conservative and precautionary approach.

7.7.4.5.5.3 Future power output

It is recognised within capital project planning and the Stanley Town Plan (FIG, 2015d) that the current eight diesel generators are reaching the end of their design life with resultant issues for capacity, reliability and maintenance costs. The three additional high-speed sets are an interim solution and contingency planning is progressing towards a new power station in a new location for the long term. FIG note that with capital funding commitments there will be significant change by 2025/6 (C. Summers *pers. comm.*).

7.7.4.5.6 Waste management infrastructure – Landfill sites

Current waste disposal and recycling facilities in the Falklands are very basic, consisting of:

- Landfill,
- Reuse of glass (as aggregate) and scrap metal, and
- The local collection and recycling of cans and tins, and household batteries batteries (which are collected for recycling in future).

Eliza Cove is a landfill site accepting general waste from Stanley. The site was regarded as being at capacity as long ago as 1997 and was recommended for closure in a study on waste management by Halcrow and Partners. However, in the absence of alternatives, it is still operating.

There are various small landfill sites in Camp and much general waste on farms and the outer islands is burned.

Currently there is no hazardous waste treatment infrastructure on the Islands and such waste streams are stored onshore and shipped in batches to the UK for treatment and disposal.

There is some low-level recycling such as reuse of plastic bags and food containers and FIG has implemented a voluntary code of conduct to charge for single use plastic bags. There is a glass imploder that is operated by the Public Works Department and there are numerous glass recycling bins located around Stanley in which residents can deposit their glass waste. FIG collects used glass from hospitality establishments and crushed glass is used as an infill material for road surfacing. Tins, cans and household batteries are collected within Stanley and recycled in the UK.

FIG developed a Waste Management Strategy in 2018. This strategy includes:

- The separation and collection of tin cans, to be fed into a proposed MoD recycling facility,
- The incineration of all combustible household waste,
- The construction of a waste collection facility to allow the public to dispose of waste which is not placed in kerbside bins, and
- The construction of a joint FIG/MoD landfill site.

Alongside this, FIG is continuing to explore options for waste electrical and electronic items (WEE), large metal waste and hazardous waste. (FIG, 2019b).

There is currently no legislation regarding recycling in the Falkland Islands. However, in line with the planned waste management strategy and associated investment, FIG is committed to development of appropriate legislation (FIG, 2018a). As of January 2024, a consultation was underway to start the development of a Pollution Prevention and Waste Management Policy (*N. Cordeiro, pers. obvs.*)

7.7.4.6 Scenery, wildlife and tourism resources

The role of tourism in the Islands' economy is increasing. Tourist numbers continue to grow, with many attracted by the Islands' pristine environment and its diverse wildlife. Approximately 60,000 tourists visit the Islands by cruise ship each year, and a further 3,500 'land-based' tourists arrive by air annually (FITB, 2022). The total number of cruise ship passengers arriving in the Islands per season (October to April) from 1995/96 to 2022/23 is shown in Figure 7-123. Visitor numbers rose steadily year on year until the 2007/08 and 2008/09 seasons. There was then a decline as a consequence of the global economic turn-down. Visitor numbers have since recovered to slightly more than those achieved prior to the global economic downturn with the peak number of cruise ship visitors to date being achieved in the 2017/18 season. A second dip is seen in visitors due to the Covid-19 pandemic, dropping to as low as zero cruise ship visitors in 2021/22. However, the 2022/23 season saw cruise ship visitor numbers increase again to levels similar to pre-pandemic numbers (N. Cordeiro, *pers. obvs.).*

Many cruise ships will visit locations in the west of the Islands to see wildlife but virtually all vessels will visit Stanley. Within Stanley, there are a number of businesses and individuals that support tourist excursions to locations within driving distance of the city. Many of these sites are important for the wildlife that they support; however, they are also important recreational sites for residents and tourism. Important sites include:

- Surf Bay,
- Gypsy Cove,
- Cape Pembroke,
- Volunteer Point,
- Murrell Farm,
- Kidney Island,
- Long Island, and
- Bluff Cove.

The tourism sector is a large contributor to the Islands economy and in 2018 (the latest figures available) contributed approximately £5.9 m to the annual GDP (FITB, 2022). FIG aims to increase the economic benefits from tourism to the Falkland Islands. A key aspect of the Tourism Development Strategy (TDS) is sustainable development, preserving and protecting the Falkland Islands' character, building on the Islands' abundant wildlife, flora, clean air, open skies, space and remote location, as well as their friendly people and virtually crime-free environment (FITB, 2016).

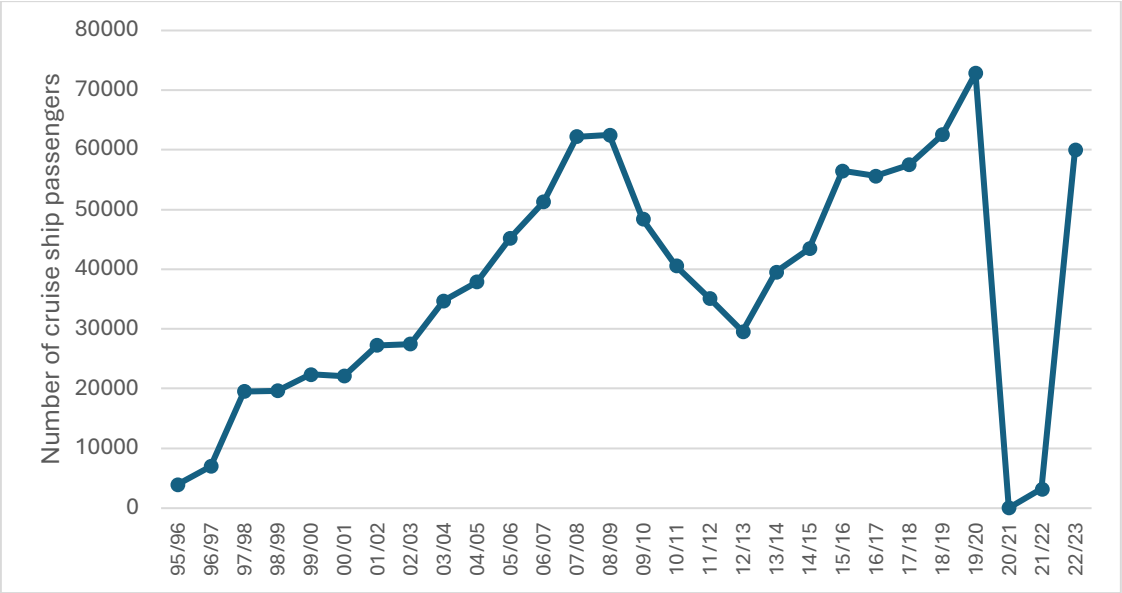


Figure 7-123: Total number of cruise ship visitors per season, from 1995/96 to 2022/2023

7.7.4.6.1 Tourism in Berkeley Sound

Berkeley Sound qualifies as a tourism resource owing to the wildlife and scenery of the area. The Sound already has a seasonally high level of shipping activity, which may impact on the view and perception of wilderness experienced by tourists (Tyler Grange, 2016), although peak vessel and tourist activity have limited overlap. The LTVs will be significantly larger than reefers and fishing vessels and may be present for over a full year and therefore may pose a potentially greater visual impact.

There are a number of sites around Berkeley Sound that are visited by tourists during the summer. Many of these arrive on cruise ships and take over-land day trips from Stanley.

In terms of visitor numbers, the king penguin colony at Volunteer Point is one of the most visited wildlife sites in the Falklands. Additionally, rockhopper penguin colonies on the south side of Berkeley Sound and gentoo penguins at Kidney Cove, both on Murrell Farm land, are popular wildlife attractions. Other tours include trips to Long Island Farm, where visitors can experience life on a Falklands farm.

Tourism away from these sites is at a low level due to access difficulties for independent visitors, although it is possible to hire a 4x4 with a driver, the number of tourists visiting other sites is generally low. However, many sites in Camp are popular with local visitors.

As an alternative to over-land travel, there are also organised visits by harbour launch to Kidney Island to see the wildlife and whale-watching trips to Berkeley Sound.

7.7.4.6.2 Tourism service providers

Tourism is described under Section 7.7.3.2.2.

7.7.4.7 Livestock and agricultural resources

Agriculture was the main economic activity in the Falkland Islands for most of the 20th century and remains an important part of the Islands economy and culture. Its relative importance in terms of GDP has been lower than the fisheries sector in recent years, but it remains the third largest employment sector in the Islands (Plexus Energy, 2012; FIG, 2023l).

Until recently the mainstay of the agricultural sector was wool production. A key constraint is the distance to markets, which makes Falklands' wool relatively expensive. The focus has therefore been

on organic wool and the production of finer wool, which may be sold for a higher price, depending on the market. In an effort to diversify the Camp economy and to help to encourage people to stay in Camp, measures were taken in 2002 to generate additional income from meat export (lamb, mutton and beef), complemented by improved farming practices and pasture improvements (Plexus Energy, 2012).

Most farming activity takes place during the summer months (September to March) and as a result there is much seasonality associated with employment in Camp. This period is also the core tourist season and as such there is competition for labour during the summer months. Contract labour is often used for shearing, fencing or tractor work and is often difficult to source, particularly at peak times of the year (Plexus Energy, 2012).

7.7.4.8 Fisheries resources

Fisheries are described under Section 7.7.3.2.1.

7.7.5 Baseline noise, odour and light levels

7.7.5.1 Stanley

7.7.5.1.1 Noise

Four noise monitoring exercises have been conducted to date in Stanley that provide information on baseline noise levels in the vicinity of the onshore supply base and the TDF. Noise measurements have previously been conducted on behalf of:

- Workboat Services Ltd in March 2013,
- Noble Energy Falklands Ltd in March 2014,
- POEPL in August 2016, and
- POEPL in February 2017.

Locations of the monitoring points are shown in Figure 7-124 and the data collected are summarised in Table 7.50.

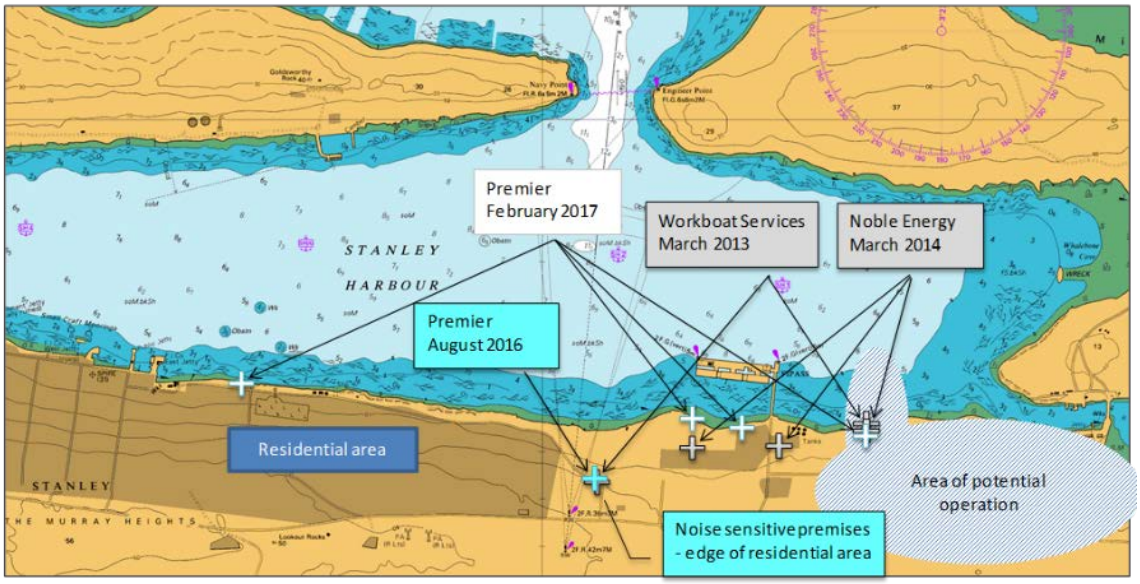


Figure 7-124: Location of noise monitoring points in Stanley

Table 7.50: Summary of the measured noise data

Reference	Description	Time period	LAeq dB [1]	LA90 dB [2]
Workboat Services March 2013	Liberty Lodge	Daytime	45.3	38.9
		Night-time	38.8	35.7
	Coastal Finger Pier	Daytime	43.4	37.7
		Night-time	37.5	34.4
Noble Energy Falklands Ltd March 2014	Stanley Growers	Daily	48.0 - 49.1	Not reported
	TDF	Daily	53.3 - 58.7	Not reported
POEPL, August 2016	Liberty Lodge	Daily	45.3	41.7
POEPL, February 2017	Various, see below	Snapshot	41.8 – 72.5	Not reported

[1] LAeq dB is the average noise level over the measurement period in decibels (dB).
[2] LA90 dB is the noise level exceeded 90 % of the time.

7.7.5.1.1.1 Conclusions from previous surveys

Noble Energy concluded that the levels of noise at premises sensitive to noise (Stanley Growers) from construction and operation activities at the TDF during exploration well campaign were 'negligible' but there was a subsequent complaint from a local resident.

Workboat Services concluded that noise levels from construction and operation of a jetty including the TDF area would be 'negligible' at Liberty Lodge, which lies at the far eastern end of Stanley and is one of the closest occupied properties to the TDF area.

POEPL survey August 2016

Noise monitoring equipment was installed outside in open ground in front of Liberty Lodge, Rowlands Rise in Stanley for 48 hours. The equipment used to undertake the noise survey was:

- Norsonic Nor118 Sound Level Meter (serial number 28248) with all-weather kit,
- GRas 40AS Microphone (serial number 004142), and
- Gras 26AK Preamplifier (serial number 044482).

Noise measurements were undertaken in accordance with current best practice guidance contained within BS7445 and BS4142. The sound level meter was mounted at a height of approximately 1.5 m above ground and was located more than 3.5 m from the nearest building facade or wall to avoid falsely elevated sound levels from reflections. The sound level meter was supplied calibrated (by UKAS accredited laboratories) and was fitted with a windshield at all times, to minimise the effect of wind on the measurements.

The measurement conditions at the monitoring point are shown in Table 7.51 and measured sound levels are shown in Table 7.52.

A frequency spectrum was recorded during this measurement period (covering all 48 hours) and is shown in Figure 7-125. The unmodified sound levels, representing the essential sound energy present, are shown by the red line, but these do not account for human hearing sensitivities, which are instead shown by the blue bars which include the human 'A' weighting[38]. The main frequencies measured contributing to noise perceived by humans (blue bars) are 250 Hz - 1000 Hz. Typically these frequencies are associated with traffic noise (e.g., SINTEF, 2008), although there are many other noise sources that give rise to these frequencies.

[38] An 'A-weighting' is normally applied to sounds measured by instruments in an effort to account for the 'loudness' as it is perceived by the human ear. Essentially, between 500 Hz and 6 kHz the human ear is much more sensitive, but below and above these frequencies the human ear is not particularly sensitive and the 'A-weighting' takes these sensitivities into account.

Although 48 hours is a short window of measurement, the time history (Figure 7-126) shows some potential features of the noise climate that are worthy of note and can be reviewed as further measurements are taken going forwards:

- Sound levels are rarely below 40 dB(A) even at night,
- Quietest periods are between 2300 - 0600,
- There are apparent noise increases relating to diurnal human activity i.e., increases through the morning 0600-0900 and 1500-1730,
- Traffic noise appears to be an important source of noise,
- Wind noise is probably a significant feature of the noise climate, and
- Military jet overflights occur several times per week and add noticeably to overall noise levels despite being of short duration.

Table 7.51: Measurement conditions for baseline sound measurement

Time and date	Location	Weather conditions	Notes
20th August 2016 18:19 to 22nd August 2016 17:39	Liberty Lodge	0-5 °C 1-4 m/s wind Intermittent light snow	Melting snow

Table 7.52: Summary of baseline sound levels at Liberty Lodge

Parameter	Value over 48 hours dB(A)	Value over 1st 24 hours[1] dB(A)	Note
A Leq	49.8	45.3	The 'average' noise level over the measurement period.
A Peak	106.3	-	The maximum noise level recorded at any time (during military jet overflight)
AF Max	95.2	72.3	The maximum noise level (F='fast', averaged over 125 milliseconds)
AF Min	31.9	31.9	The minimum noise level ('F')
AFL 1.0	56.6	-	The noise level exceeded 1 % of the time (F)
AFL 5.0	52.4	-	The noise level exceeded 5 % of the time (F)
AFL10.0	51	-	The noise level exceeded 10 % of the time (F)
AFL50.0	44.9	-	The noise level exceeded 50 % of the time (F)
AFL90.0	41.3	40.5	The noise level exceeded 90 % of the time (F)
AFL95.0	40.5	-	The noise level exceeded 95 % of the time (F)
AFL99.0	38.8	-	The noise level exceeded 99 % of the time (F)
AFL99.8	37	-	The noise level exceeded 99.8 % of the time (F)

[1] The second 24-hours included a period of suspected wind noise so has been discounted. The first 24 hours is considered more representative of overall noise character.

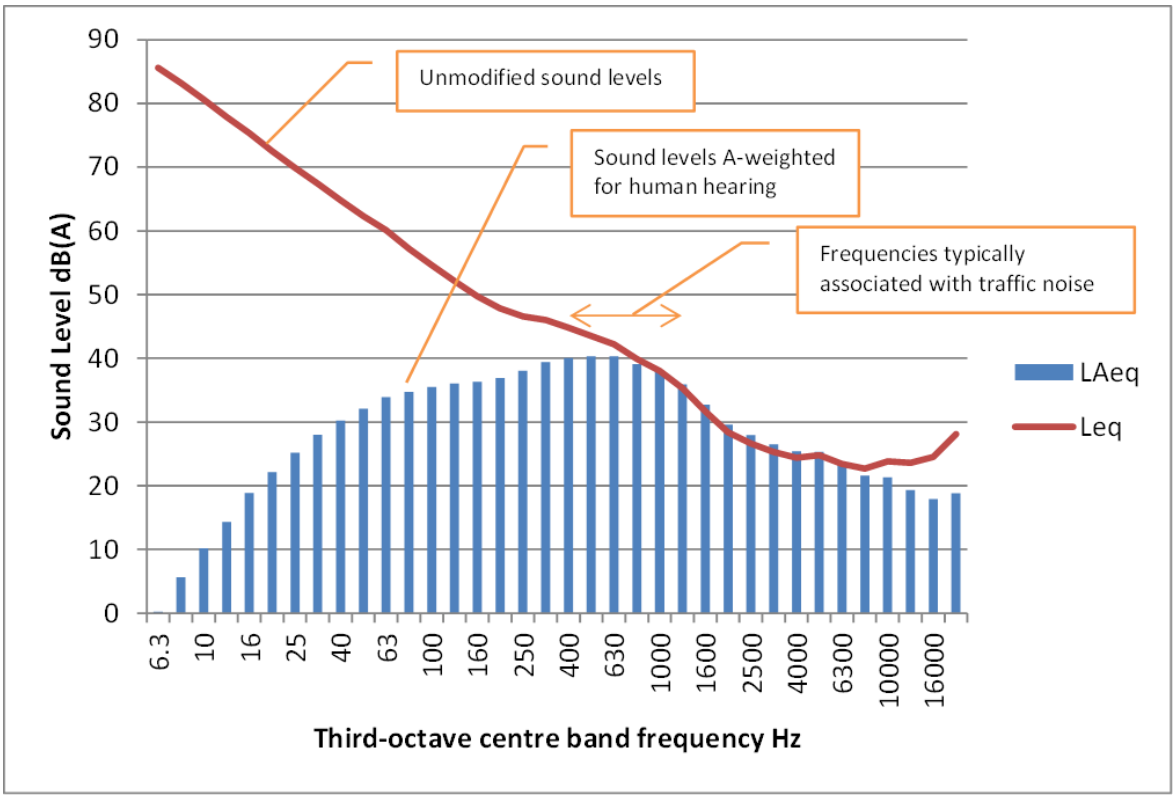


Figure 7-125: Frequency profile for Liberty Lodge sound level measurement

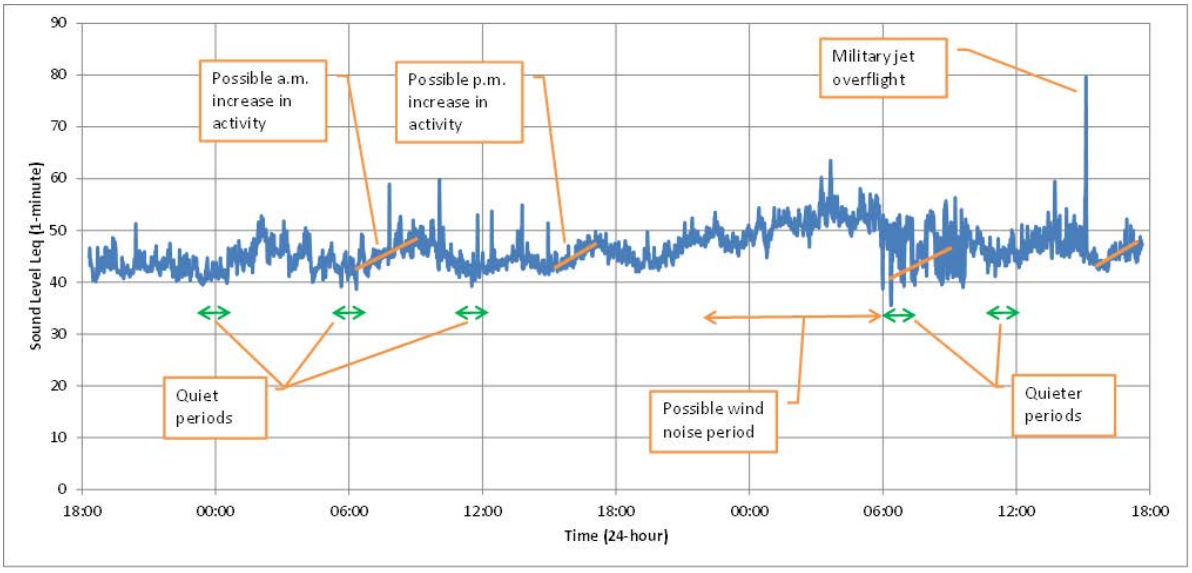


Figure 7-126: Time sequence of noise measurements at Liberty Lodge (1-minute intervals)

POEPL survey February 2017

On 16 February 2017, further baseline noise measurements were taken from several points in and around Stanley. Other sites were associated with the power station, one of the loudest sources of ambient noise, and Moody Brook, at the extreme western end of Stanley Harbour. Snap-shot measurements over a period of 5 – 6 minutes were taken at each point using Mirus Sound Level Meter GA117 s/n 35777, Class 1 microphone, UKAS certified, proprietary windshield. The results are summarised in Table 7.53 (all measurements are 'A' weighted).

On the day, the air temperature was 17 °C, air pressure was 1,004 mbar and wind speed was *c.* 5 m/s (equivalent to *c.* 10 knots). Sources of ambient noise included:

- Several jiggers in the harbour approximately 200 m from the shore, and
- Ongoing refurbishment of FIPASS, which involved grit blasting, compressors and moving plant.

Table 7.53: Summary of baseline sound levels collected in February 2017

Ref	Measurement location	Type	Time	Duration	Leq	Lmax	Lmin	Notes
L11	Ross Road - slipway	Sound level only	13:43	00:06:37	51.3 dB	69.6 dB	47.8 dB	Jigger 1. Passing car.
L12	Ross Road - slipway	SL & 3rd Octave	13:50	00:06:28	60.1 dB	73.2 dB	48.8 dB	Jigger 2 starts (louder).
L13	Ross Road - slipway	SL & 3rd Octave	14:03	00:06:46	56.1 dB	78.4 dB	48.6 dB	Jigger 2. Passing cars.
L14	Ross Road - slipway	Sound level only	14:10	00:05:53	54.9 dB	67.2 dB	47.9 dB	Jigger 2. Ship horn sounding. Passing cars.
L15	FIPASS - Shoreline at west extent of FIPASS pontoons (near Stanley Growers)	Sound level only	14:34	00:06:45	60.0 dB	72.4 dB	47.9 dB	Jigger noise. Grit blasting. Metal deck reverberation. Compressor noise.
L16	FIPASS - Shoreline at west extent of FIPASS pontoons (near Stanley Growers)	SL & 3rd Octave	14:41	00:05:03	61.1 dB	72.8 dB	46.6 dB	
L17	FIPASS - Shoreline opposite gap between two east most pontoons	SL & 3rd Octave	14:55	00:05:14	49.2 dB	54.7 dB	43.0 dB	Jigger noise significantly reduced. Grit blasting. Metal deck reverberation. Compressor noise.
L18	FIPASS - Shoreline opposite gap between two east most pontoons	Sound level only	15:01	00:05:42	46.0 dB	58.5 dB	38.7 dB	
L20	TDF - Shoreline	Sound level only	15:30	00:05:59	45.2 dB	51.4 dB	41.0 dB	Subdued noise from FIPASS maintenance and jiggers
L21	TDF - Shoreline	SL & 3rd Octave	15:36	00:05:03	45.3 dB	50.5 dB	41.7 dB	
L23	Outside power station	SL & 3rd Octave	16:34	00:05:49	72.5 dB	75.6 dB	71.1 dB	Highly dominant engine, exhaust and mechanical noise
L24	Outside power station	Sound level only	16:40	00:05:03	72.5 dB	75.2 dB	71.1 dB	
L25	Field above power station	Sound level only	16:48	00:05:02	62.9 dB	84.8 dB	45.4 dB	Power station noise. Passing cars
L26	Field above power station	SL & 3rd Octave	16:53	00:05:04	53.6 dB	68.3 dB	44.2 dB	Power station noise. Loud lorry using engine to brake downhill.
L27	Moody Brook	SL & 3rd Octave	17:09	00:05:03	41.8 dB	63.3 dB	29.4 dB	Background noise. Wind picking up 5-10 m/s, potential crackle.
L28	Moody Brook	Sound level only	17:14	00:05:03	44.0 dB	58.1 dB	29.4 dB	

7.7.5.1.2 Odour

No information is currently available on the odour baseline in Stanley. Scoping consultations did not raise it as an ongoing issue, nor was it raised during previous O&G operations.

7.7.5.1.3 Light

Stanley is currently lit at night by streetlights and there are 'operational' lights at night from the industrial end of Stanley (the Gordon Lines area), as well as from FIPASS. Lights can also be seen from vessels in the harbour. The number of vessels depends on the season but is generally highest in January and February, prior to the start of the *Illex* season. During previous O&G operations there were lights at the TDF and supply bases and it was noted during previous scoping consultations that light from the TDF, vessels and yard is noticeable to Stanley residents. A community complaint was also made to POEPL during the 2015 exploration drilling campaign regarding the lighting from vessels moored up in the harbour at night.

The New World Atlas of Artificial Brightness shows that the Falklands are a relatively dark sky area, with the majority of the population living with little very light pollution (CIRES, 2016).

7.7.5.2 Berkeley Sound

7.7.5.2.1 Noise

7.7.5.2.1.1 Long Island Farm - August 2016

In August 2016, POEPL took noise measurements outside Long Island Farm, facing Berkeley Sound, over a period of 30 hours. During this time there was only one vessel in Berkeley Sound (FIMA, 2024, *pers comm*.). Unfortunately, they appear to have been affected by wind. Normally, measurements taken in conditions with winds above 5 m/s are not deemed reliable for noise assessments due to the effect of wind on ambient noise and more specifically the effect of buffeting on the microphone, both effects elevating the noise measurement. More specifically, for assessment or baselining purposes it is recommended to use noise levels derived from measurements taken with appropriate equipment at windspeeds less than 5 m/s. The results are nevertheless shown below. In the absence of wind they would indicate relatively high levels for a rural location, and so are not thought to be reliable. It was not possible to secure another period of quiet weather to re-do the modelling in August 2016; however a further monitoring exercise was undertaken in February 2017 (see below). Table 7.54 shows the measurement conditions for the monitoring. Table 7.55 summaries the measured baseline sound levels.

Table 7.54: Measurement conditions for baseline sound measurement

Time and date	Location	Weather conditions	Notes
23rd August 2016 12:54 to 24th August 2016 19:39	Long Island Farm, Berkeley Sound	1-5 Celsius 2-10 m/s wind No precipitation	Gusting wind, one vessel in Berkeley Sound

Table 7.55: Summary of baseline sound levels at Berkeley Sound

Parameter	Value over 48 hours dB(A)	Note
A Leq	54.3	The 'average' noise level over the measurement period.
AF Max	89.9	The maximum noise level (F='fast', averaged over 125 milliseconds)
AF Min	35	The minimum noise level ('F')
AFL90.0	46.6	The noise level exceeded 90 % of the time (F)

7.7.5.2.1.2 Long Island Farm - February 2017

On 21st February 2017, sound recording equipment was deployed at Long Island (Berkeley Sound) to establish the ambient, background noise level. During this time there were no vessels in Berkeley Sound (FIMA, 2024, *pers comm*.). Following the exercise in 2016, a measurement period was deliberately chosen to measure noise in the absence of strong winds. Although winds were not monitored continuously, they were subjectively very low at the start and end of the measurement (*c.* 0-5 m/s) and no significant changes in weather were noted locally in this time. This reflects conditions when added noise from the proposed project activities may cause the most annoyance. In this area, wind noise is a common and very apparent feature most of the time, and it was difficult to identify a period of more than a few hours when winds were low, and the previous measurement in 2016 was discounted as being wind-influenced (Section 7.7.5.2.1). The results should be read in this context, that they represent unusually 'quiet' conditions and do not reflect long-term averages. Air temperature ranged between 8-14 °C and air pressure 1,002 mbar.

Guidance on how to calculate background noise for assessment purposes was taken from BS4142:2014. Background noise is the 90th percentile of LAeq measurements (i.e., 90 % of measurements are above this) and is considered separately for night-time (11pm - 7am) and daytime (7am - 11pm).

Once established, a comparison against commercial or industrial operating noise can be made to assess the potential impacts on human receptors.

The recorded sound levels are shown in Figure 7-127, from which the following background noise levels (in the absence of significant wind noise) are calculated:

- Daytime LA90, 1 hour 30.8 dBA, and
- Night-time LA90, 15 mins 29.5 dBA.

Generally, daytime noise levels average around 40 dB(A), and night-time background levels average around 30 dB(A) for significant periods. Background (LA90 levels) noise at Long Island Farm was around 10 dBA lower during the daytime and only slightly lower than average at night. Periodic loud noise events were observed lasting 1-2 minutes (Figure 7-127). These were unidentified, but were unlikely to be passing local vehicles given the location of the meter, and would be consistent with passing aircraft.

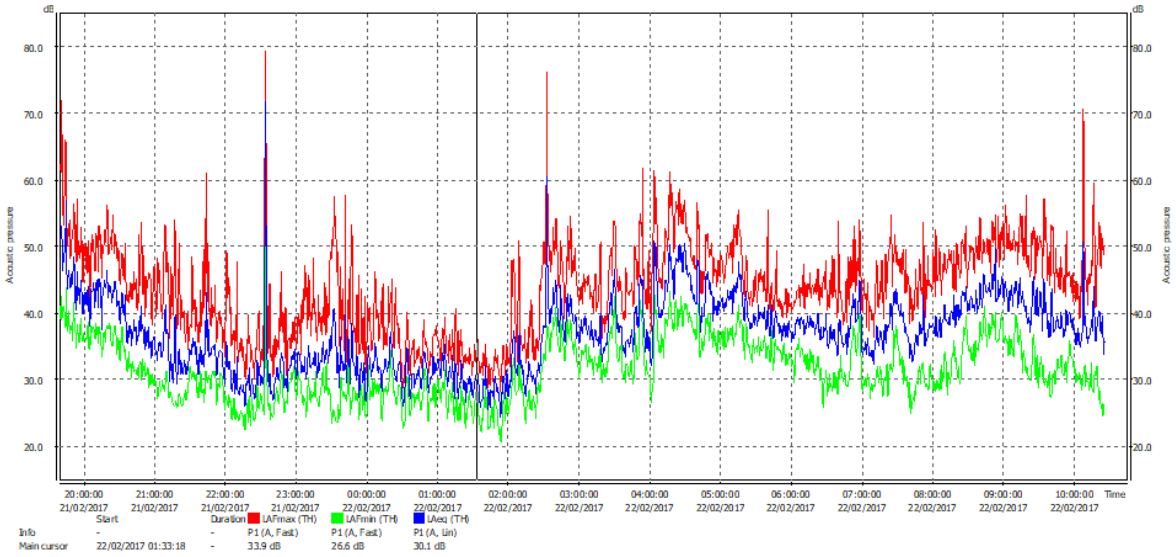


Figure 7-127: Sound pressure levels recorded at Long Island Farm on 21st - 22nd February 2017

7.7.5.2.2 Odour

No information is currently available on the odour baseline in Berkeley Sound. Scoping consultations did not raise it as an ongoing issue.

7.7.5.2.3 Light

Sources of existing anthropogenic light include the jiggers that utilise Berkeley Sound to tranship their catches to reefer vessels and to refuel. Although the full rig of jigging lights is not deployed in Berkeley Sound, there is a considerable amount of light emitted from these vessels, the glow from which can be seen from Stanley (A. Black, *pers. obs.).* In addition to the jiggers, other vessels use Berkeley Sound as an anchorage, primarily for the transshipment of fish catches.

Although vessels can be present in all months of the year, activity peaks between March and June, when more than a dozen vessels can be present, but this varies considerably from year-to-year. Combined, these vessels represent a large source of anthropogenic light. Despite this, The New World Atlas of Artificial Brightness describes the Falklands are a relatively dark sky area, with the majority of the population living with little very light pollution (CIRES, 2016).

7.7.6 Marine archaeology

7.7.6.1 Wrecks in the NFB and Sea Lion Field

The UK Hydrographic Office Wrecksite database indicates that there are 177 shipwrecks recorded within Falkland Islands waters, with records dating from the 1800s to present day (UK Hydrographic Office, 2023). There are nine recorded wrecks within 100 nautical miles radius of the Phase 1 & 2 offshore development site (Table 7.56). The two closest of these wrecks are both located approximately 40 nautical miles from the field (Figure 7-128). There are no recorded wrecks within the immediate vicinity of the Development site.

Table 7.56: Recorded wrecks within 100 miles of the Phase 1 & 2 Development

Wreck	Vessel Type	Latitude	Longitude	Depth (m)	Date
ARA Comodoro Somellera	Argentine patrol boat	49°30'00.2"S	58°30'17.8"W	400	1982
MFV Chiann Der III	Small fishing boat	48°30'00.0"S	59°43'00.0"W	*c.* 480	1986
MFV Dong Yung 510	Trawler	49°05’00.0”S	60°45’00.0”W	-	1998
MFV Chin Yuan Hsing	Jigger	49°27’00.0”S	60°57’00.0”W	-	1993
Wreck No 129700356	Unknown	49°55'06.1"S	58°02'47.8"W	300	unknown
MFV Dong Bang 31	Jigger	48°04’00.0”S	60°22’00.0”W	-	2008
Wreck No 140502865	Unknown	50°17'12.2"S	60°11'17.8"W	160	unknown
MFV Dae Woong 5	Jigger	49°37’00.0”S	61°13’00.0”W	-	2000
MFV Ferralemes	Falkland Islands trawler	50°15'30.4"S	58°13'23.4"W	135	2008

(Source: UK Hydrographic Office, 2023)

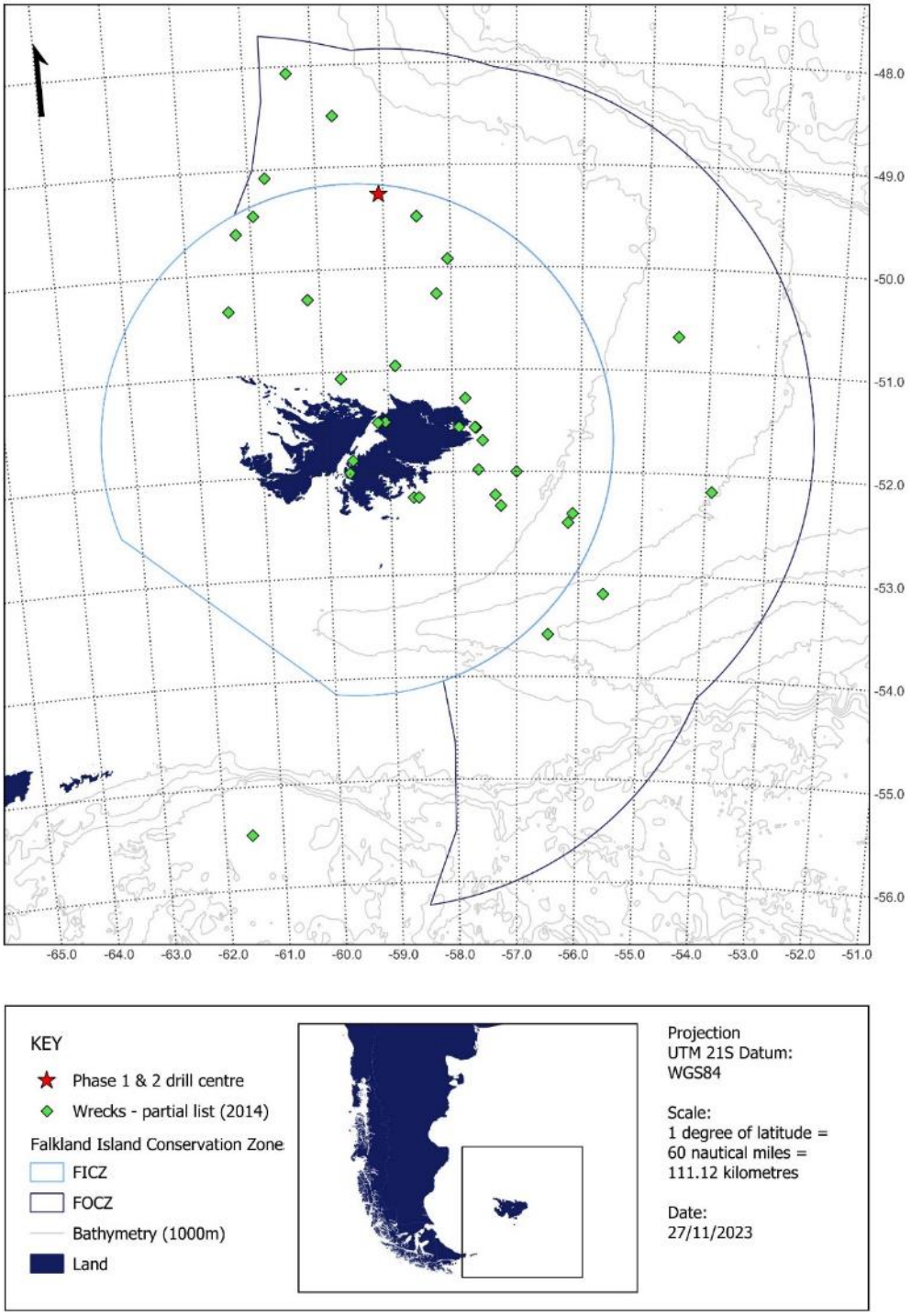


Figure 7-128: Known shipwrecks within the Falklands Continental Shelf

7.7.6.2 Berkeley Sound

7.7.6.2.1 Wrecks

Two wrecks were identified within the survey area Figure 7-129, the trawler Ocean 8 to the north-west and the Blakeney to the south-east. Both wrecks are charted on Admiralty Charts; however, the

charted position of the Blakeney wreck is approximately 1 km due east of the position interpreted from the sonar data. The wreck of the Ocean 8 lies approximately 100 m south-west of the charted position but within the Admiralty buffer.

The wreck Ocean No. 8 was observed within the survey area at 437260E, 4287300N with a shallowest point of 21.5 m surrounded by a seabed of 31 m below CD (Stanley).

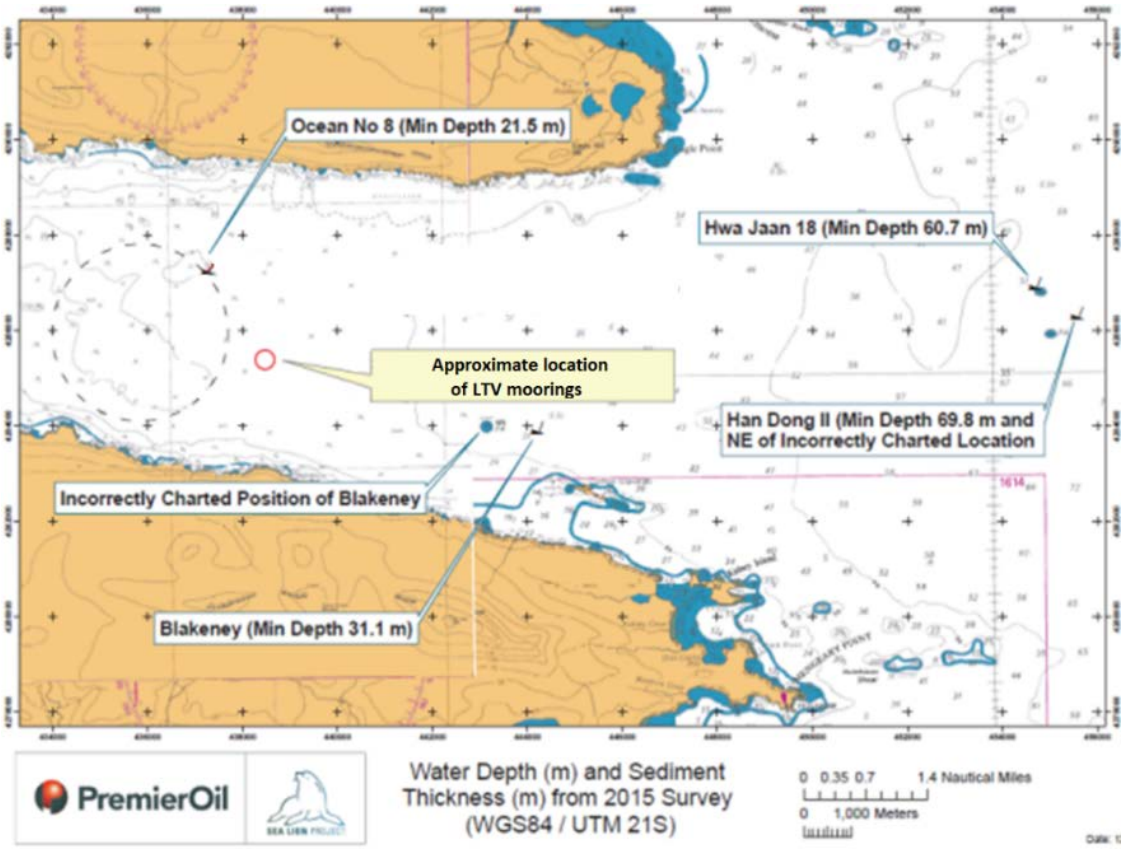


Figure 7-129: The location of wreck sites within Berkeley Sound

7.7.6.2.2 Anchor scars

Reflecting the heavy use of Berkeley Sound as an anchorage, evidence of shipping activity was found throughout the Sound (BSL, 2015a).

The seabed in the sound, especially in the more sheltered western end, is heavily scarred with linear features generated by dragging anchors. A number of anchor scars observed were over 100 m long indicating significant vessel drift, 'anchor drag'. Fan shaped patterns were also observed on the seabed, which are thought to be caused by anchor chains dragging across the surface as a vessel 'swings' on its anchor (BSL, 2015a).

The physical dragging of the anchors disturbs benthic communities, stripping hard surfaces and overturning soft sediments. Seabed imagery indicated the possible presence of the filamentous bacteria *Beggiatoa* sp. within the anchor scars, visible as a white mat on the seabed. This bacteria is generally only found in areas that interface aerobic and anaerobic conditions and is often found in areas of organic enrichment.

7.7.6.2.3 Man-made objects

During a sonar survey in 2015, a total of 1,459 potentially man-made objects were identified within Berkeley Sound (BSL, 2015b). A contact was interpreted as man-made if it had a distinctly linear shape

or shadow and appeared to be of man-made origin, otherwise it was classified as a boulder. Where possible further details were added, however, many targets have been listed at 'debris' if the object could not be further identified.

Many contacts were identified as tyres, piping and lengths of rope, cable or chain which have distinctive forms allowing easy identification. These sorts of debris are typical of an area used by commercial shipping and fishing vessels. Some targets warranted further investigation due to their size and / or proximity to the proposed Berkeley Sound anchorage location. A box shaped object was identified on sonar located at 434699E 4285499N with dimensions of 2.4 m x 2.4 m x 0.7 m (Length x Width x Height). A drop down camera pass was undertaken over the target which showed a metal frame with meshing which looks to be some lost or discarded fishing equipment, possibly a jigger arm (Figure 7-130).



Figure 7-130: Photograph of large man-made object found on the floor of Berkeley Sound (BSL, 2015b)

7.7.6.3 Aviation wrecks and UXO (Unexploded Ordinance)

Previous surveys across the Sea Lion Field and Berkeley Sound have been completed by a range of contractors including but not limited to SAERI, Benthic Solutions, Earth Sciences & Surveying (EGS) and Gardline. The area's marine archaeology is well known and well documented. Further, FIMA (Falkland Islands Maritime Authority) confirms it is not aware of any aviation wrecks or UXO in the area of Sea Lion's proposed activities (S. Barlow, 2024, *pers. comm*.).

7.8 Summary of Key Environmental and Social Sensitivities

7.8.1 Key environmental sensitivities

The key biological sensitivities of the Falkland Islands offshore environment and Berkeley Sound are summarised in Table 7.57 and Table 7.58 respectively. Note that in order to give an overview of the environmental sensitivities, the tables indicate the relative importance of each month, regardless of which particular species, fishery or site is the cause.

Table 7.57: Summary of key environmental sensitivities in the Sea Lion Phase 1 & 2 Development area

Environmental baseline and sensitivity at Sea Lion											
Low[1]				Medium[1]				High[1]			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Plankton: Plankton comprises of small to microscopic plants (phytoplankton) and animals (zooplankton) that drift in the surface layers of the sea. Phytoplankton require sunlight, like all other plants, to survive, and zooplankton graze upon the phytoplankton or prey on other zooplankton. The oceanic fronts around the Falkland Islands result in nutrient rich waters which create an area of very high phytoplankton productivity immediately to the north of the Islands (and approx. 60 km to the south of the Sea Lion Field). This phytoplankton productivity is seasonal and in turn supports complex communities of zooplankton, which then support complex pelagic (in the water column) and demersal (near the seabed) ecosystems.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marine flora: Not applicable to offshore location.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Benthic fauna: Benthic fauna are those animals which live on, or below, the seabed. Overall, benthic fauna around the Sea Lion area is very uniform, with polychaetes (i.e., marine worms) and crustaceans (e.g., crabs) being the two most abundant groups present, followed by molluscs (e.g., clams).											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fish and shellfish: The convergence of the temperate and sub-Antarctic regions in the Falkland Islands archipelago results in the presence of species belonging to both. The six sub-Antarctic, and seven temperate, fish and squid species found in abundance in Falkland Islands' waters primarily utilise the NFB as feeding grounds, migrating in and out of the area as food availability changes and to follow seasonal spawning migrations. Other species feed in the area as juveniles and move to deeper waters as they mature and become adults. This results in seasonal changes in the fish assemblages across the ecosystem.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Seabirds: Over 70 % of the global population of black-browed albatross breed on the Falkland Islands with a significant proportion of the global populations of gentoo and rockhopper penguins doing the same. The waters surrounding the Falklands also support numerous species that breed elsewhere. Of the species recorded in the Sea Lion area, the Atlantic petrel, grey-headed albatross, and northern royal albatross are all listed as 'Endangered' on the IUCN Red List, and the southern rockhopper penguin, white-chinned petrel, southern royal albatross and the wandering albatross are listed as 'Vulnerable'.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marine mammals: Confirmed records indicate that 25 species of cetacean (whales, dolphins and porpoises) occur within Falkland Islands waters and three species of pinniped (seals) breed on the Islands. Many of the cetacean species are rare and inconspicuous and some are only known from stranded animals. Of these 25 cetacean species, two species are listed as 'Endangered' on the IUCN Red List, namely the sei whale and the less common blue whale, two species, the fin and sperm whales, are listed as 'Vulnerable' and the southern right whale is listed as being of regional conservation concern.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Conservation sites: There are no designated marine protected areas in Falkland Islands waters. The Falkland Islands Government (FIG) has identified several areas as proposed Marine Managed Areas, for which a public consultation was held in 2022[2]. Policy work is ongoing (as of March 2024) but it is anticipated the proposed Marine Managed Areas will be designated. Non-statutory Key Biodiversity Areas (KBAs) have also been identified for sei whales and seabirds around the Falkland Islands. On land, a number of Important Bird Areas (IBAs) have been designated. Additionally, a network of National Nature Reserves (NNR) and Important Plant Areas (IPAs) protect many of the most important seabird breeding sites and areas supporting native flora respectively.											

[1] Note that the terms Low, Medium and High in this context provide a guide only as to the general sensitivity / abundance as it is relevant to each receptor. Specific sensitivities of each receptor to each environmental impact are explored in full within the EIS.

[2] Consultation report and scientific evidence to support Marine Managed Areas is available *via* FIG website https://www.falklands.gov.fk/policy/environment/marine-managed-areas-consultation-report.

Table 7.58: Summary of key environmental sensitivities in Berkeley Sound

Environmental baseline and sensitivity in Berkeley Sound											
Low[1]				Medium[1]				High[1]			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Plankton: Plankton comprises small to microscopic plants (phytoplankton) and animals (zooplankton) that drift in the surface layers of the sea. The most conspicuous component of the inshore zooplankton community is lobster krill, which is an important prey species for higher predators (such as penguins and whales).											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marine flora: Marine plants are the major primary producers in the marine environment. The most common species of seaweed within the Falklands are the giant kelp and the tree kelp, which are found around the entire Falklands coastline. Kelp is a habitat forming species and is a very important part of the inshore ecology.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Benthic Fauna: Benthic fauna are those animals which live on, or below, the seabed. Berkeley Sound supports a wide range of benthic habitats (including biogenic and geogenic reefs), each supporting a characteristic range of species. Although none of the species found is rare or protected under any Falkland Islands legislation. Work is ongoing to identify important marine areas, and as such work develops, new designations can be incorporated in the ongoing management of the project *via* the EMMP and the 5-yearly review of the EIS.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fish and shellfish: The most conspicuous species found inshore off the east coast is loligo squid, which play a key role in the inshore ecology as predator and prey. n addition, loligo support the second largest fishery in the Falklands. Loligo are known to migrate inshore to spawn, although the key spawning sites remain unknown. Periods of 'high sensitivity' reflect the spawning periods of the two loligo cohorts. There are several species of shellfish found within Berkeley Sound that are commercially exploited elsewhere but not currently in the Falklands.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Seabirds: Berkeley Sound encompasses significant breeding populations (>1 % of the national population) of gentoo and rockhopper penguins and a far higher proportion of the national populations of king penguins, sooty shearwaters and white-chinned petrels. In addition to king and gentoo penguins, there are large resident populations of imperial and rock shags and Falklands steamer ducks, which are present year-round. Of the species breeding in Berkeley Sound the white-chinned petrel and southern rockhopper penguin are listed as 'Vulnerable' on the IUCN Red List.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marine mammals: Berkeley Sound supports small breeding populations of South American sea lions (Diamond Cove), South American fur seals (Volunteer Rocks) and is likely to have breeding populations of Commerson's and Peale's dolphins. Conspicuous seasonal visitors include sei whales, which are most numerous in the late summer and autumn. Several other species of large whale have been recorded within Berkeley Sound including southern right and Antarctic minke whales. An influx of southern right whales was first *recorded* during the winter of 2017 and seems to have sustained since.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Conservation sites: The entrance to Berkeley Sound is flanked by two National Nature Reserves (Volunteer Point and Cow Bay, and the Kidney Island Group), which are also classed as Important Bird Areas, and a proposed Marine Management Area has also been proposed. Further, the importance of sei and southern right whales in Berkeley Sound and surrounds has resulted in a Key Biodiversity Area and two Important Marine Mammal Areas to be adopted.											

[1] Note that the terms Low, Medium and High in this context provide a guide only as to the general sensitivity / abundance as it is relevant to each receptor. Specific sensitivities of each receptor to each environmental impact are explored in full within the EIS.

7.8.2 Key social sensitivities

The key social sensitivities of the Falkland Islands are summarised in Table 7.59.

Table 7.59: Summary of key social sensitivities in the Sea Lion Phase 1 & 2 Development area

Social baseline and sensitivity											
Low[1]				Medium[1]				High[1]			
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Commercial fisheries: The three most important fisheries within the Falklands Economic Exclusion Zone (EEZ) are the jig fishery for Argentine shortfin squid, Loligo squid and the trawl fishery for Patagonian rock cod, which accounted for 49.5 %, 25.1 % and 5.2 % of the 2013-2022 catches by weight respectively. There is also a fleet of trawlers that operate over the Falklands continental shelf that target a range of finfish species. Currently, the only other fishery in the Falklands EEZ is the longline fishery for Patagonian toothfish, which operates in deeper waters (> 600 m).											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tangible property and resources: There is a range of onshore infrastructure on the Falkland Islands that will be utilised during the Phase 1 & 2 Development, which could lead to competition for resources with other users of these facilities. The main areas of potential impact include the use of: port facilities, supply routes, airports and airlinks, the road network, accommodation, freshwater and electricity supply. During the austral summer period, accommodation, flight availability and freshwater may all be less available.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tourism: The majority of tourists visiting the Falkland Islands arrive on cruise ships. Many cruise ships visit locations in the west of the Islands to see wildlife and most vessels visit Stanley. Within Stanley, there are a number of businesses and individuals that support tourist excursions to locations within driving distance of the city. Many of these sites are important for the wildlife that they support; however, they are also important recreational sites for residents.											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marine archaeology: The UK Hydrographic Office Wreck site database indicates that there are 177 wrecks recorded within Falkland Islands waters, with records dating from the 1800's to present day. There are six recorded wrecks within 100 nautical miles of the proposed drilling sites; the closest of these wrecks is located approximately 50 nautical miles from the nearest well site. Two wrecks were identified within the Berkeley Sound survey area: the trawler Ocean 8 to the north-west, and the Blakeney to the south-east.											

[1] Note that the terms Low, Medium and High in this context provide a guide only as to the general sensitivity as it is relevant to each receptor. Specific sensitivities of each receptor to each social impact are explored in full within the EIS.

8 ENVIRONMENTAL IMPACT AND RISK ASSESSMENT METHODOLOGY

Table of Contents

8.1 Introduction 555
8.2 Overview of the environmental impact and risk assessment process 555
8.3 Aspect, impact and risk identification 556
8.4 Environmental baseline and receptor identification 558
8.5 Impact assessment methodology for planned events 558
8.5.1 Environmental Impact Assessment process 559
8.5.2 Assessment of environmental impacts 559
8.5.2.1 Assessment of sensitivity of receptors 559
8.5.2.1.1 Sensitivity of global (transboundary) receptors 560
8.5.2.2 Assessment of severity of effect 564
8.5.3 Assessment of impact significance 567
8.6 Risk assessment methodology for unplanned and accidental events 568
8.6.1 Environmental risk assessment process 568
8.6.2 Assessment of environmental risks 569
8.6.2.1 Assessment of the potential environmental impact 569
8.6.2.2 Assessment of the likelihood of unplanned / accidental events occurring 569
8.6.3 Assessment of risk significance 570
8.7 Impact and risk mitigation 571
8.8 Residual assessments 572
8.9 Cumulative impact assessment and impact interactions 573
8.9.1 Cumulative impact 573
8.9.2 Impact interaction 573
8.10 Confidence in the assessment 575
8.10.1 Monitoring 575
8.11 Offsetting of impacts 576
8.11.1 Legislation and Policy 576
8.11.2 Review of offsetting options 577
8.11.2.1 Direct offsetting 577
8.11.2.2 Indirect offsetting 580
8.11.3 Carbon and Biodiversity Offsetting Fund 580
8.11.4 Conclusion 580

8.1 Introduction

The impact and risk assessment process provides a framework for assessing the potential environmental and social consequences that may arise from the proposed development based on the information made available during project planning. The purpose of this chapter is to describe the methodology used to identify and assess the environmental aspects and potential impacts and risks resulting from the Sea Lion Northern Development Area Phase 1 & 2 (hereafter referred to as the Phase 1 & 2 Development).

The methodology has been prepared based on the:

- FIG Environmental Impact Assessment Guidance Note (FIG, 2016e),
- Navitas Operating Management System (SEL-REG-OPM-PLN-00001-00), and
- International best practice (IEEM, 2010; Horvath (IAIA), 2013; Morris and Therivel, 2009; Glasson, *et al.,* 2013).

8.2 Overview of the environmental impact and risk assessment process

The International Standard for Environmental Management (ISO14001:2015) defines an environmental impact as 'any change to the environment, whether adverse or beneficial, wholly or partially resulting from a project's environmental aspects'. Environmental aspects refer to the way in which the project activities may interfere with the environment.

Environmental aspects, impacts and risks can be identified by assessing the planned activities that must occur for the project to be successfully completed and by exploring what could happen as a result of these activities. Further, during the course of any project execution, there is a risk that unplanned and accidental events may occur and it is therefore also necessary to consider what could go wrong.

Planned activities give rise to environmental impacts, while unplanned and accidental events pose a risk of environmental impact, if they occur. The risk of environmental impacts resulting from unplanned or accidental events is evaluated by taking the likelihood of the event occurring into consideration.

Therefore, with regard to assessing the Phase 1 & 2 Development:

- Planned activities are subject to an impact assessment only, and
- Unplanned and accidental activities / events are subject to the same impact assessment followed by an assessment of the likelihood that the unplanned or accidental event will actually occur.

Initial assessment of the impacts and risks takes account of key legal compliance requirements, additional industry-standards, controls that are built-in to the basis of design / design philosophies to reduce impacts, and also any input from key stakeholders received during the scoping exercises (Chapter 6). 'Impacts and risks that are initially assessed as 'Low' or 'Very Low' using the base-case mitigations, industry-standard and OMS measures were not prioritised with regard to further project-specific mitigation as extensive additional measures were not considered 'reasonably practicable'. Where an impact or risk is deemed 'significant' (i.e., 'Moderate' or above), alternatives must be considered and project-specific mitigation measures proposed, to eliminate impacts and risks, or reduce them to a level that is 'As Low As is Reasonably Practicable' (ALARP) in line with Navitas' ALARP Procedure (SLN-HSE-RMA-PCD-00001-00). Following identification of project-specific mitigation measures, the 'residual' impact or risk is assessed.

Residual impacts and risks that are assessed as 'Very Low' or 'Low' using the base-case mitigations, industry-standard and OMS measures were not prioritised with regard to further project-specific mitigation as extensive additional measures were not considered 'reasonably practicable'. Where a

residual impact remains 'Moderate' or above, offsetting measures were considered (see Section 8.11). Additionally, throughout the process, the potential for any positive or beneficial impacts is noted.

Further to the assessment of the individual impacts and risks associated with the Phase 1 & 2 Development, the potential for cumulative impacts, which may be caused by the presence of other operations ongoing in the vicinity, are also assessed.

Throughout the whole process, the assessment follows a precautionary approach, taking account of any data gaps and uncertainties. However, upon completion of each assessment, a confidence rating is assigned to the impact and risk rating to inform the reader on the overall level of confidence in each assessment, and to inform the level of monitoring that may be required throughout the life of the operation.

All monitoring requirements will be captured within the Environmental Monitoring and Management Plan (EMMP). Future remedial action may be required where monitoring indicates that an impact is higher than predicted in this EIS and / or where the prescribed regulatory requirements and best practice are considered insufficient. An overview of the EIA process is provided in Figure 8-1 below.

8.3 Aspect, impact and risk identification

Using the project basis of design (Chapter 5), the environmental aspects are determined by walking through the different stages of the Phase 1 & 2 Development and identifying the ways they may impact upon the environment or society (i.e., the human population).

When identifying the environmental and social aspects, impacts and risks, it is important to note that the project activities (e.g., drilling, production, use of vessels etc.) can interact with the environment in many ways.

It is understood that:

- Planned activities with known outputs will inevitably lead to impacts e.g., it is inevitable that there will be some atmospheric emissions and waste,
- Unplanned events may occur which carry the risk of an impact due to, for example:
  - The potential for downtime in equipment e.g., the vapour recovery package, the produced water reinjection unit, and / or
  - The potential for events that are outwith Navitas' control.
- Accidental events may occur which carry the risk of an impact in the event of a loss of control over project activities e.g., oil spills would only result from an accidental or uncontrolled event such as a vessel collision or well blow-out.

Therefore, impacts, and / or the risk of an impact, are associated with planned activities and with unplanned / accidental events.

Environmental and social aspects, impacts and risks are identified during ENVironmental Impact IDentification (ENVIID) workshops. The outcomes of the Sea Lion Northern Development Area Phase 1 & 2 ENVIID are described in Chapter 9.

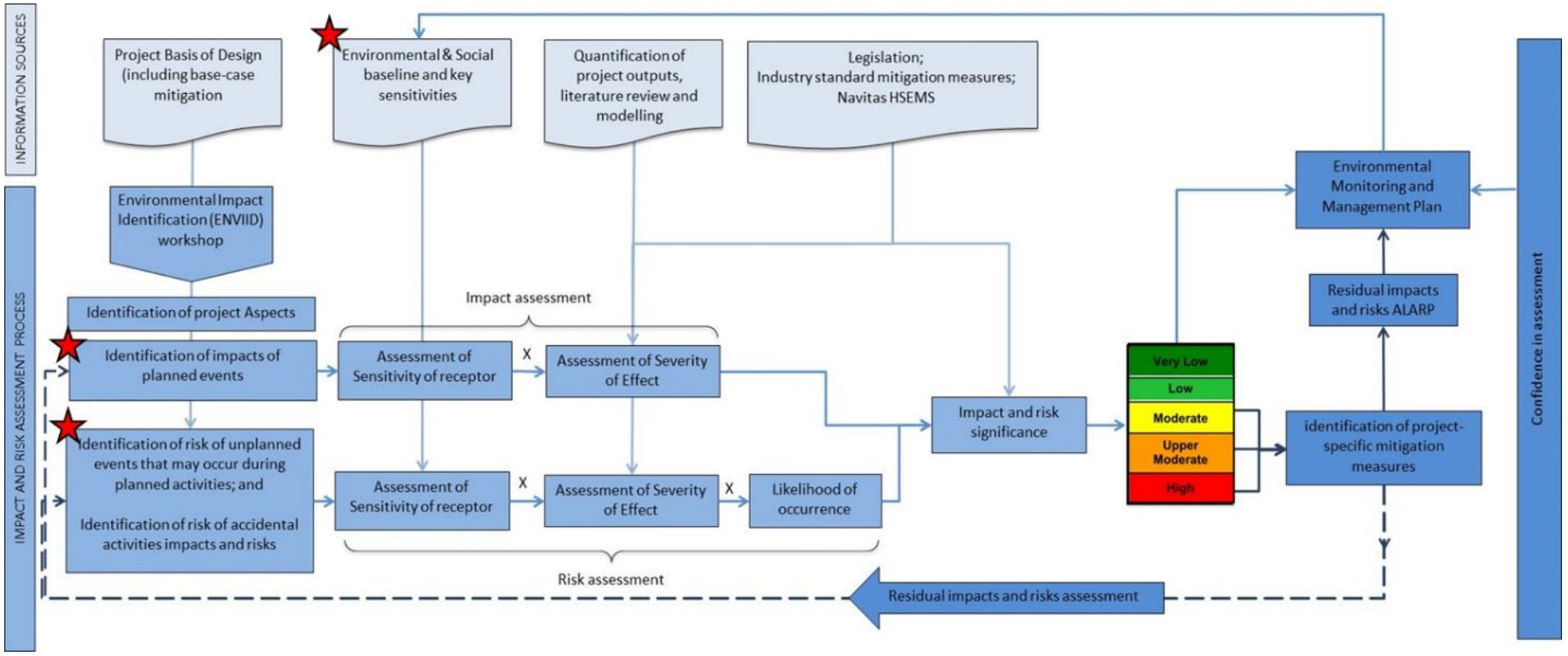


Figure 8-1: Overview of EIA process (Note: the red stars indicate areas informed by the scoping process as described in Chapter 6)

8.4 Environmental baseline and receptor identification

In order to assess the impact or the risk it is necessary to have an understanding of the existing environment and the components within it (i.e., the environmental receptors). Full detail on the environmental and social baseline is provided in Chapter 7.

The term 'environmental receptor' effectively describes the receiving environment which may be impacted by an activity or outcome of the Development (i.e., environmental aspect). Environmental receptors therefore include individuals, species, populations, habitats, the physical environment (locally and globally) and ecological processes. The environmental components or receptors which must be considered in an EIA are defined within Paragraph 4 (2a-k) – Schedule 4 of the FIG Offshore Minerals Ordinance (Section 3.1.7.3.1) and are listed below. Some receptors have been broken down into sub-components to demonstrate how they have been addressed in this EIA.

The sensitivity of the following receptors to environmental impact is described in Section 8.5.2.1 below.

- Human population:
  - Stakeholder and or regulatory concern,
  - Disturbance,
  - Health,
  - Commercial fisheries,
  - Tourism, and
  - Transboundary impacts.
- Flora and Fauna:
  - Benthic (animals living on or in the seabed) and terrestrial ecology,
  - Plankton (plant or animals which live in the water column and drift with the ocean currents),
  - Fish ecology,
  - Seabirds,
  - Marine mammals, and
  - Designated sites (on account of their populations of flora or fauna).
- Soil (including the seabed) (referred to in this EIA as 'Seabed (including soil)'),
- Water quality (including the sea and aquifers under the seabed),
- Air quality (local),
- Climatic factors (global),
- Landscape and seascape,
- Tangible property (e.g., fishing vessels and finite resources such as landfill space, diesel, potable water),
- Architecture and archaeological heritage, and
- The interaction between these factors (in any combination).

8.5 Impact assessment methodology for planned events

This section describes the methodology used for the assessment of environmental impacts arising from planned events.

8.5.1 Environmental Impact Assessment process

The evaluation of impacts follows a structured methodology that systematically:

- Identifies planned project activities and environmental aspects that could lead to an environmental impact (Section 8.3),
- Assesses the sensitivity of the receptor (Section 8.5.2.1),
- Assesses the severity of the effect (Section 8.5.2.2) on the respective receptor/s taking account of statutory and industry-standard safeguards, BAT (Best Available Technology / Techniques) and BEP (Best Environmental Practise) mitigation technologies built-in to the project basis of design (Section 8.7),
- Assesses the initial significance of the impact (Section 8.5.3) of planned activities based on the above,
- Identifies project-specific mitigation measures (Section 8.7) as required to reduce any 'significant' environmental impacts to ALARP,
- Evaluates the residual impact (Section 8.8) taking account of project-specific mitigation measures,
- Evaluates the potential for cumulative impacts and impact interaction (Section 8.9),
- Assesses the degree of confidence (Section 8.10) in the impact assessment, and
- Explores the potential for offsetting significant impacts where possible (Section 8.11).

8.5.2 Assessment of environmental impacts

During the assessment of the sensitivity of receptors and the severity of effect, a precautionary approach is taken.

8.5.2.1 Assessment of sensitivity of receptors

Assessment of the 'sensitivity of the receptor' draws upon the data in the environmental baseline description (Chapter 7) and considers a number of factors (IEEM, 2010; Morris and Therivel, 2009) including, but not limited to:

- The relative importance of the local population size e.g., as a percentage of global / regional population size,
- The conservation status of the habitat or species e.g., does it sit within an IUCN (International Union for Conservation of Nature) threat category,
- Whether the habitat is a designated conservation site,
- The seasonal migrations and abundance of species and populations e.g., whether or not the species or population is likely to be in the relevant area at the time of the proposed activity,
- Species sensitivities e.g., during vulnerable periods of a species' lifecycle, and
- Sensitivity to ecosystem services resulting in changes to species health and ability to survive, including livelihoods and aesthetics or forced behavioural change (migration pattern, livelihoods).

Project-specific guidelines were developed to inform the assessment of receptor sensitivity (Table 8.1). These are based on the criteria for assigning value to ecological features as described in IEEM (2010).

The guide descriptions provided in Table 8.1 are purposefully kept at a high level to afford a degree of flexibility and judgement during the assessment. Details on the rationale behind the allocation of a category e.g., 'Low' is provided in the narrative in the impact assessment chapters. Each descriptor may not be applicable to each receptor and some receptors may be classified within two different

categories. For example, a receptor may have an IUCN status of 'Least Concern' ('Very Low') but may also comprise 1 % of the global population ('Very High') such as the Southern Giant Petrel. In such a case, the worst-case category ('Very High') is applied.

8.5.2.1.1 Sensitivity of global (transboundary) receptors

While most receptors have a sensitivity value based on local conditions, it is acknowledged that emissions have a global impact on climate change which is measured over time (i.e., current day compared to pre-industrial times) rather than by global location. Consequently, the assessment of sensitivity of the atmosphere, or global climate, as a receptor is not included within the sensitivity guidelines in Table 8.1, but is assessed based on the latest IPCC Climate Change 2014 Synthesis Report, Summary for Policy Makers Report.

Within this impact assessment the current sensitivity status of the global receptor, climate, is considered to be 'Very High', based on the following statements from IPCC (2014):

- Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history. Recent climate changes have had widespread impacts on human and natural systems,
- Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed; the amounts of snow and ice have diminished, and sea level has risen,
- Effects of anthropogenic greenhouse gas emissions have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century,
- In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans. Impacts are due to observed climate change, irrespective of its cause, indicating the sensitivity of natural and human systems to changing climate,
- Continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reductions in greenhouse gas emissions, which together with adaptation, can limit climate change risks, and
- Many aspects of climate change and associated impacts will continue for centuries, even if anthropogenic emissions of greenhouse gases are stopped. The risks of abrupt or irreversible changes increase as the magnitude of the warming increases.

Table 8.1: Project-specific guidelines for the sensitivity of environmental receptors ***(as adapted from the Navitas OMS (SEL-REG-OPM-PLN-00001-00))***

Level	Category	Environmental receptor sensitivity guide description
5	**Very High**	**Flora and Fauna**[39]: • Population size, of any species present, is of international importance (1 % of global population) and is within the zone of influence of project activity, • Habitat / site is of international value and is protected under international designation (e.g., RAMSAR sites, IBAs during breeding season), • Habitat / site is undesignated but considered to be of international importance (e.g., an IBA that is not formally protected), • A species with IUCN 'Critically Endangered' status has notable presence[40] within the zone of influence of project activity, • Large populations of animals considered under wider threat (e.g., ACAP species) are present within the zone of influence of project activity, and / or • Presence of individuals or species in vulnerable phases of life cycle (e.g., high concentration of synchronous spawning fish) within the zone of influence of project activity. **Seabed (including soil)**[41]**:** Seabed sediment unmodified (e.g., no known demersal fishery). High-grade soil quality, high likelihood of transmitting contaminants to nearby sensitive receptors. **Water quality:** Enclosed water body with no flushing. **Air quality**[42]**:** Very densely populated area within 20 m, very sensitive receptors (e.g., school, hospital), sheltered from winds. **Landscape and seascape:** Location is currently undeveloped, is considered locally an area of beauty, and is 'used or appreciated' by businesses, residents and / or visitors for business promotion and / or recreation e.g., Kidney Island. Includes distinctive, individual or rare features. Placement of objects would conflict with the current use of the area. **Human population:** The receptor has little or no capacity to absorb change without fundamentally altering its present character, or is unacceptable to all stakeholders. **Tangible property:** Resource use has direct or indirect environmental or social impact (e.g., use of diesel, freshwater, landfill space) and resource being used is unsustainable in the short-term (e.g., within five years of commencement of the project). **Architecture and archaeological heritage:** International heritage importance whether designated or not, extremely well preserved.

[39] Adapted from IEEM, 2018.

[40] Notable presence does not refer to a particular number but indicates more than presence of an individual (*i.e.,* greater presence than a rarely occurring 'edge of range' or vagrant species).

[41] Adapted from: https://naturalresources.wales/media/685627/130-soils-and-contamination_190418.pdf.

[42] Adapted from Institute of Air Quality Management (IAQM, 2011). Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance. http://iaqm.co.uk/text/guidance/construction_guidance_2011.pdf.

Level	Category	Environmental receptor sensitivity guide description
4	High	**Flora and Fauna:** • Population size, of any species present, is of regional importance (1 % of biogeographic population) and is within the zone of influence of project activity, • Habitat / site is of national value and is protected under national designation (e.g., fishery closed areas or spawning sites, Falkland red-list habitats), • Habitat / site is undesignated but considered to be of regional importance (as informed by the consultation process), • A species with IUCN 'Endangered' or 'Vulnerable' status has notable presence within the zone of influence of project activity, • Local conservation priority species are present within the zone of influence of project activity (Falklands red-list species), and / or • Presence of individuals or species in vulnerable phases of life cycle (e.g., high concentration of asynchronous spawning fish) within the zone of influence of project activity. **Seabed (including soil):** Seabed sediment experienced previous modification event (e.g., longline fishing effort). Moderate grade soil quality, moderate potential to transmit contaminants to nearby sensitive receptors. **Water quality:** Semi-enclosed water body with limited flushing. **Air quality:** Densely populated area within 20 m exposed to strong winds, moderately populated area within 20 m sheltered from winds. **Landscape and seascape:** Location is partially developed with non-industrial infrastructure e.g., residential settlements or agricultural buildings in camp and may therefore be used for recreational purposes. Distinct landscape character. Placement of objects could conflict with the current use of the area. **Human population:** The receptor has low capacity to absorb change without fundamentally altering its present character, or, unacceptable to the majority of stakeholders. **Tangible property:** Resource use has direct or indirect environmental or social impact (e.g., use of diesel, freshwater, landfill space) and resource being used is unsustainable in the medium term (e.g., between 5 and 30 years of commencement of the project). **Architecture and archaeological heritage:** Regional heritage importance and / or well preserved.

Level	Category	Environmental receptor sensitivity guide description
3	Moderate	**Flora and Fauna:** • Population size, of any species present, is of national importance (1 % of Falkland Islands population) and is within the zone of influence of project activity, • Habitat / site is undesignated but considered to be of national or local importance (as informed by the consultation process), • A species with IUCN 'Near Threatened' status has notable presence within the zone of influence of project activity, and/or • Presence of individuals or species in vulnerable phases of life cycle (e.g., moderate concentration of dispersed spawning fish) within the zone of influence of project activity. **Seabed (including soil):** Seabed sediment subject to infrequent modification (e.g., infrequent demersal trawling). Poor grade soil quality, low potential to transmit contaminants to nearby sensitive receptors. **Water quality:** Semi-enclosed water body with good flushing. **Air quality:** Moderately populated area within 20 m, suburban or edge of town, commercially sensitive land within 20 m, exposed to strong winds. **Landscape and seascape:** Location is used commercially and is developed by local businesses and residential buildings. Some distinct landscape features. Placement of objects would be unlikely to conflict with the current use of the area. **Human population:** The receptor has moderate capacity to absorb change without significantly altering its present character, or, unacceptable to minority of stakeholders. **Tangible property:** Resource use has direct or indirect environmental or social impact (use of diesel, freshwater, landfill space) and resource being used is limited and unsustainable in the medium term (e.g., more than 30 years of commencement of the project). **Architecture and archaeological heritage:** Local heritage importance and / or averagely well preserved.
2	Low	**Flora and Fauna:** • Low numbers of any species of geographical importance present within the zone of influence, • Habitat / site is undesignated and of poor quality, • A species with IUCN 'Least Concern' status has notable presence within the zone of influence of project activity, and/or • Presence of individuals or species out with vulnerable phases of life cycle (e.g., dispersed spawning fish) within the zone of influence of project activity. • Seabed (including soil): Seabed sediment subject to frequent modification (e.g., annual demersal trawling). Very poor grade soil quality, no potential to transmit contaminants to nearby sensitive receptors. **Water quality:** Coastal water body in shallow water. **Air quality:** Sparsely populated area within 20 m exposed to strong winds **Landscape and seascape:** Location is considered an 'industrial hub' and is developed e.g., an industrial estate, a quarry. No distinct landscape features. Area designated for industrial use. **Human population:** The receptor is tolerant of change without detriment to its character, or, unacceptable to a handful of stakeholders. **Tangible property:** Resource use has direct or indirect environmental or social impact (e.g., use of diesel, freshwater, landfill space) but resource being used is not unsustainable. **Architecture and archaeological heritage:** Local heritage interest, site integrity already compromised and value limited by poor preservation.

Level	Category	Environmental receptor sensitivity guide description
1	Very Low	**Flora and Fauna:** • Negligible numbers of any species of geographical importance present within the zone of influence, • Habitat / site is undesignated, of poor quality and / or already degraded, • Species of IUCN 'Least Concern' status notable presence within the zone of influence of project activity, and/or • Presence of individuals or species out with vulnerable phases of life cycle (e.g., highly dispersed asynchronous spawning fish) within the zone of influence of project activity. **Seabed (including soil):** Very poor grade soil quality, no potential to transmit contaminants to nearby sensitive receptors. Seabed sediment highly modified (e.g., multiple demersal trawls per year). **Water quality:** Open ocean conditions. **Air quality:** Unpopulated area exposed to strong winds. **Landscape and seascape:** Location is severely degraded e.g., a waste dump. **Human population:** The receptor is not resistant to change, or, issue is acceptable to all stakeholders. **Tangible property:** Resource use has no direct or indirect environmental or social impact and / or resource being used is unlimited or is created by the Development. **Architecture and archaeological heritage:** No heritage value.

8.5.2.2 Assessment of severity of effect

Assessment of the 'severity of the effect' on the receptor draws on the data in the Development Description and the base-case mitigations (Chapter 5), information gathered in subject-specific literature reviews on the nature of the impact, quantification of the project outputs (where possible) and modelling (where it has been carried out). Taking account of these, the assessment of the severity of effect considers:

- Whether the effect is positive or negative,
- The spatial extent of the effect e.g., the footprint area, or zone of influence, over which the impact occurs,
- The magnitude of the effect e.g., the size or amount of an effect such as the number of seabirds that may be affected,
- The duration of the effect e.g., duration over which the impact is expected to last prior to recovery,
- The timing and frequency of the activity e.g., when the activity will occur and how many times it may be repeated,
- The reversibility of the effect e.g., whether or not recovery from the impact is possible or whether the effect is irreversible and thus permanent, and
- Exposure of the receptor to the effect.

Project-specific guidelines intended to inform the assessment of the severity of the effect on the receptor were adapted from IEEM (2010) and Morris and Therivel (2009) and are presented in Table 8.2.

Table 8.2: Project-specific guidelines for the severity of effect ***(as adapted from the Navitas OMS (SEL-REG-OPM-PLN-00001-00))***

Level	Severity	Environmental severity of effect guide description
5	**Major**	**Flora, Fauna, soil, water quality:** Major effect over large (regional) area. Potential for long-term damage to species / regional population / habitat / ecosystem (recovery period is receptor specific[43]). **Air quality:** Emissions exceed Air Quality Objectives (AQO)[44] by >5 % in locations where receptors are exposed. **Atmospheric emissions (Climatic factors):** Extensive contribution to global emissions, (e.g., when compared to UK annual emissions and current annual Falkland Islands emissions) which will impact upon UK ability to meet current emissions targets and / or future targets. **Landscape and seascape:** Object will be permanently located *in situ* for full Field Life (30 years), is prominent and will be visible from many perspectives, at all times to residents and visitors, potentially imposing upon 'iconic' views. **Human population:** Irreversible effect on livelihood and / or health e.g., permanent damage to fishing grounds, inconvenience of resource use, or very high levels of disturbance to local population, is considered to be a concern to all stakeholders **Tangible property:** Extensive and frequent use of a finite resource throughout lifecycle of project. **Architecture and archaeological heritage:** Major impact on integrity of internationally significant heritage, intrusive, impair appreciation and seriously damage the setting.
4	**Serious**	**Flora, Fauna, soil, water quality:** Serious effect over large but sub-regional area. Serious and long lasting (multi-year) but eventually reversible (recovery period is receptor specific) impact on species / habitat / ecosystem. **Air quality:** Emissions exceed AQO by up to 5 % in locations where receptors are exposed. **Atmospheric emissions (Climatic factors):** Large contribution to global emissions (e.g., when compared to UK annual emissions and current annual Falkland Islands emissions) which could impact upon UK ability to meet current emissions targets and / or future targets. **Landscape and seascape:** Object will be *in situ* for full Field Life (30 years), is quite prominent and will be visible from limited perspectives to residents and visitors e.g., the supply base which blends into the existing context. **Human population:** Long-term effect on livelihood and / or health e.g., seasonal closure of fishing grounds adjacent to the proposed project, inconvenience of resource use, high levels of disturbance to local population, is considered to be a concern to the majority of stakeholders. **Tangible property:** Extensive but infrequent use of a finite resource throughout lifecycle of project. **Architecture and archaeological heritage:** Damaging to regionally or nationally significant heritage assets, adversely affect the setting and appreciation of the assets.
3	**Moderate**	**Flora, Fauna, soil, water quality:** Moderate effect in local area. Temporary and reversible impact on species / habitat / ecosystem (recovery period is receptor specific).

[43] Recovery periods form part of the impact assessment and are discussed, as necessary, in the assessment chapters
[44] As defined by the World Health Organisation, the European Union or the UK as appropriate.

Level	Severity	Environmental severity of effect guide description
		Air quality: Emissions exceed the UK Environment Agency (EA) 'significance' threshold[45] over long- or short-term duration AQO where receptors may be exposed, but do not exceed the actual AQO. **Atmospheric emissions (Climatic factors):** Moderate contribution to global emissions (e.g., when compared to UK annual emissions and current annual Falkland Islands emissions) which will not impact upon UK ability to meet current emissions targets but may in the future as targets are reduced. **Landscape and seascape:** Object will be *in situ* periodically for full Field Life (30 years), will be prominent only when in place and will be visible from limited perspectives to residents and visitors e.g., vessels using port facilities. **Human population:** Medium-term impact on livelihood and / or health e.g., localised temporary closure of fishing grounds, inconvenience of resource use, moderate levels of disturbance to local population, is considered to be a concern to a minority of stakeholders. **Tangible property:** Moderate use of a finite resource throughout lifecycle of project. **Architecture and archaeological heritage:** Compromise the integrity of locally important heritage, be intrusive to the setting and appreciation of the assets.
2	**Minor**	**Flora, Fauna, soil, water quality:** Minor, localised short-term, fully reversible environmental effect once activity ceases. Barely detectable impact on species / habitat / ecosystem. Highly localised. **Air quality:** Emissions exceed the UK Environment Agency (EA) 'screen out' threshold[41] over long- or short-term duration AQO where receptors may be exposed, but do not exceed the 'significance threshold'. **Atmospheric emissions (Climatic factors):** Low contribution to global emissions (e.g., when compared to UK annual emissions and current annual Falkland Islands emissions) but which will not impact upon UK ability to meet current emissions targets and are unlikely to impact upon future targets. **Landscape and seascape:** Object will be in place temporarily and may impact upon the view from close range e.g., unplanned losses of non-biodegradable waste such as plastics. **Human population:** Short term / minor impact on livelihood and / or health, inconvenience of resource use, minor levels of disturbance to local population, is considered to be a concern to a handful of stakeholders **Tangible property:** Minimal use of a finite resource throughout lifecycle of project or moderate use for finite stages of the project. **Architecture and archaeological heritage:** Minor detrimental impact on the context of locally important historic environment.
1	**Slight**	**Flora, Fauna, soil, water quality:** Negligible environmental effect, change not detectable above background variability, rapidly and fully reversible once activity ceases (short-term impact); highly localised effects. No habitat / population effects. **Air quality:** Emissions do not exceed the UK EA 'screen out' threshold[41] over long- or short-term duration AQO at locations where receptors may be exposed. **Atmospheric emissions (Climatic factors):** Negligible contribution to global emissions (e.g., when compared to UK annual emissions and current annual Falkland Islands emissions) with no impact upon UK ability to meet emissions targets in future. **Landscape and seascape:** Object will be in place temporarily and may impact upon the view from close range e.g., unplanned losses of biodegradable waste.

[45] https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

Level	Severity	Environmental severity of effect guide description
		Human population: No impact on livelihood or health, negligible levels of disturbance to local population, or there is considered to be no concern to stakeholders **Tangible property:** No or negligible use of a finite resource for a finite period or throughout the lifecycle of project. **Architecture and archaeological heritage:** Negligible impact on the integrity or setting of the historic environment.

8.5.3 Assessment of impact significance

The significance of an environmental impact is assessed as:

Significance of the **impact** = The **sensitivity** of the receptor to the environmental aspect x The **severity** of the effect on the receptor

The significance of the impact in both the initial and residual assessments, was determined using the impact assessment matrix in Table 8.3, which indicates whether an impact is 'Very Low', 'Low', 'Moderate', 'High' or 'Very High'.

Once the significance has been determined, it is then possible to define whether or not an impact is considered acceptable or otherwise (Table 8.4).

While the significance of an impact is ultimately defined by its category (i.e., 'Very Low', 'Low', 'Moderate', 'Upper Moderate' or 'High'), each category within Table 8.3 is accompanied by an associated score. Note that this score is not on a linear scale and it is not the case that a 'Very High (25)' impact is five times 'worse' than a 'Low (5)' impact. The score simply provides a means of differentiation within the categories in order to inform assessment of what type of mitigation might be most appropriate. For example, where an impact is 'Moderate (5)', a mitigation measure which reduces the severity of effect may be most appropriate. Further, while the mitigation measure may only reduce the severity of effect to such a degree that the overall significance of the impact remains Moderate e.g., from 'Moderate (5)' to 'Moderate (4), the score indicates that improvement has still been achieved (Table 8.3). Definitions and implications of each of the impact significance categories are provided in Table 8.4.

Table 8.3: Environmental impact significance of effect matrix[1]

Impact			Severity of Effect				
			1 Slight	2 Minor	3 Moderate	4 Serious	5 Major
Sensitivity of Receptor	Very high	5	5	10	15	20	25
	High	4	4	8	12	16	20
	Moderate	3	3	6	9	12	15
	Low	2	2	4	6	8	10
	Very low	1	1	2	3	4	5

[1] Dark Green = Very Low, Yellow = Low, Orange = Moderate, Dark Orange = Upper Moderate, Red = High

Table 8.4: Definition and implication of impact significance categories

Impact Significance Level		Impact Significance Definition (planned events)[1]
Unacceptable	High	Action required to eliminate impact *via* project design or to reduce it to an acceptable level *via* additional mitigation measures and controls which aim to minimise consequence where feasible, effective and reasonably practicable. If impact cannot be reduced, the project cannot proceed.
ALARP Region (Impact Tolerable if demonstrably ALARP)	Upper Moderate	Impacts assessed as "Upper moderate" may not be tolerable. Action is required to eliminate or reduce impact *via* project design and / or additional mitigation measures and controls which aim to minimise consequence where feasible, effective and reasonably practicable. Impacts remaining within this category are considered to be within the upper reaches of tolerability and are placed here owing to the combination of a precautionary approach based upon data gaps and / or a lack of further reasonable mitigation options. Where the impact is ALARP[2] and remains within this category, regular reviews (at a minimum of annually) will be held to determine whether the impact can be further reduced based upon the availability of new data and / or new technology. If the impact cannot be further reduced, consideration may also be given to offsetting of the impact (see Section 8.11).
	Moderate	Impacts assessed as "Moderate" require action to identify opportunities for improvement *via* project design, additional mitigation measures and controls which aim to minimise consequence where feasible, effective and reasonably practicable. Where the impact is ALARP and remains within this category, it will be subject to regular ALARP reviews[2] as described above.
	Low	Impacts assessed as low are within the levels of existing natural environmental variability. No project-specific mitigations will be implemented over and above industry-standard measures and controls unless it is stated as a requirement in conditions to EIS approval or Falkland Islands Legislation and / or approved policy. Nonetheless, impacts shall be regularly reviewed to ensure that suitable controls remain in place and shall be subject to continuous improvement where opportunities exist.
Broadly Acceptable	Very Low	Impact barely detectable. No additional actions required beyond industry-standard measures and controls. Nonetheless, impacts shall be periodically reviewed to ensure that suitable controls remain in place and shall be subject to continuous improvement where opportunities exist.
	Beneficial	Has a positive effect.

[1] **Note:** Assessment of the Impact Significance is based on the EIA undertaken to date and detailed in this EIS. Initial views of key stakeholders were sought during the scoping consultation process (Chapter 6). Thereafter, the EIS was updated wherever applicable in response to comments / information received from the previous public consultation. Comments received through the formal communication and consultation process are detailed in Chapter 0.

[2] ALARP Procedure (SLN-HSE-RMA-PCD-00001-00).

8.6 Risk assessment methodology for unplanned and accidental events

This section describes the methodology used for the assessment of environmental risk of unplanned and accidental events.

8.6.1 Environmental risk assessment process

The evaluation of risks follows a similarly structured methodology through systematic:

- Identification of potential unplanned or accidental events that carry the risk of environmental impact,

- Assessment of the significance of the impact (Section 8.5.3) based on the sensitivity of the receptor and the severity of the effect should the unplanned event occur,
- Assessment of the likelihood of the unplanned or accidental event occurring (Section 8.6.2.2) taking account of statutory industry-standard safeguards and BAT / BEP mitigations built-in to the project basis of design (Section 8.7),
- Assessment of the initial significance of the risk (Section 8.6.3) of accidental or unplanned events based on the significance of the impact and the likelihood of the unplanned or accidental event occurring,
- Identification of any project-specific mitigation measures (Section 8.7) as required to reduce 'significant' risks to ALARP by preventing or reducing the likelihood of the event occurring and / or by minimising the consequence should it occur,
- Evaluation of the residual risk significance (Section 8.8) taking account of project-specific mitigation,
- Assessment of the degree of confidence (Section 8.10) in the risk assessment, and
- Explores the potential for offsetting impacts of significant risks where possible (Section 8.11).

8.6.2 Assessment of environmental risks

Risks are evaluated in two steps:

- By assessing the level of environmental impact that could result from the unplanned / accidental event occurring (Section 8.5.2), and
- By assessing the likelihood that the unplanned or accidental event will occur (Table 8.5).

8.6.2.1 Assessment of the potential environmental impact

The significance of an environmental impact that could result from an unplanned / accidental event follows the same methodology as for all impact assessments, see Section 8.5.2 above. The sensitivity of receptor definitions are as outlined in Table 8.1 above, and the severity of effect for unplanned or accidental events are as defined in Table 8.2 above.

8.6.2.2 Assessment of the likelihood of an unplanned or accidental event occurring

The likelihood of the unplanned or accidental event considered two factors as appropriate on a case-by-case basis. These are:

- Whether the unplanned or accidental event has occurred within the industry before and the frequency of occurrence if it has, and / or
- The number of control barriers that might need to be breached for the unplanned or accidental event to occur.

Project-specific guidelines were developed to inform the assessment of the likelihood of occurrence of an unplanned event during the Sea Lion Northern Development Area Phase 1 & 2 Development (Table 8.5). The guidelines have purposefully been kept at a high level to afford a degree of flexibility and details on the rationale behind each assessment are provided in the narrative within the relevant chapters. Where possible, historical frequency of occurrence data will be used to inform the assessment of likelihood and will be described within the respective risk assessment chapters. As with the impact assessment process, a precautionary approach is taken when selecting the likelihood category.

Table 8.5: Project-specific guidelines for assessing the likelihood of an unplanned / accidental event occurring ***(as adapted from the Navitas OMS (SEL-REG-OPM-PLN-00001-00))***

Level	Likelihood	Definition
5	**Very Likely**	Likely to occur more than once per operation e.g., every well or every shutdown, can occur following breach of a minimal number of controls.
4	**Likely**	Likely to occur more than once per applicable time unit, can occur following breach of a minimal number of controls.
3	**Possible**	Likely to occur less than once per applicable time unit and more than once in 10 applicable time units, breach of operational controls would be required e.g., procedural controls.
2	**Unlikely**	Has occurred previously in the industry, however, failure of numerous operational controls would be required e.g., procedural and engineering controls.
1	**Very Unlikely**	Impact almost never observed, few if any events in the industry, failure of nearly all operational controls would be required.

8.6.3 Assessment of risk significance

The significance of the risk is assessed as:

Significance of the **risk**	=	(----------Impact----------) The **sensitivity** of the receptor to the environmental aspect	x	The **severity** of the effect on the receptor	x	The **likelihood** that an unplanned or accidental event will occur

The significance of the risk in both the initial and residual assessments, was determined using the risk assessment matrix in Table 8.6, which indicates whether the significance of the risk is 'Very Low', 'Low', 'Moderate', 'Upper Moderate' or 'High'.

The overall significance of a particular risk is determined according to the highest level of risk associated with the project activity against any one of the receptors. For example, in the event that an oil spill was to occur, the risk might be higher to seabirds than to benthic organisms and is therefore ranked according to the highest assessment (i.e., seabirds).

While the significance of a risk is ultimately defined by this category, each category within Table 8.6 is accompanied by an associated score. As with the assessment of impact significance, (Section 8.5.3) this score provides a means of differentiation within the categories in order to inform assessment of what type of mitigation might be most appropriate. Definitions and implications of each of the risk significance categories are provided in Table 8.7.

Table 8.6: Environmental Risk Assessment matrix[1]

Risk			Likelihood				
			1 Very Unlikely	2 Unlikely	3 Possible	4 Likely	5 Very Likely
Impact	High	5	5	10	15	20	25
	Upper Moderate	4	4	8	12	16	20
	Moderate	3	3	6	9	12	15
	Low	2	2	4	6	8	10
	Very Low	1	1	2	3	4	5

[1] Dark Green = Very Low, Yellow = Low, Orange = Moderate, Dark Orange = Upper Moderate, Red = High

Table 8.7: Definition and implication of risk significance categories

Risk Significance Level		Risk Significance Definition (planned events)
Unacceptable	High	Action required to eliminate risk *via* project design or to reduce it to an acceptable level *via* additional mitigation measures and controls which aim to minimise consequence where feasible, effective and reasonably practicable. If risk cannot be reduced, the project cannot proceed.
ALARP Region (Risk Tolerable if demonstrably ALARP)	Upper Moderate	Risks assessed as "Upper moderate" may not be tolerable. Action is required to eliminate or reduce risk *via* project design and / or additional mitigation measures and controls which aim to minimise consequence and likelihood where feasible, effective and reasonably practicable. Risks remaining within this category are considered to be within the upper reaches of tolerability and are placed here owing to the combination of a precautionary approach based upon data gaps and / or a lack of further reasonable mitigation options. Where the risk is ALARP[2] and remains within this category, regular reviews (at a minimum of annually) will be held to determine whether the risk can be further reduced based upon the availability of new data and / or new technology. If the risk cannot be further reduced, consideration may also be given to offsetting of the risk (see Section 8.11).
	Moderate	Risks assessed as "Moderate" require action to identify opportunities for improvement *via* project design, additional mitigation measures and controls which aim to minimise consequence and likelihood where feasible, effective and reasonably practicable. Where the risk is ALARP and remains within this category, it will be subject to regular ALARP reviews[2] as described above.
	Low	Risks assessed as low are within the levels of existing natural environmental variability. No project-specific mitigations will be implemented over and above industry-standard measures and controls unless it is stated as a requirement in conditions to EIS approval or Falkland Islands Legislation and / or approved policy. Nonetheless, risks shall be regularly reviewed to ensure that suitable controls remain in place and shall be subject to continuous improvement where opportunities exist.
Broadly Acceptable	Very Low	Risk barely detectable. No additional actions required beyond industry-standard measures and controls. Nonetheless, risks shall be periodically reviewed to ensure that suitable controls remain in place and shall be subject to continuous improvement where opportunities exist.

Note: Assessment of the Risk Significance is detailed in this EIS. Initial views of key stakeholders were sought during the scoping consultation process (Chapter 6) and thereafter, the EIS was updated wherever applicable in response to comments / information received from the previous public consultation. Comments received through the formal communication and consultation process are detailed in Chapter 0.
[2] ALARP Procedure (SLN-HSE-RMA-PCD-00001-00).

8.7 Impact and risk mitigation

Mitigation measures aim to avoid, reduce or remedy the predicted significant adverse impacts of an activity (Morris and Therivel, 2009; Glasson, *et al.,* 2013). These different mitigation outcomes are known as the mitigation hierarchy (Glasson, *et al.,* 2013), which focuses on the principal of 'prevention rather than cure'.

Consequently, for planned events, options to avoid and reduce impacts should be considered and implemented before those to remedy the impact. Similarly, for unplanned events, measures to minimise the 'likelihood of occurrence' should be considered first, followed by those to minimise the consequences should the event occur. Further, it is important that mitigation measures are designed with monitoring in mind to ensure that the efficacy of the measures can ultimately be evaluated (Section 8.10.1).

Mitigation measures used in the Sea Lion Northern Development Area Phase 1 & 2 fall into three categories:

- **'Base-case' mitigations** - which refer to the use of BAT / BEP within the project basis of design. These are described in the Development Description (Chapter 5) and are intended to reduce outputs (e.g., emissions) and / or to minimise the likelihood of unplanned events occurring (e.g., the use of inshore exclusion zones, vessel speed restrictions etc.) and thus aim to eliminate (avoid) or reduce impacts. These are factored into the initial impact / risk assessment,
- **Industry-standard mitigations** - which include measures which are not defined by law but are accepted as best practise observed within the O&G industry (and are, therefore, often built-in to the basis of design). These are factored into the initial impact / risk assessment along with legislative requirements, and
- **Project-specific mitigations** - which are additional measures intended to further reduce or remediate significant impacts and / or risks. The need for these is specifically informed by the EIA process when the initial impact assessment indicates that an impact or risk remains significant despite the base-case and industry-standard mitigations.

Ultimately, the aim of all mitigation is to reduce the overall impact or risk associated with an activity to a level that is 'As Low As is Reasonably Practicable' (ALARP), irrespective of whether this is achieved by prevention, reduction and / or remediation (see ALARP Procedure, SLN-HSE-RMA-PCD-00001-00). Very importantly however, 'ALARP' is not synonymous with 'Low' and the concept takes into account the balance between the costs and benefits of a mitigation measure. Here it is recognised that while it may be possible to reduce an impact or risk further, the process of doing so may require excessive time and resource such that it is not considered 'reasonably practicable' in light of the benefits that can be gained.

For the Sea Lion Northern Development Area Phase 1 & 2, and given the concept of ALARP, impacts and risks that were considered to be 'Low' (or below) in the initial assessment were not prioritised with regard to project-specific mitigation as extensive additional measures were not considered 'reasonably practicable'. This said, where project-specific mitigations were immediately available and reasonably practicable, these may be applied even for 'Low' impacts and risks.

However, where impacts were of 'Moderate' significance or above in the initial assessment, it was considered necessary by Navitas to identify and consider project-specific mitigation measures to further drive the impact / risk to a level that is ALARP (SLN-HSE-RMA-PCD-00001-00).

8.8 Residual assessments

The term 'residual impact / risk' refers to the impact / risk that remains once project-specific mitigation measures have been taken into account. As described above, residual assessments were only required for those impacts and risks that were considered to be significant i.e., 'Moderate' or higher significance during the initial assessment.

The residual assessments of impact and risk follow the same process as described above, using the same definitions of sensitivity, severity of effect, likelihood and impact significance but with awareness of the additional mitigation measures which may reduce the severity of effect and / or the likelihood of an unplanned or accidental event occurring.

8.9 Cumulative impact assessment and impact interactions

8.9.1 Cumulative impact

The EIA process initially assesses the impacts / risks to environmental receptors from the proposed operation alone. However, the activities associated with the proposed operations are unlikely to occur in isolation and it is thus important to consider the cumulative impacts also. Cumulative impacts may arise from similar activities being carried out by Navitas, another O&G operator or by another sector at the same time, or in the same space as the proposed development.

Specifically, spatio-temporal cumulative impacts include:

1) Impacts (such as noise, CO_2 emissions, drilling mud) occurring from more than one source and overlapping in space and time. This may result in an increase in the concentrations / level to which the same environmental receptors are exposed (Figure 8-2 below),
2) Impacts (such as noise, CO_2 emissions, drilling mud) occurring from more than one source and occupying adjacent 'spaces' at the same time, or approximately the same time. This may increase the number of organisms directly exposed and thus the extent and proportion of the local or regional population that is exposed (Figure 8-2 below), and / or
3) Impacts (such as noise, CO_2 emissions, drilling mud) from more than one source occupying the same 'space' consecutively or soon after each other. This may increase the duration of exposure for the same receptors and/or the proportion of the local or regional population (Figure 8-2 below).

Importantly, it is not possible to know what activities may be carried out in the future, or to quantify what their impacts / emissions / discharges may be, and therefore it is not possible to assess the cumulative impacts of the proposed Navitas development in combination with future and currently unplanned developments. Therefore, cumulative assessments within this EIA include only those operations that immediately precede the proposed operation and / or will occur simultaneously. Any cumulative impacts of this operation in conjunction with future operations will be assessed in the EIA associated with the future development.

Note that cumulative outputs e.g., emissions, discharges etc. will be quantified where possible. However, most commonly it will not be possible to estimate outputs from other activities and here the cumulative assessment will be in the form of a qualitative narrative.

8.9.2 Impact interaction

Impact interactions include:

1) Different sources of impacts which have known additive or synergistic effects to any of the above, leading to potentially greater negative effects on individuals or ecosystems than would occur if only one type of contaminant were present (Figure 8-2), and/or
2) Different sources of impacts which have known cancelling or ameliorating effects to any of the above, leading to potentially smaller negative effects on individuals or ecosystems than would occur if only one type of contaminant were present (Figure 8-2).

Chapter 13 will consider the impact interactions of the project as a whole. For example, the interaction of impacts of underwater noise on marine mammals in conjunction with the impacts of increased presence of vessels; or the fact that birds attracted to a vessel due to artificial light may be more likely to experience contamination in the event of a spill.

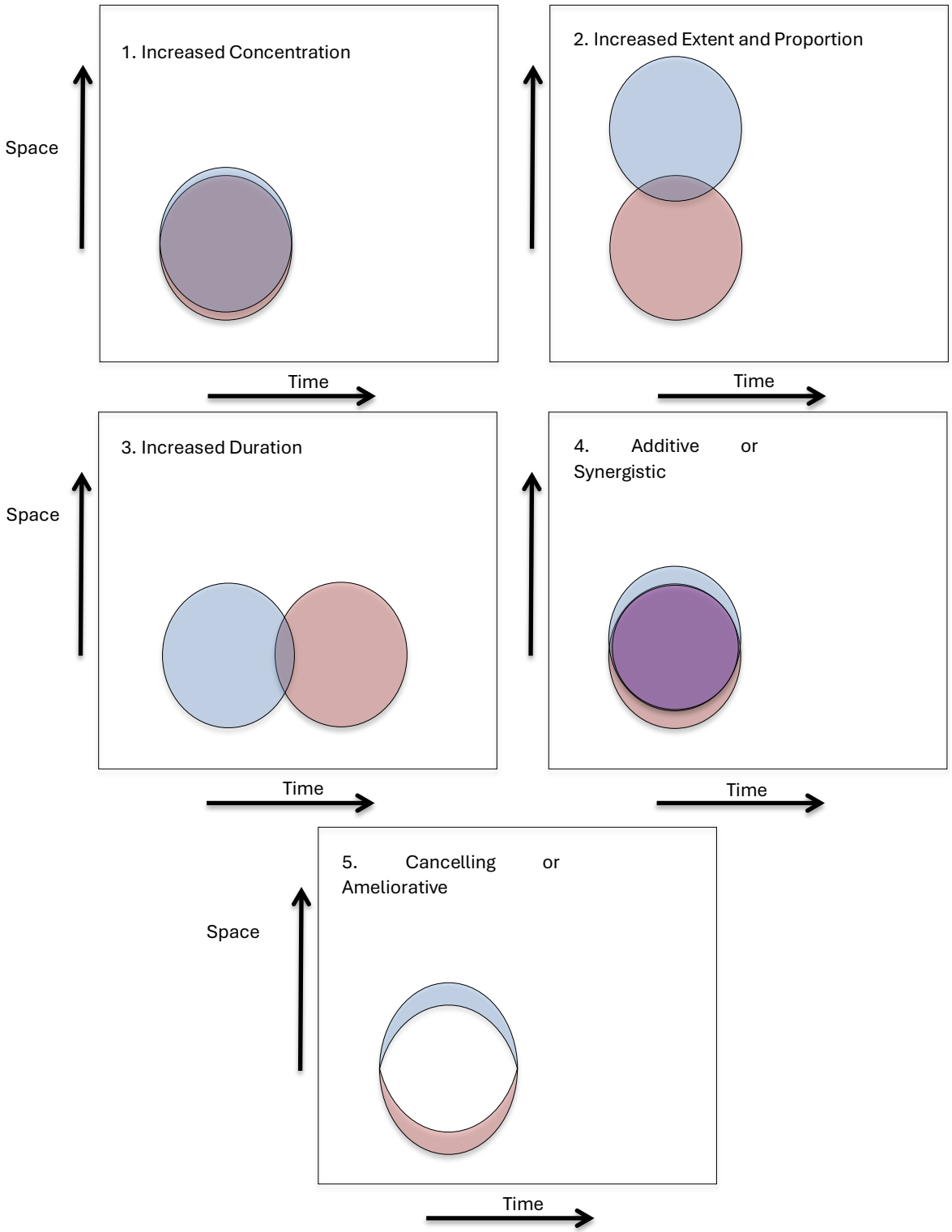


Figure 8-2: Illustrating cumulative impacts and impact interaction on an environmental receptor. Note: Red circle denotes impact from principal Navitas operation, blue circle denotes impact from any other source of impact

8.10 Confidence in the assessment

While a precautionary approach is taken during the impact and risk assessments such that the level of confidence in the data is reflected in the impact / risk significance, it is important to qualify, and indicate, the overall level of confidence in the assessment. The level of confidence in the outcomes of the impact / risk assessment depends upon the degree of uncertainty associated with the basis for the assessment, including:

- The clarity of definition and degree of certainty of project activities,
- The adequacy of available data, knowledge, and understanding about the environmental component / receptor being assessed,
- The number of data gaps,
- The known reliability of the proposed technology,
- The nature of the project-environment interaction, and
- The efficacy of proposed mitigation measures (IAIA, 2013).

Where moderate or greater levels of uncertainty exist, appropriate levels of monitoring may be determined to more fully characterise the impacts / potential risk as part of the on-going Environmental Monitoring and Management Plan (EMMP) (Chapter 15). Where monitoring indicates that the predictions made in the EIA were incorrect such the impact is greater than anticipated, remedial measures may be taken.

The level of confidence in the impact and risk predictions takes into account key characteristics of the impact (e.g., magnitude, extent, reversibility, duration, timing and frequency of effect), and the sensitivity of the receptor (IAIA, 2013). For the purposes of this EIA, the degree of confidence associated with the assessed impact, is evaluated using the qualitative scale: Certain, Probable, Uncertain (IEEM, 2010). Project-specific definitions for these categories have been developed and described in Table 8.8.

Table 8.8: Project-specific definition of the degree of confidence in the impact assessment

Degree of Confidence	Project-specific Definition
Certain	The project activities are clearly defined and are not subject to change. The nature of the impact is well understood from previous projects in terms of the magnitude, extent, reversibility, duration and frequency of the impact. The sensitivity of the receptor is well understood and documented.
Probable	The project activities have been defined although they may be subject to change as the project progresses, a precautionary approach has been taken. The nature of the impact on the environmental receptor is understood, although data gaps exist. The status and sensitivity of the receptor is largely understood, although some data gaps exist. The data gaps are not considered to have the potential to significantly change the outcome of the assessment.
Uncertain	The project activities are poorly defined and are subject to change as the project progresses. The nature of the impact on the environmental receptor is poorly understood and little monitoring data exists from previous projects. The status and sensitivity of the receptor is poorly understood and large data gaps exist.

8.10.1 Monitoring

Where confidence in the assessment is low due to uncertainties concerning the significance of impacts or the efficacy of proposed mitigation measures, monitoring activities should be identified to address these, including, where appropriate, further studies to fill data gaps.

Opportunities for monitoring are identified throughout the impact assessment process. Monitoring activities will be focused on the aspects that are considered to pose an impact of Moderate significance, or those activities that have been highlighted as a particular concern by stakeholders. Monitoring requirements will be recorded in the project-specific EMMP as per the outline provided in Chapter 15.

Monitoring should be carried out when the measuring and recording of tangible variables (e.g., emissions, sediment deposition, property) can:

- Provide feedback on the efficacy of mitigation measures,
- Facilitated improved assessment of the actual impacts resulting from the project activities,
- Enable comparison between the actual impacts and the predicted impacts,
- Provide additional information relating to the nature of the impact where data gaps existed during the EIA,
- Inform future EIAs,
- Provide an early warning system to identify harmful trends in the vicinity of the project activities before it is too late to take remedial action (Glasson, *et al.,* 2013), and
- Enable effective impact auditing.

8.11 Offsetting of impacts

8.11.1 Legislation and Policy

Section 64C of the Offshore Minerals Ordinance states that EISs must contain a description of measures proposed to:

'Eliminate or reduce significant adverse effects…remedy those effects and offset them.'

Appendix 2 to the FIG Hydrocarbons Environmental Impact Assessment Guidance Note (FIG, 2016e) provides offsetting guidance. ExCo paper 124/16 (FIG, 2016d) details FIG's recommendations for further developing offsetting guidance and suggested the establishment of an Environmental Fund.

ExCo paper 124/16 (FIG, 2016d) states that hydrocarbon development should seek meaningful offsetting of any impacts that cannot be avoided or mitigated, specifically in relation to greenhouse gas emissions and biodiversity (FIG, 2016d). The options for offsetting of these impacts include:

- Direct offsetting, i.e., the operator develops local projects to offset, like-for-like, the impacts arising from the Development that cannot be avoided or mitigated,
- Indirect offsetting, i.e., implementing measures that do not directly compensate for the impacts / risks identified, but may provide opportunities to achieve environmental benefits and improve the environment in the longer-term, or
- An environmental fund whereby the operator contributes to a fund with a governance panel to direct, manage and oversee various offsetting projects[46].

The Operator is required to demonstrate how offsetting measures have been considered which may further reduce significant adverse residual impacts identified in the EIS.

Navitas has ambitions for significant future local offsetting programmes, however these need to be informed by feasibility along with empirical data. Navitas will commit to a Carbon and Biodiversity offsetting Fund (see section 8.11.3) that will lay the foundations to inform scaling for island-wide

[46] Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to an environmental trust fund. Consequently, the foregoing dialogue in relation to a Navitas carbon and biodiversity offsetting fund has been superseded.

restoration to achieve carbon and biodiversity benefits. Therefore, the Environmental Carbon and Biodiversity offsetting Fund is a precursor to any offsetting initiative.

The section below details the offsetting options considered by Navitas and the reasons for the approach being proposed.

8.11.2 Review of offsetting options

Following elimination and / or reduction of all the impacts and risks identified for the Phase 1 & 2 Development, Navitas conclude that only tangible significant impacts / risks (i.e., those assessed as 'Moderate' or above), may be offset.

Navitas has reviewed its significant residual impacts / risks, and explored practicable, effective and locally beneficial direct offsetting measures in relation to these, see Section 8.11.2.1. Navitas has also reviewed indirect offsetting, as described in Section 8.11.2.2.

8.11.2.1 Direct offsetting

Direct or 'like-for-like' offsetting means compensating for impacts / risks to the environment at one site through activities that specifically address the nature of the impact in the local area. For example, this might include re-forestation of a nearby area where trees have been cleared for a construction site. For each residual impact / risk assessed as 'Moderate' or above, Navitas has looked for practicable, local, environmentally beneficial and effective opportunities to directly offset them, see Table 8.9 below. However, for each of the significant residual impacts / risks, Navitas has not at this time identified direct 'like-for-like' offsetting that is feasible, effective or reasonably practicable, see Table 8.9. The reasons for this are:

- It has not been possible to sufficiently quantify the impact / risk,
- Navitas has been able to conceive of a suitable project to achieve like-for-like offsetting, and / or
- Navitas has conceived of suitable projects but has not yet been able to determine feasibility, empirically define or formulate the details.

In addition, Navitas conclude it is not possible to offset accidental events where the impact may or may not happen, such as an oil spill. There is the risk of a spill occurring, but it is not possible to state if, when and what the impact of that spill might be, thus the impact is risk assessed in terms of the likelihood of it occurring. The impact itself is very difficult to quantify, and any efforts to remediate an impact that has arisen as the result of a risk, e.g., an oil spill, is considered 'remediation' as opposed to offsetting.

While potential offset initiatives have been identified in relation to atmospheric emissions, it has not been possible at this time for Navitas to determine the feasibility of these projects to confirm and quantify the benefit to the local environment, and that they are practicable for Navitas to implement. As such, while Navitas is committed to offsetting where practicable and to securing a positive environmental legacy, Navitas will not commence direct, like-for-like, offsetting for the residual significant impacts / risks from the Sea Lion Development until such time that identified initiatives have been further developed and proved through and it has been demonstrated that they are practicable and achievable within the Falkland Islands environment[47].

[47] Since the public consultation, Navitas has agreed with FIG that it will make payments to a fund which will support local offsetting projects.

Table 8.9: Significant environmental impacts / risks and direct offsetting[1] options considered

Impact / risk	Section in EIS	Residual impact / risk	Reason for level of impact / risk ranking and uncertainties	Direct Offsetting[1]
Risk of bird strikes due to artificial light	Section 10.1	Moderate	There are a number of uncertainties around the impact of bird strike. Bird strike monitoring carried out by the previous operator during the exploration campaign indicates this has not occurred during offshore operations in the area but occurred on two occasions inshore. There are many other, stronger, sources of light both in the Southern Ocean and inshore that complicate predictions of impact and measures of effectiveness of mitigation, and the assessment is therefore precautionary.	Offsetting is not practicable in this instance as the uncertainty of the impact makes it difficult to quantify and Navitas has not been able to conceive of a realistic and effective direct offset for this impact.
Impact on and behavioural disturbance to marine mammals from underwater noise offshore	Section 10.4	Moderate	Disturbance to marine mammals from continuous[2] noise is assessed as significant largely due to the sensitivity of the receptor.	Identifying a realistic and effective direct offsetting project for this impact has not been possible.
Impacts of drill cuttings discharge on benthos including burial of benthic fauna, modification of habitat, toxicity and oxygen depletion	Section 10.6	Moderate	Burial of benthic fauna is rated as significant in relation to the area of seabed damaged.	In this instance, Navitas could not identify a realistic and effective direct offset for this impact.
Impacts from atmospheric emissions	Section 10.9	Moderate	The impact of emissions directly associated the execution of the Development[3] has been rated as Moderate mainly due to the contribution to global warming and ocean acidification.	There are no emissions trading schemes in the Falklands. Navitas has identified potential carbon offsetting initiatives relating to renewable energy and habitat restoration/carbon sequestration but further research and analyses are required to determine their efficacy and the quantum of potential offset prior to such initiatives being taken forward.

Impact / risk	Section in EIS	Residual impact / risk	Reason for level of impact / risk ranking and uncertainties	Direct Offsetting[1]
Use of regulated landfill for waste disposal	Section 10.10	Moderate	Use of a finite resource: sensitivity of the receptor is considered 'High'	Identifying a realistic and effective direct offsetting project for this impact has not been possible and it has not been possible to accurately quantify the risk.
Risk of injury to marine mammals *via* collision in Berkeley Sound	Section 10.11	Moderate	Inshore operations involving the LTVs and subsea installation vessels are assessed as moderate severity on a precautionary basis given the uncertainty around potential cetacean collisions.	Identifying a realistic and effective direct offsetting project for this impact has not been possible and it has not been possible to accurately quantify the risk.
Risk of introducing marine non-native species from Navitas *ad hoc* freighter vessels	Section 10.12	Moderate	Offsetting is not practicable in this instance as the uncertainty of the impact makes it difficult to quantify.	Navitas has not been able to develop a realistic direct offset for this impact.
Risk of introducing marine non-native species from third-party vessels (i.e., vessels not directly managed by Navitas)		Upper Moderate		
Risk of introducing terrestrial non-native species by marine and air freight	Section 10.13	Upper Moderate		
Accidental releases of oil to sea offshore	Section 12.1	Moderate	Offshore spills, including well blow-out and FPSO inventory loss, are assessed as presenting a significant risk to receptors.	It has not been possible develop a practicable direct offset due to the uncertain impact, particularly as it may not occur during the life of field.
Accidental release of oil to sea inshore	Section 12.2	Moderate		
Accidental spills at-shore	Section 12.3	Moderate	There is a risk of small leaks / spills during day-to-day operations which may present a significant risk to receptors.	

[1] Where direct offsets cannot be identified, indirect offsetting will be undertaken (Section 8.11.2.2).
[2] Please note that no sources of impulsive noise are proposed for use within the Sea Lion Development.
[3] Please note that the emissions associated with combustion of the sold product are included within the emissions chapter (see Section 10.9). However, once sold at the FPSO, it is beyond the ability of Navitas to influence or track the final destination or end use of the product. Consequently no offsets are proposed in relation to emissions from sold product.

8.11.2.2 Indirect offsetting

Indirect offsetting refers to implementing measures that do not directly compensate for the impacts / risks identified above but may provide opportunities to achieve environmental benefits and improve the environment of the Falklands in the longer-term.

Navitas is also committed to exploring indirect offsetting opportunities onshore and offshore in the Falklands Islands. These may include, for example:

- Habitat restoration projects,
- Pest and invasive species eradiation / control and conservation,
- Biodiversity educational initiatives and the research required to inform them.

FIG's offsetting guidance requires proposed offsetting projects to be described in detail (including costs and timelines), to be realistic, practicable and effective, be as quantitative as possible, additional to current projects/schemes or funding sources, and to provide a level of redundancy. Navitas cannot make ad hoc commitments to indirect offsetting projects that are not fully understood, and at this stage it has not been practicable to develop potential indirect offsetting projects to the level of maturity required by the EIA guidance. Given this, as a first step Navitas is working in close collaboration with FIG to initially identify schemes, undertake research as necessary in order to develop local indirect offsetting initiatives for future funding support.

8.11.3 Carbon and Biodiversity Offsetting Fund

Navitas has committed to undertaking operator-led direct and indirect offsetting in the Falkland Islands including the establishment of a carbon and biodiversity offsetting fund which shall undertake Falklands-specific habitat restoration projects. To enable this, in agreement with FIG, Navitas will make contributions to a fund which shall be both proportionate in scale and meaningful in value and impact. Initially the fund will commission research and feasibility studies that lead to pilot offsetting schemes that can be expanded to enable large scale in-Falklands habitat restoration (Carbon sequestration) and biodiversity offsetting. Navitas will monitor opportunities to fund/undertake direct and indirect offsetting throughout Field Life. The Fund will regularly monitor its offsetting initiatives and reporting on its performance.

8.11.4 Conclusion

Navitas is committed to meaningful offsetting of any significant impacts that cannot be avoided or mitigated, specifically in relation to operational greenhouse gas emissions and impacts to the region's biodiversity. Once the Fund is established, which will occur following Final Investment Decision (FID), offsetting projects that benefit the Falkland Islands environment will be identified and prioritised over international schemes. As feasibility of various identified potential direct and indirect offsetting initiatives cannot be confirmed prior to further research, analysis and development, Navitas is not in a position to specify offsetting projects in the detail required by the FIG Offsetting Guidance at the time of issuing this EIS. Given this, Navitas will contribute to a Falklands-specific fund[48] which will initially address and inform the feasibility of large-scale carbon and biodiversity offsetting through commissioned research and investigation. Following this feasibility stage, Navitas will provide further funding to the viable projects identified in order to discharge its offsetting obligation, to work towards achieving carbon neutrality and no net loss to biodiversity and secure a positive environmental legacy. Performance of Navitas' offsetting projects will be monitored and reported on at regular intervals.

[48] Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund.

9 ENVIRONMENTAL IMPACT AND RISK IDENTIFICATION AND SCREENING

Table of Contents

9.1 ENVIID workshop 582
9.1.1 ENVIID workshop attendees 582
9.1.2 ENVIID workshop process 583
9.1.2.1 Identification of environmental and social aspects 583
9.1.2.2 Identification of impacts from planned activities 584
9.1.2.3 Identification of risks of unplanned events or accidental activities 585
9.2 ENVIID outcomes - preliminary impact assessment and screening 586

9.1 ENVIID workshop

Having identified the activities associated with the Phase 1 & 2 Development (Chapter 5) and the environmental and social sensitivities specific to the North Falkland Basin, as well as the relevant inshore, onshore and at-shore locations (Chapter 7) it is possible to:

- Identify the environmental and social aspects specific to the project, and
- What the impacts and risks of these may be.

This chapter presents the results of the aspect, impact and risk identification and screening exercises, which were carried out during three ENVironmental Impact IDentification (ENVIID) workshops.

The key objectives of the ENVIIDs were to identify:

- What project activities might interact with the environment and / or the human population, and how (i.e., the aspects, impacts and risks),
- The impacts and risks that could be '**Scoped out**' because of their **Very Low** significance, and
- The impacts and risks that warranted further investigation in the EIA.

Owing to the broad range of activities involved in the Phase 1 & 2 Development, three ENVIIDs were carried out to simplify the process and ensure that all potential impacts / risks were captured. The ENVIIDs were structured to identify impacts and risks in accordance with whether the activities were:

- Offshore,
- Inshore, or
- Onshore / at-shore / logistical.

The ENVIID results are presented in this chapter in accordance with the above location. However, in the remainder of the EIS, the assessment chapters have been grouped by aspect e.g., environmental emissions, discharges etc. to avoid repetition. For example, many activities, regardless of their location, will result in atmospheric emissions and these are assessed in a single chapter to ensure a cumulative assessment of emissions is provided and to avoid repeated explanations of how emissions may impact upon the environment and human population.

Note: as described in Section 5.12, decommissioning of the Phase 1 & 2 Development will be considered a separate project. Therefore, a separate ENVIID will be carried out in support of the EIA that will accompany the decommissioning programme nearer the end of Field Life.

9.1.1 ENVIID workshop attendees

Each workshop was attended by a multidisciplinary team to ensure that all aspects, impacts and risks were considered. The personnel that attended each of the ENVIID workshops were as follows:

- South Atlantic Environmental Research Institute (SAERI) Falklands Ltd. attendees:
  - 4 x Environmental Consultants.
- Operator Attendees:
  - Chief Operating Officer,
  - Development Project Manager,
  - Vice President of Subsea Operations,
  - Falkland Islands Country Manager,
  - Operations Manager,
  - Process and Pipelines Engineer,
  - Logistics Manager,

- Drilling and completions Engineer, and
- Drilling Fluids Engineer.

9.1.2 ENVIID workshop process

During the ENVIID workshops, the team did a 'walk-through' of all the activities that will occur during the Phase 1 & 2 Development.

The ENVIID workshop included identification of the specific activities associated with:

- Offshore operations:
  - Development drilling,
  - Installation of subsea drilling and production facilities and hook-up of production facilities and the Floating Production, Storage and Offloading (FPSO) vessel,
  - Simultaneous drilling and production operations (SIMOPS), and
  - Steady state production.
- Inshore operations:
  - Mooring of two Large Transport Vessels (LTVs) in Berkeley Sound to subsea infrastructure prior to installation, and
  - Manoeuvring of construction vessels as equipment is loaded from the LTV to the construction vessel for transit to the Sea Lion Field.
- Onshore, at-shore and logistical activities required in support of all of the above:
  - Use of the liquid mud plant and dry bulk facility,
  - Use of onshore supply base,
  - Use of port facilities (i.e., 'at-shore'),
  - Use of resources, and
  - Logistical support:
    - Use of vessels, and
    - Use of transportation e.g., fixed-wing flights, helicopters, road transport.

9.1.2.1 Identification of environmental and social aspects

During the 'walk-through' of the Phase 1 & 2 Development activities (Chapter 5), the routes *via* which the planned Phase 1 & 2 activities, and unplanned and accidental events, may interact with the environment and the human population were identified as:

- Environmental aspects:
  - Placement of objects on the seabed,
  - Drill cuttings and mud discharges to sea,
  - Operational discharges to sea,
  - Thermal discharges,
  - Artificial light offshore,
  - Artificial light inshore,
  - Underwater noise offshore,
  - Underwater noise inshore,
  - Atmospheric emissions,
  - Waste:

        - Discharges to sea of grey water, black water, food, drainage and bilge water, and
        - Management of solid wastes.
    - Noise from the use of helicopters,
- Social aspects:
    - Increased vessel use and disturbance to other users of the sea,
    - Competition for resources:
        - Accommodation,
        - Freshwater,
        - Electricity,
        - Road networks, and
        - Airlinks.
    - Disturbance to the human population through:
        - Onshore light,
        - Onshore noise,
        - Odour, and
        - Visual impacts.
- Unplanned / Accidental events:
    - Collisions with marine mammals (including entanglement of cetaceans in mooring apparatus),
    - Introduction of marine and terrestrial non-native species,
    - Vessel collisions offshore,
    - Vessel collisions inshore,
    - Loss of control leading to oil / chemical spill,
    - Small spills contributing to chronic oil pollution, and / or
    - Fuel spill either from bunkering operations or from an accidental event.

The environmental and social aspects relevant to each planned, unplanned and accidental activity / event are summarised in the tables below.

9.1.2.2 Identification of impacts from planned activities

When considering the impact of planned activities associated with the above, the following questions were considered and discussed:

- Will this activity:
    - Require the use of artificial light offshore, inshore, onshore or at-shore?
    - Require the use of helicopters over land?
    - Disturb the seabed or require placement of objects or material on the seabed?
    - Generate underwater noise?
    - Require the discharge of drill cuttings?
    - Require the discharge of liquid to sea e.g., produced water or cooling water?'
    - Require the use and / or discharge of chemicals?
    - Result in the discharge of heat to the environment?
    - Result in the emission of greenhouse gases e.g., *via* fuel combustion, flaring or fugitive emission?

- Result in, or require, the venting of gases?
- Require the use of F-Gases?
- Generate hazardous or non-hazardous solid or liquid waste?
- Require the use of vessels offshore, inshore or in the Falkland Islands' port facilities?
- Require the delivery of cargo to the Islands from overseas?
- Interfere with the activities carried out by other users of the sea?
- Require the use of resources e.g., accommodation, freshwater, electricity, road networks, airports or airlinks to and from the Islands?
- Generate airborne noise inshore, onshore or at-shore?
- Result in odour emissions inshore or onshore?
- Generate exhaust emissions inshore? and / or
- Require the transfer of oil between vessels?

9.1.2.3 Identification of risks associated with unplanned events or accidental activities

To identify the risks, each planned activity was considered and the expertise in the workshop was used to determine:

- What unplanned events could happen as a result of the presence of the operation, malfunction of equipment or loss of control?
- What accidental events could occur?

With regard to the risk of unplanned events therefore, the following questions were asked:

- Could the presence of the operation, malfunction of equipment or loss of control result in:
  - Bird-strikes with vessels?
  - Large dropped objects?
  - Unplanned discharges e.g., of produced water?
  - A release of natural gas?
  - A release of F-gas?
  - The loss of containment of solid or liquid waste to land or sea?
  - The generation of unplanned or unexpected waste quantities?
  - Collision with cetaceans?
  - Entanglement of cetaceans?
  - The introduction of non-native marine or terrestrial species?
  - Collision between vessels?
  - Snagging of subsea infrastructure by trawl fishing gear?
  - Unexpected use of onshore resources?
  - A release of oil offshore via:
    - A well blow-out?
    - A loss of inventory from a vessel, flowline or bunkering hose?
    - The release of small quantities of oil?
  - A release of fuel oil inshore via:
    - A loss of inventory from a vessel due to loss of power, collision or grounding?
    - A loss of inventory from a bunkering / transfer hose?

- A release of fuel oil or chemicals at-shore via:
  - Day-to-day activities at the Temporary Dock Facility?
  - Loss of containment during bulk transfers?

9.2 ENVIID outcomes - preliminary impact assessment and screening

The ENVIID workshop resulted in a detailed list of all planned activities and unplanned and accidental events that could lead to impacts and / or the risk of impacts. A preliminary assessment of their significance was latterly undertaken by the environmental team using the methodology described in Chapter 8. The preliminary assessment was used to determine which of the potential impacts and risks required further investigation in this EIA and which could be '**Scoped out**'.

Specific activities and associated impacts were '**Scoped out**' of further assessment when:

- It was established, with a high degree of confidence during the preliminary assessment, that the significance of the impact of the activity would be '**Very Low'**,
- It was determined that the impact could not occur owing to prevention measures built-in to the Development, and / or
- It was estimated that the impact from a particular source would be sufficiently covered by the assessment of a similar impact or risk of greater magnitude. For example, not every single source of small oil spill was assessed in place of a general assessment of the chronic impact of repeated small releases of oil (Section 12.1).

Aspects and impacts were '**Scoped in**' for a more detailed assessment when:

- Identified impacts and risks had the potential to be of '**Low**' significance, or above,
- Where there was any uncertainty as to the significance of the impact or risk, and / or
- Concern had been expressed by stakeholders during the scoping consultations (Chapter 6).

Table 9.1, Table 9.2 and Table 9.3 provide a summary of the outcomes of the offshore, inshore and onshore ENVIIDs respectively and indicate those aspects, impacts and risks that were '**Scoped out**' and those for which further investigation was considered necessary.

Note: The activities / aspects that were identified as a concern during the informal stakeholder scoping consultation are described and identified in Chapter 6.

Table 9.1: Summary of the outcomes of the *offshore* ENVIID and the preliminary assessment, which was used to determine the environmental and social aspects, impacts and risks that required further investigation in the EIA

Project activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative	Comments
Action required: F = Further assessment required; S = Scoped out of EIA																				
Offshore operations: Subsea installation, drilling, production, offloading of crude from FPSO to CTT																				
Walk-through of planned activities and unplanned events offshore																				
Placement and presence of objects on the seabed e.g., anchors / manifolds	Placement of objects	P	F				F		F	F				F				S	F	**Section 10.3**: Placement of objects on the seabed. **Section 10.11:** Cetacean collisions / Entanglement Impacts to archaeological sites were **Scoped out** as there are no wrecks in the vicinity of the Sea Lion Field and wrecks near Stanley Harbour have been in place for many years with no impact from other vessels.
Presence of hard substrate on seabed following placement of objects	Placement of objects	P	F						F										F	
Large dropped objects	Placement of objects	U	F						F					S	S					
Small dropped objects e.g., a tool	Placement of objects	U	S											S						**Scoped out** during preliminary assessment: Sensitivity of receptor: 'Very Low'; Severity of effect: '**Slight**'

Project activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative	Comments
Offshore operations: Subsea installation, drilling, production, offloading of crude from FPSO to CTT																				
Walk-through of planned activities and unplanned events offshore																				
																				Overall Impact: '**Very Low**' Likelihood: '**Likely**' Overall Risk: '**Low**'
Use and discharge of chemicals during drilling	Drill cuttings and mud	P	F	F	F				F	F									F	**Section 10.6**: Discharge of drill cuttings and mud.
Discharge of drill cuttings to seabed		P	F	F	F				F	F									F	
Use of explosives downhole in the event of stuck-pipe when drilling	Underwater noise generation	P	S	S	S		S													**Scoped out** during preliminary assessment because downhole explosives to relieve stuck-pipe will be used at depths greater than 100 m downhole which means noise levels are largely dissipated by the time they reach the surface of the seabed. Therefore, no receptors are likely to be affected.

Action required:	
F	Further assessment required
S	Scoped out of EIA

Project activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative	Comments
Offshore operations: Subsea installation, drilling, production, offloading of crude from FPSO to CTT																				
Walk-through of planned activities and unplanned events offshore																				
Discharge of iron to the marine environment (e.g., in water-based mud)	Drill cuttings and mud; and Operational discharges	P		S						S										**Scoped out** during preliminary assessment: Sensitivity of receptor: 'Very Low'; Severity of effect: '**Slight**' Overall Impact: '**Very Low**'
Use and discharge of chemicals in produced water during initial production and PWRI unit commissioning	Operational discharges	P	F	F	F	F	F		F	F									F	**Section 10.7**: Operational discharges to sea Discharges associated with the chlorination of seawater were not considered separately as the resulting biocide (sodium hypochlorite) will be discharged with the produced water and are covered by the produced water assessment.
Discharge of oil in produced water during initial production and PWRI unit commissioning	Operational discharges	P	F	F	F	F	F		F	F									F	
PWRI unavailability and discharge of produced water (oil and chemicals) to sea	Operational discharges	U	F	F	F	F	F		F	F									F	
Chlorination of seawater through hypochlorite unit	Operational discharges	P								S										

Action required: F – Further assessment required; S – Scoped out of EIA

Project activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative	Comments
Offshore operations: Subsea installation, drilling, production, offloading of crude from FPSO to CTT																				
Walk-through of planned activities and unplanned events offshore																				
Process upsets and blockages leading discharge of produced water and / or use of more chemicals	Operational discharges	U	F	F	F	F	F		F	F									F	
Subsea discharges of chemicals e.g., pre-commissioning pipeline fluids or hydraulic fluid during valve actuation	Operational discharges	P	F							F									F	
Topside discharge of de-aerated / fresh water	Operational discharges	P		S	S					S										**Scoped out** during preliminary assessment: Sensitivity of receptor: 'Very Low'; Severity of effect: '**Slight**' Overall Impact: '**Very Low**'
Discharge of de-aerated injection water at seabed while flowing until hot	Operational discharges	P	S		S				S											
Sand requiring removal from separator during normal maintenance - oily solids and	Operational discharges	U		S	S					S										**Scoped out** during preliminary assessment: Sensitivity of receptor: 'Very Low';

Action required:	
F	Further assessment required
S	Scoped out of EIA

Project activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative	Comments
Offshore operations: Subsea installation, drilling, production, offloading of crude from FPSO to CTT																				
Walk-through of planned activities and unplanned events offshore																				
sands (not predicted to occur from Sea Lion)																				Severity of effect: '**Slight**' Likelihood of occurrence: 'Very Unlikely' Overall Risk: '**Very Low**'
Marine life sucked into seawater inlet valve when lifting seawater for injection	Operational discharges	P		S																**Scoped out** during preliminary assessment: Sensitivity of receptor: 'Very Low'; Severity of effect: '**Slight**' Overall Impact: '**Very Low**'
Cold start of dual fuel turbines with diesel and fall out of acidic liquid when the temperature is below the acid dew point.	Operational discharges	U								S										**Scoped out:** considered within general operational discharges
Discharge of hot water from cooling systems	Thermal discharges	P		F		F	F			F									F	**Section 10.7**: Thermal discharges to sea

Action required:
F – Further assessment required
S – Scoped out of EIA

Project activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative	Comments
Offshore operations: Subsea installation, drilling, production, offloading of crude from FPSO to CTT																				
Walk-through of planned activities and unplanned events offshore																				
Heat generated subsea (hot fluids inside piping and flowlines, electrically trace heated lines)	Thermal discharges	P	F		F				F										F	
Lighting on installations offshore from flaring	Artificial light	P		F	F	F	F												F	**Section 10.1**: Artificial light offshore
Generation of underwater noise by vessels offshore	Underwater noise	P	F	F	F	F	F												F	**Section 10.4**: Underwater noise offshore
Underwater noise from drilling	Underwater noise	P	F	F	F	F	F												F	
Power generation by vessels and installations offshore	Atmospheric emissions	P							F	F	S	F							F	**Section 10.9:** Atmospheric emissions
Venting during drilling operations e.g., bentonite / barite / cement tanks and mud shakers	Atmospheric emissions	P										F							F	**Section 10.1**: Artificial light offshore **Section 10.9**: Atmospheric emissions
Potential need to flare from MODU during initial well clean-up / testing	Atmospheric emissions /	P				F			F	F	S	F							F	

Action required:

F	Further assessment required
S	Scoped out of EIA

Action required:	
F	Further assessment required
S	Scoped out of EIA

Project activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative	Comments
Offshore operations: Subsea installation, drilling, production, offloading of crude from FPSO to CTT																				
Walk-through of planned activities and unplanned events offshore																				
	Artificial light					F			F	F		F							F	
Release of hydrocarbon gases/vapours from flare system, crude oil tanks and leaks	Atmospheric emissions	U										F							F	
HP Flare Pilot light	Atmospheric emissions / Physical Presence	P				F			F	F	S	F								
Need to flare from FPSO during process upset or incident	Atmospheric emissions	U				F			F	F	S	F							F	
Use of F-gases on MODU / FPSO	Atmospheric emissions	P										F							F	
Leakage of F-gas	Atmospheric emissions	U										F							F	
Generation of solid hazardous and non-hazardous waste	Waste	P													F		F		F	

Project activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative	Comments
Offshore operations: Subsea installation, drilling, production, offloading of crude from FPSO to CTT																				
Walk-through of planned activities and unplanned events offshore																				
Discharge of liquid waste streams to sea e.g., drainage, bilge, hypersaline, black and grey water	Waste	P		F	F	F	F			F									F	**Section 10.7.** Operational discharges **Section 10.10:** Waste Management **Section 10.13:** Introduction of terrestrial invasive species **Section 12.1** and **12.3** on offshore and at-shore spills
Loss of containment of solid waste offshore	Waste	U	F		F	F	F		F	F			F	F			F		F	
Loss of containment of liquid waste to sea	Waste	U		F	F	F	F		F	F									F	
Generation of excess waste owing to system malfunction (e.g., TCC goes down)	Waste	U													S					**Scoped out:** In the event that the TCC malfunctioned, no extra waste would be generated and cuttings would be stored until the TCC was operational again
Deluge water system activated	Waste	U								S										**Scoped out:** If the deluge system is triggered, it could backfill the open drains. However, these specific activities were not assessed further in the EIA as

Action required: F – Further assessment required; S – Scoped out of EIA

Project activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative	Comments
Offshore operations: Subsea installation, drilling, production, offloading of crude from FPSO to CTT																				
Walk-through of planned activities and unplanned events offshore																				
																				such discharges would be required under force majeure
Emptying of rainwater out of uncontaminated bunds into drainage system	Waste	P								S										**Scoped out** during preliminary assessment: Sensitivity of receptor: 'Very Low'; Severity of effect: '**Slight**' Overall Impact: '**Very Low**'
Washing of turbines to remove salt build-up etc. in turbine	Waste	P								S										**Scoped out:** Covered by hypersaline discharges in **Section 10.7.**
Presence of vessels and collision with a marine mammal offshore	Marine mammal collision	U					F												F	**Section 10.11**: Collision with marine mammals.
Marine growth on MODU / FPSO / vessels when they arrive at Sea Lion Field	Non-native species	U															S			**Scoped out:** The introduction of marine invasive species to the offshore environment is not

Action required:	
F	Further assessment required
S	Scoped out of EIA

Project activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative	Comments
Offshore operations: Subsea installation, drilling, production, offloading of crude from FPSO to CTT																				
Walk-through of planned activities and unplanned events offshore																				
Introduction of marine invasive species to offshore environment through ballast water / biofouling	Non-native species	U															S			considered to be a concern over and above the introduction to inshore waters owing to the short durations of vessels' presence and lack of proximity of vessels.
Introduction of marine invasive species from Falklands water to elsewhere in the world	Non-native species	U															S			**Scoped out:** out of scope; the ecosystems of remote Islands, such as the Falklands, are deemed of greater significance than the impacts of non-native species on regions that adjoin continental land masses
Presence of MODU, FPSO and vessels offshore	Physical presence	P												F					F	**Section 11.1:** Disruption to other users of the sea offshore
Presence of vessels offshore	Physical presence	P												F					F	

Action required:
F – Further assessment required
S – Scoped out of EIA

Project activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative	Comments
Offshore operations: Subsea installation, drilling, production, offloading of crude from FPSO to CTT																				
Walk-through of planned activities and unplanned events offshore																				
Presence of 500 m exclusion zone around MODU / Wells and 1,275 m around the FPSO	Physical presence	P												F					F	
Submerged turret buoy - 50 m below surface - in exclusion zone	Physical presence	P												F					F	**Section 11.1**: Disruption to other users of the sea offshore
Collision between vessels leading to loss of third-party vessel	Physical presence	A												F	F					**Section 10.11**: Disruption to other users of the sea offshore
Water returns through restricted orifice at entrance to caisson will lead to aeration of discharge assisting marine growth, creating noise and requiring cleaning	Underwater noise / non-native species	P					S			S							S			**Scoped out:** Native marine growth will have no discernible impact and underwater noise will not be discernible over other sources assessed in **Section 10.4**
Topside release of reservoir hydrocarbon	Oil spill	A	F	F	F	F	F		F	F			F	F	F	F			F	**Section 12.1**: Accidental and chronic oil pollution offshore
Well blow-out	Oil spill	A	F	F	F	F	F		F	F			F	F	F	F			F	
Damage to infrastructure leading to leaks e.g., rupture of flowlines	Oil spill	A		F	F	F	F			F						F			F	**Section 12.1**: Accidental and chronic oil pollution offshore

Action required:
- F: Further assessment required
- S: Scoped out of EIA

Project activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative	Comments
Offshore operations: Subsea installation, drilling, production, offloading of crude from FPSO to CTT																				
Walk-through of planned activities and unplanned events offshore																				
Loss of diesel inventory of vessel	Oil spill	A	F	F	F	F	F		F	F			F	F					F	
Loss of inventory of reservoir hydrocarbon on FPSO	Oil spill	A	F	F	F	F	F		F	F			F	F	F	F			F	
Subsea leak of reservoir hydrocarbon	Oil spill	A	F	F	F	F	F		F	F					F	F			F	
Potential for chronic impact from small volume releases of oil e.g., rupture of hoses, malfunction in couplings / valves, human error.	Oil spill	A	F	F	F	F	F		F	F			F	F					F	**Section 12.1:** Accidental and chronic oil pollution offshore
Build-up of oil in the top of the PW discharge caisson	Oil spill	A		F	F	F	F			F									F	
Collision between Development vessels and third-party vessel	Oil spill	A	F	F	F	F	F		F	F				F	F	F		S	F	**Section 12.1**: Accidental and chronic oil pollution offshore
Loss of station of MODU and potential for loss of riser contents	Oil spill	A	S	S	S				S	S										**Scoped out:** MODU will be held in position by anchor, rather than dynamic positioning.

Action required:

F	Further assessment required
S	Scoped out of EIA

Project activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative	Comments
Offshore operations: Subsea installation, drilling, production, offloading of crude from FPSO to CTT																				
Walk-through of planned activities and unplanned events offshore																				
																				Note other causes of loss of riser contents have been assessed in **Section 12.1**
Leaks of oil or chemical to deck	Oil spill	A								S					S					**Scoped out:** Leaks and small spills to deck will be contained within the hazardous drains system.
Collision during direct offtake of crude from the FPSO to a CTT	Oil spill	A	F	F	F	F	F		F	F				F	F	F		S	F	**Section 12.1:** Accidental and chronic oil pollution offshore
Hose rupture during direct offtake of crude from the FPSO to a CTT	Oil spill	A	F	F	F	F	F		F	F				F	F	F		S	F	**Section 12.1**: Accidental and chronic oil pollution offshore

Action required:	
F	Further assessment required
S	Scoped out of EIA

[1] The term 'regional' refers to 'a specific area on Earth that is defined by its unique characteristics and common feature'. In the context of the Sea Lion field, the term regional would refer to the Northern Slope.

Table 9.2: Summary of the outcomes of the *inshore* ENVIID and the preliminary assessment, which was used to determine those environmental and social aspects, impacts and risks that required further investigation in the EIA

Action required:		Project Activity	Environmental Aspect	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities																Cumulative Impact	Comment
					Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / Other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological		
F	Further assessment required	**Inshore operations: Use of Berkeley Sound as a logistics base during the subsea installation campaign**																				
S	Scoped out of EIA	**Walk-through of planned activities and unplanned events inshore**																				
		Presence of LTVs in Berkeley Sound (maximum two at any time)	Physical presence	P					F						F	F	F		F		F	**Section 10.11:** Cetacean collisions / Entanglement **Section 11.2**: Disturbance to other users of the sea inshore **Section 11.8**: Disturbance to human population from light **Scoped out:** Dislocation of marine mammals from feeding grounds has been scoped out as the LTV's will occupy only 0.004 % of the available area.
			Seabed disturbance	P	F		F			F	F									S	F	**Section 10.3**: Disturbance to seabed
			Visual impact	P												S					S	**Scoped out:** LTVs to be on location for a maximum of 13 months over the course of Stage 1, 2a & 2b.

Action required:		Project Activity	Environmental Aspect	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities																Cumulative Impact	Comment
					Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / Other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological		
F	Further assessment required																					
S	Scoped out of EIA																					
Inshore operations: Use of Berkeley Sound as a logistics base during the subsea installation campaign																						
Walk-through of planned activities and unplanned events inshore																						
																						Unlikely to stand out over other vessel traffic.
		Air quality											S								S	**Scoped out:** The LTVs will be present at sea for a maximum duration of 13 months and will be at anchor.
Use of artificial lighting on vessels inshore		Artificial light	P					F	F							F					F	**Section 10.1**: Artificial light **Section 11.8:** Disturbance to human population from light
Underwater noise generated by LTV's and all vessels during inshore operations		Underwater noise	P	F	F	F	F	F													F	**Section 10.5**: Underwater noise inshore
Fuel combustion for power generation by all vessels during all activities		Atmospheric emissions	P							F	F	S	F								F	**Section 10.9**: Atmospheric emissions
Fugitive emissions during fuel transfer operations		Atmospheric emissions	P									S	S								F	

Action required:		Project Activity	Environmental Aspect	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities																Cumulative Impact	Comment
					Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / Other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological		
F	Further assessment required																					
S	Scoped out of EIA																					
Inshore operations: Use of Berkeley Sound as a logistics base during the subsea installation campaign																						
Walk-through of planned activities and unplanned events inshore																						
		Generation of solid hazardous and non-hazardous solid or liquid waste	Waste	P													F				F	**Section 10.7** Operational Discharges **Section 10.10**: Waste Management **Section 12.1** and **12.3** on spills Offshore and At-shore
		Management of liquid / solid waste streams when inshore e.g., macerated food, drainage, bilge, hypersaline, black and grey water	Waste	P												F					F	
		Discharge of liquid waste streams to sea e.g., macerated food, drainage, bilge, hypersaline, black and grey water	Waste	P		F	F	F				F									F	
		Loss of containment of solid waste inshore	Waste	U				F	F	F					F							
		Loss of containment of liquid waste to sea	Waste	U		F	F				F	F										

Action required:		Project Activity	Environmental Aspect	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities																Cumulative Impact	Comment
					Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / Other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological		
F	Further assessment required																					
S	Scoped out of EIA																					
Inshore operations: Use of Berkeley Sound as a logistics base during the subsea installation campaign																						
Walk-through of planned activities and unplanned events inshore																						
		Collision of a vessel with a marine mammal offshore	Marine mammal collision	U					F												F	**Section 10.11**: Collision with marine mammals.
		Introduction of marine invasive species to Berkeley Sound from vessel ballast water / biofouling	Non-native species	U	F	F	F	F	F	F						F			F		F	**Section 10.12**: Introduction of marine invasive species
		Spread of marine invasive species from Stanley Harbour to Berkeley Sound from biofouling	Non-native species	U	F	F	F	F	F	F						F			F		F	
		Fuel bunkering for support vessels	Physical presence	P							F				F	F					F	**Sections 11.1 and 11.2:** Increased vessel presence and other sea users
		Generation of airborne noise by inshore operations	Physical presence	P												F					F	**Section 11.9**: Disturbance to human population from noise
		Fuel spill from OSV due to collision, power grounding, drift grounding, non-	Oil spill	A	F	F	F	F	F	F	F	F			F	F	F	F			F	**Section 12.2**: Accidental and chronic oil pollution inshore

Action required:		Project Activity	Environmental Aspect	Planned / Unplanned / Accidental	Receptors which may be impacted by the activities																Cumulative Impact	Comment
					Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / Other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological		
F	Further assessment required																					
S	Scoped out of EIA																					
Inshore operations: Use of Berkeley Sound as a logistics base during the subsea installation campaign																						
Walk-through of planned activities and unplanned events inshore																						
		accidental structural failure and foundering, fire / explosion																				
		Potential for chronic impact from small volume releases of oil e.g., rupture of hoses, malfunction in couplings / valves, human error	Oil spill	A	F	F	F	F	F	F	F	F			F	F	F	F			F	**Section 12.2**: Accidental and chronic oil pollution inshore

[1] The term 'regional' refers to 'a specific area on Earth that is defined by its unique characteristics and common feature'. In the context of the Sea Lion field, the term regional would refer to the Northern Slope.

Table 9.3: Summary of the outcomes of the onshore, at-shore and logistics ENVIID, which describes all the activities required to support the offshore and inshore activities associated with the project and the aspects, impacts and risks that required further investigation in the EIA

Action required:	
F	Further assessment required
S	Scoped out of EIA

Project Activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors that may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / Other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative Impact	Comments
Onshore and at-shore operations required in support of all offshore and inshore activities described above: Presence and use of onshore supply base and use of port facilities																				
Walk-through of planned activities and unplanned events onshore and at-shore																				
Fuel combustion in vessel use e.g., ships, cars, forklift etc.	Atmospheric emissions	P							F	F	S	F								**Section 10.9**: Atmospheric emissions
Generation of waste at supply base	Waste	P													F					**Section 10.10**: Waste management **Section 12.1** and **12.3** on spills Offshore and At-shore
Domestic and office waste at supply base	Waste	P													F					
Presence of additional personnel on Falkland Islands and domestic waste	Waste	P												F	F					
Loss of containment of solid waste at supply base	Waste	U				F	F	F					F							

Action required:	
F	Further assessment required
S	Scoped out of EIA

Project Activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors that may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / Other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative Impact	Comments
Onshore and at-shore operations required in support of all offshore and inshore activities described above: Presence and use of onshore supply base and use of port facilities																				
Walk-through of planned activities and unplanned events onshore and at-shore																				
Loss of containment of liquid waste at supply base - discharge to drainage	Waste	U							F											
Loss of containment of liquid waste at supply base - discharge to soil	Waste	U							F											
Use of the Existing TDF for offloading of cargo and loading of supply vessels, and use of FIPASS (freshwater and fuel supply only)	Physical presence	P					F							F	F				F	**Section 10.11** Cetacean collisions / Entanglement **Sections 11.1 and 11.2:** Increased vessel presence and other sea users
Use of diesel to support all activities	Competition for resource	P												S					S	**Scoped out:** need met according to basic market forces

Project Activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors that may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / Other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative Impact	Comments
Onshore and at-shore operations required in support of all offshore and inshore activities described above: Presence and use of onshore supply base and use of port facilities																				
Walk-through of planned activities and unplanned events onshore and at-shore																				
Use of freshwater to support all activities	Competition for resource	P												F	F				F	**Section 11.4:** Competition for freshwater
Use of food to support all activities	Competition for resource	P												S						**Scoped out:** need met according to basic market forces
Use of accommodation to support all activities	Competition for resource	P												F	F				F	**Section 11.3:** Competition for accommodation
Use of electricity to support all activities	Competition for resource	P												F	F				F	**Section 11.5:** Competition for electricity
Use of flights to support all activities	Competition for resource	P												F					F	**Section 11.6:** Competition for resources – air links

Action required:	
F	Further assessment required
S	Scoped out of EIA

Project Activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors that may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / Other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative Impact	Comments
Onshore and at-shore operations required in support of all offshore and inshore activities described above: Presence and use of onshore supply base and use of port facilities																				
Walk-through of planned activities and unplanned events onshore and at-shore																				
Use of sewage infrastructure to support all activities	Competition for resource	P												F	F				F	**Section 10.10:** Waste
Use of roads to support all activities	Competition for resource	P									F			F	F				F	**Section 11.7**: Competition for resources – roads
Lighting on TDF and supply base	Physical presence	P				F								F					F	**Section 10.1**: Artificial light **Section 11.2:** Other users inshore **Section 11.8**: Disturbance to human population from light **Section 11.9:** Disturbance to human population from noise
Presence of vessels in port facilities	Physical presence	P												F	F				F	
Physical presence and use of laydown and storage bases in supply base	Physical presence	P												F					F	

Action required:

F	Further assessment required
S	Scoped out of EIA

Action required:	
F	Further assessment required
S	Scoped out of EIA

Project Activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors that may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / Other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative Impact	Comments
Onshore and at-shore operations required in support of all offshore and inshore activities described above: Presence and use of onshore supply base and use of port facilities																				
Walk-through of planned activities and unplanned events onshore and at-shore																				
Introduction of non-native marine species from vessel ballast water / biofouling	Non-native species	U	F	F	F	F	F										F		F	**Section 10.12**: Introduction of marine invasive species **Section 10.13:** Introduction of terrestrial invasive species
Delivery of cargo and potential introduction of non-native terrestrial species on cargo	Non-native species	U						F					F	F	F		F		F	
Spillage of liquid cargo e.g., chemical containers at TDF during loading to supply vessels	Spill	A	F	F	F	F	F	F	F	F			F	F	F	F			F	**Section 12.3**: Accidental and chronic oil pollution at-shore
Spillage of fuel at TDF / FIPASS	Oil spill	A	F	F	F	F	F	F	F	F			F	F	F	F			F	
Fuel combustion by all shipping, vessel, land transport, fixed wing and helicopter use	Atmospheric emissions	P							F	F	S	F							F	**Section 10.9**: Atmospheric emissions
Temporary waste incineration at supply base (note this is	Air quality	P									S								S	**Scoped out:** FIG have approved plans for a new municipal waste facility and the project

Action required:	
F	Further assessment required
S	Scoped out of EIA

Project Activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors that may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / Other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative Impact	Comments
Onshore and at-shore operations required in support of all offshore and inshore activities described above: Presence and use of onshore supply base and use of port facilities																				
Walk-through of planned activities and unplanned events onshore and at-shore																				
contingent only as it expected that the new FIG municipal facility will be complete)																				will only provide stand-alone incineration in the event that this is not available. The temporary siting of a supply base incinerator is not considered to add cumulatively to any impacts already present from the FIMCO incinerator due to their relatively distant locations.
Use of vessels offshore, inshore and at port facilities	Physical presence	P												F	F				F	**Sections 11.1 and 11.2:** Increased vessel presence and other sea users **Section 11.8**: Disturbance to human population from light **Section 11.9**: Disturbance to human population from noise **Note:** the use of vessels contributes to very many of the potential impacts and so is listed
At-shore collision between Navitas vessels	Physical presence	U												F	F				F	
At-shore collision between a Navitas and third-party vessel	Physical presence	U												F	F				F	

Project Activities	Environmental Aspects	Planned / Unplanned / Accidental	Receptors that may be impacted by the activities: Benthos	Plankton	Fish / cephalopods	Seabirds	Marine mammals	Designated sites	Seabed and soil	Water quality	Regional[1] air quality	Global atmosphere	Landscape / seascape	Human population / Other users	Tangible property	Commercial fisheries	Biosecurity / Biodiversity	Archaeological	Cumulative Impact	Comments
Onshore and at-shore operations required in support of all offshore and inshore activities described above: Presence and use of onshore supply base and use of port facilities																				
Walk-through of planned activities and unplanned events onshore and at-shore																				
																				as a source of impact in numerous chapters (Table 2.2)
Airborne noise from use of helicopters for transporting personnel to and from the Islands' to the MODU / FPSO and CTT	Noise disturbance	P				F	F							F	F				F	**Section 10.2**: Disturbance to wildlife from helicopter use **Section 11.9**: Disturbance to human population noise
The potential for nuisance caused by dust and odour from the onshore supply base and TDF, e.g., yard surfacing, dry bulk chemicals and storage and mixing of other chemicals.	Dust / odour nuisance	P												S						**Scoped out:** Design, operation and management of the yard and TDF will minimise any dust and odour. Additionally, predominant westerly winds will direct dust and odour away from Stanley.

Action required:

F	Further assessment required
S	Scoped out of EIA

[1] The term 'regional' refers to 'a specific area on Earth that is defined by its unique characteristics and common feature'. In the context of the Sea Lion field's onshore and at-shore operations, the term regional would refer to the Stanley area.

10 ENVIRONMENTAL IMPACT AND RISK ASSESSMENT

Table of Contents

10.1 Artificial light 613
10.2 Onshore disturbance to wildlife from helicopter use 646
10.3 Disturbance to seabed 659
10.4 Underwater noise - Offshore 682
10.5 Underwater noise inshore 721
10.6 Discharge of drilling fluid and cuttings 740
10.7 Operational Discharges 773
10.8 Thermal discharges 817
10.9 Atmospheric emissions 829
10.10 Waste Generation and Management 888
10.11 Collision / entanglement between cetaceans, vessels and moorings 920
10.12 Introduction of marine non-native species 939
10.13 Introduction of terrestrial non-native species 964

10.1 Artificial light

Table of Contents

10.1.1 Introduction 615
10.1.1.1 Relevant legislation 615
10.1.2 Sources of impact and risk 616
10.1.2.1 Navigational lights 617
10.1.2.2 Living spaces 617
10.1.2.3 Deck lights 617
10.1.2.4 Flaring 617
10.1.3 Potential receptors 618
10.1.4 Characterising and quantifying the impact 618
10.1.4.1 Influencing factors 618
10.1.4.1.1 Number of Phase 1 & 2 light sources and duration of light exposure 619
10.1.4.1.2 Location of light sources 619
10.1.4.1.3 Intensity of light 620
10.1.4.1.4 Orientation of lights 621
10.1.4.2 Impacts of attraction to artificial light 622
10.1.4.2.1 Zooplankton, fish and squid 622
10.1.4.2.2 Seabirds 622
10.1.4.2.3 Marine Mammals 623
10.1.4.3 Risks associated with artificial light 623
10.1.4.3.1 Seabird collisions 623
10.1.4.3.1.1 Direct and indirect mortality 624
10.1.4.3.1.2 Seabird behaviour and susceptibility to l light and collision 624
10.1.4.3.1.3 Weather conditions and moon phase 625
10.1.4.3.1.4 Susceptible seabirds and their abundance 625
10.1.4.3.1.5 Historical observations of bird-strike associated with O&G in the Falkland Islands 628
10.1.5 Industry standard mitigations 629
10.1.6 Impact and risk assessment 630
10.1.6.1 Impact assessment of attraction to offshore artificial light 630
10.1.6.1.1 Attraction of marine life (zooplankton, fish and squid) 630
10.1.6.1.2 Attraction of seabirds in the Sea Lion Field 630
10.1.6.1.3 Attraction of seabirds in Berkeley Sound 631
10.1.6.2 Risk assessment of artificial light use 632
10.1.6.2.1 Risk of small scale seabird strikes in the Sea Lion Field 632
10.1.6.2.2 Risk of multiple (large scale) seabird strikes in the Sea Lion Field 632
10.1.6.2.3 Risk of small-scale seabird strikes in Berkeley Sound 633
10.1.6.2.4 Risk of multiple seabird strikes in Berkeley Sound 633
10.1.6.3 Indirect impacts and impact interactions 634
10.1.7 Project-specific mitigation 634
10.1.7.1 Reducing light pollution 634
10.1.8 Residual impact assessment 637
10.1.9 Cumulative impacts 638

10.1.9.1 Sea Lion Field 638
10.1.9.2 Berkeley Sound 638
10.1.10 Confidence 642
10.1.10.1 Monitoring required 643
10.1.11 Offsetting 643
10.1.12 Findings summary 643

10.1.1 Introduction

Numerous vessels and offshore installations will be used throughout the three Stages of the Phase 1 & 2 Sea Lion Development, each of which requires the use of artificial light. Further, while there is a zero planned flaring philosophy once into steady state production, there is a contingency within the basis of design to test up to four wells to the Mobile Offshore Drilling Unit (MODU) which would require short-term flaring (Section 5.4.8) and up to 30 days flaring will be required during commissioning of the gas system (Section 5.4.9).

The level of anthropogenic light in the night-time sky has increased dramatically in recent decades and is increasingly becoming an issue relating to impacts on biodiversity (Hölker, *et al.,* 2010). Additionally, light was raised as a concern by stakeholders during consultations in 2014, 2015 and 2016 (Chapter 6). Where light has the potential to adversely effect humans or other animals, this is referred to as 'light pollution' (see Davies, *et al.,* 2014 for review). However, most ecological studies take place during day-light hours and therefore the extent of the ecological consequences of light pollution are only just beginning to be appreciated.

Artificial light and flares can affect the natural behaviour of animals in several ways including disturbance to activity patterns and hormone-regulated processes dictated by the internal clock. A more obvious effect however, is the attraction of animals and seabirds to man-made light sources and their subsequent disorientation. This phenomenon is known as positive phototaxis.

Positive phototaxis is actively exploited to catch species of squid (FAO, 2014), with approximately 63-89 % of the global squid catch being made by light-fishing vessels (jiggers). Equally, it has long been known that seabirds are attracted to lights at-sea (Murphy, 1936), which has also been exploited as a technique for capturing seabirds. There is a growing awareness of the impact that anthropogenic sources of light are having on seabirds (Montevecchi, 2006; Marangoni, *et al.,* 2022), although quantitative studies are few in number (e.g., Rodríguez, *et al.,* 2015b; 2017).

This chapter assesses the potential ecological impacts and risks associated with anthropogenic light arising from the Phase 1 & 2 Development of the Sea Lion Field, which include:

- Attraction of marine life, e.g., plankton, fish and squid, and
- Attraction of seabirds and subsequent collision risk with vessels or flares.

Note: the other impacts associated with vessel use are described elsewhere in this document, as are the social impacts of artificial light on humans, as described in Table 2.2.

10.1.1.1 Relevant legislation

Outside the EIA process for major projects, no legislation is in place in the Falkland Islands to govern the environmental impact of artificial light, although offshore industry guidelines are in place (see Section 10.1.5 below).

While not directly related to the environmental impact of artificial light, it is important to understand during this assessment that mitigation measures will be limited by the need to ensure the use of sufficient lighting for safety reasons. Specifically, offshore installations are required to be illuminated in line with the:

- International Regulations for the Prevention of Collisions at Sea (ColRegs) (Rule 22 and Annex 1).

Lighting of the Floating Production, Storage and Offloading (FPSO) vessel and MODU decks, walkways and process areas will be governed by compliance with occupational safety requirements and process safety requirements. For example, the FPSO design requires that luminance levels for general and

emergency operating conditions shall be in accordance with IEC 61892-2 which follows from compliance with Falkland Islands health and safety legislation for the offshore industry.

Lighting of helicopter landing areas (FPSO, MODU and Commercial Trading Tanker (CTT)) is a requirement of CAP 437 (CAA, 2013).

Offshore flaring (i.e., flaring associated with well testing, well clean-up operations and pressure relief) is regulated in the Falklands by the Department of Mineral Resources (DMR) under the:

- Offshore Mineral Ordinance 1994 (1997 and 2011 Amendments).

10.1.2 Sources of impact and risk

Offshore operations associated with the Development will introduce several sources of artificial light into the offshore waters of the North Falkland Basin (NFB), and in Berkeley Sound, all of which will add to the existing ambient light (Section 10.1.9).

As a worst-case, the Phase 1 & 2 Development sources of artificial light and flaring will include the following:

- Vessels:
  - Within the Sea Lion Field:
    - The MODU,
    - Installation / construction vessels,
    - The FPSO,
    - Supply / support vessels,
    - An Emergency Response and Rescue Vessel (ERRV), and
    - Oil export CTT and Offshore Support Vessel (OSV) used for direct offtake.
  - In transit to inshore locations:
    - *Ad hoc* freighter vessels,
    - Offshore Construction Vessels (OCV),
    - Supply / support vessels, and
    - Large Transport Vessels (LTVs).
  - Within Berkeley Sound:
    - Up to two LTVs in the Sound at any one time, and
    - Subsea Construction Vessel/s during subsea construction.
- Flaring:
  - From the MODU during contingent well clean-up / testing,
  - Permanent flare pilot light on the FPSO,
  - From the FPSO during shut-down and start-up, and
  - In the event of emergency blowdowns

Sources of light on the Phase 1 & 2 vessels will include:

- Navigational lights,
- Illuminated living spaces within all vessels,
- Floodlighting to provide a safe working environment on the decks of ships and MODU,
- Flaring from the MODU during contingent well clean-up and testing,
- Small permanent pilot flare of associated gas from the FPSO, and

- Periodic high-pressure (HP) flaring of gas, only in the event of a blowdown.

The number and type of vessels present at the Sea Lion Development site will vary with the Stage of the Field's development and the activities undertaken (Section 5.11.2). Away from the Development site, support vessels will regularly steam to and from the supply base in Stanley throughout all Stages. Throughout the life of the Development, activities will operate for 24 hours a day and to do this safely, all working areas will have to be well illuminated.

In Stage 1 of the subsea construction campaign, up to four LTVs will be used over a twelve month period. However, the current schedule expects that, during Stage 1, a maximum of two LTVs will be present in Berkeley Sound for a maximum of 13 non-consecutive months. Efforts will be made to avoid competition for sea room during the peak fishing period.

It is expected that Stage 2a only one LTV will be moored for a duration of approximately four months. During Stage 2b, the construction campaign is expected to require an additional three LTVs which would be expected to be on location in Berkley sound for no more than six months. Again, there will be only two LTVs onsite at any one time.

Offshore, direct offtake to the CTT from the FPSO requires the presence of an Offshore Support Vessel (OSV) to manoeuvre and hold the CTT in place during the offtake operation.

10.1.2.1 Navigational lights

Vessels are required to display navigational lights when at-sea. These are relatively small coloured lights (white, red and green) that are of low intensity to avoid glare. Alone, these lights are unlikely to cause impacts or pose any risk (see Poot, *et al.,* 2008).

10.1.2.2 Living spaces

Light can be emitted from living spaces (accommodation, mess rooms etc.) through uncovered portholes and windows on the rig and other vessels (Figure 10-1).

10.1.2.3 Deck lights

Deck lighting is required to provide a safe working environment. These lights are usually very bright floodlights, designed to illuminate a wide area. It is these light sources that are most difficult to manage as they are outside and are essential for safe working practices (Figure 10-1).

10.1.2.4 Flaring

During steady state production from the Phase 1 & 2 Sea Lion Development, there will be no routine flaring of gas with the majority of excess gas being reinjected into the Gas Injection (GI) well (Section 5.8.4.4). However, for safety reasons, there will be a small constant gas fed pilot flare at the end of the flare boom. Periodically, excess gas and hydrocarbons may be burned off by flaring during start-up following process and emergency shutdowns, or during emergency blowdowns.

No flaring is planned during the drilling process as the Open Hole Gravel Pack completion is designed to minimise debris such that clean-up to the MODU will not be required. All wells will be flowed back to the FPSO. However, the contingency is retained to flow / test up to four wells to the MODU (Section 5.4.8). Any flaring would be carried out for one day per well. Further, 30 days flaring will be carried out during the commissioning of the gas system (Section 5.4.9).



a) Lighting arrangement for a representative MODU



b) Lighting arrangement for a representative FPSO

Figure 10-1: Photographs of representative offshore lighting arrangements

10.1.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify those environmental receptors upon which the impacts and / or risks of artificial light warranted further investigation (Chapter 9). These include:

- Zooplankton (Section 7.4.1.3),
- Fish and squid offshore and inshore (Section 7.4.4),
- Seabirds offshore and inshore (Section 7.4.5), and
- Marine mammals offshore and inshore (Section 7.4.6).

The offshore marine environment is essentially dark at night, except for moonlight and sources of bioluminescence. The above receptors have evolved to function in accordance with a diurnal cycle where, over any 24-hour period, there are predictable periods of daylight and darkness. The introduction of artificial light during the hours of darkness therefore has the potential to confuse the circadian rhythms (the body clock) followed by the receptors over the 24-hour cycle, leading to impacts on normal behaviour as well as the risk of collision for seabirds.

10.1.4 Characterising and quantifying the impact

When characterising and quantifying the impacts and risks of artificial light it is necessary to consider the:

- Influencing factors,
- The impact of attraction to artificial light and flares, and
- The risk of collision caused by artificial lights and flares.

10.1.4.1 Influencing factors

The potential impact of artificial light from the project's Phase 1 & 2 Development on marine life is influenced by the:

- Number of Phase 1 & 2 light sources and the duration of light exposure,
- Location of light sources,
- Intensity of light,
- Orientation of light,

- Season of activity (and the likely occurrence of receptors), and
- Local weather conditions.

10.1.4.1.1 Number of Phase 1 & 2 light sources and duration of light exposure

The number of light sources and the duration of light exposure during each different stage of the operation is summarised in Table 10.1.

Table 10.1: Number, source and duration of lights during the Phase 1 & 2 Development

Phase 1 & 2 Development Stage		Duration of Stage	Light sources
Offshore			
Phase 1 wells	Stage 1: Mobilisation and installation of materials and equipment, pre-First-Oil drilling by MODU, installation, hook up and commissioning of the FPSO and 'First-Oil'	31 months	Installation vessels, MODU, FPSO, support vessels, oil export vessels and potential flaring
	Stage 2a: SIMOPS with post First-Oil drilling by the MODU and concurrent production operations by the FPSO and oil export	7 months	
	Stage 3: Steady phase production	28 months	FPSO, support vessels and oil export vessels
Phase 2	Stage 2b: SIMOPs SIMOPS with in-fill drilling by the MODU and concurrent production operations by the FPSO and oil export	28 months	Installation vessels, MODU, FPSO, support vessels, oil export vessels and potential flaring
	Stage 3: Steady phase production	325 months (27.1 years)	FPSO, support vessels and oil export vessels
Inshore (Berkeley Sound)			
Phase 1 & 2	Stages 1, 2a & 2b: Anchoring and operation of LTVs	Intermittently for a total of up to 13 months	Up to four separate LTVs with only two anticipated to be *in situ* at any one time, Installation / construction vessels

10.1.4.1.2 Location of light sources

Should initial well clean-up be required to the MODU, flaring will take place from the MODU (Section 5.4.8), whereas intermittent flaring carried out during production (Stage 3) during shutdowns etc. (Section 5.9.4) will take place from the FPSO.

Most of the vessel activity that requires deck lighting will be based offshore at the Sea Lion Field location, which represents a fixed / permanent source of light.

Inshore, up to two LTVs will be temporarily anchored in Berkeley Sound in support of the subsea construction campaign.

Deck lighting will have to be maintained by all vessels to provide a safe working environment.

When in transit to and from inshore waters, light will be limited to navigation lights in accordance with ColRegs (Section 10.1.1.1).

10.1.4.1.3 Intensity of light

Luminous intensity is the amount of light emitted in a given direction and is the most useful measure of 'brightness' with regards to environmental impact. It is measured in candelas, which are a measure of light emission (lumens) per 'solid angle' (steradian). This gives an indication of light intensity received by a receptor. Candelas are used to describe navigation standards for shipping and aviation. There is generally a positive relationship between the power consumption of a light source (in kilowatts) and the amount of light emitted, which is known as 'luminous efficacy' and is measured in 'lumens per watt' (lm/W).

The intensity of light emitted by each vessel will vary depending on activity. At the time of writing the exact identity of the specific vessels involved is unknown; however, some good representative comparisons can be made with vessels operating elsewhere (Figure 10-1 above) and with reference to regulatory requirements.

Marguenie and van de Laar (2004) experimented with the lighting of a gas-production platform (gas production platform L5) in the North Sea to investigate the relationship between light intensity and bird attraction (reported in Poot *et al.,* 2008). By disconnecting different sources of light, they were able to show that bird attraction was influenced by light intensity, although they were more concerned with migratory land birds than seabirds.

For illustrative purposes, Table 10.2 shows the power consumption of different lights on the L5 platform in Danish waters; this can provide a rough guide for light intensity as an increase in power consumption results in an increase in light intensity. It was thought that, at full intensity (30 kW) the light's influence extended 3-5 km from the platform. By way of comparison in the squid fishing industry, each jigger is equipped with lights totalling 300 kW and the fleet may contain up to 100 vessels within Falkland Islands waters.

The lights used on the MODU and large vessels are likely to differ from those on the L5 platform; however, it has been used as an example as information regarding the specific lighting specifications of the MODU or other vessels, are not yet available.

All vessels in the field (including the MODU, FPSO, standby vessel, and supply vessels) will, as a minimum, comply with the Collision at Sea Regulations (ColRegs) requirements for visibility. This requires vessels to maintain lighting that is visible over certain ranges. The lights in vessels of 50 m or more in length must be visible at the following minimum ranges:

- Masthead lights - six miles,
- Sidelights, sternlights and towing lights - three miles, and
- White, red, green or yellow all-round lights - three miles (Figure 10-2).

The intensity of a light visible over six nautical miles will typically be 94 candelas (ColRegs Annex 1).

For helicopter landing, some key requirements of CAA standards for offshore helicopter landing areas (CAP 437) (Section 10.1.1.1) are as follows:

- The periphery of the landing area should be delineated by omni-directional green perimeter lights visible from up to 1.5 nm in good visibility with a minimum intensity of three candelas in the horizontal plane going up to thirty candelas from above,
- The touchdown circle must be yellow light with a minimum intensity of 15 candelas in the horizontal plane up to 60 candelas from above, and
- The green 'H' heliport marking must have a minimum intensity of 10 candelas in the horizontal plane up to 60 candelas from above.

Table 10.2: Examples of the power required by different light sources on gas production platform L5, located in Danish waters in the North Sea

Source	Source power consumption (kW)
Navigational lights (red and green)	0.3
Sodium floodlights of crane	1.5
Helicopter platform	0.16
Landing lights	0.48
Platform total mostly tube lights (400 x 36 W) and sodium floodlights (20 x 400 W)	30

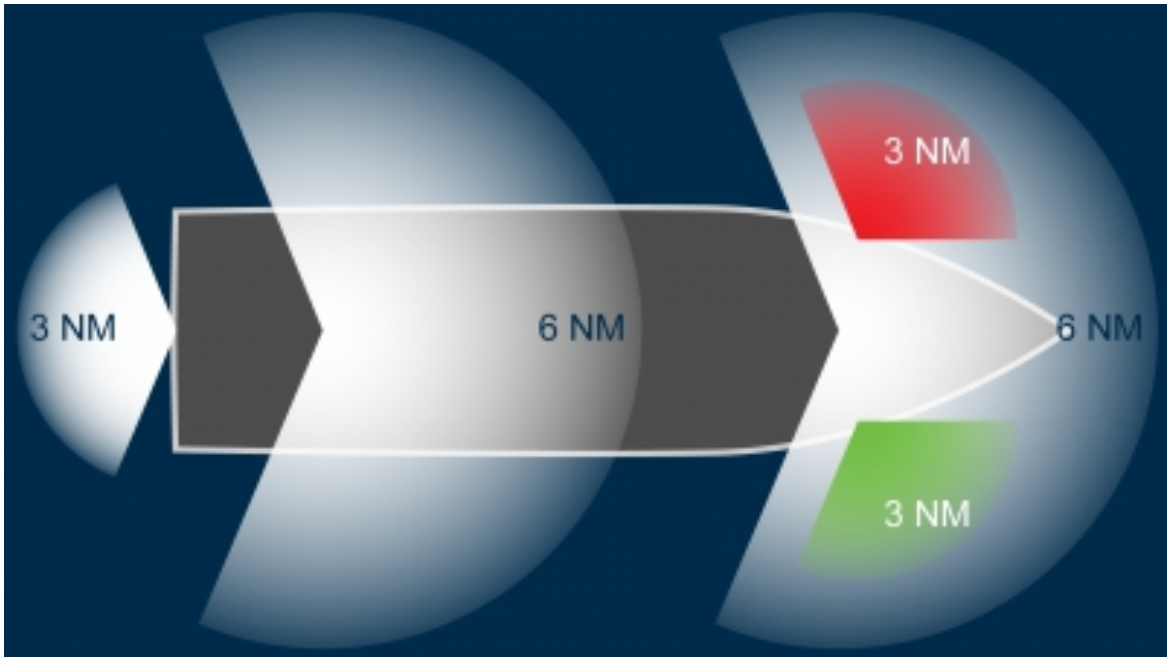


Figure 10-2: Navigational lighting requirements for a vessel over 50 m in length

10.1.4.1.4 Orientation of lights

Some lights, such as navigation lights, are designed to be seen by other vessels and therefore are orientated to face out-board. However, these are usually low intensity lights (Table 10.2 above; ColRegs, 2005). Helicopter platform and landing lights also face outwards, or upwards, to guide incoming aircraft; intensity is required to be highest near the horizontal plane and lowest in the vertical. These are also usually of relatively low intensity (Table 10.2 above).

The highest intensity lights are the deck or crane floodlights, which are generally orientated to illuminate any operational activity being undertaken on the deck of the vessel and surrounding water e.g., during supply boat transfers but can vary in orientation if following a moving load suspended on the crane.

Lights for escape purposes e.g., lifeboat positions must shine overside but their use is limited to actual use of the lifeboats or exercises.

During flaring the flame is emitted from the flare stack, the highest point on the MODU or FPSO (away from any other infrastructure), and would be vertically orientated, with a possible flame height of approximately five metres.

10.1.4.2 Impacts of attraction to artificial light

10.1.4.2.1 Zooplankton, fish and squid

It is well documented that marine zooplankton are attracted to artificial light (Davies, *et al.,* 2014). Aggregations of zooplankton may then attract small fish, which in turn attract larger predatory fish or squid. This effect appears to be more pronounced with static light sources. This principle is very successfully exploited by jigger fishing vessels to catch *Illex* squid (Argentine shortfin squid*, Illex argentinus*; Section 7.7.3.1.1).

Inshore, lobster krill is the 'species' most likely to be attracted to ships' lights that illuminate the water. These animals can form very dense shoals, which can attract predators and even interfere with a ship's ability to work by blocking water intake filters. Other species that may be attracted to ships' lights include squid (in the spawning season), and potentially rock cod, at the beginning of the calendar year through to March (P. Brickle, *pers. obs.*).

Experimental trials to investigate the impacts on abundance and behaviour of fish in response to artificial light indicated that nocturnal lighting created conditions that potentially benefit larger, piscivorous (fish-eating) fish. This outcome was believed to result from both the concentration of prey and the foraging advantage afforded to visual predators (Becker, *et al.,* 2013).

There are relatively few commercially exploitable pelagic (water-column) fish species in the deeper waters of the NFB or inshore waters. Catch statistics indicate that hoki is the most abundant species in the NFB (FIG, 2024b); however, it is likely that unexploited species such as lantern fish (Myctophidae) are also likely to be present. Inshore, species such as Falkland sprat, tessellated rock cod and smelt are known to be present. Section 7.4.4.2 contains further details regarding the distribution of fish in the NFB and inshore waters.

The spread of *Illex* squid catches indicates that there is considerable inter-annual variation in the distribution of this species. However, the distribution of fishing effort in some years indicates that a small proportion of the stock is likely to be near the Sea Lion Field during April and May (Waluda, *et al.,* 2008).

There are numerous other species of squid that are found within Falkland Islands waters. The most numerous of these is likely to be *Onykia ingens* (greater hooked squid), which is widespread at low density throughout the NFB but shows seasonal movement on and off the Shelf (Jackson, *et al.,* 1998; Arkhipkin, *et al.,* 2012b).

Inshore, loligo are very abundant off the east coast of the Islands. This species spawns inshore and the animals migrate into deeper waters (to the edge of the Patagonian Shelf) as they grow before migrating back inshore to spawn as they mature (Section 7.7.3.2.1.1).

Note: Much of the baseline data on fish and squid derives from fisheries surveys with less detail available on non-commercial species. It is accepted that light will also attract other squid and fish species in the area.

10.1.4.2.2 Seabirds

Seabirds take advantage of natural sources of light to find prey and to navigate. Both these essential life functions may be impacted by disorientation from artificial lights and flares. Seabirds may circle an artificial light source for prolonged periods using valuable energy reserves in a process which leads neither to feeding nor effective navigation, and both of which may result in exhaustion (*c.f.* NAM, 2007). Nonetheless, the greater impacts to seabirds result from the risk of collision with the light or flare, or landing on the vessel, both of which are characterised and quantified below in Section 10.1.4.3.1.

10.1.4.2.3 Marine Mammals

Research on the impact of artificial light on marine mammals remains limited. Existing studies, such as Miller and Rice (2023), indicate a lack of evidence supporting direct attraction behaviors of marine mammals to artificial light. This suggests that they are not inherently drawn to artificial light. However, indirect impacts may still occur (Section 10.1.6.3), particularly if marine mammals are attracted to prey species that aggregate around artificial light sources. For example, artificial light inshore may attract prey such as fish and lobster krill (*Grimothea gregaria*, formally *Munida gregaria*) which may in turn attract foraging species like sei whales. Sei whales are known to feed on lobster krill in Falkland Islands waters (Weir, 2022) and changes in prey distribution and abundance could influence their behavior and habitat use. However, there is little information on light attraction to lobster krill.

Therefore, further research is needed to better understand both the direct and indirect impacts of artificial light on marine mammals. Considering their documented sensitivity to other sensory pollutants, such as noise, it is likely that marine mammals respond to multiple stressors across varying gradients. Due to limited data available in the literature on this impact on marine mammals, this issue was not assessed further.

10.1.4.3 Risks associated with artificial light

10.1.4.3.1 Seabird collisions

Globally, there are issues regarding the interaction between birds and anthropogenic light sources. Birds can be impacted directly by a wide range of artificial light sources within marine environments. Of relevance to this assessment, they are often attracted to and collide with offshore hydrocarbon platforms (Ortego, 1978; Hope-Jones, 1980; Tasker, *et al.,* 1986; Baird, 1990; Wiese, *et al.,* 2001; Burke, *et al.,* 2005; NAM, 2007; Ronconi, *et al.,* 2015), as well as commercial fishing vessels and other boats using lights (Dick and Donaldson, 1978; Ryan, 1991; Arcos and Oro, 2002; Black, 2005a; Merkel and Johansen, 2011; Glass and Ryan, 2013).

The receptors can be broadly split into migratory land birds and seabirds. Although there is some seasonal movement of birds between the Falklands and South America, the location of the Sea Lion Field and Berkeley Sound are not regarded to be on the route of migrating land birds (White, *et al.,* 2002) and therefore the potential risk to seabirds is of greatest concern.

Light generated by the O&G industry, and other marine users, has the potential to lead to direct and indirect mortality from:

- The impact of a collision (OSPAR, 2012),
- Incineration in the flare - flaring is the most problematic form of artificial light at-sea, with a high risk of mortality posed to any birds flying too close to the flame (Hope-Jones, 1980; Montevecchi, 2006), and / or
- Loss of feather condition and hypothermia due to contact with the decks of vessels (Black, 2005a; Glass and Ryan, 2013).

Collisions between birds and vessels (known as bird-strikes) are episodic events that, in addition to influencing factors such as the amount and orientation of light (Section 10.1.4.1), are related to a number of other variables including:

- Visibility which can be affected by weather conditions (e.g., reduced visibility due to mist, fog or snow) and moon phase,
- Seabird behaviour (e.g., activity patterns, fledging), and
- Seabird abundance (e.g., large aggregations close to a breeding site)

The number of variables makes the risk of bird-strikes difficult to quantify or predict. Nonetheless, when all of these factors align, hundreds of birds can collide with a vessel on a single night. Although the Sea Lion Field is not located near breeding colonies or areas of notably high seabird density, the impact of lighting has been estimated to extend to 3-5 km around offshore installations (Marquenie, 2007), although it should be noted that this could vary with age / life-stage etc. Therefore, Navitas cannot rule out birds that may be attracted at a much greater distance and there is a risk of episodic bird-strikes throughout the life of the Development.

In contrast, Berkeley Sound contains the largest known colonies of sooty shearwaters and white-chinned petrels in the Falklands and a large number of birds congregate at the entrance to the Sound throughout the breeding season (September to May) (Section 7.4.5.3.2).

10.1.4.3.1.1 Direct and indirect mortality

With regard to the above, some individuals will be killed outright by a collision or contact with a flare, others may be injured, and others still may survive the initial impact.

The likelihood of direct mortality is species-specific and relates to flight style, with species like diving-petrels colliding at great speed being more likely to be killed outright by the impact than larger petrels and shearwaters that have a gentler landing (Glass and Ryan, 2013).

Once on the deck however, petrels, in particular, find it difficult to become airborne as these birds only come to land to breed in burrows and, unlike land birds or gulls, are not well adapted to walking. Therefore, petrels will often seek shelter under gratings, containers etc. This behaviour can potentially lead to indirect impacts in two ways:

- Hypothermia and death caused by contamination of feathers given that the decks of ships can be contaminated with oily, greasy residues and detergents as well as carrying hazards such as save-alls (devices intended to catch waste products and / or prevent losses) (MMS, 2010), and
- Condition loss and / or starvation caused by the time spent hidden away in nooks and crannies where they may stay for prolonged periods.

10.1.4.3.1.2 Seabird behaviour and susceptibility to artificial light and collision

Seabirds of all species can collide with any vessel at-sea whether at night or day. However, not all species are equally susceptible to light induced bird-strike. Diurnal albatrosses and petrels (i.e., active during the daytime) seem less likely to be involved in light induced bird-strikes than birds that are active at night (Wiese, *et al.,* 2001; Black, 2005a). However, fledglings of most species tend to depart from colonies at night and may be more vulnerable at this time (Rodríguez, *et al.,* 2015a). Attraction to artificial lights is particularly strong in small, planktivorous (plankton eating) procellariiform seabirds (i.e., petrels, shearwaters and storm-petrels) that remain active at night (Ryan, 1991; Black, 2005a; Rodríguez, *et al.,* 2017).

It is unclear what exactly attracts birds to light but there are several theories:

- The most susceptible species feed on bioluminescent planktonic organisms that migrate close to the surface at night, and are therefore attracted to light sources (Imber, 1975),
- Light from the moon may be a navigational cue for some species of seabird (Montevecchi, 2006), and
- In the absence of celestial light, on overcast nights, Poot *et al.* (2008) propose that artificial lights interfere with a bird's magnetic compass. It is thought that the magnetic compass is linked to light receptors in the eye that require light of blue wavelengths to function; red light appears to impair this function (Poot *et al.,* 2008).

Whatever the reason, it is clear that small petrels can collide with anthropogenic structures at-sea and die as a consequence (for examples see Ryan, 1991; Wiese, *et al.,* 2001; Black, 2005a; Glass and Ryan, 2013).

It is safe to assume that where artificial light exists at-sea there will be some interaction between vessels and seabirds, which will usually involve small numbers of individuals. However, in conditions of poor visibility (due to fog, snow or rain) the problem is exacerbated, and more individuals are likely to interact with vessels emitting light.

Where artificial light, poor visibility and high seabird numbers coincide, 1,000's of birds may collide with a vessel on a single night (Coleman, *et al*., 2022). While there are no published records, light induced bird collisions with vessels, with varying numbers of birds affected, are a regular occurrence around the Falkland Islands (A. Black, *pers. obs.*), elsewhere in the South Atlantic (Ryan, 1991; Black, 2005a; Glass and Ryan, 2013) and elsewhere in the world (e.g., Wiese, *et al.,* 2001; Merkel, 2010).

10.1.4.3.1.3 Weather conditions and moon phase

Virtually every reported large bird-strike associated with artificial light at-sea is linked to weather conditions (e.g., Ryan, 1991; Black, 2005a; Merkel, 2010; Glass and Ryan, 2013). The probability that snow will fall on any given day (thus reducing visibility) is higher during the winter months than the summer months, so there may be a seasonal component to bird-strike statistics. Fog is generally related to wind direction and in the Falklands is more frequently observed during periods of north or north-easterly winds, which can be experienced at any time.

Additionally, the influence of artificial light appears to be greatest on moonless nights when there is limited ambient natural light (Montevecchi, 2006). The longer nights and poorer weather experienced during the winter months are therefore more conducive to bird-strikes.

10.1.4.3.1.4 Susceptible seabirds and their abundance

Bird-strikes reported by Ryan (1991), Black (2005a) and Glass and Ryan (2013) and observations on vessels in Falkland Islands waters (A. Black, *pers. obs.*) indicate that the most vulnerable species groups in the South Atlantic are; prions, blue petrels, storm-petrels, diving-petrels, gadfly (*Pterodroma*) petrels and shearwaters. Most of these birds are migratory or widely dispersed during the non-breeding season, which results in seasonal patterns of abundance in the region of the Sea Lion Field. These species generally have very large population sizes, are found over extensive ranges and are mostly regarded as being of 'Least Concern' status by IUCN; however, sooty shearwaters are 'Near Threatened' and some of the gadfly petrels (such as Atlantic petrel) are regarded as 'Endangered', due to a restricted breeding distribution and land-based threats.

With regard to abundance, it has been suggested that a mortality rate of >1 % of the natural mortality rate has the potential to have an impact at the population level (OSPAR, 2012). However, this approach can be problematic, not least because it is not possible to determine the size of many / any of the populations of the species most likely to be impacted. The impact of individual mortality is likely to be greater in species that are classified nationally or internationally as 'Declining', 'Threatened' or 'Endangered'. In the NFB at the Sea Lion location, these species include black-browed albatross, white-chinned petrel, sooty shearwater, southern royal albatross, northern royal albatross, Magellanic penguin, grey-headed albatross, wandering albatross, Atlantic petrel and rockhopper penguin (Section 7.4.5.3.2).

Sea Lion Field

Data compiled from at-sea surveys, annual monitoring programs, coastal surveys and tracking data were used to indicate the seasonal abundance of the most susceptible species near the Sea Lion Field (Knipe and Pendoley, 2019). This data indicate that in the NFB, prions were generally the most

numerous 'species' recorded in all months, although they were never encountered in very large numbers (White, *et al.,* 2002; Knipe and Pendoley, 2019).

In addition to prions, small numbers of other potentially vulnerable species, such as blue, Atlantic and Kerguelen petrels may be present during the winter months. For example, Kerguelen petrels have been recorded as striking vessels (Premier, 2015d; Ryan, 1991; A. Black, *pers. obs.*). This species is present, in relatively low numbers, within Falkland Islands waters during the winter months but absent during the summer months (White, *et al.,* 2002; Knipe and Pendoley, 2019).

To characterise the vulnerability of different species, Knipe and Pendoley (2019) undertook a vulnerability assessment of seabirds known to occur, or potentially occur, within the Sea lion Field. The vulnerability assessment was based on the frequency of occurrence of a species and the likelihood of a negative interaction (Knipe and Pendoley, 2019). The vulnerability assessment highlighted that Procellariforms have the highest vulnerability score compared to other seabird sand shorebirds (Table 10.3) (Knipe and Pendoley, 2019). These species include: grey-headed albatross (winter, autumn), northern royal albatross (winter), southern royal albatross (winter, summer, autumn) wandering albatross (spring, summer, autumn), white chinned petrel (all seasons), cape petrel (winter, spring, autumn), Antarctic fulmar (winter, spring, autumn), soft-plumaged petrel (summer autumn), southern giant petrel (all seasons), blue petrel (winter, spring, summer), Wilson's storm petrel (all seasons), grey-backed storm-petrel (all seasons), black-bellied storm-petrel (spring, summer, autumn), prion species (all seasons), great shearwater (summer, autumn), sooty shearwater (spring, summer, autumn), little shearwater (summer, autumn).

Table 10.3. Summary of vulnerability scores for seabirds, shorebirds and terrestrial birds from Knipe and Pendoley (2019)

Species group	Species sub-group	Season	Highest Vulnerability Score	IUCN Red List (range)	Wavelength sensitivity
Seabirds	Procellariforms	Winter	Highest / High	LC – EN	Ultraviolet-blue-green
		Spring	Highest	VU	
		Summer	Highest	VU	
		Autumn	Highest	VU	
	Penguins	Winter	Moderate	LC – VU	Unknown
		Spring	Moderate	LC – VU	
		Summer	Moderate	LC – VU	
		Autumn	Moderate	LC – VU	
Shorebirds	Gills, skuas, sheathbills	Winter	Low	LC	Foraging: Ultraviolet-blue Migration: Red
		Spring	Moderate	LC	
		Summer	Moderate	LC	
		Autumn	Moderate	LC	
	Terns	Winter	Lowest	LC	
		Spring	Lowest	LC	
		Summer	Lowest	LC	
		Autumn	Lowest	LC	
	Waders and waterfowl	Winter	Low	LC	
		Spring	NA	NA	
		Summer	Low	LC	
		Autumn	High	LC	
Terrestrial birds	Passerines and raptors	Winter	Low	LC	Migration: Red
		Spring	Low	LC	
		Summer	Low	LC	
		Autumn	Low	LC	

Berkeley Sound

The waters near Berkeley Sound are numerically dominated by sooty shearwaters during the spring, summer and autumn months. The relative abundance of susceptible species is generally highest during the summer months (Table 10.4), however, the shorter nights and lower likelihood of poor weather conditions at this time act to counter higher seabird numbers.

There is evidence to suggest that fledgling birds on their maiden flight are more susceptible to disorientation by lights than other birds (Troy, *et al.,* 2011; Rodríguez, *et al.,* 2015a) and therefore the sooty shearwater fledging period is likely to be the most critical time. However, the indicative LTV anchorage location is situated approximately 5 - 10 km to the WNW of the breeding colonies (on Cochon and Kidney Islands respectively), so birds will not routinely pass the LTV site *en route* to the colony (Bonnet-Lebrun, *et al*., 2020). The breeding phenology (cyclic and seasonal phenomena) of sooty shearwaters has not been studied in-depth in the Falklands but young birds fledge (depart from the colony) throughout April and early May (Woods, 1988). Sooty shearwater mortality has been

observed on a jigger departing from Berkeley Sound in early May 2014, when six out of 11 birds striking the vessel suffered broken wings or necks and died as a consequence (R. James, *pers. comm.*).

Table 10.4: An example of relative species abundance within approximately 15 nautical miles of the Sea Lion Field and Berkeley Sound (shaded areas indicate relative abundance)

Species	IUCN status	Relative seasonal abundance (see key below)							
		North Falkland Basin				Berkeley Sound			
		Sum	Aut	Win	Spr	Sum	Aut	Win	Spr
Prion species	LC								
Diving-petrel species	LC								
Wilson's storm-petrel	LC								
Grey-backed storm-petrel	LC								
Black-bellied storm-petrel	LC								
Great shearwater	LC								
Sooty shearwater	NT								
Little shearwater	LC								
Soft-plumaged petrel	LC								
Atlantic petrel	EN								
Kerguelen petrel	LC								
Blue petrel	LC								

Key: Relative abundance of seabirds *(Source: JNCC database, Birdlife International, 2024)*

Not recorded	Very Low	Low	Moderate	High

10.1.4.3.1.5 Historical observations of bird-strike associated with O&G in the Falkland Islands

During the 2011 exploration drilling campaign carried out by Rockhopper Exploration plc, in the NFB, observations from the ERRV recorded birds associating with the MODU but did not record any negative interactions (Munro, 2011). Most observations were made from a support vessel some distance from the MODU. In order to be able to detect small petrels at night, observations would ideally be carried out on board the vessel concerned (the MODU in this case); although for reasons of bed space and health and safety this can be difficult. Statistically, significantly more bird association was recorded during the morning than the afternoon and it was suggested that this was due to attraction to lights during the night (Munro, 2011).

During the 2015 exploration campaign in the NFB, Navitas (then POEPL) developed and implemented a Bird-Strike Management Plan (BSMP) in accordance with the Bird-Strike Management Standard (Premier, 2015b) to monitor, record, report and mitigate (if required) bird strikes on the MODU and associated vessels (Table 10.5). During this campaign, there were no reports from the MODU but there were five records from the supply vessels (Table 10.5). All of these incidents were reported from supply vessels and at least three of the incidents were reported as having occurred in Stanley Harbour.

Given all that is described above, it is not possible to estimate the number of birds at risk from light induced bird-strikes during the life of the Phase 1 & 2 Development. However, from experience gained on vessels that operate in South Atlantic waters (Ryan, 1991; Black, 2005a; Glass and Ryan, 2013; A. Black, *pers. obs.*) and on O&G platforms elsewhere (Hope-Jones, 1980; Tasker, *et al.,* 1986; Wiese, *et al.,* 2001), it is considered likely that some birds will collide with vessels involved with the Development.

Table 10.5: Bird-strikes reported during the 2015 Exploration Drilling Campaign

Date	Species	Number	Weather	Location	Outcome
30th April	Sooty shearwater	1	Overcast / foggy	TDF	Injured
1st May	Sooty shearwater	1	Overcast / foggy	TDF	Injured
13th June	Kerguelen petrel	1	Occasional snow	52° 09' S, 55° 42' W	Released OK
14th June	Grey-backed storm-petrel	1	Not recorded	Not recorded	Oiled
31st August	Snipe	1	Clear	Stanley Harbour	Dead

10.1.5 Industry standard mitigations

Good working practice and design will help to limit the amount of light pollution and reduce the risk of bird-strikes. However, as light is required to maintain a safe working environment, it is not possible to eliminate all sources of light (black-out) as compliance with the ColRegs (Section 10.1.1.1) must be maintained.

Nonetheless, the Convention for the Protection of the Marine Environment of the North-East Atlantic (the 'OSPAR Convention') has published the following guidelines based on discussions at the 2012 OSPAR Workshop aimed at reducing potential lighting impacts on migrating birds and seabirds:

- Guidelines to reduce the impact of offshore installations lighting on birds in the OSPAR maritime area (OSPAR Agreement 2015-08).

These guidelines recommend:

- Assessment of light sources:
  - All lighting equipment on offshore installations potentially emitting light outside the physical boundary of an installation should be assessed to determine whether the light is essential for safety reasons and whether there is the potential for reducing external emissions. As part of this process, photographs taken in the dark from outside the offshore installations can be used to detect significant light sources, including stray and spurious light sources, emitting light to the surrounding environment.
- Reduction of light emissions:
  - The lighting on offshore installations should be reduced to a minimum compatible with safe operations whenever, and wherever, possible. This includes the use of black out blinds, minimising the number of lights and the intensity of the lights and / or adapting the spectrum of the lights to bird-friendly lighting systems,
  - Unnecessary light sources should be removed, as far as possible,
  - In areas where lighting is not a continuous requirement, light sources should be automatically or manually controlled through the process control system. Normally unmanned platforms should have switches installed and during unmanned periods lights should be switched off apart from lighting requirement to comply with national and international regulations on aviation and shipping navigation, and
  - Where the use of automatic or manual light controls is impractical, the installation of light barriers (shielding) should be considered. This could be used, for example, in areas external to living quarters in order to ensure that adequate lighting is available on external steps but there are limited emissions outside the structure.
- Optimum alignment and light shields:

- Light sources should, if possible and consistent with safe working practices, be positioned in places where emissions to the surrounding environment can be minimised. Additional shielding should also be installed, where practicable.

There are no industry-standard mitigations available with regard to light associated with flaring during initial well clean-up / testing from the MODU in terms of reduction of light impacts. During production, flaring will be minimised and the base-case is for all excess gas to either be used as fuel on the FPSO or to be re-injected into the reservoir (Sections 5.8.3.3 and 5.8.5.9).

10.1.6 Impact and risk assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities. The assessment of unplanned events includes an assessment of the 'Likelihood of Occurrence' to determine the 'Risk'.

A summary of the impact and risk assessment outcomes is tabulated in Section 10.1.12, which shows the worst-case impact / risk for each activity and receptor.

10.1.6.1 Impact assessment of attraction to offshore artificial light

10.1.6.1.1 Attraction of marine life (zooplankton, fish and squid)

Any impact of the project's Phase 1 & 2 Development on zooplankton, fish and squid is expected to be very small and localised. Vessels in transit should only be displaying navigation lights, which are of low light intensity (Section 10.1.4.1.3). Additionally, relatively slow-moving plankton, fish and squid would be unable to maintain position alongside a moving vessel. Therefore, the impact on this group of receptors is likely to be greatest around the MODU, FPSO and stationary vessels; where the surface of the water may be illuminated. These animals may be attracted to the lights of the vessels but there is nothing to suggest that this should be regarded as a significant impact on these organisms, although there could be some indirect impacts. For example, squid and fish may be attracted to the vessels to feed on zooplankton and may in turn be an easier target for larger squid, fish, seabirds or marine mammals. Nonetheless, given that there is likely to be 'negligible numbers of any species of geographical importance' (as per the methodology described in Chapter 8) present within the zone of influence, the sensitivity of this receptor group is considered to be '**Very Low**'.

It is anticipated that the impact on zooplankton, fish and squid will be very localised (in the immediate vicinity of the vessels) and any impacts resulting from changing predation patterns will 'not be detectable above background variability' and / or will be 'reversible once activity ceases'. Therefore, the severity of the impact is assessed as '**Slight**'.

Therefore, the overall significance of the impact of artificial light on zooplankton, fish and squid is assessed as '**Very Low (1)**'.

10.1.6.1.2 Attraction of seabirds in the Sea Lion Field

As indicated in Section 10.1.4.3.1.4, not all seabirds are susceptible to the impacts and risks associated with artificial light and flares. The available survey data indicate that there will be a low number of individuals of all of the potentially susceptible species present within the zone of influence of the Development (Section 10.1.4.3.1.4, Table 7.17 and Table 7.23) Although accurate population estimates are not available for all species, the biogeographical populations are known to be very large. Therefore, it is anticipated that the assemblage of birds within the zone of influence of the Development, at any given time, will not be of geographical importance (i.e., <1 % of the local population). As shown in Table 10.4 above, the majority of species that are typically impacted in the south-west Atlantic have an IUCN status of 'Least Concern'. Atlantic petrels (IUCN 'Endangered') are occasionally sighted in the

NFB but they are not considered to be a notable presence within the zone of influence of the Development. Therefore, the sensitivity of the receptor is considered to be '**Low**'.

In the absence of collision, mortality after contact with a flare or oiling of feathers (Section 10.1.4.3.1.1), the severity of effect on seabirds from simple attraction to artificial lights or flares is expected to be low. Seabirds may be distracted from natural feeding behaviour, or may expend energy flying in circles around the vessel (Burger, *et al.*, 2019). This has the potential to affect the body condition of the birds, particularly during migratory movements. However, if the impact is short-lived (a matter of hours), and there is no contact between the birds and the vessel, the long-term consequences are anticipated to be low. Therefore, the severity of effect of distraction by artificial light or flares (i.e., with no resultant contact with the vessel) to seabirds is considered to be '**Slight**'.

The overall significance of the impact of distraction of seabirds by artificial light or flares (i.e., the birds do not come into contact with the vessel or flare) is assessed as '**Very Low (2)**'. However, the distance from which birds are attracted to light remains unclear and the impact could be higher, if light detection is further than commonly reported (5-15 km) (e.g., Rodríguez, *et al.,* 2014).

Please also see Section 10.1.6.2 below which assesses the impacts where contact with the vessel is made.

10.1.6.1.3 Attraction of seabirds in Berkeley Sound

As indicated in Section 10.1.4.3.1.4, not all seabirds are susceptible to the impacts and risks associated with artificial light. Within Berkeley Sound, sooty shearwater is the species of greatest concern, although other species, such as, great shearwater, common diving-petrel, Wilson's and grey-backed storm-petrel are also thought to breed on Kidney Island and are present in the waters adjacent to the Sound. The colony of the IUCN 'Near Threatened' sooty shearwaters on Kidney Island is situated approximately 10 km from the indicative LTV anchorage location and during the Phase 1 & 2 Development, the LTVs will be present for short durations only, with a maximum duration of 13 months in total between Stages 1 and 3 of the Development (Section 5.5.1). The IUCN status indicates that the sensitivity of the sooty shearwater as a receptor is 'Moderate'. However, Kidney Island is the largest of the known colonies in the Falkland Islands and represents a significant proportion of the biogeographic population (i.e., >1 % of the South Atlantic population[49]). Although the shearwaters are only present for part of the year (September to May) and this may or may not overlap with the presence of the LTVs, the worst-case sensitivity of the receptor is considered to be '**High**'[ibid].

In the absence of collision or oiling of feathers (Section 10.1.4.3.1.1), the severity of effect on seabirds from simple attraction to artificial lights is expected to be minimal. Although sooty shearwaters do feed inshore, these birds gather in large numbers at the entrance to Berkeley Sound late in the day (between September and May) but do not return ashore to visit nest burrows until dusk. Experience from elsewhere in the world, suggests that lights do not prevent adult shearwaters from returning to their colonies and impact on fledglings is of greater concern (Rodriguez, *et al.,* 2015a & b). Therefore, the severity of effect of distraction by artificial light (i.e., with no resultant contact with the vessel) to seabirds is considered to be '**Slight**'.

Overall the significance of the impact of distraction of seabirds by artificial light (i.e., the birds do not come into contact with the vessel) is assessed as '**Low (4)**' [ibid].

[49] **Post-consultation update (July 2025):** Table 7.23 in Section 7.4.5.3.3 above has been updated showing that the Falkland Islands population of sooty shearwaters is now considered to be 3.2 % of the global population (BirdLife International, 2025). As such, according to the methodology Section 8.5.2.1, the sensitivity of the receptor would now be considered '**Very High**'. However, the overall impact category remains the same, changing from '**Low (4)**' to '**Low (5)**'.

Please also see Section 10.1.6.2 below which assesses the impacts where contact with the vessel is made.

10.1.6.2 Risk assessment of artificial light use

Given the number of variables that influence the potential for bird-strikes it is challenging to assess the risk of bird strikes with the Phase 1 & 2 vessels (Section 10.1.4.1). It can be stated however, that collision with a vessel or installation, and then landing on a deck, may result in injury to a wild bird that is likely to have implications for the survival of the individuals concerned (Section 10.1.4.3.1). Additionally, collision with a flare may result in mortality (Section 10.1.4.3.1.1).

10.1.6.2.1 Risk of small scale seabird strikes in the Sea Lion Field

The sensitivity of the receptors in the Sea Lion Field is as described above in Section 10.1.6.1.2. Therefore, the sensitivity of the seabird receptors impacted by artificial light has been assessed as '**Low**'.

Where a single bird-strike occurs, the effect is localised and it is unlikely that any impact will be detectable above background variability and therefore will not pose a threat to the populations of the species involved. Although birds may be killed, which is clearly undesirable, the severity of effect of artificial light at this scale is considered to be '**Slight**'.

The overall significance of the impact of small-scale seabird strikes in response to artificial light and flares is considered to be '**Very Low (2)**'.

With regard to the likelihood of a single bird-strike event occurring, observations on other vessels operating within Falkland Islands waters indicate that these small-scale events occur on a regular basis. Although the results of observations during the 2015 exploration drilling campaign suggest that these events occur less frequently, small scale bird-strike events, concerning low numbers of birds, are likely to occur on multiple occasions per year. Therefore, the likelihood of a single bird-strike is considered to be '**Likely**'.

The overall significance of the risk of single bird-strike events is therefore considered to be '**Low (4)**'.

10.1.6.2.2 Risk of multiple (large scale) seabird strikes in the Sea Lion Field

The sensitivity of the receptors in the Sea Lion Field is as described above in Section 10.1.6.1.2. Therefore, the sensitivity of the seabird receptors impacted by artificial light and flares has been assessed as '**Low**'.

Multiple bird strike events can result in hundreds of bird mortalities in a single night, however, these events usually occur close to land (i.e., breeding sites) where some birds congregate at dusk. The Sea Lion Development is 220 km offshore, in an area that supports relatively low seabird densities throughout the year, and therefore it is not considered likely that multiple bird strikes will occur on a regular basis. While, like all seabirds, the susceptible species are relatively long-lived, reproduce slowly and have low natural adult mortality rates, the biogeographic populations of the most susceptible species are very large (millions of individuals) and so it is not anticipated that the impact of light induced bird-strikes from the Sea Lion Development will affect the local populations. Losses at this scale however, may add cumulatively to mortality caused by other sources of anthropogenic light. Additionally, concern regarding this issue was expressed by stakeholders during scoping (Chapter 6) and has been raised as an issue within the Falkland Islands' Offshore Hydrocarbons Environmental Forum (FIOHEF, 2013). Therefore, there is a need to identify opportunities for improvement through mitigation and controls, and to consult with project stakeholders. On balance, the severity of effect of multiple seabird strikes caused by artificial light or flares is considered to be '**Moderate**'.

The overall significance of the impact of multiple seabird strikes in response to artificial light or flares is considered to be '**Moderate (6)**'.

With regard to the likelihood of a multiple bird-strike event occurring, such a strike is likely to occur less than once per year but more than once in 10 years. Therefore, the likelihood of a multiple bird-strike is considered to be '**Possible**'.

Therefore, the overall significance of the risk of multiple bird-strike events is considered to be '**Moderate (9)**'.

10.1.6.2.3 Risk of small-scale seabird strikes in Berkeley Sound

The sensitivity of the receptors in Berkeley Sound is as described above in Section 10.1.6.1.3. Therefore, the sensitivity of the seabird receptors is considered to be '**High**'[50].

Where a single bird-strike occurs, the effect is localised and it is unlikely that any impact will be detectable above background variability (considering the area is already subject to a high degree of light pollution from fishing vessels), and will not pose a threat to the populations of the species involved. The LTVs will only be present within Berkeley Sound for a limited amount of time (i.e., for up to twelve months) (Section 10.1.2). Therefore, the severity of effect of artificial light and losses of this scale is considered to be '**Slight**'.

The overall significance of the impact of single seabird strikes in response to artificial light is considered to be '**Low (4)**'.

With regard to the likelihood of a single bird-strike event occurring, observations on other vessels operating within Berkeley Sound indicate that these small scale events occur on a regular basis. Therefore, the likelihood of a single bird-strike is considered to be '**Likely**'.

Therefore, the overall significance of the risk of single bird-strike events is assessed as '**Moderate (8)**'[ibid].

10.1.6.2.4 Risk of multiple seabird strikes in Berkeley Sound

The sensitivity of the receptors in Berkeley Sound is as described above in Section 10.1.6.1.3. Therefore, the sensitivity of the seabird receptors is considered to be '**High**'[51].

Multiple bird strike events can result in hundreds of bird mortalities in a single night, these events usually occur close to land (i.e., breeding sites) where birds congregate at dusk. However, the situation in Berkeley Sound is unusual in that the indicative LTV anchorage location is situated approximately 10 km inshore of the breeding colony, so birds will not routinely pass the site *en route* to the colony. This is significant as multiple seabird strikes are closely linked to weather conditions (Section 10.1.4.3.1.3) and are more likely to occur when visibility is reduced due to fog or snow. However, under these conditions, the deck lights of vessels may not be visible at a range of 10 km such that the zone of influence is effectively reduced. The severity of the impact would be higher for vessels entering or departing from the Sound, which would pass close to the colony on Kidney Island.

---

[50] **Post-consultation update (July 2025):** Table 7.23 in Section 7.4.5.3.3 above has been updated showing that the Falkland Islands population of sooty shearwaters is now considered to be 3.2 % of the global population (BirdLife International, 2025). As such, according to the methodology Section 8.5.2.1, the sensitivity of the receptor would now be considered '**Very High**'. However, the overall impact category remains the same, changing from '**Low (4)**' to '**Low (5)**'. The risk category of '**Moderate (8)**' remains unchanged.

[51] Post-consultation update (July 2025): Table 7.23 in Section 7.4.5.3.3 above has been updated such that the Falkland Islands population of sooty shearwaters is now considered to be 3.2 % of the global population (BirdLife International, 2025). As such, according to the methodology Section 8.5.2.1, the sensitivity of the receptor would now be considered '**Very High**'. However, the overall impact category remains the same, changing from '**Moderate (8)**' to '**Moderate (10)**'. The risk category of '**Moderate (9)**' remains unchanged.

The greatest impact is likely to affect fledglings, which seem to be more susceptible to disorientation by artificial light than adults regardless of weather conditions. Fledging is a once in a lifetime event that occurs over a period of several weeks for the entire population (during April and May). However, the overlap between LTV activity, and fledging is expected to be limited with the maximum duration of LTV presence being 13 months in total (Section 5.5.1).

Berkeley Sound has been the focus of shipping activity for many years. There is considerable light pollution in the area (Section 10.1.9.2), primarily from vessels engaged in transhipment, although this can vary considerably from year-to-year depending on squid (*Illex*) catches. Nonetheless, while there are records of bird-strikes in Berkeley Sound at this time (R. James, *pers. comm.*), the issue has not been investigated in great detail and the population of sooty shearwaters on Kidney has apparently increased (Woods and Woods, 1997; Clark, *et al.,* 2019).

Therefore, the current impact is not thought to be a threat to the population of sooty shearwaters and therefore the severity of the effect of the additional light from LTVs is considered to be '**Minor**'.

The overall significance of the impact of multiple seabird strikes in response to artificial light from Inshore vessels is considered to be '**Moderate (8)**'[ibid].

The LTVs will be present in the Sound for a combined period of up to 13 months for all LTVs. Nonetheless, it is likely that more than one multiple bird-strike may occur during this intermittent period and therefore the likelihood of a multiple bird-strike is considered to be '**Possible**'.

The overall significance of the risk of multiple bird-strike events is therefore considered to be '**Moderate (9)**' [ibid].

10.1.6.3 Indirect impacts and impact interactions

Other marine life may be indirectly impacted by artificial light and flares if it is attracted to food sources clustering beneath vessels. For example, where marine mammals are attracted to food sources which were initially attracted by the light, this may render marine mammals more vulnerable to underwater noise. Equally, diurnal birds may be attracted to additional food sources and, once attracted there is the risk of these birds colliding with the structure, flare or becoming contaminated from any minor oil spills.

Further, 'additive or synergistic' impact interactions (Section 8.9) may occur where attraction of marine life and seabirds to artificial light or flares then increases the likelihood of other impacts, such as those associated with underwater noise (Sections 10.4 and 10.5), operational discharges (Section 10.7) or accidental spills (Chapter 12). An overview of the potential for impact interactions is provided in Chapter 13.

10.1.7 Project-specific mitigation

It is best practice to minimise any impacts to the marine environment and the amount of light spilling horizontally into the environment will be minimised where practical and possible.

10.1.7.1 Reducing light pollution

During the FPSO FEED process, the number of lights and light levels on the FPSO topsides, and other external areas, will be reviewed. The minimum and maximum luminance levels for general and emergency operating conditions shall be in accordance with IEC 61892-2'. OSPAR Agreement 2015/08 (Section 10.1.5) will also be followed in the Best Practical Environmental Option (BPEO) process during FPSO design.

Likewise, during the direct offtake the decks and water around vessels will be illuminated to provide a safe working environment and to facilitate monitoring of spills, leaks or other potential hazards.

Nonetheless, Navitas recognise there is a driver to minimise light pollution from all project vessels particularly in the South Atlantic region, to limit the incidence of bird strikes. A summary of the design and auditing procedures associated with the project vessels is provide in Table 10.6. However, while lighting will be minimised from a cost / maintenance perspective, there is limited opportunity to implement additional measures specifically designed to reduce the risk of bird strike.

Shielding of light is a possible method of limiting the intensity of light emissions in certain directions but, if done without proper thought or analysis, it can actually increase overall light emissions. For example, applying shielding after lighting has been designed can increase the illumination of the work area, whereas if it is applied as part of the lighting design it can reduce the required output of the lighting units. Intelligent shielding at the design stage can reduce attraction of birds to lighted structures and significantly reduce associated mortality (MMS, 2010). Lights can also be designed to minimise upward emissions where these are not required.

As shown in Figure 10-3 the issue of bird-strikes is recognised by the cruise ship industry in the Southern Ocean and the International Association of Antarctic Tour Operators (IAATO) has guidelines for their vessels, which have been adopted by other operators in the region. Some of these measures are practical for use on the FPSO, supply and installation vessels, the ERRV and the MODU. These include:

- Dousing of deck lighting on supply vessels when not in use, necessity and emergencies notwithstanding, and
- Dousing of helideck landing lights when not in use and at night, if this is permissible (e.g., helidecks may need to be kept available to third-party aircraft in distress).

Elsewhere in the South Atlantic, the issue of bird-strikes on fishing vessels operating around Tristan da Cunha has been managed through a strike policy of blacking-out at night (Glass and Ryan, 2013). However, this is clearly not feasible in an industry that operates 24 hours a day.

As far as possible without increasing safety risks, it should be an aim to coincide planned flaring, such as flaring during initial well clean-ups / testing (contingency only) and blowdowns in preparation for periods of maintenance during Stage 3, with daylight hours. This intent will be carried forward into the flaring policy in the FPSO operating procedures. Further mitigation measures (e.g., the use of different light spectra and the use of a ballistic flare ignition system to negate the need for a pilot light) will be explored in the FEED process with Reliability, Availability and Maintenance (RAM) studies conducted for viable options. Ongoing monitoring during the operation will serve to validate the impact assessment and adjust the use of mitigation measures as necessary. Monitoring of light-related impacts forms a part of the EMMP (Chapter 15) and further mitigation will be discussed should adverse impacts be identified.

Table 10.6: The design and auditing procedures associated with lighting on project vessels

Vessel	Design / auditing procedure
FPSO	Overall, the design intent will be to ensure the right level of light coverage to extend to the edges of structures (where there are often walkways and escape routes). Attempting to shield individual lights onto focused areas will likely lead to neighbouring areas not meeting the specified minimum values and hence, additional lights would be required, which may ultimately serve to increase the overall level of light pollution. Application of OSPAR 2012.
MODU	The MODU will undergo a strict regime of acceptance audits in line with Navitas' rig acceptance processes. Part of these audits, albeit primarily for safety, will include a lighting survey which may identify unwanted light emissions and recommend practical shielding and operational practices to minimise unwanted light taking account of safety and operational requirements (application of OSPAR, 2012). The outputs of this survey will be incorporated

Vessel	Design / auditing procedure
	into the Master Corrective Actions Register for the rig along with all other HSE actions. Crew inductions will include information about the risks of unnecessary light alongside other HSE priorities. The BSMP will feed back into ongoing operational adjustments and incident resolution.
Contracted third-party vessels	Navitas has limited control over third-party vessels; nevertheless the importance of minimising light will be communicated to contractors tendering for the work and they will be asked to make a statement on their proposals to minimise unwanted light as part of their tender evaluation. Ongoing operational reviews and crew inductions will include information about the risks of unnecessary light. Navitas vessels representatives will be responsible for ensuring bird-strikes are recorded and incidents resolved satisfactorily.
CTT	Site-specific HSE priorities including unwanted lighting will be communicated to incoming CTTs and all vessels hired by Navitas. Support vessels will communicate directly with any vessel that appears to be emitting unnecessary light to minimise sources.

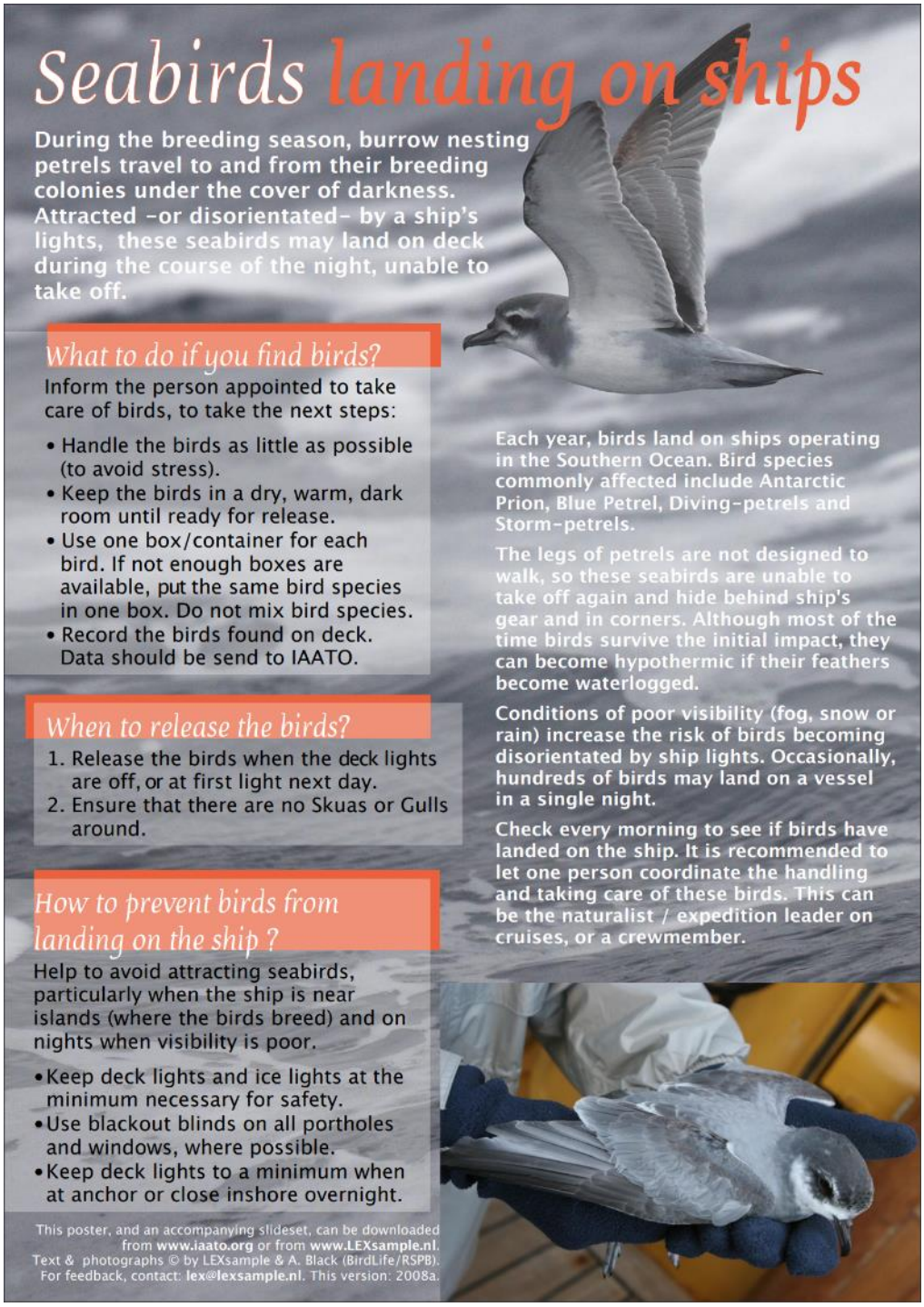


Figure 10-3: Example of an educational poster for the management of birds on deck ***(Source: www.LEXsample.nl)***

10.1.8 Residual impact assessment

The impacts on zooplankton, invertebrates, fish and seabirds associated with artificial light offshore are considered to be of '**Very Low**' or '**Low**' significance such that no mitigation measures are considered necessary.

However, the risks of large-scale seabird collisions in offshore waters of the NFB and both small and large-scale seabird collisions in Berkeley Sound are '**Moderate**'. While numerous mitigation options exist that may be incorporated into the design of vessels, until further investigation during the FEED process, with associated RAM studies, has been conducted to indicate that these are effective, the risk of collisions must remain the same as described above[52].

10.1.9 Cumulative impacts

Under natural conditions, the only sources of light at-sea are moonlight, starlight and bioluminescence. In addition to the artificial lights from the Phase 1 & 2 Development, there are currently several other sources of anthropogenic light in the wider area of the NFB and in Berkeley Sound which can lead to cumulative impacts from increased 'concentration' and increased 'extent and proportion' (Section 8.9.1).

10.1.9.1 Sea Lion Field

The most significant source of artificial light in the south-west Atlantic is the *Illex* (Argentine shortfin squid) jigging fleet (Table 10.7; Figure 10-4 and Figure 10-5). Numbers of jiggers fishing in the Falklands EEZ varied until about 2011 when numbers of licenced vessels plateaued at between 99-109 vessels (FIG, 2024b). The distribution of these vessels can be followed *via* satellite images (Rodhouse, *et al.,* 2001; Waluda, *et al.,* 2008), which have been used to quantify fishing effort. The presence of Argentine shortfin squid, and the vessels that fish for them, within Falklands waters is seasonal and the licence period extends from February to June (FIG, 2014a). Therefore, jigger fishing vessels represent a seasonal high intensity source of anthropogenic light in the NFB (Table 10.7).

A small number of jiggers have FIFD (Falkland Islands Fisheries Department) observers deployed on board every year, which has provided some evidence of interactions between these vessels and seabirds inshore. For a short period, dedicated seabird observers were deployed on jiggers to assess the degree of seabird bycatch on these vessels. Although the focus of these observations was interactions between seabirds and fishing gear, there was no evidence to suggest that these vessels had a significant bird-strike problem (Wolfaardt, *et al.,* 2010). It is not clear why bird-strikes are not a more significant issue on jigger vessels. It could be that the lights are so bright that birds are able to see the superstructure of the vessels and therefore avoid collisions; however, this remains unproven. Some jiggers (especially Korean vessels) use lights that are tinted green. Studies in the North Sea (Poot, *et al.,* 2008) have shown that the wavelength of light emitted influences the behaviour of birds. However, many jiggers appear to use white light so this would not mitigate the fleet as a whole.

The additional light of the MODU and supporting vessels will add to light emitted by other vessels in the NFB and therefore adds to the extent of artificial light and proportion of seabird populations exposed to artificial light in the NFB. However, it is not anticipated that this will constitute a significant cumulative effect due to the overwhelming influence of the jigging fleet. Nonetheless, the Sea Lion Development vessels will be operating year-round, whereas the presence of fishing vessels is seasonal. Additionally, the effect of artificial light attracting birds to the Development site may expose these birds to other impacts, such as accidental spills, that they would otherwise not be exposed to, although it is noted that accidental spills are not solely related to O&G operations.

10.1.9.2 Berkeley Sound

Places of human settlement and industry ashore represent permanent sources of light pollution. In the Falklands, these are primarily associated with the two major population centres, Stanley and Mount

[52] **Post-consultation note (July 2025):** The residual impact assessment does not take account of measures that may be written into the vessel ASOGs as described in Section 5.5.1 above regarding entrance routes into Berkeley Sound and avoidance time windows. These will be determined in consultation with relevant stakeholders prior to operations.

Pleasant Complex (MPC). Additionally, Berkeley Sound is used as an anchorage for the trans-shipment of fish and is also a significance seasonal source of light pollution.

Sources of existing anthropogenic light within Berkeley Sound are summarised in Table 10.7. Notably, the jiggers described above utilise Berkeley Sound to tranship their catches to refrigerated cargo ships known as 'reefer' vessels and to refuel. Although the full rig of jigging lights are not deployed in Berkeley Sound, there is a considerable amount of light emitted from these vessels, the glow from which can be seen from Stanley (A. Black, *pers. obs.*) and can also be seen from space, resembling a small town (Figure 10-6). It is noted that 2007 (see Figure 10-5 and Figure 10-6) was a busy year for jiggers and this year was chosen to illustrate the magnitude of artificial light sources already in the south Atlantic, to which Navitas will make a relatively minor contribution.

In addition to the jiggers, other vessels use Berkeley Sound as an anchorage, primarily for the transshipment of fish catches.

Although vessels can be present in all months of the year, activity peaks between March and June when tens of vessels can be present. Combined, these vessels represent a large source of anthropogenic light. The inshore LTVs will add to this with varying degrees of significance depending on timing / season. The period of greatest conservation concern is linked to the sooty shearwater fledging, which occurs in April and early May.

At other times of the year, there may be very few vessels using Berkeley Sound and therefore the LTVs will add considerably to the ambient level of light pollution but these are likely to be periods when very few susceptible receptors are present.

The data presented in Figure 10-5 and Figure 10-6 are a composite of the data collected over the period of a year (2007 in this case) to display the average light intensity. Vessel activity within Berkeley Sound is highly seasonal and therefore the light intensity within the Sound during the period of peak vessel activity (March to May) will be considerably higher than illustrated (for example, the value for a light only detected half the time is discounted by 50 %).

Table 10.7: Other sources of artificial light in the NFB and Berkeley Sound

Source	Light source	Seasonality / frequency	Description
NFB			
Coasters / Freighters / Tankers	Navigation lights and Accommodation lights.	Year round	Several shipping routes pass close to the Sea Lion Field (see Section 11.1)
Finfish trawl fleet	Navigation lights, Accommodation lights and Deck lights.	During two fishing seasons (Feb to May and Aug to Nov)	Operates along the edge of the continental slope (200 m depth contour) approximately 50 km to the south and west of the Sea Lion Field (Section 7.7.3.1.1.1). Although these vessels often stop fishing at night, deck lighting may remain on throughout the night.
Illex jigging fleet	Navigation lights, Accommodation lights, Deck lights and Squid jigging lights.	Between February and June	Operates over the continental shelf to the south and west of the Sea Lion Field. These vessels use powerful arrays of lights (up to 150 bulbs totaling 300 kW per vessel) to attract squid to jigging lures. The size of the jigger fleet and distribution of fishing effort are related to squid abundance, which can vary considerably from year-to-year.
Berkeley Sound			
Reefers	Navigation lights, Accommodation lights and Deck lights.	Peak activity during the *Illex* season (March to June)	The number of reefers varies considerably from year-to-year and is closely linked to the amount of *Illex* squid caught each year.
Finfish trawl fleet	Navigation lights, Accommodation lights and Deck lights.	During two fishing seasons (Feb to May and Aug to Nov)	Trawlers are licensed to fish in two seasons and can be present in small numbers in most months of the year. However, due to the generally small catch these vessels visit Berkeley Sound far less frequently than jiggers
Illex jigging fleet	Navigation lights, Accommodation lights, Deck lights and Squid jigging lights.	Between February and June	During periods of good fishing, each jigger in a fleet of approximately 100 vessels, may visit Berkeley Sound on a weekly basis. However, catches show very high inter-annual variation (Section 7.7.3.2.1). Jiggers tend to use 4-6 of the fishing lights to illuminate the deck when transhipping.
Fueling vessels	Navigation lights, Accommodation lights and Deck lights	Year round	Vessels bunkering fuel



Figure 10-4: Jigging vessel fishing at-sea in Falkland Islands waters

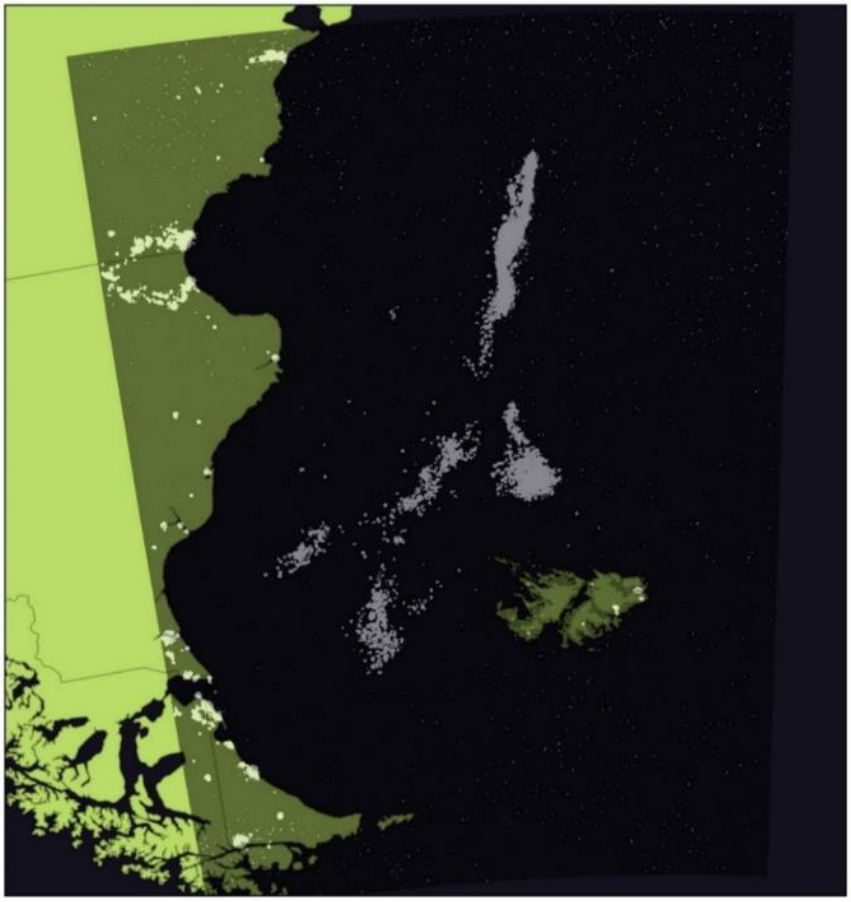


Figure 10-5: The distribution of anthropogenic light in the south-west Atlantic, 2007 ***(Credit: Earth Observation Group, NOAA National Geophysical Data Centre)***

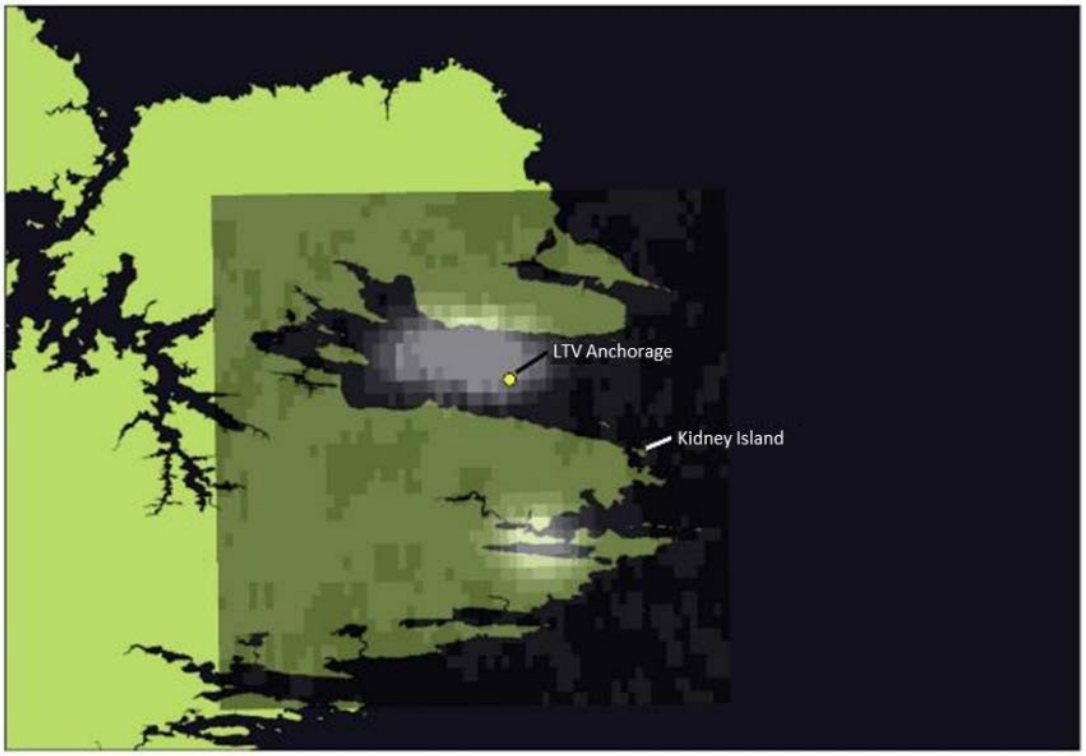


Figure 10-6: The distribution of anthropogenic light in the region of Berkeley Sound, 2007 ***(Credit: Earth Observation Group, NOAA National Geophysical Data Centre)***

10.1.10 Confidence

While the approximate timing and type of vessels used during the Phase 1 & 2 Development of the Sea Lion Field is known, the intensity and orientation of lights on the FPSO, MODU, and other vessels are not yet quantifiable, and representative, analogous examples have been used in this assessment. Additionally, there is the potential that flaring may be undertaken during up to four well tests (contingency only) over four days and will also be required periodically during process and emergency shutdowns, and in the event of emergency blowdowns.

The nature of the impact on the environmental receptor is understood, however, the scale of the potential impacts and risks are difficult to predict due to their episodic nature; this is acknowledged as a data gap. Some monitoring data exist from previous Falklands campaigns, although these were short-term and did not directly record a significant issue with bird-strikes. While some specific survey data exist for seabirds in the wider NFB and the area around the Sea Lion Field, these data are limited to very short time points and lack good spatial coverage over several years that would take into account the temporal and spatial variability of such mobile species. Therefore, although it can be assumed that some birds may be killed as a result of bird-strikes, it is not possible to predict the potential impact in quantitative terms.

The use of deck lighting, occurrence of potentially susceptible species (albeit in low numbers offshore) and the likelihood of poor weather conditions (reduced visibility) combined suggest that some incidents of bird-strike are likely to occur throughout the life of the Development. Navitas' BSMP will help to determine the accuracy of this assessment and inform future management plans. The initial focus of the BSMP is monitoring, but also includes awareness training for workers on the MODU and other vessels. The information collected should help to better assess whether bird-strikes associated with the O&G industry are an issue in the Falklands and prompt additional mitigation, if required.

With the available data, the level of confidence in the impact predictions (in terms of the nature of the impact and its level of significance) is considered to be '**Probable**'. Additionally, the data gaps are not considered to have the potential to significantly change the outcome of the assessment.

10.1.10.1 Monitoring required

As during the 2015 exploration drilling campaign, Navitas will develop and implement a BSMP, which describes the processes required to monitor, record and report seabird interactions during the Development.

The Bird Collision Observation Form will be submitted to FIG on a monthly basis (at a minimum) and the contributing factors for the events that result in bird-strikes will be reviewed. If it is determined that any bird-strike events have similar contributing factors, or a trend is identified, the most appropriate mitigation measure will be identified and implemented.

Opportunistic observations of rare events have highlighted the potentially deleterious nature of bird-vessel interactions (e.g., Ryan, 1991; Black, 2005a) and observations were made of bird-strikes during the previous exploration campaign. However, systematic observations by trained independent observers would provide more valuable data towards better understanding of bird / vessel interactions.

Offshore, Navitas will use independent Seabird and Marine Mammal Observers (SMMOs) on support vessels and investigate the possibility of a collaborative survey with FIFD, potentially using the fisheries patrol vessel as a platform. A seabird distribution monitoring programme will be developed over several years with an understanding of ongoing work and in collaboration with FIFD, if possible. This will cover the offshore area, transit zones and targeted onshore colonies. Dedicated seabird observers will be deployed offshore during any initial well test and commissioning flaring to quantify any impacts.

The practicalities of adopting the OSPAR green lighting strategy will be investigated during the project FEED phase as a potential additional mitigation against bird-strikes. Navitas will also investigate a pilot-free flare design using an automated ignition system.

Detailed monitoring requirements have been established during the project-specific Phase 1 & 2 Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the EMMP. An outline of the EMMP is provided in Chapter 15).

10.1.11 Offsetting

For significant residual and impact and risks ('Moderate' or above), offsetting *via* a Carbon and Biodiversity Offsetting Fund is proposed, see Section 8.11 for further details.

10.1.12 Findings summary

Table 10.8: Summary of the impacts and risks associated with artificial light offshore and inshore arising from the Phase 1 & 2 Sea Lion Development

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Presence of all vessels / MODU / FPSO	Deck and accommodation lights and flaring during shutdowns	Attraction of plankton, invertebrates and fish	Planned	1, 2 & 3	Very Low	Slight	n/a	**Very Low (1)**	**n/a**	**Probable**	**Industry-standard:** Use of blackout blinds **Project-specific:** None proposed
		Attraction and disorientation of seabirds offshore			Low	Slight	n/a	**Very Low (2)**	**n/a**	**Probable**	
		Attraction of and impact to marine mammals			n/a	n/a	n/a	n/a	n/a	n/a	
Presence of all vessels in Berkeley Sound	Deck and accommodation lights	Attraction and disorientation of seabirds inshore	Planned	1 & 2	High	Slight	n/a	**Low (4)**	**n/a**	**Probable**	
		Attraction of and impact to marine mammals			n/a	n/a	n/a	n/a	n/a	n/a	
Small scale bird collisions offshore	Deck and accommodation lights Flaring	Injury or fatality to single / handful of birds	Unplanned	1, 2 & 3	Low	Slight	Likely	**Low (4)**	**n/a**	**Probable**	**Industry-standard:** Use of blackout blinds,

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Large scale bird collisions offshore	Vessel deck and accommodation lights Flaring	Injury or fatality to multiple (dozens) birds	Unplanned	1, 2 & 3	Low	Moderate	Possible	**Moderate (9)**	**Moderate (9)**	**Probable**	**Project-specific:** Reduce light pollution by: Auditing, and Dousing of unrequired lights.
Small scale bird collision inshore	Deck and accommodation lights	Injury or fatality to single / handful of birds	Unplanned	2 & 3	High	Slight	Likely	**Moderate (8)**	**Moderate (8)**	**Probable**	**Industry-standard:** Use of blackout blinds, **Project-specific:** Reduce light pollution by: Auditing, and Dousing of unrequired lights
Large scale bird collision inshore	Deck and accommodation lights	Injury or fatality to multiple (dozens) birds	Unplanned	2 & 3	High	Minor	Possible	**Moderate (9)**	**Moderate (9)**	**Probable**	

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

10.2 Onshore disturbance to wildlife from helicopter use

Table of Contents

10.2.1 Introduction 647
10.2.1.1 Relevant legislation 647
10.2.2 Sources of impact and risk 647
10.2.3 Potential receptors 647
10.2.4 Characterising and quantifying the impact 648
10.2.4.1 Nature of potential impact to wildlife 648
10.2.4.1.1 Seabirds 648
10.2.4.1.2 Seals 649
10.2.4.2 Quantifying the impact of helicopter disturbance on wildlife 650
10.2.4.2.1 Helicopter activity during the Phase 1 & 2 Sea Lion Development 650
10.2.4.2.2 Helicopter noise levels 651
10.2.4.2.3 The distribution of helicopter-sensitive receptors 652
10.2.4.2.4 Overlap between helicopter flight paths and wildlife aggregations 653
10.2.4.2.4.1 Flights to the Sea Lion Field 653
10.2.4.2.4.2 Flights to the CTT 654
10.2.4.2.4.3 SAR Test Flights 654
10.2.5 Industry standard mitigations 654
10.2.6 Impact assessment 656
10.2.6.1 Disturbance to wildlife 656
10.2.7 Project-specific mitigation 656
10.2.8 Residual impact assessment 656
10.2.9 Cumulative effects 656
10.2.10 Confidence 657
10.2.10.1 Monitoring required 657
10.2.11 Offsetting 657
10.2.12 Findings summary 657

10.2.1 Introduction

There is the potential for aircraft noise to impact upon colonies of penguins and seals (Hughes, *et al.,* 2008) and also to impact upon livestock and the human population. Concern over such impacts was raised by stakeholders during the scoping consultation (Chapter 6).

This chapter investigates the potential for disturbance to penguins and other wildlife caused by the use of helicopters during the transport of personnel to and from the offshore Sea Lion Field. The potential for social impacts and disturbance to livestock and the human population from helicopter noise and other sources of noise is described in Section 11.9.

Note: the other impacts associated with helicopter use e.g., atmospheric emissions, are described elsewhere in this document, as described in Table 2.2.

10.2.1.1 Relevant legislation

There are numerous pieces of International and Overseas Territory legislation in place to govern air safety which are out with the scope of this EIA which is only concerned with environmental and social impact and risk.

Aviation activities within the Falklands specifically are overseen by Falkland Islands Civil Aviation Department (FICAD). Their work is principally governed by the following:

- Air Navigation (Overseas Territories) Order (AN(OT)O) (2013), and
- International Conventions and Standards ('Rules of the Air').

While no legislation is in place specifically with regards to the environmental impacts of disturbance, guidelines have been developed in the Falklands, and elsewhere, to minimise the impact due to concerns over disturbance to wildlife and livestock from low flying aircraft. Detail on these guidelines is provided in Section 10.2.5 below under Industry-Standard mitigations.

10.2.2 Sources of impact and risk

During the Phase 1 & 2 Development the use of helicopters will be required:

- To carry personnel and / or equipment to and from the Mobile Offshore Drilling Unit (MODU) in Stages 1, 2a & 2b and the Floating Production, Storage and Offloading (FPSO) vessel throughout the project life,
- To carry personnel and / or equipment to and from the FPSO in Stages 2a, 2b & 3,
- To carry a Falklands marine berthing crew to and from the purchaser's Conventional Trading Tanker (CTT) prior to each direct offtake operation, and
- For Search and Rescue (SAR) exercises and test flights.

10.2.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify the specific receptors upon which the impacts and / or risks associated with helicopter use warranted further investigation (Chapter 9). The specific receptors that may be impacted include:

- Seabirds (Section 7.4.5), and
- Marine mammals (seals) (Section 7.4.6).

While cetaceans at or near the surface may experience brief exposure to helicopter overflight noise, such events are typically transient due to the rapid transit of helicopters and their operational altitudes, which exceed 3,400 feet except during take-off and landing. Given that cetaceans generally spend limited time at the surface—particularly in comparison to hauled-out seals or seabird colonies—any disturbance is expected to be minimal. Consequently, helicopter noise is not considered a

significant factor in this assessment. All Sea Lion helicopter operations will be conducted in accordance with the FILFH Guidelines and so the potential impact of helicopter noise on cetaceans is not assessed.

In the Falklands, the most vulnerable receptors are breeding and moulting penguins; a number of species of which will be present on land throughout the year. Similarly, seals haul-out regularly throughout the year on the Falkland Islands to rest and breed.

10.2.4 Characterising and quantifying the impact

In order to characterise the quantify the impact of noise from helicopters, it is necessary to:

- Understand the nature of the impact to seabirds (specifically penguins) and seals, and
- To quantify the number and routes of flights to determine the levels of exposure to noise disturbance.

10.2.4.1 Nature of potential impact to wildlife

Aircraft are increasingly used to support research and other operations in remote environments, such as the Arctic and Antarctic. Although there has been little dedicated research into the effects of disturbance on wildlife, with most evidence coming from opportunistic observations, there is a strong suggestion that low flying aircraft result in both behavioural and physiological changes in penguins and seals (Culik *et al.,* 1990; Cooper *et al.,* 1994; Southwell, 2005).

10.2.4.1.1 Seabirds

Numerous bird species could be disturbed by low flying aircraft. This includes, for example, shorebirds, where disturbance can lead to a flight response, which has an energetic cost, including a loss in foraging time and potentially foraging habitat (Derose-Wilson, *et al.,* 2015; Linssen *et al.,* 2019; van der Kolk, *et al.,* 2020). Nevertheless, the focus of this section is on seabirds and specifically, penguins. This is because of the known overlap between penguin colonies and the proposed helicopter flight paths (see Figure 10.7) and a comparatively poor understanding of the distribution and breeding density of shorebirds. In addition, several seabird colonies in the area of helicopter operations are mixed breeding colonies of Rockhopper penguins and Imperial Shags. Little information exists on low flying aircraft and impacts on shags. However, the impacts reported for penguins (as described below), are likely to be relevant to shags.

Low flying aircraft may invoke particularly strong behavioural responses in penguins, which could lead to trampling of adults, chicks and eggs, and / or the loss of exposed eggs and chicks to predators. Indeed, one well publicised (though unverified) incident of mass mortality of approximately 7,000 king penguins on Macquarie Island was linked to panic caused by the over-flight of a C-130 Hercules aircraft (Rounsevell and Binns, 1991; Cooper, *et al.,* 1994). While a few studies have already linked helicopter activity with local population declines (Thomson, 1977; Wilson, *et al.,* 1990), incidents such as that on Macquarie Island have led to more dedicated research.

The most comprehensive study of the impacts of aircraft noise on penguins was carried out by Hughes *et al.* (2008) at a king penguin colony on South Georgia. This study aimed to quantify the short-term effects of helicopter overflights, with emphasis on:

- The relative effects of different overflight altitudes on behaviour,
- Whether noise levels are associated with specific levels of disturbance, and
- Whether penguin responses change with repeated overflights.

Although no mortality was recorded, the results of the study found significant changes in penguin behaviour during all overflights (at altitudes between 230 and 1,768 m). Differences in behavioural response were recorded between incubating and non-incubating birds with birds sitting on eggs

tending to remain in place and non-incubators moving away from the approaching helicopter. Pre-overflight behaviour resumed within 15 minutes of the aircraft passing overhead and no chicks or eggs were taken by predators as a consequence of the behavioural response to the overflights.

In terms of the specific cause of the impact, no relationship was observed between helicopter noise level and penguin behavioural response in this study. Although the sound of the helicopter is likely to be an important factor, it is understood that the visual disturbance is the greater contributor to the changes in the penguins' behaviour. As a helicopter approaches, the colony becomes silent and penguins, and other birds, look upwards and follow the aircraft as it passes (A. Black, *pers. obs.*). Cooper *et al.* (1994) suggested that penguins react to the visual appearance and size of the helicopter as they would do a natural aerial predator, such as a skua or gull. However, as the study of Hughes *et al.* (2008) progressed, the penguins exhibited a reduced behavioural response to overflights suggesting a degree of habituation to aircraft.

In conclusion, to minimise disturbance to king penguins, Hughes *et al.* (2008) recommended a precautionary approach and suggested that overflights occur at the maximum altitude that is operationally practical, or preferably, that colonies are avoided altogether.

With regard to physiological impacts, a number of studies have investigated the relationship between behavioural response and physiological stress in penguins (for example, Ellenberg, *et al.,* 2006; Ellenberg, *et al.,* 2007). The results indicate that even in the absence of a behavioural response, in incubating birds for example, the animal is still subjected to stress as is evidenced by changes in physiological indicators, such as heart rate, and increased body temperature (Sladen, *et al.,* 1966; Regel and Pütz, 1997). Therefore, the fact that incubating birds did not move from their nest sites does not necessarily indicate the absence of an impact from helicopter overflights. Breeding and other activities, such as moulting, all have associated energy costs and disturbances from helicopter overflights that cause animals to move, or induce a physiological stress response at this time would incur an additional burden in terms of energetic cost. Such physiological stress has been linked to reduced breeding success in penguins and other seabirds (Regel and Pütz, 1997). Moulting penguins fast for about a month and during this time birds lose over 40 % of their body weight (Williams, *et al.,* 1992) such that additional energy expenditure could lead to starvation or have chronic impacts on the survival of individuals (Regel and Pütz, 1997).

10.2.4.1.2 Seals

Seals haul-out throughout the year to rest and to aid thermoregulation and digestion, and therefore this behaviour is an essential part of the animal's routine. If disturbed while on land, seals will usually depart for the water thus escaping the perceived threat. If seals are continually disturbed, the physical exertion and energy expended to haul-out repeatedly, combined with inefficient digestion of food, could disturb the balance of the animal's energy budget and have chronic impacts on survival and reproduction.

Although seen onshore throughout the year, the most sensitive period for these animals is the breeding season. Fur seals and sea lions display complex territorial or harem behaviour, which helps to maintain the genetic fitness of the population. Continual disturbance could interfere with the breeding behaviour of these animals leading to unforeseen consequences for population fitness (French, *et al.,* 2011). Additionally, young animals can become separated from their mothers and therefore from their source of food.

There has been some dedicated research to investigate the impact of disturbance to lactating southern elephant seals. Arnbom *et al.* (1997) found that lactating bouts were shorter in stressful environments, which resulted in pups with lower weaning weights than found in undisturbed pups. Given that

elephant seal pup weight at weaning is directly related to its chances of survival in its first year (McMahon, *et al.,* 2000) there is a direct link between disturbance and pup survival rate.

As a worst-case, it is apparent that some responses of seals to disturbance can be associated with reduced survival and reproduction. However, other less severe responses, such as increased alertness, can be temporary and have little or no impacts on fitness. As with seabirds, the degree of response is linked to the proximity of the aircraft to the animal (Southall, 2005).

10.2.4.2 Quantifying the impact of helicopter disturbance on wildlife

When quantifying the potential impacts of helicopter disturbance on wildlife, it is necessary to consider the following:

- The proposed helicopter activity during the Development,
- Helicopter noise levels,
- The distribution of helicopter-sensitive wildlife, and
- The overlap between helicopter flight paths and seal, sealion and penguin distribution.

10.2.4.2.1 Proposed helicopter activity during the Phase 1 & 2 Sea Lion Development

As detailed in the project description (Section 5.11.3), helicopter flights will occur most frequently during Stage 2a & 2b of the Development when routine flights to the MODU and FPSO may occur up to ten times per fortnight and there are regular flights to coincide with the offtake operation, along with SAR test flights and exercises.

It is likely that crews arriving at Mount Pleasant Airport (MPN) on the fixed-wing flight will be transported by road to Stanley airport, where the helicopters are based, prior to being taken offshore. However, in some instances, the helicopters may collect crews directly from MPN before transporting them offshore, and crews returning would be taken directly to MPN. At the time of writing, it is possible that the SAR aircraft may be based at MPN rather than at Stanley Airport and that the test flights will be conducted in the vicinity of MPN. A summary of the estimated number of helicopter flights that will occur is provided in Table 10.9.

Details on the proposed flight paths are provided in Section 10.2.4.2.4 below.

Table 10.9: Number of helicopter flights during the Phase 1 & 2 Development

Helicopter activity[1]	Stage 1 (31 months, 942 days)		Stage 2a & b (35 months, 1,064 days)		Stage 3 (325 months, *c.* 27 years)	
	Frequency of flights	Number of flights[1]	Frequency of flights	Number of flights[1]	Frequency of flights	Number of flights[1]
Crew change to MODU	10 / fortnight	670	10 / fortnight	750	-	-
Crew change to FPSO					2 / week	2,795
Berthing crew transfer to CTT	n/a	n/a	Per direct offtake (average every 10 days)	106	Per direct offtake (average of 36 / year over Field Life)	972
SAR training	6.7 / month[2]	208	6.7 / month[2]	235	6.7 / month[2]	2,178
Total number of	**-**	**878**	**-**	**1091**	**-**	**5,945**

Helicopter activity[1]	Stage 1 (31 months, 942 days)		Stage 2a & b (35 months, 1,064 days)		Stage 3 (325 months, *c.* 27 years)	
	Frequency of flights	Number of flights[1]	Frequency of flights	Number of flights[1]	Frequency of flights	Number of flights[1]
flights per Stage						
Total	7,914					

[1] Based on an average of 30.4 days per month, and an average of 4.3 weeks per month.
[2] Based upon 20 hours flying per month at 3 hours per trip.

10.2.4.2.2 Helicopter noise levels

The noise received by a receptor on the ground is related to a helicopter's altitude and prevailing weather conditions at the time. Disturbance to wildlife is not purely due to noise (as explained in Section 10.2.4.1 above) but is an important contributor to disturbance. Note that there are no sound level thresholds for disturbance in terrestrial wildlife (or marine animals when on land) and research indicates that there is no direct relationship between noise level and behavioural response (Hughes *et al.,* 2008).

While helicopters are widely used in the O&G industry, there are few data available regarding the sound level generated in-flight. Sound levels are measured in decibels (dB), which is a logarithmic scale and, in effect, an increase in sound level of 10 dB is equivalent to a doubling in the perceived sound level.

The noise experienced on the ground will be directly related to the distance between the helicopter and the receptor. One study, looking at the impact on human health, reported sound levels of 110-115 dB as passengers boarded an idling Sikorsky S92 aircraft (Ognedal, 2012). The same helicopter would be considerably louder when in-flight. BMT (2005) contains measurements of a Eurocopter EC155 B1, a type of helicopter commonly used for O&G shuttle purposes, and reports 88.9 dB at a horizontal distance of 150 m with an overflight at 150 m height (a straight line distance of 212 m). By applying a simple ISO9613-2 attenuation calculation to the scenario, it is likely that the source level was around 144 dB (sound power level) which approximates to 133 dB sound pressure level at 1 m for a spherically spreading source. This allows the sound pressure level at other distances to be estimated. A similar calculation has been undertaken for two other common types of helicopter: Super Puma EC225 and a Sikorsky S-92 (Norske Olje & Gass, 2014). The anticipated levels of sound experienced at different distances from the source are shown in Table 10.10 along with noise levels of actual recordings of flights in the Falkland Islands and day-to-day activities for comparison.

It is important to note however, that environmental factors, especially wind, will influence the propagation of sound and far more sophisticated models would be required to accurately predict the noise level experienced by different receptors at any given point under a range of environmental conditions. Therefore, the values given here should be regarded as a rough guide to sound perceived under still conditions.

Table 10.10: Sound level from helicopter and flight activity experienced at ground level *(adapted from Norske Olje and Gass, 2014; BMT, 2005)*

Activity	Maximum sound level at distance from sound source (dB(A))[1]			
	Equivalent at 1 m	Approx. 100 m	600 m	3,500 m
Super Puma[2] EC225 (idling)	>114	-	*c.* 68	*c.* 43
Sikorsky S92 (idling)	>110	-	*c.* 54	*c.* 39
EC155 (overflight)	133	-	77	48
Sikorsky S61[2] taking off (recorded at MPN)	-	145	-	-
FIGAS Britten-Norman Islander (recorded at Stanley Airport)	-	148	-	-
Comparison with typical noise levels experienced by the public[3]	Chainsaw (120 dB)	-	Conversation (60 dB) Small penguin colony (65 – 69 dB)	Street in the evening (41 dB)

[1] An 'A-weighting' is normally applied to sounds measured by instruments in an effort to account for the 'loudness' as it is perceived by the human ear. Essentially, between 500 Hz and 6 kHz the human ear is much more sensitive, but below and above these frequencies the human ear is not particularly sensitive and the 'A-weighting' takes these sensitivities into account.
[2] Superpumas and S-61s are no longer used in the O&G industry.
[3] After NoMEPorts, 2008.

10.2.4.2.3 The distribution of helicopter-sensitive receptors

The wildlife receptors likely to be most vulnerable to helicopter noise are mostly coastal in distribution. Wildlife colonies of note in the north of East Falkland include:

- The king penguin colony at Volunteer Point. The unusual breeding strategy of this species means that breeding birds will be present year-round, as it takes over a year to raise a chick. This colony supports virtually the entire Falklands' breeding population of this species.
- Gentoo penguins breed between October and February on the coasts of northern East Falkland (e.g., at Seal Bay), but also return to shore to rest at other times throughout the year when they may congregate away from breeding colonies. The number of breeding birds on the coasts of northern East Falkland is approximately 23 % of the Islands' population (Baylis, 2012).
- Magellanic and rockhopper penguins will be on land between September and April while they moult and breed and are at-sea between May and August. When breeding, Magellanic penguins are dispersed around much of the coastline and there are no population estimates although there are colonies at Seal Bay. Rockhopper penguins are relatively uncommon in the north of East Falkland, which supports approximately 2.3 % of the Islands' population.
- There are several small southern giant petrel colonies in the north of East Falkland, at Black Point (Volunteer Lagoon) and Rincon Grande. Generally, the birds return to colonies in September but do not lay until late October with the chicks fledging in late March.
- Eddystone and Volunteer Rocks are used by South American fur seals which favour the seclusion of isolated offshore rocks / small islands (Cárdenas-Alayza, *et al.*, 2016). Fur seals are at their most vulnerable during the pupping, which takes place between October and December.

- There are several locations on the north coast of East Falkland where South American sea lions breed or haul-out (including Diamond Cove, Big Shag Island and Cape Bougainville). Sea lions pup during December and January and are likely to be more susceptible to impacts associated with disturbance at this time.

A visual summary of the above, showing the temporal distribution of colonies on the north coast of East Falkland is provided in Table 10.11, which indicates that colonies of penguins and seals will be present year-round and most predominantly in the austral summer when breeding and moulting occur.

It is likely that other species of seabird and seals would also be disturbed by helicopter over flights (for example, shorebirds Dorose-Wilson *et al.,* 2015, van der Kolk *et al.,* 2020). In the Falkland Islands, areas with notably high wildlife significance are designated as National Nature Reserves (NNRs) (e.g., Volunteer Point), Important Bird Areas (IBAs) (e.g., Kidney and Cochon Islands, Volunteer Point, Seal Bay and Cow Bay and Cape Dolphin) or Ramsar sites (e.g., Bertha's Beach) (Section 7.5.2).

Table 10.11: Temporal distribution of colonies and / or haul outs on and around the northern coast of East Falkland

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
King penguins	Breeding at Volunteer Point											
Gentoo penguins	Breeding			Occasional return to shore to rest						Breeding		
Magellanic / rockhopper penguins	Breeding and moulting				-	-	-	-	Breeding and moulting			
Southern giant petrel	Breeding			-	-	-	-	-	Return to shore for breeding			
South American fur seals	Haul-out throughout year									Pupping		
South American sea lions	Pupping		Haul-out throughout year									pupping

10.2.4.2.4 Overlap between helicopter flight paths and wildlife aggregations

Figure 10.7 below shows the spatial distribution of sensitive environmental receptors and community settlements in the north of East Falkland alongside the expected flight paths associated with the Development.

10.2.4.2.4.1 Flights to the Sea Lion Field

Direct flightpaths between the two main heliports and the Sea Lion Field are indicated by the arrows in Figure 10.7. The flightpath from Stanley Airport to the Sea Lion Field is on a bearing of 340° (I. Ewen, *pers. comm.*).

Flights from MPN directly to the Sea Lion Field will pass close to gentoo breeding colonies on the north coast but this area is not designated as an NNR, IBA or Ramsar site (Figure 10.7).

Helicopters flying between Stanley and the Phase 1 & 2 Development would pass approximately 5.5 km to the west of the king penguin colony at the Volunteer Point NNR / IBA and directly over Seal Bay on the north coast of East Falkland. Seal Bay is designated an IBA due to the populations of breeding rockhopper, gentoo and Magellanic penguins and sooty shearwaters (Section 7.5.2.3.1). Additionally, there are a number of small rockhopper penguin colonies in Berkeley Sound, which are undesignated.

10.2.4.2.4.2 Flights to the CTT

During the direct offtake operation of crude from the FPSO to the CTT, a berthing crew will be transported from Stanley Airport by helicopter to the CTT at an offshore location close to the Sea Lion Field.

Flight paths out to the CTT will generally be similar to those going out to the FPSO but may range slightly further east or west depending on from which direction the CTT is arriving at the field. It is not possible to predict their exact routes at the time of writing but all flights out to the CTT (as with all Sea Lion helicopter flights around the Islands) will comply with the Falkland Islands Low Flying Handbook (FILFH, 2024).

10.2.4.2.4.3 SAR Test Flights

SAR test flights may occur from MPN or from Stanley Airport, as occurred during the 2015 exploration campaign.

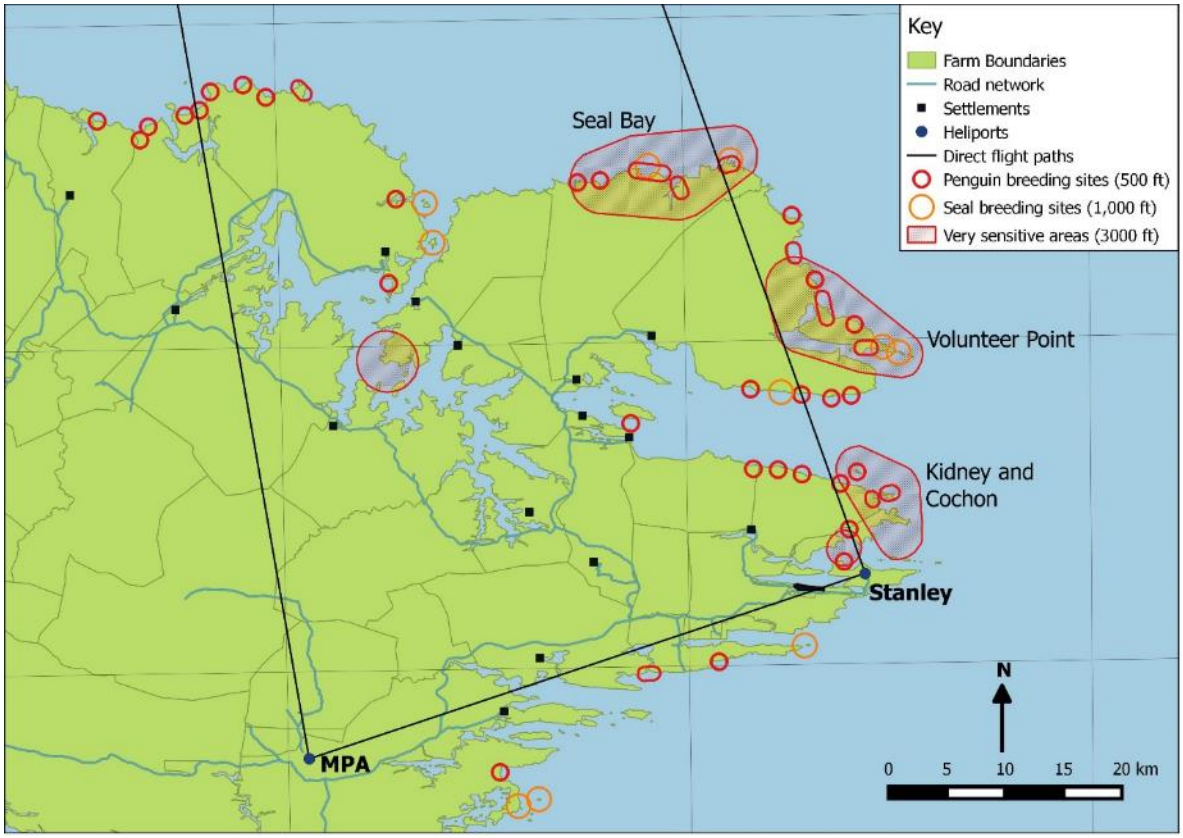


Figure 10.7: The distribution of sensitive wildlife receptors and settlements in relation to the most direct helicopter flightpaths

Note: penguin colonies at Kidney and Cochon islands, Berkeley Sound and Cape Bougainville contained mixed colonies of Rockhopper penguins and Imperial Shags.
Note: the arrows heading out to sea ultimately converge at the Sea Lion Field 220 km offshore.
Note: the sensitive areas shown in Figure 10.7 are taken from the Ministry of Defence's Falkland Islands Range and Avoidance Areas (5-GSGS) map (MoD, 2014).

10.2.5 Industry standard mitigations

While no industry-standard mitigations exist for the O&G industry specifically, guidelines have been developed in the Falklands, and elsewhere, to minimise the environmental impacts of disturbance from helicopters. These include:

- The Ministry of Defence's (MoD's) Falkland Islands Range and Avoidance Areas (5-GSGS) map (MoD, 2014),
- The Falkland Islands Low Flying Handbook (FILFH, 2024), and
- South Georgia Low Flight Avoidance Map (GSGSSI, 2009).

The simplest and most effective way to mitigate the effects of disturbance from helicopter overflights is to route helicopters away from colonies of penguins, other seabirds and seals. Following the example set by the MoD (MoD, 2014) and on other islands such as South Georgia, impact reduction methods (e.g., flight avoidance maps) can be used, which generally have a history of successful use and acceptance.

In addition to guidance on the avoidance of bird activity with regard to flight safety etc., the key avoidance areas are marked on the FILFH avoidance maps. Specifically, the FILFH (2024) lists the following guidance:

- Sensitive areas with increased risk of birdstrike - not to be over flown by any aircraft below 3,000 ft unless landing or taking off. Full details are provided on the Falkland Island Range and Avoidance Areas, GSGS 5563, Ed 5/6,
- National Nature Reserves - to be avoided by 1,000 ft above ground level (AGL) vertically and 0.25 nm laterally unless otherwise specified. See Falkland Island Range and Avoidance Areas, GSGS 5563, Ed 5/6 for more details,
- Sensitive breeding sites - to be avoided by 1,000 ft AGL vertically and 0.25 nm laterally unless otherwise specified. See Falkland Island Range and Avoidance Areas, GSGS 5563, Ed 5/6 for more details, and
- Penguin and Seal Avoids - areas listed as 'known sensitive breeding sites of penguins or seals' are not to be over flown by any aircraft below 1,000 ft AGL. See Falkland Island Range and Avoidance Areas, GSGS 5563, Ed 5/6 for more details.

Importantly, according to the FILFH (2024), the source data for the 'avoid areas' above is unknown. Both the Falkland Islands Director of Civil Aviation and Environmental Departments have been consulted but they do not have a record of the origin. Until a full review can be completed, the GSGS 5563 is to be used as the source document.

In addition to the restricted areas identified on the MoD map and the guidance in FILFH (2024), the following additional recommendations are made in the GSGSSI (2009):

- When following the coastline, maintain a vertical separation distance of 600 m and a horizontal separation of about 500 m from the coastline where possible,
- Cross coasts at right angles and above an altitude of 600 m where possible,
- Never hover or make repeated passes over wildlife concentrations or fly lower than necessary, and
- At all times, the number of animals exposed to disturbance will be reduced to as low as reasonably practical taking account of safety, weather conditions etc.

As the above is considered standard practice within the Falklands, Navitas will develop an approved project-specific flight plan, which should be sufficient to mitigate the impact of helicopter disturbance on wildlife. Navitas will use the flight avoidance map as the basis for flight planning, following the Falkland Islands Low Flying Handbook Guidance (FILFH, 2024). All helicopter pilots will:

- Be briefed on flight avoidance protocols for sensitive areas prior to flying,
- Sign a document indicting that that the FILFH (2024) has been read and understood,

- Be accompanied by a pilot experienced in the area on their first flight, and
- Be issued with an approved flight path.

The above mitigation measures are taken into account during the initial impact assessment described below.

10.2.6 Impact assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities.

A summary of the impact assessment outcomes for this Development is tabulated in Section 10.2.12, which shows the worst-case impact for each activity.

10.2.6.1 Disturbance to wildlife

Of all the helicopter-sensitive wildlife described, the species of greatest concern is the king penguin as these birds breed year-round onshore, and virtually the entire Falklands' population is in one location at the Volunteer Point NNR / IBA (Section 10.2.4.2.3). As well as passing *cc.* 5.5 km away from the Volunteer Point IBA, direct flight lines from Stanley to the Sea Lion Field would also pass directly over, or close to, a number of small rockhopper penguin colonies at Seal Bay (Figure 10.7). Further, other undesignated but significant penguin colonies and are on (or close to) the direct flight paths between the Sea Lion Field and the Stanley and MPN heliports (Figure 10.7). The national importance of these areas and the species they support means that the sensitivity of the receptors could be considered to be 'Very High'. However, as a flight plan will be in place, in line with the FILFH (Section 10.2.5), the exposure time and the frequency / level of exposure that these colonies will experience is greatly reduced. As the colonies will not actually be exposed to the helicopter noise, the sensitivity of the receptor to the impact of helicopter noise can be considered to be '**Low**'.

The impact of a single helicopter overflight on any population of penguins is likely to be short-term and rapidly reversible. However, the combined impact of numerous (potentially daily) disturbances could have serious implications for the survival of moulting birds or chicks. If this were to continue over a number of years, it could result in a reduction in the local populations or redistribution of known colonies (Section 10.2.4.1.1). Nonetheless, as the FILFH compliant flight plan will prevent such chronic exposure, the severity of effect of helicopter over-flights is considered to be '**Minor**'.

Therefore, the overall significance of the impact of helicopter disturbance on wildlife is considered to be '**Low (4**)'.

10.2.7 Project-specific mitigation

As the impact is considered to be '**Low (4)**', there is no need to consider any additional project-specific mitigation measures.

10.2.8 Residual impact assessment

No residual assessment was carried out as the initial impact was considered to be '**Low (4)**' owing to the use of the FILFH compliant flight plan.

10.2.9 Cumulative effects

Low flying aircraft are a common sight around the Falkland Islands and therefore there is the potential for cumulative impacts in the form of increased 'concentration', 'extent and proportion' and 'duration' (Section 8.9.1).

The Government Air Service (FIGAS) operates a small fleet of Britten-Norman Islander fixed-wing aircraft that transport passengers and small quantities of freight around the Islands, most of which

have an airstrip. Additionally, there are a number of military fixed-wing aircraft (from Typhoon jets to A400N Atlas) that regularly practice low-level flying around the Islands.

In addition to the Navitas helicopters, there are a number of helicopters based at MPN that are used for SAR and transporting military personnel and cargo around the Islands. Additionally, helicopters fly visitors to some of the offshore islands that support concentrations of wildlife and occasionally overfly Stanley. SAR helicopters occasionally undertake exercises in Stanley Harbour and deliver patients to the King Edwards Memorial Hospital (KEMH), landing on the school's football pitch.

In recognition of the threat posed by low-flying aircraft to wildlife, and also the risk of bird strikes and damage to aircraft, all flights within the Falkland Islands adhere to the MoD flight avoidance map (MoD, 2014). Although, notably, MoD aircraft may breach the guidelines if operationally necessary.

Under normal operating conditions, helicopter activity during the Phase 1 & 2 Development will follow the project-specific flight plan (Section 10.2.5) and will have no need to land anywhere other than Stanley airport or MPN. Therefore, with the impact considered to be '**Low**', the Development should not result in any additional impact on wildlife.

10.2.10 Confidence

The project activities are clearly defined in terms of the:

- Start and end points of flights,
- Frequency of flights, and
- Adherence to project-specific flight plans.

Equally, the locations of vulnerable receptors are known. While the long-term consequences of the impact of noise on wildlife are not fully understood, the application of the Falkland Islands Low Flying Handbook and associated guidance will take account of tried and tested mitigation measures such that the confidence in the assessment is considered to be '**Certain**'.

10.2.10.1 Monitoring required

No specific monitoring over and above any legal requirements, or those indicated in Navitas' corporate standards have currently been identified. However, monitoring requirements were recorded during the project-specific Phase 1 & 2 Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the EMMP. An outline EMMP is provided in Chapter 15.

10.2.11 Offsetting

As no residual impacts or risks identified in this section are considered significant, i.e., Moderate or above, offsetting is not considered necessary for this impact (see Section 8.11).

10.2.12 Findings summary

Table 10.12: Summary of the assessment of impacts to wildlife associated with helicopter disturbance during the Phase 1 & 2 Sea Lion Development

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance a		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Helicopter use	Disturbance to wildlife	Behavioural and physiological stress reactions to helicopter over-flights, leading to trampling, increased vulnerability to predation, increased energy demands and possible reduced breeding success	Planned	1, 2a, 2b & 3	Low	Minor	n/a	**Low (4)**	**n/a**	**Certain**	**Industry-standard:** Use of project-specific flight plan in line with the flight avoidance map as the basis for flight planning, following the Falkland Islands Low Flying Handbook Guidance (FILFH, 2024). **Project-specific:** None

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

10.3 Disturbance to seabed

Table of Contents

10.3.1 Introduction 661
10.3.1.1 Relevant legislation 661
10.3.2 Sources of impact and risk 661
10.3.3 Potential receptors 662
10.3.4 Characterising and quantifying the impact 662
10.3.4.1 Nature of the impact from installation, presence and removal of structures 663
10.3.4.1.1 Impacts to benthic fauna 663
10.3.4.1.2 Impacts to biodiversity from habitat modification and marine growth 663
10.3.4.1.2.1 Anthropogenic installation of new habitats 664
10.3.4.1.2.2 Damage to existing habitats 665
10.3.4.2 Potential impacts at the Phase 1 & 2 Development locations 665
10.3.4.2.1 Impacts in the Sea Lion Field 665
10.3.4.2.1.1 Existing habitats and fauna 665
10.3.4.2.1.2 Habitats of importance 666
10.3.4.2.1.3 Anticipated marine growth 666
10.3.4.2.2 Impacts in Berkeley Sound 667
10.3.4.2.2.1 Existing habitats and fauna 667
10.3.4.2.2.2 Habitats of importance 668
10.3.4.2.2.3 Anticipated marine growth 668
10.3.4.3 Quantification of the subsea infrastructure 668
10.3.4.3.1 FPSO and MODU mooring systems 668
10.3.4.3.2 Well infrastructure, SPS and SURF 672
10.3.4.3.3 Inshore LTV anchors 676
10.3.4.4 Risk of dropped objects 676
10.3.5 Industry standard mitigations 676
10.3.5.1 Seabed disturbance 676
10.3.5.2 Marine growth on hard substrates 677
10.3.5.3 Dropped objects 677
10.3.6 Impact and risk assessment 677
10.3.6.1 Impact assessment of disturbance to the seabed 677
10.3.6.1.1 Sea Lion Field 677
10.3.6.1.1.1 Disturbance to fauna and existing habitats 677
10.3.6.1.1.2 Habitat modification and marine growth 678
10.3.6.1.2 Berkeley Sound 678
10.3.6.1.2.1 Disturbance to fauna and existing habitats 678
10.3.6.2 Risk assessment of unplanned and accidental events 678
10.3.6.2.1 Risk of dropped objects 678
10.3.7 Project-specific mitigation 679
10.3.8 Residual impacts and risks 679
10.3.9 Cumulative impact 679
10.3.9.1 Sea Lion Field 679
10.3.9.2 Berkeley Sound 679

10.3.10 Confidence 679
10.3.10.1 Monitoring required 680
10.3.11 Offsetting 680
10.3.12 Findings summary 680

10.3.1 Introduction

The Phase 1 & 2 Development will require the short-term and long-term placement of objects on the seabed at the offshore location as well as the use of temporary anchors in Berkeley Sound. Both the installation and removal of subsea structures can cause disturbance to the seabed, potentially affecting the benthos and habitats. Additionally, the introduction of hard substrates to the seabed may present the opportunity for marine growth and for 'artificial reefs' to form.

This chapter assesses the potential impacts associated with the installation and presence of structures and the removal of temporary structures, as well the risk associated with accidentally dropped objects.

All long-term structures will be installed in anticipation of full removal at the time of decommissioning (Section 5.12) and the impacts of removing these will be assessed in a dedicated EIA in support of the Decommissioning Programme (Section 5.12.1).

Note: the impacts to other users of the sea from the placement of objects on the seabed are assessed elsewhere in the document as described in Table 2.2.

Note: the potential for impacts to marine mammals and entanglement with seabed infrastructure (i.e. mooring lines etc.) is assessed in Section 10.11.

10.3.1.1 Relevant legislation

Currently there is no legislation enacted in the Falkland Islands which governs the placement (or removal) of objects on the seabed or any associated disturbance of the seabed.

However, UK Legislation which may be relevant from the environmental perspective are the:

- Petroleum Act 1998.
- Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (and all associated amendments).
- Offshore Marine Conservation Regulations (Natural Habitats, &c) 2007 (as amended) (which implement the Habitats Directive).
- The Marine and Coastal Access Act 2009 and The Marine (Scotland) Act 2010, which introduced the requirement for marine licences for objects placed on the seabed and for disturbance of the seabed (normally applies to objects not directly related to drilling, production or pipelines).
- Energy Act 2008 (Part 4A) which covers navigational issues and the consent to locate.

10.3.2 Sources of impact and risk

The following chapter assesses the impacts of the offshore and inshore seabed disturbance which will result from the Sea Lion Phase 1 & 2 Development. As described in Section 2.1.1, the Sea Lion Development offshore subsea layout and location of wells has been optimised and the sources of offshore seabed disturbance include:

- Offshore:
  - Mooring systems:
    - The repeated installation and removal of the temporary Mobile Offshore Drilling Unit (MODU) mooring system, and
    - Installation of the long-term Floating Production, Storage and Offloading (FPSO) mooring system (in place for Field Life).
  - Installation of well infrastructure:
    - Conductors, and

        - Wellheads for drilling (with Blow Out Preventors (BOPs) and X-mas trees placed on top of the wellhead during drilling and production respectively).
    - The Subsea Production System (SPS) and Subsea Umbilicals, Risers and Flowlines (SURF):
        - Manifolds,
        - Production, water injection, gas injection and diesel service flowlines / risers,
        - Flexible jumpers and flying leads,
        - Umbilicals,
        - Sandbags and gravel bags used as markers and construction aids, and
        - Temporary deposits e.g., clump weights for installation of equipment and for downlines for hydrotesting.
    - Survey equipment, transponders and sampling equipment.
    - Accidentally dropped large objects e.g., subsea infrastructure during installation.
- Inshore impacts will relate to the:
    - Use of temporary anchors by up to two Large Transport Vessels (LTVs) anchored in Berkeley Sound at any one time.

Note: the MODU will either be moored by anchors or by pre-installed suction anchors. The exact number of anchors used will not be known until the rig is selected, it is assumed for the purposes of assessment that approximately ten anchors will be used with different lengths of chain required in order for the rig to maintain position.

Note: smaller dropped objects such as tools etc. are considered to have negligible impact to the seabed and were scoped out as indicated in Chapter 9. The risks associated with large potential dropped objects are assessed below.

10.3.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify those receptors upon which the impacts and risks of seabed disturbance warranted further investigation (Chapter 9). These include:

- Benthic fauna and habitats at the Sea Lion Field (Section 7.4.3.2) (as impacted directly and by impacts to seabed and water quality), and
- Benthic fauna and habitats in Berkeley Sound (Section 7.4.3.3), (as impacted directly and by impacts to seabed and water quality).

Note: impacts to sites of archaeological interest were scoped out during the ENVIID (Chapter 9) as there are no known shipwrecks in the vicinity of the Phase 1 & 2 Development locations (Section 7.7.6). In Berkeley Sound, the location of the LTVs and associated anchors has been chosen to avoid known wrecks, the location of which has been confirmed through sidescan and multibeam sonar survey (BSL, 2015a).

Note: based upon the historical drilling locations, no previous WBM cuttings piles are expected to be disturbed by MODU / FPSO anchor chains.

10.3.4 Characterising and quantifying the impact

When characterising and quantifying the potential impacts and risks associated with placing and removing objects on the seabed it is necessary to consider the:

- Nature of the impact from the installation and presence of objects on the seabed,
- Potential impacts at the Phase 1 & 2 Development locations including:

- Fauna and habitats in the Sea Lion Field, and
- Fauna and habitats Berkeley Sound.

- Quantification of the subsea infrastructure including the dimensions and footprint of the:
  - FPSO and MODU mooring systems,
  - Well infrastructure, SPS, SURF and temporary deposits, and
  - Temporary inshore anchors used by the LTVs during the early construction stages.
- Risk of large dropped objects and associated impacts on benthic fauna.

10.3.4.1 Nature of the impact from installation, presence and removal of structures

Placement and / or removal of objects on the seabed may directly and / or indirectly impact upon:

- Benthic fauna (as impacted directly and by impacts to seabed and water quality), and
- Biodiversity *via* habitat modification and marine growth.

10.3.4.1.1 Impacts to benthic fauna (and seabed and water quality)

Benthic fauna are primarily impacted by:

- Direct crushing of sessile or sedentary organisms, and
- Indirect smothering of organisms with re-settling suspended sediments.

Direct impacts include the crushing of sessile or sedentary organisms which cannot move away. These effects will be immediate, very localised and will affect the area directly covered by the structure, and possibly the immediate vicinity in which the activity occurs. During installation processes however, seabed sediments will be stirred up and become suspended, which can lead to indirect impacts.

While larger, more mobile animals, such as crabs, fish, shrimps and prawns may be able to avoid these impacts, the suspension of sediment into the water column can cause clogging, smothering or abrasion of sensitive feeding and respiratory apparatus in sedentary or slow moving organisms (Nicholls, *et al.,* 2003). These impacts are of greatest concern for filter feeders such as the saltwater clams (*Thyasira* spp.) found at the offshore Development site.

One study (Carlmark, 1971) involved laboratory testing of objects falling into sediments in test conditions and contains notes on the behaviour of the sediments on impact. Overwhelmingly, there was displacement of solids either side of the impact and an elevated 'lip' forming to the impact depression, but very little material was visibly ejected into the water column.

However, and importantly, the degree of the impact upon filter feeders depends upon the duration of exposure to suspended sediments. For instance, experiments have shown that the filter feeding scallop *Pecten novaezelandiae* was unaffected by exposure to 250 mg/l of sediment in suspension for a single week, but decreased growth was observed in individuals exposed to lower density suspensions for periods longer than one week (Nicholls, *et al.,* 2003).

10.3.4.1.2 Impacts to biodiversity from habitat modification and marine growth

Habitat modification can result from the placement of hard substrates on the seabed and can have direct and indirect impacts on biodiversity as follows:

- The anthropogenic installation of new habitat in an area leading indirectly to:
  - The settlement and growth of native marine fauna not otherwise present in the immediate area,
  - Provision of a ‘stepping-stone’ for species with only moderate dispersal abilities (BAS, 2014), and

- The establishment of non-native species.
- Direct damage to existing habitats.

10.3.4.1.2.1 Anthropogenic installation of new habitats

When hard substrates are placed on the seabed in an area where such materials are naturally sparse, there is the potential that these structures may become colonised by species which prefer hard substrates and would not ordinarily be in the area. Further, such habitats may enable the spread of species with moderate dispersal abilities by providing 'stepping-stones' which create interconnectivity with other regions (BAS, 2014).

It is observed that installations in the North Sea are predictably colonised with numerous epifauna groups which wouldn't otherwise be present in the area (OSPAR, 2009a). For example, seaweeds, mussels, anemones, sponges, hydroids and cold-water corals are frequently recorded on Oil and Gas (O&G) structures (e.g., jackets, risers and seabed infrastructure) (Coolen *et al.,* 2015). A very specific example of the settlement of fauna which is otherwise not found in an area is the presence of the cold-water coral *Lophelia pertusa*[53] in the North Sea. This species was most frequently reported on the shelf-edge and the offshore banks of the north-east Atlantic (Roberts, 2002) and is now found in the North Sea where it had not previously been recorded (Gass and Roberts, 2006). Importantly, these colonised 'habitats' can then attract more mobile fauna which are attracted by the shelter and food source provided.

While the likelihood of colonisation, and the composition of marine growth on a particular structure depends on a variety of factors (such as water temperature, water depth, wave action, the indigenous and / or non-native species present in the area and the season in which the structure was installed (Fortreath, *et al.,* 1982; OGUK[54], 2011)), it is generally recognised that the presence of marine growth on artificial hard substrates can impact upon biodiversity and species abundance in an area.

Indeed, in order to better understand the extent to which artificial substrates associated with the O&G industry affect biodiversity, and to examine the impact of habitat creation by O&G activities in the North Sea in general, OEUK[1] launched a scientifically led and long-term environmental Joint Industry Project to assess the 'INfluence of man-made Structures In The Ecosystem' (INSITE). The INSITE Programme was launched in 2014, with the aim of providing stakeholders with the independent scientific evidence-base needed to better understand the influence of man-made structures on the ecosystem of the North Sea. The INSITE programme is currently funded by the Natural Environment Research Council (NERC) and the Centre for Environment, Fisheries and Aquaculture Science (Cefas), and is sponsored by an industry partnership of North Sea asset operators (UKRI, 2022).

While it is debatable as to whether the impact of 'artificial reefs' is positive, negative or negligible in the immediate location, there may be the potential for broader reaching negative effects. For example, based on laboratory work, Holst and Jarms (2007) suggest that one reason for a worldwide increase in mass occurrences of Scyphozoan jellyfish may be due to increases in artificial substrates and marine litter in coastal and offshore regions, which provide increased settlement opportunities for larval stages. Although the cause is unlikely to be directly related to artificial substrates or litter, jellyfish blooms are already experienced in Falklands waters, with peaks in jellyfish catch approximately every ten years and long-term trend of growing catches (J. Pompert, *pers. comm.*).

With regard to non-native species, there is the potential for the creation of new habitats to enable such species to settle and become established. The potential for this may be enhanced where the

[53] *Lophelia pertusa* is now known as *Desmophyllum pertusum*. This change is based on molecular evidence although there remains some uncertainty about the change which may be reversed following further investigation.
[54] Oil and Gas UK (OGUK) is now known as Offshore Energies UK (OEUK).

surfaces of the artificial 'habitat' are heated, which may increase the range of species able to survive in the region, growth rates and maturation times (BAS, 2014). An overview of the potential for such impact interactions (i.e., the combined effect of species introduction and artificial habitat provision) is provided in Chapter 13.

10.3.4.1.2.2 Damage to existing habitats

Damage to existing habitats can result directly from the placement of objects on the seabed. The significance of such damage will depend upon the extent of the damage, the importance of the habitat with regard to its ecological value and whether or not the habitat is ubiquitous, rare or isolated. Detail on the habitats of the Sea Lion Field and the LTV locations in Berkeley Sound are provided below.

10.3.4.2 Potential impacts at the Phase 1 & 2 Development locations

10.3.4.2.1 Impacts in the Sea Lion Field

10.3.4.2.1.1 Existing habitats and fauna

The sediment at the Sea Lion site is classed as medium to coarse silt with a high percentage of fine material (61-80 %) (Section 7.3.7.1.1) which is likely to become suspended during the installation processes with the potential to impact the fauna present.

With regard to fauna present, an 'area-wide' seabed survey of the Sea Lion development area was carried out in 2012 (Gardline, 2013a & b), and several surveys were carried out in support of the 2015 exploration drilling campaign (Section 7.2.2). These surveys indicated that the benthic communities in the area were:

- Typical of the sediment type and were rich in species assemblages, diversity and abundance (Gardline, 2013a & b), and
- Relatively homogeneous throughout the surveyed area (Section 7.3.7.1.1).

Nonetheless, hard substrates do occur in the North Falklands Basin (NFB) and these areas have been colonised. For example, about 40 km to the south of the Sea Lion Field, in the region of the Isobel Deep well, seabed photography revealed the presence of hard substrates in the form of clay outcrops, boulders and drop-stones associated with glacial and iceberg groundings (Premier, 2014c). Assessment of the epifaunal assemblages within these habitats, confirmed the presence of a relatively well populated community of species. Brittlestars, sea urchins, starfish, hard and soft corals, bryozoans, hydroids, ascidians and anemones were frequently encountered. In turn, this colonisation has led to the presence of demersal fish (notably Notothenidae spp.), pelagic fish and cephalopods. An example of the growth found on erratic glacial rocks is shown in Figure 10-8.



Figure 10-8: Example of marine growth on seabed boulder in the Isobel Deep area of the NFB
(Source: MG3, 2015)

10.3.4.2.1.2 Habitats of importance

There is a low likelihood of there being habitats in the region of the Sea Lion Field that are equivalent to those of conservation significance in the UK as defined by the Offshore Marine Conservation of Habitats Regulations (Section 7.4.3.2.2). Although some indicator taxa of important habitats are predicted to be present (≥50 % probability), these are likely to occur in low densities and not in aggregations as would typically contribute to the definition of important habitats. Predicted habitats are found widely in areas adjacent to the license area, and as such any potential impacts within the license area are not likely to impact the health of the local population.

10.3.4.2.1.3 Anticipated marine growth

With regard to marine growth opportunities, in the upper water column, colonisation by seaweeds and mussels may occur quite quickly on the upper lengths of risers and FPSO anchors chains as is observed in similar latitudes. At depths of approximately 450 m however, it is likely that colonisation and growth on the subsea infrastructure will be slower.

In order to obtain a firmer estimate of marine growth potential, British Antarctic Survey (BAS) were commissioned by POEPL to estimate the type of marine growth that could occur in the Sea Lion Field (BAS, 2014).

Existing oceanographic data and models suggest predominant currents at the location of the proposed Sea Lion Development come from East Falkland and north of Tierra del Fuego with the current speed generally being less than 15 cm/s (Section 7.3.3). Following biofilm development in the initial weeks of deployment, *Ectocarpus* and *Enteromorpha* algae, tubicolous polychaete worms and acorn barnacles

are likely to establish. These will be followed by a complex succession of fouling types. Ultimately, barnacles, oysters or mussels (probably the latter) are likely to dominate.

The study indicated that, by far, most growth should occur in the top 40 m, as is seen in the North Sea. However, thicknesses of marine growth are predicted to be less, overall, than that seen the North Sea, and comparative estimates are shown in Table 10.13. The most unpredictable element with regard to marine growth, is the chance establishment of the occasional giant kelp.

Elsewhere, seaweeds have been shown to grow on oil structures, particularly in shallow, well-lit areas where conditions support their attachment and growth. Such structures provide a hard substrate that facilitates the settlement of marine organisms, including macroalgae (Foster and Willan, 1979; Ponti, *et al.,* 2015). While this growth can alter local biodiversity, excessive biofouling by seaweeds and other sessile organisms can also pose operational challenges, such as increased structural load, hydrodynamic drag, and maintenance costs (Perkol-Finkel and Benayahu, 2007). To mitigate these effects, operators use various biofouling management strategies, including anti-fouling coatings (Section 5.8.3.1). These mitigation measures help maintain the structural integrity and functionality of offshore oil installations while minimising environmental impacts.

The roughness of fouling growth is generally expected to peak at 2-6 cm in the top 20 m depth within 3-9 years (BAS, 2014).

In the event that marine growth on risers / anchor chains exceeds safety parameters with regard to structural integrity, the marine growth will be mechanically cleaned off to sea. This process will destroy all native, and any non-native, marine growth and the organic matter will fall to the seabed as natural detritus.

Table 10.13: Summary of terminal marine growth estimates in the UK versus Sea Lion (BAS, 2014)

Area	Depth	Type of growth		
		Hard (m)	Soft (m)	Algae / kelps (m)
UK	0 - 15 m	0.2	0.07	3
	15 - 30 m	0.2	0.3	Unknown
	30 m to seabed	0.01	0.3	No growth
Sea Lion	0 - 15 m	0.15	0.1	Unknown
	15 - 30 m	0.12	0.1	Unknown
	30 m to seabed	0.04	0.01	No growth

10.3.4.2.2 Impacts in Berkeley Sound

The area that may be affected in Berkeley Sound is limited to the location of the LTVs' anchor site (Section 5.5.1).

The following sections describe what is known of the species and habitats in the area.

10.3.4.2.2.1 Existing habitats and fauna

Full detail on the flora, fauna and habitats of Berkeley Sound are provided in Section 7.4 of the Environmental Baseline chapter. The following section provides a summary of the results of surveys which were carried out for the project.

Within the Sound, the dominant sediment type was slightly gravelly sand. Finer sediments occurred more in the inner bays to the west with sediments generally becoming coarser toward the east end. The nearest sampling station to the proposed LTV anchorage was found to contain slightly gravelly sand with some hard substrates located approximately 4 km to the west.

The flora and fauna throughout Berkeley Sound is highly variable in terms of species abundance, richness and composition, as would be expected given the highly variable nature of the sediment and

the large scale of survey area. Samples taken nearest to the identified potential LTV anchorage indicated comparatively average species richness with low abundance but high diversity.

Overall, the habitats found within Berkeley Sound are widespread and the seabed is scarred from historic and ongoing ship anchoring.

10.3.4.2.2.2 Habitats of importance

As is detailed in Section 7.4.3.3.3, a number of habitats were identified within the surveyed area of Berkeley Sound that could potentially qualify as those of conservation significance under the UK's Offshore Marine Conservation Regulations 2010 (which implements the EU Habitats Directive). One of these locations (BS_ENV_42), primarily a rock face and cobbles habitat, was found to carry the mottled sea star, *Glabraster antarctica*, amongst the coralline algae encrusted bedrock exposures. This species is described as 'a primarily Antarctic and Sub-Antarctic species only rarely seen inshore in the Falklands' by SMSG (Neely and Brickle, 2013). BS_ENV_42 is near the coast, south of the LTV anchoring locations that are 1.2 nm from the coast (Figure 5-5 above). Other survey locations closest to the proposed LTV sites (namely BS_ENV_31 and 40, Section 7.4.3.3.3) did not indicate habitats of conservation significance.

10.3.4.2.2.3 Anticipated marine growth

As described above, Berkeley Sound contains varied habitats, and hard substrates are already found in the area. As such, marine growth on LTV anchors is likely to be typical of fauna and flora already in the area. However, as the anchors are temporary, marine grown on introduced hard substrates in Berkeley Sound is not considered further.

Nonetheless, the potential for the LTV anchors to provide an added, albeit temporary, hard substrate for the settlement of any non-native species which may be introduced by biofouling on the LTVs is considered in Section 10.12.

10.3.4.3 Quantification of the subsea infrastructure

10.3.4.3.1 FPSO and MODU mooring systems

During Stage 1 of the Development, the MODU will be in position to drill, and during Stages 2a & 2b, both the MODU and the FPSO will be in the field, carrying out simultaneous operations (SIMOPS). An example of the anticipated FPSO anchor array is shown in Figure 10-9. It is expected that the greatest disturbance to the seabed will result from the installation of the mooring systems.

For the purpose of this EIA, a ten anchor spread has been assessed for the MODU using '15T Stevpris MK6 anchors' and it is anticipated that 300 m of chain will be laid upon the seabed for each anchor (Table 10.14). Of note, when in position over a given DC, the MODU will be able to move between wells (Section 5.4.3.1). However, anchor lay and anchor lift will be required for each move to another DC. Therefore, according to the DC locations and drilling schedule (Section 5.4.2), over the course of Stages 1, 2a & 2b, a total of 20 anchor lays / lifts has been assumed (note that this is 20 lift / lay events over the DC's, not 20 different locations). As a result, the total area disturbed by the MODU mooring system throughout the Phase 1 & 2 drilling campaign is estimated at 0.66 km^2 (Table 10.14).

The mooring system for the FPSO will be installed toward the end of Stage 1 and will remain in place for the duration of the Field Life. The mooring system will comprise 12 suction-piled anchors distributed in clusters of four. Each cylindrical anchor will be six metres in diameter. The installation aids will protrude from the top of the suction anchors by approximately one to two metres.

The area that may be disturbed during the installation of the FPSO mooring system is estimated to be 0.095 km^2 while the long-term footprint of the mooring system is 0.0016 km^2 (Table 10.14).

The total area of seabed disturbance anticipated from the deployment of anchors / moorings for the MODU and FPSO combined is 0.75 km^2 with a long-term footprint of 0.0016 km^2 (Table 10.14).

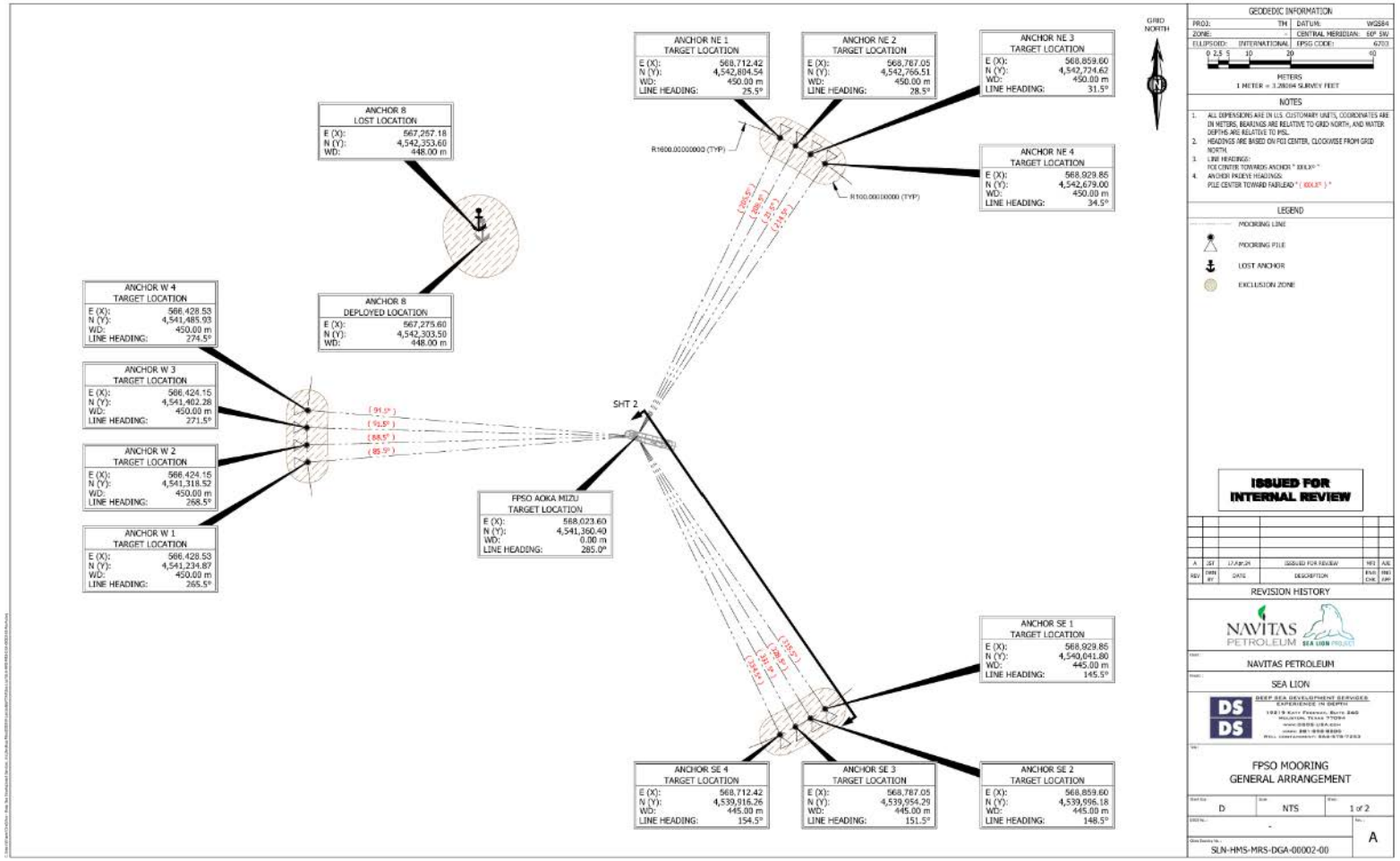


Figure 10-9: Layout of long-term FPSO anchors

Table 10.14: Dimensions[1] and footprints of the FPSO and MODU anchor layouts

Installation	Structure	Quantity	Dimensions			Worst-case assumptions	Temporary seabed disturbance (m^2)	Permanent footprint (m^2)
			Outer diameter (m)	Length (m)	Width (m)			
MODU (temporary[2])	Anchor chains	10	n/a	1,371	0.08	300 m in contact with seabed and impact corridor width 10 m	30,000	n/a
	15 tonne Stevpris MK6 Anchors	10	6	6.7	6	Disturbance zone of 300 m^2 per anchor	3,000	n/a
	Total area of disturbance for each MODU placement						**33,000**	**n/a**
	Total for all MODU anchor placements and removals (10 anchor placements and 10 anchor removal events over the three DC locations (not 20 different locations))						**660,000**	**n/a**
							0.66 km^2	**n/a**
FPSO (Permanent[3])	Anchor chains	12	n/a	1,537	0.132	780 m in contact with seabed and impact corridor width 10 m	93,600	1,236
	Cylindrical suction anchors	12	6	n/a	n/a	Disturbance zone of 100 m^2 per anchor	1,200	339.3
	Total FPSO						94,800	1,575
							0.095 km^2	**0.0016 km^2**
Total FPSO and MODU disturbance							754,800	1,575
							0.75 km^2	**0.0016 km^2**

[1] Areas for unconventional shapes are calculated by assuming an oblong / square according to the longest dimensions as a worst-case.
[2] The MODU will be *in situ* for a total of 66 months during Stages 1 and 2 (a & b) of the Development.
[3] The FPSO moorings will be installed in Stage 1 and will be in place for the life of the field.

10.3.4.3.2 Well infrastructure, SPS and SURF

The dimensions of the well infrastructure, SPS, SURF and associated supports are summarised in Table 10.15, as are the assumptions made with regard to the area impacted. The SURF will be installed directly on the seabed and no mechanical trenching or burial will be required for the permanent infrastructure, although sand and gravel bags may be used for support and placement.

Further, temporary deposits will include items such as clump weights, ROV tooling baskets, tethers etc. and wet storage areas may also be required to store jumpers, umbilicals, anchor wires etc. prior to installation (Section 5.5.3.3). An overall 10 % allowance is added for deposits, wet storage and for other construction-related deposits such as sandbags (Table 10.15). As described in Section 5.5.3.3, this allowance is considered highly precautionary and is used in the absence of specific details on the definite number of temporary and permanent deposits.

Including allowance for the above, the total seabed disturbance from the well infrastructure, SPS and SURF installation is estimated to be 0.143 km^2. The long-term (until decommissioning) footprint is estimated to be 0.024 km^2.

Table 10.15: Estimated dimensions of subsea equipment and temporary deposits

Equipment	Quantity	Dimensions			Worst-case assumption	Temporary seabed disturbance (m^2)	Permanent footprint (m^2)
		Outer diameter (m)	Length (m)	Width (m)			
Well infrastructure							
conductor casings	23	1.07	n/a	n/a	Disturbance will be assessed in the drill cuttings assessment, only the long-term footprint is included here	n/a	20.7
Blow-out preventor	These will all be placed on top of the conductor casing so will leave no permanent footprint. Temporary disturbance may result from wet storage prior to install and this is included within the contingency allowances below.						
Subsea Wellhead							
Subsea X-mas trees							
Subsea Production System (SPS)							
Production Manifolds	3	n/a	18	8	Area of disturbance when positioning extends 1 m around the structure	600	432
Water Injection Manifold	4	n/a	11	7		468	308
Gas Lift Manifold	2	n/a	9	9		242	162
Gas Injection Manifold	1	n/a	9	9		121	81
Subsea Umbilicals, Risers and Flowlines (SURF)							
Main Drill Centre Dynamic and Static Umbilical #1	1	0.18	2700	n/a	Assume 1 m disturbance corridor during lay	2,700	432
Static Umbilical #2	1	0.11	1800	n/a	Assume 1 m disturbance corridor during lay	1,800	198
Static Umbilical #3	1	0.11	3900	n/a		3,900	429
Static umbilical #4	1	0.11	2800	n/a		2,800	308
Dynamic and Static Umbilical #5	1	0.18	4100	n/a		4100	738
Static Umbilical #6	1	0.11	1900	n/a		1,900	209
insulated flexible production flowlines / risers	2	0.48	2800	n/a	Assume 2 m disturbance corridor during lay	11,200	2688

Equipment	Quantity	Dimensions			Worst-case assumption	Temporary seabed disturbance (m^2)	Permanent footprint (m^2)
		Outer diameter (m)	Length (m)	Width (m)			
insulated flexible production flowlines / risers	2	0.48	4100	n/a		16,400	3936
Insulated flexible WI line	1	0.47	1700	n/a		3,400	799
Insulated flexible WI line	1	0.42	3000	n/a		6,000	1,260
Insulated flexible WI line	1	0.42	5000	n/a		10,000	2,100
Insulated flexible WI line	1	0.42	4700	n/a		9,400	1,974
Flexible Gas Lift line	1	0.28	2700	n/a		5,400	756
Gas Lift Jumpers	4	0.26	200	n/a	Assume 2 m disturbance corridor during lay	1,600	208
Flexible Gas injection flowline / riser	1	0.28	7000	n/a		14,000	1960
Flexible Gas Production & injection flowline	1	0.26	4400	n/a		8,800	1,144
Production jumpers	16	0.47	50	n/a		1,600	376
Water Injection jumpers	6	0.42	50	n/a		600	126
Gas Injection jumpers	1	0.26	50	n/a		100	13
Flying Leads including electrical, hydraulic and chemical injection paths to each well	70	0.12	150	n/a		21,000	1,260
GRP Bridge Crossing Structure installed to	7	n/a	13.6	7		983	666

Equipment	Quantity	Dimensions			Worst-case assumption	Temporary seabed disturbance (m^2)	Permanent footprint (m^2)
		Outer diameter (m)	Length (m)	Width (m)			
allow laying over other lines					Area of disturbance when positioning extends 1 m around the structure		
Subsea Distribution Units	4	n/a	9	9		484	324
Mudmats to support Subsea Umbilical Termination Assembly (SUTA)	9	n/a	3	3	Area of disturbance when positioning extends 1 m around the structure	225	81
5 % contingency for pre-installation laydown and wet storage areas						6,491	-
5 % contingency for support structures and other deposits and equipment e.g., sandbags, gravel bags, clump weights and tethers for use during installation as markers and construction aids during installation of the subsea equipment as well as ROV basket, flying lead installation frame, concrete mattresses etc.						6,491	1,149
Total						**142,805**	**24,138**
						0.143 km^2	**0.024 km^2**

10.3.4.3.3 Inshore LTV anchors

Over the duration of Stages 1, 2a & 2b, up to four different temporary LTVs will be used as floating storage barges however, only two are anticipated to be anchored within Berkeley Sound at any one time.

The dimensions of the anchoring systems used are summarised in Table 10.16, as are the assumptions made with regard to the seabed area impacted. The assumptions are based on the worst-case disturbance that could be caused during installation and / or use e.g., anchor placement and disturbance as the vessels weathervane around the anchors.

The overall seabed disturbance is estimated at 0.06 km^2 which amounts to about 0.12 % of the total area of Berkeley Sound (Table 10.16).

Table 10.16: Estimated dimensions of inshore LTV anchoring

Installation	Structure	Quantity	Dimensions		Worst-case assumptions	Seabed disturbance (m^2)	Permanent footprint (m^2)
			Length (m)	Width (m)			
Up to two LTVs *in situ* at any time	Anchor chains	2 (1 per vessel)	100	0.08	75 m of disturbance to seabed in circular band around the vessel	58,905[1]	n/a
	Drag embedment anchors	2 (1 per vessel)	5	4	Disturbance zone of 300 m^2 per anchor	600	n/a
Overall total						**59,505**	**n/a**
						0.06 km^2	**n/a**

[1] This was calculated as the difference between a 200 m diameter circle (based on the vessel weathervaning on a 100 m anchor chain) and 50 m diameter circle (namely the centre point where the 25 % of the chain length does not contact the seabed).

10.3.4.4 Risk of dropped objects

Throughout the entire Phase 1 & 2 Development there is the potential for subsea infrastructure to be accidentally dropped during the installation process.

In the event that a large object is dropped, the nature of the impacts will be the same as for intentionally placed objects, *via* direct crushing of benthic fauna and suspension of sediments (Section 10.3.4.1.1). However, owing to the uncontrolled nature of a dropped object it is possible that such an event could lead to substantial suspension of sediment and the associated impacts.

Equally, there is the potential that subsea infrastructure already in place could be damaged leading to spills or leaks. The environmental impact of oil leaks and spills is assessed in Chapter 12.

10.3.5 Industry standard mitigations

10.3.5.1 Seabed disturbance

Over and above an EIA of potential effects, there are few industry-standard mitigation requirements with regard to the disturbance of the seabed from the placement of objects. Those that do exist, e.g., the use of chain mats deployed from bottom-trawl fishing vessels in the North Sea to flatten the profile

of raised clay berms (and thus reduce the future risk to fishermen), do not apply in the Sea Lion location as the lines are not being trenched or buried, nor is the sediment comprised of clay.

However, during all vessel anchoring, preparation and management activities, good operational practices, e.g., optimal tensioning of anchor chains, will be used to minimise anchor scouring and damage to the seabed.

10.3.5.2 Marine growth on hard substrates

In the North Sea, the composition of marine growth and the depth of each marine growth layer (e.g., seaweed, mussels etc.) is periodically surveyed and the growth is removed if the structural integrity of the asset is compromised by the added weight of marine growth. This applies less for an FPSO than for fixed structures. However, if the FPSO risers become fouled to a point where they fall out of design safety parameters, the marine growth may be cleaned off into the sea. The FPSO will be treated with antifoulants to minimise the potential for growth. However, seabed surveys / inspections throughout the Development will inform the level of growth on the seabed structures and mooring systems.

10.3.5.3 Dropped objects

Good oilfield practice will be observed such that all dropped objects will be reported to FIG and retrieved, where possible, as soon as is reasonably practicable. Any remaining debris will be retrieved in the decommissioning process and checked with a seabed clearance survey.

10.3.6 Impact and risk assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall impact of planned activities. The assessment of unplanned events includes an assessment of the 'Likelihood of Occurrence' to determine the 'Risk'.

A summary of the impact and risk assessment outcomes is provided in Section 10.3.12, which shows the worst-case impact / risk for each activity and receptor.

10.3.6.1 Impact assessment of disturbance to the seabed

10.3.6.1.1 Sea Lion Field

10.3.6.1.1.1 Disturbance to fauna and existing habitats

It is assumed at this time that the benthic species diversity and abundance in the area of the Drill Centres (DCs) will be similar to that recorded in the previous benthic surveys across the Sea Lion Field area and that the benthic communities are typical of the area (Section 7.4.3.2).

The area likely to be disturbed during the installation of subsea infrastructure is relatively small (Section 10.3.4.3) as, with the exception of the conductor pipes, the equipment is laid directly onto the seabed without the need for trenching or burial operations. Furthermore, the seabed area is likely to contain 'negligible numbers of any species of geographical importance' and no habitats have been identified that would be equivalent to designated sites under UK legislation (Section 10.3.4.2.1.2). Should any species or habitats which are of ecological importance be identified in site-specific surveys, the zone of influence remains sufficiently small such that the sensitivity of the receptor is considered to be '**Very Low'**.

While direct impacts will be fatal to a small number of individuals, the combined area likely to be impacted by direct crushing or smothering is small. Similarly, the suspension of sediments following one-off installation processes will be very short-lived and therefore unlikely to result in any impact (Section 10.3.4.1.1). Therefore, any changes will be barely detectable above background variability. At the population level, any impacts will be fully reversible once the installation activity ceases and therefore the severity of effect is considered to be '**Slight**'.

The overall significance of impact is considered to be '**Very Low (1)**'.

10.3.6.1.1.2 Habitat modification and marine growth

Assessing the 'sensitivity of the receptor' and 'severity of effect' of marine growth on hard substrates is a challenge as the impact of 'artificial reefs' on biodiversity may be considered positive or negative (Section 10.3.4.1.2.1). However, for the purposes of this assessment, it assumed that any anthropogenic contribution to the environment is 'negative'.

The main receptors that may be impacted by marine growth are flora and fauna. The biodiversity of the local area may be affected should any species not common to the area be able to settle. The broader region may be affected should such species use the substrate as a stepping-stone (Section 10.3.4.1.2). However, species diversity and abundance in the NFB is relatively uniform, and the species are not considered to be of geographical or conservation importance (Section 10.3.4.2.1.1). Therefore, the sensitivity of the receptors in the existing Sea Lion baseline is estimated to be '**Very Low**'.

There are not believed to be any habitats of particular ecological importance that could be damaged in the Sea Lion Field (Section 10.3.4.2.1.2). However, given the homogenous nature of the seabed and sediments at the Sea Lion Field, and the relative absence of hard substrates in the region, the installation of infrastructure will effectively create a new habitat in the area. The small surface area of the artificial substrate and the isolated location indicate that the colonisation of seabed infrastructure will be slow. Although, as is shown in Section 10.3.4.2.1.3 above, it is likely that the hard substrate will become colonised and this change to the benthic community in the area will be detectable against the background environment. Nonetheless, this impact will be very localised and reversible once the infrastructure is removed such that, on balance, the severity of effect is considered to be '**Moderate**'.

The overall significance of impact is assessed as '**Low (3)**'.

10.3.6.1.2 Berkeley Sound

Given the temporary nature of the LTV anchorages, the long-term impact of habitat modification and marine growth is not considered.

10.3.6.1.2.1 Disturbance to fauna and existing habitats

Berkeley Sound supports a wide range of habitat types and benthic species. Most of these are widespread and commonly found elsewhere in the Falklands archipelago. However, the mottled sea star which was found at the BS_ENV_42 location is considered to be rare in inshore waters (Section 7.4.3.3.3). Further, the identification of habitats that could potentially qualify as geogenic reefs, also at BS_ENV_42, indicates that a precautionary approach should be taken. Given that these habitats are 'currently undesignated but could be of local importance', the sensitivity of the receptors to damage / crushing / smothering is, on balance, considered to be '**Moderate**'.

The area that will be disturbed by the anchored LTVs is very small (Section 10.3.4.3.3) and is likely to be in a part of the Sound that has frequently been subject to numerous anchor placements before (as indicated at BS_ENV_31, Section 7.4.3.3.3), as has much of Berkeley Sound. While the previous scarring of the area does not directly affect this assessment, it does indicate that the disturbance caused by the use of anchors is unlikely to stand out over and above the existing baseline and therefore, the severity of effect is considered to be '**Slight**'.

The overall significance of impact is assessed as '**Very Low (3)**'.

10.3.6.2 Risk assessment of unplanned and accidental events

10.3.6.2.1 Risk of dropped objects

Given that dropped objects would be an unplanned event, it is not possible to predict what might fall or what the extent of any impacts may be. Although a dropped object may result in the suspension of

sediment, even if a large object was dropped, a relatively small area would be affected. It is likely that negligible numbers of any species of geographical importance will be present within the zone of influence and therefore the sensitivity of the receptor is considered to be '**Very Low**'.

Equally, the duration of sediment suspension will be very short such that the severity of effect is considered to be '**Slight**'.

Therefore, the overall significance of impact is assessed as '**Very Low (1)**'.

With regard to the likelihood of objects being dropped, over a period of 37 years (1970 - 2007), only one dropped object was recorded worldwide from units ranging from FPSOs to semi-submersibles (OGP, 2010b). This amounts to a frequency of 0.027 incidents per year. According to the OGP (2010b) on mechanical lifting failures, the probability of a dropped object from a mobile unit is 0.0000014 per lift. Given the ongoing developments that have occurred in the industry since 2007 with regard to improvements in safety, the loss of a larger object during the installation process would require the failure of numerous engineering and procedural controls and therefore the likelihood of occurrence is considered to be '**Unlikely**'.

Therefore, the overall risk associated with disturbance to the seabed from dropped objects considered to be '**Very Low (2)**'.

10.3.7 Project-specific mitigation

The impacts and risks are considered to be '**Low**' or '**Very Low**' such that there is no need for any further project-specific mitigation measures.

Note: please see also the mitigation measures described in Section 10.12 with regard to the introduction / spread of non-native marine species.

10.3.8 Residual impacts and risks

Not applicable.

10.3.9 Cumulative impact

10.3.9.1 Sea Lion Field

Given the absence of any other O&G activities in the NFB, there is no potential for cumulative effects at this time, or for the interconnectivity of 'created habitats'. In the event of future O&G activity however, the potential for cumulative effects and interconnectivity with regard to the potential 'stepping-stone' effect of marine growth (BAS, 2014) would need to be re-examined in the EIA carried out by future operators. Note that fisheries within the Sealion field have not been considered as a factor that could influence cumulative impacts on seabed disturbance of the project. The impacts to fisheries are considered in Section 11.1.

10.3.9.2 Berkeley Sound

Scarring on the seabed in Berkeley Sound is widespread and extensive owing to the extent of historical and ongoing vessel activity and anchoring (Section 7.7.6.2). While the LTVs will anchor during the initial construction phase, and will weathervane around the anchors, this will occur in one location causing damage to only a very small area. Therefore, the LTV anchors are not expected to make a significant contribution to cumulative impacts on biodiversity.

10.3.10 Confidence

The uncertainties within this assessment include:

- Confirmation on which MODU anchor array will be used,

- The absence of site-specific offshore benthic surveys and detail on the diversity and abundance of benthic fauna around the DCs and the GPI well(s),
- Final location of the LTV anchorages, and
- The absence of samples at the specific LTV anchoring locations.

The use of a different MODU anchor array is not considered to affect the impact assessment because of the contingencies included in the calculations.

While the wider survey of the Sea Lion Development area has provided sufficient information on which to base the current assessment, the specific benthic habitats and fauna at the Sea Lion location have not yet been surveyed and this is acknowledged as a data gap.

Beyond the above, the subsea infrastructure requirements are well understood and the data used for the assessment assume the worst-case with regard to equipment dimensions and the local environment. Overall, the confidence in the seabed disturbance and marine growth assessments is '**Probable**'.

10.3.10.1 Monitoring required

As noted in, seabed surveys will be required prior to, and throughout, the Development for numerous reasons and will be used to:

- Further inform the environmental baseline,
- Enable validation of this EIA in future years, and
- Assess any needs for remediation.

Detailed monitoring requirements have been established during the project-specific Phase 1 & 2 Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the EMMP. An outline EMMP is provided in Chapter 15.

10.3.11 Offsetting

As no residual impacts or risks identified in this section are considered significant, i.e., Moderate or above, offsetting is not considered necessary for this impact (see Section 8.11).

10.3.12 Findings summary

Table 10.17: Summary of the impact and risk assessment for the placement and removal of objects on the seabed

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance a		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Placement of objects on the seabed	Installation of MODU / FPSO mooring systems, SPS and SURF at Sea Lion Field	Disturbance to the seabed, water and sediment quality, benthic fauna and habitats offshore	Planned	1	Very Low	Slight	n/a	**Very Low (1)**	**n/a**	**Probable**	**Industry-standard:** Good operational practices. Marine growth removal. Seabed surveys / inspections. **Project-specific:** None proposed.
		Habitat modification and marine growth	Planned	1, 2 & 3	Very Low	Moderate	n/a	**Low (3)**	**n/a**	**Probable**	
	Anchoring of the LTVs, in Berkeley Sound for a combined period of up to 13 months for the complete subsea campaign	Disturbance to the seabed, water and sediment quality, benthic fauna and habitats	Planned	1 & 2	Moderate	Slight	n/a	**Very Low (3)**	**n/a**	**Probable**	
Dropped objects	Loss of equipment or infrastructure to the seabed	Disturbance to the seabed, water and sediment quality, and benthic fauna	Unplanned	1, 2 & 3	Very Low	Slight	Unlikely	**Very Low (2)**	**n/a**	**Probable**	**Industry-standard:** Reporting and retrieval of dropped objects **Project-specific:** None proposed.

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

10.4 Underwater noise - Offshore

Table of Contents

10.4.1 Introduction 684
10.4.1.1 Relevant legislation 684
10.4.1.1.1 Offences against marine mammals 685
10.4.2 Sources of underwater noise 685
10.4.2.1 Drilling 686
10.4.2.2 Installation 686
10.4.2.3 Vessel noise 686
10.4.3 Potential receptors 687
10.4.4 Characterising and quantifying the impact of underwater noise 687
10.4.4.1 The behaviour of sound and how it is measured and described 687
10.4.4.2 Ambient noise 689
10.4.4.3 Hearing thresholds in receptors - the concept 690
10.4.4.4 Nature of the impact and the hearing thresholds of each receptor group 691
10.4.4.4.1 Plankton 692
10.4.4.4.2 Invertebrates 692
10.4.4.4.2.1 Invertebrate injury / disturbance thresholds 693
10.4.4.4.3 Fish 693
10.4.4.4.3.1 Fish hearing thresholds 693
10.4.4.4.3.2 Responses of fish to anthropogenic sounds 694
10.4.4.4.3.3 Fish injury and disturbance thresholds 695
10.4.4.4.4 Seabirds 696
10.4.4.4.4.1 Seabird injury / disturbance thresholds 697
10.4.4.4.5 Marine mammals 697
10.4.4.4.5.1 Marine mammal hearing thresholds 698
10.4.4.4.5.2 Diving capabilities of marine mammals 698
10.4.4.4.5.3 Responses of marine mammals to anthropogenic sounds 699
10.4.4.4.5.4 Marine mammal injury thresholds 700
10.4.4.4.5.5 Marine mammal displacement and disturbance thresholds 701
10.4.4.5 Quantification of the impacts - sound modelling 701
10.4.4.5.1 Step 1: Identification of Phase 1 & 2 source sound levels 702
10.4.4.5.2 Step 2: Sound propagation modelling 704
10.4.4.5.3 Step 3a: Comparison of model results with injury thresholds 704
10.4.4.5.3.1 Fish injury 705
10.4.4.5.3.2 Marine mammal injury 707
10.4.4.5.4 Step 3b: Comparison of model results with disturbance and behavioural response thresholds 710
10.4.4.5.4.1 Fish disturbance by vessels 710
10.4.4.5.4.2 Marine mammal disturbance by vessels 710
10.4.5 Industry standard mitigations 713
10.4.5.1 Vessel noise 713
10.4.6 Impact assessment 713
10.4.6.1 Fish injury and disturbance 714
10.4.6.2 Invertebrates 714

10.4.6.3 Seabirds 714
10.4.6.4 Marine mammals 715
10.4.6.4.1 Marine mammal injury and vessel noise 715
10.4.6.4.2 Marine mammal disturbance 715
10.4.7 Project-specific mitigation 716
10.4.8 Residual impacts and risks 717
10.4.9 Cumulative impacts 717
10.4.10 Confidence 717
10.4.10.1 Monitoring required 718
10.4.11 Offsetting 718
10.4.12 Findings summary 719

10.4.1 Introduction

Underwater noise will be generated in the Sea Lion Field throughout the Development and will result from the use of vessels.

The properties of sound in water (range and speed of travel) are exploited by many marine animals as a means of communication, navigation and detecting prey or predators. Sound travels at approximately 1,500 m/s in water (about five times faster than in air) and low frequency sound can propagate over hundreds to thousands of kilometres, although the effective range of most biological functions is tens of kilometres. Human-made (anthropogenic) noise in the marine environment can interfere with these processes and is recognised as having the potential to cause harm to marine animals. Consequently, underwater noise is regarded as a form of pollution.

The sources of underwater noise generated by the Oil and Gas (O&G) industry are well documented (e.g., Wartzok, *et al.,* 2004; Gordon, *et al.,* 2004; Southall, *et al.,* 2007 and 2019; OSPAR, 2009b; NOAA, 2018). However, despite the growing volume of research this remains an area with many uncertainties, largely due to the difficulties of observing and measuring the impact of noise on animals in the marine environment. Therefore, a precautionary approach is required during any impact assessment.

This chapter provides an assessment of the potential impacts of underwater noise generated during the offshore components of the Phase 1 & 2 Sea Lion Development. When assessing the impact of sound on any animal, it is necessary to compare the sounds being made with the thresholds above which the animal may experience injury or may exhibit behavioural reactions to disturbance. It is also necessary to consider how close the animal needs to be to the source of the noise for it to experience the sound at levels above the injury and disturbance thresholds. Therefore, to inform the assessment, Genesis Oil and Gas Consultants Limited (Genesis, 2024a & b) have been commissioned to conduct underwater noise modelling to identify and characterise the sources of underwater noise that will be generated during the Phase 1 & 2 Development, and their potential impacts.

The impact of underwater noise from any vessels used inshore (i.e., LTVs in support of the subsea construction campaign) is assessed in Section 10.5.

Note: the other impacts associated with vessel use are described elsewhere in this document, as described in Table 2.2.

10.4.1.1 Relevant legislation

The following legislation is relevant to the management of underwater noise:

- European legislation:
  - EC Habitats Directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora).
  - EU Marine Strategy Framework Directive (Council Directive 2008/56/EC).
- UK legislation:
  - The Conservation of Offshore Marine Habitats and Species Regulations 2017 - and the potential need for a Disturbance Licence.
  - Conservation (Natural Habitats) Regulations 1994 listing of all European Protected Species (EPS).
- Falkland Islands legislation:
  - Marine Mammals Protection Ordinance 1992.
  - Conservation of Wildlife and Nature Ordinance 1999.

- Fisheries (Conservation and Management) Ordinance 2005.

The following guidelines are relevant to the management of underwater noise:

- International Maritime Organisation, MEPC.1/Circ.833 Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life, 7th April 2014,
- Convention on the Conservation of Migratory Species of Wild Animals (CMS), Best Available Technology (BAT) and Best Environmental Practice (BEP) for Mitigating Three Noise Sources: Shipping, Seismic Airgun Surveys, and Pile Driving - Technical Series No. 46, 2023,
- Falklands Conservation Cetacean Code of Conduct for the Falkland Islands, 2020,
- The Falkland Islands Species Action Plans (SAP) for Cetaceans, and Seals and Sea Lions. **Note:** the 2008 SAPs (FIG, 2008b & 2008d) expired in 2018 and a new version is currently in draft and will highlight the need to:
  - Assess and manage acoustic disturbance – including the application of appropriate licence conditions under the Offshore Minerals Ordinance (or relevant proposed replacement legislation), and
  - Assess and manage physical disturbances from development activities such as aquaculture, O&G exploration and extraction industries with the application of environmental impact assessments where appropriate.
- The Sei Whale Conservation Management Plan (2024).

10.4.1.1.1 Offences against marine mammals

The Falkland Islands' Marine Mammals Ordinance 1992 states that it is an offence to:

- Intentionally take, wound, or kill any marine mammal in Falkland Islands waters.

However, what constitutes a 'wound' is not clearly defined. Therefore, following the definitions used by the EC Habitats Directive, injury to a marine mammal (assumed to be analogous to wounding) is assumed to include:

- The creation of a 'Permanent Threshold Shift (PTS)' in hearing.

Further the Ordinance does not cover disturbance to marine mammals. Therefore, again, the EC Habitats Directive guidelines are followed in this assessment whereby it is an offence to intentionally or deliberately disturb any marine mammal in a way which is likely to:

- Impair its ability to:
  - Survive, reproduce or rear / nurture their young, and / or
  - Migrate.
- Significantly affect the local distribution or abundance of the species to which it belongs.

Note: in the UK, it is not an appropriate defence to claim that an impact upon a protected species was an 'incidental result of an otherwise lawful activity'. Therefore, in the UK, the potential for injury and / or disturbance must be assessed prior to commencement of relevant activities to determine the need for mitigation measures, or the need for a 'Disturbance Licence' where impacts may occur and cannot be mitigated. No such equivalent currently exists in the Falkland Islands.

10.4.2 Sources of underwater noise

Anthropogenic sources of underwater noise associated with the Phase 1 & 2 Development offshore include moderate intensity continuous (non-pulsed) sounds associated with:

- Drilling by a Mobile Offshore Drilling Unit (MODU),
- Noise from the Floating Production, Storage and Offloading (FPSO) vessel, and
- Vessel engine / thruster noise from the offshore support vessels, installation vessels and the CTTs.

Note: On examination, underwater noise from helicopters flying in accordance with (and in excess of) the FILFH (2024) minimum altitude was scoped out of the underwater noise assessment.

10.4.2.1 Drilling

Sound associated with drilling from the MODU will be created by rotating equipment such as generators, pumps and the drill string.

Drilling will occur during Stages 1 and 2 of the Phase 1 & 2 Development and noise will be continuously generated for sustained periods throughout the drilling operations.

In general, sound from drilling has been found to be predominantly low frequency (<1,000 Hz) with relatively low source levels (Greene, 1987; Huang, *et al.,* 2022; McCauley, 1998; Nedwell and Edwards, 2004). Furthermore, a study by Greene (1987) found that the sound generated by drilling activities from a semi-submersible did not exceed local ambient levels beyond one kilometre.

10.4.2.2 Installation

Transponders will not be required to site the FPSO or MODU. During construction, transponders may be used to site subsea equipment; these will be used for short periods of time and removed once the subsea construction phase is complete.

10.4.2.3 Vessel noise

Noise from vessels is generated by propeller cavitation, thrusters such as those used in Dynamic Positioning (DP) systems, and noise transferred to the ship's hull from the engine and other systems. Numerous vessels will be used during the Phase 1 & 2 Development.

Full detail on the type and purpose of all the vessels used throughout the Development is provided in Section 5.11.2.

Vessel noise will be present throughout all Stages of the Phase 1 & 2 Development (> 30 years). However, the frequency of vessel visits to the FPSO by the CTT will decrease over the life of the Field as oil production rates decline.

The relatively constant nature of the sound generated by the FPSO and direct offtake CTT vessels (when on site) means that animals are not subjected to sudden bursts (pulses) of noise. As the vessels, or animals, move through the water the sound intensity will increase, or decrease, gradually. The animals will be aware of sounds from large distances away and are unlikely to be startled.

The assessment within this section recognises that the source sound level will vary depending on activity. Although there is already a degree of vessel noise in the area (which is near a route taken by numerous fishing and trade vessels (Section 7.7.3.1)) during the course of the year, the static nature of the FPSO and several of the associated vessels represents a semi-permanent source of anthropogenic noise.

DP systems can be a specific source of marine noise given the relatively high-power thrusters employed. The approach of the CTT to the FPSO will be at low speed under its own propulsion and will be aided by a support vessel (tug) under low power that will hold the stern of the CTT under tension, sufficient to control heading (Section 5.10). During close approach, the CTT-tug combination will not operate on DP, although the tug would be DP-capable if required in an emergency. During offtake, the CTT-tug combination will again operate under relatively low power and low noise levels.

On departure, the CTT will move away at low speed, again under its own propulsion. When full, tankers will then either depart to market under main propulsion or remain in field maintaining position until the FPSO has a second cargo to offload, at which time the sequence will be repeated.

10.4.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify those receptors upon which the impacts of underwater noise offshore warranted further investigation (Chapter 9). These include:

- Plankton (Section 7.4.1) and invertebrates in the North Falkland Basin (NFB) and around the Sea Lion Field (e.g., cephalopods and crustaceans) (Section 7.4.4.2),
- Fish in the NFB and around the Sea Lion Field (Section 7.4.4.2),
- Seabirds in the NFB and around the Sea Lion Field (Section 7.4.5.2), and
- Marine mammals in the NFB and around the Sea Lion Field (e.g., whales, dolphins and seals) (Section 7.4.6.2).

The above may be impacted upon as they either exist in, or spend time in, the zone influenced by anthropogenic sound. To varying degrees, all the above may use, or rely on, sound for various life functions and / or may be impacted upon directly by sound.

10.4.4 Characterising and quantifying the impact of underwater noise

When characterising and quantifying the impacts of underwater noise, it is necessary to consider:

- The behaviour of sound and how it is measured,
- Ambient noise levels,
- The concept of hearing thresholds in receptors (e.g., fish, seabirds and marine mammals),
- The nature of the impact on receptors, and
- Quantification of sound propagation - sound modelling.

10.4.4.1 The behaviour of sound and how it is measured and described

All sound travels in waves. Figure 10-10 illustrates a sound wave and the relationship between ‘peak pressure’ and ‘root mean squared pressure’. In understanding this chapter it is important to understand that:

- The 'Zero to Peak' Sound Pressure Level (PK) indicates the highest level of instantaneous sound received by a receptor at a given distance from the source (of note, ‘Zero to Peak’ is not used for continuous noise thresholds (i.e., for vessel noise)[55], and
- 'Root mean square' Sound Pressure Level (rms) is a means of displaying the average sound pressure over a period of time and is of greater use when assessing the potential for disturbance. This information is used to determine the distance at which injury and displacement / disturbance thresholds are exceeded.

Although continuous non-pulsed sounds (e.g., vessel noise) are often represented by an average, it should be noted that there will always be variability inherent in the sound source (i.e., peaks in sound output).

[55] SPLpk is not used in the updated modelling as the thresholds used are expressed in terms of rms SPL and SELcum. It is noted in the modelling report that the 0-pk level is estimated from rms levels accordingly: ‘For conversion of rms to zero-to-peak SPL, an increase of 3 dB has been assumed. This assumption is only valid for continuous sounds as it assumes an ideal sinusoidal wave and is therefore only an approximate conversion.

When reading this chapter, it is important to appreciate that the field of underwater acoustics utilises a great deal of technical terminology and to enable greater understanding of this chapter, the key terminology is defined in Table 10.18.

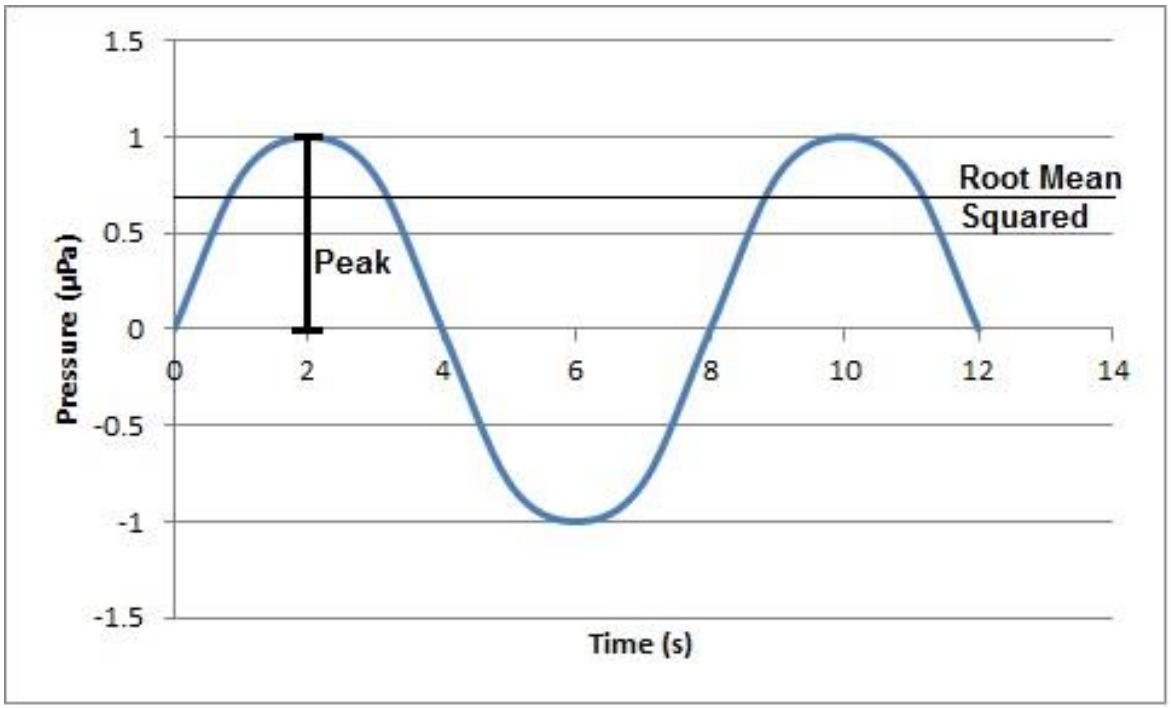


Figure 10-10: Sinusoidal wave showing changes in pressure over time, illustrating measurement parameters for Peak pressure (PK) and Root Mean Squared (rms) pressure

Table 10.18: Definitions of terms found in the text

Term	Definition
Hz	Hertz, a measurement of sound frequency (in cycles / waves per second). Differences in sound frequency are experienced by the listener as changes in pitch (a high frequency is high pitched whereas a low frequency is low pitched). Marine mammals have evolved to hear sounds over a specific range of frequencies, which are used to describe different hearing groups (e.g., low, moderate and high frequency cetaceans).
Recoverable injury	Recoverable injury, refers to injuries, including hair cell damage, minor internal or external bleeding. None of these injuries are likely to cause direct mortality.
TTS	Temporary Threshold Shift, a temporary, reversible increase in the threshold of audibility (i.e., a reduction in sensitivity) at a specified frequency or portion of an individual's hearing range (i.e., temporary deafness).
PTS	Permanent Threshold Shift; a permanent, irreversible increase in the threshold of audibility (i.e., a reduction in sensitivity) at a specified frequency or portion of an individual's hearing range (i.e., permanent, but not necessarily complete, deafness).
decibel dB (re. 1µPa)	The decibel (dB) unit is used to conveniently represent sound levels. re. 1µPa indicates a reference pressure for underwater sound The decibel (dB) is measured on a logarithmic scale. For example, the smallest audible sound (near total silence) is 0 dB. A sound 10 times more powerful is 10 dB., a sound 100 times more powerful than near total silence is 20 dB., and a sound 1,000 times more powerful than near total silence is 30 dB
Impulse sound	Sound sources that are typically short (less than 1 second) and of high intensity. Impulse sounds characteristically have high peak sound pressure with rapid rise and rapid decay. They can occur in repetition e.g., pile driving, or as a single event.

Term	Definition
Non-impulse sound	Generally, a continuous noise with little variation in level. Examples of non-impulse sound sources include drilling, marine vessels, aircraft, machinery operations / construction.
rms	Root mean square is the square root of the mean of the squares of the values under consideration, e.g., pressure levels measured. This can be used as a measure of the average sound pressure received. For conversion of rms to zero-to-peak SPL, an increase of 3 dB has been assumed. This assumption is only valid for continuous sounds as it assumes an ideal sinusoidal wave and is therefore only an approximate conversion.
Source level	Refers to the sound level at a nominal distance of one metre from the underwater sound source, expressed as dB re. 1 µPa @ 1m. In reality, it is not the actual sound level at one metre from the source, as the 'source level' is a construction based on long range measurement.
Sound Pressure Level (SPL)	A ratio of sound pressure and reference sound pressure, expressed in dB re. 1 µPa.
Zero to Peak Sound Pressure Level (PK)	Peak Sound Pressure is defined as the greatest absolute sound pressure within a specified time interval and frequency band. Although relevant to all sources of sound, zero to peak sound pressure is most relevant to impulsive sounds (e.g., short duration and high amplitude), which can create a greater risk of causing direct mechanical fatigue to the inner ear in comparison to sounds that are strictly non-impulsive. PK is expressed in dB re 1 µPa.
Cumulative Sound Exposure Level (SEL(cum))	A measure of the energy of a sound. This is therefore related to the Sound Pressure Level and time (exposure). SEL(cum)s are considered useful when making predictions about the physiological impact of noise: hearing damage can be modelled as a function of the acoustic energy of a stimulus, and the onset of temporary hearing damage depends on the SPL and exposure time (e.g., a subject can be safely exposed to a weaker stimulus for a longer time, but exposure to a loud stimulus would only be acceptable for a short time). SEL(cum) is expressed as dB re 1µPa^{2}s.
Hearing threshold	The average sound level, that is just audible to a subject (e.g., a human or a marine mammal) under quiet conditions.
Injury threshold	The sound threshold (intensity) at which a receptor may experience hearing injury, which would lead to a permanent shift in the receptors hearing ability.
Disturbance threshold	The sound threshold (intensity) at which a receptor may experience disturbance due to an inability to hear biologically significant sounds (such as communication calls) or may change its behaviour.
Avoidance / displacement threshold	The sound threshold below the injury threshold but sufficient for an animal to depart from an area to avoid disturbance. This can result in a cessation of feeding or mating behaviour.
Received noise level	The noise level at the receptor position of interest (in terms of modelling this can be thought of as the predicted level at the position of interest). This might be weighted to account for the hearing of the subject, if required.

10.4.4.2 Ambient noise

Hipsey *et al.* (2013) recorded ambient noise in the Sea Lion area and compared it to data gathered from other projects. The Sea Lion area was considered relatively quiet in terms of the rms SPL metric compared to other locations. Low frequency noise levels (10–100 Hz) however, were quite high compared to other regions, especially given the relative paucity of the anthropogenic sources that often dominate this part of the spectrum. Medium frequency noise levels (100–1,000 Hz) were lower than all but one of the other regions and those at higher frequencies (1,000-10,000 Hz) were comparable to most.

Recorded ambient noise levels were generally consistent with a remote, deep, continental shelf location in a temperate climate with occasional fishing activity but little or no regular mercantile shipping traffic. Ambient noise at the Sea Lion Field was considered to be mainly influenced by:

- Wind, waves and precipitation at the sea surface,
- Biological organisms,
- Shipping, and
- Distant seismic survey activity.

10.4.4.3 Hearing thresholds in receptors - the concept

It is important to acknowledge that the sound perceived by different species, and individuals within species, is not necessarily the same as the sound actually made. In other words, not all receptors (e.g., humans, marine mammals, seabirds) will perceive the same sound in the same way; to one it may be very loud while another cannot hear it at all. Similarly, hearing thresholds can differ between individuals and / or can change within an individual's lifetime.

For example, hearing sensitivity usually declines with age, particularly in the high frequency range. Such changes can occur naturally as a result of aging and associated wear and tear, or as a result of hearing injury caused by exposure to high intensity noise.

Irreparable damage to an individual receptor's hearing apparatus, and the associated shift in hearing sensitivity, is referred to as a 'Permanent Threshold Shift' (PTS). Shorter-term reversible changes to an individual's hearing ability (e.g., temporary tinnitus following exposure to loud music) is referred to as a 'Temporary Threshold Shift' (TTS) which can be experienced when individuals are exposed to sound levels below the PTS threshold.

Therefore, although perceived loudness is proportional to the 'Sound Pressure Level' (SPL), a SPL value in isolation would be meaningless if one wanted to predict how loudly another animal has perceived a sound, or whether a sound is likely to elicit a response or inflict injury. In part, this is because the hearing systems of animals are not equally sensitive to all frequencies. Therefore, in light of the above, an important concept is that of the 'hearing threshold'.

The hearing threshold is the level that is just audible to a subject under quiet conditions (Table 10.18). When the hearing threshold is plotted as a function of frequency, the plot is called an 'audiogram'. Figure 10-11 shows the audiograms for a range of receptor species. The audiogram plot indicates the average hearing threshold for a range of frequencies for each species. Note however, that the audiograms for most marine species remain unknown and those that have been published are often derived from a few individuals under artificial conditions. This is important in the context of baleen whales in the North Falkland basin.

Importantly, SPLs below the hearing threshold will not be detected at all.

To work through an example, in order to understand the audiograms (Figure 10-11), at a frequency of 1,000 Hz, the humpback whale has a hearing threshold of 42 dB re 1 µPa. This means that if a sound at 1,000 Hz was made, a humpback whale would not hear the received sound unless it was at or above a level of 42 dB re 1 µPa. The variables which affect whether or not a sound may be this loud include the nature of the source and the distance of the receptor from the sound.

When an animal experiences hearing loss due to excessive sound, the line displayed on the audiogram shifts upward (i.e., the animal would become less sensitive to sound at a given frequency).

This has resulted in the accepted use of weighting functions for some animal groups such as marine mammals that are applied to received noise levels to adjust them in relation to their hearing sensitivities, which is discussed further below.

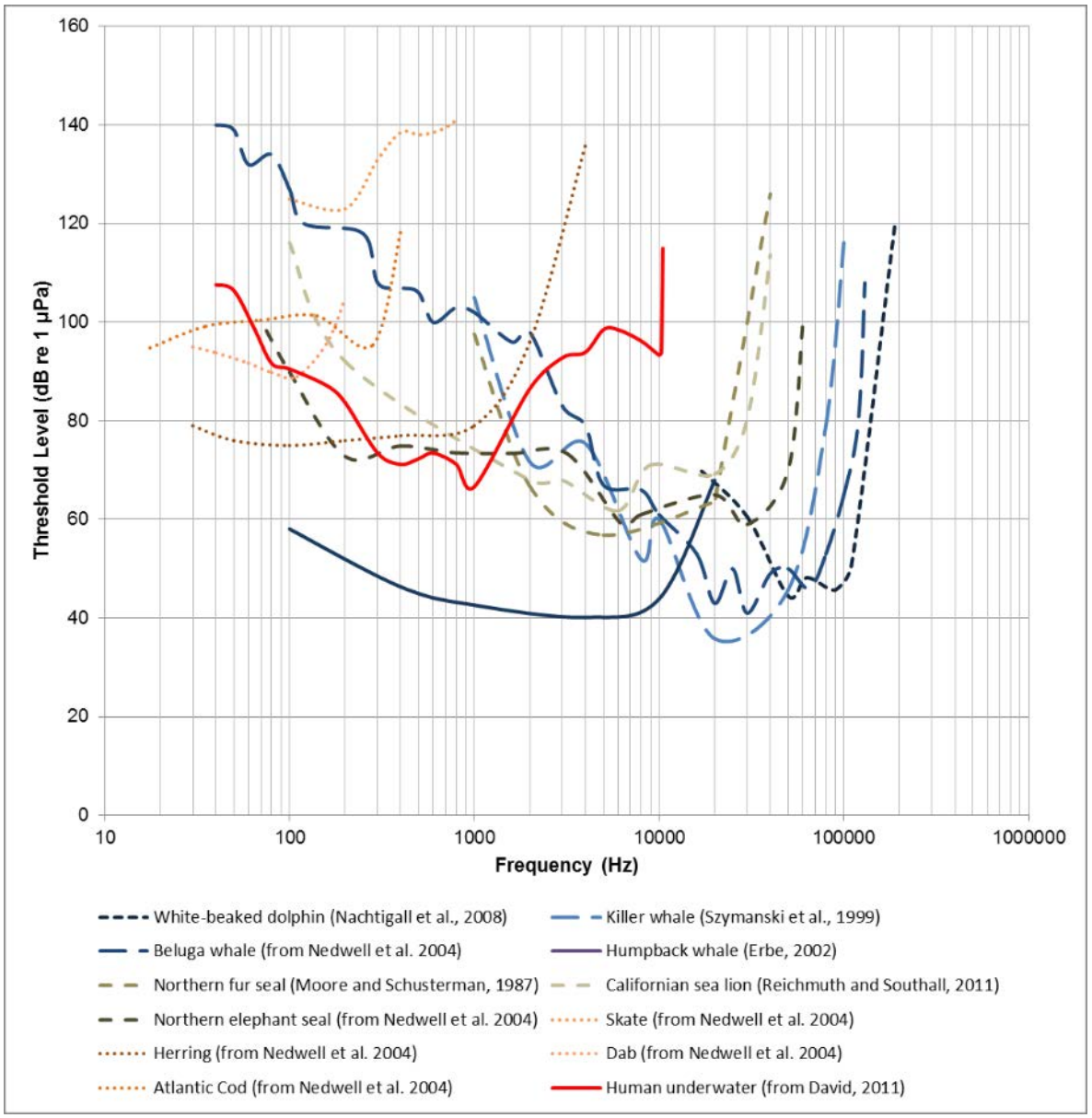


Figure 10-11: Audiograms covering a range of fish and marine mammal hearing groups and humans (underwater). Note that while some audiograms are measured others are estimated (e.g., humpback whale (Erbe, 2002)). This figure is included to give an understanding of audiograms only; these audiograms are not used in any later weighting functions but they have informed works like Southall *et al.* (2007; 2019)

10.4.4.4 Nature of the impact and the hearing thresholds of each receptor group

When assessing the impact of underwater noise on a given receptor there are two important considerations:

- Whether, and how, the sound will impact upon individual animals, and / or
- Whether, and how, the sound will impact upon the long-term viability of populations.

An action or activity becomes biologically significant to an individual animal when it interferes with normal behaviour and activity, or affects the animal's ability to grow, survive, and reproduce. Where a biologically significant proportion of a population is impacted, such effects may have consequences at the population-level and may affect the viability of the species (NRC, 2005). For receptor groups that are generally very numerous and reproduce often (such as invertebrates and fish) the impact at the population level is the key consideration. Where a species has a relatively small population size, and / or long generation time (e.g., marine mammals) the impact on individuals is more significant and may have direct implications for the local population.

10.4.4.4.1 Plankton

Research on the impacts of underwater noise to plankton is limited. Some research has shown that zooplankton can suffer various anatomical impacts because of noise exposure. Impacts can include internal cellular damage, disorientation, hearing loss and in some cases death (McCauley, *et al.,* 2017; Weilgart, 2018). Noise exposure can also cause elevated levels of stress hormones, which can have subsequent impacts on a variety of homeostatic processes (Nedelec, *et al.,* 2015). However these are mostly in response to impulse sounds such as seismic guns, which will not be used as part of the Phase 1 & 2 Development.

As no impulse sounds will be generated by the Sea Lion Development activities, plankton are not considered further within this chapter, or chapter 10.5 below.

10.4.4.4.2 Invertebrates

It is widely accepted that anthropogenic noise can impact invertebrates through:

- Physical effects (e.g., death, injury, damage to auditory system) (Harding and Cousins, 2022),
- Physiological effects (e.g., changes in stress levels, metabolism, immune responses), and
- Behavioural effects (e.g., avoidance responses, decreased foraging efficiency) (Celi, *et al.,* 2015; Edmonds, *et al.,* 2016; Hawkins and Popper, 2017; Vazzana, *et al.,* 2020).

However, while there is increasing research effort into understanding acute and chronic impacts of anthropogenic noise on invertebrates, it remains challenging to assess. This is in-part related to the difficulty associated with determining the sensitivity of marine invertebrates to sound (Hawkins and Popper, 2017).

The available evidence suggests that some species of cephalopod (e.g., squid and octopus) and crustaceans (e.g., crabs, lobsters and shrimps) are capable of detecting sound within the low frequency range, less than 3 kHz (OSPAR, 2009b). For example, Hu *et al.* (2009) discovered experimentally that the common octopus (*Octopus vulgaris*) can detect sounds between 400 Hz and 1,000 Hz. The bigfin reef squid (*Sepiotheutis lessoniana*) can detect a wider range of frequencies from 400 Hz to 1,500 Hz. The thresholds of *S. lessoniana* were generally lower than those of *O. vulgaris*, indicating greater sensitivity over a wider range of frequencies, and highlighting that species differ in their sensitivity to noise. The lowest thresholds for both species were at 600 Hz.

Other research has shown that some species of squid are similar to fish in their ability to detect sound (Mooney, *et al.,* 2010; OSPAR, 2009b) and are able to detect sounds of the types and frequency produced during O&G related activities. Further, studies have shown a potential behavioural response in squid, albeit to very high intensity underwater noise (e.g., seismic airguns of the kind that will not result from the Phase 1 & 2 Development) (McCauley, 2001). Nonetheless, in the absence of known injury or disturbance thresholds such as exist for fish, the potential impacts to squid have been assessed qualitatively. While commercially exploitable aggregations of squid are not known to occur

within the area of the Sea Lion Field (e.g., Section 7.7.3.1.1), it is necessary, from an ecosystem perspective, to assess the potential impact upon these animals.

Regarding other invertebrate groups, Wale *et al.* (2016) observed the effects of the playback of six hours of vessel noise to blue mussel *Mytilus edulis* in laboratory conditions. Algal clearance rates of noise-exposed mussels were significantly lower, and oxygen consumption rates higher than those of control animals, indicating stress. DNA damage in the gills and haemolymph was also observed.

10.4.4.4.2.1 Invertebrate injury / disturbance thresholds

There are no widely accepted criteria for the levels of sound likely to cause injury or disturbance to invertebrates. However, it has been suggested that further work on behavioral responses, effects of particle motion, development of dose-response data, hearing and population studies, would help to fill the research gaps required to develop robust thresholds and criteria (Hawkins and Popper, 2017).

Exposure to underwater sound from offshore shipping and construction activity can alter the contributions to fluid and particle transport from sediment dwelling invertebrates, which in turn could impact benthic nutrient cycling (Solan, *et al.,* 2016). The effects of sound may not be lethal, but could have significant functional, fitness and ecological consequences. For example, in the case of *Nephrops norvegicus*, Solan *et al.* (2016) showed that the addition of an anthropogenic sound source repressed burying and bio irrigation behaviour and reduced locomotion activity.

Jones *et al.* (2021) assessed the impact of pile driving underwater noise on feeding and alarm (defense) behaviour of longfin squid (*Doryteuthis pealeii*). They found that this type of impulsive noise can disrupt feeding behaviors. While there is no such impulsive noise planned during the Phase 1 & 2 Development, this demonstrates that squid are sensitive to certain types of underwater noise.

However, there is no reference in the literature to specific impact thresholds and as such, the potential for impacts to squid is assessed qualitatively in this chapter. In the absence of impulsive sounds from the Development activities, impacts to other invertebrates (e.g., crustacea) are not considered further within this chapter.

10.4.4.4.3 Fish

There have been some experimental investigations into the impacts of sound on fish but most of these investigations only concern a few fish species (and sometimes only a few individuals of these species). In many cases, the experimental design is flawed and the results vary widely (reviewed in Popper and Hastings, 2009). Nonetheless, it is understood that fish are able to both generate and detect sound which is used to communicate, sense their environment, and detect predators and prey (Popper, *et al.,* 2014). A recent study has shown that exposure to noise during breeding can have detrimental effects on the early-life development of common gobies (decreased yolk sac reserve and brood size, area and density decreased as noise increases) (Blom, *et al.,* 2024).

10.4.4.4.3.1 Fish hearing thresholds

Relatively little is known about sound perception in fish, particularly hearing sensitivity to particle motion (Popper and Hawkins, 2019). However, it is likely that particle motion is equally important as sound pressure in how fish and invertebrates perceive sound. It is known that otoliths (ear bones) and gas-filled bladders are both used to detect sound and fish can be broadly categorised according to the structures used for hearing (Table 10.19) (Hawkins and Popper, 2017).

The presence of a gas bladder is likely to increase the ability of many species of fish to detect sounds over a broader frequency range and at greater distances from the source than fish without such structures (Popper, *et al.,* 2014). Further, gas bladders, and their anatomical location within the body, make fish more susceptible to pressure-mediated injury to the ears and general body tissues than species lacking gas bladders.

In addition to the 'hearing' structures used, a number of other factors are likely to influence the impact of sound on any given fish species. These include:

- The hearing capabilities, whether generalist or specialist, and the lateral line structures of the fish,
- Life-styles (e.g., bottom dwelling *vs*. mid-water fish),
- The size of the individuals, and
- Behavioural responses to potential 'fright' stimuli (e.g., fish that stay in one location *vs.* species that swim away).

Most fish can hear, or detect, sound within the low range of <50Hz to 300 - 500 Hz (Popper and Hawkins, 2019) with some able to detect even lower frequencies. This range of frequencies overlaps with most anthropogenic sound sources in the marine environment and fish are known to react to approaching vessels at distances of 0.1 - 1.0 km (Mitson, 1995). Many species of fish also produce sounds for communication that are typically emitted at low frequencies below 1 kHz (Montgomery, *et al.,* 2006).

While many higher predators such as marine mammals and seabirds are considered of conservation importance, no specific marine fish species are listed in the 1999 or 2011 Falkland Islands Biodiversity Snapshots (Procter and Fleming, 1999; FIG, 2011) nor in the Falkland Islands Biodiversity Framework 2016-2030 and Falkland Islands Environment Strategy 2021-2040 (FIG, 2021a). Nonetheless, several species are important for commercial fishing.

Data are limited concerning the effects of sound on developing eggs and larvae. A study by Banner and Hyatt (1973) quoted in Buehler *et al.* (2015) found increased mortality was found in eggs and embryos of sheepshead minnow (*Cyprinodon variegates*) exposed to broadband noise (100–1,000 Hz) that was about 15 dB above ambient sound level. However, the same study found that hatched fry of sheepshead minnow and fry of longnose killifish (*Fundulus similes*) were not affected by the same exposure.

Table 10.19: Categorisation of fish hearing groups

Hearing Group	Characteristics
Fish with no swim bladder or other gas chamber (e.g., flatfish, skate)	These species are less susceptible to barotrauma and only detect particle motion, not sound pressure. However, some barotrauma may result from exposure to sound pressure.
Fish with swim bladders in which hearing does not involve the swim bladder or other gas volume (e.g., Atlantic salmon)	These species are susceptible to barotrauma although hearing only involves particle motion, not sound pressure.
Fish in which hearing involves a swim bladder or other gas volume (e.g., Atlantic cod, herring and relatives)	These species are susceptible to barotrauma and detect sound pressure as well as particle motion.
Fish eggs and larvae	For eggs and developing larvae, which may contain gas filled spaces, the inability to rapidly move away from sound sources make them susceptible to barotrauma

(Source: Popper, et al., 2014)

10.4.4.4.3.2 Responses of fish to anthropogenic sounds

The effect of exposure to excessive sound in fish can result in:

- Behavioural responses e.g., avoidance or an absence of response owing to masking of ambient sounds,
- Stress and other physiological responses,
- Hearing loss and damage to auditory tissue,
- Damage to non-auditory tissue e.g., damage to non-auditory swim-bladder and muscle tissue, and enhanced gas bubble growth and traumatic brain injury (see Richardson *et al.,* 1995; Hastings and Popper, 2005 for reviews),
- Mortality,
- Effects on the developing larvae and young fish in the presence of sound and / or after termination of sound, and / or
- Effects on larval behaviour and longer-term survival (Popper and Hastings, 2009).

There is evidence that fish react to vessel noise, which can be an issue for survey vessels conducting stock assessment research (Mitson, 1995). However, there is no suggestion that disturbance due to vessel noise causes long-term impacts on fish populations. Fish in the early stages of life are considered to be most vulnerable to sound (OSPAR, 2009b; Popper, *et al.,* 2014). Planktonic eggs and larvae may be more vulnerable than adult fish simply because they are unable to actively move away from a sound source. Further, eggs and larvae appear to be susceptible to barotrauma (pressure trauma) caused by rapid pressure changes resulting from impulse sounds (such as pile driving (which is not within the Phase 1 & 2 basis of design)); however, the available data suggests that mortality of eggs and larvae would only occur within a few metres of such sound sources (Popper and Hastings, 2009).

10.4.4.4.3.3 Fish injury and disturbance thresholds

Although data regarding the impact on fish is extremely patchy, a working group has published guideline thresholds for noise induced injury and disturbance in fish (Hawkins and Popper, 2014). Data gaps and critical questions concerning the effects of human-made sound on aquatic life are reviewed by Hawkins *et al.* (2015). The disturbance and injury thresholds for non-impulsive (e.g., vessel) noise are shown in Table 10.20 for fish grouped by their different hearing structures (Table 10.19 above). In some cases numerical guidelines are provided, expressed in appropriate noise metrics. In the context of fish injury thresholds, 'recoverable injury' refers to injuries, including hair cell damage, minor internal or external bleeding, none of which are likely to cause direct mortality. Although TTS injury is also, by definition, recoverable, TTS refers to changes in hearing sensitivity.

When there were insufficient data to support numerical values, the relative likelihood of effects occurring was evaluated at a range of distances from the source, although the actual likelihood of effects depends on the received level.

Table 10.20: Criteria for noise induced disturbance and injury in fish (shipping and continuous sounds)[1]

Fish type [2]	Thresholds for mortality and potential mortal injury	Impairment thresholds			Behaviour [4]
		Recoverable injury	Temporary Threshold Shift	Masking effect [3]	
Shipping and continuous sounds					
No swim bladder	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low

Fish type [2]	Thresholds for mortality and potential mortal injury	Impairment thresholds			Behaviour [4]
		Recoverable injury	Temporary Threshold Shift	Masking effect [3]	
Swim bladder not involved in hearing	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Swim bladder involved in hearing	(N) Low (I) Low (F) Low	170 dB rms for 48 hrs	158 dB rms for 12 hrs	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Eggs and larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

[1]*Source: Hawkins and Popper, 2014.*
[2] See Table 10.19 above.
[3] The phenomenon where ambient sounds an animal may ordinarily respond to are masked, and thus not heard, due to anthropogenic sound.
[4] Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N), intermediate (I) and far (F).

10.4.4.4.4 Seabirds

The majority of seabirds do not spend prolonged periods underwater and are therefore not subjected to, or impacted by, anthropogenic underwater noise. However, some species; particularly penguins but also diving-petrels and shearwaters (many of which are recorded as present within the Sea Lion area (Section 7.4.5.2.1)), do spend considerable periods underwater.

Penguins are known to use contact calls to communicate when on the surface and there is some evidence to suggest that they vocalise underwater (Thiebault, 2019). Therefore, it is likely that penguins are able to sense sound underwater and may use sound to detect predators or prey (Thiebault, *et al.,* 2019). Recent research shows that gentoo penguins (*Pygoscelis papua*) show a graded reaction to underwater noise bursts, with little to no response up to 100 dB re 1 µPa to a strong reaction in nearly 60 % of playbacks at 120 dB (Sørensen, *et al.,* 2020). Although there has been limited dedicated research on these species, the presence of gas-filled spaces in these animals (i.e., lungs, inner ears) leads to the assumption that the impact of high intensity sound could result in barotrauma similar to that experienced by marine mammals and fish. Indeed, Cooper (1982) reports mortality of over 1,000 penguins and cormorants over a period of six months during which underwater blasting was carried out. In addition, a recent study showed that African Penguins (*Spheniscus demersus*) were temporarily displaced from their favoured fishing areas during seismic survey operations in South Africa, fishing significantly further from the seismic survey vessel during the operations and returning to the area once the operations ceased (Pichegru, *et al.,* 2017). Although the circumstances and intensity of the sound source during these observations were significantly higher than those predicted for the activities associated with the Sea Lion Development, these observations highlight the potential for underwater noise to impact seabirds.

Thiebault, *et al.* (2019) recorded a total of 203 underwater vocalisation from all three species of penguin during 4 h 43 min of underwater footage. Vocalisations were very short in duration (0.06 seconds on average), with a frequency of maximum amplitude averaging 998 Hz, 1,097 Hz and 680 Hz for king, gentoo and macaroni penguins, respectively. The vocalisations were emitted during feeding dives with more than 50 % directly associated with hunting. The function of these

vocalisations remain speculative. They seem to be related to hunting behavior and the authors conclude that this area warrants further research.

In addition, diving seabirds, such as penguins, are frequently observed reacting at close range (<100 m) to an approaching vessel (A. Black, *pers. obs*.). These birds abruptly change direction, swimming speed and dive duration, and are observed to flee (as if reacting to a predator) in a direction perpendicular to the vessel's course. However, it seems that these birds primarily react to the presence of the vessel rather than the sound, as the sound would be audible at a greater range. Further, penguins have been observed being positively attracted to stationary vessels (up to 100 in length) operating on DP control (A. Black, *pers obs*.).

10.4.4.4.4.1 Seabird injury / disturbance thresholds

Very little is known about the effects of underwater noise on seabirds. Current scientific understanding of the ability of seabirds to hear underwater is poor and it is not possible to undertake a quantitative assessment. For seabirds, there are no guidelines to determine what constitutes a behavioural disturbance or threshold sound level, although the work by Sørensen *et al.* (2020), would indicate that if penguins are <50 m from the sound source they may react to sounds at 120 dB re 1 µPa and above. However, it is recognised that seabirds foraging below the sea surface could be disturbed. Should this occur, it is predicted that seabirds will remain on the sea surface and will avoid being underwater until a specific vessel has moved away from the area, or the birds will temporarily relocate away. Temporary displacement from the area is not predicted to cause a significant effect as seabirds are recognised to have moderate to high level of habitat flexibility and are not constrained to the immediate area (Furness and Wade, 2012). It is therefore not expected that the proposed works will have a significant effect on bird species.

10.4.4.4.5 Marine mammals

The long-term continuous nature of vessel noise as a source of sound pollution could result in chronic impacts on a number of marine mammal species (Rolland, *et al.,* 2012; Hatch, *et al.,* 2008). It is understood that anthropogenic sources of sound in the ocean can disturb marine mammals (cetaceans and pinnipeds), evoking behavioural responses, similar to the response to predator risk, and can trigger physiological stress responses (Tyack, 2008; Rolland, *et al.,* 2012). Marine mammals are generally considered to be of the greatest conservation concern in relation to underwater noise pollution as they are protected species that are known to use sound to communicate over large distances, to navigate, and to detect potential prey or predators. Equally, the diving capacity of some marine mammals means that even sound energy emitted close to the seabed (e.g., from drilling) may be accessible to these receptors.

The Falkland Islands are a key area for beaked whales (MacLeod and Mitchell, 2023). Although beaked whale habitat normally occurs in deep waters (≥1000 m), Otley (2012) suggested that in the Falklands, beaked whales use shallower waters, which is known to occur elsewhere (Filatova, *et al.,* 2024).

Beaked whales are highly vulnerable to anthropogenic sound, which can displace the animals from foraging areas, cause permanent damage, or cause incidental mortality (Taylor, *et al.,* 2000; Barlow and Gisiner, 2006; Weilgart, 2013; Cholewiak, *et al.,* 2017; Joyce, *et al.,* 2018; Feyrer, *et al.,* 2024). However, quantifying impacts in open sea is extremely difficult, as the arrival of carcasses to the shore depend on environmental features and human population density (Faerber and Baird, 2010; Williams, *et al.,* 2011; Prado, *et al.,* 2013).

JNCC guidelines recommend that the proportion of the marine mammal population which could potentially be disturbed is assessed. Although there are sightings from various surveys and recordings from an acoustic monitoring study, there are currently no population estimates for any cetacean species in Falkland Islands waters. However, the available data do not indicate that the area

surrounding the Sea Lion Field is home to resident populations of marine mammals or is a feeding area of overriding importance for any species.

10.4.4.4.5.1 Marine mammal hearing thresholds

Cetaceans are known to emit sound over a large range of frequencies; from low frequencies (10 Hz) in the blue whale to higher frequencies (200 kHz) in some dolphins (OSPAR, 2009b). The hearing range of species however, is likely to extend beyond the known emitted sound range.

The auditory range of species can be determined through field observations, but this is extremely difficult for free-ranging animals in the marine environment. Auditory ranges may also be determined through experiments with animals in captivity. Of note, there is a lack of measured hearing range data for baleen whales. Furthermore, the full range of vocalisations used by many species encountered in the south-west Atlantic are poorly understood (Hipsey, *et al.,* 2013). Nonetheless, it is understood that different species of marine mammal are sensitive to different frequency ranges and animals can be categorised into one of five groups (Table 10.21). Inclusively, the range of frequencies utilised by an assemblage of marine mammal species can therefore be very extensive.

Table 10.21: Marine mammal hearing groups[1]

Functional hearing group	Estimated auditory bandwidth[2]	Species occurring in the Development area (Hipsey, *et al.,* 2013)
Low-frequency (LF) cetacean	7 Hz – 35 kHz	Southern right whale, humpback whale, fin whale, sei whale and minke whale (baleen whales)
High-frequency (HF) cetacean	150 Hz – 160 kHz	Sperm whale, southern bottlenose whale, long-finned pilot whale, killer whale and southern right whale dolphin (toothed whales and dolphins / porpoises)
Very high-frequency (VHF) cetacean	275 Hz – 160 kHz	Hourglass dolphin, Peale's dolphin and Commerson's dolphin
Phocid pinnipeds, (true seals, underwater)	50 Hz – 86 kHz	Southern elephant seal and leopard seal
Otariid pinnipeds, (eared seals, underwater)	60 Hz – 39 kHz	Fur seal species and South American sea lion

[1] **Note:** Both Southall *et al.* (2019) and the National Marine Fisheries Service (NMFS) (2018) provide estimated auditory bandwidths for hearing group categories. The 'Functional hearing Group' categories used in this chapter are those provided by Southall *et al.* (2019). While the NMFS (2018) use different names for the groups, both papers indicate the same frequency banding for the respective groups.
[2] Represents frequency band of hearing for entire group as a composite, individual hearing ranges are typically not as broad.

10.4.4.4.5.2 Diving capabilities of marine mammals

The diving capability of marine mammals is relevant because it indicates the potential for animals to be close to the source of the sounds made below the surface of the sea during the Phase 1 & 2 Development.

The water depth in the project area is in the region of 450 m. In terms of the position of receptors in the water column, while 450 m is deeper than the maximum diving range of fur seals and is on the limits of sea lion diving abilities (Riedman, 1990), this depth is well within the capabilities of southern elephant seals, which repeatedly dive to depths between 400 and 2,000 m (McIntyre, *et al.,* 2010; Piot, *et al.,* 2023). Massie, *et al.* (2015) recorded an average dive duration of 33 minutes for adult female elephant seals (maximum duration 95 minutes), which makes it difficult to visually track these animals.

Of the species of cetacean present in the NFB (Section 7.4.6.2), many are capable of diving to depths in excess of 450 m, the sperm whale, the pilot whale, beaked whales and orca are extreme divers,

with deeper and longer foraging dives than any other mammal species (Tyack, *et al.,* 2006; Schorr, *et al.,* 2014; Towers, *et al.,* 2019). Following habitat utilisation of beaked whales elsewhere, it is presumed that sighted individuals from fishing vessels operating in the Falklands might be residents (e.g., Gowans, *et al.,* 2000; MacLeod and Zuur, 2005; McSweeney, *et al.,* 2007; Falcone, *et al.,* 2009).

10.4.4.4.5.3 Responses of marine mammals to anthropogenic sounds

Underwater noise may result in a number of different impacts on marine mammals, as described in Table 10.22.

The strength of the effect on a marine mammal is affected by the sound received by the animal, which is related to the:

- The sound source level,
- Distance of the receptor from the sound source,
- Frequency of the sound, and
- Length of exposure to the sound.

However, although marine mammals will react to noise, the response between species and individuals also varies with context and is not only related to the sound level. For example, animals engaged in feeding may be reluctant to leave an area or animals that are accustomed to vessel noise may react to a lesser extent.

Further, it should be noted that behavioural changes in response to anthropogenic noise, such as moving away from an area for a short period of time, changes in dive-time, masking of communication signals or echolocation clicks for short periods, do not necessarily result in detrimental effects on the animals involved. A reaction lasting less than 24 hours, and not recurring on subsequent days, was not regarded as particularly severe by Southall *et al.* (2007). Though it should be noted that most project vessels will be attending the field for longer than 24 hours.

Table 10.22: The nature of potential impacts of sound upon marine mammals

Potential impact upon marine mammal	Nature of the impact
Masking	Masking occurs when anthropogenic sounds impair the ability of marine mammals to detect biologically significant sounds, such as communication calls, echolocation clicks or passive environmental sounds used in navigation or prey detection.
Behavioural disturbance – Avoidance / displacement	Behavioural disturbance is usually detected by changes in activity due to sound. This can range from strong avoidance behaviour (displacement) to subtle changes in vocalisations. The degree of behavioural change is very difficult to measure in the field and is likely to differ between, and within, individuals depending on their motivational state. For example, animals that are engaged in feeding may be more reluctant to change their behaviour and move away from a food source despite being subjected to noise.
Discomfort / stress	While Rolland *et al.* (2012) published results that correlate changes in stress related hormones with changes in the density of shipping traffic, there is limited information regarding stress in marine mammals as it is very difficult to measure. Consequently, the long-term impacts of noise induced stress are unknown.
Hearing loss	In more extreme cases, underwater noise may result in hearing loss, which could have severe consequences for animals through impaired communication and navigation skills and impaired prey / predator detection. Hearing loss can be classified as either: TTS (Temporary Threshold Shift), or

Potential impact upon marine mammal	Nature of the impact
	PTS (Permanent Threshold Shift). Recovery from TTS can occur over a relatively short period i.e., hours or days, whereas, PTS results from tissue or structural damage and is permanent. It is likely that behavioural changes will occur at thresholds below the TTS.
Tissue damage	Research on the non-auditory effects of sound on marine mammals (i.e., tissue damage) is in its infancy (OSPAR, 2012). However, there is evidence of enhanced gas bubble growth and traumatic brain injury (see Richardson *et al.,* 1995; Hastings and Popper, 2005 for reviews). It has been proposed that avoidance / displacement behaviour, induced by anthropogenic sound, may cause some deep-diving species (such as beaked whales) to surface rapidly or remain on the surface for extended periods. This can induce a condition similar to decompression sickness and has been proposed as a potential cause of stranding in these animals (Crum & Mao, 1996 in OSPAR, 2009b).

10.4.4.4.5.4 Marine mammal injury thresholds

The injury thresholds for marine mammal hearing groups, as provided by NMFS (2018) and Southall *et al.* (2019) are summarised in Table 10.23.

The PTS thresholds have been estimated from TTS levels, which have been derived for a limited number of species and TTS growth rates (change in TTS with increase in acoustic exposure) from studies of land mammal species. These PTS and TTS thresholds are taken for a single source (NMFS, 2018; Southall, *et al.,* 2019) and are used here to provide an indication for the potential injury from multiple sources.

Cumulative Sound Exposure Level (SELcum) is a measure of energy, summed over multiple exposures or a stated period of time (Table 10.18 above). It can be an extremely useful metric for assessing cumulative exposure because it enables sounds of differing duration, sometimes involving multiple exposures, to be compared in terms of total energy. The SEL values are weighted to account for the variable sensitivity to specific frequencies across these groups (Table 10.21 above).

Table 10.23: Marine mammal TTS and PTS injury criteria for non-impulsive sounds, as adopted in this assessment[1,2]

Hearing Groups [2]	Cumulative SEL (SELcum) Thresholds (dB re 1 µPa²s)	
	Permanent Threshold Shift (PTS)	Temporary Threshold Shift (TTS)
Low-Frequency Cetaceans (LF)	199	179
High-Frequency Cetaceans (HF)	198	178
Very High-Frequency Cetaceans (VHF)	173	153
Phocid pinnipeds in Water (PW)	201	181
Otariid pinnipeds in Water (OW)	219	199

[1] Note that these thresholds do not consider the cumulative or aggregate effect of multiple sources, and do not represent the entirety of an effects analysis but, rather, serve as one tool to help evaluate the effects of noise produced during a proposed action on a marine mammal.

[2] Sources: NMFS (2018) and Southall *et al.* (2019) - despite the difference in naming, the hearing groups proposed by NMFS (2018) and Southall *et al.* (2019) are equivalent and include the same marine mammal species. This report uses the Southall *et al.* (2019) terminology of marine mammal hearing groups.

[3] See Table 10.21 above.
[4] While the proposed activities do not include sources of impulsive noise, PK values are included for completeness as they can provide an upper limit threshold for both impulsive and non-impulsive sounds.

10.4.4.4.5.5 Marine mammal displacement and disturbance thresholds

The SPL thresholds for disturbance of marine mammals are as follows:

- Avoidance / displacement behaviour may occur at, or above, 160 dB re 1 µPa (rms), and
- Behavioural disturbance may occur at, or above, 120 dB re 1 µPa(rms).

These thresholds are given in Southall *et al.* (2007) and are unchanged by NMFS (2018) and Southall *et al.* (2019).

10.4.4.5 Quantification of the impacts - sound modelling

In order to quantify the potential impacts of underwater noise on fish and marine mammals, the sound generated by the different activities associated with the Phase 1 & 2 Development was modelled and compared with published thresholds for injury and disturbance (Section 10.4.4.4). Note however that there are currently no injury thresholds or disturbance guidelines for invertebrates or seabirds and therefore the impacts of underwater noise on these species are not specifically modelled. The modelling was carried out by Genesis Oil and Gas Consultants Ltd. using their in-house modelling software FARAM (Faunal Acoustic Risk Assessment Model). FARAM employs the parabolic equation and ray tracing algorithms developed by Collins (1993) and Porter and Liu (1994), respectively, for estimating received sound levels from various noise sources (Genesis, 2024a).

The modelling process was carried out in three main steps:

1) Identification of the levels of sound likely to be made by the Phase 1 & 2 sources of underwater noise. Source levels for use in the modelling have been derived from representative third octave band rms sound pressure level (SPL) frequency spectrums that have been obtained from published underwater sound measurements and mathematical models (Genesis, 2024a),
2) Use of a sound propagation model which assesses the way these sounds are likely to travel out from the sources and calculates the received levels at a given range. This utilises a fully range-dependent propagation model that includes bathymetry and properties of the water column and seabed, and
3) Assessment of the received sound levels against the defined injury and disturbance thresholds. As described in (Section 10.4.4.4), published data are available for:
   - Injury thresholds:
     - Fish (Popper, *et al.,* 2014), and
     - Marine mammals (NMFS, 2018; Southall, *et al.,* 2019).
   - Disturbance and behavioural response thresholds:
     - Fish (Popper, *et al.,* 2014), and
     - Marine mammals (Southall, *et al.,* 2007).

Scenarios were identified and modelled to assess the impacts of underwater noise associated with the different stages of the Phase 1 & 2 Development (Table 10.24).

To enable brevity in this section, the following provides only the information required to ensure appreciation and understanding of the modelling results and the impact assessments. Additional detail on the modelling methodology, the positioning of the sound sources, and results are provided in Genesis (2024a).

Table 10.24: Modelled offshore scenarios

Scenario ID	Project Description Phase	Sound Sources
Scenario 1	Drilling and Construction	1 x MODU (Mobile Offshore Drilling Unit) 2 x AHTs (Anchor Handling Tug) 1 x shared ERRV (Emergency Response Rescue Vessel) 2 x OCVs (Offshore Construction Vessel) 1 x PSV (Platform Supply Vessel)
Scenario 2	Steady State Production	1 x FPSO (Floating Production, Storage and Offloading unit) 1 x CTT (Conventional Trading Tanker) 2 x MRSV (Multi-Role Supply Vessel) 1 x shared ERRV
Scenario 3	SIMOPs (when Drilling, Construction and Production take place at the same time (Section 5.7))	Combination of all the sources in Scenarios 1 and 2, Only one ERRV is included in this scenario.

10.4.4.5.1 Step 1: Identification of Phase 1 & 2 Development source sound levels

Source levels for use in the modelling have been derived from representative third octave band rms SPL frequency spectrums that have been obtained from published underwater sound measurements and mathematical models (Genesis, 2024a). The representative levels are shown in Figure 10-12 and described in Table 10.25. It is anticipated that the Development activities will produce predominantly low frequency (<1,000 Hz) continuous sounds.

Vessel noise is primarily from propellers, propulsion and other machinery (Ross, 1976; Wales and Heitmeyer, 2002). Vessels are considered to be a continuous noise source. Where appropriate (based on vessel class), the JOMOPANS-ECHO model (MacGillivray and de Jong, 2021) has been used to estimate the source levels from the vessels in the described scenarios. The model uses the vessel length, speed and vessel class to determine the source level of the vessel. This model has been shown to provide a better match to measured vessel source level data compared to previous mathematical models such as the RANDI model (Breeding, *et al.,* 1996).

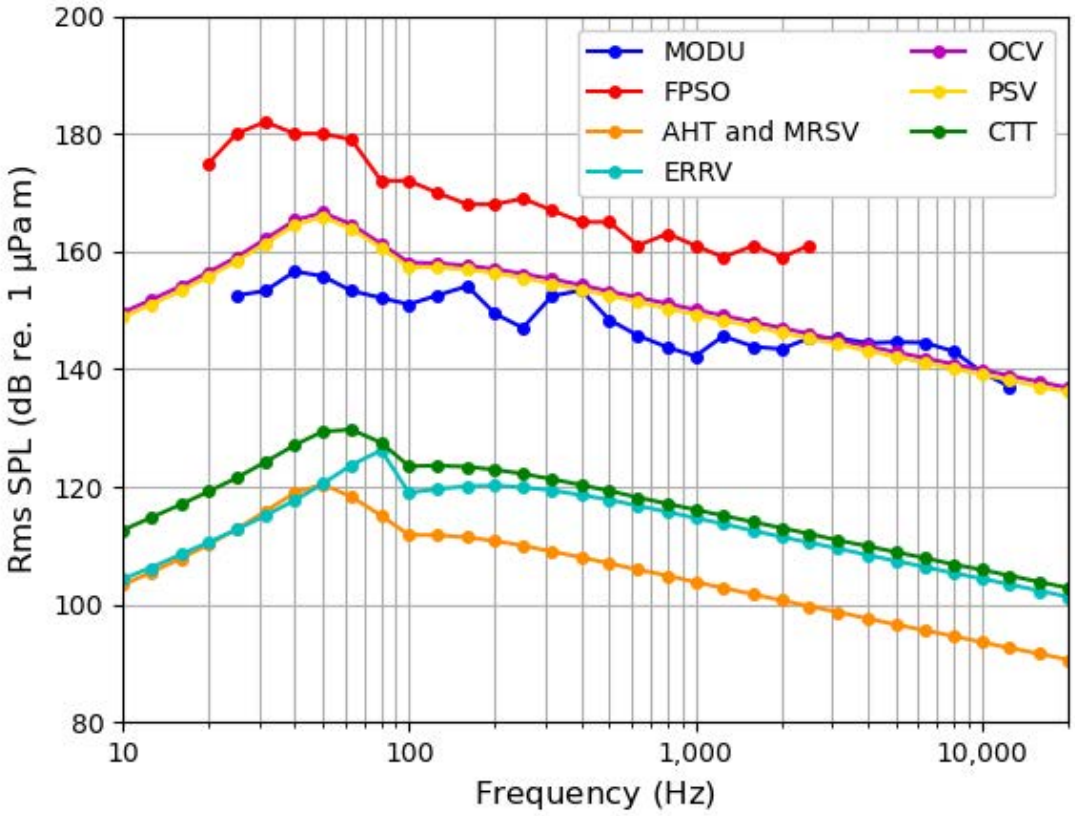


Figure 10-12: Generic vessel frequency spectrums used in noise modelling for Scenarios 1, 2 and 3

Table 10.25: Summary of specific source levels used in modelling[1]

Sound Source	Representative Source Spectrum Used in Modelling	Reference	Broadband rms SPL (dB re 1 µPa at 1 m)
MODU	Jack-up rig	Todd, *et al.,* 2020	165
AHT and MRSV	Bulker (speed = 2 knots, length = 282 ft)	JOMOPANS-ECHO model (MacGillivray and de Jong, 2021)	127
OCV	Bulker (speed = 11 knots, length = 348 ft)	JOMOPANS-ECHO model (MacGillivray and de Jong, 2021)	173
PSV	Bulker (speed = 11 knots, length = 319 ft)	JOMOPANS-ECHO model (MacGillivray and de Jong, 2021)	172
ERRV	Emergency Vessel (speed = 2 knots, length = 185 ft)	JOMOPANS-ECHO model (MacGillivray and de Jong, 2021)	133
FPSO	FPSO	Erbe, *et al.,* 2013	188
CTT	Tanker (speed = 2 knots, length = 820 ft)	JOMOPANS-ECHO model (MacGillivray and de Jong, 2021)	137

[1] Please note the Broadband rms SPL values in Table 10.25 do not exactly correlate with the peak values shown in Figure 10-12 as those in Figure 10-12 are *generic* values for a range of vessels, whereas those in Table 10.25 are the specific vessel SPLs used in the model. The latter are, in fact, higher than the generic SPLs in Figure 10-12, to ensure a precautionary approach was taken in the modelling.

10.4.4.5.2 Step 2: Sound propagation modelling

The sound propagation models used in this assessment determine:

- The rms SPL, which indicates the received level of sound at a given distance from the source. This information is used to determine the distance at which injury and disturbance thresholds are exceeded, and
- The cumulative Sound Exposure Level (SELcum), which is a standardised measure of the overall sound energy that an animal will be exposed to (i.e., related to SPL and exposure time) over a specified length of time (a 24 hour period in this assessment).

As described in Southall *et al.* (2019), the SELcum was weighted according to the marine mammal hearing types (i.e., LF, HF, VHF and PW and OW hearing groups in Table 10.21 above). This accounts for the differences in the sensitivity of these groups to different frequencies.

10.4.4.5.3 Step 3a: Comparison of model results with injury thresholds

The purpose of the model is to determine whether or not the Phase 1 & 2 Development will emit sounds which can exceed the injury or disturbance thresholds, and the generalised area over which the injury or disturbance is likely to take place. Where available, the internationally recognised thresholds for injury and disturbance to fish and marine mammals have been used. There are no thresholds for assessing the impact of continuous sound on seabirds or squid. A qualitative assessment has therefore been undertaken for these receptor groups.

The descriptions below indicate where the relevant injury and disturbance thresholds for each receptor have been breached.

10.4.4.5.3.1 Fish injury

To quantitatively assess any potential injury to fish, fish eggs and larvae from the offshore activities, received noise levels in terms of unweighted rms SPL have been predicted and compared to the Popper *et al.* (2014) thresholds for injury for shipping and continuous sounds (Section 10.4.4.4.3.3).

Table 10.26 summarises (for all three scenarios described in Table 10.24 above) whether the thresholds for mortality and potential mortal injury for fish (Table 10.20 above) were breached for fish and, where appropriate, the distance from the source at which fish would be exposed to injurious sound. As shown, this threshold was not exceeded at any distance from the source in either of the scenarios (Table 10.26).

The modelling predicts that injury thresholds for fish with swim bladders involved in hearing will not be exceeded. For all other fish groups, the probability of mortality and potential mortal injury, recoverable injury and TTS is expected to be low at near, intermediate and far distances from the sound sources.

Figure 10-13 shows the maximum predicted rms SPL from the Scenario 3 activities in comparison to the Popper *et al.* (2014) rms SPL thresholds for potential injury to fish species. The offshore Scenario 3 result is the combination case (when Drilling, Construction and Production take place at the same time) and may be treated as the worst-case offshore setup. Figure 10-13 reflects the conclusions of Table 10.26, showing the recoverable injury threshold of 170 dB rms and the TTS threshold of 158 dB rms are not exceeded for fish. The other scenarios are presented in Genesis report: J-UK-00200-218436-Y-TN001-Sea Lion Project-Underwater Noise-Offshore-Report 0 (Genesis, 2024a).

The modelling predicts that the injury thresholds for fish with swim bladder involved in hearing will not be exceeded. For fish with no swim bladder and fish with swim bladder involved in hearing, the probability of TTS near to the sound source is moderate. For all other impairments and thresholds assessed, the probability of mortality and potential mortal injury, recoverable injury and TTS is expected to be low at near, intermediate and far distances from the sound sources.

Table 10.26: Predicted maximum distances from the offshore activities (all scenarios) where the rms SPL thresholds for injury to fish are exceeded

Fish Group	Impairment[1]	Threshold[1,2,3]	Maximum Distance to Threshold Exceedance (m)
Fish with no swim bladder	Mortality and potential mortal injury	Low	N/A[4]
	Recoverable injury	Low	N/A
	TTS	(N) Moderate (I) Low (F) Low	N/A
Fish with swim bladder not involved in hearing	Mortality and potential mortal injury	Low	N/A
	Recoverable injury	Low	N/A
	TTS	(N) Moderate (I) Low (F) Low	N/A
Fish with swim bladder involved in hearing	Mortality and potential mortal injury	Low	N/A
	Recoverable injury	170 dB rms SPL for 48 h	Threshold not exceeded
	TTS	158 dB rms SPL for 12 h	Threshold not exceeded

Fish Group	Impairment[1]	Threshold[1,2,3]	Maximum Distance to Threshold Exceedance (m)
Sea turtles	Mortality and potential mortal injury	Low	N/A
	Recoverable injury	Low	N/A
	TTS	(N) Moderate (I) Low (F) Low	N/A
Eggs and larvae	Mortality and potential mortal injury	Low	N/A
	Recoverable injury	Low	N/A
	TTS	Low	N/A

[1] See Table 10.20 above.
[2] Quantitative thresholds are expressed in terms of rms SPL.
[3] Quantitative thresholds were not established for all fish types or impairment types. Where this is the case, the risk of injury or impairment has been qualitatively assessed (Popper, *et al.,* 2014).
[4] Where there are no quantitative limits, the 'Maximum Distance to Threshold Exceedance' cannot be assessed. Therefore, for those rows this applies to, the notion that there is a maximum distance is not applicable.

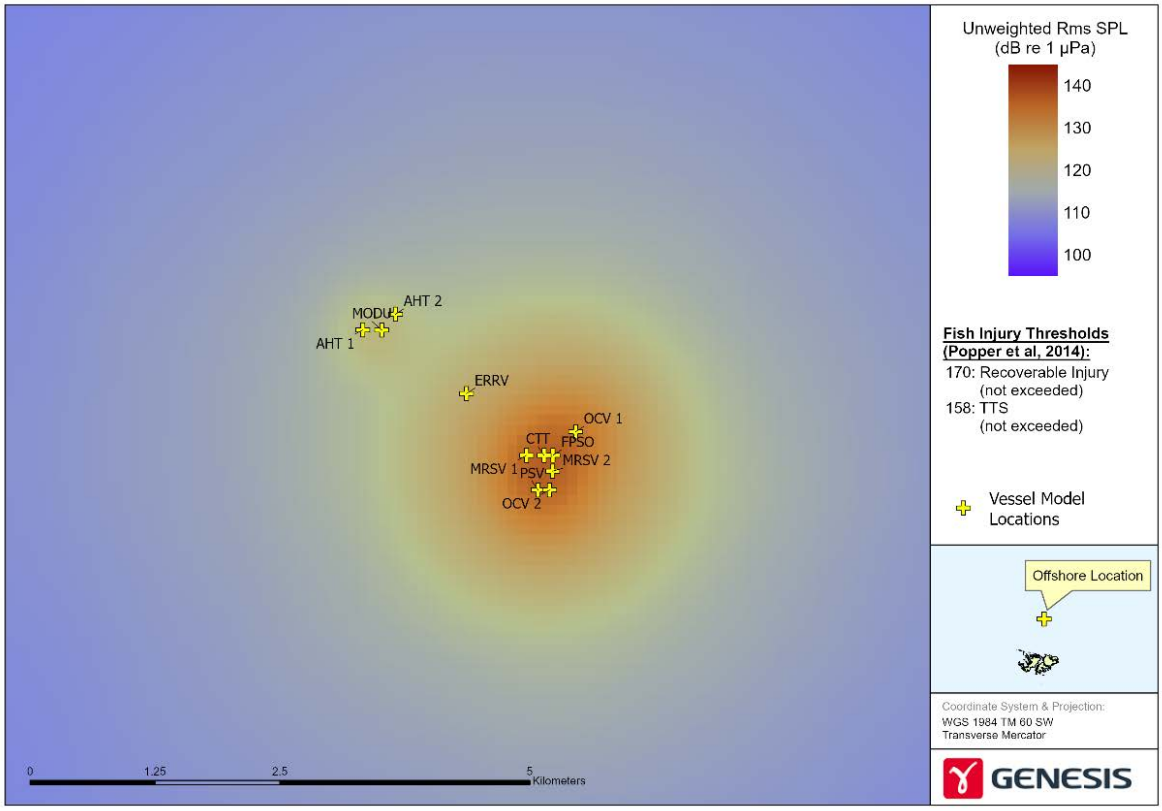


Figure 10-13: Maximum rms SPL received by fish in Scenario 3

10.4.4.5.3.2 Marine mammal injury

Received noise levels from the vessels in each modelling scenario have been predicted in terms of weighted cumulative SEL to identify the spatial area in which the onset of PTS or TTS may occur to marine mammals.

The marine mammal weightings are those given by Southall *et al.* (2019). In essence, these account for the hearing thresholds described in Section 10.4.4.3 and seen by the audiograms in Figure 10-11. The weighting curves are generalised forms for the different receptor groups described in Table 10.21.

Two situations are considered:

1) Where the mammals remain stationary, and
2) Where the mammals are assumed to flee from the noise source

Mammals assumed to be stationary

In the first situation, only the VHF cetaceans show a threshold exceedance (TTS threshold), and this is only for Scenarios 1 and 3 (Table 10.27). As well as assuming the marine mammals remain stationary in this case, the cumulative SEL results assume the period of interest is 24 hours. This means that in Scenarios 1 and 3, a VHF cetacean, e.g., a Peales's dolphin, would have to remain stationary within the respective 0.1 km^2 or 0.2 km^2 threshold exceedance areas for 24 hours for the TTS threshold to be breached, i.e., for a temporary hearing impairment to occur. The predicted areas where noise levels are above the cumulative SEL threshold for stationary mammals are summarised in Table 10.27.

Except for the VHF cetaceans, for all other marine mammal hearing groups (LF and HF cetaceans, and PW and OW pinnipeds), the cumulative SEL thresholds for PTS and TTS were not predicted to be exceeded over 24 hours for any of Scenarios 1 through 3. The exceedance VHF cetacean cases (for modelling Scenarios 1 and 3) are shown in Figures 10-14 and 10-15. These figures show the predicted cumulative SEL around the vessel location over 24 hours assuming that marine mammals remain stationary.

Table 10.27: Predicted areas where the cumulative 24-hour SEL may cause TTS[1] onset to marine mammals that remain stationary.

Scenario	Marine Mammal Hearing Group	Cumulative SEL TTS Threshold (dB re 1 μPa^2s)	Area of Threshold Exceedance [2,3] (km^2)
Scenario 1	VHF cetaceans	153	0.1[4]
Scenario 2	VHF cetaceans	153	Threshold not exceeded
Scenario 3	VHF cetaceans	153	0.2

[1] PTS thresholds are not included here as there are no scenarios where these are exceeded.
[2] Predicted areas have been rounded to the nearest 0.1 km^2
[3] Namely, the area surrounding the source within which the mammals may experience sounds which exceed the injury threshold.
[4] Navitas recognise that a TTS could be considered an injury and thus an offence under the Marine Mammals Protection Ordinance 1992 (section 1.1.1.1), however it is considered extremely unlikely that an animal would remain stationary within the areas identified for 24 hours in order to sustain the TTS impairment. This assessment demonstrates that impacts can only occur in an unrealistic situation.

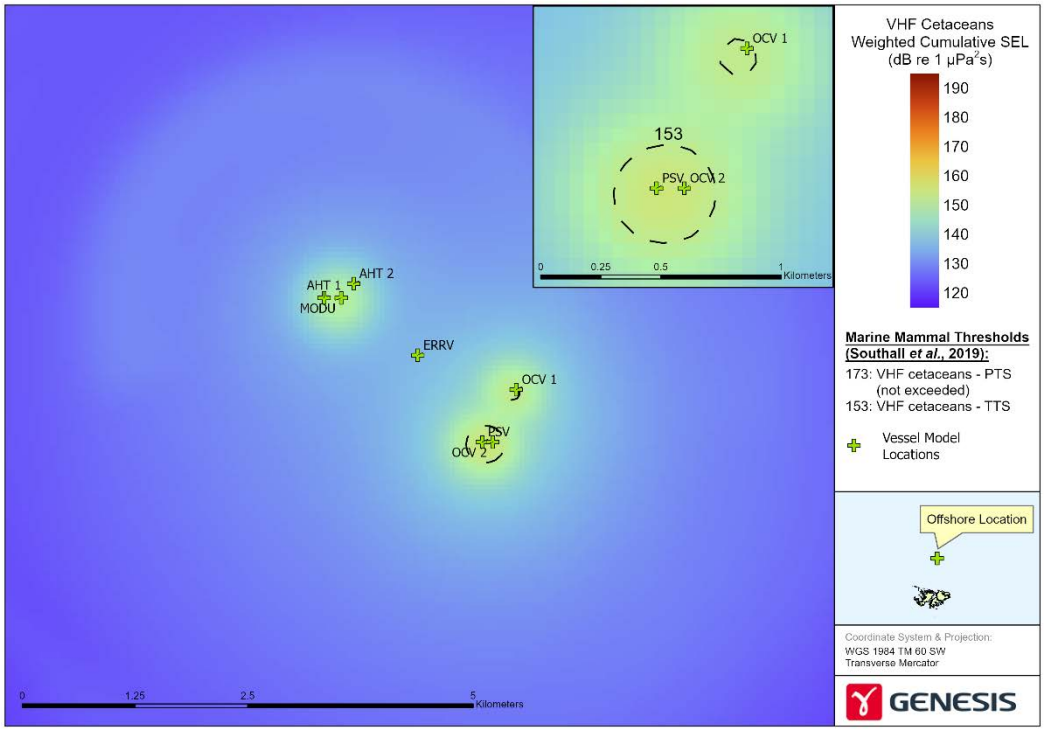


Figure 10-14: Predicted cumulative SEL received by VHF cetaceans during Scenario 1 over 24 hours; marine mammals are assumed to remain stationary

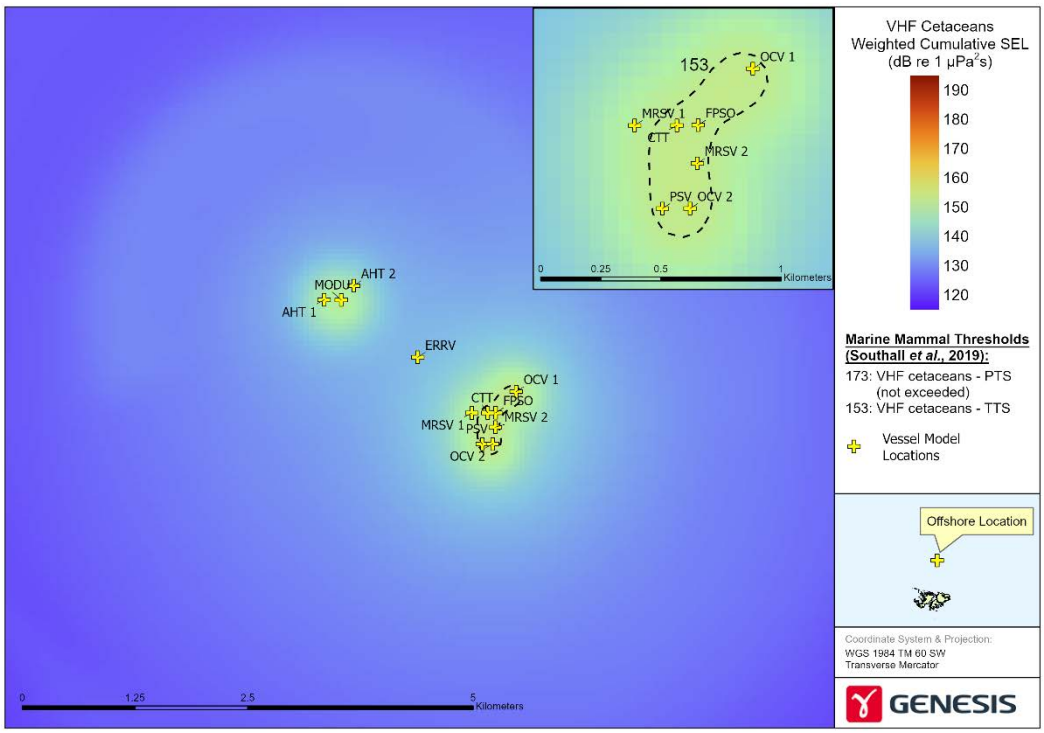


Figure 10-15: Predicted cumulative SEL received by VHF cetaceans during Scenario 3 over 24 hours; marine mammals are assumed to remain stationary

Mammals assumed to flee

In the second situation, marine mammals have been simulated swimming away from the vessel location at different swim speeds and from different initial starting distances from the vessel location. As the marine mammals swim away, their swim depth is allowed to change such that upon receiving sound, they are at the depth where sound levels are highest (note that the predicted received sound levels vary with depth). This is a conservative measure and will result in the highest predicted cumulative SEL received by the marine mammals as they swim away.

The vessel with the highest source level in each scenario has been used for the calculation. Here, this assumes a worst-case situation where the source levels of some vessels that may normally be stationary are instead taken to be moving at transit speed, i.e., are emitting more sound than usual. The relationships for many vessels noise source levels are related to ship speed; e.g., the JOMOPANS-ECHO model (MacGillivray and de Jong, 2021). For the Scenario 2 calculation, the CTT source levels used are the levels for the CTT at transit speed. Table 10.28 shows the vessel source levels of interest in the fleeing marine mammal calculations. Again, the cumulative SEL results assume the period of interest is 24 hours.

The predicted initial start distances from the source that marine mammals must be at, to not be exposed to sound levels exceeding the PTS and TTS thresholds, are summarised in Table 10.29. As shown, the modelling predicts that the marine mammal PTS and TTS thresholds will not be exceeded for any marine mammal hearing group in any offshore scenario provided that they swim away at a speed of at least 1.5 m/s from the vessel location. Therefore, it is expected that the risk of PTS or TTS occurring to any marine mammals will be low.

Table 10.28: Summary of source levels used in the fleeing marine mammal calculations

Sound Source	Representative Source Spectrum Used in Modelling	Reference	Broadband rms SPL (dB re 1 µPa at 1 m)
OCV	Bulker (speed = 11 knots, length = 348 ft)	JOMOPANS-ECHO model (MacGillivray and de Jong, 2021)	173
CTT	Tanker (speed = 16 knots[1], length = 820 ft)	JOMOPANS-ECHO model (MacGillivray and de Jong, 2021)	191

[1] Note the CTT will never be moving at 16 knots in the vicinity of the Sea Lion Field, this speed is used only to give the worst-case sound profile for the vessel within the model.

Table 10.29: Predicted initial starting distances from the vessel location where the adopted weighted cumulative SEL thresholds for non-impulsive noise[1] are exceeded for marine mammals swimming away from the vessel location at 1.5 m/s

Scenario	Representative Vessel	Marine Mammal Group	Distance to Threshold Exceedance[2] (m)	
			PTS	TTS
Scenario 1	OCV	All marine mammals	Not exceeded	Not exceeded
Scenario 2	CTT	All marine mammals	Not exceeded	Not exceeded
Scenario 3	CTT	All marine mammals	Not exceeded	Not exceeded

[1] See Table 10.23 above

[2] Namely, the area surrounding the source within which the mammals may experience sounds which exceed the injury threshold.

10.4.4.5.4 Step 3b: Comparison of model results with disturbance and behavioural response thresholds

Where noise levels fall below injury thresholds, animals exposed to long-term and continuous vessel noise can exhibit acute and / or chronic behavioural responses, rather than injury. The following sections discuss whether the modelled operations would result in potential disturbance and behaviour change in fish and marine mammals.

10.4.4.5.4.1 Fish disturbance by vessels

Documented behavioural effects of underwater noise on fish behaviour are variable, ranging from no discernible effect (Wardle, *et al.,* 2001) to startle reactions followed by immediate resumption of normal behaviour (Wardle, *et al.,* 2001; Hassel, *et al.,* 2004). Despite some documented behavioural effects, there are no well-established criteria or thresholds for assessing behavioural disturbance to fish. In fact, it was concluded in Popper *et al.* (2014) that there lacked sufficient evidence to recommend specific thresholds that correspond to behavioural disturbance to fish.

Popper *et al.* (2014) suggest that all fish are at high risk of masking[56] when they are close to continuous low frequency sources of noise, and those that use the swim bladder to detect sound are also at high risk at long range (Table 10.20). Fish that use the swim bladder are also at high risk of behavioural change when near to the source of noise (Table 10.20). However, if fish are disturbed during the proposed operations, it is assumed this would occur within the immediate vicinity of vessel activity. This area is very small in relation to the available area and the likely distribution of fish species

10.4.4.5.4.2 Marine mammal disturbance by vessels

While injury is very unlikely (Section 10.4.4.5.3.2), there is greater potential for long-term continuous vessel noise to cause behavioural disturbance. As described in Section 10.4.4.4.5.3, marine mammal responses to vessels vary but are generally not regarded as particularly severe (Southall, *et al.,* 2007)

Therefore, it is considered unlikely that a transiting vessel, such as those steaming to and from Stanley, would cause more than trivial disturbance that would be rapidly recoverable once the vessel passes (JNCC, 2010).

To predict distances at which potential behavioural disturbance to marine mammals may occur during the Development, received noise levels in terms of unweighted rms SPL have been estimated and compared to the adopted behavioural disturbance thresholds of 120 dB re µPa and 160 dB re µPa (Section 10.4.4.4.5.5).

The maximum unweighted rms SPL received from the vessels for all three modelling scenarios are shown in Figure 10-16 to Figure 10-18. The contours highlighted in the figures represent the threshold for signifying behavioural disturbance to all marine mammals.

The avoidance / displacement behaviour threshold 160 dB re 1 µPa is shown not to be exceeded in any of the modelling scenarios. However, there are a range of areas related to the activities of Scenarios 1, 2 and 3 where the behavioural disturbance 120 dB re 1 µPa threshold is exceeded. Scenario 3 (the combination case when Drilling, Construction and Production take place at the same time), results in the greatest area over which this behavioural threshold exceedance is seen (9 km^2, see Table 10.30 below. The table gives the predicted areas where noise levels are above the behavioural disturbance threshold.

The disturbance areas indicated should be treated as areas within which some (not all) marine mammals may exhibit behavioural responses. It is not suggested that all marine mammals will vacate

[56] Masking occurs when anthropogenic sounds impair the ability of an animal to detect biologically significant sounds.

these areas. Marine mammals will likely exhibit increased behavioural responses at distances closer to the vessel locations and there will be a reduced likelihood of response with increasing distance from the vessel locations (Southall, *et al.,* 2021).

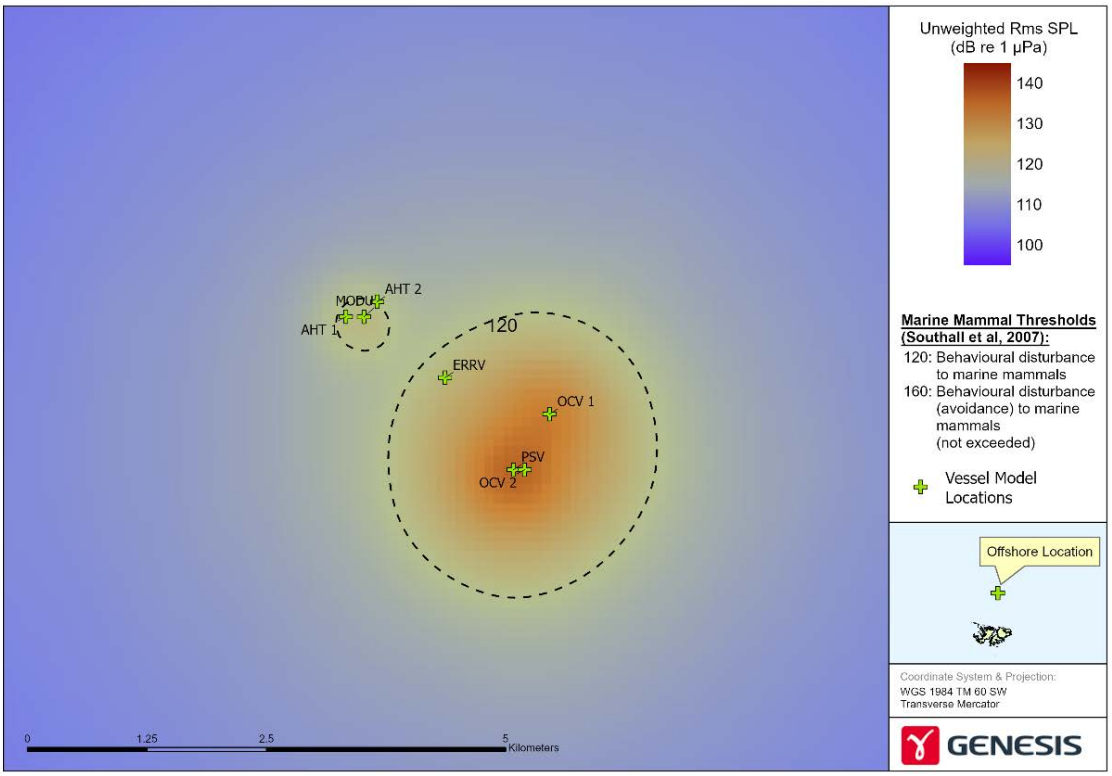


Figure 10-16: Predicted unweighted rms SPL received by marine mammals during Scenario 1

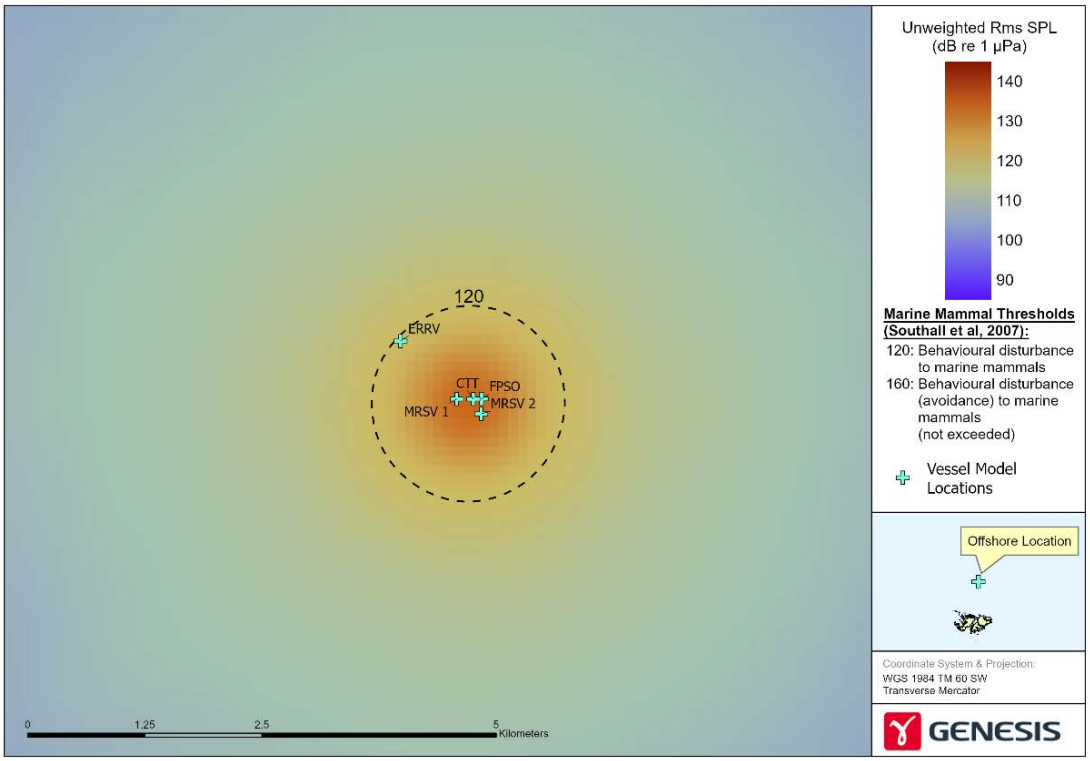


Figure 10-17: Predicted unweighted rms SPL received by marine mammals during Scenario 2

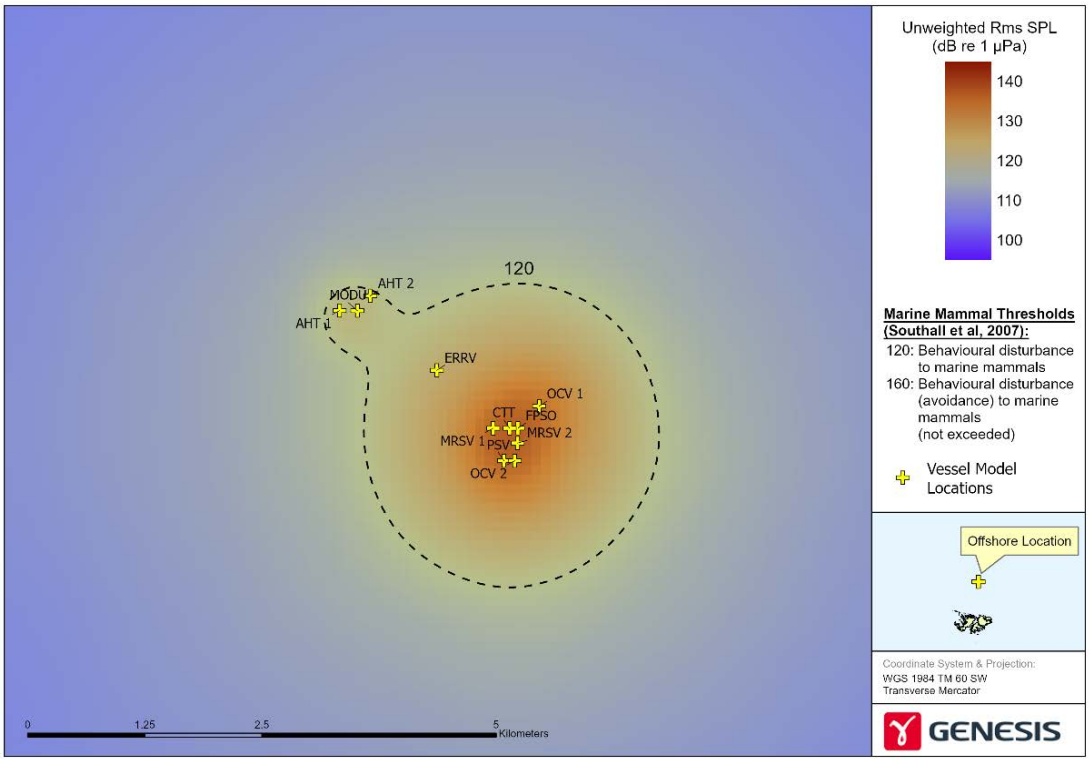


Figure 10-18: Predicted unweighted rms SPL received by marine mammals during Scenario 3

Table 10.30: Predicted area where the adopted unweighted rms SPL thresholds for disturbance to marine mammals is exceeded

Criteria	Behavioural Disturbance Threshold	Reference	Scenario	Area of Threshold Exceedance [1,2] (km^2)
Behavioural disturbance to all marine mammals	Rms SPL: 120 dB re 1 µPa	Southall, *et al.*, 2007	1	7
			2	4
			3	9
Behavioural disturbance (avoidance) to all marine mammals	Rms SPL: 160 dB re 1 µPa	Southall, *et al.*, 2007	1	Threshold not exceeded
			2	
			3	

[1] Predicted area has been rounded up to the nearest 1 km^2
[2] Namely, the area surrounding the source within which the mammals may experience sounds which exceed the injury threshold.

10.4.5 Industry standard mitigations

10.4.5.1 Vessel noise

There are no industry-standard mitigation measures specifically designed to reduce the impact of vessel noise on fauna. This is an area of developing good practice and improvements in ship design should be expected over time. For example, in 2014, the IMO published MEPC.1/Circ.833 Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life, and these were revised and approved in August 2023 (IMO, 2023). Also in 2023, the CMS produced a Technical Note on the Best Available Technology (BAT) and Best Environmental Practice (BEP) for mitigating noise from shipping (Section 10.4.1.1). These include considerations such as design measures to minimise noise due to propeller cavitation, improve hull flow and wake noise, the application of a 'radiated noise level' to ships, as well as reducing ship speed. These considerations are not as yet, an established part of marine vessel hire, but may form part of future environmental considerations. However, as part of the vessel hire process, Navitas will ensure vessels will be dry docked in accordance with their classification requirements and hulls and propellers will be cleaned accordingly. During operations, engines shall be maintained similarly and DP will be used only when necessary. All these actions will minimise underwater noise from all vessels.

Standard operating procedures, such as maintenance schedules, will help to minimise the noise generated by propeller cavitation. For fixed pitch propellers, sound generated is relative to vessel speed, whereas for variable pitch propellers the relationship between vessel speed and propeller speed (and the inception of cavitation) is more complex. All of the Sea Lion offshore vessels will have variable pitch propellers. Although speed restrictions are not proposed offshore, vessels operating in the vicinity of the Sea Lion Field are likely to be operating at low speed.

10.4.6 Impact assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of vessel noise on the varying receptors.

A summary of the impact assessment outcomes for this Development is tabulated in Section 10.4.12, which shows the worst-case impact for each activity and receptor and details are provided below.

10.4.6.1 Fish injury and disturbance

The sound modelling indicates that the thresholds for potential mortality to fish set by Hawkins and Popper (2014) are not exceeded for all three scenarios described in Table 10.24.

Although the influence of vessel noise may be detectable within the immediate vicinity of the Development (Section 10.4.4.5.4.1), this area is unlikely to contain significant populations of any species of fish (i.e., is unlikely to contain >1 % of the Falklands population). Therefore, the sensitivity of the receptor is considered to be '**Low**'.

Most species of fish in Falkland Islands waters are subject to commercial fisheries and any impact due to vessel noise from the Sea Lion Development will be insignificant in comparison. Therefore, the severity of the impact of vessel noise on fish is assessed as '**Slight**'.

Overall the significance of the impact of disturbance caused by vessel noise to fish is therefore considered to be '**Very Low (2)**'.

10.4.6.2 Invertebrates

Although there are no thresholds for the levels of sound likely to cause injury or disturbance to invertebrates such as squid, the literature suggests that impacts to feeding behaviour of invertebrates may be observed (albeit from impulsive noise) (Section 10.4.4.4.2).

While the influence of vessel noise may be detectable within the immediate vicinity of the Development, this area is unlikely to contain a significant abundances of any commercial squid species, and these would be transitory. Therefore the sensitivity of the receptor is considered to be '**Low**'.

Squid are subject to commercial fishing in the Falklands and any impact due to noise from the Sea Lion Development will be insignificant in comparison. Therefore the severity of the impact of vessel noise on squid is assessed as '**Slight**'.

Overall, the significance of the impact of disturbance caused by vessel noise to invertebrates is therefore assessed as '**Very Low (2)**'.

10.4.6.3 Seabirds

The presence of two of the four principle breeding species of penguin (rockhopper and Magellanic penguins) is highly seasonal within Falkland Islands waters, being far less numerous between May and September. However, the other two species (gentoo and king penguins) are present year-round and are more numerous in the NFB in the winter months. Therefore, it is possible to encounter penguins in the NFB throughout the year (Section 7.4.5.2.1). All of the species of penguin breeding in the Falklands (except the king penguin) are listed as priority conservation species and rockhopper penguins are classified as IUCN 'Vulnerable'. The Falklands population has shown a long-term decline in numbers and is the subject of a dedicated management plan (Kuepfer and Stanworth, 2023). Therefore, the worst-case sensitivity of receptor (penguins) is considered to be '**High**'.

There is nothing to suggest that vessel sound has any more than a very short-term and completely reversible impact on penguins. Indeed, it has been observed that some species of penguin, clearly evident in chinstrap penguins, are positively attracted to stationary research vessels (up to 100 m in length) operating on DP control (A. Black, *pers. obs*.). Although anecdotal, these observations indicate that penguins do not strongly avoid areas where vessel noise is prevalent, although have also been observed to flee in response to moving vessels (A. Black, *pers. obs*.). Additionally, research shows that penguins vocalise underwater and may use sound to detect predators or prey, with some penguins reacting to noise levels of 120 dB re 1 µPa, albeit only within 50m of the sound source (Section 10.4.4.4.4). Given the extent of available 'habitat' for penguins offshore, it is expected that

any impact would be transitory and therefore the severity of the effect on seabirds of disturbance due to vessel noise is assessed as '**Slight**'.

The overall significance of the impact of disturbance due to underwater noise is considered to be '**Low (4)**'.

10.4.6.4 Marine mammals

10.4.6.4.1 Marine mammal injury and vessel noise

Injury to marine mammals is not considered to be a credible possibility. Two situations were considered: marine mammals remaining stationary in the presence of the introduced noise, and the case where they flee in response to the noise.

For the stationary marine mammal situation (Section 10.4.4.5.3.2), only the VHF cetaceans (for Scenarios 1 and 3) are predicted to exceed the cumulative SEL TTS threshold. However, this would only occur if the animal remained stationary for 24 hours within (worst-case) a 0.2 km^2 area of the sound source. For all other marine mammal hearing groups (LF and HF cetaceans, and PW and OW pinnipeds), the cumulative SEL thresholds for PTS and TTS were not predicted to be exceeded over 24 hours for any of Scenarios 1, 2 or 3.

If the marine mammals are assumed to flee from the noise source, Section 10.4.4.4.3.2 shows that the marine mammal PTS and TTS thresholds will not be exceeded for any marine mammal hearing group, in any offshore scenario, provided that they swim away at a speed of at least 1.5 m/s from the vessel location.

Therefore it is expected that the risk of PTS or TTS occurring to any marine mammals will be negligible and the impact assessment is considered to be 'not applicable'.

It is assumed that animals would move away from the source of noise before being subject to a sound exposure level that would cause injury and therefore the impact of vessel noise is assessed as disturbance (below) rather than the potential for injury.

10.4.6.4.2 Marine mammal disturbance

The long-term continuous nature of vessel noise as a source of sound pollution could result in chronic impacts on a number of marine mammal species (Section 10.4.4.4.5).

Available evidence suggests that marine mammals are present within the zone of influence of vessel noise (within 30 km of the Development site) albeit with seasonal variation (Section 7.4.6.2.3). Although it is unlikely that the area under the influence of vessel noise around the Development site supports resident populations of cetaceans, it is likely that the area is traversed by numerous animals on migration (Section 7.4.6.2.3).

In terms of species sensitivity, the low-frequency cetaceans, such as fin, southern right and sei whales (all in the LF (7 – 3,500 Hz) hearing group), are considered the most sensitive receptors, due to their IUCN 'Vulnerable' and 'Endangered' statuses respectively and the overlap in their hearing range with vessel noise. To take a precautionary approach, it is assumed that the fin whale, known to be in the area year-round, and the sei whale, known to be seasonally abundant (Section 7.4.6.2.3), are the main receptor species. Additionally, within Falkland Islands waters all marine mammals are protected under the Marine Mammals Ordinance 1992 and all pelagic cetaceans, fur seals and sea lions are highlighted as Falkland Islands conservation priority species. Therefore, the sensitivity of the receptor is considered to be '**High**'.

Operations during the Phase 1 & 2 Sea Lion Development will add to the ambient noise levels in an area that normally experiences little anthropogenic sound (Section 10.4.4.2). Development activities

will produce predominantly low frequency (<1,000 Hz) continuous sounds (Section 10.4.4.5.1). Modelling of three typical scenarios (Table 10.24) was carried out and each scenario was shown to have spatially limited behavioral impact (Section 10.4.4.5.4.2):

- Avoidance behaviour / displacement of marine mammals: there was no exceedance of the 160 dB re 1 µPa threshold, and
- Behavioural disturbance of marine mammals: the areas shown in exceedance of the 120 dB re 1 µPa threshold are relatively localised (confined to the spatial extent of the development) and small, ranging from 4 - 9 km^2 across the three modelled scenarios.

Underwater vessel noise will occur throughout the Development's Field Life (*c.* 30 years), although it has been suggested that cetaceans can adapt to ambient noise and the area concerned is relatively small compared with the amount of available habitat. While a small increase in vessel noise around animals already subjected to, and possibly accustomed to, vessel noise may disrupt feeding and cause short-term stress, these impacts are very hard to measure. The constant nature of vessel noise means that marine mammals are gradually exposed to higher sound levels as they move closer to the source, hence they are able to change direction (i.e., move away from the sound source) before the impact causes any long-term effects. It is expected that any negative impact would be readily reversible once the animals move away from the source (as found by Rolland *et al.,* 2012). However, if the source was located in an area that was regarded as an important feeding or breeding ground the impact would be more significant. Globally, disturbance to marine mammals due to vessel noise is becoming a bigger issue (NOAA, 2004; Hatch, *et al.,* 2008), as the volume of vessel traffic increases year-on-year and the populations of these species (notably large baleen whales) increase following partial recovery from human exploitation. There is little information regarding the long-term implications of vessel noise on marine mammal populations and therefore a precautionary approach has been taken and the severity of effect has been assessed as '**Minor**'.

The overall significance of the impact caused by vessel noise emanating from the Development site has therefore been assessed as '**Moderate (8)**'.

10.4.7 Project-specific mitigation

Although the impact of moderate intensity sound (e.g., from vessel noise) is considered to be of 'Moderate' significance (mainly owing to the protected nature of the receptors and the precautionary assessment of the severity of effect) there are currently no guidelines governing anthropogenic noise that does not exceed the PTS threshold.

In some circumstances, a reduction in ship speed may reduce the level of underwater noise. However, this applies only to vessels with fixed pitch propellers when the speed becomes lower than the cavitation inception speed (i.e., it does not result in a lower sound with all vessels). Therefore, for ships equipped with controllable pitch propellers, there may be no reduction in noise with reduced speed (IMO, 2023).

The project incorporates a moored MODU. This has significantly lower noise impacts than a MODU that uses solely DP for station-keeping that would also be viable in this location. Additionally, the use of a tug to hold back and position the CTT during offloading also has a significantly lower noise impact compared with the use of a DP tanker. Lastly, the change in well design means that piling will not be required, which significantly reduces the underwater noise produced. However, it is noted that these options are chosen for reasons other than their environmental impact and are not implemented as mitigation to address any significant impacts or risks.

10.4.8 Residual impacts and risks

Disturbance due to vessel noise will continue throughout the *c.* 30 year Field Life of the Development and is the most significant impact associated with underwater noise. While there are means of reducing the amount of noise emitted by vessels, as described above, the most effective of these need to be built-into the design of the vessels concerned.

The degree of residual impact will therefore depend on the vessels contracted to work on the Sea Lion Development and, at the time of writing, these details are unknown. Therefore, as a precautionary approach at this pre-FEED stage in the process, the residual impacts from vessel noise, to all receptors, remain the same. Therefore, the worst-case impact remains as '**Moderate (8)**' with regard to behavioural disturbance to marine mammals.

10.4.9 Cumulative impacts

Commercial shipping is a major contributor of low frequency (5 - 500 Hz) background noise in the world's oceans and therefore there is the potential for cumulative impacts from increased 'concentration', increased 'extent and proportion' and increased 'duration' of underwater noise (Section 8.9.1).

Globally, the number of ships in operation has tripled in the last 50 years and shipping noise levels have increased at the rate of approximately 3 dB per decade (OSPAR, 2009b). Indeed, disturbance from vessel noise is becoming an issue in areas where high shipping density and cetaceans coexist (Hatch *et al.,* 2008).

Acoustic recordings indicate that the Sea Lion Field is subject to low ambient anthropogenic noise (Section 7.4.6.2.1.2) and therefore there will be little cumulative impact near the Field. Shipping routes around the Falkland Islands converge on Stanley and Berkeley Sound. Therefore, vessels associated with the Development travelling to and from Stanley have greater potential to add cumulatively to the existing vessel noise in inshore waters off the east coast of the Falklands (see Section 11.1).

The cumulative impact of underwater noise from other users of the NFB would fall under Category 2 (see Section 8.9.1) whereby the extent and proportion of the impact may be increased. The edge of the continental shelf to the south of the Development (along the 200 m isobath) is heavily fished by demersal trawlers. Although these vessels are not static and individually may not have a significant impact, where several vessels are fishing in the same general area, or a single vessel is fishing the same area for consecutive days, they could contribute to the disturbance impact.

In comparison to the impact of commercial fisheries on fish and cephalopod species in Falkland Islands waters, the impact of vessel sound during the Phase 1 & 2 Development is considered to be negligible.

10.4.10 Confidence

The noise sources modelled for disturbance impacts are representative of different stages of the project. The scenarios modelled form a realistic build-up of the likely underwater noise climate and established and peer reviewed thresholds for injury and disturbance have been explored to show the likely extent of impact. Importantly, a fully range dependent noise model has been utilised that incorporates:

- Site-specific bathymetric grids to account for the influence of varying bathymetry on noise propagation,
- Site-specific range and depth dependent water column temperature, salinity, and sound speed profiles based on modelled hydrological conditions,

- Acoustic properties of the predominant seabed sediments in the modelling area,
- Frequency dependent propagation effects (e.g., volume attenuation, reflection, scattering at different frequencies), and
- Specific properties of the noise source under consideration.

These factors combined are considered a best approach to making sound judgements on the impact to marine life from the Development's proposed noise related activities.

However, there is uncertainty over the long-term impact of less intense continuous underwater noise such as that from vessels and also over the marine mammal distribution on the NFB.

The uncertainty over the potential impact of noise disturbance on individual marine mammals and populations is acknowledged as a data gap. Furthermore, while there are some data available regarding the intensity of sound produced by vessels and activities associated with the O&G industry under operational conditions, the exact vessels to be used for the Sea Lion project have not yet been determined. Accurate input parameters are vital for modelling purposes.

With regard to the uncertainty over marine mammal distribution, previous observational and acoustic surveys give a reasonable indication of the species present but further surveys would help to determine the inter-annual variation in marine mammal abundance in the area and help to resolve the status of rare species. Furthermore, acoustic surveys would help to evaluate the vocal range of the species encountered within Falkland Islands waters. The inter-annual distribution and abundance of marine mammals in the NFB is acknowledged as a data gap.

With regard to other receptors considered, e.g., squid and diving seabirds, the impact assessments are qualitative, and the absence of disturbance or injury thresholds is acknowledged.

Therefore, on balance, the confidence in the assessment of noise disturbance is assessed as '**Uncertain**'.

10.4.10.1 Monitoring required

It is clear that disturbance due to vessel noise is becoming an increasingly significant issue and yet there is very little hard evidence to support the precautionary conclusions of this assessment and therefore monitoring will be required.

UK good practice will be followed and there will be Seabird and Marine Mammal Observers (SMMOs) on board vessels to provide ongoing monitoring. Monitoring of day-to-day operational noise *via* hydrophones (i.e. Passive Acoustic Monitoring (PAM)), including during activation of thrusters as well as various vessel scenarios will also be undertaken to understand baseline noise levels during operations.

A review of all SMMO reports will be carried out every six months and after the first three years of SMMO deployment to validate the EIA and to inform decisions on whether ongoing monitoring is necessary.

Navitas will investigate the use of noise minimisation in the design of vessels, where possible.

Detailed monitoring requirements have been established during the project-specific Phase 1 & 2 Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the EMMP. An outline EMMP is provided in Chapter 15.

10.4.11 Offsetting

For significant residual and impact and risks ('Moderate' or above), offsetting *via* a Carbon and Biodiversity Offsetting Fund is proposed, see Section 8.11 for further details.

10.4.12 Findings summary

Table 10.31: Summary of the impact assessment for underwater noise offshore[1]

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity[1]	Severity[1]	Likelihood[1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Underwater Vessel noise	Continuous moderate intensity noise	Injury and disturbance to fish	Planned	1,2a, 2b & 3	Low	Slight	n/a	**Very Low (2)**	**n/a**	**Uncertain**	**Industry-standard:** None. **Project-specific:** None proposed.
		Injury and disturbance to invertebrates (including squid[2])		1,2a, 2b & 3	Low	Slight	n/a	**Very Low (2)**	**n/a**		
		Injury to seabirds		1,2a, 2b & 3	High	Slight	n/a	**Low (4)**	**n/a**		
		Injury to marine mammals		1,2a, 2b & 3	n/a	n/a	n/a	**n/a**	**n/a**		
		Behavioural disturbance to marine mammals		1,2a, 2b & 3	High	Minor	n/a	**Moderate (8)**	**Moderate (8)**		

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.
[2] Squid and seabirds are qualitatively assessed as there are no thresholds against which to compare modelling outputs.

10.5 Underwater noise inshore

Table of Contents

10.5.1 Introduction 722
10.5.1.1 Relevant legislation 722
10.5.2 Sources and types of underwater noise associated with LTVs 722
10.5.2.1 Use of Large Transport Vessels (LTVs) 722
10.5.2.2 Use of Offshore Construction Vessels (OCVs) 723
10.5.2.3 Bunkering of LTVs 723
10.5.3 Potential environmental receptors 723
10.5.4 Characterising and quantifying the impact of underwater noise 723
10.5.4.1 The behaviour of sound and how it is measured and described 723
10.5.4.2 The concept of hearing thresholds in receptors 724
10.5.4.3 The nature of the impact and the hearing thresholds 724
10.5.4.4 Quantification of sound impacts - noise modelling 724
10.5.4.4.1 Step 1: Identification of source sound levels 725
10.5.4.4.2 Step 2: Sound propagation modelling 726
10.5.4.4.3 Comparison of model results with injury thresholds 727
10.5.4.4.3.1 Fish injury 727
10.5.4.4.3.2 Marine mammal injury 728
10.5.4.4.4 Comparison of model results with thresholds 729
10.5.4.4.4.1 Fish disturbance from vessels 729
10.5.4.4.4.2 Seabirds disturbance from vessels 730
10.5.4.4.4.3 Marine mammal disturbance from vessels 730
10.5.5 Industry-standard mitigation measures 732
10.5.6 Impact assessment 732
10.5.6.1 Fish displacement and disturbance 733
10.5.6.2 Squid displacement and disturbance 733
10.5.6.3 Seabird displacement and disturbance 733
10.5.6.4 Marine mammal displacement and disturbance 734
10.5.7 Project-specific mitigation 734
10.5.8 Residual impacts 734
10.5.9 Cumulative impact 734
10.5.10 Confidence 737
10.5.10.1 Monitoring 737
10.5.11 Offsetting 738
10.5.12 Findings summary 738

10.5.1 Introduction

Underwater noise will be generated by vessels operating in Berkeley Sound during two relatively short periods in the early years of Field Development.

Large Transport Vessels (LTVs), used for floating storage of the subsea infrastructure will be anchored for up to thirteen months to support the offshore construction stages of the Development. These will be periodically attended by Offshore Construction Vessels (OCVs) to which the infrastructure will be offloaded for transportation to the Sea Lion Field for installation. Thereafter there will be no project related vessels anchored in Berkeley Sound.

Note: the other impacts associated with vessel use are described elsewhere in this document, as summarised in Table 2.2, and the impacts of noise from vessels used offshore are assessed in Section 10.4.

Note: owing to the complexity of language used when assessing the impact of sound, it is advised that Section 10.4 be read first as many sections in the following chapter refer back to sections that provide common information to avoid repetition.

10.5.1.1 Relevant legislation

A summary of the key pieces of legislation relating to environmental impact from underwater noise is given in Section 10.4.1.1.

10.5.2 Sources and types of underwater noise associated with LTVs

Anthropogenic sources of underwater noise associated with the inshore activities of the Phase 1 & 2 Development include:

- Moderate intensity continuous (non-pulsed) sounds from vessels:
  - Use of LTVs during the offshore construction phase, and
  - Vessel engine / thruster noise generated by visiting OCVs.

Following the offshore installation campaigns, vessel presence within Berkeley Sound would be an exception (e.g., to shelter during bad weather), with the base case being zero project vessels within Berkeley Sound.

Note: On examination, underwater noise from helicopters flying in accordance with (and in excess of) the FILFH (2024) minimum altitude was scoped out of the underwater noise assessment.

10.5.2.1 Use of Large Transport Vessels (LTVs)

LTVs will be used to transport the following to the Falkland Islands where they will be stored onboard until they are required offshore:

- Drilling infrastructure e.g., Blow-Out Preventors (BOP's) (Section 5.4.10),
- Subsea Production System (SPS) infrastructure (Section 5.5.3),
- Subsea Umbilicals, Risers and Flowlines (SURF) (Section 5.5.3),
- The Floating Production, Storage and Offload (FPSO) vessel mooring infrastructure (Section 5.6),
- General equipment, and
- Bulks.

On arrival in the Islands, the LTVs will anchor in Berkeley Sound and function as floating storage / logistics barges. Materials and equipment will be collected from the LTVs by the OCVs and transported offshore to Sea Lion for installation.

A maximum of two LTVs at any one time will be present for around five months during Stage 1, two months during Stage 2a, and six months relating to Stage 2b (beginning one month before Stage 2b begins) (Section 5.5.1). Each vessel will have its own individual 500 m exclusion zone.

When at anchor and not offloading their cargo, the LTVs will maintain one generator to keep the ship's facilities running but otherwise they will be on the anchor, weather vaning, minimising the noise they produce. When offloading they will be fully powered to enable safe operations.

The proposed anchorage locations are shown in Section 5.5.1. However, Navitas will work with FIG FIMA / Fisheries to identify optimum locations within Berkeley Sound that will cause the least disruption to other users during periods of high marine traffic in the Sound.

10.5.2.2 Use of Offshore Construction Vessels (OCVs)

During the offshore installation campaigns the OCVs will visit the LTVs in Berkeley Sound to collect equipment required for the offshore installation. It is anticipated that during:

- Phase 1 drilling, the OCVs will visit Berkeley Sound 11 times, and
- Phase 2 drilling, the OCVs will visit Berkeley Sound four times.

10.5.2.3 Bunkering of LTVs

As required, a Stanley Services' tanker will supply Marine Gas Oil (MGO) to the LTVs.

10.5.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify those receptors upon which the impacts of underwater noise warranted further investigation (Chapter 9). These include:

- Invertebrates (e.g., cephalopods and crustaceans) in Berkeley Sound (Section 7.4.4),
- Fish in Berkeley Sound (Section 7.4.4.3),
- Seabirds in Berkeley Sound (Section 7.4.5.3), and
- Marine mammals in Berkeley Sound (e.g., whales, dolphins and seals) (Section 7.4.6.3).

The above may be impacted upon as they either exist in, or spend time in, the zone influenced by anthropogenic sound. To varying degrees, all the above may use, or rely on, sound for various life functions and / or may be impacted upon directly by sound.

10.5.4 Characterising and quantifying the impact of underwater noise

When characterising and quantifying the impacts of underwater noise inshore, it is necessary to consider:

- The behaviour of sound and how it is measured and described,
- The concept of hearing thresholds in receptors (e.g., fish and marine mammals),
- The nature of the impact on receptors, and
- Quantification of sound propagation - sound modelling.

10.5.4.1 The behaviour of sound and how it is measured and described

The behaviour of sound and how it is measured is described in Section 10.4.4.1 of the offshore underwater noise chapter, along with a description of the key terminology used. In shallow water regions, there is significant interaction of the sound with the seabed through reflections and scattering effects, and strong attenuation may occur as sound penetrates the seabed.

10.5.4.2 The concept of hearing thresholds in receptors

The concept of hearing thresholds is described in Section 10.4.4.3 of the offshore underwater noise chapter.

10.5.4.3 The nature of the impact and the hearing thresholds of each receptor group

The nature of the impact of underwater noise on different receptor groups, along with details on their hearing thresholds and injury, displacement and disturbance thresholds, is described in Section 10.4.4.4 of the offshore underwater noise chapter. The following add details that are relevant and specific to Berkeley Sound and the inshore noise impact assessment provided in Section 10.5.6 below.

As described in underwater noise offshore, research on the impact of noise on plankton is limited (Section 10.4.4.4.1). However, given the abundance of plankton, it is not expected that the vessel activities within Berkeley Sound will have a significant overall impact. As such, plankton are not considered further within this chapter.

As described in Section 10.4.4.4.2, there are very few data on the impact of noise on invertebrates although there is some evidence that cephalopods may be similar to fish in their ability to detect sound (Hu, *et al.,* 2009). As there are no thresholds for impacts to squid, a qualitative assessment is presented in this chapter. Berkeley Sound does support spawning loligo squid but the size of the local population and distribution of spawning sites are poorly known (Section 7.4.4.3.2.1). Impacts to other invertebrates (e.g., crustacea) are not considered further within this chapter.

With regard to seabirds, Berkeley Sound contains significant populations of breeding seabirds, including 4.9 % of the Falkland Islands Gentoo penguin breeding population, 1.8 % of the Islands' rockhopper penguin population and close to 100 % of the king penguin population (at Volunteer Point) (see Section 7.4.5.3.3).

With regard to whales, Berkeley Sound is known to be a feeding site for sei whales and other marine mammals (Section 7.4.6.3). Specific to Berkeley Sound, Weir (2022) reports a decrease in southern right whale calls in relation to an increase in vessel noise. Southern right whales use Berkeley Sound to breed requiring that their contact calls (upsweeps) and song (gunshots) can be heard.

10.5.4.4 Quantification of sound impacts - noise modelling

Noise modelling has been undertaken to simulate the vessel activity in Berkeley Sound associated with the Sea Lion Development. The modelling was carried out by Genesis Oil and Gas Consultants Ltd. using the Genesis in-house modelling software FARAM (Faunal Acoustics Risk Assessment Model).

To enable brevity, the following Sections provide only the information required to ensure appreciation and understanding of the modelling results and the impact assessments. Additional details on the modelling methodology, the positioning of the sound sources, and results are provided in the following report (Genesis, 2024b): Genesis, 2024. Sea Lion Project-Underwater Noise-Inshore-Report. Document Number: J-UK-00200-218436-Y-TN002/0. As with the offshore noise modelling in Section 10.4.4.5, the modelling process was carried out in three main steps:

1) Identification of the levels of sound likely to be made by the underwater noise sources inshore. Source levels for use in the modelling have been derived from representative third octave band rms Sound Pressure Level (SPL) frequency spectrums that have been obtained from published underwater sound measurements and mathematical models (Genesis, 2024b),
2) Use of a sound propagation model which assesses the way these sounds are likely to travel out from the sources and calculates the received sound levels at a given range. This utilises a

fully range-dependent propagation model that includes bathymetry and properties of the water column and seabed, and

3) Assessment of the received sound levels against the defined injury and disturbance thresholds (Section 10.4.4.4).

Based on the inshore activities associated with the Sea Lion Development, two scenarios have been identified and modelled to assess the typical sound levels likely to be generated during inshore activities. These are shown in Table 10.32. A third scenario to indicate the baseline background level of noise from other vessels in Berkeley Sound was also modelled to inform the assessment of cumulative impacts. This is described in Section 10.5.9 below.

Table 10.32: Modelled inshore scenarios

Scenarios	Description	Associated sound sources
Scenario 1: Arrival of OCVs	2 x LTVs at anchor and OCV entering the Sound	LTVs anchored and OCV travelling at eight[1] knots.
Scenario 2: LTVs at anchor, OCV loading	2 x LTVs at anchor and OCV attending LTV	LTVs anchored, OCV anchored on low power

[1] As a project-specific mitigation to reduce the likelihood of collisions with marine mammals inshore, vessels within Berkeley Sound will be travelling at reduced speeds of no more than eight knots (Section 10.11.7).

10.5.4.4.1 Step 1: Identification of source sound levels

The noise levels generated by vessels depend on many factors. The primary sources of sound from vessels are from propellers, propulsion and other machinery (Ross, 1976; Wales and Heitmeyer, 2002). Vessels are considered to be a continuous noise source. Larger vessels tend to produce lower frequency noise than smaller vessels (OSPAR, 2009b). However, the level of noise will vary depending on the vessel's speed and activity, with vessels using thrusters generally producing higher sound levels (OSPAR, 2009b).

Some vessel sound measurements were taken by Cerchio *et al.* (2022) reported in Weir (2022) inside Berkeley Sound recording a peak of 130 dB rms re: 1µPa in relation to either a reefer or a tanker although it is unknown at what distance the vessel was from the hydrophone at the time. As such, a model has been used to determine vessel source noise.

The JOMOPANS-ECHO model (MacGillivray and de Jong, 2021) has been used to estimate the source levels from the Development vessels used in Berkeley Sound. The model uses the vessel length, speed and vessel class to determine the source level of the vessel. This model has been shown to provide a better match to measured vessel source level data compared to previous mathematical models such as the RANDI model (Breeding, *et al.,* 1996). The broadband rms SPL and vessel frequency spectrums used to estimate source sound levels from vessel activity for each modelled scenario are presented in Figure 10-19 and Table 10.33.

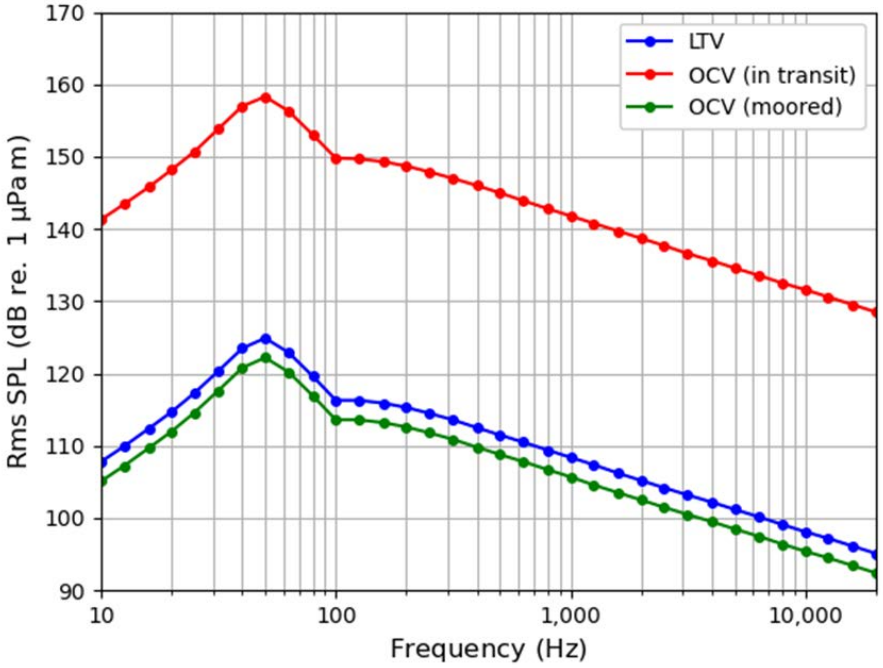


Figure 10-19: Generic vessel frequency spectrums used in noise modelling for Scenarios 1 and 2

Table 10.33: Summary of specific source levels used in the modelling[1]

Vessel Type	Representative Source Spectrum Used in Modelling	Reference	Broadband rms SPL (dB re 1 µPa at 1 m)
LTV	Bulker (speed = 2 knots, length = 475 ft)	JOMOPANS-ECHO model (MacGillivray and de Jong, 2021)	131
OCV (in transit)	Bulker (speed = 8 knots, length = 348 ft)	JOMOPANS-ECHO model (MacGillivray and de Jong, 2021)	165
OCV (moored)	Bulker (speed = 2 knots, length = 348 ft)	JOMOPANS-ECHO model (MacGillivray and de Jong, 2021)	129

[1] Please note the Broadband rms SPL values in Table 10.25 do not exactly correlate with the peak values shown in Figure 10-12 as those in Figure 10-12 are *generic* values for a range of vessels, whereas those in Table 10.25 are the specific vessel SPLs used in the model. The latter are, in fact, higher than the generic SPLs in Figure 10-12, to ensure a precautionary approach was taken in the modelling.

10.5.4.4.2 Step 2: Sound propagation modelling

The results of the sound propagation models used in this assessment determine:

- The rms Sound Pressure Level (SPL), which indicates the received level of sound at a given distance from the source. This information is used to determine the distance at which injury and displacement / disturbance thresholds are exceeded, and
- The cumulative Sound Exposure Level (SELcum), which is a standardised measure of the overall sound energy that an animal will be exposed to (i.e., related to the SPL and exposure time) over a specified length of time (a 24 hour period in this assessment).

As described in Southall *et al.* (2019), the SELcum was weighted according to the marine mammal hearing types (i.e., LF, HF, VHF and PW and OW hearing groups as described in Table 10.21 in Section

10.4.4.4.5.1). This accounts for the differences in the sensitivity of these groups to different frequencies.

10.5.4.4.3 Comparison of model results with injury thresholds

Where available, the internationally recognised thresholds for injury and disturbance to fish (Section 10.4.4.4.3) and marine mammals (Section 10.4.4.4.5) have been used. There are no thresholds for assessing the impact of continuous sound on seabirds or squid so qualitative assessments have been undertaken for these receptor groups.

10.5.4.4.3.1 Fish injury

To quantitatively assess any potential injury to fish, fish eggs and larvae from the inshore activities, received noise levels in terms of unweighted rms SPL have been predicted and compared to the Popper *et al.* (2014) thresholds for injury for shipping and continuous sounds. The maximum predicted distances where the thresholds are exceeded are summarised in Table 10.34. The table represents the inshore Development Scenarios 1 and 2.

The modelling predicts that the injury thresholds for fish with swim bladder involved in hearing will not be exceeded. For all other fish groups, the probability of mortality and potential mortal injury, recoverable injury and TTS is expected to be low at near, intermediate and far distances from the sound sources.

Table 10.34: Predicted maximum distances where rms SPL thresholds for injury to fish are exceeded for Scenario 1 and Scenario 2

Fish Group	Impairment	Threshold [1,2]	Maximum Distance to Threshold Exceedance[3] (m)
Fish with no swim bladder	Mortality and potential mortal injury	Low	N/A
	Recoverable injury	Low	N/A
	TTS	(N) Moderate (I) Low (F) Low	N/A
Fish with swim bladder not involved in hearing	Mortality and potential mortal injury	Low	N/A
	Recoverable injury	Low	N/A
	TTS	(N) Moderate (I) Low (F) Low	N/A
Fish with swim bladder involved in hearing	Mortality and potential mortal injury	Low	N/A
	Recoverable injury	170 dB rms SPL for 48 h	Threshold not exceeded
	TTS	158 dB rms SPL for 12 h	Threshold not exceeded
Eggs and larvae	Mortality and potential mortal injury	Low	N/A
	Recoverable injury	Low	N/A
	TTS	Low	N/A

[1] Quantitative thresholds are expressed in terms of rms SPL.

[2] Quantitative thresholds were not established for all fish types or impairment types. Where this is the case, the risk of injury or impairment has been qualitatively assessed (Popper *et al.,* 2014).

[3] Namely, the area surrounding the source within which the mammals may experience sounds which exceed the injury threshold.

10.5.4.4.3.2 Marine mammal injury

Received noise levels from the vessels in each modelling scenario have been predicted in terms of weighted cumulative SEL to identify the spatial area in which the onset of PTS or TTS may occur to marine mammals as a result of the inshore Development activities (Table 10.32 above).

The marine mammal weightings are those given by Southall *et al.* (2019). In essence, these account for the hearing thresholds described in Section 10.4.4.3 of the offshore underwater noise chapter and the audiograms in Figure 10-11. The weighting curves are generalised forms for the different receptor groups described in Table 10.21 of the offshore underwater noise chapter.

Two situations are considered:

1) Where the mammals remain stationary, and
2) Where the mammals are assumed to flee from the noise source.

Mammals assumed to be stationary

In both modelled scenarios, the cumulative SEL thresholds for PTS and TTS were not predicted to be exceeded over 24 hours for any marine mammal hearing group. This means that if a marine mammal was to remain stationary for 24 hours within the vicinity of the inshore activities, the PTS and TTS thresholds would not be exceeded, i.e., the risk of permanent or temporary impairment is very unlikely.

An example of the predicted cumulative SEL (due to Development vessel noise) is shown in Figure 10-20, which depicts the cumulative SEL received by LF cetaceans during Scenario 1 over 24 hours. The representation assumes that the LF cetaceans remain stationary.

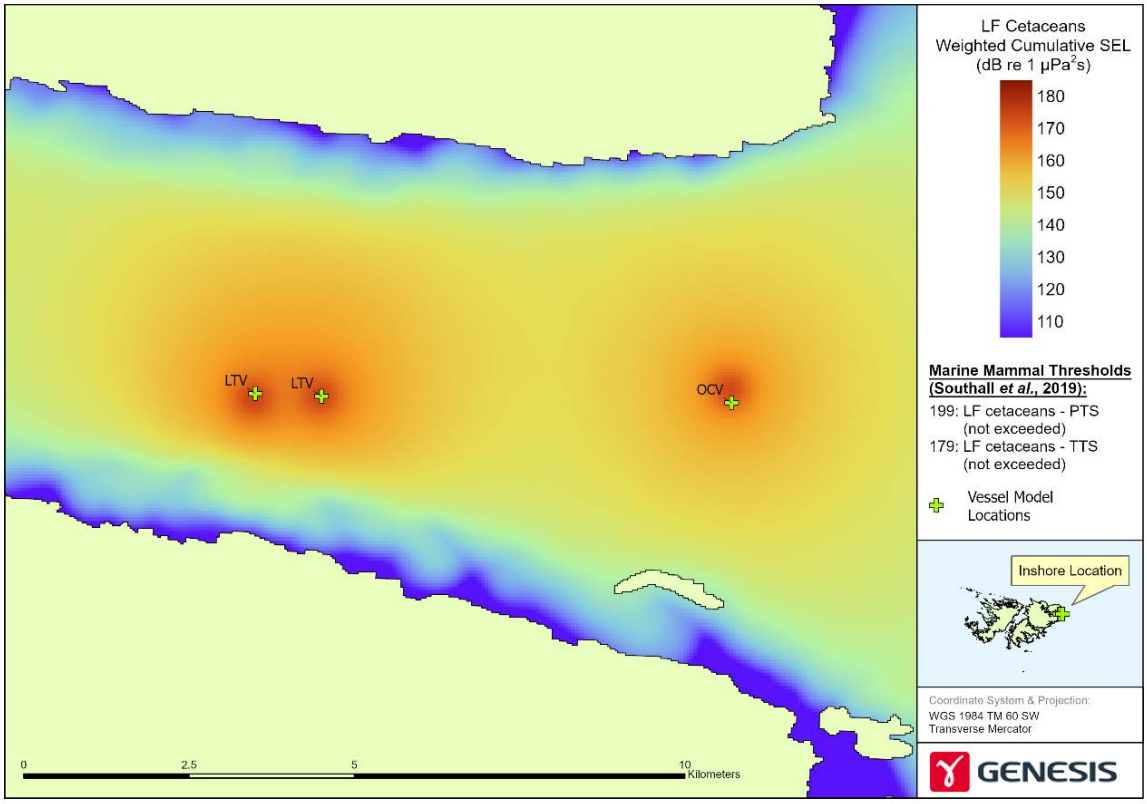


Figure 10-20: Predicted cumulative SEL received by stationary LF cetaceans during Scenario 1 over 24 hours

Marine mammals assumed to flee

The cumulative SELs received by marine mammals belonging to the different hearing groups when they swim away from the vessel location was also calculated. The vessel with the highest source level in each scenario was used for the calculation. Marine mammals have been simulated swimming away from the vessel location at different swim speeds and from different initial starting distances from the vessel location. As the marine mammals swim away, their swim depth is allowed to change such that upon receiving sound they are at the depth where sound levels are highest (note that the predicted received sound levels vary with depth). This is a conservative measure and will result in the highest predicted cumulative SEL received by the marine mammals as they swim away.

The predicted initial start distances from the sound source that marine mammals must be at to not be exposed to weighted cumulative SELs sound levels exceeding the PTS and TTS thresholds, are summarised in Table 10.35. The modelling predicts that the marine mammal PTS and TTS thresholds will not be exceeded for any marine mammal hearing group in Scenario 1 or 2, provided that they swim away at a speed of at least 1.5 m/s from the vessel location. As such, it is expected that the risk of PTS or TTS occurring to any marine mammals will be low.

Given that the sound sources associated with inshore operations do not exceed internationally recognised thresholds for injury, the remainder of the assessment focusses on the potential for vessel noise to induce avoidance behaviour or disturbance.

Table 10.35: Predicted initial starting distances from the vessel location where the adopted weighted cumulative SEL thresholds for non-impulsive noise are exceeded for marine mammals swimming away from the vessel location at 1.5 m/s

Scenario	Representative Vessel	Marine Mammal Group	Distance to Threshold Exceedance (m)	
			PTS	TTS
1	OCV (in transit)	All marine mammals	Threshold not exceeded	Threshold not exceeded
2	LTV	All marine mammals	Threshold not exceeded	Threshold not exceeded

10.5.4.4.4 Comparison of model results with disturbance and behavioural response thresholds

10.5.4.4.4.1 Fish disturbance from vessels

Documented behavioural effects of underwater noise on fish behaviour are variable, ranging from no discernible effect (Wardle, *et al.,* 2001) to startle reactions followed by immediate resumption of normal behaviour (Wardle, *et al.,* 2001; Hassel, *et al.,* 2004). Despite some documented behavioural effects there are no well-established criteria or thresholds for assessing behavioural disturbance to fish. In fact, it was concluded in Popper *et al.* (2014) that there lacked sufficient evidence to recommend specific thresholds that correspond to behavioural disturbance to fish.

Popper *et al.* (2014) suggest that all fish are at high risk of masking[57] when they are close to continuous low frequency sources of noise, and those that use the swim bladder to detect sound are also at high risk at long range (Table 10.36). Fish that use the swim bladder are also at high risk of behavioural change when near to the source of noise (Table 10.36).

Table 10.36: Assessment of disturbance to fish (Popper *et al.,* 2014)

Fish Group	Impairment	Assessment
Fish with no swim bladder	Masking	(N) High

[57] Masking occurs when anthropogenic sounds impair the ability of an animal to detect biologically significant sounds.

Fish Group	Impairment	Assessment
		(I) High (F) Moderate
	Behaviour	(N) Moderate (I) Moderate (F) Low
Fish with swim bladder not involved in hearing	Masking	(N) High (I) High (F) Moderate
	Behaviour	(N) High (I) High (F) Moderate
Fish with swim bladder involved in hearing	Masking	N) High (I) High (F) High
	Behaviour	(N) High (I) Moderate (F) Low
Eggs and larvae	Masking	(N) High (I) Moderate (F) Low
	Behaviour	N) Moderate (I) Moderate (F) Low

10.5.4.4.4.2 Seabirds disturbance from vessels

For seabirds, there are no guidelines to determine what constitutes a behavioural disturbance or threshold sound level. Section 10.4.4.4.4.1 of the offshore chapter notes that the current scientific understanding of seabird hearing underwater is limited and poor. However there is some evidence to suggest that penguins may vocalise underwater (Thiebault, *et al.,* 2019), and may show behavioural changes when exposed to noise levels of 120 dB re 1 µPa within 50m of the sound source.

As such, it is recognised that seabirds foraging below the sea surface could be disturbed. Should this occur, it is predicted that seabirds will remain on the sea surface and will avoid being underwater until a specific source has ceased, or the birds will temporarily relocate away. Section 10.4.4.4.4.1 also notes that a temporary displacement from the area is not predicted to cause a significant effect as seabirds are recognised to have moderate to high level of habitat flexibility and are not constrained to the immediate area.

10.5.4.4.4.3 Marine mammal disturbance from vessels

While the modelling has indicated that injury is very unlikely in marine mammals, there is the potential for long-term continuous vessel noise to cause behavioural disturbance. However, as described in Section 10.4.4.4.5.3, reactions to infrequent noise lasting <24 hours is unlikely to have any lasting effect (Southall, *et al.,* 2007). While it is understood that project vessels are likely to be at the inshore location for >24 hours, it is considered unlikely that vessels engaged in inshore operations would cause more than trivial disturbance that would be rapidly recoverable once the operation is complete (JNCC, 2010).

To predict distances at which potential behavioural disturbance to marine mammals may occur during the Development, received noise levels in terms of unweighted rms SPL have been estimated and compared to the adopted behavioural disturbance thresholds of 120 dB re µPa and 160 dB re µPa (Section 10.4.4.4.5.5).

The maximum unweighted rms SPL received from the vessels related to the Development are shown in Figure 10-21 and Figure 10-22; these show the cases for Scenarios 1 and 2 respectively. The contours highlighted in the figures represent the threshold for signifying behavioural disturbance to all marine mammals.

The avoidance / displacement behaviour threshold (160 dB re 1 µPa) is shown not to be exceeded. However, there are some small areas around the vessels in Scenarios 1 and 2 where the behavioural disturbance threshold (120 dB re 1 µPa) is exceeded. For both scenarios, the modelling predicts that disturbance to marine mammals may occur over a total area of 2 km^2 in Berkeley Sound.

The results are summarised in Table 10.37, which gives the predicted areas where noise levels are above the adopted behavioural disturbance threshold.

The disturbance areas shown should be treated as areas within which some (not all) marine mammals may exhibit behavioural responses. It is not suggested that all marine mammals will vacate these areas. Marine mammals will likely exhibit increased behavioural responses at distances closer to the vessel locations and there will be a reduced likelihood of response with increasing distance from the vessel locations (Southall, *et al.,* 2021).

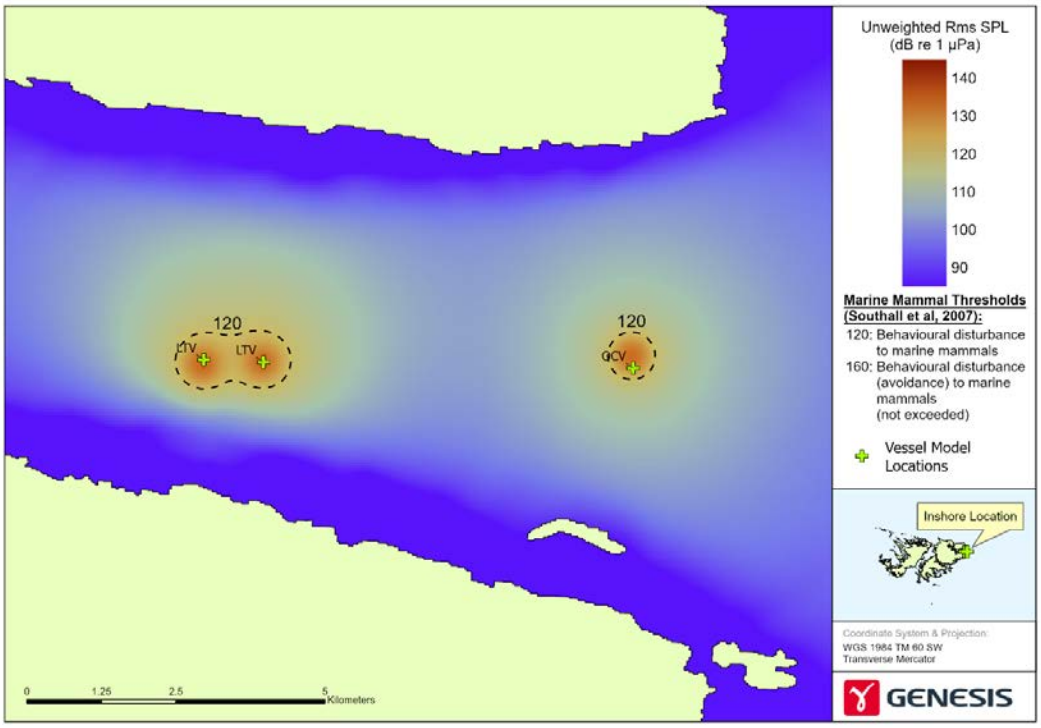


Figure 10-21: Predicted unweighted rms SPL received by marine mammals during Scenario 1

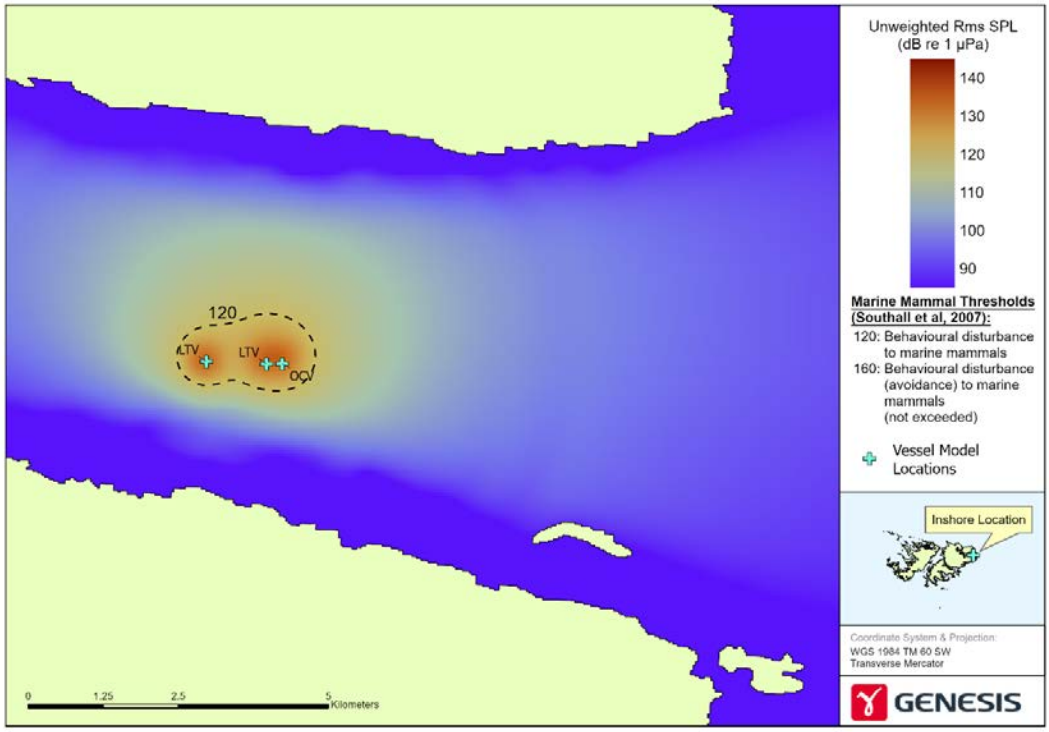


Figure 10-22: Predicted unweighted rms SPL received by marine mammals during Scenario 2

Table 10.37: Predicted area where the adopted unweighted rms SPL thresholds for disturbance to marine mammals are exceeded

Criteria	Behavioural Disturbance Threshold	Reference	Scenario	Area of Threshold Exceedance [1] (km^2)	% of available area in Berkeley Sound
Behavioural disturbance to all marine mammals	Rms SPL: 120 dB re 1 µPa	Southall *et al.*, 2007	1	2	1.1
			2	2	
Behavioural disturbance (avoidance) to all marine mammals	Rms SPL: 160 dB re 1 µPa	Southall *et al.*, 2007	1	Threshold not exceeded	0
			2		

[1] Namely, the area surrounding the source within which the mammals may experience sounds which exceed the injury threshold.

10.5.5 Industry-standard mitigation measures

As stated in Section 10.4.5, there are no industry-standard mitigation measures specifically designed to reduce the impact of vessel noise on fauna. However, standard operating procedures, such as maintenance schedules, will help to minimise the noise generated by propeller cavitation.

10.5.6 Impact assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of vessel noise on the varying receptors.

A summary of the impact assessment outcomes for this Development is tabulated in Section 10.5.12, which shows the worst-case impact for each activity.

Note: as described in Section 10.5.4.4.3, injury thresholds were not breached for fish or marine mammals such that these can effectively be scoped out from further consideration.

10.5.6.1 Fish displacement and disturbance

Fish occur in low numbers of geographical importance in Berkeley Sound and therefore the sensitivity of the receptor is considered to be '**Low**'.

It is recognised that masking effects may be high when fish are close to continuous low frequency sources of noise, and fish that use the swim bladder to detect sound are also at high risk at long range (Table 10.36). Fish that use the swim bladder are also at high risk of behavioural change when near to the source of noise (Section 10.5.4.4.4.1), any impacts during the manoeuvring of the OCV will be intermittent and very short-term. Therefore, it is expected that any impact will be fully reversible such that the level of disturbance would be barely detectable above background variability and the severity of the effect is considered to be '**Slight**'.

The overall significance of the impact of vessel noise on fish is considered to be '**Very Low (2)**'.

10.5.6.2 Invertebrate displacement and disturbance

Although there are no thresholds for the levels of sound likely to cause injury or disturbance to invertebrates, the literature suggests that impacts to feeding behaviour of invertebrates may be observed (albeit from impulsive noise) (Section 10.4.4.4.2).

Berkeley Sound does support spawning loligo squid but the size of the local population and distribution of spawning sites are poorly known (Section 10.5.4.3). However, there are unlikely to be any significant aggregations within the zone of influence of underwater noise generated by inshore operations. While the influence of vessel noise may be detectable within the immediate vicinity of the LTVs, this area is unlikely to contain significant abundances of any commercial squid species, and these would be transitory. The sensitivity of the receptor is considered to be '**Low**'.

Squid are subject to commercial fishing in the Falklands and any impact due to noise from the Sea Lion Development will be insignificant in comparison. Therefore the severity of the impact of vessel noise on squid is assessed as '**Slight**'.

Overall, the significance of the impact of disturbance caused by vessel noise to squid is therefore assessed as '**Very Low (2)**'.

10.5.6.3 Seabird displacement and disturbance

As described in Section 10.4.4.4.4.1, there are no quantified thresholds for assessing the impacts of displacement or disturbance to seabirds.

Berkeley Sound contains significant populations of breeding seabirds (Section 10.5.4.3). Of these, the rockhopper penguin is described as 'Vulnerable' by the IUCN and is on the Falkland Islands list of priority species. Consequently, the sensitivity of the receptor is considered to be '**High**'.

Noise modelling indicates that levels of sound during inshore operations will be similar to the noise levels currently occurring within Berkeley Sound (see Section 10.5.9 on cumulative impacts) and therefore, there will be little or no additional impact from underwater noise on seabirds present in the area. However, the period of inshore activity may extend throughout the summer months (August to March), which extends the period of 'normal' shipping activity in the Sound. While there are no published disturbance thresholds for birds, if loud enough, the levels of noise could cause birds to

temporarily relocate, reduce feeding activity underwater or remain above water for the time operating vessels pass by.

Nonetheless, impacts from underwater noise during the maneuvering of the project vessels will be localised, infrequent, very short-term and fully reversible such that the level of disturbance would be barely detectable above background variability. Therefore, the severity of the effect is considered to be '**Slight**'.

The overall significance of the impact of vessel noise on seabirds is considered to be '**Low (4)**'.

10.5.6.4 Marine mammal displacement and disturbance

Although a number of marine mammal species may occasionally occur within Berkeley Sound, the most regularly recorded are sei, southern right and Antarctic minke whales, Commerson's and Peale's dolphins, South American sea lions and fur seals. Southern right whales in particular are known to use Berkeley Sound to breed (Section 10.5.4.3). All marine mammals are conservation priority species in the Falkland Islands and therefore the sensitivity of the receptor is considered to be '**High**'.

The SPL threshold for displacement behaviour by marine mammals is 160 dB re 1 µPa (rms) and that for disturbance is 120 dB re 1 µPa(rms) (Section 10.4.4.4.5.5).

Noise modelling undertaken indicates that the displacement thresholds are not exceeded in Scenarios 1 or 2. However, the lower *disturbance* threshold is exceeded such that marine mammals of all hearing groups may exhibit altered behaviour within an area of 2 km^2 around the vessels (Section 10.5.4.4.4.3). Noise generated by the transiting vessels could lead to disturbance *via* reduced communication and reduced feeding, swim speeds and dive intervals. Berkeley Sound is known to be a feeding site for sei whales and other marine mammals (Section 10.5.4.3). Importantly however, noise from transiting vessels will be intermittent, of very short duration (Section 10.5.2) and the affected area accounts for only 1.1 % of the available area in Berkeley Sound (Section 10.5.4.4.4.3). Once the vessels have stopped, noise levels will reduce to background levels. In consequence, any additional disturbance impacts will quickly return to existing background levels.

It is therefore expected that the level of disturbance would be barely detectable above background variability and, therefore, the severity of the effect is considered to be '**Slight**'.

The overall significance of the impact of vessel noise on marine mammals is considered to be '**Low (4)**'.

10.5.7 Project-specific mitigation

The significance of the impact of underwater noise associated with inshore operations within Berkeley Sound is assessed as '**Low**' or '**Very Low**' for all receptors and therefore project-specific mitigation is not required.

10.5.8 Residual impacts

Not applicable.

10.5.9 Cumulative impact

All vessel use during the Phase 1 & 2 Development will contribute to the existing vessel activity and background noise in Berkeley Sound and, therefore, may lead to cumulative impacts *via* increased 'concentration', increased 'extent and proportion' and increased 'duration' (Section 8.9.1).

Scenarios 1 and 2 for the Development inshore vessels were modelled assuming that no other sources of underwater noise were present in Berkeley Sound which is rarely the case. The baseline number of vessels using Berkeley Sound varies considerably from one year to the next, which is linked to the amount of squid caught in any particular year. A total of 232 vessels were recorded in the Sound in 2022 (Section 7.7.3.2). Fishing vessels and reefers were the most frequent vessel with 201 recorded

over the 12 month period. A further 23 tankers and eight other assorted vessels were also recorded over the same period (FIMA, 2024).

There are also considerable month-to-month differences in the number of vessel visits, with the highest number of visits between March and June (Section 7.7.4.1.4). Further, there are seasonal and potentially inter-annual variations in the number of receptors present (such as sei and southern right whales) such that the cumulative impact will be highly variable.

To quantify the baseline noise levels associated with other vessels in Berkeley Sound, a third Scenario was modelled using the same method as was used for Scenarios 1 and 2 (Section 10.5.4.4). Scenario 3 assumed the presence of six fishing vessels, a tanker and a reefer.

The JOMOPANS-ECHO model (MacGillivray and de Jong, 2021) was used to estimate the source levels from the types of other vessels used in Berkeley Sound. The model uses the vessel length, speed and vessel class to determine the source level of the vessel. The broadband rms SPL and vessel frequency spectrums used to estimate source sound levels from vessel activity in Scenario 3 are presented in Table 10.38 and Figure 10-23.

The unweighted rms SPL values for Scenario 3 are shown in Figure 10-24. The contours highlighted in the figures represent the threshold for signifying behavioural disturbance to all marine mammals. As seen in Figure 10-24, the lower disturbance threshold (120 dB re 1 µPa(rms)) is exceeded over a larger area than that affected by the Sea Lion Development vessels alone and other vessel activity in the Berkeley Sound is likely to have a greater impact on the overall underwater noise environment than the activities associated with the Sea Lion project. Nonetheless, when the Development vessels are added there will be an increased 'concentration' and potentially an increased duration given the seasonality of other vessels. However, the LTVs and the attendant OCVs will only be in the Sound for a total of 13 (non-consecutive) months and the overall level of noise is not predicted to rise significantly above the current levels, which may already cause a degree of disturbance.

It is concluded that the short-term and temporary nature of the additional vessels is unlikely to significantly alter the baseline noise levels already experienced by the receptors.

Table 10.38: Summary of source levels used in the Scenario 3 modelling

Vessel Type	Representative Source Spectrum Used in Modelling	Reference	Broadband rms SPL (dB re 1 µPa at 1 m)
Fishing vessel	Fishing vessel (speed = 10 knots, length = 150 ft)	JOMOPANS-ECHO model (MacGillivray and de Jong, 2021)	176
Tanker	Bulker (speed = 16 knots, length = 500 ft)	JOMOPANS-ECHO model (MacGillivray and de Jong, 2021)	186
Reefer	Bulker (speed = 16 knots, length = 1200 ft)	JOMOPANS-ECHO model (MacGillivray and de Jong, 2021)	195

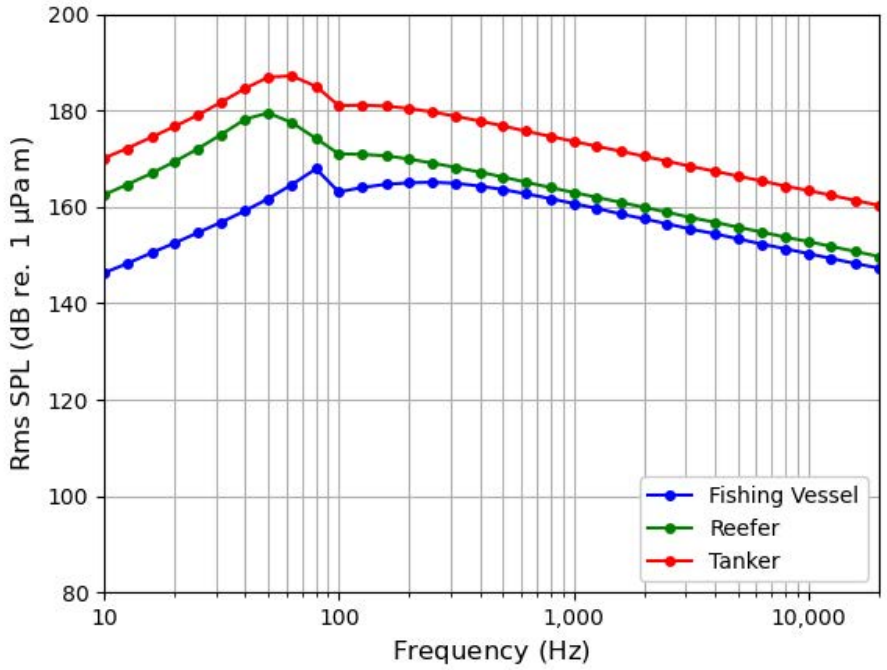


Figure 10-23: Vessel frequency spectrums used in noise modelling for Scenario 3

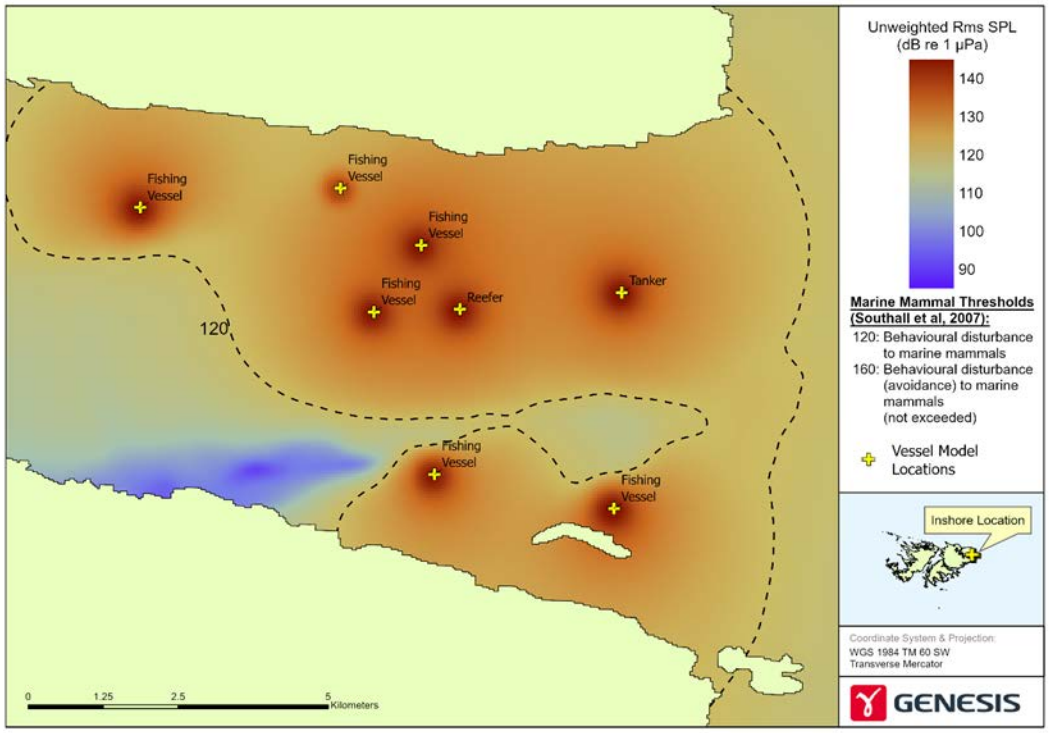


Figure 10-24: Predicted unweighted rms SPL received by marine mammals during Scenario 3

10.5.10 Confidence

Sound propagation in water is well understood and models used to determine this are utilised extensively but there has been, and to some extent remains, limited information on vessel noise. The vessels used in the modelling described above are considered representative of the proposed project vessels, and utilise the most recent published material, e.g., JOMOPANS-ECHO model (MacGillivray and de Jong, 2021). Section 10.4.10 of the offshore chapter describes in greater detail the nature of the fully range dependent noise model also used for the inshore modelling.

The location of the LTV mooring and OCV is variable since there are planned to be three locations (although only two LTVs at any one time), and these may be adjusted in discussion with FIG / Fisheries to agree locations that cause the least interference. Nevertheless, the predictions represent plausible noise scenarios and the results are interpreted in this context.

The status of the potential receptors in Berkeley Sound is relatively well understood, although the documented influx of southern right whales in the winter of 2017 (Section 7.4.6.3.1.1) highlights that unusual years do occur and long-term trends can change. The seasonal distributions of the regularly occurring marine mammals, birds and fish are broadly known, although, with the exception of the breeding seabirds, there is limited information on their population sizes. The inter-annual distribution and abundance of marine mammals are acknowledged as a data gap, as is the spatial / bathymetric distribution and habitat characterisation of loligo spawning sites.

Less is known on the sensitivity of the receptors to noise. Studies on physiological effects or behavioural responses to underwater noise are limited to a relatively few species of marine mammal and fish and very little is known on the ability of cephalopods or birds to detect sound underwater, or indeed to vocalise underwater (Thiebault, *et al.,* 2019) and, again, these issues are acknowledged data gaps.

Based on the predicted severity of effect from vessel noise, there is enough information to have a 'Probable' degree of confidence in the conclusions of this assessment. However, due to the gaps in understanding, in particular relating to the physiological and behavioural responses to noise by species likely to be present within the Sound, the confidence in the assessment is conservatively assessed as '**Uncertain**'.

10.5.10.1 Monitoring

Disturbance to marine mammals due to vessel noise is becoming an increasingly significant issue globally. It is known that Berkeley Sound supports a significant assemblage of marine mammals and therefore monitoring of the impacts of vessel activity on these animals will be undertaken as follows:

- Seabird and Marine Mammal Observers (SMMOs) will be placed on the OCVs and records of animal behaviour will be kept for subsequent analysis,
- A review of the inshore SMMO reports will be conducted after operations in Berkeley Sound have ceased in order to validate the EIA, and
- Investigation of the use of noise minimisation in the design of vessels, where possible.

Two projects studying the inshore cetaceans of the Falklands, with a focus on Berkeley Sound, have recently completed (Weir, 2020; 2021). The results from these studies have helped to better understand the Falkland Islands' cetacean populations and may focus future monitoring.

Detailed monitoring requirements have been established during the project-specific Phase 1 & 2 Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the EMMP. An outline EMMP is provided in Chapter 15.

10.5.11 Offsetting

As no residual impacts or risks identified in this section are considered significant, i.e., Moderate or above, offsetting is not considered necessary for this impact (see Section 8.11).

10.5.12 Findings summary

Table 10.39: Summary of the impacts from vessel noise during inshore operations

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Vessel operations within Berkeley Sound	Intermittent moderate intensity noise during inshore operations	Injury to Invertebrates, fish, seabirds and marine mammals[2]	Planned	1, 2a &2b	n/a	n/a	n/a	**n/a**	**n/a**	**n/a**	**Industry-standard:** None. **Project-specific:** None proposed
		Displacement and behavioural disturbance to fish		1, 2a & 2b	Low	Slight	n/a	**Very Low (2)**	**n/a**	**Uncertain**	
		Displacement and behavioural disturbance to invertebrates (including squid[3])		1, 2a & 2b	Low	Slight	n/a	**Very Low (2)**	**n/a**	**Uncertain**	
		Displacement and behavioural disturbance to seabirds		1, 2a & 2b	High	Slight	n/a	**Low (4)**	**n/a**	**Uncertain**	
		Displacement and behavioural disturbance to marine mammals		1, 2a & 2b	High	Slight	n/a	**Low (4)**	**n/a**	**Uncertain**	

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.
[2] Noise modelling results indicate that noise levels within Berkeley Sound that could cause injury (as opposed to disturbance) will not occur during any stage of Phase 1 & 2 Sea Lion development to any of the receptors.
[3] Squid and seabirds are qualitatively assessed as there are no thresholds against which to compare modelling outputs.

10.6 Discharge of drilling fluid and cuttings

Table of Contents

10.6.1 Introduction 742
10.6.1.1 Relevant legislation 742
10.6.1.1.1 The PON 10 and oil on cuttings compliance 742
10.6.1.1.2 Chemical compliance 743
10.6.2 Sources of drill cuttings and fluids discharges 743
10.6.2.1 Tophole discharges 744
10.6.2.2 Bottomhole discharges 745
10.6.2.3 Resuspension of cuttings 745
10.6.3 Potential receptors 746
10.6.4 Characterising and quantifying the impact of drilling discharges 746
10.6.4.1 Influencing factors 746
10.6.4.1.1 Ocean hydrodynamics 746
10.6.4.1.2 Background sediments 746
10.6.4.1.3 Drilling Fluid composition 746
10.6.4.1.3.1 Chemicals 746
10.6.4.1.3.2 Metals 747
10.6.4.2 Nature of the impact on receptors 748
10.6.4.2.1 Water quality 748
10.6.4.2.2 Seabed sediment 748
10.6.4.2.3 Phytoplankton and Zooplankton 748
10.6.4.2.4 Benthic fauna 749
10.6.4.2.4.1 Disturbance and smothering 749
10.6.4.2.4.2 Changes to sediment structure 749
10.6.4.2.4.3 Availability of oxygen 750
10.6.4.2.4.4 Physical impacts 750
10.6.4.2.5 Fish and squid 750
10.6.4.2.5.1 Displacement from feeding grounds 750
10.6.4.2.5.2 Disturbance to eggs, larvae and juveniles 750
10.6.4.2.5.3 Metal contamination and bioaccumulation in marine organisms 751
10.6.4.3 Quantification of the discharges - discharge modelling 752
10.6.4.3.1 The DREAM / ParTrack modelling approach 753
10.6.4.3.2 Discharge parameters and assumptions used in DREAM / ParTrack 753
10.6.4.3.3 Understanding the model 755
10.6.4.3.3.1 PEC:PNEC 755
10.6.4.3.3.2 Environmental Impact Factor 755
10.6.4.3.4 Modelling results 756
10.6.4.3.4.1 Seabed impacts 756
10.6.4.3.4.2 Water column impacts 762
10.6.5 Industry-standard mitigation measures 764
10.6.6 Impact Assessment 764
10.6.6.1 Water quality 765
10.6.6.2 Phytoplankton and zooplankton 765

10.6.6.3 Seabed sediments....765
10.6.6.4 Benthic fauna....766
10.6.6.5 Fish and shellfish....766
10.6.7 Project-specific mitigation measures....767
10.6.8 Residual impacts....767
10.6.8.1 Impacts to benthic fauna....767
10.6.9 Cumulative impact....767
10.6.10 Confidence....769
10.6.10.1 Monitoring required....770
10.6.11 Offsetting....771
10.6.12 Findings summary....771

10.6.1 Introduction

Drilling fluids will be used during all Phase 1 & 2 drilling operations and will consist of a liquid phase into which various chemicals and solids have been added to modify the operational properties of the drilling system (Section 5.4.6). The wells will be drilled in sections and will generate drill cuttings as a waste product. Both the used drilling fluid and the cuttings must be disposed of responsibly as with any other waste product. The use of chemicals during the Phase 1 & 2 Development was raised as a concern by stakeholders during scoping consultations (Chapter 6).

This chapter assesses the impacts associated with the discharge of solid and liquid drilling wastes. Modelling was carried out to enable greater understanding of the impacts.

Note: the impacts associated with other sources of disturbance to the seabed, liquid waste discharges and solid waste management are described elsewhere in this document, as described in Table 2.2.

10.6.1.1 Relevant legislation

Conventions and legislation relevant to drilling discharges to sea include:

- OSPAR Decisions:
  - OSPAR Decision 2000/2 on a Harmonised Mandatory Control System (HMCS) for the Use and Reduction of the Discharge of Offshore Chemicals.
  - OSPAR Decision 2000/3 on the Use of Organic-Phase Drilling Fluids (OPF) and the Discharge of OPF-Contaminated Cuttings (16 January 2001).
- UK legislation:
  - Offshore Chemical Regulations (OCR) 2002 (and all amendments).
  - Offshore Petroleum Activities (Oil Pollution Prevention and Control) (OPPC) Regulations 2005 (and all amendments).
  - Conservation (Natural Habitats, &c.) Regulations 1994 and Conservation of Habitats and Species Regulations 2017.
- Falkland Islands requirements:
  - Petroleum Operations Notice (PON) No.10 - Application to Use and Discharge Non-Aqueous Drilling Fluids (NADF) and Associated Cuttings.
  - Falkland Islands Maritime Ordinance 2017.

Under the above, there are numerous compliance requirements with regard to the receiving habitat, oil content on cuttings and chemical selection.

10.6.1.1.1 The PON 10 and oil on cuttings compliance

The discharge of cuttings contaminated with Non-Aqueous Drilling Fluid (NADF) must be managed in accordance with the FIG PON 10 to ensure best practice. The FIG PON 10 reflects the requirement of OSPAR Decision 2000/3 and prohibits the following:

- The discharge of whole Organic Phase Fluids (OPF) e.g., NADF,
- The discharge of whole OPF when drilling tophole sections, and
- The discharge of cuttings contaminated with OPF at a concentration >1 % by weight on dry cuttings.

Appendix I of OSPAR Decision 2000/3 also states that Best Available Techniques (BAT) and Best Environmental Practice (BEP) must be utilised to minimise oil concentration on discharged cuttings.

10.6.1.1.2 Chemical compliance

Navitas proposes to manage offshore chemicals in a similar way to the UK system where offshore chemicals have been controlled since 1979 *via* the Offshore Chemical Notification Scheme (OCNS). This has developed into an OSPAR-wide control scheme *via* the Harmonised Mandatory Control System (HMCS) which is an outcome of OSPAR Decision 2000/2, Recommendations 2010/3 and 2010/4, and which continues to be developed. This contains requirements for chemicals to be pre-screened by applying standardised laboratory tests in an application known as the Harmonised Offshore Chemical Notification Format (HOCNF). Those with acceptable properties are given rankings as to their potential risk in typical usage are added to the Centre for Environment, Fisheries and Aquaculture Science (Cefas) Definitive Ranked List of Registered Products (https://www.cefas.co.uk/data-and-publications/ocns/downloads-and-useful-links/). Only chemicals from this list may be used or discharged offshore for O&G purposes.

Chemicals with the best performance (lowest toxicity, lowest bioaccumulation and lowest persistence) are given a classification of 'Gold'. In the UK and Netherlands, the risks are assessed at a distance of 500 m from the discharge using a dispersion calculation known as the Chemical Hazard and Risk Model (CHARM). For those chemicals that cannot be assessed using CHARM, such as inorganic chemicals, a separate OCNS classification is given from 'A' to 'E', with 'E' being the best environmental performance. Chemical discharge must be subject to a risk assessment unless they are:

- Categorised as Posing Little Or No Risk (PLONOR) to the environment according to OSPAR Agreement 2013/6 (including, for example, inert minerals, nut fibres, methanol and mono-ethylene glycol),
- Are given a Hazard Quotient (HQ) of 'Gold' under the HCMS (unless the Cefas template dosage is exceeded which will require a site and use-specific risk assessment), or are
- Categorised as 'E' under the OCNS.

For any chemicals that have specific undesirable properties around biodegradation, toxicity and bioaccumulation, these are given a 'Substitution Warning' which means that their use must be justified, and replacements sought. The goal was a phase out of discharge of these chemicals by 1st January 2017, and this was largely achieved but there remain in use some chemicals whose function requires them to be biocidal or persistent for example, and their use and discharge must be justified in applications. Chemicals with traces of certain undesirable substances such as particular metals, including those on a list for priority action (OSPAR 2004-12, revised 2023) are given a 'Product Warning' code and their use must be specifically justified in applications.

All chemicals dosed into the drilling muds will be selected to minimise the potential environmental impacts as much as possible in line with the OSPAR Decision 2000/2.

During the Phase 1 & 2 Development, chemicals with the best environmental rating (e.g., PLONOR, Gold or OCNS 'E') will be selected where possible. Where technical feasibility issues dictate otherwise, full justification of the chemical use will be provided as instructed by FIG with the options to substitute for less harmful chemicals over the course of the drilling campaign kept under review.

10.6.2 Sources of drill cuttings and fluids discharges

For the Phase 1 & 2 Development a maximum of 26 wells will be drilled by the Mobile Offshore Drilling Unit (MODU) (only 23 of which will be completed for operation) and will be connected ('tied-back') to the Floating Production, Storage and Offloading (FPSO) unit. The 23 completed wells will comprise:

- 16 x oil production wells (hereafter referred to as OP or 'production' wells),
- 6 x Water Injection (WI) wells, and

- 1 x GI (Gas Injection) well.

As stated, there may be up to 26 actual drilling operations to result in the above. This is because:

- In the event the planned GI well location is unsuitable for gas injection, e.g., oil is encountered on the NW flank instead of gas, a second GI well will be drilled at a different location, and
- A contingency is allowed for re-drilling of two wells that may be required if a problem is encountered with any of the primary wells above.

Therefore, while only 23 wells will be completed, cuttings may be generated from up to 26 penetrations.

The Phase 1 & 2 Development wells will be drilled from six Drill Centres (DC) with a contingency for an alternative gas injection DC. The distribution of the wells over the DC's is as follows, noting that the two additional potential redrills allowed for could be at any location:

- Phase 1 (Stages 1 and 2a):
  - 7 x OP Wells,
  - 3 x WI Wells,
  - 1 x GI well, and
  - 1 x contingent GI well at the 'Casper' gas reservoir.
- Phase 2 (Stage 2b):
  - 9 x OP wells, and
  - 3 x WI wells.
- Either Phase 1 or Phase 2
  - Two contingent re-drills (the complete re-drilling of individual wells, or of sections of wells (collectively referred to as 're-drills'), may be required in response to technical problems (Section 5.4.4.5).

Details on the well profiles with regard to section diameters and lengths are provided in the Development Description (Section 5.4.5.2).

Note: to ensure that a conservative worst-case is assessed with regard to spatial extent, concentration and thickness of cuttings, the modelling described in Section 10.6.4.3.4 covers the maximum number of wells (26) being drilled.

Specifically, the discharges will include:

- Tophole sections: seabed discharges of seawater, bentonite mud and associated drill cuttings,
- Bottomhole sections: surface discharges of drill cuttings contaminated with NADF at a target average concentration of <0.5 % by weight on dry cuttings, and
- Resuspension of cuttings during clearing of equipment.

10.6.2.1 Tophole discharges

The two tophole sections of each well will be drilled with seawater and bentonite sweeps followed by a displacement mud. All tophole drilling fluid and cuttings will be discharged directly to the seabed as no marine riser will be in place to enable cuttings to be returned to surface.

10.6.2.2 Bottomhole discharges

The OP wells will each comprise two or three lower sections, whilst the WI wells and the GI wells will contain two. The lower sections of all the wells will all be drilled using NADF. The use of NADF for the lower hole sections of the OP and WI wells provides much improved control of hole stability and shale performance when drilling at highly deviated angles (Section 5.4.5.3.1). However, for the GI wells, the final decision with regard to the choice of drilling mud (i.e., Water-based Mud (WBM) or NADF) used for the lower well sections will depend upon the success of the batch drilling process and which type of drilling fluid the MODU is configured to at that time (Section 5.4.5.2 and 5.4.5.3).

The NADF cuttings will be returned to the rig and treated by shale-shakers to recover most of the drilling fluid for re-use. The remaining cuttings will then be treated by a Thermomechanical Cuttings Cleaner (TCC) to remove most of the base oil. The recovered base oil will be returned to the NADF system on the rig, leaving <0.5 % oil on cuttings by dry weight to ensure compliance with legislation (Section 10.6.1.1). The TCC unit also grinds the cuttings to a finer grain material in the process.

The treated NADF cuttings will then be discharged from a cuttings chute extending up to 20 m below the sea surface after re-mixing with the recovered water (from the TCC unit) which allows a slurry to be formed, which will flow and descend in the water column. The exact depth of discharge is dependent on the rig and equipment and may be shallower than 20 m, but cuttings modelling based on a 20 m depth is conservative as a shallower discharge will provide more opportunity for dispersion of the cuttings before reaching the seabed.

In the event that it is not possible to treat and discharge the NADF cuttings offshore, it would be necessary to transfer the cuttings to shore for storage and / or eventual treatment and disposal. However, facilities for the onshore treatment and disposal of NADF cuttings is not available in the Falkland Islands (Section 10.10). Therefore, it is necessary to ensure that a high availability of the offshore treatment process is maintained. Therefore, the following measures will be in place:

- The contractor management process will ensure that the selected TCC supplier can demonstrate a high level of uptime and reliability for the TCC e.g., established TCC unit operators claim, on average, a 99.5 % uptime based on historical performance. This demonstration will form part of the initial contractor management selection process and the subsequent audit process (Section 3.2.15 and Section 3.2.13),
- Planned preventative maintenance and condition monitoring programmes,
- Flexibility in scheduling for alternative work i.e., should there be any major issues with the TCC unit, Navitas will be able to suspend the well, recover the BOP and continue with alternative tophole work. This is consistent with Navitas' batching and BOP maintenance philosophy, aiming to have alternative tophole work available, and
- Spares will be carried to ensure maximum uptime of the equipment. As the supply chain to the Falkland Islands is challenging, Navitas will hold sufficient spares commensurate to the remote area of operations. For example, discussion with the TCC suppliers indicates that the 'sparing package' should include a complete spare mill and engine.

10.6.2.3 Resuspension of cuttings

The cuttings discharged directly at the seabed (the vast majority of which come from the tophole sections) may accumulate around the well and can reach up to two metres in height. Experience from operations on the UK Continental Shelf (UKCS) indicates that the settlement of cuttings can sometimes obscure subsea equipment and risk the integrity of the various components e.g., self-sealing control fluid lines. In order to ensure that these components are kept clear of cuttings, very localised planned mobilisation of cuttings is anticipated using ROV-mounted dredging equipment at any such locations.

Using the ROV water pump, the cuttings will be sucked or blown so that they are relocated a distance of a few metres from the O&G infrastructure. This operation is kept to the minimum necessary to allow good access to the subsea equipment. The impact of this activity on the initial water column and sediment is very similar to that which occurs when the cuttings first settle, and so is considered to be inherent in the impact assessment that follows.

10.6.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify those receptors upon which the impacts of drilling discharges warranted further investigation (Chapter 9). These include the impacts to:

- Water quality,
- Seabed sediments offshore (Section 7.3.7.1),
- Phytoplankton and zooplankton in the North Falkland Basin (NFB) (Section 7.4.1),
- Benthic organisms offshore (Section 7.4.3.2), and
- Fish and squid in the NFB (Section 7.4.4.2).

The above may be affected by the settlement of solids and suspended particles at the seabed which may bury animals, affect the sediment chemistry and grain size, water chemistry and water turbidity. These physical impacts may in turn affect plankton, benthic organisms and / or fish and squid species during vulnerable life stages.

10.6.4 Characterising and quantifying the impact of drilling discharges

When characterising and quantifying the impacts of drilling discharges, it is necessary to consider the following:

- Influencing factors:
  - Ocean hydrodynamics,
  - Background sediment, and
  - Drilling fluid composition.
- The nature of the impact on each of the different receptors, and
- Quantification of the drilling discharges using discharge modelling.

10.6.4.1 Influencing factors

10.6.4.1.1 Ocean hydrodynamics

The surface currents in the Sea Lion Field predominantly move in northerly and north-westerly directions, with the current speed generally being <15 cm/s. At the seabed, the currents tend to move in westerly directions with the current speed typically being <10 cm/s (see Section 7.3.5.2).

10.6.4.1.2 Background sediments

The sediment survey for the NFB Licence Areas, PL032, PL033 and PL004 (Gardline, 2012; Section 7.2.2) concluded that the mean sediment grain size at the Sea Lion area is 27 µm. The sediments were found to comprise, on average, 70.5 % of fines, 27.9 % of sand and 1.6 % of gravel across the survey area (Section 7.3.7.1.1).

10.6.4.1.3 Drilling Fluid composition

10.6.4.1.3.1 Chemicals

Both the bentonite mud and the NADF will contain the chemical additives required to ensure:

- The correct weight of the drilling fluid so that wells are sufficiently 'overbalanced' (weighted) to prevent 'kicks' of oil / gas from the reservoir into the wellbore (Section 5.4.9), and
- Optimal performance to prevent problems when drilling e.g., the drillbit becoming stuck.

In line with the OCNS, every effort will be made to ensure that chemicals with low environmental impact are selected for use (Section 10.6.1.1.2).

The bentonite sweeps used when drilling the tophole sections will contain:

- Barite (OCNS E, PLONOR),
- Bentonite (OCNS E, PLONOR),
- Caustic soda (OCNS E, PLONOR),
- Soda ash (OCNS E, PLONOR), and
- Lime (OCNS E, PLONOR).

Caustic soda, soda ash and lime were not included as a mud component in the discharge model (Section 10.6.4.3) due to their PLONOR status but are accounted for as a contributor to the total drilling fluid mass. Although barite and bentonite are also included on the PLONOR list as inert minerals and require no risk assessment under OSPAR rules, scientific studies have identified pseudo-toxic properties for zooplankton and filter feeders, primarily due to the particle size and sharpness of the minerals compared with natural suspended solids (Smit, *et al.,* 2006). As such, these two components are included in the modelled risk assessment.

Note: the bentonite displacement mud used in the topholes comprises the same components as the bentonite sweeps with the exception of lime.

The additives that will be required within the NADF are not yet known, but a typical NADF comprises:

- Barite (OCNS E),
- Non-aqueous fluid,
- Emulsifiers,
- Brines, and
- Gelling agents.

10.6.4.1.3.2 Metals

A comparison was made between the background metal concentrations in sediment in the Sea Lion area (Gardline, 2012) and the levels contained within an analogous Water-based Mud (WBM) (Table 10.40). As shown, the concentrations of cadmium, copper, iron, mercury, lead and zinc would all be higher in the drilling fluid than in the background sediment.

Table 10.40: Metal concentrations of MI-High[1] drilling fluid and Sea Lion sediment

Metal	Mi-High ($\mu g.g^{-1}$)[1]	Sea Lion Sediment ($\mu g.g^{-1}$)
Cadmium (Cd)	0.77	0.3
Chromium (Cr)	6.5	46
Copper (Cu)	88	22
Iron (Fe)	9,270	-
Mercury (Hg)	5.9	0.03
Lead (Pb)	243	7.5
Zinc (Zn)	167	71
Nickel (Ni)	-	18

[1] Mi-high is a type of barite used in WBM and is used as a conservative estimate of metal content within UK-market sourced drilling mud barite (Neff, 2005).

10.6.4.2 Nature of the impact on receptors

10.6.4.2.1 Water quality

The primary impacts of drilling discharges on water quality, at the seabed or from the surface, arise from the suspension of particulate matter in the water and the presence of chemicals within the discharge. Importantly, the impact on water quality is closely tied to the impacts on marine organisms.

Nonetheless, the Sea Lion Field is located in an area within the Falkland Islands continental shelf that is directly influenced by both Patagonian Shelf waters and superficial sub-Antarctic waters which spread over wide areas of the continental shelf and serve to rapidly disperse and dilute any discharges (Section 7.3.3). Further, all chemical components within the discharges will be selected to ensure minimal impact (Section 10.6.1.1.2).

10.6.4.2.2 Seabed sediment

The main recognised impacts from the discharge of drill cuttings and associated muds are on the sediment and to the epifauna and infauna.

Sediment quality at the Phase 1 & 2 drill sites will primarily be affected by the discharge of drill cuttings direct to the seabed from the two tophole sections of each well (Section 10.6.2.1) and the impacts on the sediment are closely tied to the impacts upon benthic fauna.

The cuttings deposition will result in a localised increase in average grain size from the existing average of 27 µm, and therefore has the potential to change sediment structure in the immediate vicinity of the wells. While these sections will also be circulated with bentonite sweeps, which contain barite, bentonite, caustic soda, soda ash and lime (Section 10.6.4.1.3), toxicologically, these components are virtually inert (Neff, 2005). Therefore, while the tophole drill cuttings may impact the sediment with regard to particle size modification, they are not expected to alter the sediment chemistry unless the water concentration in the sediment pores exceeds the published 'Predicted No Effect Concentration' (PNEC).

As the NADF cuttings will be ground by the TCC prior to discharge from the surface (Section 10.6.2.2), the particles of thermally treated cuttings are expected to be smaller than those discharged as part of the WBM cuttings. Therefore, smothering from NADF treated cuttings is expected to be less than for WBM cuttings (Aquateam COWI, 2014).

10.6.4.2.3 Phytoplankton and Zooplankton

Surface drilling discharge suspensions may lead to increased turbidity which can reduce light penetration in the upper water column. The waters of the NFB are highly productive during the austral spring (Section 7.4.1.2.1) and any significant reduction in light penetration could potentially affect primary production *via* a shorter, or shifted, phytoplankton bloom period, or even changes in species composition if impacts were over a wide enough area and / or for a significant period of time.

However, experiments assessing the impact of WBM concentrations on survivorship of the marine diatom (*Thalassiosira pseudonana*) following exposure to 50 mg/l for a period of 10 days did not show any significant changes in algae biomass or physiological condition (Cranford, *et al.,* 1998a).

Runciman (2001) carried out water-phase exposures in accordance with OSPAR methods (using the phytoplankton *Skeletonema costatum*) for assessing aqueous toxicity using WBM samples collected from seabed cuttings piles. The study concluded that it was very unlikely that significant effects on phytoplankton productivity would occur during a short-term exposure if this type of material were re-suspended in the water column.

With regard to zooplankton, high concentrations of suspended particulates may cause impacts owing to physical interaction with the gills, gastrointestinal tract and feeding behaviour which are expected

to be of greater concern than impacts from chemical toxicity (Smit, *et al.,* 2006). Nonetheless, in a review of impacts, Wills (1999) concluded that water column organisms would rarely be exposed to drilling fluids long enough and at sufficiently high concentrations to elicit any acute or sub-lethal responses.

In terms of impacts from NADF heat treated cuttings, a Norwegian study concluded that the environmental risk associated with these discharges is comparable to that from WBM discharges (Aquateam COWI, 2014).

10.6.4.2.4 Benthic fauna

Surveys carried out on the NFB (Section 7.2.2) indicated that the benthic communities in the area were typical of the sediment type and were fairly homogeneous throughout the surveyed area (Section 7.4.3.2). Further, there are no known habitats in the area equivalent to those of conservation significance in the UK (Section 7.4.3.2.2). Although some indicator taxa of important habitats are predicted to be present (≥50 % probability) (Section 7.4.3.2.3), these are likely to occur in low densities and not in aggregations as would typically contribute to the definition of important habitats.

Nonetheless, impacts to benthic fauna from drilling discharges may include:

- Disturbance and smothering caused by burial,
- Changes to species assemblages owing to modified sediment structure (particle size),
- Changes to availability of oxygen within the sediment, and / or
- Physical impacts caused by suspended particles.

10.6.4.2.4.1 Disturbance and smothering

The impacts of disturbance, smothering and burial of benthic organisms by cuttings are direct and immediate and will affect only those organisms directly beneath the deposition. Studies have indicated that there is a risk of impact to benthic fauna when burial layers exceed a thickness of 6.5 mm (Trannum, 2004; Kjeilen-Eilertsen, *et al.,* 2004; Neff, 2005; Smit, *et al.,* 2006).

10.6.4.2.4.2 Changes to sediment structure

Of greater impact to the benthos in the longer term is the potential for change in the sediment structure which could affect the suitability of the seabed for re-colonisation by species normally characteristic of the area. It is thought that such effects can persist for many years (Genesis, 2015a). It is suggested by Smit *et al.* (2006) that, in the absence of any other stressors, a 95 % increase in the existing median grain size (i.e., to >52 µm) would be sufficient to carry the risk of impacting upon 5 % of the most sensitive benthic organisms present.

Studies have shown that re-colonisation of cuttings pile sediments may commence 1-2 years after the cessation of cuttings discharges (UKOOA[58], 1999; Neff, 2005) and such predictions are supported by results from environmental surveys conducted in the Sea Lion area during 2012 (Section 7.2.2). Studies were carried out comparing data from baseline surveys where no drilling had previously taken place, with those from post-drilling surveys around areas of historical drilling activity carried out in 2009 (Section 7.2.2). These surveys indicated that there was no evidence of sustained disturbance as a result of historical drilling activities and that species diversity, community assemblage and abundance were typical of those found in background / undisturbed areas (Section 7.4.3.2). Additionally, environmental surveys carried out during the FOSA drilling campaign in 1998 included pre- and post-drilling surveys around the 'Little Blue A' well and indicated no change in the composition of dominant species, and

[58] Now known as Offshore Energies UK (OEUK).

similar levels of abundance and species diversity in both surveys (Section 7.3.7.1.1). Therefore, exploration drilling activities did not appear to appreciably disturb the benthic community in the area.

10.6.4.2.4.3 Availability of oxygen

While impacts on benthos are most commonly assumed to occur as a result of direct burial, Trannum *et al.* (2010) conducted experiments comparing the impacts of burial by WBM cuttings versus burial by natural sediments. The study found a significant reduction in number of taxa, abundance, biomass and diversity of macrofauna with increasing thickness of drill cuttings, which was not observed for the natural sediment particles and it was thought that the WBM influenced oxygen consumption and oxygen penetration depth in the sediment (Trannum, *et al.,* 2010).

It was concluded that drill cuttings initiated a typical eutrophication response and that impacts to benthos were not, therefore, limited to the physical disturbances caused by direct burial but could also result from changes to the sediment environment (Trannum, *et al.,* 2010). It is suggested by Smit *et al.* (2006) that oxygen depletion of >20 % would be sufficient to carry the risk of impacting upon benthic organisms.

10.6.4.2.4.4 Physical impacts

Benthic filter feeding organisms, such as bivalve molluscs, are known to be affected by suspended particulate matter due to clogging in the gills (Cranford, *et al.,* 1998b). Indeed, laboratory studies have shown that elevated concentrations of bentonite and barite can affect the growth of filter feeding organisms (Cranford and Gordon, 1992; Cranford, *et al.,* 1999; Barlow and Kingston, 2001). Nonetheless, particles such as barite settle out rapidly resulting in declining concentrations of barite in the water column, and even in the benthic boundary layer where most bivalves feed, it is considered probable that barite has limited effect (Neff, 2010).

10.6.4.2.5 Fish and squid

Impacts to fish and squid from drilling discharges may include:

- Displacement of adults from feeding grounds, and
- Disturbance to eggs, larvae and juvenile stages.

The potential for metal contamination is also discussed below.

10.6.4.2.5.1 Displacement from feeding grounds

As stated above, surface and seabed drilling discharges can result in high levels of suspended particulate matter within the water column prior to its settlement on the seabed. Studies suggest that concentrations of suspended particulate matter of approximately 200 mg/l may damage the gills of fish while higher concentrations may inhibit feeding activity (Smit, *et al.,* 2006). While adult fish are able to move away from turbid areas, such avoidance behaviour may serve to displace them from important feeding areas.

The proposed well locations are situated within the Falkland Islands Northern Slope (NS) habitat zone which has been identified as an important feeding area for a number of fish species, whose abundance varies with season (Section 7.4.4.2.2.1). As the drilling operations are scheduled to occur over a duration spanning more than one year, they may be ongoing at any time of year and could therefore coincide with recorded high abundances of numerous fish species, many of which are of commercial importance (Section 7.4.4.2.4). Although, it should be noted that the important fishery areas are in the shallower zones of the NS (250-350 m depths).

10.6.4.2.5.2 Disturbance to eggs, larvae and juveniles

Experiments carried out by Cranford *et al.* (1998a) assessing the impact of turbidity on survivorship of fish embryos and larvae showed a significant decrease in survivorship in late-stage haddock embryos (8-12 days old) and yolk sac larvae (3-7 days post-hatch) at the highest WBM concentrations tested

(100 mg/l). In contrast, early stage embryos (1-4 days old) and feeding larvae (13-17 days post-hatch) showed no significant response to any of the WBM concentrations (Cranford, *et al.,* 1998a).

Whilst a number of fish and squid species spawn within the Falkland Islands waters, no commercial species are known to have spawning grounds within the area of the Sea Lion Field and many migrate outside of Falkland Islands waters to spawn (Section 7.4.4.2.3). However, some non-commercial species e.g., species of fathead sculpins such as *Psychrolutes marmoratus* and small morid cods are likely to spawn in the area (Section 7.4.4.2.3). Equally, it is understood that a number of skate species breed in the area due to their distributions and based on the known occurrence of egg cases, hatchlings and reproductively active females (Arkhipkin, *et al.,* 2008; Pompert, 2011; Arkhipkin, *et al.,* 2012a; P Brickle, *pers. obs*.).

10.6.4.2.5.3 Metal contamination and bioaccumulation in marine organisms

A concern over potential metals contamination of demersal finfish, including the Patagonian toothfish, was raised during scoping consultations carried out under the previous operator (Chapter 6).

Metals in general have been shown to biomagnify[59] through food chains, including 'heavy metals', which is a loose term for certain metals and non-metals that have more harmful effects (OSPAR, 2000). However, heavy metals in barite, which is contained within WBM and NADF (Section 10.6.4.1.3), occur as virtually insoluble salts and their bioavailability is therefore very limited (Carroll, *et al.,* 2000). Indeed, numerous studies have concluded that the heavy metals present in drilling fluids, at the given concentrations, are not likely to be biologically available at all.

For example, a study undertaken by Neff *et al.* (1988a) exposed four species of benthic marine animals to marine sediments containing barite from WBMs. The results indicated that when exposed over a long period at high concentrations, the benthic organisms had a slight tendency to accumulate heavy metals in the gut and the gills in the form of unassimilated barite particles. However, the concentrations of barite used in the experimental sediments were much higher than would be found in the environment surrounding the drill cutting piles. It was therefore concluded that the likelihood of heavy metal uptake from WBM barites in the field was minimal.

Neff *et al.* (1988b) undertook another experiment, again to assess the biomagnification of heavy metals (barium and chromium) from barite. Flounder and lobster were provided with sandworms (*Neanthes virens*) that had been exposed to sediments containing the settle-able fraction of drilling fluids. The results indicated that neither barium nor chromium had been accumulated by the lobster or the flounder. Again, the barium and chromium that was present in the sandworm was found in the ingested sediments in the gut, rather than in the animal's tissues.

The level of heavy metals in heat treated NADF cuttings is expected to be the same as that in WBM cuttings so similar impacts, or lack thereof, are expected (Aquateam COWI, 2014). Indeed, Stagg and McIntosh (1996) investigated the bioaccumulation of metals from NADFs using variations in sediment contamination and found no differences in the liver or muscle of the demersal fish used (the Dab (*Limanda limanda*)) between treatments. In addition to this, the fish exposed to the drill cuttings directly did not exhibit increased concentrations of metals, again indicating that the metals were non-bioavailable.

Bowmer *et al.* (1996) also showed that there was no evidence of bioaccumulation of metals in the cardiid bivalve mollusc (*Cerastoderma edule*), the tellinid bivalve mollusc (*Macoma balthica*) or the arenicolid polychaete annelid (*Arenicola marina*). The concentrations of metals in the test organisms were not significantly different to those exposed to control sediments.

[59] Biomagnification is the increase in concentration of chemicals in each organism up the food chain. This is as opposed to bioaccumulation which is the buildup of absorbed chemicals in an organism over time.

In contrast to the above studies, Farestveit *et.al.*, (reported in Fjogstad, *et al.,* 2000) who also investigated the bioavailability of weighting materials such as barite, did find some evidence for bioaccumulation of metals. Toxicological studies were conducted using fish-feed with a 10 % addition of high lead (5,000 ppm) barite and while no acute metal poisoning occurred during the 10 week test, the barite-exposed fish did show enriched values of lead in both liver and blood. Importantly however, the study used an extremely high dose that could not be experienced in practice (i.e., twenty times the levels reported for 'high' metals barite in Table 10.40 above), and ten times that used in exploration campaign barite, which was <500 ppm. Similarly, Schaaning *et al.* (2002) also found bioaccumulation of metals in polychaetes and gastropods fed on barite-spiked sediments for 28 days, however, with the exception of lead, similar bioaccumulation levels were also observed in organisms fed on uncontaminated sediments so it was unclear as to whether adequate depuration time had been observed before analysing the gastropods.

With regard to the background in the Sea Lion area, there has been little work carried out on the baseline levels of heavy metals in fish inhabiting the Falkland Islands, let alone on the North Slope or areas adjacent to the Sea Lion Field. Therefore, little baseline information is available. However, Hanchet *et al.* (2012) analysed muscle tissue samples collected from Antarctic toothfish and Patagonian toothfish, and some of their prey species, from the Ross Sea off Antarctica to determine their mercury content. The levels were highly variable within, and between, the species studied but were positively correlated with fish length in four of the five species studied (toothfish and their prey). In particular, the mercury levels in Patagonian toothfish were more than four times greater than in Antarctic toothfish. Hanchet *et al.* (2012) suggested that the differences between the two toothfish species could be explained through differences in their distribution and differences in their positions in the food web. However, the low levels of mercury in Antarctic toothfish relative to its prey species, could only be explained by a lower rate of mercury assimilation within this species and / or a higher rate of mercury elimination.

It is clear that a baseline is required for toothfish and other species in this environment. Given the low concentrations of heavy metals in MI-High drilling mud, the finite period of drilling and low levels in Sea Lion sediment in conjunction with the relatively low abundances of toothfish in this area it is very unlikely that drilling will have an impact on the rate of bioaccumulation of heavy metals in the ichthyofauna of the area.

10.6.4.3 Quantification of the discharges - discharge modelling

To enable greater understanding of the impacts associated with drilling discharges, Navitas conducted the following modelling:

- 'DREAM' (Dose-related Risk and Effect Assessment Model) / 'ParTrack' (Particle Tracking)) model published by the Foundation for Scientific and Industrial Research (SINTEF) (v6.5.1, v8.0 and v14.1).

The OP and WI wells will be drilled over six DCs plus a second remote GI well if required (Section 10.6.2). The modelling below therefore covers the maximum number of wells being proposed across all the DCs (Section 5.4.4).

The aim of the model is to estimate:

- Impacts to the sediment which requires assessment of the:
  - Thickness of the mud and cuttings layer on the seabed, and
  - Overall environmental risk to the sediment based on:
    - Grain size change,
    - Toxicity, and

        - Pore water oxygen depletion.
- Water column impacts:
    - Environmental risk in the water column resulting from:
        - Toxicity, and
        - Particle suspension.
- Recovery of the water column and sediments over time.

10.6.4.3.1 The DREAM / ParTrack modelling approach

The DREAM / ParTrack model calculates particle dispersion in the water column and deposition on the seabed and also calculates the time required for concentrations of contaminants to return to previous levels once the discharges have ceased. In doing so, the model factors in processes such as:

- Mixing,
- Re-suspension and dilution due to currents,
- Sediment re-colonisation leading to bioturbation and biodegradation of the sediments, and
- Changes in chemical toxicity over time.

The DREAM / ParTrack model predictions have been validated through field measurements at the Trolla Field in water depths of 265 m in the Norwegian Sea. Here, a correlation was observed between the simulated and the measured deposition of the cuttings on the sea floor (Rye, 2010; Jødestøl and Furuholt, 2010). Indeed, the observed deposition thickness was lower than that predicted by the ParTrack model, which suggests that the modelling results can be considered conservative.

To enable brevity in this section, the following describes only the information required to ensure appreciation and understanding of the modelling results. Detail with regard to the modelling parameters utilised e.g., metocean data (currents, wind, temperature and salinity and bathymetry) is provided in Section 7.3.2.

10.6.4.3.2 Discharge parameters and assumptions used in DREAM / ParTrack

DREAM/Partrack version 14.1 was used in the modelling, being the current version at the time of EIS preparation. Details on the well profiles are provided in the Development Description (Section 5.4.5). For the purposes of this assessment, the total weight of drilling fluids used and associated cuttings are summarised in Table 10.41 and here include drilling fluids carried over from one well section to the next as part of the batch drilling process.

Within the model, the wells were placed according to the design layout (Figure 10-25). Further, in addition to the maximum well count being modelled, it was assumed that the wells drilled at each DC location would be drilled consecutively. The exact spud locations (i.e., the place where the first tophole section is drilled) may vary slightly as design and operations progress, and if a tophole section is unsuccessful it may need to be re-drilled in an adjacent location (Section 10.6.2), but overall the wells are expected to be drilled within the same overall area. It is possible that if the progress of a well is not satisfactory, the whole well will be re-drilled. This is difficult to predict but two re-drills have been allowed for (within the NA-P-01 DC cluster). Note that these re-drills, and associated additional cuttings, are included in the model and are within the maximum well count of 26 (Table 10.41).

The oil content in the model is represented by an aliphatic component with a toxicity of 70 mg/l in pore water, as adopted in OSPAR Agreement 2015/05. In the model, the component has been modified to give it a low vapour pressure, as would be expected after going through a thermal treatment process.

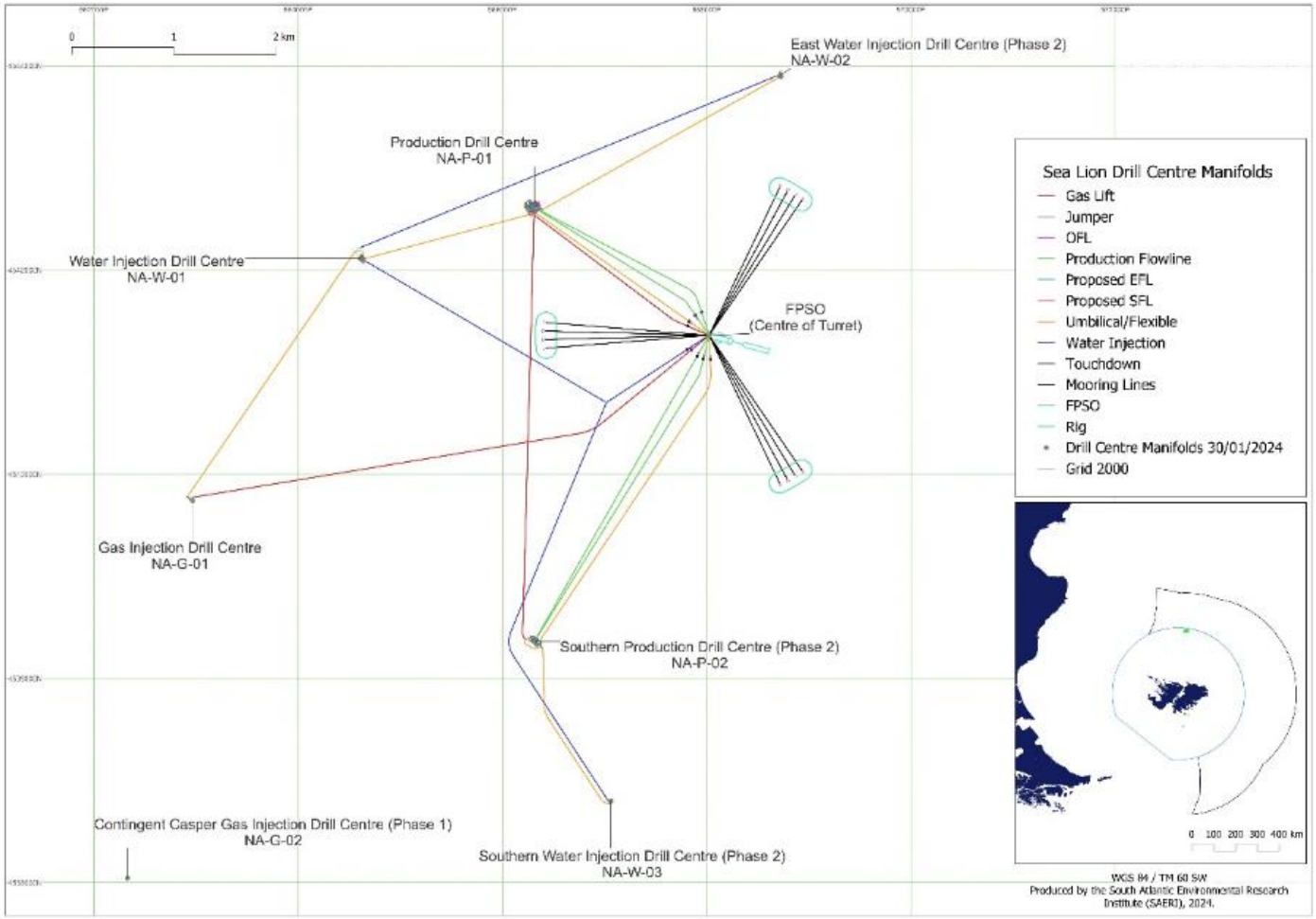


Figure 10-25: Modelled production, water injection and gas injection drill centres

Table 10.41: Summary of drilling fluid and cuttings totals[1]

Well type	Max. no. of wells	WBM on cuttings (t)	WBM discharged (t)	NADF cuttings (t)	Base oil on cuttings (t)
Production	16	12,276	14,884	13,809	78
Production redrills[2]	2	1,260	1,414	2,712	8
Water injection	6	3,744	4,788	3,924	18
Gas production / injection	2	1,476	1,860	460	2
Total	**26**	**18,756**	**22,946**	**20,905**	**106**

[1] These figures are as provided by Navitas and include drilling fluids carried over from one well section to the next.
[2] Two potential redrills have been included as production wells for the purposes of modelling, although any of the wells could be redrilled.

10.6.4.3.3 Understanding the model - PEC:PNEC ratio and Environmental Impact Factor (EIF)

10.6.4.3.3.1 PEC:PNEC

The DREAM model was originally designed to assess the impacts of produced water discharge. While the model can be adapted to assess drilling discharges, the factors considered for water column and sediment impacts differ slightly and are based on comparisons of the PEC:PNECs as follows:

- Sediment (PEC:PNEC$_1$):
  - PEC$_1$ (Predicted Environmental Change) i.e., the level of change to the sediment with regard to the following stressors:
    - Concentration of a chemical in pore water to which marine organisms could be exposed during and after the discharge,
    - Thickness of the deposition,
    - Degree of change to grain size, and
    - Oxygen content depletion.
  - PNEC$_1$ (Predicted No Effect Change) i.e., the highest level of changes caused by the above stressors at which no harmful effects are expected to occur to marine organisms, as determined from scientific literature.
- Water column (PEC:PNEC$_2$):
  - PEC$_2$ (Predicted Environmental Concentration) i.e., the concentration of a chemical, oil or suspended matter to which marine organisms in the water column would be exposed during and after the discharge as predicted by the model, and
  - PNEC$_2$ (Predicted No Effect Concentration) i.e., the highest theoretical concentration of the same components at which no harmful effects are expected to occur to marine organisms in the water column.

Despite the differing definitions however, the interpretation of the PEC:PNEC ratio is the same for both the sediments (PEC:PNEC$_1$) and water column (PEC:PNEC$_2$), and both are referred to as 'PEC:PNEC' hereafter. While the PEC is predicted by the model, the PNEC is defined as the change / concentration at which the Potentially Affected Fraction (PAF) of a species is 5 %.

A PAF of 5 % corresponds to a PEC:PNEC ratio of 1 and is a generally accepted risk level representing the concentration below which marine organisms are unlikely to be affected (EC, 2003). Where the PEC:PNEC ratio is >1, adverse effects from the discharges are anticipated and this is referred to as having a 'risk >5 %'.

10.6.4.3.3.2 Environmental Impact Factor

The model expresses the impacts to the water column and sediment in terms of the Environmental Impact Factor (EIF):

- For water column modelling, an EIF of 1 is defined as a cuboid volume of water equal to 100 m x 100 m x 10 m (0.0001 km^3), in which the calculated PEC exceeds the PNEC i.e., there is a risk to >5 % of the most sensitive species present in 0.0001 km^3,
- For sediment modelling, an EIF of 1 is defined as a square equal to 100 m x 100 m (0.01 km^2), in which the calculated PEC exceeds the PNEC i.e., there is a risk to >5 % of the most sensitive species present over 0.01 km^2,
- The results of the model are therefore expressed as:
  - The volume (km^3) in which there is a risk to >5 % of the most sensitive species present in the water column e.g., an EIF of 12 means that there is a risk to >5 % of the most sensitive species in 12 km^3 of water, and
  - The area (km^2) in which there is a risk to more than 5 % of the most sensitive species present on the seabed an EIF of 12 means that there is a risk to more than 5 % of the most sensitive species in 12 km^2 of seabed.

10.6.4.3.4 Modelling results

10.6.4.3.4.1 Seabed impacts

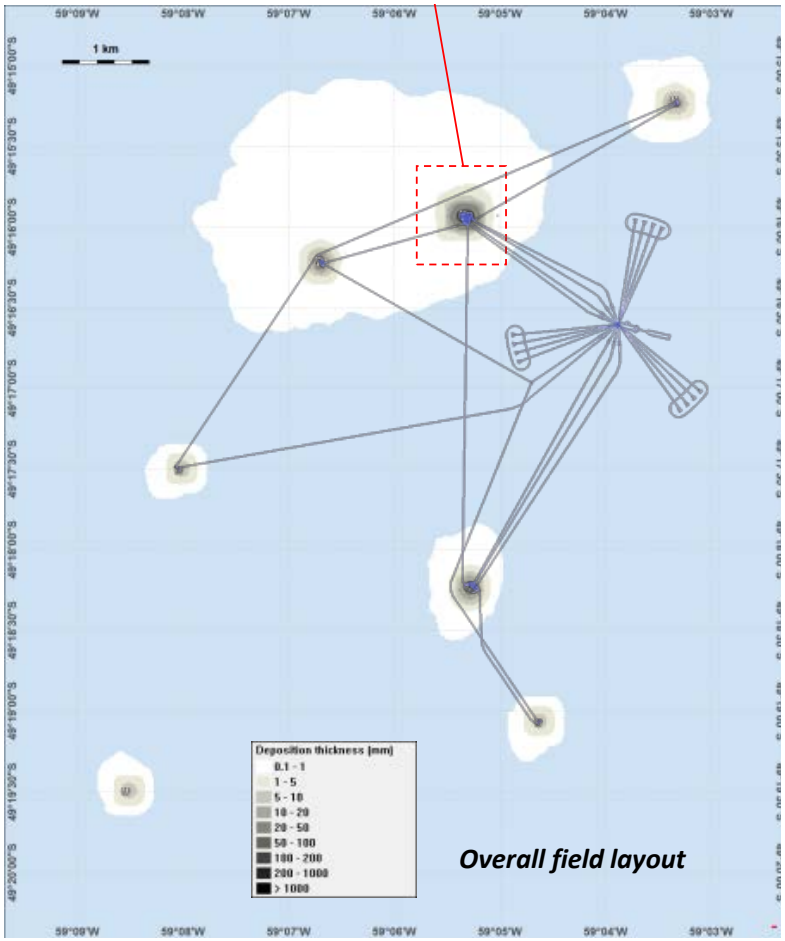
The model estimates the thickness of the deposited layer of matter, the grain sizes of the deposition, the toxicity of oil / chemical components in the deposited material and the depletion of oxygen by any biodegradation of organic matter (in this case both toxicity and oxygen depletion are caused by the oil content of the TCC cleaned cuttings). All four parameters are used to inform the assessment of the total risk to the sediment (i.e., the EIF). To best reflect this relationship, the modelling results are shown in Table 10.42 to show the contribution of deposition thickness and changes in grain size to the overall risk.

Table 10.42: Modelling results for the environmental risk to the sediments around the drill centres

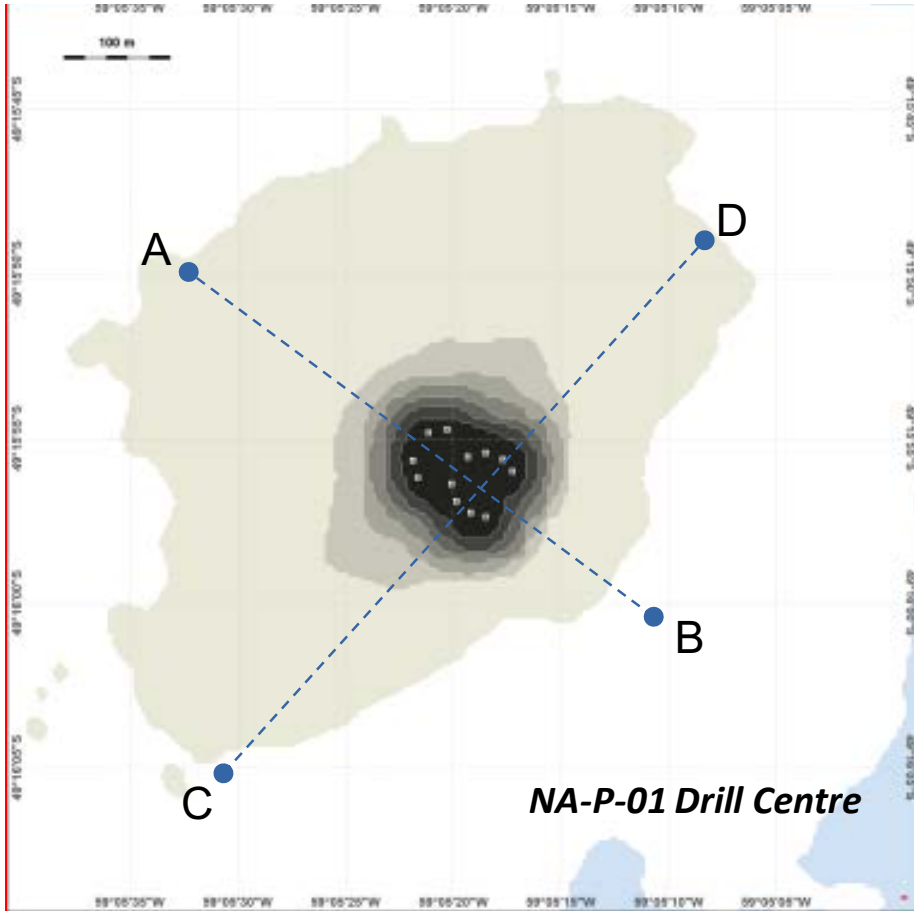
Deposition thickness	Sediment grain size, toxicity and oxygen depletion
Figure 10-26 shows the predicted worst-case deposition thickness at the end of drilling all 26 wells. Burial thickness accounts for 56 % of the predicted risk. There is no significant overlap in deposition between the main drilling locations. In the absence of any other stressors, it was estimated by Smit *et al.* (2006) that a burial thickness exceeding 6.5 mm could result in 5 % of the most sensitive species being impacted (Section 10.6.4.2.4.1). Deposition thicknesses were predicted to exceed 6.5 mm up to around 120 m from the centre of the NA-P-01 DC, with smaller deposition areas at the NA-P-02 and the eastern drill centres, extending to only 50 m from the GI wells. As anticipated, the thickest areas of deposition are immediately around each drilling location (out to approximately 60 metres from each well) with a maximum deposition thickness of around 1,000 mm at the NA-P-01 DC (Figure 10-27) although there may be local fluctuations around these figures. This thickness is mainly due to the larger cuttings particles from the tophole sections which are discharged directly onto the seabed. The total depositional thickness at the end of drilling the wells was found to exceed 6.5 mm over an area of up to 0.42 km^2. Beyond this area, the thickness decreases rapidly with distance from the wells to <1 mm at approximately 400 m from the NA-P-01 DC, 290 m from the NA-P-02, NA-W-02 and NA-W-03 DC and 150 m from the GI well DCs (Figure 10-27). A wider area is covered by a thinner deposition layer resulting from the finer barite, bentonite and cuttings particles that are discharged at the sea surface following treatment of the NADF cuttings. Since these barite and bentonite particles are discharged 20 m below the sea surface rather than at the seabed, they can be carried long distances by ocean currents (several kilometres) before settling.	The predicted influence of drill cuttings on grain size, toxicity and oxygen depletion at the NA-P-01 DC (which has the highest number of wells drilled) are shown in Figure 10-28. The risk contribution of 20 % from grain size change is due to smaller particles depositing far from the well, and larger particles (> 52 µm, Section 10.6.4.2.4.2) depositing in the areas immediately around the wells. Outside the immediate vicinity of the wells, oxygen depletion and burial thickness are the main contributors to environmental risk in the seabed, representing 23 % and 56 % of risk respectively. Oil toxicity is relatively small and diminishes over time as the oil biodegrades, although this transfers to oxygen depletion in the process, which 'grows in'. This is caused by the breakdown of the oil component which consumes oxygen, and the oxygen levels are restored very slowly from oxygen dissolved in seawater. This, too, will diminish over time and will eventually disappear. Overall, the aggregate oxygen depletion starts to reverse and shows a net recovery beginning about 2 months after the end of drilling.
Total environmental risk to the sediment (based on the EIF)	
Figure 10-29a shows the environmental risk to the seabed around the NA-P-01 DC at the end of drilling. The total environmental risk incorporates the estimates of burial thickness, grain size change, toxicity and pore-water oxygen depletion. The area of seabed around the NA-P-01 DC wells in which there is >5 % risk to sensitive species present is 2.51 km^2 at the end of drilling, and is predicted to extend to around 1 km at the furthest point immediately after drilling has ceased. Figure 10-29b shows the recovery of the seabed five years after drilling has ceased, after which time substantive recovery of the pile is normally observed, and the maximum extent of the area of 5 % risk has reduced significantly. Twenty years after drilling, there is substantial recovery, with the 5 % risk area reducing to 0.53 km^2 and extending to around 80 m Figure 10-29d. At that point, the seabed is expected to have returned to a productive state, albeit modified compared to its original condition.	

Given that the DCs are sufficiently far from each other, there are not expected to be any cumulative impacts from the drilling at these locations.
Contributions to the environmental risk to sediment
The sediment risk caused by drilling is predicted to be primarily due to burial thickness (Figure 10-28) resulting from the deposition of cuttings and mud solids. Oxygen depletion, grain size and chemical toxicity change follow in order of the stress they cause to the seabed. Recovery is expected rapidly at first and a permanently modified area of around 80 m from the wells and within the 500 m zone of the DCs and GI wells is ultimately expected at the end of Field Life[1].

[1] Note the modelling uses very conservative assumptions. The deposition thickness modelling covers the maximum number of wells drilled (26, with only 23 completed). The sediment risk (grain size, toxicity and oxygen depletion) and total environmental risk scenarios were modelled for the NA-P-01 DC wells as this location has the highest number of wells and is therefore a worst-case proxy.

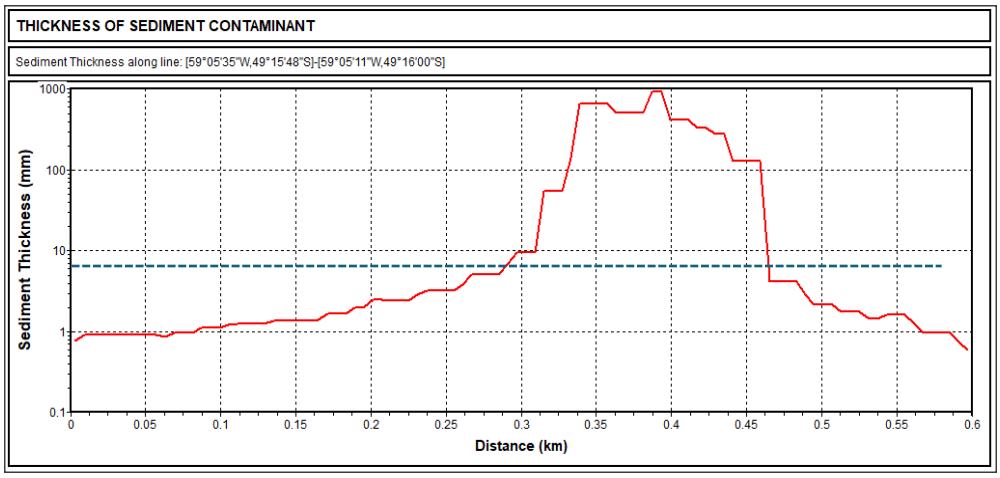


a) Overall field layout, indicating location of the NA-P-01 Drill Centre in the red box

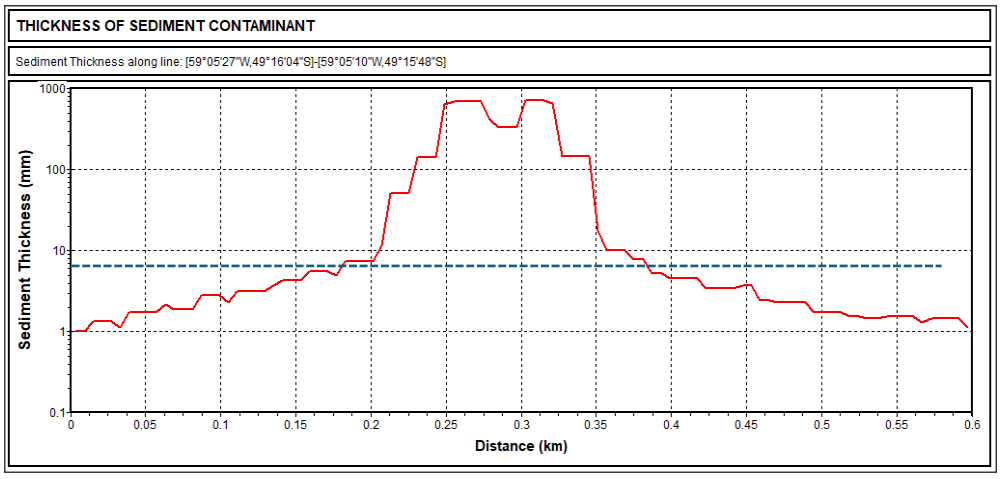


b) NA-P-01 Drill centre

Figure 10-26: Modelled drill cuttings deposition at well locations at end of drilling. Note: the colour legend applies to both figures



a) NA-P-01 DC at the end of drilling - cross section A-B (See Figure 10-26 above).



b) NA-P-01 DC at the end of drilling - cross section C-D (See Figure 10-26 above).

Figure 10-27: NA-P-01 drill centre modelled drill cuttings deposition thickness profiles. Location of cross sections through A-B (top plot) and C-D (bottom plot) are shown in Figure 10-26 above. Note y-axis is a log scale. The blue dashed horizontal line indicates 6.5 mm thickness

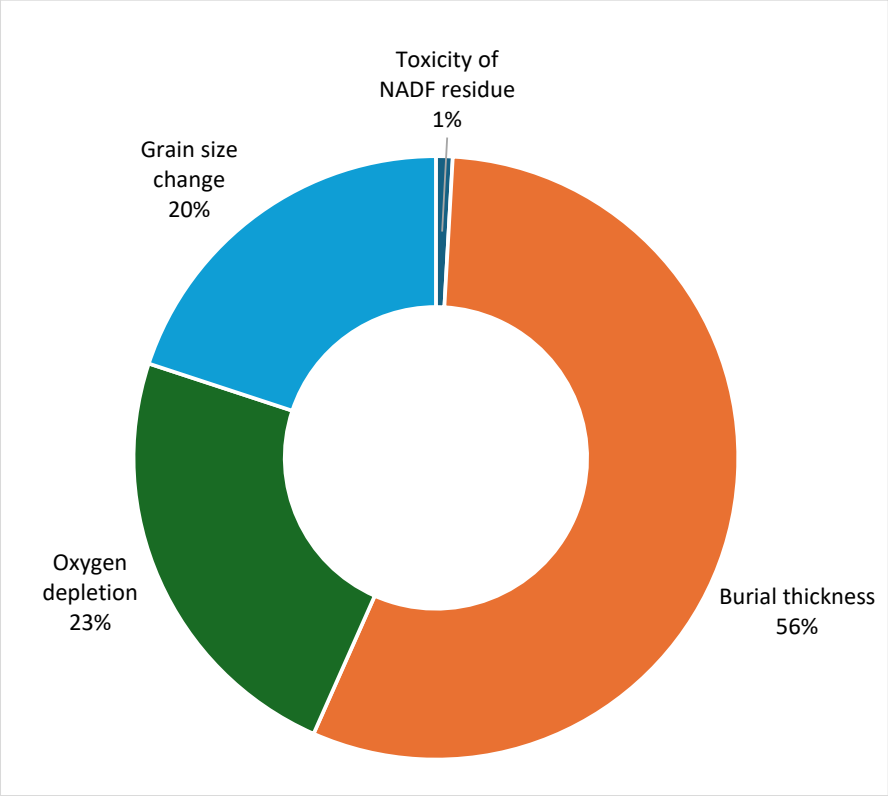
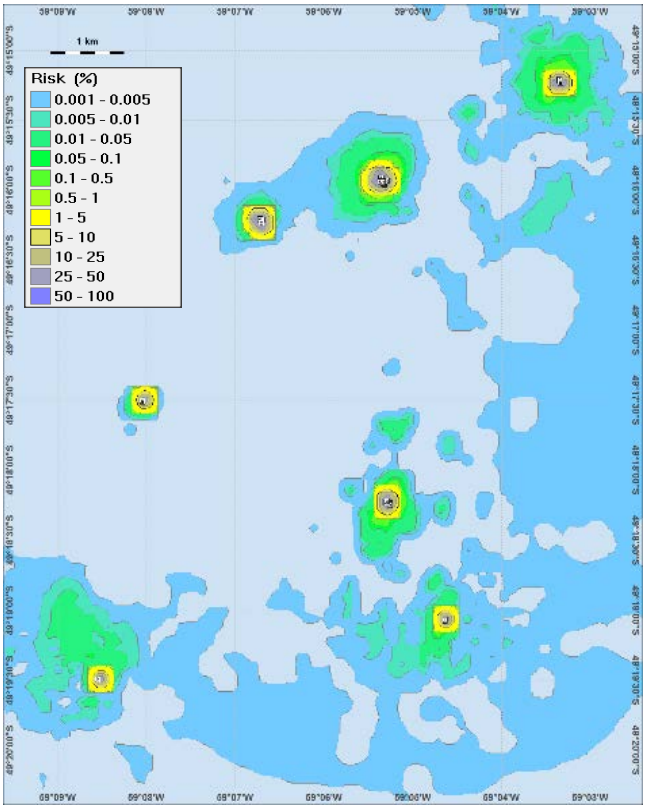
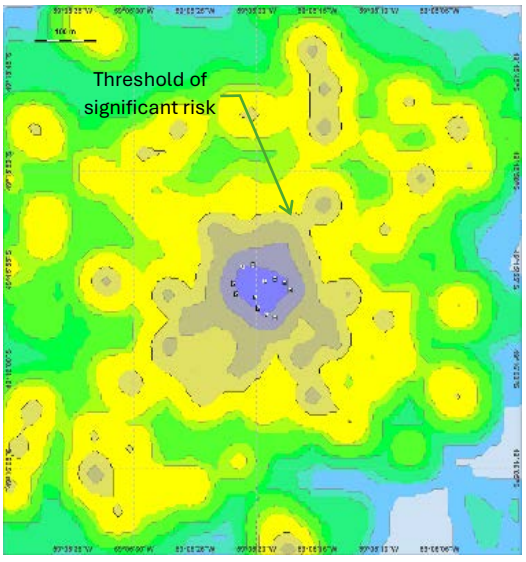


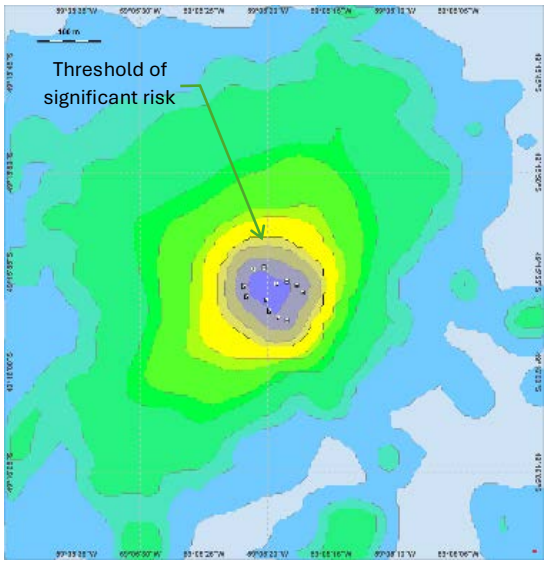
Figure 10-28: Contribution to risk to the 2.5 km^2 of affected at the end of drilling



a) Whole project area - end of drilling campaigns



b) NA-P-01 DC - end of drilling campaigns



c) NA-P-01 DC - after 20 years recovery

Figure 10-29: Total environmental risk to the sediment at the NA-P-01 DC at end of drilling and 20 years after drilling

10.6.4.3.4.2 Water column impacts

The modelling predicted that the plume of suspended particles and fluids generated during the drilling of each well section would disperse before drilling of the next section is commenced. These results therefore focus on two worst-case example plumes:

- One generated during the largest tophole discharge of bentonite sweeps and drilling fluid (WBM) at the seabed during the drilling of a representative 32'' well section, and
- One generated during discharge of the largest batch of treated NADF cuttings from the MODU, 20 m below the sea surface, following drilling of a representative 12 ¼'' well section.

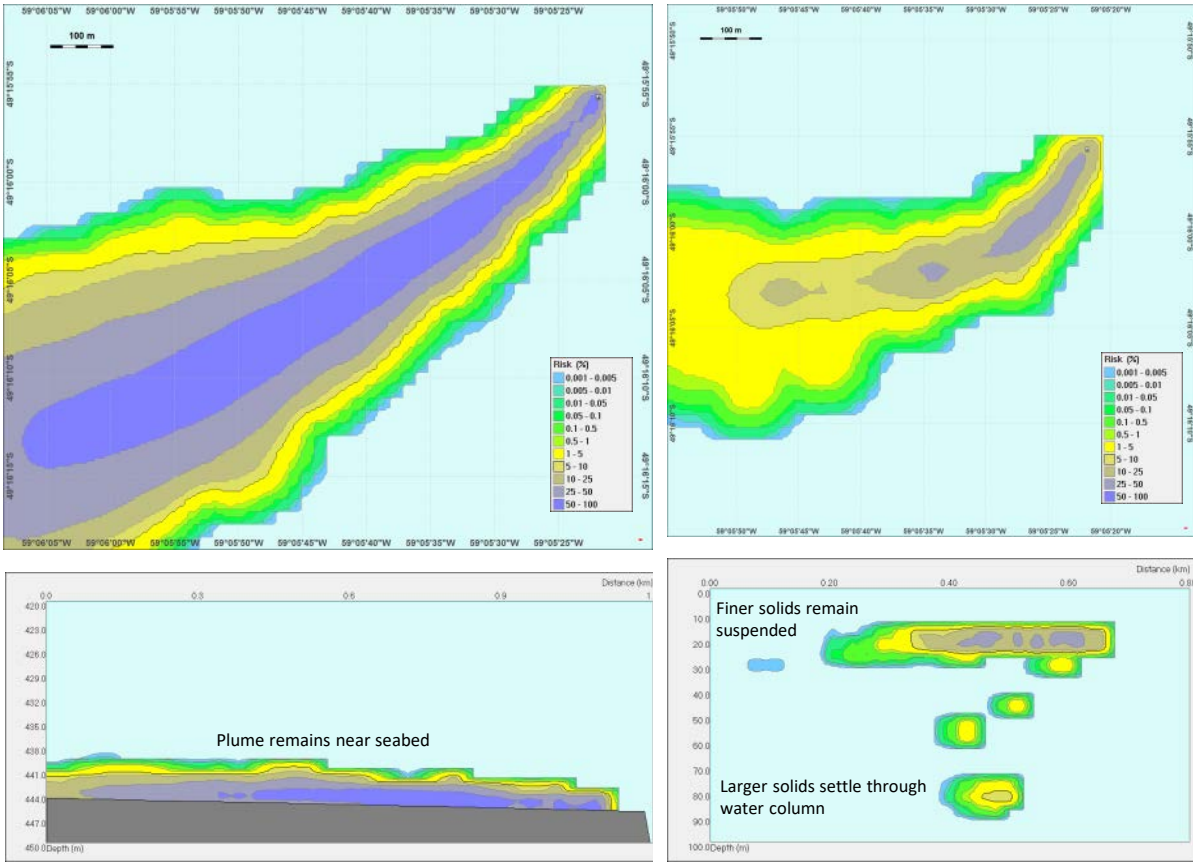
The predicted instantaneous risk to the water column from these two plumes is shown in Figure 10-30.

During drilling of the tophole section, the risk was >5 % up to 4 km from the discharge point (at the seabed) and fell to <5 % at 4 km, 2.5 days after drilling had ceased. The plume was confined to the bottom 50 m of the water column (Figure 10-30a). The total volume of water impacted at >5 % during the entire discharge was 0.011 km^3 and the main contributors to water column risk were the bentonite particles used in the tophole drilling fluid, followed by the cuttings particles (Figure 10-30a). The risk from these particles quickly falls as the materials are dispersed and settle out of the water column.

As shown in Figure 10-30b, the plume of treated NADF cuttings, discharged from the surface after drilling the 12 ¼'' production well section, was dispersed quickly away from the discharge point owing to the:

- Strong sub-surface currents,
- Dispersion horizontally and vertically *via* settlement of larger particles, and
- Lower rate of discharge than occurs with the tophole sections that have a larger borehole diameter and no recycling of the drilling fluid.

As a result, the risk associated with NADF cuttings surface discharges was very small and fell to <5 % after only five hours. During the discharge, and at most, 0.0061 km^3 of water column was at >5 % risk and this was mainly confined to the top 50 m of the water column (Figure 10-30b). The majority of the risk is caused by the concentration of oil in the discharge followed by the barite and cuttings particles.



a) Seabed discharges from the 32'' production well tophole section (above = plan, below = cross section)

b) Surface (-20 m) discharges from the 12¼'' production well section (above = plan, below = cross section)

Figure 10-30: Predicted instantaneous risk to the water column

10.6.5 Industry-standard mitigation measures

The following base-case and industry-standard mitigation measures were factored into the initial impact assessment:

- NADF drilling fluids will be re-circulated with cuttings being separated from the muds and the mud being re-used to minimise discharges of cuttings and waste mud as far as possible,
- NADF cuttings will be returned to the rig and thermally treated with the TCC to ensure the oil content complies with legislation as a minimum (Section 10.6.1.1), with the aim of exceeding the compliance requirement prior to discharge (i.e., <0.5 % oil on cuttings by dry weight**:** the main reason for targeting 0.5 % oil on cuttings is to limit the risks to both the sediments and the water column. Such a target is also routinely achieved in practice and therefore is considered BAT), and
- Selection of the most environmentally benign chemicals available on the Cefas list of registered products where possible (notwithstanding the need for optimal operational performance).

10.6.6 Impact Assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities.

A summary of the impact assessment outcomes is tabulated in Section 10.6.12, which shows the worst-case impact for each activity and receptor.

10.6.6.1 Water quality

All discharges are to the open ocean in depths of 450 m, and the affected water column is influenced by numerous currents (Section 10.6.4.1.1) and therefore, the sensitivity of the receptor is considered to be '**Very Low'**.

The discharge of drill cuttings is expected to result in a very localised reduction in water quality both in surface waters and in the lower part of the water column, due to an increase in turbidity and the presence of chemicals (Section 10.6.4.3.4). While the worst-case modelling results indicate that a seabed plume of tophole discharges (at seabed) could extend several km down-current from each well location, affecting a maximum volume of 0.011 km^3, turbidity in the water column is not expected to extend more than 50 m above the seabed whilst drilling the tophole sections, or significantly below 50 m of the sea surface whilst drilling the lower well sections (Section 10.6.4.3.4). On completion of drilling operations, the oceanic currents will rapidly dilute the suspended particles within the water column which is predicted to recover within 2.5 days of each tophole section and five hours of each lower well section being drilled (Section 10.6.4.3.4). Based on the relatively small volume of water being affected and the rapid and full recovery once the activity ceases such that any effect is unlikely to be detectable against background levels, the severity of effect is considered to be '**Slight**'.

Therefore, the overall significance of impact to water quality is considered to be '**Very Low (1)**'.

10.6.6.2 Phytoplankton and zooplankton

Both phytoplankton and zooplankton are widely distributed throughout the Falkland Islands Continental Shelf and do not represent any rare or vulnerable species. Therefore, the sensitivity of the receptor is considered to be '**Very Low'**.

The impact on phytoplankton and zooplankton will be very localised and temporary. The increase in water column turbidity, and reduced light penetration, resulting from suspended fine particulates is expected to be localised and the upper water column is predicted to rapidly recover (Section 10.6.4.3.4). Given the negligible nature of the impact based upon the literature (Section 10.6.4.2.2), and that the environmental risk from each discharge plume is predicted to be very localised with rapid and full recovery such that any affect is unlikely to be detectable against background levels, it is anticipated that any effects will be fully-reversible with no potential for cumulative effects. Therefore, the severity of effect to plankton is considered to be '**Slight**'.

Therefore, the overall significance of impact to phytoplankton and zooplankton is considered to be '**Very Low (1)**'.

10.6.6.3 Seabed sediments

Given that the habitat is undesignated and that there is no potential to transfer contaminants to any nearby sensitive areas (Section 10.6.4.2.2), the sensitivity of the receptor is assessed as '**Very Low**'.

The impact of grain size change will diminish rapidly with increasing distance from the wells and sediment risks >5 % due to grain size change are expected to be confined to within around 60 m of each well (Section 10.6.4.3.4). The impact is expected to be restricted to a very localised area such that there will be a barely detectable impact on habitats, however, there is expected to be a long-term impact to 0.53 km^2, 20 years after the drilling operation (Table 10.42 above). Therefore, on balance, the severity of the effect to sediment quality is considered to be '**Moderate**'

Therefore, the overall significance of impact to seabed sediments is considered to be '**Low (3**)'.

10.6.6.4 Benthic fauna

According to the surveys already carried out (Section 10.6.4.2.4), there are no known vulnerable species recorded within the benthos and the community structure is widespread and typical of the area. Although some indicator taxa of important habitats are predicted to be present, as described in Section 10.6.4.2.4 above, these are likely to occur in low densities and not in aggregations that would typically contribute to the definition of important habitats. Predicted habitats are found widely in areas adjacent to the license area, and as such any potential impacts within the license area are not likely to impact the health of the local population. However, a data gap exists because the Sea Lion environmental baseline survey did not sample the specific drilling locations. Whilst differences in benthic habitat are considered to be very unlikely, and the sensitivity of the receptor is likely to be 'Very Low', to take a precautionary approach it is assessed here as '**Low**'.

Deposition thicknesses were predicted to exceed 6.5 mm up to 120 m from the centre of the NA-P-01 DC (at the maximum reach) and up to 50 m from the GI well(s) (at the maximum reach) (Section 10.6.4.3.4.1, Table 10.42) and the impacts of disturbance and smothering will be restricted to sessile organisms within these distances (Section 10.6.4.2.4.1). Increases in grain size that could result in a change to sediment structure were predicted to extend to a maximum of 1 km from each well (Section 10.6.4.3.4.1, Table 10.42). The model indicates that a risk to >5 % of the species present around the main DC is expected to occur in an area of 2.51 km^2 at the end of drilling (Section 10.6.4.3.4). While this area is small, the model also predicts that the area will be reduced in five years and is expected to reduce to approximately 0.53 km^2 after 20 years (Section 10.6.4.3.4). However, as described in Section 10.6.4.2.4, field studies in the area have indicated that recovery periods for exploration drill cuttings piles are far quicker than estimated in the model and that the model tends to overestimate deposition thickness. Additionally, both literature and ground-truthing (albeit from WBM well sites) indicate that recolonisation of the pile will commence within 1-2 years (Section 10.6.4.2.4.2). Other studies support the modelled outputs in concluding that the fine layer of barite that may settle out from the discharge of treated NADF cuttings is unlikely to have any toxic effect (Section 10.6.4.2.5.3).

Further, as stated in Section 10.6.4.3, the modelling carried out is highly conservative as it assumes the maximum number of 26 wells being drilled from the new subsea layout (namely 23 completed wells, one contingency GI well and two side-track / redrill potentials), with worst-case assumptions used for well length. It also assumes the worst-case use of NADF in the lower well sections of the GI wells. The modelling also assumes that the wells are drilled consecutively at each DC i.e., with no drilling break.

However, the planned Sea Lion drilling programme includes several rig moves between the drill centres. The modelling assumptions include this level of well sequencing detail, although the operations are more closely spaced in time in the model than expected in reality to conserve computing power, and are therefore likely to overestimate the impacts slightly, because sediments are buried more quickly and have less time to recover between discharges.

In conclusion, and on balance, the severity of the effect to the benthic fauna is considered to be '**Moderate**'.

Therefore, the overall significance of impact to benthic fauna is considered to be '**Moderate (6)**'.

10.6.6.5 Fish and shellfish

The modelling indicates that a maximum instantaneous volume of water of 0.11 km^3 would be at >5 % environmental risk during the drilling operations (Section 10.6.4.3.4). The spatial extent (volume) of the habitat predicted to be affected by the total drilling discharges is therefore of little to no geographical importance (<0.001 % of available habitat) to the fish populations migrating to the area to feed. Further, while the grey-tailed and yellownose skate and the spurdog both have an IUCN status of 'Endangered' or 'Vulnerable', such elasmobranchs are highly mobile species and have the ability to

move to another area of habitat if disturbed by drill cuttings discharges. Further they are generally found in shallower waters, are not abundant within the zone of influence and are dispersed spawners (Section 10.6.4.2.5). Therefore, due to the very small proportion of key species that could be affected, the sensitivity of the receptor is considered to be '**Low**'.

Owing to the localised area and short-term and reversible nature of the effect, the severity of the effect to fish species is considered to be '**Minor**'.

Therefore, the overall significance of impact to fish and shellfish is considered to be '**Low (4)**'.

10.6.7 Project-specific mitigation measures

The impacts are anticipated to range from '**Very Low**' to '**Moderate**'. Since the majority of risk to the seabed is caused by the oil content of treated cuttings through oxygen depletion, the key project-specific mitigation measure is the efficient operation of the TCC unit to minimise oil content which is part of the base-case (Section 5.13) and is thus factored into the initial impact assessment. Although the process has not been trialled in this specific geology before, the strata are of types experienced elsewhere and experience worldwide is that 0.5 % oil (by dry weight) on cuttings is rarely exceeded. On a long campaign such as this there is time to optimise, and continually improve, the process to achieve lower levels of oil on cuttings discharged.

Pre-drilling environmental surveys will also be carried out to confirm that no habitats or species of conservation significance are present within the zone of influence, and analysis of PAH content of treated NADF cuttings will be undertaken. Seabed grabs for sediment characterisation, benthos, chemistry and heavy metal analysis will also take place post first drilling (Section 10.6.10.1).

10.6.8 Residual impacts

10.6.8.1 Impacts to benthic fauna

The initial assessment takes account of all the mitigation measures which are built-in to the project (i.e., use of the TCC unit), and while continuing efforts to improve the oil on cuttings concentration may reduce the impact slightly if improvements can be made over the duration of the drilling campaign, this is not guaranteed. As such, the residual impact and risk assessments remain the same such that the impact to benthic fauna remains '**Moderate (6)**'.

Note: it is anticipated that the outcomes of the pre-drilling survey will indicate that the benthos in the Sea Lion Field is the same as the surrounding areas (which have been surveyed extensively). Should this occur, the sensitivity of the receptor would be reduced to 'Very Low', thus reducing the overall impact significance to 'Low (3)', however the impact is left as 'Moderate (6)' for now to take a precautionary approach.

10.6.9 Cumulative impact

In terms of cumulative impacts resulting from increased 'concentration' and the 'extent and duration' (Section 8.9.1) of drill cuttings discharges, there are no other O&G activities currently scheduled to occur in the NFB during the Sea Lion Phase 1 & 2 drilling campaign. Nonetheless, exploration drilling has occurred on the NFB since 1998 and each of the exploration wells, carried out by numerous operators, discharged WBM and cuttings both at the seabed and the surface.

A number of wells have been drilled in the area to appraise the initial Sea Lion discovery, as is shown in Figure 10-31. The closest well to the NA-P-01 DC is 14/10-4, which is an abandoned well, approximately 555 m to the south-east and was spudded in March 2011.

In March 2012, Gardline Environmental conducted a post-drilling survey at five well locations within the Sea Lion Field (Gardline, 2013b). In summary, 32 stations were sampled surrounding wells that had

been drilled in 2009 with WBM (14/10-1, 14/10-2, 14/10-6, 14/10-9 and 14/15-4a). The results indicated that, there was little detectable change at these locations from the surrounding areas. The survey showed that:

- The sediment was dominated by medium and coarse silt,
- Hydrocarbon and metal concentrations recorded during the survey were generally within the expected range for the region,
- Depth and sediment type gave no evidence of any previous point source contamination, and
- The fauna recorded was considered homogeneous, with no evidence of any previous disturbance to the benthic community as a result of historical drilling activity at the existing wells (Gardline, 2013b).

The lack of detectable change from background levels at these abandoned well sites indicates that there is unlikely to be any significant cumulative impact between the current proposed operation and previous exploration drilling campaigns in the region.

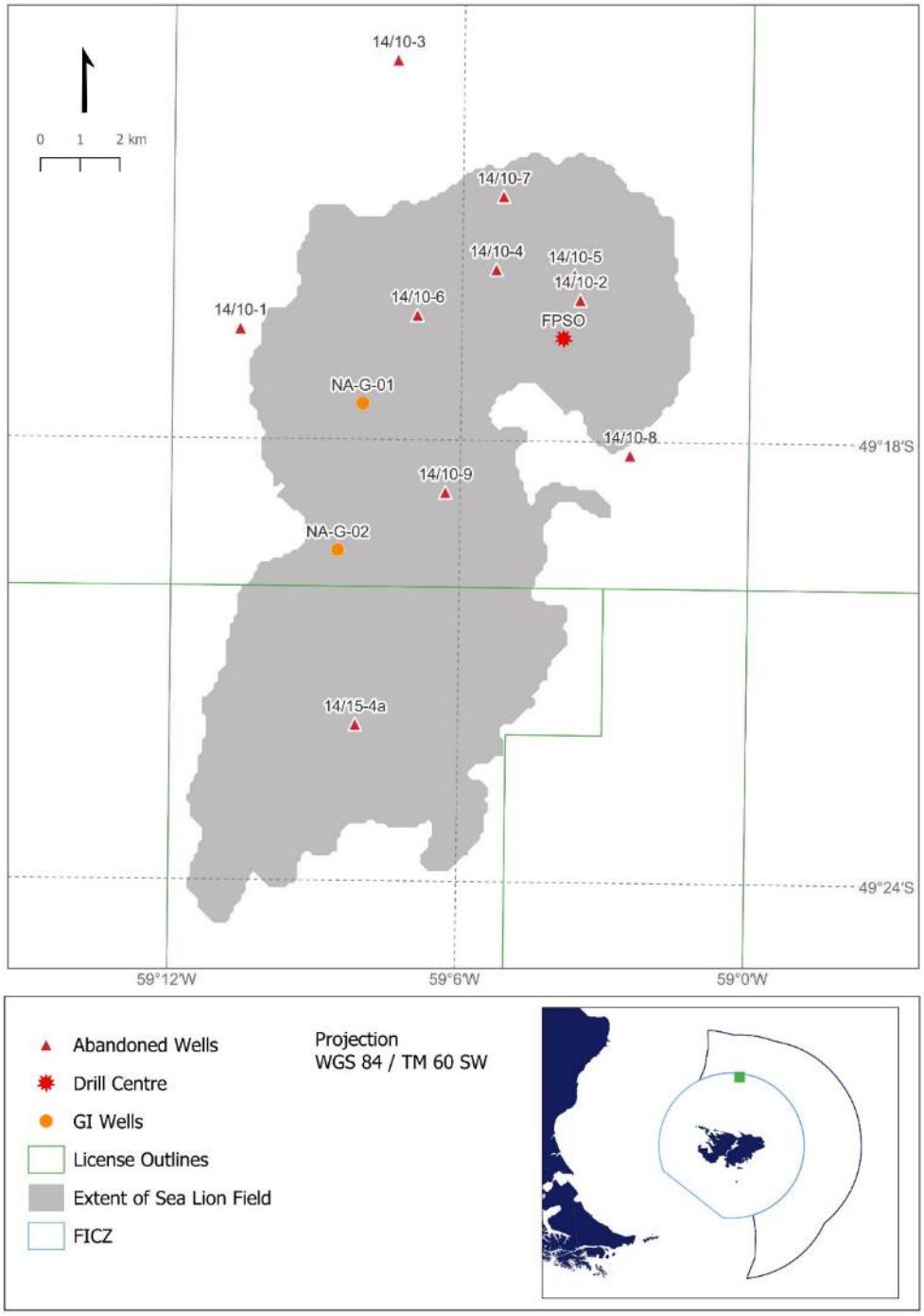


Figure 10-31: The locations of existing (abandoned) wells within 2.5 km of the drill centre

10.6.10 Confidence

The details of the drilling campaign are clearly defined and the quantities of drilling mud and cuttings have been estimated on a conservative basis. The nature of the impact of drilling discharges is relatively well known from several decades of research, model validation studies conducted by SINTEF and the ground-truthing study carried out following the 2012 Sea Lion survey described above (Section 10.6.4.2.4.2). Modelling uncertainties have been identified (Table 10.43) and while their potential to materially alter the outcome of the modelling has been considered within the assessments above, it is acknowledged that improvements in the modelling design could increase the accuracy of

quantification of the impact. Indeed, improvements in the modelling process may lead to predictions of lesser impacts, as was indicated by the ground-truthing study carried out in the Trolla Field (Section 10.6.4.3.1).

While the Gap Analyses Programme (GAP) identified benthic ecosystems as a priority area which would benefit from further research to inform environmental assessments (Section 7.2.4.1), benthic data collected in the drilling area so far has not indicated the presence of any species or habitats of conservation concern and the benthos is believed to be relatively homogeneous across the area (Section 7.4.3.2). Nonetheless, the absence of a site-specific benthic survey to date is acknowledged as a data gap, although it is considered unlikely that these data gaps have the potential to significantly change the outcome of the assessment. If anything, completion of the pre-drilling survey may enable a less precautionary approach with regard to the assessment of the sensitivity of benthic species and habitats as a receptor. Note that Rockhopper and POEPL commissioned an extensive benthic survey of the PL032 licence block comprising drop down cameras and benthic grabs in the vicinity (Section 7.2.2).

On balance, owing to the uncertainties within the model and the acknowledged data gap, the degree of confidence in the impact assessment is considered to be '**Probable**'.

Table 10.43: Modelling uncertainties

Uncertainty	Description
Discharge quantities	The discharge geometry is constrained by operational equipment and typical drilling rig design and is unlikely to significantly change. The downhole conditions are potentially quite variable in terms of volumes of mud required but this is allowed for in the inputs provided to the model, which are based on conservative assumptions.
Cuttings particle size distribution	The size distribution of the cuttings particles is based on an average of data from drilling in the Norwegian Sea and on Navitas-supplied analysis from representative drilling projects. Regional variation is possible relating to the rock types being drilled and it would be beneficial to report on cuttings particle size distribution from ongoing drilling campaigns in this region to inform future modelling.
Metocean conditions	The metocean dataset covers three years. This provides a wide range of weather conditions and the modelling results consistently show a tendency for dispersion tending towards the north-west of the site. However, the currents do move in all directions at different times and deposition is locally variable due to the short nature of each discharge such that the plumes may disperse more efficiently than is indicated in the model.
Environmental sensitivities	Grain size change is an important parameter and the threshold for this parameter within the risk assessment is based on the analysis of environmental monitoring data from the Norwegian Continental Shelf covering 246 species. Burial thickness is based on data from Europe and the United States. Importantly, there may be regional differences in prevailing fauna that would mean different thresholds are appropriate in the Sea Lion area. Nevertheless, the basis of the thresholds is considered to represent the best available data and covers a wide range of benthic fauna.

10.6.10.1 Monitoring required

The following monitoring will be carried out to improve the degree of confidence in the impact assessment:

- Pre-drilling survey: this will typically involve video only to determine the nature of the seabed at the precise drilling site,
- Post-drilling benthic survey: Post-drilling benthic surveys will be carried out every five years in line with the methodology recommended by the GAP project which includes seabed grabs, for sediment characterisation, benthos, chemistry and heavy metal analysis, video and water column sampling,

- Post-drilling cuttings pile analysis: the assumptions used in the modelling have a large impact on the predicted environmental risk to the seabed. Navitas will conduct sediment sampling of the seabed post-drilling in order to inform future assessments of drilling discharges in the region, and
- Analysis of PAH content of treated cuttings from the TCC unit.

Detailed monitoring requirements have been established during the project-specific Phase 1 & 2 Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the EMMP. An outline EMMP is provided in Chapter 15.

10.6.11 Offsetting

For significant residual and impact and risks ('Moderate' or above), offsetting *via* a Carbon and Biodiversity Offsetting Fund is proposed, see Section 8.11 for further details.

10.6.12 Findings summary

Table 10.44: Summary of the impact assessment for discharge of drill cuttings during the Phase 1 & 2 Development

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Drilling operations	Discharge of: Seawater and bentonite sweeps, Tophole drill cuttings, and Thermally treated and ground NADF drill cuttings	Water quality: Suspension of particles leading to increased turbidity	Planned	1 & 2	Very Low	Slight	n/a	**Very Low (1)**	**n/a**	**Probable**	**Industry-standard:** Drilling discharges to be minimised as far as possible in line with BAT, Selection of benign chemicals where possible, NADF cuttings returned to the rig and thermally treated to minimise oil on cuttings (aiming to exceed compliance requirements), and Post-drilling monitoring of seabed recovery. **Project-specific:** Continual improvement so that oil on cuttings will be minimised, as far as is possible, during drilling campaign to below a 0.5 % average
		Plankton: Reduction in the ambient light, chemical content or plume and barite particles may affect zooplankton			Very Low	Slight		**Very Low (1)**	**n/a**		
		Seabed sediment: Deposition of drill cuttings modifying sediment particle size			Very Low	Moderate		**Low (3)**	**n/a**		
		Benthic fauna: Burial of benthic fauna, modification of habitat, toxicity and oxygen depletion			Low	Moderate		**Moderate (6)**	**Moderate (6)**		
		Fish and shellfish: Suspended barite particle may affect gill structures			Low	Minor		**Low (4)**	**n/a**		

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

10.7 Operational Discharges

Table of Contents

10.7.1 Introduction 775
10.7.1.1 Relevant legislation 775
10.7.1.1.1 Produced water compliance 776
10.7.1.1.1.1 Oil in water 776
10.7.1.1.1.2 Produced water as a substance 777
10.7.1.1.2 Chemical compliance 777
10.7.1.1.3 Non-Aqueous Drilling Fluids in well clean-up and completion fluids 778
10.7.1.1.4 Naturally Occurring Radioactive Materials (NORM) 778
10.7.1.1.5 The PON 8 and oil sheen reporting 778
10.7.1.1.6 Sewage and food waste 779
10.7.1.1.7 Oil content in drainage and bilge water 779
10.7.2 Sources of operational discharges to sea 779
10.7.2.1 Hydrotesting and ballasting discharges to sea 780
10.7.2.2 Wellbore clean-up and completion fluids 780
10.7.2.3 Cooling water discharges to sea 780
10.7.2.4 Hydraulic fluids during operation of subsea valves 781
10.7.2.5 Produced water discharges to sea 781
10.7.2.6 Grey and black water 782
10.7.2.7 Food waste 782
10.7.2.8 MODU / FPSO bilge and drainage water 782
10.7.2.9 Hypersaline discharges 782
10.7.3 Potential receptors 782
10.7.4 Characterising and quantifying the impact and risk of discharges to sea 783
10.7.4.1 Composition, behaviour and fate of discharges 783
10.7.4.1.1 General operational fluids 783
10.7.4.1.2 Produced water 784
10.7.4.1.2.1 Composition of PW 784
10.7.4.1.2.2 Behaviour and fate of PW discharges 789
10.7.4.1.3 Grey water, black water and food waste 789
10.7.4.1.4 MODU / FPSO bilge and drainage discharges 790
10.7.4.1.5 Hypersaline water 790
10.7.4.2 Nature of the potential impact 790
10.7.4.2.1 General operational fluids 790
10.7.4.2.2 Produced water as a substance 790
10.7.4.2.2.1 Uptake routes and biomarkers 791
10.7.4.2.2.2 Acute impacts of PW discharge on marine organisms 792
10.7.4.2.2.3 Chronic impacts of PW discharge on marine organisms 792
10.7.4.2.3 Grey water, black water and food waste 795
10.7.4.2.4 Drainage and bilge water 795
10.7.4.2.5 Hypersaline water 795
10.7.4.3 Potential for oil sheens 795
10.7.4.3.1 Sources of oil sheens 795

10.7.4.3.2 Formation of oil sheens 796
10.7.4.3.3 Sheens and seabird contamination 797
10.7.4.4 Volume of planned discharges 798
10.7.4.4.1 Operational fluid discharge volumes 798
10.7.4.4.2 Volumes of planned PW discharges during commissioning 798
10.7.4.4.3 Volumes of grey and black water 798
10.7.4.4.4 Volumes of MODU / FPSO bilge and drainage water 799
10.7.4.4.5 Volumes of hypersaline discharge 799
10.7.4.5 Estimation and modelling of unplanned PW discharges 800
10.7.4.5.1 Potential volumes of unplanned PW discharges 800
10.7.4.5.2 The DREAM / EIF modelling approach 801
10.7.4.5.2.1 Discharge parameters used in DREAM 801
10.7.4.5.2.2 Understanding the model 802
10.7.4.5.2.3 DREAM Results 803
10.7.4.5.2.4 Comparison with North Sea EIFs 808
10.7.5 Industry-standard mitigation 808
10.7.6 Impact and risk assessment 809
10.7.6.1 Impact assessment of operational discharges 809
10.7.6.1.1 General operational fluids 809
10.7.6.1.2 Produced water discharges during commissioning 810
10.7.6.1.3 Grey water, black water and food waste 810
10.7.6.1.4 Discharge to sea of drainage and bilge water 811
10.7.6.1.5 Discharge of hypersaline water 811
10.7.6.2 Risk assessment of unplanned events 811
10.7.6.2.1 PW discharge during PWRI downtime 811
10.7.6.2.2 Oil sheens from PW or bilge/drainage water 812
10.7.7 Project-specific mitigation measures 813
10.7.8 Residual impacts and risks 813
10.7.9 Cumulative impact 813
10.7.9.1 General operational fluids 813
10.7.9.2 Produced water, drainage and bilge discharges 813
10.7.9.3 Grey and black water and food discharges 813
10.7.9.4 Hypersaline discharges 814
10.7.10 Confidence 814
10.7.10.1 Monitoring required 815
10.7.11 Offsetting 815
10.7.12 Findings summary 815

10.7.1 Introduction

Numerous discharges to sea will occur throughout the Phase 1 & 2 Development. These will include domestic wastewaters, drain, bilge and ballast waters from vessels throughout the Field Life, drill cuttings and fluids during Stages 1, 2a & 2b of the Development, and operational and marine discharges which will occur mostly during steady state production (Stage 3). The use of chemicals during the Phase 1 & 2 Development was raised as a concern by stakeholders during scoping consultations (Chapter 6).

This chapter assesses the impacts and risks associated with operational and domestic discharges, including:

- Hydrotesting water – which is used to test for leaks when commissioning flowlines etc., and may contain dyes so that leaks can be identified and other preservatives.
- Wellbore clean-up and completion fluids – water that has been flushed through the wellbore to clean out any debris and residual drilling fluids,
- Cooling water (CW) – filtered seawater used within the cooling system, which may contain chemicals intended to preserve the system pipework e.g., by preventing algal growth,
- Subsea hydraulic fluids – which provide energy transmission and lubrication within valves. These are glycol based fluids that are usually discharged when valves actuate,
- Produced water (PW) - a by-product of oil production as the reservoir depletes. Water already present in the reservoir and water injected into the reservoir are produced alongside the oil, and this produced water will contain oil, production chemicals and other contaminants,
- Grey and black water – domestic wastewater and sewage,
- Food waste,
- Drainage and bilge water, and
- Hypersaline water – which is a by-product of the water-makers held on the vessels and installations.

Note: the impacts associated with other discharges to sea e.g., drill cuttings discharges and ballast water and warm water from cooling systems are described elsewhere in this document as indicated in Table 2.2.

10.7.1.1 Relevant legislation

Conventions and legislation relevant to operational discharges to sea include:

- International Conventions:
  - International Convention for the Prevention of Pollution from Ships (MARPOL) 1973/78:
    - Annex I – Regulations for the Prevention of Pollution by Oil,
    - Annex IV – Prevention of Pollution by Sewage from Ships, and
    - Annex V – Prevention of Pollution by Garbage from Ships.
  - Convention on the Protection of the Marine Environment of the North East Atlantic 1992 (OSPAR Convention):
    - OSPAR Recommendation 2001/1 for the Management of Produced Water from Offshore Installations as amended by OSPAR Recommendation 2006/4.
    - OSPAR Decision 2000/2 on a Harmonised Mandatory Control System (HMCS) for the Use and Reduction of the Discharge of Offshore Chemicals.

  - OSPAR Recommendation 2012/5 for a Risk-based Approach to the Management of Produced Water Discharges from Offshore Installations, associated guidelines in OSPAR Agreement 2012/7 and PNEC data in OSPAR Agreement 2014/05.
  - OSPAR Agreement 2005/8 on a Monitoring Programme for Concentrations of Radioactive Substances in the Marine Environment (updated 2011).
- Key UK Legislation:
  - Offshore Petroleum Activities (Oil Pollution Prevention and Control) (OPPC) Regulations 2005 (and all amendments).
  - The Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008 which implement Annex IV and Annex V of MARPOL 73/78 and provide a general prohibition against the overboard disposal of all types of garbage waste from vessels and offshore installations.
  - Offshore Chemical Regulations (OCR) 2002 (and all amendments).
  - The Environmental Authorisations (Scotland) Regulations 2018 which replaced The Radioactive Substances Act 1993 Amendment (Scotland) Regulations.
- Relevant Falklands legislation:
  - Marine Environment (Protection) Ordinance of 1995.
  - Environment Protection (Overseas Territories) Order of 1988.
  - Environment Protection (Overseas Territories) (Amendment) Order of 1997.
  - Offshore Petroleum (Licensing) Regulations 1995 and 2000.
  - Oil in Territorial Waters Ordinance (1960).
  - Maritime Ordinance 2017 (Dumping and Deposits at Sea), Part 14.
- Relevant Falklands operational notices:
  - Petroleum Operations Notice (PON) No. 8.

Under the above, there are numerous compliance requirements with regard to oil content, chemical selection and the discharge of PW as a whole.

10.7.1.1.1 Produced water compliance

10.7.1.1.1.1 Oil in water

The OSPAR Convention, and its associated Recommendations, contains an underpinning requirement to use Best Available Techniques (BAT) and Best Environmental Practice (BEP) to minimise pollution and this extends to the management of PW. OSPAR 2006/5 introduced a presumption that Produced Water Reinjection (PWRI) would be taken as a starting position in determining what is BAT for a particular asset or discharge.

OSPAR Recommendation 2001/1 specifies that all discharges of PW must comply with a monthly average dispersed oil in water (OiW) content of 30 mg/l or less, and that no single discharge should exceed 100 mg/l. PW must be treated to minimise the OiW content using BAT/BEP. In the UK, consent conditions normally require sampling and analysis of PW two times per day when discharging, or once per month when reinjecting. Other requirements are included in guidance and consent conditions including those for metering, management of critical elements and the reporting of unusual oily sheens visible beyond 500 m from the installation.

FIG PON8 guidance specifies a target of 40 mg/l for PW although Navitas understand that FIG expects to adopt a 30 mg/l monthly average standard in line with the UK, averaged over those days when a discharge occurs and ignoring days when there is no discharge (e.g., because PWRI is online).

10.7.1.1.1.2 Produced water as a substance

In addition to reservoir hydrocarbons, chemicals and NORM, PW also contains other naturally occurring substances that are present in the hydrocarbon reservoir. In line with OSPAR requirements these are analysed and reported twice a year.

The OSPAR commission aimed to achieve a reduction in the discharge of hazardous substances to sea and targeted the cessation of hazardous discharges by 2020. The ultimate aim is to achieve concentrations in the marine environment which are near background levels for naturally occurring substances, and close to zero for man-made substances. To this end, OSPAR embarked on a process of risk-based assessment of PW discharges and formalised this approach in OSPAR Recommendation 2012/5, and Agreement 2012/7. These were adopted with a view to understanding the toxicity of PW as a whole substance in efforts to achieve the 2020 goal. OSPAR has set new strategic objectives in its North-East Atlantic Environment Strategy 2030, including to ensure by 2027 that measures to eliminate discharges, emissions, and losses of hazardous substances are in place to achieve or maintain good environmental status, which parallels EU marine strategy. The emphasis therefore moves to controlling the effects of hazardous substances rather than their elimination *per se*.

All parties contracting to OSPAR are required to use a Risk-Based Approach (RBA) when assessing the environmental risk posed by their PW discharges. The RBA is a method of:

- Assessing the toxicity of 'whole PW' as a substance in its own right, and
- Prioritising mitigation actions for discharges or substances that pose the greatest risk.

In the UK, this resulted in a voluntary implementation programme that engages all discharging assets in undertaking an RBA. For assets that can clearly show the risks are adequately managed according to certain tests, they can 'drop out' of the tiered assessment process with no further action. For many assets however, the process shows scope for risk minimisation and a plan is required to identify future steps to minimise risks.

The process informs justifications presented in ongoing submissions under the OPPC Regulations and under the Offshore Chemicals Regulations.

10.7.1.1.2 Chemical compliance

The UK has controlled the use and discharge of offshore chemicals since 1979 *via* the Offshore Chemical Notification Scheme (OCNS). This has developed into an OSPAR-wide control scheme *via* the Harmonised Mandatory Control System (HMCS) which is an outcome of OSPAR Decision 2000/2 and Recommendations 2010/3 and 2010/4. This contains requirements for chemicals to be pre-screened by applying standardised laboratory tests in the Harmonised Offshore Chemical Notification Format (HOCNF). Those with acceptable properties are given rankings as to their potential risk in typical usage and are added to the Cefas (Centre for Environment, Fisheries and Aquaculture Science) Definitive Ranked List of Registered Products. Only chemicals on this Cefas list may be used or discharged offshore for Oil and Gas (O&G) purposes. Chemicals with the best performance (lowest toxicity, lowest bioaccumulation and highest biodegradation) are given a classification of 'Gold'.

In the UK and Netherlands, the site-specific risks of chemical discharge are assessed at 500 m from the discharge using a dispersion calculation known as the Chemical Hazard and Risk Model (CHARM). For those chemicals that cannot be assessed using CHARM, such as inorganic chemicals, a separate OCNS classification is given from 'A' to 'E', with 'E' being the best environmental performance. Chemical discharge must be subject to a site-specific risk assessment unless they are:

- Categorised as Posing Little Or No Risk (PLONOR) to the environment according to OSPAR Agreement 2013/6 (including, for example, inert minerals, nut fibres, methanol and monoethylene glycol),

- Are given a Hazard Quotient (HQ) of 'Gold' under the HCMS (provided the Cefas Template dosage is not exceeded, in which case a site and use-specific risk assessment may be required), or are
- Categorised as 'E' under the OCNS.

Chemicals that have specific undesirable properties regarding their biodegradation, toxicity and / or bioaccumulation characteristics, are given a 'Substitution Warning' (SUB) which means that their use must be justified and replacements sought within a specified timescale. The goal was a phase-out of the discharge of SUB chemicals by the 1st January 2017. This was largely achieved but there remain in use some chemicals whose function requires them to be biocidal or persistent for example, and their use and discharge continues, but must be justified in applications. Chemicals with traces of certain undesirable substances such as particular metals, including those on a list for priority action (OSPAR 2004-12, revised 2023) are given a 'Product Warning' code and their use must also be specifically justified in UK chemical permit applications.

All chemicals dosed into the Cooling Water (CW) and Produced Water (PW) will be selected to minimise the potential environmental impact in line with OSPAR Decision 2000/2. They will be subject to ongoing review and improvement where practicable.

10.7.1.1.3 Non-Aqueous Drilling Fluids in well clean-up and completion fluids

The Offshore Chemical Regulations (OCR) include the discharge of hydrocarbon chemicals or substitute hydrocarbon chemicals (i.e., Non-Aqueous Drill Fluids (NADF) such as Oil Based Muds (OBM)). If any NADF is to be discharged within well fluids, such as clean-up or completion fluids, the discharge will be conditioned to meet certain maximum discharge volumes and concentrations. The O&G UK (now OEUK) Well Clean-up Good Practice Guidelines provide information on the industry standards (Section 10.7.5). It is noted that, in the UK, any reservoir oil in clean-up or completion fluids would be managed separately under the OPPC Regulations.

Representative samples of the discharged material shall be collected at regular intervals during the course of the discharge to determine the hydrocarbon chemical or substitute hydrocarbon chemical content of the discharge. In the event of any discharge giving rise to a visible 'oil sheen' on the sea surface, FIG will be notified of the discharge operation in line with the PON8 (Section 10.7.1.1.5) and all discharges will be reported to FIG following completion of the operation.

10.7.1.1.4 Naturally Occurring Radioactive Materials (NORM)

In the Northern European marine environment, the OSPAR Radioactive Substances Strategy relates to discharges of all radioactive substances and includes the aim of attaining 'concentrations in the environment near background values for naturally occurring radioactive substances' (Gwynn, *et al.,* 2022).

Under OSPAR Agreement 2013/11, it is necessary in the UK to sample discharged PW on a quarterly basis to test for quantities of radionuclides which can occur naturally in the PW.

10.7.1.1.5 The PON 8 and oil sheen reporting

The FIG PON8 is primarily intended for use when reporting oil spills. However, as per the guidance below, the *pro forma* must also be used to report on oil sheens which may result from PW discharges. This guidance is intended to reflect the fact that all oil spills are reportable under law but that normally operating PW discharge streams (if applicable) are already reported *via* the installation's PW monitoring records and returns.

The PON 8 directly specifies the following:

- If the sheen does not result directly from the PW stream it must be reported using the PON 8 regardless of its size. There is no lower limit to the size of spill / sheen reported.
- If the sheen results from the PW stream and the discharge contains in excess of 100 mg/l oil in water then it must be reported using the PON 8 regardless of its size. There is no lower limit to the size of spill / sheen reported.

Therefore, if the sheen results from the PW stream and the discharge contains less than 100 mg/l of oil in water, then a spill need not be reported. However, if the appearance of the sheen is unusual, or if another source or discharge is causing an unusual coloration of the water around the installation then the Department of Mineral Resources (DMR) and the Falkland Islands Maritime Authority (FIMA) should be informed of the incident by telephone as soon as possible. This should not be treated or recorded as an oil spill. The purpose of the report will be to enable the Departments to respond to enquiries from third parties (spotter planes, civilian aircraft, ship's masters etc.). The decision as to whether the sheen is 'unusual' in appearance is left to the common sense and judgement of the Offshore Installation Manager (OIM) at the time.

10.7.1.1.6 Sewage and food waste

In compliance with MARPOL Annex IV, which applies to vessels > 400 GT or certified to carry > 15 persons on board, untreated black water (sewage) may only be discharged beyond 12 nm from shore whilst the vessel is moving. Between 3-12 nm, sewage must be treated prior to disposal at sea and only if vessels are moving at a speed of greater than or equal to four knots. Depending on the vessel's sewage treatment equipment, some sewage may be discharged within three nm, and again only if it is travelling at a minimum of four knots. For stationary offshore 'vessels' such as the Floating Production, Offloading and Storage (FPSO) unit and the Mobile Offshore Drilling Unit (MODU), although they are >12 nm from shore, sewage must be treated before discharge to sea.

Food waste must be macerated to ensure a maximum solid particle size of 25 mm prior to discharge as required under MARPOL Annex V, to aid its dispersal and decomposition in the water column.

All vessels must maintain a Waste Disposal Log.

10.7.1.1.7 Oil content in drainage and bilge water

Under MARPOL Annex I, the discharge to sea of drainage or bilge water by vessels at sea is prohibited unless the oil content of the discharge, without dilution, is less than or equal to 15 parts per million (ppm). Discharges must cease in the event that a sheen becomes visible.

Under the OPPC regulations, the discharge of drainage water from offshore installations is prohibited unless the oil content of the discharge, without dilution, is less than or equal to 40 mg/l (mg/l is another way of measuring concentration that is very close to ppm).

When in transit, both the MODU and the FPSO will qualify as vessels under MARPOL and will thus adhere to the 15 ppm limit. When stationary and operational however, the MODU and FPSO will qualify as offshore installations under OPPC and would be required to adhere to the 40 mg/l limit. However, Navitas has committed to adhering to the lower 15 ppm limit once on station as well as when in transit for both the MODU and FPSO.

All vessels must use an Oil Record Book to record all oil discharges from drainage and bilge water.

10.7.2 Sources of operational discharges to sea

Operational discharges to sea during the Phase 1 & 2 Development include:

- Hydrotesting water and ballasting liquids at the pre-commissioning stage,
- Wellbore clean-up fluid,

- Cooling water (CW) throughout steady state production,
- Hydraulic fluids during operation of subsea valves,
- PW when it first starts to appear and the Produced Water Re-Injection (PWRI) system is being commissioned which may take three to six months,
- PW during unplanned PWRI downtime at any time throughout the Field Life,
- Grey water e.g., wastewater from showers, cooking, cleaning, food preparation,
- Black water e.g., sewage,
- Food waste,
- Drainage and bilge water from the MODU / FPSO, and
- Hypersaline water from the creation of potable water.

10.7.2.1 Hydrotesting and ballasting discharges to sea

During installation in Stage 1 of the Development, structures, and Subsea Umbilicals, Risers and Flowlines (SURF) will be lowered to the seabed. To control buoyancy and vertical position, these are often filled with a carrier liquid which can be topped up using liquids in attached bladders, often inhibited seawater or an inhibited mix of water and monoethylene glycol. During descent to the seabed, some of these liquids are discharged and during connection of the equipment and disconnection of the installation vessel, all of the liquids may be discharged.

During pre-commissioning in Stage 1 of the Development, it will be necessary to hydrotest the SURF. Hydrotesting of the flowlines and risers is an important step in confirming their structural integrity and to demonstrate the absence of leaks.

During the test, the SURF will be flooded with inhibited seawater or an inhibited mixture of water and monoethylene glycol and the lines will be pressurised and monitored for a period (typically less than 24 hours) to check for leaks before the water is released in a controlled discharge to sea. Pipeline hydrotesting normally involves pumping a biodegradable gel ahead of the flushing water to ensure the whole pipeline contents are displaced, leaving the pipeline with the correct preservation fluids prior to startup.

10.7.2.2 Wellbore clean-up and completion fluids

When each well is displaced from Non-Aqueous Drill Fluid (NADF) to brine during completion, NADF contaminated water is returned to the mud pits on the MODU, becoming progressively cleaner as water circulates around the well. The NADF is skimmed off and the water sheen tested before discharge to the sea. This typically results in about 3,000 bbls (approximately 477 m^3) per well (78,000 bbls / 12,394 m^3 for the total drilling campaign) of visibly oil-free water being discharged offshore. Navitas will operate an oily water separator on the MODU to further remove oil from such discharges. Any residuals that cannot be discharged will be returned to the supply base for incineration.

The visibly oil-free water will be discharged in line with legislation (Section 10.7.1.1.1.1) and the O&G UK (now OEUK) Well Clean-up Good Practice Guidelines (Section 10.7.5).

10.7.2.3 Cooling water discharges to sea

As described in Section 5.8.4.2, the cooling water system will use cold seawater to absorb heat from a cooling medium system *via* a series of heat exchangers, with the warm seawater being discharged back to sea on a continuous loop. These cooling water (CW) discharges will be at an elevated temperature of approximately 28°C. This discharge is assessed in Section 10.8.

10.7.2.4 Hydraulic fluids during operation of subsea valves

Valves that control flow and operation of the subsea system are operated by means of hydraulic fluids pumped from the FPSO. The control system includes dual high pressure and low pressure hydraulic control lines for full redundancy. The distribution networks shall be designed to avoid common modes of failure and promote reliable operations. Self-sealing connectors are provided between the control lines within the umbilicals and the subsea manifolds so that there is negligible discharge of fluids during connection and maintenance. Each time a valve is operated, an amount of fluid is released. A small amount of fluid also passes across the valve seals during normal operations as the liquid is held in a pressurised state. Industry guidance on the management of such fluids will be followed (Energy Institute, 2016a).

A biodegradable water / glycol-based fluid will be used. These are typically composed of water and monoethylene glycol which is a PLONOR chemical along with a dye to help pinpoint any leaks should they occur. This selection may be subject to change (e.g., a different manufacturer) as the design progresses but a glycol-based fluid with a similar performance would be chosen, and no substitution chemicals will be used.

10.7.2.5 Produced water discharges to sea

Produced water comprises formation water which has been trapped within the reservoir for millions of years and / or a mixture of seawater and formation water, when seawater has been injected in order to maintain pressure in the reservoir during oil and gas production (Hosseini, *et al.,* 2012).

Once into steady state production, PW will be treated and a concentration of 10 mg/l dispersed OiW will be targeted for PW treatment performance. Treated PW will be mixed with treated seawater before reinjection into the reservoir at a maximum concentration of 10 mg/l dispersed OiW *via* one of two PWRI units. This is intended to enhance oil recovery from the reservoir (Section 5.8.5.6) and alleviate the need to discharge PW to sea during normal production operations. This effectively ensures the long-term re-use of a major discharge stream with zero planned PW discharges to sea during normal operations.

However, when PW from the oil production wells first starts to arrive on the installation, there is the potential that some PW will be discharged while the PWRI units are commissioned. The volumes of PW that may be discharged during commissioning are, as yet, unknown but are expected to be small and short-lived as the PWRI units will be brought online as soon as possible. Additionally, throughout Field Life, it may be necessary to discharge PW in the event that the PWRI units malfunction or that the water cannot be cleaned to the necessary 10 mg/l dispersed OiW required for reinjection.

In the event of PW discharge during commissioning or unavailability of the PWRI option, the water will be cleaned prior to discharge to ensure that, as a minimum, it is compliant with PW legislation (Section 10.7.1.1.1), namely a dispersed oil concentration of no more than 30 mg/l monthly average and 100 mg/l in any one sample. It is anticipated that such discharges will carry an OiW concentration in the region of 10 - 15 mg/l. In the event that the OiW concentration is higher, the water can be diverted to the off-spec tank temporarily.

Legally compliant PW discharges, in the event of PWRI unavailability during early and late Field Life, were modelled using DREAM (Section 10.7.4.5) to assess the impact of PW discharges and to align with the RBA requirements of OSPAR Recommendation 2012/5 (Section 10.7.1.1.1.2). Although it is not a requirement in the UK to apply RBA until first water production, it has been applied here as a good practice to help identify any issues that would be addressed more efficiently at this stage and as a means of predicting the scale of potential impacts.

10.7.2.6 Grey and black water

Grey water (e.g., domestic wastewater from showers, dishwashing etc.) and black water (sewage) will undergo treatment prior to discharge as described in Section 10.7.1.1.6.

The sewage discharge points will be at minimum draught (*c.* 7 - 9m) below the surface of the water.

10.7.2.7 Food waste

Food waste from the galley will be macerated prior to discharge as described in Section 10.7.1.1.6. The discharge points will be at minimum draught (*c.* 7 - 9 m) below the surface of the water.

10.7.2.8 MODU / FPSO bilge and drainage water

The MODU is a registered ship and will adhere to the 15 ppm limit while acting as a ship and also when moored and operating as a mobile O&G drilling installation (Section 10.7.1.1.7).

The FPSO will be registered as a ship for transit (and potentially thereafter). However, when moored in the exclusion zone, the FPSO would qualify as an offshore installation to which OPPC would apply in the UK and therefore, in principle, it would be normal for an upper limit of 40 mg/l to apply to all drainage.

However, the requirement to demonstrate BAT would also apply and it is expected that the FPSO's bilge and slops oily water systems will discharge at an upper limit of 15 ppm. The FPSO bilge water system will accept drainage from 'machinery spaces' (mainly the engine room) and will have a MARPOL-compliant bilge water treatment system that cannot discharge water in excess of 15 ppm.

The oil separated from the drainage and bilge water will typically be returned to the processing facilities on the MODU and FPSO. However, occasionally the recovered oil may be sufficiently 'off spec' that it will not be suitable for processing offshore and in these instances it will be collected and stored in drums / transit tanks and will be shipped back to the onshore supply base. From there it will be transferred into a sludge truck for disposal at the FIG Stanley incinerator. It is understood that the FIG Stanley Incinerator will be operational by end of 2026. However, should the FIG Stanley incinerator not be available, Navitas would store the waste in suitable containers onshore until:

- The FIG incinerator is available,
- Offshore treatment on board either the MODU or FPSO is available / possible, or
- A suitable volume is ready for export to the UK.

Waste oils from this process shall always be considered candidates for re-use and incineration is a secondary solution. For example, with the agreement of FIG and Stanley Services Ltd, waste oils may be provided to local businesses for use in oil burning heaters.

10.7.2.9 Hypersaline discharges

Hypersaline water will be generated by desalination plants used to generate freshwater from seawater. The freshwater will be used for numerous operations as well as for consumption, as described in Section 5.11.4.2. The hypersaline water will be discharged to sea.

10.7.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify those receptors upon which the impacts and / or risks associated with operational discharges to sea warranted further investigation (Section 9.2).

Marine environmental receptors, which may be impacted by operational discharges, are:

- Water quality,

- Plankton (Section 7.4.1),
- Benthos (including sediment) (Section 7.4.3),
- Fish and squid (Section 7.4.4.2),
- Seabirds (Section 7.4.5.2), and
- Marine mammals (Section 7.4.6.2).

The above are considered to be receptors owing to the potential for acute and chronic impacts associated with the oil, chemical and natural components of operational discharge plumes. Of note, to avoid repetition, the impacts to these receptors are not assessed individually below and instead they are grouped and assessed as 'marine organisms'.

10.7.4 Characterising and quantifying the impact and risk of operational discharges to sea

When characterising and quantifying the potential impacts and risks of operational discharges, it is necessary to consider the following:

- The composition, behaviour and fate of discharges,
- Nature of the potential impact e.g., acute and chronic effects,
- The potential for oil sheen formation,
- Volume of planned operational discharges, and
- Estimation of volumes associated with unplanned PW discharges, and the associated risks.

10.7.4.1 Composition, behaviour and fate of discharges

10.7.4.1.1 General operational fluids

For the purposes of this section, general operational fluids refers to hydrotest, wellbore clean-up / completion fluid and cooling waters. The composition, behaviour and fate of the hydrotest, wellbore clean-up / completion fluid and cooling waters, and that of the hydraulic fluids is provided in Table 10.45. All chemicals will be selected in line with the OCNS (Section 10.7.1.1.2).

Table 10.45: Discharge composition, behaviour and fate

Discharge fluid	Composition, behaviour and fate
Hydrotest water	The SURF will be flooded with inhibited seawater which will be dosed with chemicals such as oxygen scavengers, corrosion inhibitors and biocides[1]. The exact volumes of water and chemicals to be discharged to sea are yet to be determined and will be defined during the Front End Engineering and Design (FEED) process. However, it is anticipated that water discharged at the seabed will be rapidly dispersed and diluted. All chemicals dosed into the hydrotesting and ballasting water and will be selected to minimise the potential environmental impact in line with OSPAR Decision 2000/2. They will be subject to ongoing review and improvement where practicable.
Wellbore clean-up and completion fluids	Wellbore clean-up and completion fluid discharged to sea may contain traces of NADF and potentially reservoir hydrocarbons. All NADF chemicals will be selected in line with the OCNS (Section 10.7.1.1.2). Discharges will be in discrete volumes at the end of each well allowing time in between discharges for the water to disperse. The water will be discharged at depth (most likely through the cuttings discharge line), which will aid mixing and dispersion.
Cooling water	CW will be dosed with a biocide to prevent marine growth in the heat exchange system and therefore, discharges will contain biocides. Given the temperature and salinity of the CW discharges, it is expected that the CW plume will be buoyant and will remain in the top 200 m of the water column. All chemicals dosed into the CW and will be selected to

Discharge fluid	Composition, behaviour and fate
	minimise the potential environmental impact in line with OSPAR Decision 2000/2. They will be subject to ongoing review and improvement where practicable.
Hydraulic fluids	Hydraulic fluids are a single substance used to enable subsea valve actuation. A biodegradable water / glycol-based fluid will be used; these typically have no Substitution Warning (Section 10.7.1.1.2) and high biodegradability, with their main components being water and monoethylene glycol which is a PLONOR chemical along with a dye to help pinpoint any leaks should they occur. With regard to its behaviour and fate, such small quantities are discharged that it is expected to be rapidly diluted by seabed currents.

[1] It is noted that by nature, biocides are intended to harm marine life, but efforts will be made to ensure selection of a Cefas Gold product with no Substitution Warnings (Section 10.7.1.1.2).

10.7.4.1.2 Produced water

10.7.4.1.2.1 Composition of PW

The chemical composition of PW from a particular field can vary considerably depending on the geological characteristics of the surrounding bedrock, the type of hydrocarbons produced, the operating conditions and the age of the field. However, if seawater injection has been practiced (as it will be here), towards the end of the production life of a field, the composition of the PW will more or less resemble that of seawater. Therefore, even if the volumes of produced water increase with time, the total mass of different elements may not increase, due to dilution (Hosseini, *et al.,* 2012).

Nonetheless, while risk-based regulations, 'greener' offshore chemicals and improved treatment systems have reduced the environmental risks of PW, where the PW is discharged, it is still the largest operational source of oil pollution to the sea from the offshore petroleum industry (Beyer, *et al.,* 2020).

Generally, treated PW may contain:

- Production chemicals to assist with:
  - Flow assurance,
  - Oil separation, and
  - Water injection.
- Naturally Occurring Radioactive Material (NORM) (Hosseini, *et al.,* 2012),
- Reservoir hydrocarbon which is separate from the aqueous phase (free oil) and is therefore mostly removed from the water in the separation process,
- Dispersed oil which refers to small droplets of oil which are suspended in the aqueous phase (normally in the range of 10–100 mg/l (Beyer, *et al.,* 2020)), and
- Dissolved oil which comprises of naturally produced low molecular weight organic compounds such as inorganic salts, organic acids, Polycyclic Aromatic Hydrocarbons (PAHs), ketones, phenol / alkylphenols, heavy metals, and volatiles which contribute to its overall toxicity (Yang and Tulloch, 2002, Veil, *et al.,* 2004, Hosseini, *et al.,* 2012; Beyer, *et al.,* 2020).

Most of the free and dispersed oil is removed from the PW in the treatment process leaving a small residue expected to be less than 10 mg/l. Although the removal of dispersed oil droplets in the treatment process removes soluble oils that are contained within the droplets, dissolved oil is not specifically removed by the separation process or by mechanical treatment processes and therefore remains within the PW.

As described in the EMMP (Section 15.7.4), once the field is into production and PW has broken-through, the water will be tested to establish its exact composition as part of the Risk Based Approach (RBA) to PW (Section 10.7.5).

Chemical content

Technological means of ensuring flow assurance and OiW separation are built-in to the Phase 1 & 2 basis of design to minimise reliance on flow assurance and separation chemicals (Section 5.8.4.1). However, some chemical use will be necessary which contributes to the overall toxicity of PW (Holdway, 2002).

The exact chemicals intended for use have not yet been selected from manufacturers and therefore Table 10.46 lists analogous chemicals representative of those that will be used and indicates the potential dosages in the PW in early and late Field Life. The dosages are lower in late Field Life owing to the declining oil production rates over time, the associated increasing water cut and the partitioning co-efficient[60] of the chemicals between the oil and water phases.

To protect commercial information, the names of the chemicals have been omitted, but actual test data for representative chemicals has been used, as shown in the table. In accordance with the legislation (Section 10.7.1.1) all chemicals will be on the approved lists and the majority of the anticipated production chemicals will have:

- An HQ band of 'Gold' (i.e., low aquatic toxicity, readily biodegradable and non-bioaccumulative), or an OCNS rating of 'E',
- No product warnings, and
- No Substitution warnings.

Table 10.46: List of analogous chemicals likely to be used during steady state production

Function	HQ band / OCNS rating	Product warning	Applied dosage into oil, gas and water (mg/l)	Partitioning co-efficient[1]	PNEC[2] (mg/l)	Concentration in water phase after partitioning (mg/l)	
						Early Field Life	Late Field Life
Flow assurance and separation chemicals							
Deoiler	Gold	No	20	-0.1	13.336	24.4	20.4
Solids flocculant	Gold	No	20	-0.1	13.340	24.4	20.4
Demulsifier	Gold	No	19	5.22	0.51	0.0001	0.0011
Oil antifoam	Gold	No	15	-3.3	0.112	127	16.7
Scale inhibitor	Gold	No	25	-0.1	10	30.5	25.5
Injected chemicals							
Wax inhibitor	Gold	No	500	3.86	0.249	55	6.1
Oxygen scavenger	Gold	No	11	-0.1	2.860	1.2	0.1
Calcium nitrate	Gold	No	150	-0.1	0.070	16.5	1.8
Organic biocide	Silver	No	500	-0.33	0.002	55	6.1
Water antifoam	Gold	No	10	0.9	0.218	1.1	0.1
Scale inhibitor	Gold	No	25	-0.1	10	2.8	0.3

[60] Describing whether or not the chemical will partition to the oil-phase or the water-phase of the total fluid.

Function	HQ band / OCNS rating	Product warning	Applied dosage into oil, gas and water (mg/l)	Partitioning co-efficient[1]	PNEC[2] (mg/l)	Concentration in water phase after partitioning (mg/l)	
						Early Field Life	Late Field Life
Solids flocculant	Gold	No	20	-0.1	13.340	2.2	0.2

[1] Indicating whether the chemical mixed into the PW is likely to partition to the oil phase or to the water phase. If it is a positive number the chemical will partition more highly into the oil phase. If it is negative it will partition more highly into the water phase and more of the chemical will thus be discharged if the PW is discharged.
[2] Predicted No Effect Concentration. A lower value means the chemical is more toxic.

NORM

Organisms are exposed to ionising radiation of natural origin as a result of the decay of radionuclides which are found naturally in their habitat. Doses arising from naturally occurring radionuclides in the marine environment will result from natural background levels of these radionuclides as well as from concentrations of naturally occurring radionuclides in PW (along with those from other anthropogenic practices) (Hosseini, *et al.,* 2012).

Several Naturally Occurring Radioactive Materials (NORM) typically occur in PW. The most abundant are usually radium-226 (^{226}Ra) and radium-228 (^{228}Ra) (Eriksen, *et al.,* 2006). Concentrations of ^{226}Ra and ^{228}Ra in PW tend to increase with salinity, although this relationship can vary (Neff, 2002). Radiation levels in PW related to NORM are generally relatively low and are usually representative of chronic low exposure situations (Hosseini, *et al.,* 2012). Further, ^{226}Ra and ^{228}Ra are moderately soluble in seawater and are typically dispersed away from their discharge points by tidal and ocean currents (Gwynn, *et al.,* 2020).

The detailed NORM content of Phase 1 & 2 PW is not yet known, although as the Sea Lion reservoir is of lacustrine[61] origin, the formation water is expected to have low salinity. Gamma rays are emitted by most radioactive decay processes and can therefore be an indicator of general radioactivity of the rocks and fluids. The two most abundant radionuclides, (^{226}Ra and ^{228}Ra), are α and β- emitters respectively and do not directly emit gamma rays. Nonetheless, the activity of these radionuclides can be estimated *via* their gamma emitting parents or daughters when aiming at the particular energy peaks of the gamma spectrum.

Gamma ray logging of the strata around the Sea Lion Field shows that there is no increase in gamma ray detection through the reservoir compared with surrounding rocks, and in fact the oil- and water-bearing sands exhibit significantly lower activity than the surrounding claystone.

Reservoir hydrocarbon content (free and dispersed oil)

OiW will be measured by an approved technique, normally a specific method of infrared absorption correlated against laboratory samples that have been tested using gas-chromatography flame ionisation detection (BEIS, 2022).

As described above, the Phase 1 & 2 philosophy is for zero discharge of PW by using PWRI, however, while the PWRI is being commissioned, and in the event of PWRI downtime or declines in injectivity, it may be necessary to discharge the PW to sea. In that case, in compliance with OSPAR and the UK OPPC regulations (Section 10.7.1.1.1), all PW will be treated, and samples will be taken twice per day to ensure that the OiW concentration in discharged PW does not exceed a monthly average of 30 mg/l and no single sample will exceed 100 mg/l. When the PWRI is online, samples will be taken at least monthly in line with UK legislation (Section 10.7.1.1.1.1)

[61] Formed from freshwater bodies.

However, given that the OiW concentration needs to be as low as 10 mg/l in order to reinject the PW, it is anticipated that the concentration would still be in the region of 10 - 15 mg/l should the PWRI units become unavailable. Further, Navitas will always endeavor to improve upon the legal maximum OiW limits in line with its annual environmental objectives and targets (Chapter 15).

Dissolved oils and naturally produced organic compounds

Naturally occurring organic substances in PW include both volatile and non-volatile compounds which are dissolved in the water and therefore cannot be removed by the OiW separation regime (C-NOPB, 2002). These dissolved oils include PAHs, monocyclic-aromatic hydrocarbons (e.g., BTEX: Benzene, Toluene, Ethyl-benzene and Xylene), metals and high molecular weight phenols e.g., alkyl-phenols (Eriksen, *et al.,* 2006, Hosseini, *et al.,* 2012, Beyer, *et al.,* 2020).

The specific composition of Sea Lion PW is not yet known. Therefore, a review of PW from North Sea reservoirs was carried out to identify a North Sea analogue. Based on this review, the composition of natural components in Sea Lion PW is estimated in Table 10.47 (Genesis, 2015b). The Predicted no-effect (PNEC) concentrations are also shown indicating the concentration below which no harmful effects will occur, as judged by an OSPAR expert panel and documented in OSPAR Agreement 2014/05.

It should be noted however that the composition of Sea Lion PW may differ significantly from North Sea PW, not least because the salinity of the Sea Lion PW is low compared to average North Sea PW. Further, as the Sea Lion oil was formed from freshwater bodies (i.e., is of lacustrine origin) and a certain level of mercury in the oil is assumed. While a low salinity North Sea analogue was used, there is a high degree of uncertainty with the estimates.

From the CEDRE testing (CEDRE, 2017), low levels of PAH were measured in the crude oil and also in water in contact with the crude. It is therefore likely that the PAH levels estimated for the modelling assessment are very conservative. It is noted here that the PAH components comprise the majority of the risk to the water column, and therefore the level of risk estimated is also probably conservative. Once into steady state production, it will be possible to identify the exact composition of the Sea Lion PW and the RBA will be taken (Section 10.7.5).

Table 10.47: Estimation of the Sea Lion PW composition based on an analogous low salinity PW from the North Sea[1]

Component	Type				Concentration in the PW (mg/l)	PNEC[2]	Component	Type				Concentration (mg/l)	PNEC[2]
	PAH	MAH	Metal	Alkyl phenols				PAH	MAH	Metal	Alkyl phenols		
Acenaphthene	✓				0.0202	0.38	Benzene		✓			27.3	8
Acenaphthylene	✓				0.0072	0.13	Ethyl Benzene		✓			2.7	10
Anthracene	✓				0.0103	0.1	Toluene		✓			15.9	7.4
Benz(a)anthracene	✓				0.0028	0.0012	Xylene		✓			10.2	8
Benzo(a)pyrene	✓				0.0014	0.00017	Copper (Cu)			✓		0.0011	2.6
Benzo(b)fluoranthene	✓				0.0035	0.00017	Arsenic (As)			✓		0.00073	0.6
Benzo(g,h,i)perylene	✓				0.0021	0.00017	Cadmium (Cd)			✓		0.00014	0.218
Benzo(k)fluoranthene	✓				0.0008	0.00017	Chromium (Cr)			✓		0.00065	0.69
Chrysene	✓				0.0097	0.007	Lead (Pb)			✓		0.00045	1.3
Dibenz(a,h)anthracene	✓				0.0024	0.00014	Mercury (Hg)			✓		0.00012	0.0472
Dibenzothiophene	✓				0.6164	0.1	Nickel (Ni)			✓		0.00298	8.6
Fluoranthene	✓				0.0046	0.0063	Zinc (Zn)			✓		0.00847	3.25
Fluorene	✓				0.1039	0.25	C1-C3 Alkyl Phenols				✓	10.339	7.7
Indeno(1,2,3-cd)pyrene	✓				0.0007	0.00017	C4-C5 Alkyl Phenols				✓	0.2996	0.64
Naphthalene	✓				7.2759	2	C6-C9 Alkyl Phenols				✓	0.0823	0.01
Phenanthrene	✓				1.5357	1.3	Dispersed Oil	Reservoir Hydrocarbons				30 (monthly average)	70
Pyrene	✓				0.0119	0.023							

[1] Note that these estimates are subject to change following the onset of steady state production and the opportunity to test the PW.
[2] Predicted No Effect Concentration.

10.7.4.1.2.2 Behaviour and fate of PW discharges

The environmental impact of PW will depend upon its behaviour and fate following discharge, both of which depend on a number of physical, chemical and biological processes:

- Physical:
  - The duration of the discharge,
  - The volume of water and density of the discharge in comparison to seawater,
  - Depth of the discharge e.g., topside or subsea,
  - Sea state,
  - Wind strength, and
  - Current direction and strength.
- Chemical:
  - The inherent toxicity of the discharge,
  - The OiW concentration,
  - The volatility of low molecular weight hydrocarbons and biodegradation of organic compounds (OSPAR, 2009a), and
  - The concentrations of the components in the water column following natural dilution.
- Biological:
  - The length of time biota are exposed to a given concentration, and
  - The sensitivity of the organisms to the particular component.

Depending upon the above, and as described by Holdway (2002) and the International Association of Oil and Gas (O&G) Producers (OGP, 2005), the potential fate of PW plumes are varied. Ultimately, PW can:

- Sink to the seabed or remain on (or rise to) the surface, depending upon the effects of temperature and salinity on the buoyancy of the discharge plume,
- Volatilise (evaporate) to the atmosphere (low molecular weight organic compounds),
- Be biodegraded by micro-organisms (low molecular weight organic compounds),
- Precipitate (become solid) on discharge (low molecular weight organic compounds),
- Adsorb (attach) onto suspended solids and settle out onto the bottom sediments (higher molecular weight organic particles),
- Be dispersed by water currents, and / or
- Be ingested and metabolised by pelagic and / or benthic marine organisms.

Individually or collectively, these processes tend to reduce concentrations of PW components in the receiving environment and thereby decrease their potential toxicity and bioavailability to marine organisms (OGP, 2005).

10.7.4.1.3 Grey water, black water and food waste

The maceration of the food, discharge concentrations, location and depth of grey and black water should all ensure that waste discharges are dispersed and diluted rapidly by the natural water movement around the vessels, thus minimising the impact of nutrient enrichment. Additionally, the natural activity of bacteria and other marine organisms will rapidly break down organic waste.

10.7.4.1.4 MODU / FPSO bilge and drainage discharges

Water from the MODU / FPSO drainage separation and bilge processes may contain emulsified oil and grease, diesel, hydraulic oil, lube oil, and marine fuels. Following separation, the water will be discharged provided it has an OiW concentration <15 ppm.

10.7.4.1.5 Hypersaline water

The volume of hypersaline discharge from each vessel will depend upon the number of crew members on board and any additional operational requirements for potable water. The potential impacts of hypersaline discharges in open ocean conditions are not well understood and the majority of studies report on the impacts to sub-tropical or temperate shallow, nearshore and low-energy marine environments. The desalination plants included in a critical review of published studies on the impacts of hypersaline water by Roberts *et al.* (2010) discharged volumes ranging from 2,000 - 288,000 m^3 per day with salinity concentrations ranging from 37.3 -to 75 psu (practical salinity units) in the nearshore, shallow water environment.

In the majority of cases, the intensity of the plume appeared to diminish rapidly and was usually no greater than 2 psu (or 2 mg/l) above the background salinity of 34 psu (34 mg/l) within 20 m of the outlet, and less than 0.5 psu (0.5 mg/l) when measured hundreds of metres from the outlet.

In a study of the impact potential of hypersaline brines released into the marine environment, Dewar *et al.* (2022) found that dispersion in a hydrodynamically active region like the North Sea acts to dilute disposed brine rapidly such that the potential impact footprint is small and can be measured in tens of metres. This was found to depend on the release scenario and site-specific data, for example the *in situ* conditions such as currents and mixing. The method of brine disposal has a significant influence on dispersal, and brines released nearer the sea surface disperse more rapidly, compared with those released at the seabed. Of note, all hypersaline discharges at the Sea Lion field will be to the surface and into a dynamic environment.

10.7.4.2 Nature of the potential impact

10.7.4.2.1 General operational fluids

All the chemicals which make up the composition of the hydrotest, wellbore clean-up / completion fluid and cooling waters as well as the NADF and hydraulic oils will be listed within the Cefas Definitive Ranked List of Registered Products (Section 10.7.1.1.2). As such, all the chemicals used will have gone through rigorous testing with regard to their biodegradability, toxicity and persistence. The potential impacts to water quality and marine organisms are associated with these factors. In particular, the hydrotest and cooling water will contain biocides that are necessarily intended to have lethal effects. While there is the possibility for acute effects, it is likely that the discharges will be rapidly diluted by seabed and surface currents such that no chronic impacts are anticipated.

With regard to hydraulic oils specifically, the potential impacts to marine organisms are associated with the components in the oil. Historically, hydraulic fluids often had Substitution Warnings (Section 10.7.1.1.2), often due to the low biodegradability of the lubricant components. However, as hydraulic fluids without Substitution Warnings are now available and are intended for use, and as such small quantities are discharged, any environmental impact is expected to be minimal.

10.7.4.2.2 Produced water as a substance

The dilution of PW when discharged to the marine environment has long been considered adequate to mitigate the risks of harmful ecological effects at offshore production fields (e.g., Koons, *et al.,* 1977; Middleditch, 1984; Somerville, *et al.,* 1987; Girling, 1989; Stephenson, 1992, Balk, *et al*., 2011). Produced water discharges will disperse and dilute in the receiving water body according to a number of factors, including:

- The composition of the discharged mixture,
- The flow rate, depth, direction and speed of the discharge jet,
- The prevailing current, tidal and wind conditions at the site,
- The differences in temperature, salinity, density, and buoyancy between the PW plume and the surrounding seawater,
- The stratification of the water column,
- Turbulent mixing conditions; and
- Advection-diffusion processes (Beyer, *et al.,* 2020).

In addition, the PW mixture will be transformed and reduced by the weathering of its constituents, particularly by volatilisation, microbial biodegradation and photodegradation (McFarlin, *et al.,* 2018).

It is known to be challenging to characterise all the possible biological impacts associated with PW discharges. Nonetheless, several earlier summaries of research and monitoring programs have concluded there is little to no evidence that significant impacts occur outside the primary dilution zone downstream of PW outfalls (Beyer, *et al.,* 2020). Modelling studies show that offshore PW plumes dilute rapidly and although the rate of dilution may vary depending on the site-specific factors mentioned above, PW may typically reach a 1,000-fold dilution at a distance of 1,000 m from the PW outfall (Neff, 2002).

However, despite these general assessments, there are still a number of unknowns such that studies continue in efforts to identify the uptake routes, suitable biomarkers[62] and to identify the possible environmental impacts from PW. Some mild acute effects are found in water column biota some kilometres away from large PW outfalls, but whether there are notable chronic (and ecologically adverse) effects occurring in a larger area downstream remains largely unknown.

10.7.4.2.2.1 Uptake routes and biomarkers

Biological uptake of hydrophobic[63] organic contaminants such as those found in PW, and NORM, can occur in numerous ways, including, but not necessarily limited to:

- Passive uptake over gill surfaces,
- Passive and active uptake over digestive linings, and
- Active uptake of contaminated food particles (Hosseini, *et al.,* 2012; Beyer, *et al.,* 2020).

In order to assess the potential impacts of exposure to PW, it is necessary to identify relevant and sensitive biomarkers. In fish, the liver-bile-faeces pathway is the major route for elimination of toxic substances such that bile metabolites are an effective way to test for contamination with, for example, PAHs and alkylphenols (Beyer, *et al.,* 2020).

Other common biomarkers used include, but again are not limited to:

- Liver enzymes used to metabolise contaminants,
- Hormonal changes resulting from xenoestrogenic[64] effects,
- The presence of precursor proteins[65],
- Endocrinology and reproductive systems,

[62] A biomarker is a biological molecule found in blood, other body fluids, or tissues that is a sign of a normal or abnormal process, or of a condition or disease.

[63] Molecules that do not mix with water.

[64] Xenoestrogens are chemicals that mimic oestrogen and can disrupt the body's natural hormonal balance.

[65] Protein precursors are proteins that serve as building blocks for other proteins and perform various cellular functions.

- Cardiac toxicity,
- Impaired development e.g., of fish embryos, and
- The presence of PAH-related DNA adducts[66].

10.7.4.2.2.2 Acute impacts of PW discharge on marine organisms

Numerous studies have been carried out to assess the impacts of acute toxicity of 'whole PW' as a substance and were reviewed by Holdway (2002). The acute effects of the PW discharges studied included:

- Alteration of benthic communities dominated by short-lived opportunistic species up to 100 m from offshore installations (Neff, *et al.,* 1992),
- A decrease in abundance of biofouling organisms on solid platform structures, and
- Increased mortality of filter feeders within 23 m of a PW outfall (Black, *et al.,* 1994a, b), and
- Detectable exposures in caged mussel and fish several kilometres downstream from PW outfalls, (but notably the biomarkers indicated only mild acute effects in these sentinels (Beyer, *et al.,* 2020).

However, within the studies reviewed by Holdway (2002), a large range in results was observed. It was concluded by the respective authors that the range in impacts observed was due to the varying concentrations and types of chemicals in the PW batches tested and distribution models predicted that acute toxicity effects would be negligible outside the immediate mixing zone (Holdway, 2002).

The UK government has summarised the potential impacts of PW in Strategic Environmental Assessment (SEA) work. The SEAs state that most studies of PW toxicity and dispersion, in the UK and elsewhere, conclude that, while under some circumstances (e.g., strong stratification), a plume concentration sufficient to result in sub-lethal effects may persist for >1,000 m, the necessary dilution to achieve a No Effect Concentration (NEC) would usually be reached at <10 to 100 m and always less than 500 m. Indeed, according to Meier *et al.* (2010), liver enzyme biomarker responses were found in fish only when the specimens (Atlantic cod (Gadus morhua)) were exposed to a PW concentration of 1 % oil in water, which realistically would represent a distance of less than 100 m from a PW outfall offshore.

With regard to NORM contamination, the radiobiological effect of ^{226}Ra on Atlantic cod embryonic cells was studied by Olsvik *et al.* (2012). The results of this study suggested that environmentally relevant activities of ^{226}Ra can induce oxidative stress and apoptosis[67] in embryonic cells of the fish. Nonetheless, while follow-up studies were suggested to better understand the link between these short-term effects and possible impacts on growth and survival rates, the authors of this study concluded that radionuclides present in produced water have a relatively low impact on early life stages of fish (Hosseini, *et al.,* 2012).

With regard to chemicals entrained within the PW, the careful selection of chemicals known to have minimal environmental effect (Section 10.7.1.1.2), will aim to ensure the acute toxicity of PW can be considered to be modest (Holdway, 2002).

10.7.4.2.2.3 Chronic impacts of PW discharge on marine organisms

There are less data available regarding the chronic effects of PW (Beyer, *et al.,* 2020). Nonetheless, some of the potential effects seen in the field, and the laboratory during chronic toxicity tests, include:

- Impacts on the surface microlayer surrounding producing installations,

[66] PAH-related DNA adducts are a form of DNA damage caused by covalent attachments of PAHs to DNA.
[67] A type of cell death caused by a series of molecular steps.

- Altered benthic community species composition,
- Altered behaviour and / or physiology e.g., cardiac toxicity syndrome,
- Reduced growth / impaired development,
- Decreased rates of reproduction (fecundity), and
- Damage to DNA (DNA adducts) (Beyer, *et al.,* 2020).

Beyer *et al.* (2020) conducted a review of the environmental effects of offshore PW discharges on the Norwegian Continental Shelf (NCS) which has a depth range of 200 – 500 m.

The review describes increased concentrations of DNA adducts which are found repeatedly in benthic fish populations, (especially in haddock (Melanogrammus aeglefinus), a North Atlantic bottom-feeding species), although it is uncertain whether these are a long-term effect of sediment contamination due to ongoing PW discharges in the region, or earlier discharges of oil-based drilling waste given that O&G operations have been conducted on the NCS for over 40 years. PAH-related DNA adducts are a form of DNA damage caused by covalent attachments of PAHs to DNA. Many studies have shown that fish will develop high concentrations of such adducts in different tissues when exposed to PAH mixtures of pyrogenic[68] or petrogenic[69] origins (e.g., Aas, *et al.,* 2000; Aas, *et al.,* 2001; Holth, *et al.,* 2009; Balk, *et al.,* 2011; Sundt, *et al.,* 2012b; Pampanin, *et al.,* 2017). If not removed by the DNA repair systems of the affected cells, these adducts can cause mutations that eventually may give rise to development of tumors and other cancer-associated diseases. However, Beyer *et al.* (2020) state that the potency for forming DNA adducts varies greatly among PAHs and the most common petrogenic PAHs in PW are generally of low potency. In support of this, caged groups of fish (Atlantic cod) were exposed to diluted PW plumes for 5–6 weeks at fixed positions in the water column and at increasing distances downstream of different PW outfalls. This caged approach provides a semi-controlled *in situ* exposure model, effectively another mesocosm study. Beyer *et al.* (2020) state that these offshore caging exposures generally did not cause increased DNA adduct concentrations, even when caging was performed close to the Statfjord and Gullfaks platforms (i.e., in the platform-dense Tampen area of the NCS) in 2001, 2002 and 2004 and at the Troll field in 2003. Likewise, subsequent surveys in 2006, 2008 and 2009 at the Ekofisk field in the central North Sea, showed no increase in DNA adduct concentrations in cod caged for 5–6 weeks. The absence of adducts was noted even in the groups caged in the diluting plume only 200–250 m downstream of the PW discharge point (Beyer, *et al.,* 2020).

Field surveys in the NCS offshore monitoring program have repeatedly used such caging of fish and mussels to test for accumulation and effects of PW contaminants. The caged sentinels were kept for up to six weeks at fixed positions in the likely path of the diluting PW plume, at least for a certain part of the tidal cycle. In contrast to the above caged studies, these offshore monitoring surveys repeatedly demonstrated that the caged biota did develop exposure signals that were in quite good agreement with their distance downstream of the PW outfall/s. The best exposure markers were two- and three-ring PAHs, with parent PAHs being detected in caged blue mussels (*Mytilus edulis*) and biliary[70] PAH metabolites being detected in the caged fish. The increased concentrations of bile metabolites of petrogenic PAHs and alkylphenols were detected in fish caged as far as 10 km downstream from offshore production platforms in the assumed direction of the PW plume (Beyer, *et al.,* 2020). However, Beyer *et al.* (2020) note that it is uncertain to what extent caged fish are representative of the real-world conditions experienced by wild and free moving fish in offshore waters. In offshore condition monitoring surveys, wild-caught fish species collected in areas relatively close to oil

[68] Of or relating to igneous origin.
[69] Of or relating to the origin or formation of rocks and especially of igneous rocks.
[70] Relating to bile or the bile duct.

platforms have generally shown few indications of exposure of contaminants from PW discharges (Beyer, *et al.,* 2020) and controlled behaviour studies have shown that adult fish will actively avoid environments contaminated with PAH or oil above certain thresholds, (e.g., Claireaux, *et al.,* 2018).

Endocrine Disrupting Compounds (EDCs) in offshore PW discharges became a concern around the mid-1990s, especially after alkylphenols were identified as a likely cause for xenoestrogenic effects in fish in some UK rivers. As such, more than 30 research studies (many conducted by the Norwegian Institute of Marine Research) to address the effects of PW discharges on the endocrinology and reproduction of offshore fish and fish populations have been carried out. However, a risk assessment based on the results of all these studies concluded that there was no significant risk of adverse reproductive effects on the cod, saithe (*Pollachius virens*) or haddock populations in the North Sea as a result of exposure to alkylphenols from offshore PW discharges (Beyer, *et al.,* 2020).

With regard to NORM, a review of studies on the impacts of NORM on biota was carried out by Hosseini *et al.* (2012). While the review stated the need for further research, the paper concluded that risk to the environment from naturally occurring radionuclides discharged in produced water is considered to be negligible (Hosseini, *et al.,* 2012). However, some studies indicate that the speciation[71], mobility and bioavailability of radium in produced water from O&G installations can vary with the barium concentration of the PW, the mixing with seawater sulphates and the presence of added flow assurance chemicals such as scale inhibitors (Eriksen, *et al.,* 2006).

Two studies conducted off Louisiana in the Gulf of Mexico in scenarios intended to reflect the wide range of activity concentrations of radium that may be present near offshore O&G installations, and the associated impacts upon fish, molluscs and crustaceans were reviewed in Hosseini *et al.* (2012) (see Hamilton, *et al.,*1991; Meinhold, *et al.,* 1996). Making use of an estimated no-effect level for individuals provided by Anderson and Harrison (1986), Hamilton *et al.* (1991) concluded that all resulting dose rates were below the threshold at which any deleterious effects might occur. Similarly, testing the dose rates for finfish and shellfish species living close to platforms, Meinhold *et al.* (1996) found that none of the subjects exceeded the reference limit. According to Neff (2002), concentrations of ^{226}Ra and ^{228}Ra in PW from the Gulf of Mexico are probably higher than other offshore locations in the world such that if no risk was identified here, NORM would be unlikely to pose a risk to marine biota elsewhere.

More recently, Beresford *et al.* (2011) applied screening level assessments for the impacts of radionuclides on three offshore *Natura 2000*[72] sites on the UKCS. Based on the outputs of their assessments, the authors concluded that there is negligible risk to the three considered sites from releases of radioactive substances from marine O&G platforms (Hosseini, *et al.,* 2012).

It is therefore the case that there remains some ambiguity as to the chronic effects of PW discharges on marine life.

Although the specific species and PW compositions in the above studies may be different to the Sea Lion Development which is located in 450 m of oceanic water, the results above show that some biota may be adversely affected by the hydrophobic organic components in PW plumes, even in highly dynamic environments. However, of note, the Sea Lion Development will be operating in isolation of other sources of PW and will be reinjecting, rather than discharging, the PW once the PWRI equipment is commissioned (Section 5.8.5.8).

[71] Radionuclide speciation is the physical and chemical properties of radionuclides, which determine their behavior in the environment and their toxicity.

[72] *Natura 2000* is a network of protected areas covering Europe's most valuable and threatened species and habitats.

The Predicted No-Effect Concentrations (PNEC) used in the DREAM analysis described in Section 10.7.4.5 below are chronic values taken from a large dataset and are included in the latest OSPAR agreed list (Agreement 2014/05, updated *via* OSPAR Working Groups). The DREAM modelling results presented below predict the area that might be at chronic toxic risk. Further, once the PW breaks through in the total fluids, further sampling will be taken and the RBA to PW as a whole substance will be taken, as described further in Section 10.7.5.

10.7.4.2.3 Grey water, black water and food waste

With regard to seawater quality, the discharge of grey water, black water and galley food waste may lead to minor localised impacts on water quality due to nutrient enrichment. This in turn can result in increased numbers of plankton, and therefore a localised increase in Biological Oxygen Demand (BOD) around the discharge point.

As with any vessel at-sea, the MODU, the FPSO and all project vessels are likely to attract a mixed flock of seabirds, including albatross and petrel species which are listed under the Agreement on the Conservation of Albatrosses and Petrels (ACAP) (Section 7.4.5.5.2), many of which rely on scavenging for much of their food.

10.7.4.2.4 Drainage and bilge water

The potential impacts of drainage and bilge water discharges are associated with any chemicals, grease, diesel or oil in the wash-down water collected by the drains or bilge tanks. While there is the possibility for acute effects through sheens, all discharges associated with drainage and bilge are likely to be highly diluted with rainwater and seawater on deck. Further, it is likely any discharges will be rapidly diluted by surface currents such that no chronic impacts are anticipated.

10.7.4.2.5 Hypersaline water

Ecological monitoring studies have found variable effects ranging from no significant impacts to benthic communities, through to widespread alterations to community structure. However, all these are from studies on discharges to poorly flushed and shallow environments (Roberts, *et al.,* 2010) and thus do little to inform an impact assessment on surface saline discharges to the open ocean. According to Dewer *et al.* (2022), little impact is observed in dynamic environments such as the North Sea, or indeed the Southern Ocean (Section 10.7.4.1.5).

10.7.4.3 Potential for oil sheens

10.7.4.3.1 Sources of oil sheens

Oil sheens (and slicks) are most commonly associated with large and small spills of oil and diesel, the impacts and risks of which are assessed in Section 12.1. However, legally compliant operational discharges such as PW, bilge and drainage waters are also recognised as a low-level contributor to chronic oil pollution (NRC, 1985; 2003).

Impact to seabirds from legally compliant discharges arises predominantly from the potential for thin surface oil sheens. While OiW concentrations of discharges are tightly controlled by legislation (Section 10.7.1.1), oil sheens can, in practice, be associated with PW (Fraser, *et al.,* 2006) and may occur at OiW concentrations as low as 25 mg/l when discharged on calm days (Wills, 2000). In the North Sea, it is necessary to report sheens which extend beyond the 500 m exclusion zone. These can occur even when all discharges have been in compliance with regard to OiW concentration and discharge volumes, although their occurrence is rare and normally coincides with extremely calm conditions.

However, OSPAR is concerned with the oiling of seabirds and in an OSPAR-commissioned report, Camphuysen (2005) states that there is good evidence that bilge oil is the main source of oil pollution, with a clear correlation between oiled guillemots and shipping lanes. Therefore, there is the potential

that compliant bilge and drainage discharges could lead to sheens although, as described above, this would require very calm weather. Such weather occurs rarely at the Sea Lion location with wave heights at 0-1 on the Beaufort Scale occurring less than 3 % of the time according to metocean reports for the location.

Nonetheless, the sensitivity of seabirds to oil pollution *via* oiling and / or ingestion is taken very seriously and therefore, to take a precautionary approach, it is necessary to consider the potential contribution of all discharges to chronic oil pollution and the acute and / or chronic impacts upon seabirds.

10.7.4.3.2 Formation of oil sheens

The relationship between the discharge of oil in PW, bilge and drainage water and the occurrence of oil sheens is not well understood. The formation of sheens may be related to the characteristics of the receiving waters, the rate and depth of discharge, the characteristics of the PW such as temperature, quantity of solids, type of hydrocarbon, discharge volume, oil droplet size and / or the presence of certain types of metals such as iron (ERIN Consulting Ltd. and OCL Services Ltd., 2003). Further, while sheens are mostly comprised of the free oil (Section 10.7.4.1.2.1), Veil *et al.* (2004) suggest that the dispersed and dissolved oils (Section 10.7.4.1.2.1), which are not easily removed from the PW, also contribute to sheen formation.

Regardless of why or how sheens form, a surface oil film of <3 µm is referred to as a 'sheen' and an oil film >3 µm is referred to as a 'slick' (ERIN Consulting Ltd. and OCL Services Ltd., 2003). According to O'Hara and Morandin (2010) a light sheen is approximately 0.1 µm thick and has a hydrocarbon volume of approximately 0.1 ml/m^2 of the surface water.

Testing of the Sea Lion crude was undertaken to determine the impact of PW streams on feathers (CEDRE, 2017). Local feathers from nine species of Falkland birds[73] were tested in dispersed oil at a concentration of 100 mg/l, and oil droplets of *c.* 100 microns were produced into the water column. In compliance with legislation (Section 10.7.1.1), and in the event of PW discharge, this is the maximum concentration that would be present at the mouth of the discharge caisson. However, as explained in Section 10.7.2.5, in the event of PWRI malfunction, the Phase 1 & 2 target is OiW concentrations of 10-15 mg/l of oil on a continuous basis. Of note, it is estimated that the PWRI system will be operational 93 % of the time, during which there would be no discharge at all.

Feathers exposed to the dispersed Sea Lion oil at 10 mg/l in the water column showed oil particles adhered to all species of feathers tested, though no structural damage to feathers was observed. However, it was noted that the barbules (the intricate 'feathery' parts in between the feather's structure) were 'messy' following contact with the oil / water solution (CEDRE, 2017). Depending on their distance from the PW caisson, birds exposed to PW would probably be exposed to concentrations two or three orders of magnitude lower than that used in the test.

Bulk crude at 55°C was also released into completely calm seawater at a temperature of 18°C. This test indicated that the Sea Lion crude can form a very thin sheen on completely calm water when a large mass is spilled. When samples of this sheen were observed in outdoor conditions they would correspond to the lower limit of Band 1 in the Bonn Agreement Oil Appearance Code i.e., near 0.04 µm thickness. When samples of the sheen were tested, the amount of oil present was below the limit of detection. This indicates that only in a large spill scenario would Sea Lion crude develop a very thin sheen, and sheens are unlikely to be observed as a result of PW discharges (CEDRE, 2017). Although

[73] The nine species selected were: black-browed albatross, gentoo penguin, king cormorant, thin-billed prion, king penguin, Wilson's storm petrel, South American tern, silver-grey fulmar and sooty shearwater. For the prion, feathers from the back and the stomach were studied, leading to a total of ten feather types (CEDRE, 2017).

the test represents a 'best estimate' on how the oil will manifest i.e., in microscopic particles, the actual nature of the oil in PW will be confirmed once the system is brought online.

10.7.4.3.3 Sheens and seabird contamination

As described in Section 10.7.4.2.3, seabirds tend to be attracted to offshore structures owing to localised enrichment from sewage and food discharges as well as the presence of artificial light (Tasker *et al.,* 1986, Baird 1990, Wiese *et al.,* 2001). Therefore, such birds may be at risk of low-level oil contamination and / or ingestion in the event of a sheen, which may lead to impacts upon:

- Feather microstructure and thus thermoregulation and buoyancy (O'Hara and Morandin, 2010; Fraser *et al.,* 2006; Levy, 1980), and / or
- Reproductive success (Camphuysen, *et al.,* 2005; Rocke, 1999; Butler, *et al.,* 1988).

While it is known that feather fouling with as little as 10 ml of heavy oil can significantly reduce thermoregulation in seabirds and may be lethal (Hartung, 1967; McEwan and Koelink, 1973; Levy, 1980; Lambert, *et al.,* 1982; Jenssen and Ekker, 1989; Burger and Fry, 1993), such a degree of contamination is unlikely to ever occur from a sheen alone. However, laboratory-based experiments determined that exposure to oil sheens at a thickness of 0.1 µm could result in measurable oil transfer to feathers. While the impact of such contamination has not been investigated in practice, the study was able to demonstrate that such contamination does affect the essential microstructure of the feathers (O'Hara and Morandin, 2010).

Additionally, Butler *et al.* (1988) found that contamination of feathers with as little as 0.1 ml of oil significantly reduced hatching success in Leach's storm-petrels (*Oceanodroma leucorhoa*) due to abandonment of the egg by the contaminated bird and / or its mate. While the breeding success of the individuals in the experiment returned to normal the following year, this indicates the potential for small amounts of feather contamination to impact upon seabirds (Butler, *et al.,* 1988).

The level of contamination however will depend upon the level of contact the bird has with the sheen and this is likely to depend upon the foraging modes of different species (King and Sanger, 1979; Camphuysen, 1989; Williams *et al.,* 1994). For example, species that feed by diving below the surface or feeding at the ocean's surface (e.g., the IUCN 'Least Concern' black-browed albatross or the 'Endangered' northern royal albatross, Section 7.4.5.2.2) are at greater risk of plumage fouling than those that pluck prey from the surface while in-flight.

While there are limited data on the level of contact, and the thickness of the sheen, required to affect the microstructure of feathers, or to contaminate the bird sufficiently to impact upon reproduction, it is believed that small quantities of oil contamination could have severe consequences (Butler, 1998; O'Hara and Morandin, 2010).

However, while the data indicate that small levels of contamination may impact upon mortality and reproductive success in seabirds, it is not clear whether or not one-off exposure to sheens translate into impacts on the fitness of individual birds or populations.

10.7.4.4 Volume of planned discharges

10.7.4.4.1 General operational fluid discharge volumes

Where possible, the estimated volumes of the discharges are provided in Table 10.48.

Table 10.48: Estimated volumes of discharge

Discharge	Estimated Volumes
Hydrotest discharges	The volumes and dosages associated with hydrotesting will be defined during the FEED / Detailed Design phase of design, at which time a more detailed assessment will be provided. At this time, it will be possible to conduct 'Osborne-Adams' subsea discharge models to determine the impact upon the benthos.
Wellbore clean-up / completion fluid	It is anticipated that approximately 3,000 bbls (477 m^3) of visibly clean water (under the OEUK Well Clean-up Guidelines, Section 10.7.5) will be discharged per well. Over the Development drilling campaign this will result in a total of 78,000 bbls (12,394 m^3) being discharged in total.
Cooling water	It is anticipated that approximately 70,000 m^3/day of CW will be discharged to sea after being used in the cooling system. While the specific biocide for use has not yet been selected, and the dosages are currently unknown, the application strategy will be optimised to ensure any impact is as low as reasonably practical given the unavoidable need for a biocide in the cooling system.
Hydraulic fluids	Small volumes of hydraulic fluid will be discharged during each valve actuation.

[1] The completion fluid is effectively the fluid in the completed well after well cleanup. On first flowback it will go through the PW system on the FPSO.

10.7.4.4.2 Volumes of planned PW discharges during commissioning

As explained above, under normal and planned operations, the FPSO facilities will be capable of treating all PW for reinjection.

It is anticipated however that there may be discharge of PW when it first starts to appear and the PWRI units are being commissioned. At the time of writing it was not possible to estimate when PW may start to arrive, nor how much may be discharged during the commissioning phase. However, water will start to cut from the production wells at different times and the PWRI commissioning process will commence upon first arrival of water from any one of the production wells. Therefore, all efforts will be made to minimise discharges that follow between the first 'water cut' and full implementation of the PWRI system. Therefore, it is anticipated that PW discharges during the commissioning stage will be low volume and short-lived.

In the event of PWRI downtime such that the PW has to be discharged to sea, all PW will be treated and sampled prior to discharge to ensure that it is compliant with the OSPAR and UK OPPC OiW concentration limits. OiW concentrations of 10-15 mg/l will be targeted at all times. In the event that the OiW concentration exceeds the legal limits, it will be diverted to the off-spec tanks (which have a capacity of *c.* 17,038 m^3) before being re-routed back into the separation process. Off-spec PW will not be discharged (Section 10.7.2.5).

Discharge volumes associated with PWRI downtime (which is unplanned) are estimated below in Section 10.7.4.5.1.

10.7.4.4.3 Volumes of grey and black water

It is estimated that the conventional systems on the vessels will generate 0.2 m^3 / person / day of grey water, and 0.07 m^3 / person / day of black water (Huhta, *et al.,* 2007). Using these data it is possible to estimate the wastewater volumes that will be produced by vessels associated with the three Stages of the project (Table 10.49).

It should be noted here that for vessels > 400 GT or certified to carry >15 persons on board, black water cannot be discharged within 3 nm of the coast (Section 10.7.1.1.6).

Table 10.49: Estimated grey and black water volumes generated by vessels during the Phase 1 & 2 Development[1]

Development stage	Water m^3 / day / person[2]		Volume of grey water (m^3)	Volume of black water (m^3)
	Grey water	Black water		
Stage 1 (31 months)				
Total	0.2	0.07	47,280	16,548
Average per month			1,525	534
Stage 2a & 2b (35 months)				
Total	0.2	0.07	59,568	20,849
Average per month			1,702	596
Stage 3 (27.1 years)				
Total	0.2	0.07	276,014	96,605
Average per month			688	241
Cumulative over whole project				
Total for 32.6 years			**382,862**	**134,002**
Average per month over 32.6 years			**979**	**343**

[1] Please note that the numbers are correct but cannot be exactly replicated in the word document due to rounding in the excel spreadsheet.
[2] The numbers of personnel used to calculate grey and black water volumes are based on an average worst-case (maximum number) of offshore personnel during each Stage and this is applied throughout that stage. Stage 1 max offshore personnel = *c.*250, Stage 2a & b = *c.* 280, Stage 3 = *c.* 140. Please note these numbers are averaged over a long period of time and are subject to rounding discrepancies.

10.7.4.4.4 Volumes of MODU / FPSO bilge and drainage water

The amount of water passing through the drains pumps will depend on the volume of precipitation received. It is therefore not possible to estimate the quantity of water (and thus oil) that may be discharged. In the event that drainage or bilge water exceeds 15 ppm however, discharges will cease. Operational discharge records will be kept in line with the current legislation (Section 10.7.1.1) and reporting will be carried out in accordance with current FIG requirements.

10.7.4.4.5 Volumes of hypersaline discharge

The volume of desalination discharge water will depend upon the demand for potable water on any given vessel (e.g., the number of people on board) and the volume of water required for operations. Typically, to generate sufficient volumes of potable water, the volume of desalination discharge water is approximately 0.3 m^3 / person / day which results in an average of 5,154 m^3 per month over the course of the Development (Table 10.50).

Operational discharge records will be kept in line with the current legislation (Section 10.7.1.1) and reporting will be carried out in accordance with current FIG requirements.

Table 10.50: Estimated hypersaline discharge volumes during the Phase 1 & 2 Development

Development stage	Water m^3 / day / person[1]	Water m^3 / day for operations	Volume of saline water (m^3)	
			For consumption	For operations
Stage 1 (31 months)				
Total	0.3	n/a	70,920	0
Average per month			2,288	0
Stage 2a & 2b (35 months)				

Development stage	Water m^3 / day / person[1]	Water m^3 / day for operations	Volume of saline water (m^3)	
			For consumption	For operations
Total	0.3	138[2]	89,352	146,913[3]
Average per month			2,553	4,198
Stage 3 (27.1 years)				
Total	0.3	138[2]	335,399	1,372,583
Average per month			1,032	4,223
Cumulative over whole project				
Total for 32.6 years			**495,670**	**1,519,495**
Average per month over 32.6 years (391 months)			**1,268**	**3,886**
Total average per month over 32.6 years			**5,154**	

[1] Volumes of hypersaline discharge water from generating potable water for consumption are estimated at 0.3 m^3 / person / day.
[2] Figure provided by Navitas as an estimate of the daily hypersaline discharge expected to result from the creation of 30 tonnes / day of potable water, to cover all FPSO freshwater requirements (including water for personnel).

10.7.4.5 Estimation and modelling of unplanned PW discharges

It is anticipated that even in the event of successful PWRI operations, the PWRI facilities may be shutdown for up to 7 % of the time (25.5 days per year). During such times, it will be necessary to divert PW to the off-spec tank for reprocessing or to discharge it to sea. In some O&G developments PWRI is not successful, and in the event of significant issues with injectivity the project may need to use seawater only for reservoir management, meaning that all PW would be disposed of overboard. In the event of abnormal conditions requiring that the PW be discharged, the effluent will be treated and sampled prior to discharge in order to ensure the OiW content is within the legal limits (Section 10.7.1.1.1.1). As stated above, PW with OiW concentrations that are higher than 10-15 mg/l will be diverted to the off-spec tank (Section 10.7.2.5).

To predict the risk to the water column from PW discharges during PWRI downtime, Genesis was commissioned to carry out the following modelling, which has been updated by Navitas:

- DREAM (Dose-related Risk and Effect Assessment Model) and EIF (Environmental Impact Factor) (DREAM/EIF) modelling to assess the risks associated with PW discharges to sea.

The aims of the model were:

- To simulate anticipated realistic worst-case PW discharges during early and late Field Life using the estimated flow rates and PW composition (based on a North Sea analogue (Section 10.7.4.1.2.1)),
- To compare the predicted concentrations of substances within the PW discharges with the known 'no-effect concentrations' published by OSPAR for discharges to the marine environment, and
- To assess the overall risk to the marine environment from the discharges of oil, low molecular weight organic compounds and chemicals.

10.7.4.5.1 Potential volumes of unplanned PW discharges

The quantity of PW generated by the Phase 1 & 2 Development will increase over time as the oil reservoir becomes depleted and the water cut increases. Therefore, in the event that the PWRI units are down, the potential daily volume of PW discharge would be higher in late Field Life than it would be in early Field Life.

The anticipated volumes of oil and PW are shown in Table 10.51. These values reflect both high oil volumes, which tend to increase concentrations of chemicals in PW, and high water volumes, which can result in the minimum rate of dispersion upon discharge.

Table 10.51: Flow rates and volumes of PW and oil production

Produced fluid	Early Field Life[1]	Late Field Life[1]
Oil Production	8,390 m^3/d	2,016 m^3/d
PW	1,626 m^3/d	16,796 m^3/d
Total produced fluids	10,016 m^3/d	18,812 m^3/d
7 % downtime	25.5 d/yr	25.5 d/yr
PW discharge in 25.5 days	41,461 m^3	428,294 m^3

[1] From 'High' case production profile

10.7.4.5.2 The DREAM / EIF modelling approach

The DREAM / EIF modelling approach is an accepted method for assessing PW and chemical discharges in the North Sea and, according to the UK RBA Guidance (BEIS, 2020), is one of the tools accepted for demonstrating levels of risk within the RBA framework (Section 10.7.1.1.1.2).

DREAM consists of both a 'dispersion model', based on wind and 3D current data, and a 'component-specific fate model' whereby the physiochemical, toxicological and biodegradation properties of the compounds within a discharge are modelled. From these combined models, overall toxicity risks to the environment are calculated.

To enable brevity in this section, the following describes only the information required to ensure appreciation and understanding of the modelling results.

10.7.4.5.2.1 Discharge parameters used in DREAM

Table 10.52 shows the discharge parameters that were used in DREAM to assess the risk associated with Phase 1 & 2 PW discharges.

Table 10.52: PW discharge parameters used in DREAM

Parameter		Value	Comments
Discharge location	Latitude	49° 16' 21.9912" S	These co-ordinates relate to an earlier proposed location of the FPSO but are sufficiently close that results remain reliable
	Longitude	59° 5' 53.0042" W	
Discharge depth (m)		8 m	A discharge 8 m below the surface has been assumed, representative of the FPSO type
Discharge temp (°C)		75°C	Process temperature may be higher but PW will cool in pipework during flow to discharge point
Discharge orientation		Vertically downwards	-
Discharge rate	Early Field Life	1,626 m^3/d	From production profiles
	Late Field Life	16,796 m^3/d	
Discharge salinity (mg/l)		6.4	From Basis of Design document (Premier, 2015a)
Discharge duration modelled		7 % downtime in a year = 25.5 days	Model duration is 42 days to allow up to two weeks for the plume to reach a steady state followed by 28 days discharge in accordance with the UK RBA Guidance (BEIS, 2020). The model assumes that PW discharges will occur continually rather than intermittently through the year.

10.7.4.5.2.2 Understanding the model, the PEC:PNEC ratio and the Environmental Impact Factor (EIF)

The risk assessment is based on a comparison of the:

- PEC (Predicted Environmental Concentration) i.e., the concentrations of different components in the water column resulting from PW discharge as predicted by the model (Table 10.53), and
- PNEC (Predicted No Effect Concentration) i.e., the highest theoretical concentration of the same components at which no harmful effects are expected to occur to marine organisms (Table 10.53).

In other words, the model assesses whether or not the concentrations resulting from Phase 1 & 2 PW discharges will exceed the concentrations which marine organisms can 'tolerate' to determine whether or not the impacts will be likely to cause significant harm (i.e., PEC:PNEC >1) (Table 10.53).

An EIF (Environmental Impact Factor) of 1 is defined as a cuboid volume of water equal to 100 m x 100 m x 10 m (0.0001 km^3) in which the calculated PEC exceeds the PNEC. In practice, an EIF of 1 signifies that within this volume (0.0001 km^3), there is a risk to >5 % of the most sensitive species present (i.e., the Potentially Affected Fraction (PAF)). Therefore, an EIF of, for example, 100, indicates that there is a risk to >5 % of the PAF in 0.01 km^3.

The model therefore uses the volume of seawater affected by PW discharge plumes as a measure for quantifying environmental risk and the results are expressed as the volume of water (km^3) in which >5 % of the PAF may be significantly impacted. Of note, there is no threshold for the EIF above or below which discharges may be permitted and the EIF is primarily a comparative tool.

Table 10.53: Explanation of the PEC, PNEC and the EIF and how these are calculated and used by DREAM

Factor	Definition	Calculated by
Predicted Environmental	The concentration of PW	DREAM calculates the fate of each component by modelling the influence of:

Factor	Definition	Calculated by
Concentration (PEC)	components in the water column resulting from the discharge of Phase 1 & 2 PW	Currents (tidal, residual, meteorological forcing), Turbulent mixing (horizontal and vertical), Density (difference through salinity and temperature), Evaporation at the sea surface, and Reduction of concentration due to biodegradation.
Predicted No Effect Concentration (PNEC)	The highest theoretical concentration of the same components at which no harmful effects are expected to occur to marine organisms	The PNEC value is derived from the: EC_{50} (i.e., the half maximal effect concentration) which is the concentration at which 50 % of test organisms experience growth inhibition when compared to a control, (LC_{50}) (i.e., the median lethal concentration) which is the concentration at which 50 % of the sample population of a specific test-animal in a specified period die from exposure, and NOEC (i.e., the No Effect Concentration) which is the highest concentration at which there is no observed effect to test animals when compared to a control. The EC_{50}, LC_{50} and NOEC are divided by an assessment factor in order to arrive at the expected chronic PNEC. An additional assessment factor is used to reflect any uncertainties in the representativeness of the laboratory results. An assessment factor of 1,000 was applied in this study in line with the RBA guidance issued by BEIS (2020).
PEC:PNEC > 1	PEC:PNEC > 1 means there is a risk to > 5 % of the most sensitive species present.	The DREAM model calculates an individual PEC:PNEC ratio for each of the components in the PW and applies a species sensitivity distribution to each. This allows the model to combine and compare the contribution of different PW components to the overall risk to species present, known as the Potentially Affected Fraction (PAF). The level of 5 % risk to the PAF (corresponding to a PEC/PNEC ratio of 1) is a generally-accepted risk level representing the concentration below which no adverse effects on organisms are expected (EC, 2003).
Environmental Impact Factor (EIF)	A volume of water equal to 100 m x 100 m x 10 m (i.e., 0.0001 km^3) in which the PEC:PNEC > 1. An EIF of 1 means that there is a risk to >5 % of the PAF in 0.0001 km^3.	DREAM predicts the PEC across the model domain and each cuboid of water within that domain in which the EIF = 1. The model then effectively adds together each cuboid to give the overall EIF for that particular release. Three EIFs for early Field Life and late Field Life were predicted: The **maximum EIF** i.e., the largest EIF value derived throughout the model run duration. This instantaneous EIF is sensitive to small changes in environmental inputs, such as wind and currents, throughout the modelling period, The **time-averaged monthly EIF** which is more stable, presenting an average EIF of the modelling period once stable conditions have been established, and The **'annualised' EIF** which takes account of the intermittent nature of any PW discharges given that 25.5 days (7 %) worth of discharge will not be continuous (as is considered acceptable in the RBA). The value of the EIF denotes the volume (expressed in km^3) over which risk to the PAF exceeds 5 %.

10.7.4.5.2.3 DREAM Results

Figure 10-32 shows the 'combined maximum instantaneous EIF' values over the entire model duration of 42 days during both early and late Field Life.

The 'combined instantaneous' element means time is not taken into account in this plot. In other words, where the model indicates there is a risk to >5 % of the PAF in one place on day one of the discharge and a risk of >5 % to the PAF in a different place on day 25 of the discharge, *all* of these maximum EIF values are plotted in Figure 10-32. Therefore, this figure indicates the maximum risks as if they were all happening at the same time. However, in reality these areas would not all be affected to the same extent at the same time.

The cross-sections below these risk plots show that the discharged water does not descend significantly into the water column due to the temperature and salinity of the plume. The PW plume is confined to the top 80 m of the water column in early Field Life, and 120 m in late Field Life (Figure 10-32).

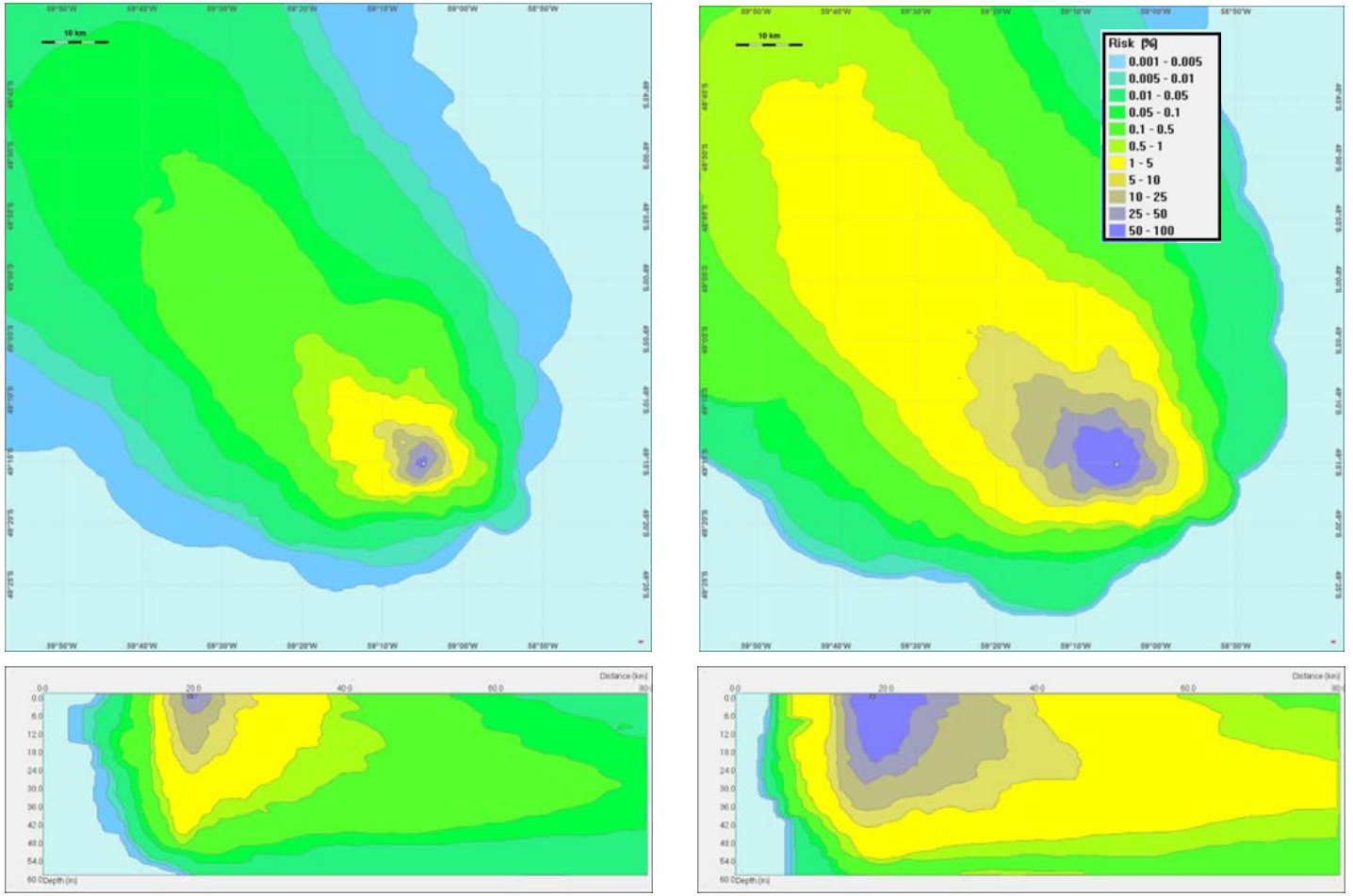
Figure 10-33 plots the distribution of the maximum instantaneous EIF on a single day during both early and late Field Life, thus incorporating the reality that the PW plume will disperse over time. Day 23 (early Field Life) and day 26.75 (late Field Life) were chosen as the days giving the highest EIFs during the month of July 2011, which in turn was chosen as the least dispersive month in the metocean record. These plots demonstrate that on any given day, the volume of water in which there was a risk to >5 % of the PAF is less than the cumulative volume indicated in Figure 10-32. Here it can also be seen in the cross-sections that in early and late Field Life, the effect of the plume on a single day does not descend significantly below 60 m into the water column (Figure 10-32) although this varies from day to day.

In order to take account of the changing metocean conditions and to provide a more stable and realistic result for comparison in line with SINTEF and DESNZ guidelines, the average EIF for the duration of the model run was calculated using the daily EIFs shown in Figure 10-34. The time-averaged EIFs for both early and late Field Life are provided in Table 10.54.

Similarly, during PWRI downtime, it is unlikely that PW discharges will occur continuously as is assumed by the model. It is more likely that any discharges will be intermittent throughout the year. Therefore, it is useful, as advised in the RBA Guidance (BEIS, 2020), to determine the 'annualised' EIF which averages the 25 day discharge over the year (Table 10.54).

As is shown in all representations of the data, the EIF is far higher in late Field Life than in early Field Life owing to the volume of PW which may be discharged.

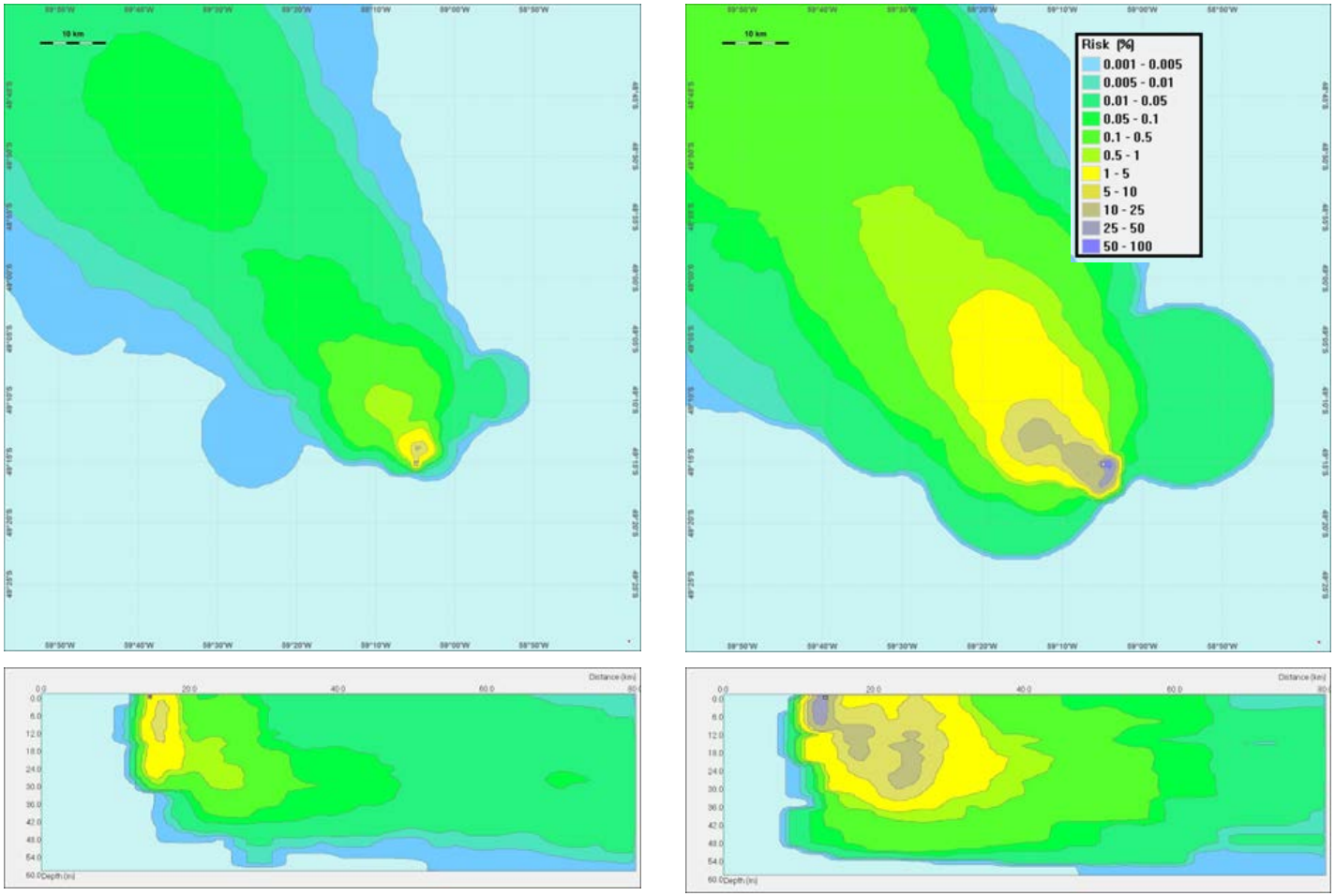
Finally, Figure 10-35 shows a breakdown of the main components which contribute to the overall EIFs in the late Field Life case (the early Field Life case has almost identical contributions). Wax inhibitor was the main contributor to the risk given its low PNEC. The other main contributors to the EIF were the naturally produced PAHs (which are expected to be higher in the analogue used than in the actual Sea Lion PW (Section 10.7.4.1.2.1)) and alkyl-phenols. Dispersed oil, conservatively modelled here as 30 mg/l, poses no significant toxic risk. In later life, the added chemicals become less important and the natural components dominate the predicted effect.



a) Early Field Life

b) Late Field Life

Figure 10-32: Maximum EIF (yellow equals 1 - 5 % risk) at any point over the model duration showing the composite risk during early and late Field Life



a) Early Field Life (day 23)

b) Late Field Life (day 26.75)

Figure 10-33: Instantaneous EIF for early and late Field Life cases at time of maximum EIF (yellow equals 1 - 5 % risk)

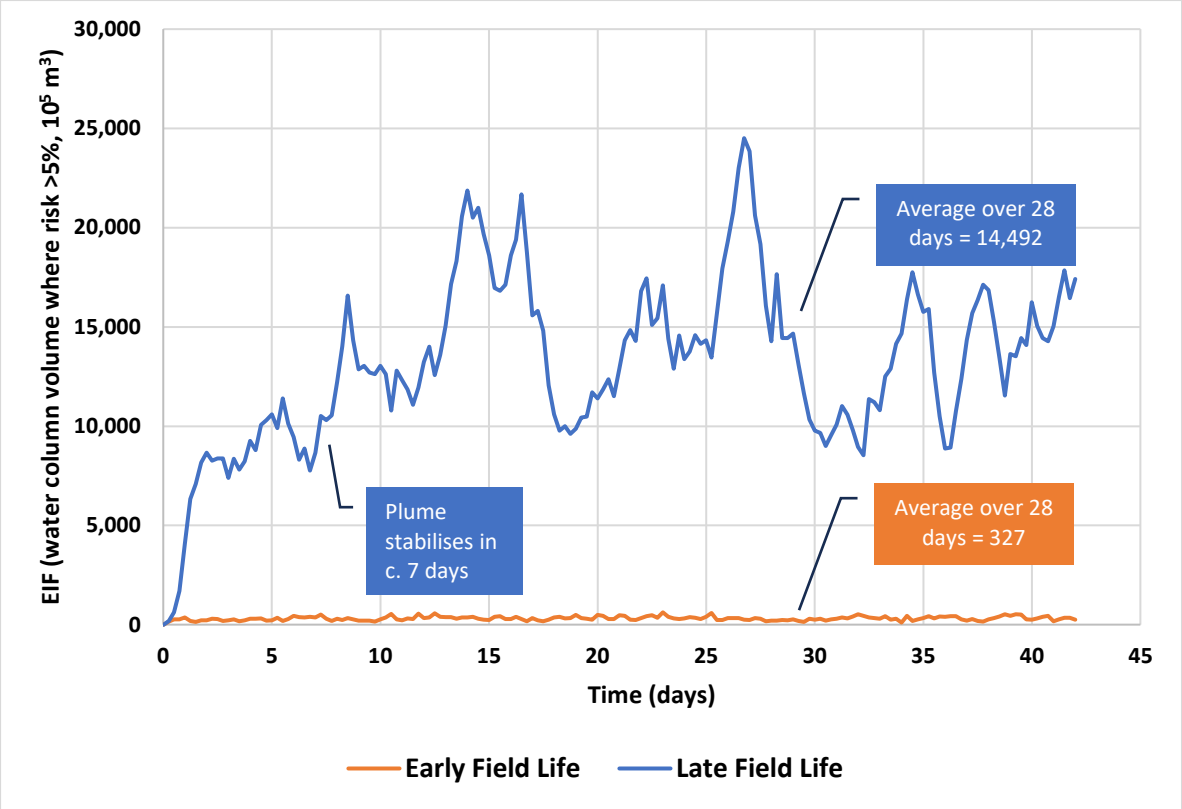


Figure 10-34: Daily EIFs over model duration (Note: the model duration is 42 days to allow up to two weeks for the plume to reach a steady state followed by 28 days discharge in accordance with the UK RBA Guidance (BEIS, 2020))

Table 10.54: Time averaged and annualised EIFs for early and late Field Life

Model result	Early Field Life		Late Field Life	
	EIF	Representing	EIF	Representing
Time averaged EIF	327	0.0327 km^3 of water in which there is a risk to > 5 % of the most sensitive species	14,492	1.45 km^3 of water in which there is a risk to > 5 % of the most sensitive species
Annualised EIF [1]	23	0.0023 km^3 of water in which there is a risk to > 5 % of the most sensitive species	1,012	0.101 km^3 of water in which there is a risk to > 5 % of the most sensitive species

[1] The annualised EIFs shows the EIF of the 25.5 days (i.e., the 7 % of the time that the PWRI units are down) averaged over the year

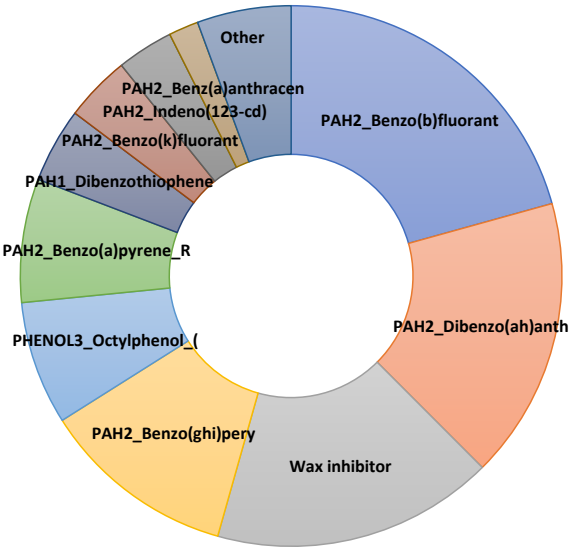


Figure 10-35: Contribution of the main components to the EIF value (late life case)

10.7.4.5.2.4 Comparison with North Sea EIFs

While it can be useful to compare the EIFs for PW from different installations, there is little published data on PW modelling studies under the OSPAR RBA process (Section 10.7.1.1.1.2).

Nonetheless, some installations on the Norwegian Continental Shelf (NCS) underwent RBA modelling in 2008, the results of which were published in Smit *et al.,* 2011[74]. Of all the installations reviewed, the maximum annualised EIF observed was 1,200 (equating to a volume of 0.12 km^3 in which the risk was >5 % to the PAF), which is slightly higher than the late Field Life EIF for the Sea Lion Field of 1,012 (Table 10.54 above). However, direct comparisons are very approximate at this stage because:

- The estimated Sea Lion PW composition (Table 10.47 above) may be very different from the real composition, which is as yet unknown,
- The analogue North Sea data used were chosen owing to the low salinity of the PW while the NCS RBA data are not from low saline PWs such that the comparison is not like-for-like,
- It is not possible from Smit *et al.* (2011) to check the basis of the calculations used for the NCS installations, and
- The EIF may have been calculated differently due to revised PNEC values.

Nevertheless, the RBA is founded on refining and reducing risk, and this can take the form of reducing all of the uncertainties in the analysis, be they compositional values, assessment factors, metocean data or other parameters, in conjunction with examining obvious risk reduction opportunities presented by choices of chemicals, availability of PWRI, physical dispersion etc. (Smit, *et al.,* 2024).

10.7.5 Industry-standard mitigation

In addition to the legal requirements of MARPOL etc. (Section 10.7.1.1), industry-standards include:

- Selection of the most environmentally benign chemicals available on the Cefas list of registered products where possible (notwithstanding the need for optimal operational performance),

[74] This 2011 paper is still regarded as the most recent compilation of EIF values.

- The use of BAT to minimise PW discharge volumes and / or OiW concentrations e.g., by using PWRI and the project target of 10-15 mg/l,
- Daily sampling of PW samples. Automatic detection devices will be available on the FPSO that measure oil in water, and other discharges and laboratory technicians will also be onboard the FPSO to undertake analysis,
- Development of an on-Island laboratory if necessary for PW analysis,
- Seabed surveys conducted every five years,
- The RBA to PW as a product, and DREAM / ParTrack modelling (or any updated model) be repeated once the exact composition is known[75], to assess the potential impact of PW as a whole substance and to determine forward actions to manage risks (Section 10.7.1.1.1.2):
    - The key rationale for using RBA in PW management is to focus mitigation actions on discharges and substances that represent the greatest risk to the environment. The RBA requires that risks of PW discharges are assessed with either a Whole Effluent Toxicity (WET) approach, a Substance Based (SB) approach, or a combination of the two (Beyer, *et al.,* 2020), and
    - The need for further sampling / monitoring of PW upon discharge will be evaluated following RBA assessment to see if it is necessary / justified (noting that this is rarely the case on the UKCS).
- That the Energy Institute (2016a) Guidance on the management of subsea hydraulic fluids is followed,
- That a Maintenance Management System (MMS) be used to ensure that all equipment is sufficiently maintained,
- Compliance with the ISO14001 certified (or equivalent) OMS working procedures and OiW objectives and targets, and
- Compliance with the O&G UK Good Practice Well Clean-up Guidelines.

10.7.6 Impact and risk assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities. Assessment of unplanned events includes an assessment of the 'Likelihood of Occurrence' to determine the 'Risk'.

A summary of the impact and risk assessment outcomes is tabulated in Section 10.7.12, which shows the worst-case impact / risk for each activity and receptor.

10.7.6.1 Impact assessment of operational discharges

10.7.6.1.1 General operational fluids

While individual marine organisms may be impacted at the point of subsea or surface discharges, any impact is anticipated to be short-lived and localised such that there will be no impact at the population level and no species or habitats that are of conservation importance will be affected. With regard to biocide discharges in particular, it is assumed that the only marine organisms likely to be impacted are those which cannot actively remove themselves from the mixing zone e.g., plankton. Further, the discharges will be to the open ocean and any effects will be localised with no potential to transmit

[75] Please note that Navitas is committed to having appropriate laboratory facilities and equipment available. If necessary, on island facilities will be developed.

contaminants to nearby sensitive receptors. Therefore, the sensitivity of the receptors (water quality and marine organisms) is considered to be '**Very Low**'.

While the specific volumes of the hydrotest, wellbore clean-up / completion fluids, cooling water discharges and hydraulic fluids, and the chemicals dosed within them, are not yet known, the chemicals will be compliant with the OCNS (Section 10.7.1.1.2) and will be selected to minimise environmental impact (Section 10.7.5). It is therefore anticipated that any impacts will not be detectable above background variability and will be rapidly and fully reversible once the activity ceases and / or outwith the mixing zone of surface discharges. Therefore, the severity of effect is considered to be '**Slight**'.

Therefore, the overall significance of the impact from the planned discharge of hydrotest water, wellbore clean-up / completion fluids, cooling water and hydraulic fluids is considered to be '**Very Low (1)**'.

10.7.6.1.2 Produced water discharges during commissioning

While individual marine organisms may be impacted at the point of PW discharges, any impact is anticipated to be short-lived and localised such that there will be no impact at the population level and no species or habitats that are of conservation importance will be affected. Further, the discharges will be to the open ocean and any effects will be localised. Therefore, the sensitivity of the receptors (water quality and marine fauna) is considered to be '**Very Low**'.

The DREAM modelling described in Section 10.7.4.5 was carried out to model the impact of unplanned discharges during PWRI downtime during early and late Field Life. However, the early life outcomes can be used to assess the severity of effect of discharges of PW during the commissioning phase.

While the exact composition of the Sea Lion PW is unknown at this time (Section 10.7.4.1.2.1), all of the components within PW have the potential to cause both acute and chronic impacts to marine organisms (Section 10.7.4.2.2), although there is a great deal of ambiguity in the outcomes of the studies cited. Of those studies which indicated the potential for impacts to marine life, the majority were based on mesocosm studies with fauna held in cages in one location downstream of significant and consistent PW plumes (Section 10.7.4.2.2).

The most appropriate modelling result to 'transfer' to the commissioning PW discharge is the Time-Averaged early-life EIF (Table 10.54). The EIF of 327 indicates that there is a risk to >5 % of the most sensitive species present over a volume of 0.0327 km^3. However, there are two key differences that should be noted. Firstly, commissioning discharges are likely to last for longer than 25.5 days overall and secondly, the volumes of discharge during commissioning are likely to be lower as the production wells will only just have started to cut water and the volumes of water will be sporadic. However, on balance, it is assumed that the result can be used to assess the commissioning discharges.

Given that this area is relatively small, and that the nature of the impact is mostly restricted to the immediate mixing zones (Section 10.7.4.2.2) the discharge is expected to have a localised effect for the duration of the discharge with fully reversible effects once activity ceases. Moreover, the DREAM model assumes a discharged OiW concentration of 30 mg/l while in reality, the concentration is anticipated to be in the region of 10-15 mg/l (Section 10.7.5). On balance, given that the discharge may occur for longer than 25.5 days while the PWRI system is commissioned, albeit with lower volumes, the severity of the effect is considered to be '**Moderate**'.

Therefore, the overall significance of the impact is considered to be '**Low (3)**'.

10.7.6.1.3 Grey water, black water and food waste

The offshore habitat in the vicinity of the Sea Lion Field is undesignated and ubiquitous in nature and, given that the discharges will be into open ocean conditions, the extent of eutrophication from the

discharge of grey and black water (Section 10.7.4.2.3) is expected to be very small. For grey water, black water and food waste, the sensitivity of water quality, and plankton, as receptors is therefore considered to be '**Very Low**'.

While the discharge to sea of grey water, black water and food waste may cause slight eutrophication of the surrounding waters, wave action will rapidly disperse and dilute effluent and the action of micro-organisms will breakdown additional nutrients (Section 10.7.4.2.3). Taking account of compliance with MARPOL Annex IV, the impacts of the discharges are expected to be rapidly reversible and barely detectable above background variability. Therefore, the severity of effect has therefore been assessed as '**Slight**'.

The overall significance of direct impacts of the discharge of grey water, black water and food waste is therefore '**Very Low (1)**'.

10.7.6.1.4 Discharge to sea of drainage and bilge water

With regard to water quality, discharges will be to the open ocean where wave action will rapidly dilute any oil remaining in the discharged water. Therefore, the sensitivity of water quality as a receptor to this level of oil contamination is considered to be '**Very Low**'.

Equally, at this concentration, any effect on the water quality will be localised, short-term and reversible and the severity of effect of drainage and bilge water discharges is therefore considered to be '**Slight**'.

The overall significance of the impact of the discharge of deck drainage and bilge water is therefore assessed as '**Very Low (1)**'.

10.7.6.1.5 Discharge of hypersaline water

The Sea Lion Field is located in the open ocean, in waters over 450 m in depth, with currents sufficient to rapidly dilute and disperse hypersaline discharges. Therefore, few flora or fauna are likely to be exposed to high saline conditions and there are no populations that are considered to be of geographical importance. Therefore, the sensitivity of the receptors is considered to be '**Very Low**'.

As described in Section 10.7.4.2.5, discharges of hypersaline water to dynamic environments are expected to have little environmental effect. Given that the Phase 1 & 2 discharges will be to the open ocean, any impacts are expected to be 'rapidly and fully reversible with highly localised effects' such that the severity of effect is considered to be '**Slight**'.

The overall significance of direct impacts of the discharge of hypersaline water is '**Very Low (1)**'.

10.7.6.2 Risk assessment of unplanned events

10.7.6.2.1 PW discharge during PWRI downtime

The sensitivity of receptors is as described above for commissioning discharges of PW and is therefore considered to be '**Very Low**'.

As described above, the DREAM model indicated that, on average, in early Field Life, there is a risk to >5 % of the most sensitive species in only 0.0327 km^3 around the FPSO. In late Field Life this volume increases to 1.45 km^3 (Table 10.54). However, all of these results assume that 25.5 days' worth of PW will be discharged continuously when, in reality, any discharges resulting from PWRI downtime would most likely be spread over the year. Taking account of the PWRI uptime of 93 %, the annualised EIFs are reduced such that in early Field Life, there is a risk to >5 % of the most sensitive species in only 0.0024 km^3 around the FPSO and 0.101 km^3 in late Field Life (Table 10.54). Given that this area, which better represents the reality, is relatively small, and that the nature of the impact is mostly restricted to the immediate mixing zones (Section 10.7.4.5.2.3) the impact is expected to have a localised effect

for short periods with fully reversible effects once activity ceases. Moreover, the DREAM model assumes a discharged OiW concentration of 30 mg/l while in reality, the concentration is anticipated to be in the region of 10- 5 mg/l. Therefore, the severity of the effect is considered to be '**Minor**'.

Therefore, the overall significance of the impact is considered to be '**Very Low (2)**'.

Given that the PW will only be discharged in the event that both PWRI units malfunction, and an off-spec tank will be used to store and re-clean any water that does not meet the discharge specification, the likelihood of occurrence of PW being discharged is '**Unlikely**'.

Therefore, the overall significance of the risk is considered to be '**Very Low (2)**'.

10.7.6.2.2 Oil sheens from PW or bilge/drainage water

Seabirds are attracted to offshore installations owing to light and the discharges of macerated food and sewage (Section 10.7.4.3.3). Of those that may be feeding in the area, it is likely that some of these species will be classed as 'Vulnerable' or 'Endangered' by the IUCN (which equates to 'High' sensitivity). Further, many of the scavenging / diving species of seabird that associate with vessels in Falkland Islands waters are also listed as ACAP species which are considered to be under wider threat (largely from fisheries related mortality). Therefore, overall, the sensitivity of the seabird receptors is considered to be '**Very High'**.

In the event that the PW needs to be discharged, all water will be treated and sampled to ensure that the OiW concentrations are low enough to secure a worst-case monthly average concentration of <30 mg/l and no PW will be discharged in the event that a sample exceeds 100 mg/l. As described in Section 10.7.2.5, it is anticipated that the OiW concentration will range between 10-15 mg/l. Regular monitoring will identify any drift in quality (Section 10.7.5) and the off-spec tank will be used for non-compliant PW (Section 10.7.2.5). The tank will be used for long enough to enable stable conditions to be achieved.

Testing of the Sea Lion crude showed that a large spill of crude can form a sheen in very calm waters and there may be the potential for sheens from the lower volume bilge and drainage discharges. However, the discharge of PW is unlikely to form a sheen owing to the low concentrations likely to discharged at the PW caisson and the minimal sheen forming behaviour observed during the CEDRE PW tests (Section 10.7.4.3.2). The tests showed that oil particles did adhere to feathers at a concentration of 10 mg/l, although no structural damage was observed (Section 10.7.4.3.3).

In practice, the impacts of contamination from sheens on long-term fitness are, as yet, unknown and the impacts may either be reversible or lethal depending on the amount of fouling (Section 10.7.4.3.3). Further, the metocean conditions in the region are such that any sheen resulting from PW discharge, bilge and drainage is likely to be temporary (Section 10.7.4.3.2). Nonetheless, given that a sheen of even 0.1 µm has the potential to reduce fitness, and to take a precautionary approach, the severity of effect is considered to be '**Moderate**'.

The overall significance of the impact of seabirds being oiled by a sheen is therefore considered to be '**Upper Moderate (15)**'.

With regard to the likelihood of occurrence, given that both PWRI units would need to malfunction before PW is discharged, that sheens are not expected at all for the PW discharge given the oil properties and that drainage and bilge will only be discharged if the OiW concentration is <15 ppm the likelihood of a persistent sheen forming and seabirds becoming oiled is considered to be '**Very Unlikely**'.

Therefore, the overall significance of the risk of a sheen oiling seabirds is considered to be '**Low (4)**'.

10.7.7 Project-specific mitigation measures

All mitigation measures are built-in to the basis of design and the OMS and are therefore taken into account in the initial impact assessment. OiW concentrations and PWRI uptime will be included within the Navitas environmental objectives and targets (Chapter 15) which are designed to ensure compliance with the Health, Safety and Security (HS&S) and Environment and Biodiversity (E&B) policies and continual improvement. At all times, Navitas will endeavour to improve upon the legally compliant OiW limits with anticipated concentrations as low as 10-15 mg/l.

Given that all the impacts and risks associated with operational discharges are considered to be '**Low**' or below, there is no need for project-specific mitigation measures over and above those which are built-into the basis of design and the use of environmental objectives and targets.

10.7.8 Residual impacts and risks

Not applicable.

10.7.9 Cumulative impact

10.7.9.1 General operational fluids

Hydrotesting and hydraulic fluid discharges will occur in the same area where drill cuttings may have disturbed the seabed. However, it is not anticipated that this will change the predicted impacts in any significant way.

Further, owing to the degree of dispersion and the fact that no other O&G installations are operating in the Sea Lion area, no cumulative impacts are anticipated from the use of compliant operational chemicals.

10.7.9.2 Produced water, drainage and bilge discharges

Details on the potential for cumulative and chronic impacts of oil discharges from all sources are provided in Section 12.1.

10.7.9.3 Grey and black water and food discharges

All vessels discharge grey and black water and food waste at sea in line with MARPOL regulations such that there is the potential for Phase 1 & 2 discharges to lead to cumulative impacts from increased 'concentration' and increased 'extent and proportion' (Section 8.9.1).

The volumes discharged are related to the number of persons on board at any given time. During the Phase 1 & 2 Development, the combined disposal of grey and black water and food waste from the MODU, FPSO and vessels will add to that produced by existing users of the marine environment.

The number of fishing vessels operating within Falkland Islands waters varies considerably throughout the year. The highest peak in number of vessels is associated with the *Illex* fishing season (Section 7.7.3.1.1.1), when the number of vessels at sea can rise to over 130. A second smaller peak is associated with the second fishing season, which comprises loligo and finfish trawlers, with a maximum of about 40 vessels (Figure 10-36). Over the course of the year, the weekly mean number of vessels fishing within Falklands waters in 2023 was 36 (data from FIFD, 2024).

While the number of crew on each fishing vessel varies, with an assumption of 40 crew per vessel, the total number of crew at-sea on fishing vessels peaks for a short-term at about 5,200. The addition of 140 crew on the rig, 80 on the FPSO and up to 300 on the support vessels represents a small increase (approximately 5 %) in the total number of people at-sea in the busiest period in these waters. Additional discharges to sea therefore amount to <5 % of those generated by fishing vessels per month. With the volumes estimated, these waste streams are not regarded as an environmental threat.

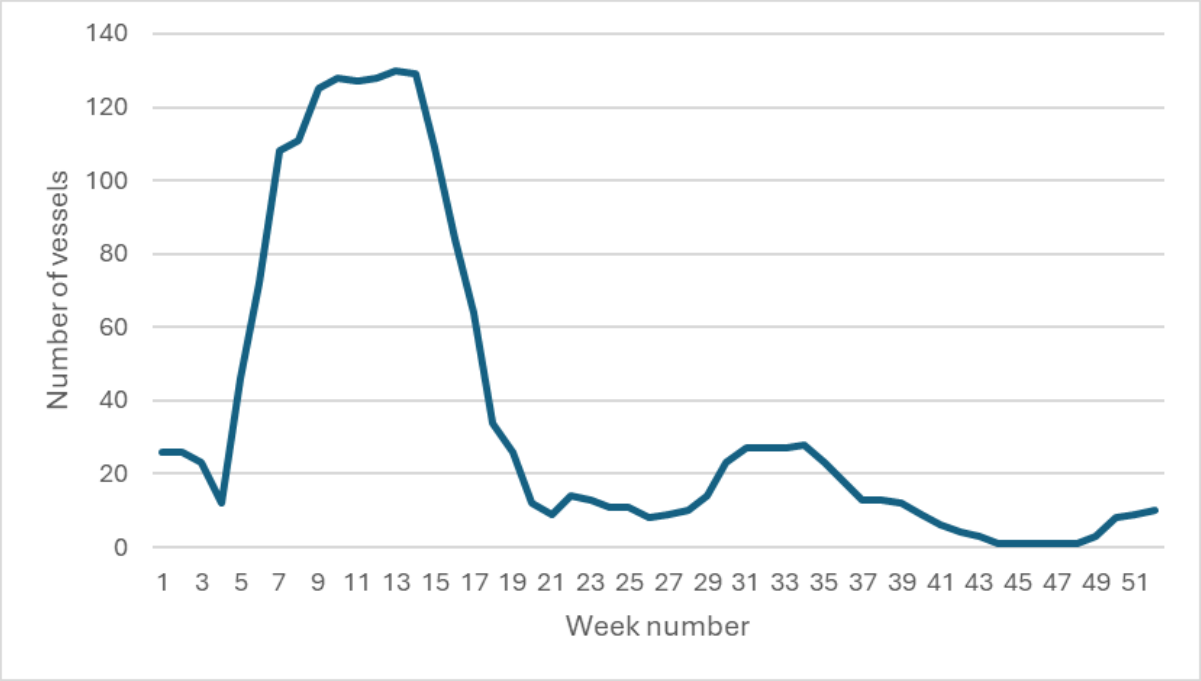


Figure 10-36: The mean number of fishing vessels operating within Falkland Islands waters on a weekly basis throughout 2023

10.7.9.4 Hypersaline discharges

Although some fishing vessels carry desalination plants, many do not such that discharges of hypersaline water from the MODU and the FPSO are not expected to add to significant existing discharges. Also, owing to the degree of dispersion and the fact that no other O&G installations are operating in the Sea Lion area, no cumulative impacts are anticipated from hypersaline discharges in the area.

10.7.10 Confidence

Given that the volume of hydrotest water, and the dosages of biocide in CW are as yet unknown, the confidence in both impact assessments is considered to be '**Probable**'. Similarly, while the clean-up and completion fluids will be 'visibly clean' (Section 10.7.2.2) and the concentration of NADF in the clean-up fluids is currently unknown, the confidence in the assessment is considered to be '**Probable**'.

PWRI has proven effective in certain reservoirs in the North Sea. However, the efficacy of the PWRI units with Sea Lion crude / reservoir conditions has yet to be assessed in practice. Therefore, the confidence in the impact assessment of PW discharges is considered to be '**Probable**'.

Confidence in the assessment of impacts from other discharges to sea (grey water, black water, food waste, drainage and bilge water, hypersaline discharge and clean-up fluids) and in the risk assessment is '**Certain**'.

The risks associated with PW discharges in the event of PWRI downtime were quantified with the DREAM model. However, a number of uncertainties in the model need to be considered with regard to the assumptions made (Table 10.55). Further, the data available in the literature with regard to the known impacts largely pertains to coastal rather than the 'open ocean'. Therefore, the confidence in the risk assessments is '**Uncertain**'.

Initial testing indicated that while Sea Lion PW is unlikely to form a sheen, feather contact with the PW does result in oil particles becoming attached to feathers, though no structural damage was observed. Therefore, on balance, confidence in the assessment of oil sheen risks is considered to be '**Probable**'.

Table 10.55: Modelling uncertainties

Uncertainty	Description
Flow rates	The Phase 1 & 2 production profiles were used for the modelling of the PW and the oil flow rate was used to calculate the partitioning of the chemicals based on their partitioning coefficients (the LogPow). While the dosages were provided by Navitas, the actual chemicals and dosages may differ when it comes to production. The volumes should be representative and the modelling has applied the best available information.
PW composition and parameters	Data on the natural composition of the Sea Lion formation water, in terms of the parameters normally used for assessing water column risk, are unavailable. The composition of a low salinity North Sea analogue was used in the model. However, as the reservoirs and geology are very different to the North Sea, the composition from the lacustrine Sea Lion reservoir could vary significantly. A review of potential PW risks is recommended at a point when Sea Lion PW composition is better understood and when PW first appears in production.
Metocean data	Three years of detailed metocean data has been analysed to identify average current speeds in the Sea Lion area. Conditions used in the modelling were chosen to be the most quiescent month of the available dataset, in order to create the calmest water and thus the least dispersion. The conclusions are conservative in this respect.

10.7.10.1 Monitoring required

Oil in PW concentrations will be monitored as standard with samples taken twice daily during any periods where it is necessary to discharge PW. Also, despite the indication that Sea Lion crude will not form a sheen, vigilance will be maintained with regard to the formation of sheens and any sheens will be reported to FIG. Further monitoring measures, such as satellite surveillance, could also identify any sheens from other sources e.g., bilge, drainage discharges or wellbore clean-up fluid to ensure that actions, if required, are correctly focused. Other monitoring measures include:

- The placement of SMMOs (Seabird and Marine Mammal Observers) on vessels with the identification of oiled or dead birds offshore included in their scope. Fingerprinting of the Sea Lion crude will also allow testing of oiled birds to help determine the source of oiling,
- All chemical use and discharge will be tracked and reported to FIG,
- All vessels will use an Oil Record Book to record all oil discharges from drainage and bilge water and a Waste Disposal Log, and
- All discharges of wellbore clean-up fluid will be conducted in line with O&G UK Guidelines (Section 10.7.5). A minimum of five representative samples spaced across each well operation will be sent onshore for analysis and duplicate samples retained on the rig.

Detailed monitoring requirements have been established during the project-specific Phase 1 & 2 Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the EMMP. An outline EMMP is provided in Chapter 15.

10.7.11 Offsetting

As no residual impacts or risks identified in this section are considered significant, i.e., Moderate or above, offsetting is not considered necessary for this impact (see Section 8.11).

10.7.12 Findings summary

Table 10.56: Summary of the impact assessment for operational discharges during the Phase 1 & 2 Development

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Chemical discharges	Discharge of hydrotesting, well clean-up fluid, cooling water and hydraulic fluids	Impacts on water quality and potential for acute and chronic impacts on marine organisms,	Planned	1	Very Low	Slight	n/a	**Very Low (1)**	n/a	**Probable**	**Industry-standard:** Selection of benign chemicals where possible, OiW target of 10-15 mg/l, RBA of PW, EI (2016) Guidance, Maintenance Management System, OMS, Off spec tank, and O&G UK Well Clean-up Guidelines **Project-specific:** None proposed.
Production from the FPSO	Discharge of PW during PWRI commissioning		Planned	2a, 2b, 3	Very Low	Moderate	n/a	**Low (3)**	n/a	**Probable**	
MODU, FPSO and vessel activity	Discharge of grey water, black water and food waste	Impact to water, plankton and seabirds	Planned	1, 2a, 2b & 3	Very Low	Slight	n/a	**Very Low (1)**	n/a	**Certain**	
	Discharge of drainage / bilge water	Impact on water quality	Planned	1, 2a, 2b & 3	Very Low	Slight	n/a	**Very Low (1)**	n/a	**Certain**	
	Discharge of hypersaline water	Impact to flora and fauna	Planned	1, 2a, 2b & 3	Very Low	Slight	n/a	**Very Low (1)**	n/a	**Certain**	
PWRI unavailability	Discharge of PW	Impact to flora and fauna	Unplanned	3	Very Low	Minor	Unlikely	**Very Low (2)**	n/a	**Uncertain**	
Off-spec discharge of PW / bilge / drainage	Formation of a sheen	Impacts to seabirds	Unplanned	2a, 2b & 3	Very High	Moderate	Very Unlikely	**Low (4)**	n/a	**Probable**	

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

10.8 Thermal discharges

Table of Contents

10.8.1 Introduction 818
10.8.1.1 Legislation regarding thermal discharges 818
10.8.2 Sources of thermal impact 819
10.8.2.1 Heated subsea infrastructure 819
10.8.2.2 Surface discharges of heated water 819
10.8.3 Potential receptors 820
10.8.4 Characterising and quantifying the impacts of thermal discharges 820
10.8.4.1 The behaviour and fate of thermal plumes 820
10.8.4.1.1 Heated subsea infrastructure and seawater 820
10.8.4.1.2 Surface discharges of heated water 820
10.8.4.2 Nature of the impact 821
10.8.4.3 Quantification of the impacts and risks 822
10.8.4.3.1 Heated subsea infrastructure 822
10.8.4.3.2 Volumes of planned PW discharges during commissioning 822
10.8.4.3.3 DREAM Modelling of surface CW and PW discharge plumes 822
10.8.4.3.3.1 Discharge parameters 822
10.8.4.3.3.2 Understanding the model 823
10.8.4.3.3.3 Model results 823
10.8.5 Industry-standard mitigation measures 825
10.8.6 Impact and risk assessment 825
10.8.6.1 Impact assessment of thermal discharges 825
10.8.6.1.1 Heated subsea infrastructure on the benthos 825
10.8.6.1.2 Cooling water discharges on pelagic receptors 826
10.8.6.1.3 Produced water discharges during commissioning 826
10.8.6.2 Risk assessment of thermal discharges 826
10.8.6.2.1 Produced water discharges 826
10.8.7 Project-specific mitigation measures 827
10.8.8 Residual impacts and risks 827
10.8.9 Cumulative impact 827
10.8.10 Confidence 827
10.8.10.1 Monitoring required 827
10.8.11 Offsetting 827
10.8.12 Findings summary 827

10.8.1 Introduction

Owing to its waxy nature, Sea Lion crude solidifies at low temperatures and it is therefore necessary to ensure that the oil remains fluid by maintaining the correct temperature. The crude has to remain hot enough to flow, but cool enough to prevent damage to flowlines and process equipment. Flow assurance is managed with flow assurance chemicals, such as wax inhibitors, and engineering solutions, such as heating and cooling systems (Section 5.8.4.1). The latter can result in the discharge of waste heat to the environment.

Although produced water reinjection (PWRI) is built into the design, Produced Water (PW) may need to be discharged to sea during PWRI system downtime. Additionally, once the produced water treatment system is required there will be a period of commissioning where PW may be discharged for between 3 - 6 months at the beginning of the Field Life. In such cases, the PW will also be at an elevated temperature and will produce a thermal plume.

Cooling water systems are also used to control the temperature of engines and turbines in order to run optimally towards efficient, safe and reliable operations. The Floating Production, Storage and Offloading vessel (FPSO) in particular has turbines, compressors and pumps that require continuous cooling when operating, which is achieved by constantly pumping seawater through heat exchangers that carry heat away from the machinery. All continuous cooling water from machinery is co-mingled and discharged *via* the crude oil cooling water outlet and is included in this assessment. Some machinery, such as fire pumps, are used occasionally and have a dedicated discharge but such discharges are small and very intermittent and have been scoped out of this assessment.

As described by Langford (1990), cooling systems that use seawater, and the associated discharges, can lead to environmental impacts via:

- The abstraction of large volumes of seawater,
- Entrainment of organisms on seawater intake filters,
- Entrainment and passage of organisms through the cooling system,
- The addition of biocides to the cooling water to control biofouling in the system, and
- The discharge and dispersal of heated seawater.

Many of the above were scoped out during the ENVironmental Impact IDentification Workshop (ENVIID) owing to the low significance of the impacts (Chapter 9), and the impact of biocides in cooling water is assessed in Section 10.7.

This chapter specifically assesses the potential impacts associated with the introduction of thermal energy to the marine environment.

Note: the impacts associated with other liquid discharges are described elsewhere in this document, as described in Table 2.2.

10.8.1.1 Legislation regarding thermal discharges

No legislation is in place to govern the impacts of thermal discharge. While such local legislation as the Conservation of Wildlife and Nature Ordinance (1999) could be considered relevant, no harm or threat of harm is anticipated as a result of thermal discharges given that the heat will disperse so rapidly. However, perhaps of greater relevance, the International Finance Corporation (IFC) Environment, Health and Safety Guidelines on Wastewater and Ambient Water Quality recommend that the:

> *'Temperature of wastewater prior to its discharge does not result in an increase greater than 3 °C of ambient temperature at the edge of a scientifically established mixing zone which takes ambient water quality, receiving water use and assimilative capacity into account.'* (IFC, 2007b)

The IFC Guidelines are mainly intended for freshwater and coastal protection. However, the intent of the guideline remains useful for offshore discharges (Genesis, 2015b). The 3 °C temperature increase reflects a threshold above which impacts on aquatic biota may occur and is also referred to in SEPA (2023b) as a 98%ile threshold for marine waters of good ecological status. The 'mixing zone' describes an area within which a 3 °C temperature increase can be tolerated, provided it does not significantly impact the larger ecological unit or the overall success of species that traverse the area (IFC, 2007b). The mixing zone is therefore site-specific and detailed guidelines are published by the US Environmental Protection Agency on how to designate such a zone (e.g., USEPA, 1991).

10.8.2 Sources of thermal impact

The potential sources of thermal impacts during the Phase 1 & 2 Development include:

- Insulated (and thus passively heated) subsea infrastructure including insulated Subsea Production Systems (SPS) and Subsea Umbilicals, Risers and Flowlines (SURF) on the seabed.
- Periodic active heating of subsea infrastructure in certain circumstances (e.g., the circulation of hot oil for flow assurance during shutdowns (Section 5.8.4.1),
- Heated surface discharges:
  - Continuous and planned cooling water discharges,
  - Potential discharge of PW during commissioning of the PWRI units (three to six months),
  - Bilge and slop water discharges, and
  - Unplanned PW discharges (under abnormal conditions only).

10.8.2.1 Heated subsea infrastructure

The produced fluids will already be at an elevated temperature. This heat is retained as much as possible using insulation to passively maintain flow assurance in the SPS and SURF. Nonetheless, during production, some heat loss at the seabed will occur.

In the event that the production process undergoes a planned or unplanned shutdown, there is a risk that the oil in SPS and SURF could cool and cause blockages. To prevent this, active flow assurance techniques are used to keep the oil at an appropriate temperature (Section 5.8.4.1), again which may result in the loss of heat at the seabed or in the water column *via* the risers.

10.8.2.2 Surface discharges of heated water

The topside cooling system will use cold seawater to absorb heat from a closed loop cooling medium circuit. The cooling medium absorbs heat from the process *via* a series of heat exchangers and is then re-cooled with the seawater; the warm seawater is then discharged back to sea. These cooling water (CW) discharges will be at an elevated temperature, with a maximum of around 50°C and all discharges will be planned.

A separate marine cooling system located in the engine room will use cold seawater to cool several marine systems including a closed loop cooling medium circuit for marine equipment, steam condensers for the closed loop steam system, and the freshwater generator package. All seawater will be discharged back to sea from several overboard discharge locations located in the engine room at a temperature in the region of 28°C. The discharged seawater capacity will increase during crude offloading periods to meet the additional cooling requirement from the steam turbines of the cargo offloading pumps.

Any discharges of PW will be at a temperature of approximately 90 °C. However, as is described in detail in Section 10.7, the target is that PW will be reinjected into the reservoir such that no discharges will occur during steady state production. However, there may be the need to discharge the PW for three to six months while the PWRI units are commissioned. Beyond this, any discharge of PW would

be due to equipment downtime or reservoir injectivity issues. In the event that both of the PWRI units fail simultaneously, it may be necessary to discharge the PW, at 90 °C, for a short duration. In the event that PWRI provides adequate reservoir pressure management, as a worst-case, it is estimated that PW discharges due to PWRI downtime may occur for up 7 % of each year (or 25 days per year).

10.8.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify those receptors upon which the impacts and / or risks of thermal discharges warranted further investigation (Chapter 9). These include the impacts and risks to:

- Plankton (Section 7.4.1),
- Fish and cephalopods (Section 7.4.4.2),
- Benthic marine flora and fauna (including water quality and sediment) (Section 7.4.3.2),
- Seabirds (Section 7.4.5), and
- Marine mammals (Section 7.4.6).

The above may be affected as the native marine flora and fauna normally inhabit sea temperatures ranging between 5 - 11 °C (Genesis, 2015b), although the seas in this area are fed by strong currents from both the Circumpolar Antarctic Current (via the Falklands Current) and the Brazil Current where larger extremes exist (Section 7.3.3). Of note, to avoid repetition, the impacts to these receptors are not assessed individually below and instead they are grouped and assessed as 'marine organisms'.

10.8.4 Characterising and quantifying the impacts of thermal discharges

When characterising and quantifying the potential impacts of thermal discharges it is necessary to consider:

- The behaviour and fate of thermal plumes resulting from:
  - Insulated subsea infrastructure, and
  - CW and PW discharges.
- The nature of thermal impacts, and
- Quantification of the impacts and risks of thermal discharges:
  - Heated seawater resulting from subsea equipment, and
  - Modelling of the discharge plumes.

10.8.4.1 The behaviour and fate of thermal plumes

10.8.4.1.1 Heated subsea infrastructure and seawater

While heated SPS and SURF may elevate the temperature of surrounding water which will rise and dissipate, some heat may be transferred to the sediments directly beneath infrastructure. Local pockets of warmer water may develop adjacent to the pipelines.

10.8.4.1.2 Surface discharges of heated water

While the ambient seawater temperature may vary with season, the temperature of CW and PW will be significantly higher than the ambient temperature year-round. Nonetheless, the heat in discharges will dissipate in the marine environment as the plume mixes.

The rate at which heat is dissipated will depend on the extent and rate of mixing between the discharge plume and the receiving body of water. Continuous thermal discharges to semi-enclosed bodies of water, such as estuaries, can result in a net increase in the temperature of the water column or in stratified layers of different temperatures. However, in open ocean conditions, the plume is likely to

mix more homogenously and thermal dissipation is expected to be rapid, particularly in turbulent metocean conditions.

In the event that the discharge plume is very buoyant such that it remains at the surface, some heat energy may also be lost to the atmosphere.

10.8.4.2 Nature of the impact

Both direct and indirect impacts can result from thermal discharges both at the surface and subsea.

The direct effects of thermal discharges on the marine environment are those that may affect the success of species present. These effects include:

- Alteration of the temperature regime of the water column or sediment (Langford, 1990; UKSAC, 2015), including changes to:
  - The mean temperature,
  - The maximum temperature,
  - Temperature fluctuations and the rate of change,
  - Lethal and sub-lethal responses of marine organisms to changes in temperature regime,
  - Stimulation in productivity in a range of organisms, and
  - Reduction in the dissolved oxygen saturation.

The indirect effects of thermal discharges on the marine environment include those which may affect the larger ecological unit and include changes in the distribution and composition of communities of marine organisms.

The majority of studies into the effects of thermal energy on marine flora and fauna explore the impacts in coastal and intertidal regions receiving discharges from power generation plants. In such regions, it is recognised that discharges over a number of years can serve to increase the ambient temperature of the receiving environment (Scheil, *et al.,* 2004; UKSAC, 2015). However, the results presented varied. Some studies showed significant changes to community structure and species abundance in key taxa, albeit with no influx of warmer-water species (Scheil, *et al.,* 2004). Other studies concluded that heated effluent did not change assemblage structure or the spatial distribution of the study taxa over and above background variability (Lardicci, *et al.,* 1989).

With regard to the potential for impacts in the open ocean however, few data are available although it is unlikely that thermal discharges would alter the temperature of the water column in any sustained way. The British Antarctic Survey (BAS) was commissioned by the previous operator (POEPL) to estimate marine growth (see Section 10.3.4.2.1.3) and noted in its report that the discharge of large volumes of warm water may change local microalgal production, which has the potential to contribute to algal blooms (BAS, 2014). However, algal blooms tend to form seasonally when the combination of photoperiod and nutrient mixing is optimal. While sustainable temperature changes may impact upon the proliferation of algal blooms, the thermal discharges associated with the Sea Lion field will disperse rapidly and will not be sustained. Nonetheless, should such unexpected impacts become apparent, these will be recorded and monitored, not least as blooms could impact the seawater intakes.

With regard to the impact of heated subsea equipment, again there is a paucity of data. While it is possible that subsea sources of heat may stimulate growth in the immediate area, it is unlikely that the equipment and surrounding environment could reach lethal or sub-lethal temperatures or change the temperature of the surrounding environment in any significant way.

10.8.4.3 Quantification of the impacts and risks

10.8.4.3.1 Heated subsea infrastructure

The aim of the insulated infrastructure is to prevent heat loss. However, whilst some heat loss from the insulated subsea infrastructure will occur, the external temperature is not expected to be much higher than the ambient temperature due to the high levels of insulation.

10.8.4.3.2 Volumes of planned PW discharges during commissioning

See Section 10.7 above.

10.8.4.3.3 DREAM Modelling of surface CW and PW discharge plumes

The DREAM (Dose-Related Risk and Effects Assessment Model) model incorporates a temperature simulation model that is capable of predicting changes in temperature in the receiving environment based on the temperature of discharged substances, the ambient conditions and thermal advection in dispersion (Genesis, 2015b). While CW discharges are planned and PW discharges, once into steady state production (Stage 3), would be unplanned, the discharges of both were modelled together to capture any accumulated effect.

The following describes only the information required to ensure appreciation and understanding of the modelling results. Full details with regard to the DREAM/EIF methodology and metocean data used are given in Premier (2017c).

10.8.4.3.3.1 Discharge parameters

The discharge parameters of the CW and PW are shown in Table 10.57.

Table 10.57: Discharge parameter inputs to DREAM

Parameter		Cooling water	Produced water	Description
Discharge location	Latitude[1]	49° 16' 21.9912"S	49° 16' 21.9912"S	CW discharge is assumed to be 50 m from the PW discharge as this is the width of the FPSO.
	Longitude[1]	59° 5' 50.5"W	59° 5' 53.0042"W	
Discharge depth and diameter (m)		4 m depth 0.457 m	8 m depth 0.3556m dia.	Typical values for FPSO discharges of these types
Discharge orientation		Vertically downwards	Vertically downwards	-
Discharge temp (°C)		50	90	Conservative – discharge temperatures may be lower than these values
Discharge rate	Early Field Life	70,000 m^3/d	1,626 m^3/d	CW discharges will be planned and Outwith the first three to six months, PW discharges will be unplanned, occurring for an estimated 7 % of the time
	Late Field Life		16,796 m^3/d	
Discharge salinity (PSU)		34 (seawater)	6.4	-

[1] This modelling was performed for updated discharge parameters (i.e., Produced water temperature and discharge depth) at the original FPSO location *c.* 2km to the north to the revised location presented in this EIS. This distance change is not considered to have a material impact on the modelling conducted.

10.8.4.3.3.2 Understanding the model

The model results are interpreted in accordance with the IFC Guidelines which require that ambient temperature of the receiving environment is not increased by > 3°C at the edge of the 'scientifically established mixing zone' (Section 10.8.1.1).

With regard to establishing the size of the mixing zone, it is necessary to consider the context of the receiving environment (USEPA, 1991). In the context of offshore thermal discharges in the OSPAR area, the edge of a 500 m radius zone around the installation is often considered an area of mixing outside which risks should be reduced to an acceptable level, and this is one way of applying the 3 °C temperature increase threshold.

In other situations, it is the point at which rapid, dynamic mixing processes give way to slower, passive mixing e.g., at the edge of a 'surface boil' when considering an outfall. Other measures quoted are the water depth applied as a distance, or simply a 100 m distance as a screening tool. In the absence of precedents in the North Falkland Basin (NFB), the distance of 100 m can be applied as a conservative test, such that if the threshold were not met in this distance, it would warrant more detailed consideration. Therefore, an increase of 3 °C within 100 m of the discharge point has been applied as a zone to reflect the IFC standard.

The results of the model are expressed as the temperature difference between the water within the mixing zone and the yearly average ambient temperature (which in the NFB is assumed to be 8 °C) near the sea surface.

10.8.4.3.3.3 Model results

The maximum temperature differences between the mixing zone (as opposed to the exact point of discharge) and ambient seawater at increasing distance from the discharge point are plotted in Figure 10-37 for early and late Field Life. Of importance, the outcomes of the model show the temperature difference over tens of meters and the discharge rates are such that rapid cooling occurs almost instantaneously. Figure 10-38 shows the instantaneous temperature difference at a single moment in time between the mixing zone and ambient water during early and late Field Life. Cross sections through the water column of both the CW and PW plumes are shown below the plots in Figure 10-38. To present the worst-case modelling results, these plots indicate the temperature differences during quiescent metocean conditions which would result in the poorest dispersion of the discharge.

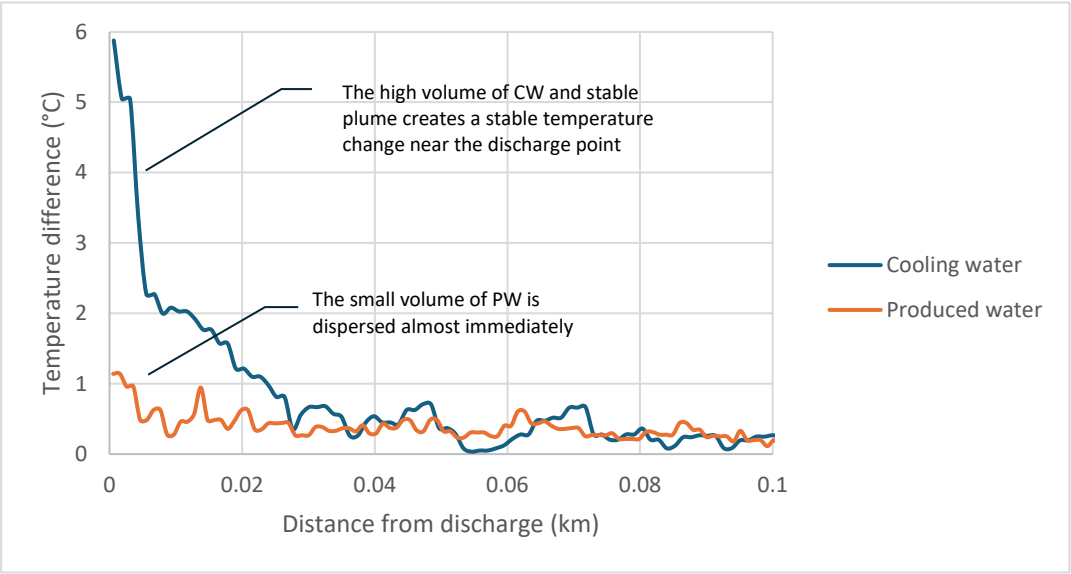
Results of the model indicated that:

- The CW plume cools down rapidly after release and drops to <3 °C above ambient within 10 m during both early and late Field Life (Figure 10-37), and
- The PW plume cools down rapidly after release and drops to <3 °C above ambient within 10 m during early Field Life and within 50-60 m in late Field Life, allowing for transient fluctuations caused by turbulence (Figure 10-37) owing to the differences between the daily PW flowrates at these times (Table 10.57 above) and the subsequent increase in volume.

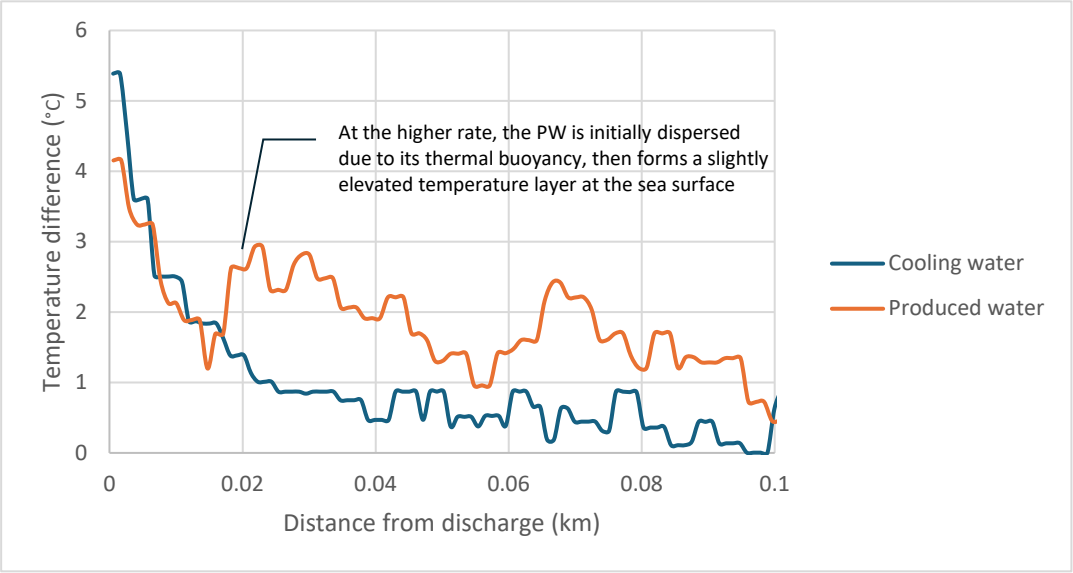
Increases in temperature caused by both CW and PW do not extend below the top 30 m of the water column (Figure 10-38).

Since the CW is a much larger volume than the PW, and is discharged at a lower temperature and is therefore less buoyant, a stable plume remains for longer in the vicinity of the discharge point (4 m below the surface) and maintains a region where the temperature is more elevated (Figure 10-37 a). The PW is discharged at a lower rate forming a smaller plume and it is much hotter, meaning it rises more quickly and moves away from the discharge point, resulting in cooling taking place in a shorter distance (Figure 10-37 a & b), while in Figure 10-37b it can be seen that an slightly elevated temperature layer persists when the plume reaches the sea surface and no longer disperses vertically.

It is also noted that the two plumes have different trajectories in the water column given their different discharge rates, depths and diameters, and the two plumes do not mix until well beyond the range where temperatures are close to the 3°C threshold. Therefore, cumulative effects, that could occur during the daily periods when currents align the trajectories of the two plumes over each other, are insignificant.

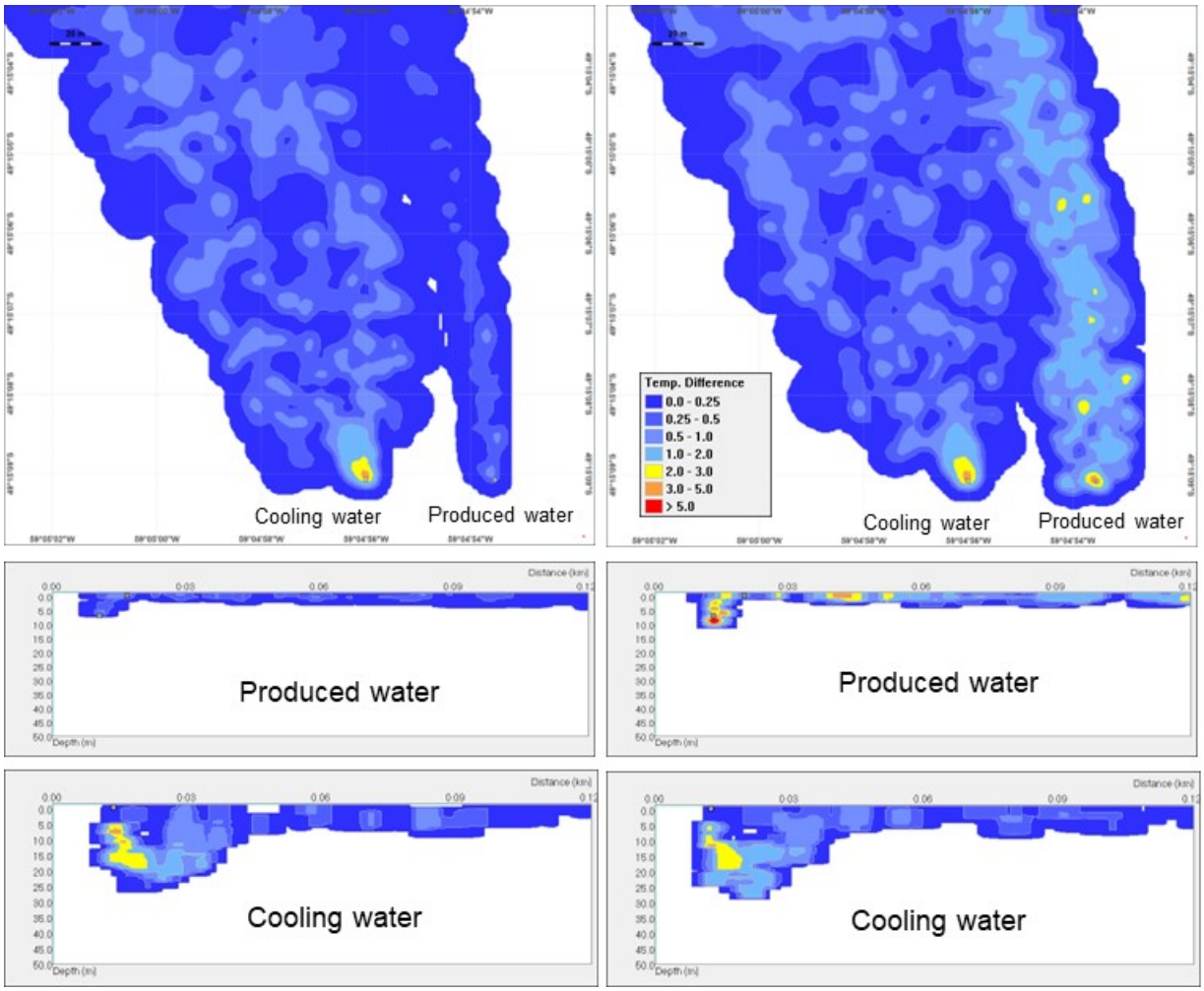


a) Early Field Life



b) Late Field Life

Figure 10-37: Graphs of maximum temperature difference from ambient seawater for both PW and CW discharges in early and late Field Life



a) Early Field Life b) Late Field Life

Figure 10-38: Plots of temperature differences (°C) from ambient seawater for both PW and CW discharges in early and late Field Life. Note: the scale base in the top left corner is 28 m

10.8.5 Industry-standard mitigation measures

No industry-standard mitigation measures exist for the management of thermal discharges, although it is common for discharges to be assessed against IFC standards, as carried out above.

10.8.6 Impact and risk assessment

10.8.6.1 Impact assessment of thermal discharges

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities. Assessment of unplanned events includes an assessment of the 'Likelihood of Occurrence' to determine the 'Risk'.

A summary of the impact and risk assessment outcomes is tabulated in Section 10.8.12, which shows the worst-case impact / risk for each activity and receptor.

10.8.6.1.1 Heated subsea infrastructure on the benthos

In the event that the subsea equipment releases sufficient heat to warm the sediment and / or the surrounding seawater, it is possible that this may impact directly upon the benthic fauna in the

immediate area. Given that any populations which may be affected are not of geographical importance however, and the habitat is undesignated, the sensitivity of the receptor is considered to be '**Very Low**'.

Equally, any effect from the heat generated by the subsea equipment is likely to be highly localised such that it is very unlikely that any impacts will be detectable above background levels. Therefore, the severity of effect is considered to be '**Slight**'.

Therefore, the significance of the impact of the temperature of subsea infrastructure is considered to be '**Very Low (1)**'.

10.8.6.1.2 Cooling water discharges on pelagic receptors

As described in Section 10.8.4.1.2, the majority of studies into the impacts of thermal discharge plumes relate to coastal and intertidal regions. Discharges of CW will be to the open ocean and temperature increases of > 3°C are restricted to within 10 m of discharge source. Therefore, these increases will not impact any species of geographical importance at a population level such that the sensitivity of the pelagic receptors is considered to be '**Very Low'**.

The turbulent metocean conditions in the Sea Lion area are such that it is unlikely that impacts will be detectable above background variability. Given that the temperature differences are < 3°C well within the 'edge' of the 100 m mixing zone (Section 10.8.4.3.3), the severity of effect is considered to be '**Slight**'.

Therefore, the overall significance of the impact from the planned discharge of CW is considered to be '**Very Low (1)**'.

10.8.6.1.3 Produced water discharges during commissioning

Discharges of PW during commissioning are expected to last for between three and six months only. This will create minimal change in water temperature differences for a short period of time. Discharges of PW will be to the open ocean and temperature increases of > 3°C are restricted to within 10 m of discharge source (Section 10.8.4.3.3.3). Therefore, these increases will not impact any species of geographical importance at a population level such that the sensitivity of receptors is considered to be '**Very Low**'.

The turbulent metocean conditions in the Sea Lion area are such that it is unlikely that impacts will be detectable above background variability. Given that the temperature differences are < 3°C well within the 'edge' of the 100 m mixing zone (Section 10.8.4.3.3), the severity of effect is considered to be '**Slight**'.

Therefore, the significance of the impact for the short-term planned discharge of PW is considered to be '**Very Low (1)**'.

10.8.6.2 Risk assessment of thermal discharges

10.8.6.2.1 Produced water discharges

The modelling results described in Section 10.8.4.3.3, indicate that unplanned discharges of PW will create minimal change with water temperature differences falling below the IFC threshold of 3°C within 10 m of the discharge during early Field Life and 50-60 m in late Field Life. Therefore, the sensitivity of the receptors and the severity of the effect are the same as described in Section 10.8.6.1.3 above). As such, the significance of the impact for the unplanned discharge of PW is the same as that for the planned discharge of CW and is considered to be '**Very Low (1)**'.

Given that the base-case is to re-inject PW using two PWRI units, the likelihood of occurrence of PW being discharged in the event of PWRI downtime 'unlikely'. However to take a precautionary approach, the likelihood is considered to be '**Possible**'.

Therefore, the overall significance of the risk is considered to be '**Very Low (3)**'.

10.8.7 Project-specific mitigation measures

Given that the impacts and risks of thermal discharges are '**Very Low**', no project-specific mitigation measures are required.

10.8.8 Residual impacts and risks

Not applicable.

10.8.9 Cumulative impact

No cumulative effects are anticipated (Section 10.8.4.3.3.3).

10.8.10 Confidence

Confidence in the impact assessment for heated subsea equipment is '**Probable**' owing to the lack of data on the level of heat loss that may occur and the potential impacts.

With regard to CW and PW, while the literature only describes the impacts of thermal discharges on coastal and intertidal regions, the DREAM modelling was used to quantify the distance at which the discharge plume will have returned to ambient levels.

Nonetheless, there is uncertainty around the influence of a continuous heated discharge stream (CW) on algal blooms. Therefore, confidence in the impact assessment for CW discharges is '**Probable**', and the impact and risk assessments for PW discharges are considered to be '**Certain**'.

10.8.10.1 Monitoring required

No specific monitoring over and above any legal or Navitas' corporate standards have currently been identified. However, all monitoring requirements have been established during the project-specific Phase 1 & 2 Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the EMMP which is provided in Chapter 15.

10.8.11 Offsetting

As no residual impacts or risks identified in this section are considered significant, i.e., Moderate or above, offsetting is not considered necessary for this impact (see Section 8.11).

10.8.12 Findings summary

Table 10.58: Summary of the impact assessment for thermal discharges during the Phase 1 & 2 Development

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Insulated subsea infrastructure (passive)	Radiation of heat	Potential to heat surrounding sediment and water with effects on benthic flora	Planned	2a, 2b & 3	Very Low	Slight	n/a	**Very Low (1)**	**n/a**	**Probable**	**Industry-standard:** None **Project-specific:** None proposed
Topside cooling process	Discharge of cooling water (50°C)	Potential for direct and indirect impacts on flora and fauna from heated discharge	Planned	2a, 2b & 3	Very Low	Slight	n/a	**Very Low (1)**	**n/a**	**Probable**	
Production from the FPSO	Discharge of PW (90°C) during PWRI commissioning		Planned	2a	Very Low	Slight	n/a	**Very Low (1)**	**n/a**	**Probable**	
PWRI malfunction or injectivity failure	Discharge of PW (90°C)		Unplanned	2a, 2b & 3	Very Low	Slight	Possible	**Very Low (3)**	**n/a**	**Certain**	

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

10.9 Atmospheric emissions

Table of Contents

10.9.1 Introduction 831
10.9.1.1 Relevant legislation 831
10.9.1.1.1 Greenhouse Gas Emissions Compliance 832
10.9.1.1.2 Global Methane Pledge and Zero Routine Flare Initiative 834
10.9.1.1.3 MARPOL Annex VI on energy efficiency in shipping 834
10.9.1.1.3.1 MARPOL: GHG and energy efficiency in shipping 834
10.9.1.1.3.2 MARPOL: Air pollution (ODS, NOx, SOx and VOCs) 835
10.9.1.1.4 Fluorinated Gas compliance 835
10.9.1.1.5 Ozone Depleting Substances (ODS) compliance 835
10.9.1.1.6 FIG Islands Plan 2022-2026 and Environmental Strategy 2021-2040 835
10.9.1.1.7 The Falkland Islands Energy Strategy and Implementation Plan 2023 836
10.9.2 Sources of atmospheric emissions 836
10.9.2.1 Base-case mitigations 838
10.9.3 Potential environmental receptors 839
10.9.4 Characterising and quantifying the impacts and risks 839
10.9.4.1 Characteristics, sources, composition and behaviour of emissions 839
10.9.4.1.1 Direct (Kyoto) GHGs 840
10.9.4.1.2 Indirect GHGs 840
10.9.4.1.3 Global Warming Potential 840
10.9.4.2 Nature of the impact 844
10.9.4.2.1 GHGs and global warming 844
10.9.4.2.2 Ocean acidification 845
10.9.4.2.3 NOx, SOx and acid deposition 846
10.9.4.3 GHG emissions context 846
10.9.4.3.1 Historic Falkland Islands GHG emissions 846
10.9.4.3.2 Historic UK GHG emissions 848
10.9.4.3.2.1 Total UK emissions 848
10.9.4.3.2.2 Recent UKCS emissions 850
10.9.4.3.2.3 Carbon Intensity 851
10.9.4.3.3 Projected future total UK GHG emissions 851
10.9.4.3.4 Global energy demand 852
10.9.4.4 Quantification of emissions from (and associated with) Phase 1 & 2 854
10.9.4.4.1 Assumptions regarding source activities 854
10.9.4.4.2 Activity (source and amount of fuel / material combusted) 860
10.9.4.4.3 Emissions factors 862
10.9.4.4.4 Estimation of worst-case Phase 1 & 2 emissions 863
10.9.4.4.5 Estimation of unplanned Phase 1 & 2 emissions 867
10.9.4.4.5.1 Emergency blowdown 867
10.9.4.4.5.2 Venting emissions offshore 867
10.9.4.4.5.3 F-Gas release 868
10.9.4.4.6 Estimation of NOx and SOx emissions 868
10.9.4.4.7 Quantification of emissions from the use of municipal electricity 868
10.9.4.4.8 Quantification of emissions from the combustion of sold product 869

10.9.4.5 Comparison of Phase 1 & 2 emissions with the existing context 869
10.9.4.5.1 Comparison with Falkland Islands emissions 870
10.9.4.5.2 Comparison with total UK GHG emissions 870
10.9.4.5.3 Comparison with total UKCS emissions 870
10.9.4.5.4 Comparison of carbon intensity with other UKCS installations 873
10.9.4.5.5 Comparison with projected total UK GHG emissions 876
10.9.4.5.6 Comparison of NOx and SOx emissions 876
10.9.4.5.7 Comparison of sold product emissions with global emissions 877
10.9.5 Industry-standard mitigation measures 880
10.9.5.1 Combustion emissions 880
10.9.5.2 F-Gas emissions 880
10.9.6 Impact and risk assessment 880
10.9.6.1 Impact assessment 881
10.9.6.1.1 Global warming and GHG emissions 881
10.9.6.1.2 Water quality and ocean acidification 881
10.9.6.1.3 Emissions associated with the combustion of sold product 882
10.9.6.2 Risk assessment 883
10.9.6.2.1 Emergency blowdowns and VRP failure 883
10.9.6.2.2 Release of F-Gases 883
10.9.7 Project-specific mitigation measures 883
10.9.7.1 Potential mitigation measures that will be considered during FEED 883
10.9.8 Residual impacts and risks 884
10.9.9 Cumulative impact 884
10.9.10 Confidence 885
10.9.10.1 Monitoring required 885
10.9.11 Offsetting 886
10.9.12 Findings summary 886

10.9.1 Introduction

Numerous activities associated with the Phase 1 & 2 Development will generate atmospheric emissions and this was raised as a concern by stakeholders during scoping consultations (Chapter 6).

Atmospheric emissions can result in global and transboundary environmental impacts including global warming, ocean acidification and acid deposition (e.g., acid rain). In an interim update to its Sixth Assessment Report (AR6) in 2023, the Intergovernmental Panel on Climate Change (IPCC) estimated that global surface temperatures increased by 1.1°C (1.98°F) between the latter half of the nineteenth century and the first two decades of the twenty-first century. If global warming continues to increase at the current rate, it is likely to reach a level of 1.5°C over pre-industrial levels between 2030 and 2052.

As described in Navitas' Carbon Strategy, Navitas acknowledges the weight of scientific research indicating the challenges faced in human-induced climate change. Therefore, reduction in emissions is a focus within the project design and a number of emission reduction technologies have been built-in to the basis of design (Section 10.9.2.1) to optimise energy efficiency and minimise outputs. The majority of emissions will arise from the combustion of fossil fuels during the transportation of goods and personnel by sea, air and road and from power generation on the FPSO.

This chapter assesses the global environmental impacts (climatic factors) of atmospheric emissions associated with the Phase 1 & 2 Development. Emissions resulting from offshore, inshore and onshore operations are all included to ensure the worst-case scenario has been assessed. Other impacts related to vessel and helicopter use are described elsewhere in this document, as described in Table 2.2.

Note: As described in Chapter 9, impacts to air quality have been scoped out owing to distance of the offshore location from environmental and social receptors, and owing to the short duration of LTV presence in Berkeley Sound (Section 5.5.1).

10.9.1.1 Relevant legislation

Conventions, legislation and strategies relevant to atmospheric emissions in the Falkland Islands are:

- International protocols, conventions and other agreements:
  - Kyoto Protocol to the United Nations Framework Convention on Climate Change (2005 – 2020) (now superceded by the Paris Agreement but included here owing to its definition of direct and indirect GHGs).
  - Paris Climate Agreement, United Nations Framework Convention on Climate Change (commenced in 2016), including:
    - 'Net Zero'
  - International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78 Annex VI on the Prevention of Air Pollution from Ships.
  - Montreal Protocol 1987.
  - Global Methane Pledge.
  - World Bank Zero Routine Flare Initiative.
- UK Legislation that may be relevant:
  - The Climate Change Act 2008 and The Climate Change Act 2008 (2050 Target Amendment) Order 2019.
  - Offshore Combustion Installations (Prevention and Control of Pollution) Regulations 2013 (as amended).

- Offshore Combustion Installations (Pollution Prevention and Control) (Amendment) Regulations 2018.
- Energy Act 2023.
- The Merchant Shipping (Prevention of Air Pollution from Ships) Regulations 2008.
- Ozone Depleting Substances (ODS) Regulations 2015.
- Fluorinated GHGs Regulations 2015 (**note**: these were being updated in 2024).

- FIG strategies:
  - FIG Islands Plan 2022 - 2026.
  - FIG Environmental Strategy 2021 - 2040 (FIG, 2021a).
  - The Falkland Islands Energy Strategy (FIG, 2023j) and Implementation Plan (FIG, 2023k).

Under the above, there are numerous compliance requirements with regard to emissions.

10.9.1.1.1 Greenhouse Gas Emissions Compliance

The following provides an overview of the relationship between the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, the Paris Agreement, the requirement for 'Net Zero' and the UK Climate Change Act 2008.

In 1992, the UNFCCC was adopted with the objective of stabilising greenhouse gas levels in the atmosphere to a safe level. The Kyoto Protocol was a legally binding international treaty that operationalised the UNFCCC and came into force in 2005 with the key aim of reducing emissions of GHGs and slowing global warming. The Protocol grouped GHGs into those which are considered 'Direct' in that they directly trap heat within the atmosphere, and those which are 'Indirect' and can affect the climate depending on atmospheric chemistry. The Kyoto Protocol set national emissions limits for each contracting party (i.e., each country which is party to the Protocol). These served to limit the total volume of CO_2 and other GHGs which could be emitted by each contracting party over a five-year period.

Under the first Kyoto commitment (2008-2012), countries that were party to the protocol agreed to reduce GHG emissions by an average of 5.2 % by 2012 when compared to 1990 levels. Under the second Kyoto commitment (the 'Doha Amendment') the remaining participants agreed to cut emissions by an average of 18 % by 2020, again compared to 1990 (base year) levels.

The second Kyoto commitment period ran from 2013 to 2020 inclusively. For this second commitment period, the (then) EU Member States and Iceland set an independent and economy-wide emission reduction target of 20 % by 2020 compared with the base year. This was known as 'the EU2020 target'. The EU2020 target was based on the understanding that it would be fulfilled jointly by the (then) EU Member States and Iceland. Under the terms of the Brexit Withdrawal Agreement, the UK remained committed to its shared target and to reporting with the EU under the Kyoto Protocol, including any further requirements for the conclusion of the true up period[76]. The EU2020 target was unconditional and was supported by EU legislation which has been in place since 2009 (The EU Climate and Energy Package). This Kyoto target included the UK, and the relevant Crown Dependencies and Overseas Territories to which the ratification is extended (DESNZ, 2023a).

The Kyoto Protocol has now been superseded by the UNFCCC Paris Agreement which is also a legally binding international treaty on climate change. It was adopted by 196 Parties at the UN Climate Change

[76] True-Up Period means the period beginning on the 'Closing Date' and concluding on the date that is 180 days after the 'Closing Date'. In essence it refers to the additional period of time allowed for fulfilling commitments.

Conference (COP21) in 2015 and entered into force on 4 November 2016, four years earlier than anticipated. Reporting against the Paris Agreement commences in 2024 (DESNZ, 2023a).

The overarching goal of the Paris Agreement is to:

> *'Hold the increase in the global average temperature to well below 2°C above pre-industrial levels.'*

However, the UN IPCC indicates that even breaching the 1.5°C threshold risks severe climate change impacts, including more frequent and severe droughts, heatwaves and rainfall such that there is now increased pressure to limit global warming to 1.5°C by the end of this century. To achieve this, GHG emissions must peak before 2025, at the latest, and decline by 43 % by 2030.

Similar to the Kyoto Protocol, the Paris Agreement works on a five-year cycle of increasingly ambitious climate action and since 2020 it has been a requirement for each country to submit climate action plans, known as Nationally Determined Contributions (NDCs). Each successive NDC is meant to reflect an increasingly higher degree of ambition compared to the previous version.

The Paris Agreement also underlines the need for 'Net Zero' which refers to a state in which the GHGs going into the atmosphere are balanced by their removal out of the atmosphere. Therefore, the Paris Agreement requires states to 'achieve a balance between the emissions from anthropogenic sources and the removal of GHGs by sinks in the second half of this century'. The IPCC concluded that Net Zero must be achieved by 2050 in order to restrict the increase in global temperature to ≤1.5 °C.

In summary, Net Zero is the internationally agreed upon goal for mitigating global warming in the second half of the century.

In the UK, the Climate Change Act 2008 (CCA) is the key instrument for tackling and responding to the above commitments. The CCA requires the UK government to set legally-binding five-yearly 'carbon budgets' to act as stepping-stones towards the 2050 target. The carbon budget is a cap on the amount of GHG emissions permitted in the UK over a five-year period.

In June 2019, the CCA was amended to commit the UK to achieving a 100 % reduction in net emissions by 2050 (Net Zero). The most recent review and update of the Energy and Emissions Projections (EEP) 2019 (EEP, 2019) was published in October 2020. However, since this time, a partial and interim update, the 'Net Zero Strategy (NZS) Baseline', was published in December 2021 and a new reference scenario was published in October 2022.

An independent Committee on Climate Change (CCC) has been created under the CCA to provide advice to the UK Government on these targets and related policies.

Of importance, the UK ratification of the UNFCCC has been extended to the Falkland Islands. However, as yet, none of the UK Overseas Territories (UKOT) have had the Paris Agreement on climate change extended to them. Therefore, while the UKOT emissions are included within the UK reporting of national emissions statistics to the UNFCCC, the NDC and UK Carbon Budgets do not include emissions from the Falkland Islands. At the time of writing there are no budgets assigned to Falkland Islands and there is little guidance on what such allowances may be. However, the 'Information to facilitate Clarity, Transparency and Understanding' (ICTU) report, which accompanies the UK NDC, makes a commitment to:

> *'Updating on the progress made in expanding the territorial scope of the NDC to include the UK's Crown Dependencies and Overseas Territories' (House of Commons Library, 2023).'*

It is anticipated that should the Carbon Budgets be extended to include the UKOTs and Crown Dependencies, they will not be dramatically increased. However, the 8th National Communication (BEIS, 2022) does not suggest an expansion of UK budgets to the Falkland Islands and, therefore, the

UK Carbon Budgets (Section 10.9.4.3.3) as they stand have been used in this EIS as the only point of comparison available at this time (Section 10.9.4.5.5).

10.9.1.1.2 Global Methane Pledge and Zero Routine Flare Initiative

The Global Methane Pledge (GMP) was launched at COP26 in November 2021 to drive action to reduce methane emissions. The Pledge now has 111 country participants who together are responsible for 45 % of global human-caused methane emissions. By joining the Pledge, countries commit to work together in order to collectively reduce methane emissions by at least 30 % below 2020 levels by 2030.

The World Bank Zero Routine Flare (ZRF) Initiative, endorsed by the UK, was launched in 2015 and is linked to the GMP since some methane is emitted unburnt in the operation of flares. Flaring is essentially the burning of gas during steady oil production because of technical, regulatory, or economic constraints that mean the gas cannot otherwise be conserved or utilised. The ZRF initiative seeks to bring GHG emissions from routine operational flaring to an end by 2030. Non-routine flaring, such as for pilot flames or for safety reasons, may still take place.

The UK aims to achieve zero routine flaring and venting targets by 2030 or sooner. Navitas strive to comply with the principles of the Methane Pledge with the target of zero cold venting as part of the Phase 1 & 2 Development basis of design, and similarly with the ZRF initiative to achieve zero routine flaring.

Navitas is aware of the updated GMP 2.0 Framework and that the UK has signed up to this. Once UK legislation has been amended to enact the requirements of the GMP 2.0, Navitas will review the Framework and its commitments, in discussion with FIG.

10.9.1.1.3 MARPOL Annex VI on energy efficiency in shipping

In 1973, the IMO adopted the International Convention for the Prevention of Pollution from Ships, now known universally as MARPOL. The convention has been repeatedly amended and updated by the Marine Environmental Protection Committee (MEPC). Annex VI was introduced in 1997 and is concerned with both energy efficiency and the prevention of air pollution by shipping.

10.9.1.1.3.1 MARPOL: GHG and energy efficiency in shipping

CO_2 emissions from international shipping cannot be attributed to any particular national economy due to its global nature and complex operation such that shipping was not included within the Kyoto Protocol[77]. Therefore, in 2011, the IMO MEPC adopted mandatory technical and operational energy efficiency measures which are expected to significantly reduce the amount of CO_2 emissions from international shipping. Chapter 4 of MARPOL Annex VI (and associated amendments to Chapter 1 and 2) came into force in 2013. Chapter 4 applies to all ships of > 400 gross tonnage and requires the following:

- Mandatory:
  - Energy Efficiency Design Index (EEDI), for new ships, and
  - Ship Energy Efficiency Management Plan (SEEMP), for all ships.
- Voluntary:
  - Use of the Energy Efficiency Operational Indicator (EEOI).

The EEDI aims to promote the use of more energy efficient equipment and engines but as it applies to new ships only, including oil tankers, bulk carriers, general cargo and container ships, it may not apply to vessels used for the Sea Lion project.

[77] As of 2033, once the sixth Carbon Budget starts, emissions from UK international aviation and shipping (IAS) will be included within recorded emissions.

The Ship Energy Efficiency Management Plan (SEEMP) is a management tool and establishes a mechanism for ship operators to improve the energy efficiency of a ship during its operation lifecycle, in a cost-effective manner. It works according to planning, implementation, monitoring and review of a number of energy efficiency measures within a continuous improvement management cycle (IMO, 2016).

The EEOI is a performance monitoring tool used to:

- Measure fuel efficiency in different operational modes (e.g., vessel speed, trim and draft), and
- To gauge the effect of changes in operation such as improved voyage planning, more frequent propeller cleaning and / or the introduction of technical measures such as waste heat recovery systems or a new propeller (IMO, 2016).

By enabling identification of the most fuel-efficient modes of operation, the EEOI may be used to inform Key Performance Indicators (KPIs) within the SEEMP (IMO, 2016). Navitas will ensure the owners of all selected Conventional Trading Tankers (CTTs) use the EEOI when developing KPIs related to their operation (Section 5.10).

10.9.1.1.3.2 MARPOL: Air pollution (ODS, NOx, SOx, PM and VOCs)

The aim of Annex VI is the progressive reduction in global emissions of oxides of sulphur (SOx), oxides of nitrogen (NOx), Ozone Depleting Substances (ODS), Volatile Organic Compounds (VOCs) and Particulate Matter (PM) by shipping, and the introduction of Emission Control Areas (ECAs) to further reduce emissions of the above in designated sea areas.

10.9.1.1.4 Fluorinated Gas compliance

Fluorinated gases (F-Gases) are man-made gases which were designed to replace Ozone-Depleting Substances (ODS) for use within refrigerants, solvents, foam blowing agents, fire-fighting fluids and HVAC (Heating, Ventilation and Air-Conditioning). F-Gases do not deplete the ozone layer, are energy efficient and are safe due to their low levels of toxicity and flammability. However, despite not harming the ozone layer, F-Gases are very powerful GHGs and as such, the emission of F-Gases is prohibited and all unplanned releases must be reported.

The phase-out of F-gases is now being significantly accelerated by a tighter phase-down. Under the F-Gas Regulations 2015, the CCC proposed that F-Gases be replaced by low-carbon alternatives in refrigeration, air conditioning and other uses by 2030. However, under the F-Gas Regulations 2024, this will be tightened again and will continue until 2050 with a ban on all F-gases. Navitas will comply with all relevant FIG / UK legislation regarding the phase out of F-Gases.

10.9.1.1.5 Ozone Depleting Substances (ODS) compliance

Under the Montreal Protocol (which is aligned with MARPOL 73/78 Annex VI), the use of ODSs is being phased out. The phase-out of most ODSs is now complete. Notwithstanding critical use exemptions, the use of virgin and reclaimed / recycled Halon, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) in new equipment and during maintenance is now prohibited.

10.9.1.1.6 FIG Islands Plan 2022-2026 and Environmental Strategy 2021-2040

FIG's Islands Plan notes that the government will:

> *'Carry out work to measure and reduce our carbon emissions.'*

While the FIG Environmental Strategy (2021a) has an objective to:

'Conduct the extraction of non-renewable resources, including any hydrocarbon development, in a way that values and conserves our unique biodiversity and ecology, supported by effective regulation'

10.9.1.1.7 The Falkland Islands Energy Strategy and Implementation Plan 2023

At the time of writing FIG has prepared a new Falkland Islands Energy Strategy for which the public consultation period has recently closed.

10.9.2 Sources of atmospheric emissions

The main sources of emissions from the Phase 1 & 2 Development which may impact upon the environment include:

- Gaseous emissions from planned activities:
  - Combustion activities associated directly with the Phase 1 & 2 Development:
    - Fuel combustion by vessels during all operations,
    - Transportation of personnel and equipment *via* vessels, road vehicles, helicopters and fixed-wing flights,
    - Fuel combustion for power generation on the Mobile Offshore Drilling Unit (MODU),
    - Fuel combustion on the Floating Production, Storage and Offload Unit (FPSO) (Section 5.8.2.3). The combustion equipment on the FPSO includes:
      - 3 x dual fuel (fuel gas and diesel) Dry Low Emission (DLE) Turbines which will be available for power generation for all power consumers on the FPSO (Table 10.59). The primary fuel will be associated gas with diesel as a back-up. Details on the power demand of the key consumers are provided in Table 10.59 in order to inform the fuel consumption rates of the turbines,
      - 1 x gas fired steam boiler for heating the injection water in the first year of production for enhanced recovery,
      - 2 x auxilliary steam boilers,
      - 2 x diesel driven essential power generators,
      - 1 x diesel driven emergency power generators,
      - 1 x diesel driven hot oil circulation pump,
      - 2 x diesel driven fire pumps, and
      - 4 x diesel driven Totally Enclosed Motor Propelled Survival Craft (TEMPSC).
    - Contingency for well flow-back / testing to the MODU with associated flaring[78],
    - Commissioning of the gas compression system prior to start-up of gas injection and gas lift systems with associated flaring[79],
    - Maintenance of the High Pressure (HP) flaring pilot light on the FPSO, and
    - Use of diesel generators at the onshore supply base on an 'as needed' basis.

[78] The base-case assumes zero flaring during well clean-up to the FPSO and zero well testing. However, a contingency is held to flow four wells (3 x OP wells and 1 x GI well) back to the MODU. Details are provided in Section 5.4.8. This chapter presents both the worst-case baseline emissions, and those which will result if contingency flow-back to the MODU is carried out.

[79] Associated gas is liberated from the oil producing wells, this released gas generates pressure within the flowline. However, there is no facility for gas storage onboard the FPSO. Therefore, there needs to be sufficient volume of gas liberated to meet with the minimum operating parameters of the gas compression system on the FPSO to allow for a safe startup of the gas compression process. During commissioning, the initial start up of the gas compression system takes longer than a normal start-up as control system and instrumentation systems need to be calibrated and tuned before handing over to normal operations (Section 5.4.9).

- Contingency use of a waste incinerator at the supply base in the event that the FIG municipal waste facility is not yet operational,
- Fugitive emissions during diesel bunkering to LTVs in Berkeley Sound, and
- Fugitive emissions during cargo offloading / transfer from the FPSO to the CTT.

- Gaseous emissions resulting from potential unplanned or emergency events associated with the Phase 1 & 2 Development:
  - Emergency blowdown (the rapid depressurisation of high-pressure vessels and pipelines and flaring of the gas for safety purposes),
  - Venting of hydrocarbon gas blankets used to buffer the FPSO cargo tanks in the event that the Vapour Recovery Package fails, and
  - Accidental release of F-Gases.
- Indirect emissions from the use of purchased municipal electricity for the supply base warehousing and offices etc., and
- Indirect emissions from combustion of the sold product, for example, use of fuels created from Sea Lion crude oil in vessels, vehicle, aircraft etc.

Note: details on the use of vessels, helicopters and fixed wing flights during Stages 1 to 3 of the Development are provided in Section 5.11 of the Development Description.

Note: in compliance with the Montreal Protocol (Section 10.9.1.1.5) no ODSs will be used during the Phase 1 & 2 Development. Therefore, these are not listed as a source of emissions. To ensure compliance with the Montreal Protocol, all vessels will be audited prior to selection in line with Navitas' Contractor Management Strategy (Section 3.2.15). This is also ensured by compliance with MARPOL certification requirements during routine vessel registration.

Table 10.59: Key consumers of electricity generated by the DLE turbines[1]

Consumer	Purpose	Power demand (kW)
1st stage High Pressure (HP) compressor A	Gas compression for gas lift, fuel gas	1,527
2nd stage HP compressor A		1,247
Booster compressor A		826
1st stage HP compressor B		1,527
2nd stage HP compressor B		1,213
Booster Compressor B		826
1st stage HP compressor C		1,527
2nd stage HP compressor C		1,247
1st stage Low Pressure (LP) compressor A		170
2nd stage LP compressor A		102
3rd Stage Medium Pressure (MP) Compressor A	Gas compression for gas lift, fuel gas	173
LP Condensate Pump A	Move liquids from gas Knock Out (KO) drum	0.6
1st stage LP compressor B	Gas compression for gas lift, fuel gas	170
2nd stage LP compressor B	Gas compression for gas lift, fuel gas	102
3rd Stage MP Compressor B	Gas compression for gas lift, fuel gas	173
LP Condensate Pump B	Move liquids from gas KO drum	0.6
Produced Water Pumps	Move produced water forward for further processing	2.1
Produced Oil Pumps	Boost crude oil for further processing and storage	44.4

Consumer	Purpose	Power demand (kW)
Degassed water pumps	Transfer separated water for further processing	72
Recirculation pumps	Transfer off spec fluids for reprocessing	3
Seawater Booster pumps	Supply water for cooling and injection processing	147
Water Injection Pumps	Supply water for reservoir pressure / flood	4,176
Well Fracturing Pump (rental)	Frac when blockages occur	762
Hot oil circulation pump (2nd unit is diesel driven)	Flow assurance of subsea facilities	372
Gel Breaking hot oil pump	Topsides wax facilities assurance	201
LP Electrostatic Coalescer	Oil processing	19
Ships Utilities	Air, Nitrogen, lighting, etc.	2,751
Propulsion	Direction Positioning (DP)	1,175
Offloading	Cargo transfer to CTT	2,749

[1] Please note that a power use profile was not used. Instead, a flat fuel consumption profile was assumed that will be conservative in the related emissions estimates.

10.9.2.1 Base-case mitigations

Numerous base-case mitigations are built-in to the basis of design to minimise outputs from these sources. These are factored into the initial impact assessment (Section 10.9.6) and include:

- The main fuel supply for the FPSO will be produced gas,
- Use of waste heat recovery to reduce the need for active heat generation and therefore to reduce fuel consumption / CO_2 emissions,
- No planned flaring during ongoing well testing throughout Field Life,
- No routine flaring during normal production (notwithstanding the flare pilot light),
- Use of a Flare Recovery Package (FRP) during normal operations,
- No venting from the FPSO during normal production,
- Use of Vapour Recovery Package (VRP) during normal operations,
- Back-up inert gas generator for use as gas blanket in the event that the VRP malfunctions to prevent venting of hydrocarbon gas,
- Use of a vapour balancing system to pass blanket gases from the FPSO cargo tanks to the CTT cargo tanks, when available, during transfer of oil,
- The use of passive heat retention systems wherever possible to maintain working temperatures and flow assurance (Section 5.8.4.1), thereby preventing energy expenditure, and its associated emissions, on active heating systems,
- Follow international standards for piping, valves etc. and best practises for integrity management e.g., UK Step Change Hydrocarbon Toolkit,
- Use of Open Hole Gravel Pack (OHGP) completions which minimise downhole debris and reduce the requirement for well clean-up to the MODU, and thus the likelihood of associated flaring. The base-case is for the wells to be flowed straight back to the FPSO (**Note:** there is a contingency flow / test four wells to the MODU if considered necessary which would require flaring),
- Use of F-Gases with the lowest Global Warming Potential, and
- Use of Marine Gas Oil (MGO) instead of Intermediate Fuel Oil (i.e., a lighter fuel) when operating inshore.

10.9.3 Potential environmental receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify those receptors upon which the impacts and / or risks of emissions warranted further investigation (Chapter 9). These include the impacts and risks to:

- The global atmosphere and the incremental and transboundary effects on:
  - Global warming (*via* the emission of GHG gases),
  - Oceanic water quality (*via* ocean acidification), and
  - Soil quality, water quality and / or flora and fauna (via acid deposition).

10.9.4 Characterising and quantifying the impacts and risks

When characterising and quantifying the global and transboundary environmental impact of emissions, it is necessary to consider the following:

- The characteristics, sources, composition and behaviour of gaseous emissions,
- The nature of the impacts,
- The existing emissions context:
  - Historic Falkland Islands' emissions,
  - Historic total UK emissions,
  - Recent Oil and Gas (O&G) emissions on the UK Continental Shelf (UKCS),
  - Carbon intensity over different O&G installations,
  - Projected future UK emissions, and
  - Global energy demand.
- Quantification of emissions from (and associated with) Phase 1 & 2 activities including:
  - Detail on the assumptions made during the emissions estimate,
  - Detail on fuel consumption rates,
  - Detail on the emissions factors used,
  - Estimation of worst-case emissions, and
  - Estimation of unplanned emissions:
    - Emergency blowdown,
    - Venting emissions offshore in event of VRP failure, and
    - F-Gas release.
  - Quantification of emissions from the use of municipal electricity, and
  - Quantification of emissions from the combustion of sold product.
- Comparison of Phase 1 & 2 emissions with the existing context:
  - Comparison with recent Falkland Island, total UK, and UKCS GHG emissions,
  - Comparison of the Phase 1 & 2 carbon intensity with other UKCS installations,
  - Comparison with projected future UK GHG emissions,
  - Comparison of NOx and SOx emissions, and
  - Comparison of emissions from combusted product with global emissions.

10.9.4.1 Characteristics, sources, composition and behaviour of emissions

Gases are emitted through the combustion of fossil fuels and the cold venting of gases (Table 10.60), the latter of which will not occur in the proposed Development. All of these gases can impact upon

global warming while CO_2, NOx and SOx also contribute to ocean acidification and NOx and SOx can lead to acid deposition.

Under the Kyoto Protocol, gaseous emissions can be grouped into direct GHGs and indirect GHGs. Each of these GHGs has the potential to contribute to global warming to differing extents and in order to estimate the impact of emissions, it is necessary to understand the Global Warming Potential (GWP) of each gas. The direct and indirect GHGs are described below followed by an explanation of the GWP.

10.9.4.1.1 Direct (Kyoto) GHGs

Direct GHGs include those that directly result in radiative warming of the atmosphere. These include gases that result from combustion (e.g., CO_2, N_2O), venting (e.g., CH_4) and the F-Gases which are used in closed systems e.g., HVAC. Together these make up the Kyoto greenhouse gases (Table 10.60).

10.9.4.1.2 Indirect GHGs

In addition to the direct GHGs, there are four gases that result from combustion and venting of fossil fuels which have an indirect GHG effect by increasing ozone (O_3) concentrations in the tropospheric layer (the lower 5-10 miles of the atmosphere) (Section 7.3.1). Specifically, O_3 in the tropospheric layer is produced when nitrogen oxides (NO_X), carbon monoxide (CO), sulphur dioxide (SO_2) and non-methane volatile organic compounds (NMVOC) react with sunlight such that these gases are known as 'ozone precursors' (Table 10.60).

Ozone is a GHG in its own right with a 100-year GWP of 1,000 (i.e., 1 tonne of O_3 is 1,000 times as powerful as CO_2 in its contribution to global warming (see below)) such that its creation can exacerbate global warming. Generally, however, tropospheric ozone is a short-lived GHG which decays in the atmosphere much faster than CO_2.

In addition to impacts upon global warming, the indirect GHGs are those which react in the atmosphere to produce acid rain (Table 10.60).

10.9.4.1.3 Global Warming Potential

The GWP of a gas is most commonly used to indicate how much heat would be absorbed by a gas over a 100 year period and is determined by understanding:

- How well the gas absorbs heat energy (preventing the heat from escaping to space), and
- How long the gas stays in the atmosphere.

To estimate the impact of each gas, all gases are compared to CO_2, which has a GWP of one (1). Therefore, the higher the GWP, the greater the influence a given gas has on global warming. When the GWP is applied to the estimated emissions for different gases, the result is expressed as the 'Carbon Dioxide Equivalent' (CO_2e); i.e., the equivalent amount of CO_2 that would have to be produced to result in the same degree of global warming.

The IPCC conducts periodic assessments on human-induced climate change and, based on the most recent scientific understanding, publishes the most up-to-date GWPs for each GHG. The Final UK Greenhouse Gas Emissions National Statistics 1990-2021 Report uses the GWP's (*without* climate-carbon feedback[80]) from Working Group 1 of the IPCC Fifth Assessment Report (AR5): Climate Change 2013 (IPCC, 2013). Further, the most recent Energy Emissions Projection Report (BEIS, 2022b) uses the same AR5 (w/o cc fb) GWP. Therefore, these will be used when comparing the estimated Phase 1 & 2 Development emissions with historic and projected UK emissions to enable like-for-like comparisons.

[80] Carbon-climate feedback processes refer to the effect that a changing climate has on the carbon cycle which in turn further changes the climate e.g., thawing permafrost releases soil carbon into the atmosphere, which serves to amplify warming and causes further thawing (Royal Society, 2021).

Of note, the UKCS emissions (Section 10.9.4.3.2.2) are estimated using the AR5 GWP's *with* carbon-climate feedback[59] (with cc fb). Therefore, to enable like-for-like comparisons in Section 10.9.4.5, the corresponding GWP's were used to recalculate the total Phase 1 & 2 Development emissions. The AR5 *without* feedback, and the AR5 *with* feedback GWPs are all presented in Table 10.60 and detail on which is used is indicated in each relevant section below.

Table 10.60: Summary of the Direct and Indirect greenhouse gases, the GWP, emission source and impact as a pollutant

GHG	100-year GWP		Source and behaviour	Impacts upon
	AR5[1] (w/o cc fb)	AR5[2] (with cc fb)		
Direct GHGs				
Carbon dioxide (CO_2)	1	1	CO_2 is emitted through fuel combustion. It serves as the baseline for other GWP values. CO_2 remains in the atmosphere for a very long time and changes in atmospheric CO_2 concentrations persist for thousands of years.	Global warming
				Ocean acidification
Nitrous oxide (N_2O)	265	298	N_2O is typically emitted through fuel combustion. N_2O emitted today remains in the atmosphere for up to 170 years.	Global warming
				Acid rain
				Air quality[3]
Methane (CH_4)[4]	28	34	While some CH_4 is emitted *via* the combustion of fuels, CH_4 is typically emitted through natural gas venting. While CH_4 absorbs more heat energy than CO_2, it is mostly removed from the atmosphere after about 12 years by chemical reaction.	Global warming
F-Gases:				
HFCs[5]	<1 -12,400	-	F-Gases are not emitted during the course of normal operations.	Global warming
PFCs[5]	<1-11,100	-		
SF_6[5]	23,500	-		
Indirect GHGs				
Nitrogen oxides (NO_X)[6]	-	-	NOx are produced during the combustion process when nitrogen and oxygen are present at elevated temperatures. Nitrogen oxides (NOx) consist of nitric oxide (NO), nitrogen dioxide (NO_2) and nitrous oxide (N_2O). Their lifespans in the atmosphere range from one to seven days for NO and NO_2, to 170 years for N_2O. Additionally, NOx are both ozone precursors and are formative in the Development of hydroxyl (OH) groups which destroy CH_4.	Global warming *via* ozone production
				Global cooling *via* destruction of CH_4
				Acid rain
				Air quality[3]
Sulphur dioxide (SO_2)	-	-	SO_2 is produced from the burning of fossil fuels that contain sulphur e.g., coal and oil. SO_2 dissolves easily in water to form sulphuric acid and is also an Ozone precursor.	Global warming *via* ozone production
				Global cooling from aerosol formation
				Acid rain
				Air quality[3]
	-	-	CO is produced by the incomplete burning of fossil fuels, including natural gas. CO is unique among pollutants in the lower atmosphere in that it lasts for approximately one	Global warming *via* ozone production

GHG	100-year GWP		Source and behaviour	Impacts upon
	AR5[1] (w/o cc fb)	AR5[2] (with cc fb)		
Carbon monoxide (CO)			month which is long enough for it to be transported long distances but not long enough to be distributed uniformly. CO is also an ozone precursor and reduces OH thus reducing CH_4 destruction	Air quality[3]
NMVOC[7]	-	-	NMVOCs are organic compounds that easily become vapours or gases. They include non-methane hydrocarbons (NMHC) and oxygenated NMHC (e.g., alcohols, aldehydes and organic acids). Along with carbon, they contain elements such as hydrogen, oxygen, fluorine, chlorine, bromine, sulphur or nitrogen. Many VOCs can react with other air pollutants to produce ground level ozone.	Global warming *via* ozone production

[1] In order to compare the Phase 1 & 2 emissions with the historical, and the projected future, UK emissions, the GWPs (*without* climate-carbon feedback) of Working Group 1 of the IPCC Fifth Assessment Report (AR5): Climate Change 2013 (IPCC, 2013) are used to estimate the project emissions. Note that once into steady state production, the current guidance on GWPs will be applied for all Phase 1 & 2 emissions accounting and reporting.

[2] In order to enable like-for-like comparisons between the Phase 1 & 2 Development emissions and the emissions recorded from the O&G industry on the UKCS (Section 10.9.4.3.2.2), the AR5 GWPs *with* climate-carbon feedback are used (Section 10.9.4.5.3).

[3] As described in Chapter 9, impacts to air quality have been scoped out owing to distance of the offshore location from environmental and social receptors, and owing to the short duration of LTV presence in Berkeley Sound.

[4] The GWP for methane includes indirect effects of tropospheric ozone production and stratospheric water vapour production.

[5] HFC = Hydrofluorocarbons, PFC = Perfluorocarbons and SF_6 = Sulphur hexafluoride.

[6] The short lifetime and complex nature of the impact of NOx on global warming through ozone enhancement, traded against the cooling effect of CH_4 reduction, make calculations of the GWP for NOx emissions uncertain (IPCC, 2007). The net radiative forcing of NOx emissions depends strongly on the location of emission and seasonal and daily timing.

[7] Non-methane volatile organic compounds.

10.9.4.2 Nature of the impact

The potential impacts to the varying receptors result from the following processes:

- Global warming from the emission of combustion-based, and other GHGs,
- Ocean acidification from the emission of CO_2, NOx and SOx, and
- The formation of acid rain from the emission of NOx and SOx.

10.9.4.2.1 GHGs and global warming

While the greenhouse effect is a natural and essential dynamic, which is required to enable life on Earth (Section 7.3.1), the increasing quantity of anthropogenic GHGs in the atmosphere accelerates the process of long-term global warming. According to the IPCC, recent anthropogenic emissions of greenhouse gases are the highest in history and changes in climate have caused impacts on natural and human systems on all continents and across the oceans.

The global consequences of atmospheric emissions include:

- Rising sea levels owing to the melting of Arctic, Antarctic and worldwide glacial ice:
  - Changing coastlines.
- Changing climate zones / weather patterns leading to:
  - Changes to ecosystems and biodiversity, and
  - Economic impacts on infrastructure, agriculture and tourism.

In 2018, the IPCC were commissioned to produce a Special Report comparing the impacts incurred by current day global temperatures with the impacts incurred by an increase of 1.5°C and 2°C (IPCC, 2018). Climate models projected robust differences in regional climate characteristics with increasing global temperature changes. These differences were to the extent of:

- Increases in mean temperature in most land and ocean regions,
- Hot extremes in most inhabited regions,
- Heavy precipitation in several regions,
- The probability of drought and precipitation deficits in some regions,
- Impacts on biodiversity and ecosystems, including species loss and extinction, and
- Risks to health, livelihoods, food security, water supply, human security, and economic growth.

Successfully limiting global warming to 1.5°C compared to 2°C is projected to:

- Lower the impacts on terrestrial, freshwater and coastal ecosystems and to retain more of their services to humans, and
- Reduce increases in ocean temperature as well as associated increases in ocean acidity and decreases in ocean oxygen levels.

Consequently, limiting global warming to 1.5°C is projected to reduce risks to marine biodiversity, fisheries and ecosystems, and their functions and services to humans, as illustrated by recent changes to Arctic Sea ice and warm-water coral reef ecosystems (IPCC, 2018).

It is anticipated that many aspects of climate change, and its associated impacts, will continue for centuries, even if anthropogenic emissions of GHG were to cease now (IPCC, 2014). However, under the Paris Agreement and the target of Net Zero, there is now increasing pressure to prevent the global temperature increase from exceeding 1.5°C over the pre-industrial levels.

A project was carried out by Upson *et al.* (2016) under the TEFRA (Terrestrial Ecosystems of the Falklands – a climate change Risk Assessment) project to consider the impacts of climate change on the terrestrial environment of the Falklands. The following potential impacts are identified:

- Changes in plant pests, diseases and invasive plants,
- Increased drying and erosion of soils,
- Inability of native plants unable to shift ranges or track changes in order to survive predicted warming, and
- Habitat disturbance by extreme events from, for example, increased risk of fires and decreases in soil carbon content.

10.9.4.2.2 Ocean acidification

CO_2 is highly soluble in water and consequently the oceans absorb CO_2 from the atmosphere by direct air-sea exchange making the oceans a global 'carbon sink' (i.e., a natural body which reduces carbon in the atmosphere). The exchange process equilibrates surface water CO_2 to atmospheric levels within a timescale of approximately one year (Doney, *et al.,* 2009). However, while the absorption of CO_2 from the atmosphere into the oceanic carbon sink could be beneficial with regard to global warming, there is an associated cost.

When CO_2 dissolves in seawater it forms carbonic acid (H_2CO_3). Over long timescales this reaches an equilibrium, and the chemical dynamics of carbonic acid in seawater serve to maintain pH in a relatively narrow range. However, recent increases in atmospheric CO_2, and therefore increases in carbonic acid concentrations, are resulting in a change to this equilibrium and a decrease in the pH, thus moving oceans toward a more acidic state. Increasing atmospheric CO_2 concentrations are expected to decrease surface ocean pH by 0.3 – 0.5 units by 2100 (Caldeira and Wickett, 2003; Orr, *et al.,* 2005). This is exacerbated at higher latitudes as CO_2 is more soluble at lower temperatures.

In addition to CO_2, the emission of NOx and SOx from emissions in the form of wet and dry acid deposition can also contribute to global ocean acidification (Doney, *et al.,* 2007). Atmospheric inputs of the dissociation products of nitric acid (HNO_3) and sulphuric acid (H_2SO_4) alter surface seawater pH, and inorganic carbon storage. Acid deposition of this kind does create an interesting dynamic however as the decrease in surface alkalinity drives a net air–sea efflux of CO_2, which actually reduces the surface levels of dissolved inorganic carbon so that the effects can offset each other, and the overall decline in surface pH is small (Doney, *et al.,* 2007).

The main effect of ocean acidification is the lowering of calcium carbonate ($CaCO_3$) saturation states, which impacts upon shell-forming marine organisms from plankton to benthic molluscs (e.g., snails, mussels and alike), echinoderms (e.g., urchins, sea cucumbers, sea lilies etc.), and corals (Doney, *et al.,* 2009). Quantification of the impact of acidification on the ability of individual species to calcify remains elusive. However, reduced skeletal growth under increased CO_2 levels has already been shown for corals, molluscs and many other marine organisms (Rodolfo-Metalpa, *et al.,* 2011). For further detailed reviews, see Mundy *et al.*, 2020 and Caldeira *et al.*, 2003.

While the direct and indirect effects of gradual global warming and subsequent heatwaves have emerged as the most pervasive drivers of observed impact and potent threat across all marine foundation species, the effects from ocean acidification, along with sea level rise and increased storminess, are expected to increase (Wernberg, *et al.,* 2024).

The Southern Ocean is naturally undersaturated with $CaCO_3$ which, along with low temperatures, means shell-forming in Antarctica requires more energy than in other oceans. The Southern Ocean is understood to sequester a disproportionally large share of anthropogenic CO_2 and accounts for *c.* 40 % of the global oceanic uptake. The effects of ocean acidification may therefore be greater in the

Southern Ocean than other oceans if GHG emissions continue on their projected trajectory (CCAMLR report CCAMLR-XXIX/BG/24, 2010) due to decreased $CaCO_3$ as well as the impacts on trace metals (Trimborn, *et al.,* 2017).

10.9.4.2.3 NOx, SOx and acid deposition

Acid deposition is a broad term that describes several ways through which acid falls out from the atmosphere. These emissions can be dry or wet (acid rain). The principal cause of acid rain is the emission of NOx and SOx from the combustion of fossil fuels (Table 10.60 above) which react with water molecules to form sulphuric and nitric acid in the atmosphere (Singh and Agrawal, 2008; OECD, 2013). While dry deposition generally occurs close to the point of emission, depending upon the quantity of emissions, wet deposition may occur thousands of kilometres away from the original source of emission.

The acidification of rain-water is identified as a serious environmental problem of a transboundary nature (WBG, 1998a; Singh and Agrawal, 2008; Beylot and Villeneuve, 2013). According to Singh and Agrawal (2008), the OECD (2013) and Doney *et al.* (2007) the potential impacts of acid deposition and nitrogen oxides include:

- Land-based impacts:
  - Impacts on forest ecosystems which can vary greatly according to soil type, plant species, atmospheric conditions, insect populations, and other factors that are not well understood (WBG, 1998b):
    - Increases in the soil acidity causing a decrease in soil fertility and negative impacts on growth and productivity of forest trees and crop plants, and
    - Direct damage to foliage.
  - Acidification of water bodies causing large scale negative impact on aquatic organisms including fish,
  - Effects on the human population *via* impacts on human health and the eroding of infrastructure, and
  - Eutrophication and subsequent changes in water quality and species richness resulting from NOx emissions (OECD, 2013).
- Oceanic impacts:
  - Lowering of oceanic and coastal pH (Section 10.9.4.2.2 above).

10.9.4.3 GHG emissions context

In order to inform the assessment of the 'severity of effect' of the Phase 1 & 2 emissions, it is necessary to quantify the Falkland Islands and UK emissions to enable comparison.

10.9.4.3.1 Historic Falkland Islands GHG emissions

Atmospheric emissions statistics for the Falkland Islands (as provided by the FIG Environment Department in 2024) indicate that the emissions in 2021 were equal to 0.422 million tonnes CO_2e (Table 10.61). Table 10.62 shows the Falkland Islands' emissions by IPCC sector. It is important to note that, at the time of writing (June 2024), the Falkland Islands' data between 1990 and 2021 do not include:

- Emissions from international aviation and shipping and vessels associated with the fishing industry e.g., reefers etc.,
- Emissions arising from previous Oil and Gas (O&G) exploration campaigns, and
- Emissions of the indirect GHGs (NOx, SO_2, CO and VOC).

These data gaps must be taken into account when making direct comparisons as is carried out in Section 10.9.4.5.1 below as the Phase 1 & 2 estimates include all sources of emissions. All comparisons between the Phase 1 & 2 Development and Falkland Islands emissions must therefore be caveated.

Table 10.61: Summary of historical Falkland Islands' emissions of direct Kyoto GHGs[1]

Emission Year	Direct GHG ($MtCO_2e$) [2]						Total ($MtCO_2e$)
	CO_2	CH_4	N_2O	F-Gases			
				HFCs	PFCs	SF_6	
1990	0.267	0.188	0.099	0.000	0.000	0.000	0.554
1995	0.203	0.178	0.095	0.000	0.000	0.000	0.477
2000	0.191	0.166	0.090	0.000	0.000	0.000	0.446
2005	0.192	0.147	0.079	0.001	0.000	0.000	0.418
2010	0.184	0.120	0.067	0.001	0.000	0.000	0.372
2015	0.277	0.118	0.069	0.001	0.000	-	0.464
2016	0.164	0.117	0.067	0.001	0.000	-	0.349
2017	0.197	0.121	0.069	0.001	0.000	-	0.387
2018	0.206	0.114	0.065	0.001	-	-	0.386
2019	0.200	0.118	0.067	0.001	-	-	0.385
2020	0.188	0.110	0.063	0.000	-	-	0.362
2021	0.233	0.120	0.069	0.001	-	-	0.422

[1] Falkland Islands emissions data provided by FIG Directorate of Policy, Economy and Corporate Services Policy Department in February, 2024.
[2] Note that these estimations are based upon GWPs from the IPPC Fifth Assessment Report (without carbon climate feedback) (Table 10.60 above).

Table 10.62: Summary of historical Falkland Islands' emissions of Kyoto GHGs by IPCC sector[1]

Year	Direct ($MtCO_2e$) [2]					Total [6] ($MtCO_2e$)
	Energy [3]	Transport[4]	Agriculture	LULUCF [5]	Waste	
1990	0.008	0.160	0.276	0.012	0.001	0.554
1995	0.008	0.129	0.266	0.013	0.001	0.477
2000	0.010	0.134	0.243	0.006	0.001	0.408
2005	0.010	0.137	0.249	0.013	0.001	0.446
2010	0.008	0.147	0.182	0.015	0.001	0.372
2015	0.009	0.240	0.180	0.013	0.001	0.464
2016	0.009	0.129	0.179	0.011	0.001	0.349
2017	0.008	0.163	0.183	0.011	0.001	0.387
2018	0.009	0.172	0.173	0.010	0.001	0.386
2019	0.009	0.165	0.178	0.010	0.001	0.385
2020	0.010	0.152	0.167	0.010	0.001	0.362
2021	0.010	0.202	0.182	0.010	0.001	0.422

[1] Source: Falkland Islands' emissions data provided by FIG Environment Department[ibid] (February, 2024) grouped according to the IPCC categories listed within the UK GHG Inventory, 1990 to 2021 (DESNZ, 2023a).
[2] Note that these estimations are based upon GWPs from the IPPC Fifth Assessment Report (without carbon climate feedback) (Table 10.60 above).
[3] These data exclude previous O&G operations.
[4] These data exclude international aviation and shipping. They include emissions from primary fishing vessels (i.e., Jiggers, Trawlers, Longliners, Potters and Combos but exclude fisheries associated vessels e.g., reefers). Data collected by FIG for these values include number of vessels and volume of fuel (FIG, *pers. comm.*),
[5] LULUCF: 'Land and use, land-use change and forestry', and

[6] Total represents the total of Falkland Islands emissions in CO_2e, not the sum of the columns.

10.9.4.3.2 Historic UK GHG emissions

To inform the assessment on the impact of Phase 1 & 2 emissions on the UK's ability to meet commitments under the Paris Agreement and the CCA, it was considered appropriate to use the total UK emissions (which include the Falkland Islands emissions as a UKOT (DESNZ, 2023a)) as a point of comparison. However, in order to provide a more direct comparison between Navitas and its peers, data are also provided for emissions from the UK Continental Shelf (UKCS) between 2018 and 2022. Additionally, a benchmark for carbon intensity is also provided to enable a point of comparison for the Development.

10.9.4.3.2.1 Total UK emissions

According to the UK GHG Inventory 1990 to 2021 (DESNZ, 2023a) the 2021 UK emissions (including those from UKOTs and Crown Dependencies that are party to the UK ratification of the UNFCCC and therefore including the Falkland Islands) amounted to 430.7 $MtCO_2e$ (Table 10.63). As shown in Table 10.64, emissions from the energy sector (88 .1 $MtCO_2e$) in 2021 specifically accounted for 20 % of all direct GHG emissions. Within the energy sector, 17 % (14.9 $MtCO_2e$) of emissions were from the O&G industry on the UKCS in 2021 (Section 10.9.4.3.2.2 below). Note that emissions of the indirect GHGs are not included in the national totals and do not require reporting. However, indirect GHG emissions (to 2021) are shown below.

Table 10.63: Summary of historical total UK emissions (including the UKOTs and Crown Dependencies) of direct Kyoto GHGs[1]

Emission Year	Direct GHG ($MtCO_2e$) [2, 3]						Total ($MtCO_2e$)
	Net CO_2	CH_4	N_2O	F-Gases			
				HFCs	PFCs	SF_6	
1990	607.3	150.9	44.4	12.1	1.5	1.2	**817.5**
1995	569.2	144.2	35.7	15.6	0.5	1.3	**766.5**
2000	569.7	124.3	26.9	7.0	0.5	1.9	**730.2**
2005	568.4	101.3	23.3	8.7	0.4	1.1	**703.1**
2010	508.6	75.7	20.7	11.5	0.3	0.7	**617.5**
2015	417.9	63.0	20.1	13.3	0.3	0.4	**515.0**
2016	394.8	60.9	19.6	13.4	0.3	0.4	**489.5**
2017	382.4	61.3	20.0	13.3	0.4	0.5	**477.8**
2018	375.1	60.9	19.8	13.0	0.1	0.6	**469.4**
2019	361.7	60.4	19.9	12.3	0.2	0.5	**455.1**
2020	321.4	58.0	18.7	11.5	0.2	0.4	**410.2** [4]
2021	342.6	57.4	19.2	10.8	0.2	0.4	**430.7**

[1] Final UK greenhouse gas emissions national statistics 1990-2021 (DESNZ, 2023b) including all UK emissions and those from UKOT and Crown Dependencies.

[2] Note that these data do not include the indirect GHG, namely NOx, SO_2, CO or VOC

[3] These estimations are based upon GWPs (*without* carbon-climate feedbacks) from Working Group 1 of the IPCC Fifth Assessment Report: Climate Change 2013 (IPCC, 2013) (Table 10.60 above).

[4] Demonstrating that the UK commitment to 'the EU2020 target' (Section 10.9.1.1.1) was met.

Table 10.64: Summary of historical total UK emissions (including UKOTs and Crown Dependencies) of direct Kyoto GHGs by IPCC sector[1]

Year	UK emissions ($MtCO_2e$) [2]									Total ($MtCO_2e$)
	Energy Supply	Business	Transport	Public	Residential	Agriculture	Industrial Processes	LULUCF [3]	Waste Management	
1990	284.7	112.1	130.0	16.0	80.8	54.9	55.4	11.2	72.3	**817.5**
1995	241.9	110.1	131.4	15.7	82.0	54.1	47.0	8.8	75.4	**766.5**
2000	226.0	113.2	134.6	13.8	89.1	52.7	26.4	6.3	67.9	**730.2**
2005	233.9	105.0	137.6	12.2	85.9	51.4	20.6	3.5	53.0	**703.1**
2010	209.8	89.0	126.5	9.5	87.7	48.8	12.7	1.8	31.7	**617.5**
2015	147.2	81.9	125.6	8.0	67.5	49.6	12.7	1.1	21.4	**515.0**
2016	123.6	79.8	128.1	8.1	68.7	48.8	10.7	1.1	20.6	**489.5**
2017	113.0	79.8	128.3	7.7	66.5	49.4	11.2	0.9	21.0	**477.8**
2018	105.9	78.9	126.6	7.8	68.7	48.6	10.3	1.5	21.0	**469.4**
2019	97.7	77.7	124.6	7.7	65.9	48.4	10.5	1.8	20.8	**455.1**
2020	85.7	74.6	100.3	7.2	65.6	46.9	9.5	1.3	19.2	**410.2**
2021	88.1	76.0	110.8	7.5	69.7	48.2	10.3	1.2	18.9	**430.7**

[1] Final UK greenhouse gas emissions national statistics 1990-2021 (DESNZ, 2023a) including all UK emissions and those from UKOTs and Crown Dependencies.
[2] These estimations are based upon GWPs (*without* carbon-climate feedbacks) from Working Group 1 of the IPCC Fifth Assessment Report: Climate Change 2013 (IPCC, 2103) (Table 10.60 above).
[3] LULUCF: 'Land and use, land-use change and forestry'.

Total UK Indirect GHG emissions

The indirect GHG emissions (to 2021) are shown in Table 10.65.

Table 10.65: Total UK Emissions of indirect GHGs for 1990 to 2021[1]

Emission Year	Indirect Greenhouse Gases (million tonnes)			
	NOx	CO	SO_2	NMVOC
1990	2.861	7.725	3.591	2.76
1995	2.467	6.357	2.541	2.279
2000	1.984	4.888	1.305	1.71
2005	1.752	3.266	0.789	1.241
2010	1.251	1.978	0.467	0.914
2015	1.02	1.608	0.27	0.824
2018	0.848	1.491	0.177	0.842
2019	0.794	1.423	0.157	0.824
2020	0.685	1.292	0.134	0.799
2021	0.689	1.312	0.127	0.783

[1] Final UK greenhouse gas emissions national statistics 1990-2021 (DESNZ, 2023a) including all UK emissions and those from UKOTs and Crown Dependencies.

10.9.4.3.2.2 Recent UKCS emissions

To enable a more direct comparison with the UK O&G industry, emissions data from the most recent OEUK Annual Environmental Report (OEUK, 2023) were used. The report does not provide a breakdown of the individual pollutants and, instead, provides only the total emissions in $MtCO_2e$ over each of the last five years (Figure 10-39). The UKCS emissions include those associated with offshore O&G exploration and production operations and excludes emissions from vessels associated with the construction and installation processes, supply, maintenance and surveys, shuttle tankers or export tankers, aviation, onshore activities and any other offshore industries. Given that the estimated Phase 1 & 2 emissions include emissions from construction, installation, MODU / FPSO transit, vessels and helicopter use it should be noted that comparisons are not like-for-like and the Development emissions may be over-represented.

Further, please note that in estimating the emissions, the OEUK report uses the AR5 GWP *with* carbon feedback whereas the total UK emissions, and the Phase 1 & 2 estimates use the AR5 GWP *without* carbon feedback. The GWPs with carbon feedback are slightly higher than those without feedback and therefore, to avoid under-representing the Development emissions, the Phase 1 & 2 emissions are recalculated using the same GWP as the OEUK data below (Section 10.9.4.5.3).

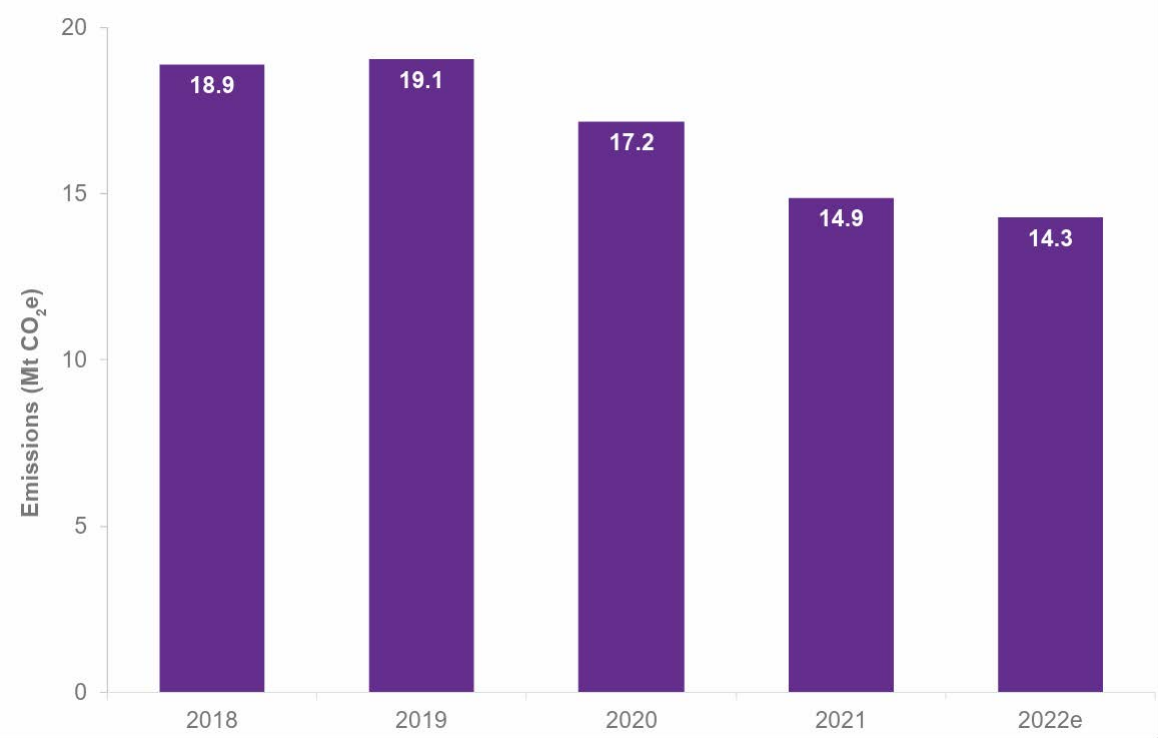


Figure 10-39: Total UKCS emissions

10.9.4.3.2.3 Carbon Intensity

In addition to estimating the absolute emissions associated with a project over a given period of time in order to enable comparison with total UK emissions, it is useful to measure the carbon intensity. Carbon intensity metrics refer to the amount of GHG emissions per unit of output in order to normalise changes in emissions due to changes in project activity. They are also a useful measure of efficiency when aiming to reduce overall emissions.

Table 10.66 indicates the carbon intensity of installations on the UKCS in 2023 based on installation age, type and size.

Table 10.66: Carbon intensity of UKCS installations, 2023 ($kgCO_2e$/boe)

Age / Asset	Small platform	FPSO	Large Platform
0 – 10 years	6	20	12
11 – 25 years	18	36	20
>25 years	33	34	52

(Source: NSTA Emissions Monitoring Report 2024)

10.9.4.3.3 Projected future total UK GHG emissions

It is acknowledged that while the Falkland Island emissions are reported to the UNFCCC as part of the UK emissions totals, UK ratification of the Paris Agreement has not yet been extended to the Falkland Islands as a UK Overseas Territory. Therefore, emissions from all UKOTs and Crown Dependencies are not included within the UK NDC and are therefore not included in the UK Carbon Budget (Section 10.9.1.1.1). At the time of writing there are no budgets assigned to the Falkland Islands and there is little guidance on what such allowances may be. It is anticipated that should the Carbon Budgets be extended to include the UKOTs/Crown Dependencies, they will not be dramatically increased and the UK Carbon Budgets as they stand have been used as the only point of comparison available at this time.

Table 10.67 shows the UK Carbon Budgets set under the UK CCA (Section 10.9.1.1.1) alongside the projected future emissions (EEP, 2019). As shown in Table 10.67, the actual UK emissions were equal to the first carbon budget target and were less than the second carbon budget. The projected emissions for the next two reporting periods (3 and 4) indicate that the emissions will remain below the targets. However, taking into account the ever more stringent targets and the uncertainty around projected data, the projected UK emissions during the future carbon budget periods (5 and 6) are expected to exceed the targets. The UK Government is currently considering ways to reduce emissions toward the goal of Net Zero by 2050 and the Energy and Emissions Projection reports are updated as necessary to take account of the UK Net Zero Strategy.

Table 10.67: Carbon Budgets[1] and actual[2] and projected[3] UK[4] CO_2e emissions and targets

Carbon budget period [1,4]		Allocated UK CO_2e budget ($MtCO_2e$)[5]	Number of years	Average allocated UK $MtCO_2e$ per year [1]	Total projected UK Carbon emissions ($MtCO_2e$)	Average projected UK $MtCO_2e$ per year (over 5 years)	Difference between UK target and projected UK emissions ($MtCO_2e$)
1	2008 to 2012	3,018	5	603.6	3,018[2,5,6]	603.6	Zero
2	2013 to 2017	2,782	5	556.4	2,565[2]	513.0	-217
3	2018 to 2022	2,544	5	508.8	2,181[3]	436.2	-363
4	2023 to 2027	1,950	5	390.0	1,930[3]	386.0	-20
5	2028 – 2032	1,725	5	345.0	1,798[3]	359.6	+73
6[7]	2033 – 2037	965	5	193.0	1,714[3]	342.8	+749
7[7]	2038 – 2042	To be set in 2025	5	-	-	-	-

[1] Climate Change Committee (ww.theccc.org.uk) – the independent, statutory body established under the Climate Change Act 2008

[2] Final UK greenhouse gas emissions national statistics 1990-2021 (DESNZ, 2023a). **Note:** GWPs used are from Working Group 1 of the IPCC Fifth Assessment Report: Climate Change 2013 (without carbon climate feedback) (see also Note 5 below).

[3] **Note:** The most recent previous full update of the Energy and Emissions Projections 2019 - 2040 (EEP, 2019) was published in October 2020. However, a more recent partial interim update, the Net Zero Strategy (NZS) Baseline, was published in December 2021 and a more recent reference baseline was published in 2022. These estimates are taken from Updated energy and emissions projections 2021 to 2040: October 2022. **Note:** Projected emissions provided in the report utilise 100-year GWPs from the Fifth IPPC Assessment Report (AR5 without climate feedback) (See AR5 Table 8.A.1). The projections assume application of all 'EEP-ready' policies (policies that have been implemented and those that are planned where the level of funding has been agreed and the design of the policy is near final) at the time of report publication (2022). EEP-ready policies in this edition include some of the policies and proposals from the Net Zero Strategy, whilst others are yet to reach the required state of development and will therefore be included in later editions. It is notable that with projections based on the current EEP-ready policies, the fifth and sixth carbon budgets will be exceeded.

[4] It is acknowledged that the Falkland Island emissions are not yet included within the UK Carbon Budgets (see narrative above).

[5] Carbon budget periods are as agreed under the Climate Change Act and are not necessarily aligned to the previous Kyoto reporting periods.

[6] **Note:** The actual emissions data vary:

- According to the UK Greenhouse Gas Inventory, 1990 to 2012 (DECC, 2014), the actual emissions for 2008 – 2012 were 2,964 $MtCO_2e$.
- According to the Final UK greenhouse gas emissions national statistics 1990-2018, the 2008 – 2012 were 2,953.7 $MtCO_2e$.
- In the Final UK greenhouse gas emissions national statistics 1990-2021 (DESNZ, 2023a), this figure has changed to 3,018 which directly matches the carbon budget. It is not clear why this change has occurred although it may be due to the use of different GWPs with IPCC AR4 figures used in the earlier estimates. Similar variations exist for 2013 – 2017 also.

[7] The 6th Carbon Budget, and subsequent budgets will include international aviation and shipping (IAS).

10.9.4.3.4 Global energy demand

According to the IEA, global oil demand as of December 2023 was 101.7 MMstb per day and was on track to average 102.8 MMstb per day in 2024 (IEA, 2023; 2024). This figure is driven by several key factors, such as the recovery from the COVID-19 pandemic, geopolitical tensions impacting supply

chains (such as the Russia-Ukraine conflict), and the accelerating transition toward renewable energy sources. While demand continues to grow in emerging economies, particularly in Asia, a structural decline in demand is observed in many advanced economies due to energy efficiency measures and shifts toward cleaner energy technologies.

The Global Energy Outlook 2023 (Raimi, *et al.,* 2023) provides a synthesised analysis from 15 different scenarios for future oil demand. This analysis notes that under most scenarios, global oil demand is considerably lower by 2050 than it is today. Raimi *et al.* (2023) observe that under Reference Scenarios from ExxonMobil, IEEJ, and OPEC, oil consumption plateaus in the 2030s and remains at or above 100 mb/d through 2050, recognising this as a level that is incompatible with achieving international climate targets. Evolving Policies scenarios illustrate a fairly wide range of future consumption, but scenarios that limit global temperature rise to 1.5°C by 2100 project that oil demand falls to roughly 20 to 25 mb/d by midcentury (Raimi, *et al.,* 2023). The large range in future trends underscore a complex interplay between energy security, economic growth, and climate imperatives.

Table 10.68 shows two end-member future scenarios which capture the range of future oil demand forecasts. The IEA STEPS (Stated Policies Scenario) (Table 10.68, Scenario 1) represents a projection of future energy demand based on current government policies and announced commitments, assuming they are implemented as stated. For oil demand, this scenario considers how factors like economic growth, population trends, and technological developments will interact with these policies. It reflects a middle-ground view, where no significant additional climate policies beyond those already planned or pledged are assumed. Under STEPS, oil demand remains resilient in the near term but plateaus and starts to decline from 2035 as energy efficiency improves and alternatives gain traction.

The BP Net Zero scenario (Table 10.68, Scenario 2) envisions a future where the world takes aggressive action to achieve net-zero carbon emissions by 2050. This scenario has been designed to achieve a Net Zero outcome. In this scenario, oil demand declines rapidly as countries prioritise renewable energy, electrification, and energy efficiency while phasing out fossil fuels. This is driven by stricter climate policies than currently exist, shifts in consumer behaviour, and significant advancements in clean technologies. By 2050, oil use in this scenario is dramatically reduced, playing a much smaller role in the global energy mix.

The Sea Lion emissions associated with the combustion of sold product, as they compare to emissions from the above global demand scenarios, are provided in Section 10.9.4.5.7 below.

Table 10.68: Current daily global oil demand (as of December 2023 as reported by IEA) and two future global oil demand scenarios.

Global Oil Demand Scenarios[1]	2023	2030	2035	2050
	Average Daily Global Oil Demand (MMstb/d) - EIA Dec 2023[3]	Average Daily Global Oil Demand (MMstb/d)	Average Daily Global Oil Demand (MMstb/d)	Average Daily Global Oil Demand (MMstb/d)
1. World Oil Demand - Scenario IEA STEPS (MMstb/d)[2]	101.7	101.7	99.1	93.1
2. World Oil Demand - Scenario BP Net Zero (MMstb/d)[2]	101.7	77.5	62.1	18.2

[1] Two end-member future scenarios are presented which capture the range of future oil demand forecasts: IEA STEPS which predicts a relatively small reduction in future global oil demand, and the BP 2023 Net Zero scenario from the Global Energy Outlook (2023) which is one of the most aggressive scenarios in terms of reduction in global oil demand.
World Oil Demand – STEPS Scenario IEA from Table A.9 in 2024 World Energy Outlook (https://iea.blob.core.windows.net/assets/6a25abba-1973-4580-b6e3-ba014a81b458/WorldEnergyOutlook2024.pdf)
World Oil Demand – Scenario BP Net Zero from Resources for the Future Global Energy Outlook (https://www.rff.org/publications/data-tools/global-energy-outlook/)
[2] Note that the source documents express the volumes in mb/d which, in these documents, refers to million barrels of oil per day. The units have been changed here for consistency as in the O&G industry mb/d often denotes thousand barrels of oil per day.
[3] Daily global oil demand from IEA as at Dec 2023 (Oil Market Report - December 2023, IEA, Paris https://www.iea.org/reports/oil-marketreport-december-2023).

10.9.4.4 Quantification of emissions from (and associated with) Phase 1 & 2

All emissions reduction technologies built-in to the basis of design (Section 10.9.2.1) have been factored into the estimation of emissions from planned activities.

As described above (Table 10.60 above), direct and indirect GHGs include those that result from the combustion of fuels (e.g., CO_2, N_2O, NOx, SO_2) and those that result from the direct venting of gas (e.g., CH_4). While F-Gases are also considered to be direct GHG, these are used in closed systems and therefore do not require emissions factors.

The amount of GHG emission resulting from the above activities is calculated as follows (from DESNZ, 2023a):

'Activity (source and amount of fuel/material combusted)' x 'the Emissions Factor for the GHG' = GHG emission'

10.9.4.4.1 Assumptions regarding source activities

Estimation of the emissions associated with a project requires an understanding of the fuel consumption rates of the combustion equipment used for both generation of electricity (the GTGs) and heat (the gas fired steam boiler). Understanding of the fuel consumption requires an understanding of the power demands of the consumers (Table 10.59 above). Emissions also result from other sources such as flaring, vessel use, fugitive emissions etc.

While these can be estimated and itemised according to an expected and best-case scenario, it is prudent to assume a degree of uncertainty and to estimate the emissions based on a worst-case scenario. Table 10.69 indicates the expected base-case with regard to operations alongside the worst-case assumptions used to estimate the emissions associated with the Phase 1 & 2 Development. The emissions estimates provided in Section 10.9.4.4.4 below, and the impact assessment provided in Section 10.9.6 both assume the worst-case as detailed below.

Table 10.69. Indicating the expected Development activity and the worst-case assumptions used for the emissions impact assessment

Source	Currently expected base-case[1]	Worst-case assumptions
Power generation on the FPSO	**The following estimates assume the use, at any one time, of two out of the three available DLE Turbines (9.7MW each) to power the consumer units which are itemised in Table 10.59 above.** **Fuel gas:** • Fuel gas is expected to become available 3 - 4 weeks after First-Oil. • During the first year of operation, fuel gas consumption is expected to average at *c.* 9.5 mmscfd every day with peak days of *c.* 12 mmscfd during offloads. While offloads at peak production are expected to occur every 7 - 10 days, they will be intermittent during the first year of production as the system is commissioned. Therefore, an average fuel gas use of 9.8 mmscfd can be assumed for the first year after First-Oil. o Fuel consumption in the initial months of Phase 1 production and the initial months of Phase 2 production is higher than in subsequent years due to the combustion of fuel gas to heat the injection water (Section 5.8.5.8). Heating this water requires *c.* 2.5 mmscfd of fuel gas to the steam boiler (Section 5.8.2.3). o Heated injection water is required for a total of 12 months across the initial Phase 1 & 2 production operations. After this it is expected that there will be a sufficient volume of hot water already in the reservoir to provide a buffer between the cold injected water and the oil to prevent wax formation. o After cessation of injection water heating, fuel gas consumption will drop down to *c.* 7.3 mmscfd. • The need / uses for power over the life of field decreases as production volumes decline such that fuel gas consumption is predicted to be[2]: o Production year 1: 9.8 mmscfd. o Production year 2: 7.3 mmscfd. o Production years 2 to 15: 6.5 mmscfd o Production years 15 to 30: 4.2 mmscfd	**Fuel gas:** • Assume fuel gas will not come online for up to three months and that diesel will be used for these three months at a rate of 35 mt/d. • Adding a 20 % contingency to the fuel gas usage, the average fuel gas consumption rate is assumed to be 6.6 mmscfd over Field Life. This is an overestimate to account for the worst-case fuel gas use assumptions that: o Injection water requires heating for a total period of 24 months, requiring extended use of the gas fired steam boiler[3], o Even during an extended stabilisation period there would still be periods of fuel gas supply, and o There will be 100 % uptime of the fuel gas system (which effectively means an element of double-counting of emissions given the assumptions below on diesel use but this is assumed to ensure a worst-case[4]). **Fuel gas Conversion rate:** • The conversion rate based on sampling has been estimated at 21.87 t per mmscf of gas[5]. **Diesel:** • Adding a contingency to the diesel use rate, the consumption rate is assumed to be 6.6 mt/d when fuel gas is available, (assumed to be 93 % of the time): o With the addition of a third dual fuel GTG the availability of using fuel gas for power

Source	Currently expected base-case[1]	Worst-case assumptions
	• Based on the above, it is anticipated that over the life of the field, the average fuel gas consumed will be *c.* 5.5 mmscfd. **Fuel gas conversion rate:** • Based on laboratory data of live oil samples recovered from the Sea Lion Field, Navitas estimate the conversion rate for the associated gas to be 1 mmscf gas = 21.87 t. • Of note, POEPL assumed a conversion rate of 1 mmscf gas = 27.8 t, which, based on the samples, Navitas consider to be highly conservative. **Diesel:** • Diesel consumption is estimated at an average of 5.2 mt per day. • Fuel gas is expected to be available for 93 - 95 % of the time. Downtime of the fuel gas relates to times of no production due to planned or emergency shutdowns.	generation increases, thus having 3 GTGs to run or select from for the supply power. Additionally, the volume of oil being produced will see sufficient associated gas being liberated to support fuel gas for longer available periods. Therefore, this buffer is in line with the basis of design reliability of the system. • Adding a contingency to the diesel use rate that may result when fuel gas is offline (e.g., during process or emergency shutdowns, estimated conservatively to occur for 7 % of the time), the use of 55 mt/d of diesel is assumed. • To incorporate the above figures in line with the estimated downtime, a weighted average will be applied: o FPSO active for total of 11,353 days: o 93 % of time @ 6.6 tpd = 10,558.29 days = 69,684.71 tonnes o 7 % of time @ 55 tpd = 794.71 days = 43,709.05 tonnes o Average daily fuel use over full Field Life = (69,684.71 + 43,709.05) / 11,353 = 10.0 tonnes/day diesel use. • [Note also the assumption of teething trouble at startup listed above leading to diesel usage at 35 mt/d for the first three months.]
	Production levels at the expected P50 case (310.5 MMstb): • At the end of Phase 1, seven oil wells will be in production and the throughput of crude is anticipated to be 45,000 bopd (barrels of oil per day),	For the purposes of the credible worst-case assumptions:

Source	Currently expected base-case[1]	Worst-case assumptions
	• At the end of Phase 2, all 16 OP wells will be in operation and throughput will peak at 55,000 bopd. • Production levels will decline over the Field Life as the basin matures and the daily average throughput over Field Life is estimated at 28,356 bopd[6] (Section 5.8.2.2.1). The P50 *and* the P10 and P90 production profiles are presented in Figure 10-40 below for transparency, showing the decline in production rates over field life.	• The emissions estimates are based on power and activity requirements which are not exactly tied to any one production case. • All three production cases (P10, P50 and P90) have been used to present a range of outcomes for both 'combustion of sold product' (Table 10.76) and emissions intensity (Table 10.78).
Use of vessels[7]	Fuel consumption rates by vessel vary according to the activity and are naturally higher when the vessel is in transit *vs*. when they are idle or in-field.	For the majority of the vessels an average of the fuel consumption rate has been taken and applied to the total duration of vessel use. This is expected to provide an over-estimate as the majority of the vessel activity will be in-field, and this will be at the lower fuel consumption rate. For the Large Transport Vessels (LTVs), separate fuel consumption rates have been used for transit time and in-field time as the vessels will be at anchor, running only generators, for the majority of the duration.
Personnel transportation[7]	As described in Section 5.11.3.1.1, charter flights will be used to transfer personnel to the Falkland Islands from the UK on a fortnightly basis. Stage 1 of the Development is expected to last for 31 months (67 fortnights). However, in reality, the charter flights will not commence until one year before First-Oil (approximately 19 months into Stage 1).	The EIA assumes charter flights will occur fortnightly for the full 31 months and this is assumed for the emissions estimates.
	As described in Section 5.11.3.1.1, charter flights may continue to be used for the full duration of stage 3. However, once into steady state production, the reliance on charter flights may diminish in favour of weekly commercial flights.	The EIA assumes the use of fortnightly charter flights for the full duration of Stage 3 and this is assumed for the emissions estimates.
Well clean-up / testing	As OHGP will be used for the well completions (Section 5.4.5.5), rather than cement and perforation, it is anticipated that there will be little solid material debris which minimises the risk of damage to the FPSO facilities. Therefore, it is anticipated that extensive clean-up / flowback operations to the MODU will not be required. As such, the base-case is to leave the wells suspended with a	As described in Section 5.4.8, the contingency is retained for well flow-back or testing to the MODU of up to four wells should circumstances necessitate it. This will involve flaring off of the oil and gas as there will be no other way to safely manage the products.

Source	Currently expected base-case[1]	Worst-case assumptions
	completion fluid that can safely be flowed back to the FPSO and no flaring associated with clean-up will be required.	The planned emissions estimate in Section 10.9.4.4.4 below presents the worst-case baseline emissions and also itemises the emissions from four well flow-backs / tests (3 x OP wells and 1 x GI well).
Flaring	Flaring associated with the Development includes the following: • The flare pilot light will be lit from First-Oil and will remain so for Field Life, assuming 0.5 mmscfd. • Commissioning of the gas lift and injection systems. In order to achieve the commissioning operations, it will be necessary to flare produced gas for up to 30 days at a rate of up to 306.2[8] tonnes of gas per day. • Year 1: 19.5 days flaring due to process upsets and emergency blowdowns, • Year 2: 13 days flaring due to process upsets and emergency blowdowns, and • Years 3 - 32: 7 days flaring due to process upsets and emergency blowdowns (per year)	• The flare pilot light will be lit from First-Oil and will remain so for Field Life, assuming 0.5[9] mmscfd • Assume 45 days flaring at 306.2[8] tonnes per day as the worst-case for commissioning the gas system. • Year 1: Assume 25 days flaring due to process upsets and emergency blowdowns, • Year 2: Assume 20 days flaring due to process upsets and emergency blowdowns, and • Years 3 - 32: Assume 10 days flaring due to process upsets and emergency blowdowns (per year).
Fugitive emissions	The methodology for calculating fugitive emissions has been published by several internationally recognised sources (DECC, 2008; API, 2021). The accepted methodology requires documenting both the total number and type of process and utility equipment relevant to the installation, such as flanges, connections, valves, vessels, pumps etc. When *in situ* operational measurements are not available, a specific emissions factor is applied to each component type and summed to derive the total estimated fugitive emissions per year. However, the degree of fugitive emissions from these components depends on the type and nature of the hydrocarbons being produced, the age of the facilities, and the specifications of each component. The Sea Lion FPSO has not yet been confirmed and contracted. However, whichever FPSO is ultimately selected will undergo modification and refitting. Therefore, the level of detail regarding the number and type of components relating to the production system at Sea Lion cannot currently be defined with any precision, making an estimate of potential fugitive emissions at this stage premature. Any estimate made at this point cannot be supported by any project-specific data and may produce an over- or under-estimate that cannot be verified. As FEED work progresses, a calculation of fugitive emissions will be made and refined in later project phases.	
Combustion of sold product	The oil produced from the Sea Lion Field will be sold into multiple markets and will be refined to produce a variety of end products. This will be dictated by the offtaker of each shipment, prevailing market forces, and the refinery that will process the oil such that it is	

Source	Currently expected base-case[1]	Worst-case assumptions
	not possible to predict what the end uses will be. For the purposes of estimating the worst-case emissions associated with use of the sold product, it is assumed that 100 % of the product will be combusted. Such emissions are estimated for Field Life production levels at: • The lower case (P90) - 242.3 MMstb, • The mid (expected) case (P50) – 310.5 MMstb, and • The upper case (P10) – 336.7 MMstb[10].	

[1] These figures represent the currently expected sources of emissions. It is expected that ongoing work during the FEED process will continue to identify further means of reduction.

[2] Power use will reduce over time for the FPSO. As oil production decreases so does associated (produced) gas, potentially requiring less compression power as re-injection gas rates will decrease. Water injection power requirements will remain at approximately the same level until total produced liquid rates fall below the nameplate capacity of the facility and, therefore, voidage replacement requirements decrease.

[3] Navitas estimates that heated injection water will be required for between 12 and 24 months over the life of the field.

[4] This scenario assumes 100 % uptime of gas whereas the downtime is factored in for diesel use i.e., fuel gas and diesel both in use when fuel gas is down, therefore this scenario will likely lead to an overestimate of emissions.

[5] Please note that the fuel gas conversion rate used for the worst-case was changed to 21.87 t per mmscf in accordance with representations during the statutory consultation period. See Chapter 0, Xodus 46.

[6] Average daily production over whole field life is calculated based on the expected total oil production divided by total production period in days. This is a representative average production rate for the life of field, in reality production rates will vary over time and be higher during early production and decline over time as shown in Figure 10-40.

[7] In sections below, comparisons are made between the estimated Sea Lion emissions and those that occur on the UKCS (Section 10.9.4.5.3 and Section 10.9.4.5.4). To ensure like-for-like estimates within these comparisons, the emissions associated with personnel transportation are excluded, as are those associated with drilling and vessels in accordance with the scope defined by the NSTA in their Emissions Monitoring Report 2023.

[8] Navitas has taken a conservative approach to the estimated volume of gas flared at start-up and the flaring rate per day will likely reduce during the FEED process as viable modifications to the selected FPSO are evaluated.

[9] Please note that the post-consultation flare pilot light gas usage was reduced from 0.7 mmscfd to 0.5 mmscfd in the worst-case assessment following representations during the statutory consultation period (see Chapter 0, OPRED 12).

[10] The Conversion factor for Sea Lion oil is 1 barrel oil = 0.1399995 tonnes oil, using specific density of the oil at Stock Tank conditions 1 atm / 60 degF = 880.5 kg/m^3.

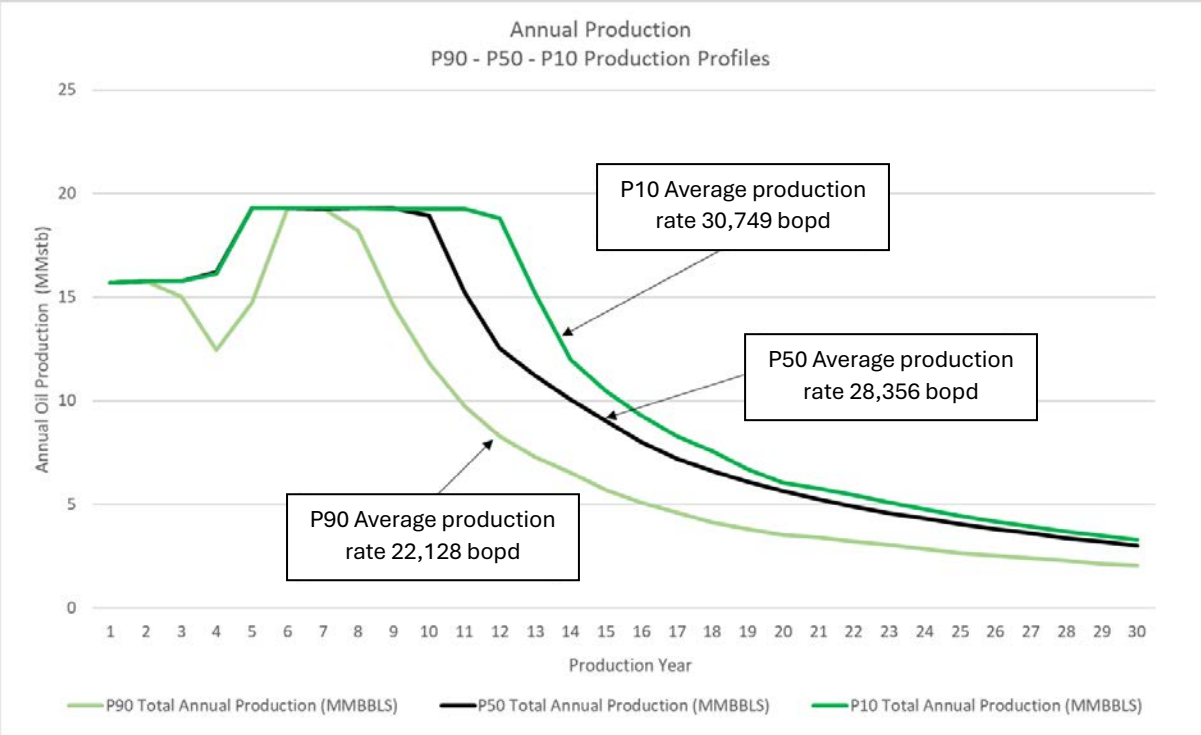


Figure 10-40: Showing the decline in production over field life for the P10 – P90 production profiles

10.9.4.4.2 Activity (source and amount of fuel / material combusted)

Combustion emissions can be estimated by multiplying the total fuel consumption by the published emissions factors (see below) for each fuel type. The total fuel consumption was estimated using the fuel consumption rates in Table 10.70 and the estimated duration of use of each source.

Table 10.70: Consumption rates for each planned source of combustion emissions[1]

Emissions Source	Fuel Type	Fuel Consumption	Fuel Consumption Units	Example Vessel/Vehicle
Drilling[2], GI well commissioning and contingency well clean-up / testing				
Semi-sub MODU - drilling	Diesel	25	tonnes/day	*Stena Don*
Flaring during GI well commissioning	Fuel Gas	306.2[3]	tonnes/day	-
Oil well clean-up/test flaring - Oil	Oil	1,262	tonnes per well	-
Oil well clean-up/test flaring - Gas	Gas	105	tonnes per well	-
Oil well clean-up/test flaring - Base Oil	Diesel	56.3	tonnes per well	-
Gas Injection well clean-up/test flaring - Oil	Oil	76	tonnes per well	-
Gas Injection well clean-up/test flaring - Gas	Gas	751	tonnes per well	-
Gas Injection well clean-up/test flaring - Base Oil	Diesel	42	tonnes per well	-
Production[1]				
FPSO - on location	Diesel	10.0	tonnes/day	*Aoka Mizu*
FPSO - on location	Fuel Gas	144.3[3]	tonnes/day	*Aoka Mizu*

Emissions Source	Fuel Type	Fuel Consumption	Fuel Consumption Units	Example Vessel/Vehicle
Flare Pilot Light	Fuel Gas	10.9[3]	tonnes/day	-
Flaring during commissioning	Fuel Gas	306.2[3]	tonnes/day (during commissioning period only)	-
Vessel Use[2]				
FPSO - sailing	Marine Gas Oil	35.0	tonnes/day	*Aoka Mizu*
Anchor Handling Tugs (AHTS)	Marine Gas Oil	12.0	tonnes/day	*Pacific Centurion*
Offshore Construction Vessel (OCV)	Marine Gas Oil	20.0	tonnes/day	*Island Frontier*
Large Transport Vessel (LTV) - on location & offloading cargo	Marine Gas Oil	5.2	tonnes/day	*Jumbo J-Type Vessel - Jumbo Jubilee*
LTV - sailing	Marine Gas Oil	30.6	tonnes/day	*Jumbo J-Type Vessel - Jumbo Jubilee*
Platform Supply Vessel (PSV)	Marine Gas Oil	7.0	tonnes/day	*Troms Pollux*
Ad hoc Freighter	Marine Gas Oil	7.0	tonnes/day	*BBC London*
Emergency Response and Rescue Vessel (ERRV)	Marine Gas Oil	3.0	tonnes/day	*Esvagt Don*
Onshore				
Car	Diesel	0.004	tonnes/day	*Land Rover Discovery*
Mobile Crane	Diesel	0.008	tonnes/day	*Liebherr 150SWL*
Forklift Truck	Diesel	0.004	tonnes/day	*10mt CAT Diesel*
Truck	Diesel	0.004	tonnes/day	*25mt Volvo cab*
Diesel Generator (supply base)	Diesel	0.184	tonnes/day	80 KW @ 75 % capacity
Personnel transportation[2]				
Helicopter - personnel transport & Search And Rescue SAR)	Aviation Fuel	0.379	tonnes/day	*Sikorsky S-92*
Helicopter - Personnel transport	Aviation Fuel	1.231	tonnes/day	*Sikorsky S-92*
Charter Airplane	Aviation Fuel	15.0	tonnes/day	*A330*
Unplanned events				
Year 1 & 2 Emergency Shut Down (ESD) events	Fuel Gas	45.1[3]	tonnes/day	25 days
Year 2 Shut Down events due to operational disruptions	Fuel Gas	36.0[3]	tonnes/day	20 days
Year 3 onwards Emergency Shut Down (ESD) events	Fuel Gas	18.0[3]	tonnes/day	10 days per year

[1] Please note that the emissions estimate is not based solely on the oil production rate. Power use will reduce over time because, as oil production decreases so does associated (produced) gas, potentially requiring less compression power as re-injection gas rates will decrease. Water injection power requirements will remain at approximately the same level until total produced liquid rates fall below the nameplate capacity of the facility and, therefore, voidage replacement requirements decrease (see Section 5.8.2.2.1 and Figure 5-8).

[2] In sections below, comparisons are made between the estimated Sea Lion emissions and those that occur on the UKCS (Section 10.9.4.5.3 and Section 10.9.4.5.4). To ensure 'like-for-like' estimates as far as possible within these comparisons, the emissions associated with drilling, vessel use and personnel transportation are excluded, in accordance with the scope defined by the NSTA in their Emissions Monitoring Report 2023.

[3] Based upon the conversion rate of 21.87 tonnes per mmscf based on sampling, as explained in Table 10.69 above.

10.9.4.4.3 Emissions factors

The emissions factors used in this assessment are provided in Table 10.71.

Table 10.71: Emissions factors

Activity (source of emissions)	Fuel	Direct GHG			Indirect GHG			
		CO_2	CH_4	N_2O	NOx	SO_2	CO	VOC
Fuel Gas (Turbines)[1]	Fuel gas	2.577	0.000138	0.000004	0.006100	0.000013	0.003000	0.000036
Diesel (Turbines)[2]	Diesel	3.164	0.000012	0.000148	0.013500	0.004000	0.000920	0.000295
Diesel (Engines)[3]	Diesel	3.164	0.000012	0.000148	0.059400	0.004000	0.015700	0.002000
Aviation fuel[4]	A1-Jet fuel	3.150	0.000078	0.000100	0.018363	0.001180	0.005655	0.000318
Shipping Transport[5]	Marine Gas Oil	3.206	0.000032	0.000145	0.059000	0.004000	0.008000	0.002400
Diesel vehicle (onshore)[6]	Diesel	2.976	0.000012	0.000147	0.007962	0.000009	0.054746	0.001376
Flaring & Flare Pilot Light[7]	Fuel gas	2.800	0.018000	0.000081	0.001200	0.000013	0.006700	0.002000
Flaring During Well Clean-up[8]	Oil	3.20	0.025000	0.00008	0.00370	0.000013	0.01800	0.02500
Flaring During Well Clean-up[8]	Gas	2.80	0.045000	0.00008	0.00120	0.000013	0.00670	0.00500
Flaring During Well Clean-up[9]	Diesel (Base Oil)[10]	3.16	0.000012	0.00015	0.01350	0.004000	0.00092	0.00030
Cold venting[11]	Produced gas	-	0.5	-	-	-	-	0.5
Combustion of sold product	Crude oil[12]	3.12 tCO_2e/tonne crude oil						
Use of purchased municipal electricity	Electricity	0.3962 $kgCO_2e/kWh$[13]						

[1] Direct GHGs: "Natural gas (100 % mineral blend)", UK Government GHG Conversion Factors for Company Reporting, v1.1 (DESNZ, 2023c). Indirect GHGs: Fuel Gas Turbine, Table 8.1-EEMS Atmospheric Emissions Calculations (2008).

[2] Direct GHGs: "Diesel (100 % mineral diesel)", UK Government GHG Conversion Factors for Company Reporting, v1.1 (DESNZ, 2023c). Indirect GHGs: Diesel Turbine, Table 8.2-EEMS Atmospheric Emissions Calculations (2008).

[3] Direct GHGs: "Diesel (100 % mineral diesel)", UK Government GHG Conversion Factors for Company Reporting, v1.1 (DESNZ, 2023c). Indirect GHGs: Diesel Engine, Table 8.2-EEMS Atmospheric Emissions Calculations (2008).

[4] Direct GHGs: "Aviation Turbine Fuel", UK Government GHG Conversion Factors for Company Reporting, v1.1 (DESNZ, 2023c). Indirect GHGs: UK National Atmospheric Emission Inventory (NAEI, 2014).

[5] Direct GHGs: "Marine Gas Oil", UK Government GHG Conversion Factors for Company Reporting, v1.1 (DESNZ, 2023c). Indirect GHGs: OGP methods for estimating atmospheric emissions from E&P operations, publication 197 (OGP, 1994).

[6] Direct GHGs: "Diesel (average biofuel blend)", UK Government GHG Conversion Factors for Company Reporting, v1.1 (DESNZ, 2023c). Indirect GHGs: UK National Atmospheric Emission Inventory (NAEI, 2014).

[7] Production Flaring, Tables 3.1 & 8.3 -EEMS Atmospheric Emissions Calculations (DECC, 2008).

[8] Well Testing, Table 10.1 -EEMS Atmospheric Emissions Calculations (DECC, 2008).

[9] Direct GHGs: "Diesel (100 % mineral diesel)", UK Government GHG Conversion Factors for Company Reporting, v1.1 (DESNZ, 2023c). Indirect GHGs: Diesel Turbine, Table 8.2-EEMS Atmospheric Emissions Calculations (DECC, 2008).

[10] Base oil will be used to promote efficient combustion and minimise risks of drop-out from the flare.

[11] DECC (2008), p37, Associated Gas.

[12] Emissions factor for combustion of crude oil (based on 30.5 API oil), stated in tonnes of CO_2e per tonne crude oil combusted as taken from Appendix 1 of CDP (2022) guidance for estimation of Scope 3 category 11 emissions for oil and gas companies.

[13] Carbon Footprint Limited (30th July 2023) Country-Specific electricity grid greenhouse gas emissions factors – 2023. https://www.carbonfootprint.com/docs/2023_07_international_factors_release_11.xlsx (CFL, 2023).

10.9.4.4.4 Estimation of worst-case Phase 1 & 2 emissions

No direct venting of process gas will occur during routine and planned operations and the emission of F-Gases is prohibited (Section 10.9.1.1.4). Therefore, the only routine emissions that will occur are those that result from combustion throughout the Development (FPSO, vessels etc.) and VOCs emitted during offloading from the FPSO to the CTT. A small amount of gas is inevitably released from seals on process gas equipment, known as fugitive emissions, which are quantified in annual reporting.

The estimated quantities of GHGs emissions from combustion for each Stage of the Phase 1 & 2 Development are provided in Table 10.72 (including flaring that may result from unplanned process upsets and emergency blowdowns once fully operational) and are summarised in Table 10.73. Both tables also itemise the emissions that may result from the contingency well flow-back / testing, should it occur (Section 5.4.8). Therefore, this provides the emissions estimated using the worst-case assumptions outlined in Table 10.69 above.

The total emissions estimated using the worst-case assumptions itemised in Table 10.69 above amount to 7.33 $MtCO_2e$ resulting in a carbon intensity of 23.6 $kgCO_2e$/boe (Section 10.9.4.5.4). This is as compared to the total emissions using the 'currently expected' assumptions, (also listed in Table 10.69), of 5.6 $MtCO_2e$, a reduction of 24 % of the worst-case assumptions, and a carbon intensity of 17.9 $kgCO_2e$/boe. Emissions over the course of Field Life are also presented visually in Figure 10-41.

Of note, when the personnel transportation, drilling and vessel emissions are excluded to enable like-for-like comparison with the actual UKCS emissions reported to the NSTA, the carbon intensity for the 'currently expected' assumptions is estimated to be 14.2 $kgCO_2e$/boe (Section 10.9.4.5.4), although please note that this figure still includes for unplanned process upsets and emergency blowdowns and so is still a likely overestimate.

The average worst-case emissions per annum over Field Life are estimated at 0.2243 $MtCO_2e$ (and 0.2249 $MtCO_2e$ including the contingency well flow-back / tests) (Table 10.73). Table 10.74 shows the percentage contribution of each activity category to the worst-case Phase 1 & 2 emissions. The greatest overall contributor is power generation on the FPSO (62.8 %) followed by non-routine flaring during operational years as a result of process upsets and emergency blowdowns (Table 10.69) at 15.0 %. Following this, all vessels contribute 11.8 % and personnel transport contributes 8.5 % to the overall emissions. It should be noted however that these figures are overestimated as, for example, contingency allowances have been added to fuel use on the FPSO (fuel gas and diesel) and charter flights will not be utilised for the full duration of Stage 1 and may not be used at all in Stage 3 (See Table 10.69 above).

Table 10.72: Estimation of worst-case atmospheric emissions[1] per Phase 1 & 2 Development Stage (using AR5 GWPs w/o cc feedback)

Total Emissions	Total fuel burned	Tonnes emitted						
		Kyoto GHGs (Direct)			Indirect GHGs			
		CO_2	CH_4	N_2O	NOx	SO_2	CO	NMVOC
Total Project Duration: (32.6 years, expected Field Life 30 years)								
Stage 1 (2.6 years)								
All Vessels[1]	50,029	160,393.24	1.62	7.25	2,951.73	200.12	400.23	120.07
Personnel Air Transportation	15,681	49,390.15	1.23	1.57	287.95	18.50	88.68	4.99
Supply Base[2]	1,752	3,956.08	0.06	0.18	1.43	0.002	9.86	0.25
Drilling & First-Oil & Well Commissioning[3]	89,951	247,772.16	173.52	4.49	1,474.19	95.29	500.39	57.53
Emissions Sub-total (Stage 1)		**461,511.63**	**176.43**	**13.49**	**4,715.30**	**313.91**	**999.16**	**182.84**
CO_2e (Stage 1)		**461,512**	**4,940**	**3,575**	-	-	-	-
Total Stage 1 GHG Emissions (CO_2e)		**470,027**			-			
Stage 2a (0.6 years)								
All Vessels	3,024	9,694.91	0.10	0.44	178.42	12.10	24.19	7.26
Personnel Air Transportation	3,522	11,091.86	0.28	0.35	64.67	4.16	19.91	1.12
Supply Base[2]	975	2,063.36	0.03	0.09	0.38	0.00	2.63	0.07
SIMOPS[4]	48,186	128,865.26	282.65	1.70	233.81	9.07	197.38	32.66
Emissions Sub-total (Stage 2a)		**151,715.40**	**283.05**	**2.59**	**477.27**	**25.32**	**244.12**	**41.10**
CO_2e (Stage 2a)		**151,715**	**7,925**	**685**	-	-	-	-
Total Stage 2a GHG Emissions (CO_2e)		**160,326**			-			
Stage 2b (2.3 years)								
All Vessels	59,378	134,099.73	1.36	6.06	2,467.84	167.31	334.62	100.39
Personnel Air Transportation	14,169	44,629.02	1.11	1.42	260.19	16.72	80.13	4.51
Supply Base[2]	3,540	7,434.71	0.09	0.33	1.54	0.002	10.57	0.27
SIMOPS[4]	173,854	468,825.25	461.15	6.41	1,938.13	106.20	817.97	91.37
Emissions Sub-total (Stage 2b)		**654,988.72**	**463.71**	**14.22**	**4,667.71**	**290.23**	**1,243.29**	**196.53**
CO_2e (Stage 2b)		**654,989**	**12,984**	**3,768**	-	-	-	-
Total Stage 2b GHG Emissions (CO_2e)			**671,740**		-			
Stage 3 - Steady State Production (27.1 years)								
All Vessels	139,642	447,691.18	4.52	20.24	8,238.88	558.57	1,117.14	335.14
Personnel Air Transportation	163,650	515,444.70	12.83	16.37	3,005.11	193.11	925.44	52.04

Total Emissions	Total fuel burned	Tonnes emitted						
		Kyoto GHGs (Direct)			Indirect GHGs			
		CO_2	CH_4	N_2O	NOx	SO_2	CO	NMVOC
Supply Base[2]	21,249	46,899.64	0.61	2.12	17.83	0.02	122.56	3.08
Production Emissions[5,6]	1,823,343	4,822,863.38	5,538.48	45.08	10,399.64	417.62	6,362.35	673.97
Emissions Sub-total (Stage 3)		**5,832,898.9**	**5,556.45**	**83.80**	**21,661.46**	**1,169.32**	**8,527.49**	**1,064.23**
CO_2e (Stage 3)		**5,832,899**	**155,581**	**22,207**	-	-	-	-
Total Stage 3 GHG Emissions (CO_2e)		**6,010,687**			-			
TOTAL BASELINE PROJECT EMISSIONS								
Total Project Emissions Sub-total		**7,101,115**	**6,480**	**114**	**31,522**	**1,799**	**11,014**	**1,485**
Total Project CO_2e		**7,101,115**	**181,430**	**30,235**	-	-	-	-
Total Baseline Project GHG Emissions (CO_2e)		**7,312,780[6,7]**			-			
Contingency Well Flow-back / Testing (Stage 1)								
Emissions from 4 x well flow-backs / tests to the MODU	5,139[8]	16,011	145	0.43	18.42	0.91	76.9	102
GHG Emissions of 4 x well tests (CO_2e)		**16,011**	**4,047**	**114**	-	-	-	-
Total GHG Emissions of 4 x well tests (CO_2e)		**20,171**			-			
TOTAL CONTINGENCY PROJECT EMISSIONS								
Total Project GHG Emissions including 4 x well clean-up / tests (CO_2e)		**7,332,951[6,7]**			-			

[1] **Note:** To ensure the worst-case estimates, the fuel consumption estimates are based on durations of vessel use which include the mobilisation and demobilisation periods which are *not* included in the vessel use estimates provided in Table 5.24 in Section 5.11.2. The vessel emissions include those that result from the use of all construction vessels.

[2] The supply base estimates include the use of all vehicles (including those associated with the onshore transportation of personnel) as well as the use of electricity generated onshore (including electricity required to pump water to vessels). It is anticipated that the development waste will be incinerated by the FIG municipal waste facility which is expected to be operational by the end of 2026. In the event that the municipal waste facility is *not* ready prior to operations, waste will either be incinerated by a temporary facility at the supply base, or it will be shipped back to the UK on returning vessels which is considered the worst-case for emissions. In terms of in-Falklands waste incineration, whether the waste is incinerated by Navitas or by FIG, the estimated emissions from the development waste would amount to *c.* 18,974 tCO_2 over the course of total Field-Life.

[3] This includes emissions from the MODU during drilling, the FPSO pilot flare, flaring from the FPSO during the worst-case 45-day commissioning and charge-up of the gas injection and gas lift systems and FPSO fuel use in the first month of startup operations, all based on the worst-case emissions assumptions presented in Table 10.69.

[4] This includes emissions from fuel use on the FPSO, the flare pilot and the MODU (when active).

[5] This includes FPSO fuel use, the flare pilot and assumes flaring per year during unplanned process upsets and emergency blowdowns in accordance with the worst-case assumptions in Table 10.69.

[6] Please note that the emissions estimates have reduced since the statutory consultation EIS owing to reductions in the fuel gas conversion rate used, and the fuel gas usage rate estimated for the pilot light. This is in accordance with changes requested during the statutory consultation (see Chapter 0, comments Xodus 46 and OPRED 12 respectively).

[7] Please note that the presented figures are rounded up from many decimal places such that the totals may not exactly match the sum of the separate components.

[8] Including emissions from the flaring of oil, gas and base oil as indicated in Section 5.4.8.

Table 10.73: Summary of worst-case total atmospheric emissions for the whole Phase 1 & 2 Development (32.6 years) (using AR5 GWPs w/o cc feedback)

Emissions	Tonnes						
	Kyoto GHG's (Direct)			Indirect GHG's			
	CO_2	CH_4	N_2O	NOx	SO_2	CO	NMVOC
Total worst-case baseline Phase 1 & 2 Development emissions (32.6 years)							
Emissions total	7,101,115	6,480	114	31,522	1,799	11,014	1,485
CO_2e	7,101,115	181,430	30,235	-	-	-	-
CO_2e	7,312,780			-			
CO_2e Sub-total	**7,312,780[1]**						
Total contingency Phase 1 & 2 Development (32.6 years) emissions including 4 x well flow-back / test							
CO_2e Sub-total	**7,332,951[1]**						
Average annual worst-case baseline emissions over 32.6 years							
Average emissions per year	217,826	199	3	967	55	338	46
Average emissions per year (CO_2e)	217,826	5,565	927	-	-	-	-
CO_2e per annum	224,318			-			
CO_2e total per annum	**224,318[1]**						
Average contingency Phase 1 & 2 Development (32.6 years) emissions including 4 x well flow-back / test							
CO_2e total per annum	**224,937[1]**						

[1] Please note that the presented figures are rounded up from many decimal places such that the totals may not exactly match the sum of the separate components.

Table 10.74: Showing the percentage contribution of each activity category to the worst-case Phase 1 & 2 emissions

Activity	Percentage contribution to total worst-case emissions
Drilling	1.5 %
All Vessels	10.4 %
Offshore personnel transport	8.5 %
Onshore supply base and personnel transport	0.8 %
FPSO fuel use	62.8 %
Flaring during commissioning (GI system)	0.7 %
Non-routine flaring during process upsets and emergency blowdowns	15.0 %
Flaring during contingency well clean-up (4 wells)	0.3 %

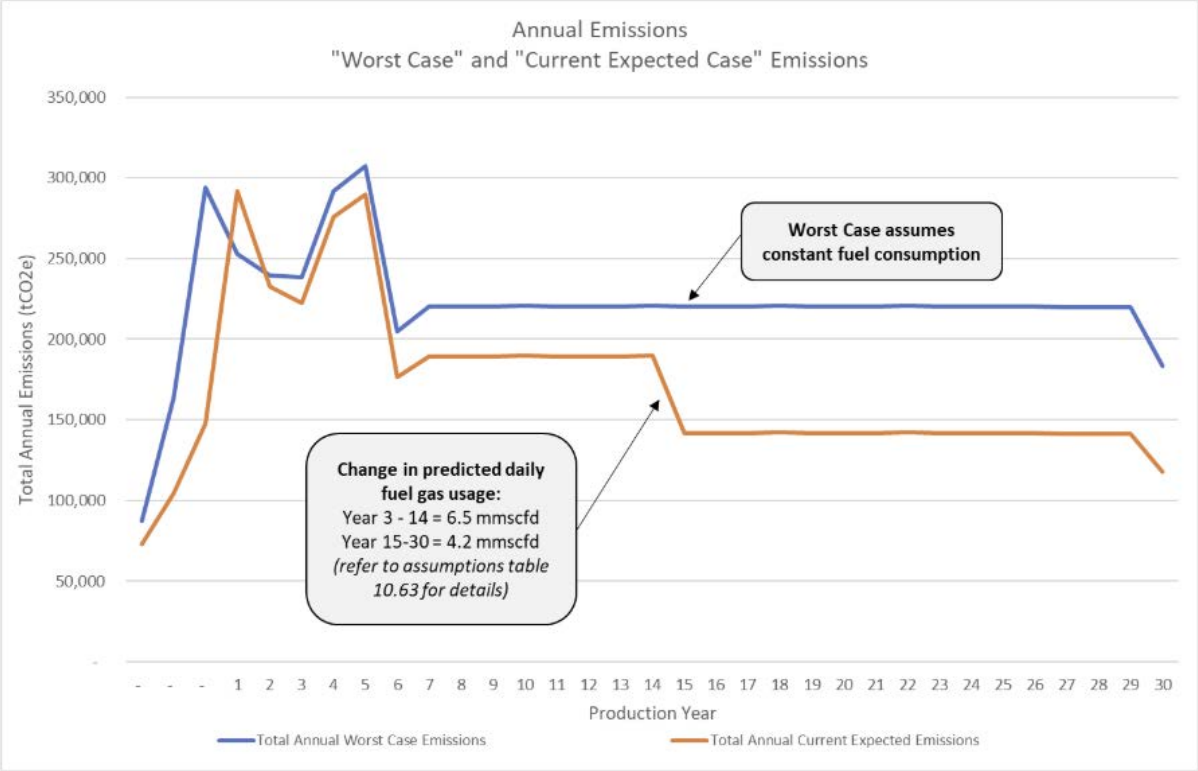


Figure 10-41: Showing the 'worst-case' and 'currently expected' emissions profiles over the course of field life. Note: emissions pre year 1 (i.e., pre First-Oil) are those associated with drilling and construction

10.9.4.4.5 Estimation of unplanned Phase 1 & 2 emissions

Please note that the following unplanned emissions are included within the estimate of the Phase 1 & 2 Development emissions provided in Section 10.9.4.4.4. However, for transparency, they are separated out and further itemised here to indicate the emissions from a single event.

10.9.4.4.5.1 Emergency blowdown

As described in Section 10.9.1.1.2, the Phase 1 & 2 Development is based on a 'zero routine flaring' philosophy during normal production activities. However, it is possible that emergency blowdowns could be required on occasion for safety reasons. Given the nature of such events, it is not possible to estimate accurately how often this would be required but through experience it is possible to estimate overall flaring volumes during operations. During an emergency blowdown it is assumed that the event would take approximately 15 minutes and the gas release rate would be approximately 204 kg/s (amounting to 184 tonnes) of exhaust gas. The CO_2e emissions resulting from a blowdown are estimated in Table 10.75 below using emissions factors listed in Table 10.71 above.

Foreseeable flaring resulting from planned shutdowns, deliberate maintenance and normal levels of unplanned flaring events are factored into Table 10.72 above.

10.9.4.4.5.2 Venting emissions offshore

As described in Section 5.8.4.6, hydrocarbon (HC) gas blanketing will be used on the FPSO to buffer the cargo tanks with a Vapour Recovery Package (VRP) system in place to prevent the release of the HC gas blanket as the cargo tanks fill. Therefore, the only source of venting would be if the VRP system were to malfunction, leading to direct venting.

In the event the VRP is unavailable, inert gas will be generated for use (Section 5.8.4.6). However, there is the potential for some of the HC gas blanket to be vented prior to a change-out to inert gas. This emission would comprise primarily methane (CH_4) and VOCs which could contribute to global warming. As a worst-case estimate, it is possible that a maximum inventory of 38.8 tonnes of HC gas could be released prior to a complete change-out to inert-gas. This assumes the VRP malfunctions when the cargo tanks are empty and that the system remains out of commission for the duration it takes for the cargo tanks to fill. In such a circumstance (albeit unlikely) the full cargo volume of HC gas would be displaced by the crude and vented to the atmosphere. Estimating the frequency of events of VRP malfunction is not tenable but will be examined during the FEED process and associated Reliability, Availability and Maintainability (RAM) studies.

The CO_2e emissions resulting from a single worst-case venting of HC gas are estimated in Table 10.75 using emissions factors listed in Table 10.71 above. However, note that venting estimates are not included in the overall estimates of the Development emissions, or annual average, as it is not possible to credibly estimate how often this may be required.

Table 10.75: Estimated emissions during emergency and unplanned events (per event)

Activity	Total (tonnes)	Tonnes									
		Kyoto GHG's (Direct)						Indirect GHG's			
		CO_2	CH_4	N_2O	F-Gas			NOx	SO_2	CO	VOC
					HFCs	PFCs	SF_6				
Emergency blowdown											
Gas burned	184	515	3.31	0.015	0	0	0	0.22	0.00	1.23	0.37
CO_2e[1]		515.20	92.74	3.95	0	0	0	0	0	0	0
CO_2e		**612**									
VRP malfunction											
Gas vented	38.8	-	19.42	-	-	-	-	-	-	-	19.42
CO_2e		-	543.8	-	-	-	-	-	-	-	-
CO_2e		**544**									

[1] Note: the GWPs used are those from AR5 without carbon feedback as per in Table 10.72 above.

10.9.4.4.5.3 F-Gas release

As described in Section 10.9.1.1.4 above, the release of F-Gases to the atmosphere is prohibited such that zero emission of F-Gases is the base-case.

In the event that an accidental release were to occur, this would be reported to FIG in terms of the CO_2e of the release. Given that this would be an unplanned event, it is not possible to estimate the potential quantities that could be released. However, Navitas will aim to use F-Gases in the lower GWP range wherever possible.

10.9.4.4.6 Estimation of NOx and SOx emissions

At the Sea Lion location the prevailing wind direction, high humidity, frequent showers of rain and the distance to land masses mean that it is extremely unlikely that measurable levels of acidity will occur over land from the FPSO emissions. Indeed, modelling studies undertaken for the project show sea level concentrations of NOx from offshore combustions emissions reducing to near zero over 10 kilometres (Premier, 2017c). Therefore, the potential for direct and localised impacts to air quality from the FPSO were scoped out (Premier, 2017c) and emissions of NOx and SOx from the FPSO are included only within the assessment of ocean acidification.

10.9.4.4.7 Quantification of emissions from the use of municipal electricity

Emissions resulting from the use of municipal electricity generation in the local Navitas offices and warehouses are estimated to be 0.0097 $MtCO_2e$ (9,686 tCO_2e), assuming an average annual usage of

750,000 kWh over the full project lifespan of 32.6 years. A total municipality emissions factor for electricity generation in the Falkland Islands of 0.3962 $kgCO_2e/kWh$[81] has been used (which includes electricity generation and transmission/distribution emissions and is based on a 50:50 fuel mix of renewable and oil). Emissions resulting from worst-case use of back-up diesel generators have been included within the emissions estimates for the Supply Base.

10.9.4.4.8 Quantification of emissions from the combustion of sold product

The oil produced from Sea Lion will be sold into multiple markets and will be refined to produce a variety of end use products throughout the duration of the 30-year production life. The sale and use of the product from Sea Lion will be to independent buyers who will determine the location of the refinery that will process the oil. Therefore, once the oil is produced and sold, it is beyond the ability of Navitas to determine where, when and how the end-use emissions will be created and thus Navitas has very little ability to influence these aspects.

It is unlikely that *all* of the product will be combusted and a proportion of the oil will contribute to products such as plastics and essential petroleum products. Nonetheless, the conservative worst-case emissions estimates, assuming all oil produced from Sea Lion is combusted, are shown below in Table 10.76. This has been calculated utilising the CDP Scope 3 Category 11 Guidance for Oil & Gas, Tier 1 Production Method, using Tier 1 default emissions factor of 3.12 for crude oil (direct-use phase emissions) as stated in Appendix 1 (CDP, 2022).

Table 10.76: Summary of emissions from combustion of sold product

Production Case	Total Oil Production (MMstb)	% of Oil Combusted	Quantity of Combusted Oil (million tonnes)[1]	Emissions Factor Crude Oil[2]	Total Emissions ($MtCO_2e$)
P90	242.3	100	33.9	3.12	105.8
P50	310.5	100	43.5	3.12	135.6
P10	336.7	100	47.1	3.12	147.1

[1] Conversion factor for Sea Lion oil is 1 barrel oil = 0.1399995 tonnes oil, using specific density of the oil at Stock Tank conditions 1 atm / 60 degF = 880.5 kg/m3. Presented figures are rounded up from many decimal places such that the totals may not exactly match the sum of the separate components.

[2] Emissions factor for combustion of crude oil from Appendix 1 of CDP (2022) guidance (based on 30.5 API oil) is 3.12 tCO_2e/tonne crude oil.

10.9.4.5 Comparison of Phase 1 & 2 emissions with the existing context

The following sections compare the Phase 1 & 2 emissions with the following:

- Falkland Islands emissions,
- Total UK emissions,
- UKCS emissions,
- Carbon intensity of other UKCS O&G installations based on NSTA data (2024),
- The projected future emissions, and
- Total UK NOx and SOx emissions.

To ensure data are as comparable as possible, the GWPs used in each comparison are indicated within each section and the results are summarised in Table 10.77 below. It should be noted in all the comparisons below, that the worst-case emissions estimated in Section 10.9.4.4.4 above are likely to be an overestimate owing to contingencies built-in to the assumptions (Table 10.69).

[81] Carbon Footprint Limited (30th July 2023) Country-Specific electricity grid greenhouse gas emissions factors – 2023. https://www.carbonfootprint.com/docs/2023_07_international_factors_release_11.xlsx (CFL, 2023).

10.9.4.5.1 Comparison with Falkland Islands emissions

For comparison with the total Falkland Island emissions, the Phase 1 & 2 CO_2 equivalents (CO_2e) were estimated using the AR5 GWPs *without* carbon climate feedback (Table 10.60 above).

As described in Section 10.9.4.3.1 it is understood that the Falkland Islands dataset is currently incomplete and is therefore an underestimate as it does not include emissions from aviation, shipping, previous offshore O&G activity or the peripheral activities associated with fishing activity e.g. use of reefers etc. [82],.

Based on the worst-case baseline CO_2e emissions (Table 10.69 above), calculated from CO_2, CH_4 and N_2O alone, the average annual emissions of direct GHGs during the Phase 1 & 2 Development (including the contingency well tests) amount to 53 % of the 2021 Falkland Islands emissions (Table 10.77 below).

Of note, when using the UKCS equivalent emissions estimate (i.e., the currently expected Sea Lion baseline emissions (Table 10.69) excluding personnel transportation, drilling and vessels), the Sea Lion emissions estimate amounts to 32 % of the Falkland Island 2021 emissions.

10.9.4.5.2 Comparison with total UK GHG emissions

For comparison with the total UK emissions, the Phase 1 & 2 CO_2 equivalents (CO_2e) were estimated using the AR5 GWPs *without* carbon climate feedback (Table 10.60 above).

Based on the worst-case CO_2e emissions, (with and without the worst-case contingency well test included) the average annual emissions of direct GHGs during the Phase 1 & 2 Development amount to 0.06 % of the total UK 2021 emissions (Table 10.77 below).

Of note, when using the UKCS equivalent emissions estimate (i.e., the currently expected Sea Lion baseline emissions (Table 10.69) excluding personnel transportation, drilling and vessels), the Sea Lion emissions estimate amounts to 0.03 % of the UK total 2021 emissions.

10.9.4.5.3 Comparison with total UKCS emissions

For comparison with the total UKCS emissions, the Phase 1 & 2 CO_2 equivalents (CO_2e) were estimated using the AR5 GWPs *with* carbon climate feedback (Table 10.60 above).

When compared to the 2021 UKCS emissions alone, the worst-case Phase 1 & 2 emissions amount to 1.50 % of the UK O&G emissions (Table 10.77 below), and 1.52 % of emissions if the four contingency well flow-back / tests are carried out. However, it should be noted that, unlike the UKCS data, the Phase 1 & 2 emissions estimated in this EIS include all the worst-case emissions associated with offshore, inshore, onshore and at-shore operations, including all construction and all associated shipping (except the purchaser's CTT) and aviation. As the UKCS data do not include emissions from all equivalent operations, the Phase 1 & 2 emissions as a percentage of the UKCS emissions appear higher than they would on a like-for-like basis. When using the UKCS equivalent emissions estimate (i.e., the

[82] At the time of writing the EIS (June 2024), Navitas was advised that the FIG emissions dataset did not include aviation, shipping, previous offshore O&G activity or fishing activity. As such, it was not considered possible to carry out a meaningful comparison with other industry sectors, as required by the EIA Guidance Note (FIG, 2016e). Subsequent to the public consultation carried out in July 2024, FIG has advised that the dataset *does* include emissions from fishing within the 'Transport' IPCC Category. FIG has specified that 'fishing' includes Jiggers, Trawlers, Longliners, Potters and Combos. Data collected by FIG for these values include the number of vessels and volume of fuel but importantly do not include peripheral emissions associated with the industry sector such as the use of reefer vessels or onshore transshipment of product and onward transport etc. Nonetheless, in order to meet the requirements of the EIA Guidance, Navitas has attempted a sectoral comparison. It can be shown that the total average annual worst-case Sea Lion emissions represent: 2,249 % of the Falklands 'energy' emissions in 2021 (noting that the data exclude previous O&G activity), 111 % of the 'transport' emissions (including small-scale fishing, but excluding international aviation) and 124 % of 'agricultural' emissions. However, it must be noted that these comparisons are considered misrepresentative owing to the data gaps currently within the Falkland Island datasets.

currently expected Sea Lion baseline emissions (Table 10.69) excluding personnel transportation, drilling and vessels), the Sea Lion emissions estimate amounts to 0.91 % of the UKCS 2021 emissions.

Table 10.77: Phase 1 & 2 average annual emissions in the context of Falkland Islands' and UK emissions data[1]

Direct GHG	Emissions of direct GHG ($MtCO_2e$)			Average Phase 1 & 2 emissions per annum ($MtCO_2e$, AR5 *without* cc fb)[3]		Average Phase 1 & 2 emissions per annum ($MtCO_2e$, AR5 *with* cc fb)[3]		Average Phase 1 & 2 CO_2e emissions per annum as a % of:					
								Falkland Islands 2021 emissions[2]		UK 2021 emissions		UKCS 2021 emissions	
	Falkland Islands (2021)[2]	UK Total (2021)[3]	UKCS (2021)	Worst-case Baseline	WC Contingency[4]	Worst-case Baseline	WC Contingency[4]	Baseline	WC Contingency[4]	Baseline	WC Contingency[4]	Baseline	WC Contingency[4]
CO_2	0.233	342.6	-	0.2178	0.2183	0.2178	0.2183	93.5 %	93.7 %	0.06 %	0.06 %	-	-
CH_4	0.120	57.4	-	0.0056	0.0057	0.0068	0.0069	4.7 %	4.8 %	0.01 %	0.01 %	-	-
N_2O	0.069	19.2	-	0.0009	0.0009	0.0010	0.0010	1.3 %	1.3 %	0.01 %	0.01 %	-	-
HFCs	0.001	10.8	-	-		-		-		-		-	-
PFCs	0	0.2	-	-		-		-		-		-	-
SF_6	0	0.4	-	-		-		-		-		-	-
Total $MTCO_2e$	**0.422**	**426.5**	**14.9**	**0.2243**	**0.2249**	**0.2256**	**0.2263**	**53.2 %**	**53.3 %**	**0.06 %**	**0.06 %**	**1.51 %**	**1.52 %**

[1] Note that these compare the direct Kyoto GHGs only and exclude NOx, SOx, CO and VOC

[2] Data do not include aviation, fishing, shipping or offshore oil and gas emissions.

[3] Including emissions from UKOTs and Crown Dependencies. See Table 10.63.

[4] The worst-case (WC) contingency includes the emissions based on the worst-case assumptions in Table 10.69, including emissions from emergency blowdowns and process upsets during steady state production, plus those that will be incurred if the contingency flow-back / testing of four wells to the MODU occurs (Section 5.4.8).

10.9.4.5.4 Comparison of carbon intensity with other UKCS installations

The annual worst-case carbon intensity[83] data for each production profile are presented in Figure 10-42 to Figure 10-44 below. These show that the average carbon intensity estimates per annum, based upon the worst-case emissions assumptions itemised in Table 10.69 above.

Table 10.78 below summarises the carbon intensity for a range of production and emissions scenarios, with comparison to NSTA benchmarks for carbon intensity for floating installations.

Of note, when focusing on the 'currently expected' baseline emissions of 5.6 million tCO_2e:

- The average carbon intensity estimates for Sea Lion range between 23.0 and 16.5 $kgCO_2e$/boe (P90-P10 production cases) (Table 10.78), and
- Removal of the personnel transportation, vessels and drilling emissions to derive a closer like-for-like comparison with UKCS emissions results in a carbon intensity range between 18.2 and 13.1 $kgCO_2e$/boe for the P90-P10 production cases (Table 10.78).

Two North Sea benchmarks for carbon intensity of floating installations are used for comparison to the Phase 1 & 2 development (NSTA 2024). These benchmarks assume a 'lease and operate' FPSO refitted between 11 - 25 years ago, with average carbon intensity of 36 $kgCO_2e$/boe, and an FPSO refitted between 0 – 10 years ago with average carbon intensity of 20 $kgCO_2e$/boe (Table 10.78). When comparing the average carbon intensity for the Development P50 production case (i.e., the most likely volume of oil expected to be produced from the field), the 'current expected' and 'worst-case' NSTA comparable emissions scenarios have an average carbon intensity of 14.2 and 18.6 $kgCO_2e$/boe[84], respectively, which compare favorably to these benchmarks (Table 10.78).

[83] Emissions Intensity ($kgCO_2e$/boe) = (Total emissions in tonnes CO_2e x 1,000 to convert to kg) / (Total oil production in barrels for each production case) e.g., 'worst case' P50 average EI = (7,332,951 tCO_2e * 1,000)/(310.5 MMbbl * 1,000,000) = 23.6 $kgCO_2e$/boe .

[84] The UKCS emissions include those associated with offshore O&G exploration and production operations and excludes emissions from vessels associated with the construction and installation processes, supply, maintenance and surveys, shuttle tankers or export tankers, aviation, onshore activities and any other offshore industries. Therefore, to present a scenario for Sea Lion that is more comparable to reported North Sea O&G emissions, "operational emissions" include fuel consumption of the FPSO during production and non-routine flaring, and exclude emissions from all vessels, drilling, personnel transport and onshore activities.

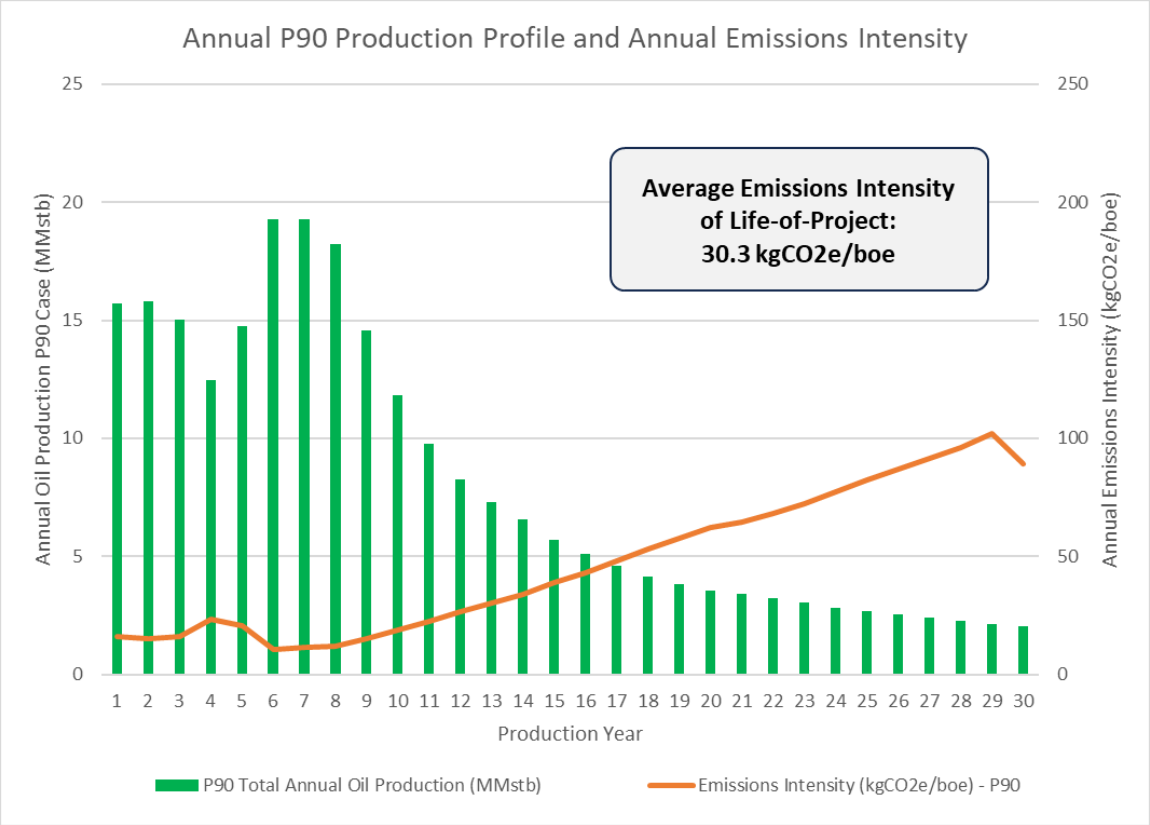


Figure 10-42. Indicating the worst-case carbon intensity, per annum, for the lower production rate (P90, 242.3 MMstb)

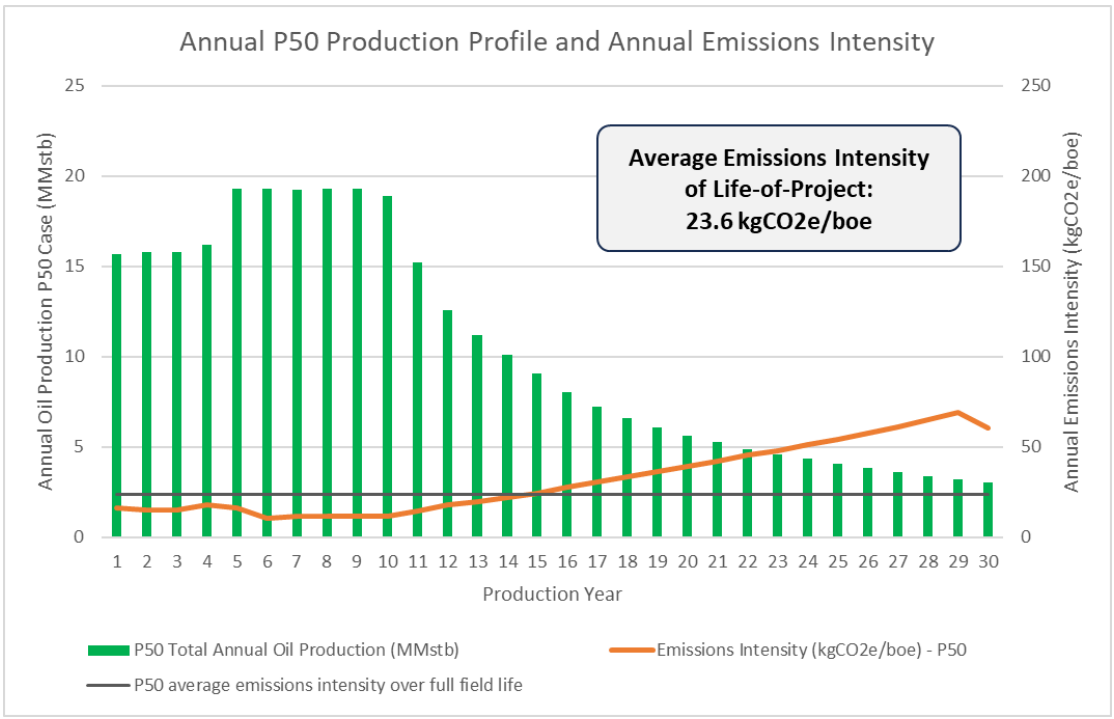


Figure 10-43. Indicating the worst-case carbon intensity, per annum, for the medium (and expected) production rate (P50, 310.5 MMstb)

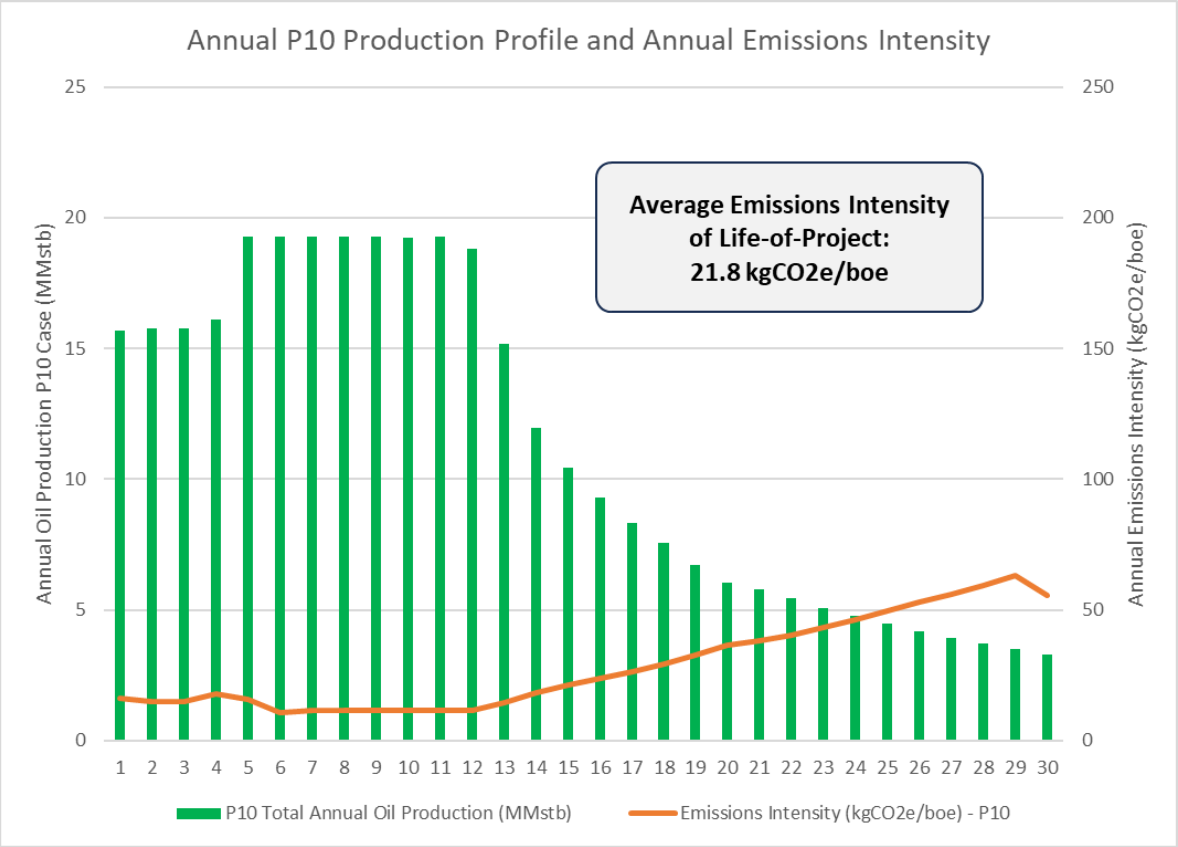


Figure 10-44. Indicating the worst-case carbon intensity, per annum, for the upper production rate (P10, 336.7 MMstb)

Table 10.78. Summary of the Sea Lion carbon intensity estimates and the NSTA benchmarks

Emissions	Carbon intensity ($kgCO_2e/boe$)		
	P90 Production Case 242.3 MMstb	P50 Production Case 310.5 MMstb	P10 Production Case 336.7 MMstb
Sea Lion 'worst-case' emissions (including contingent well flow-back/testing) (Table 10.73)	30.3	23.6	21.8
Sea Lion 'currently expected' emissions (including emergency blowdowns and process upsets)	23.0	17.9	16.5
Sea Lion worst-case emissions with the personnel transportation, vessels and drilling emissions removed to enable meaningful comparison with NSTA benchmark data (NSTA, 2024)	23.8	18.6	17.2
Sea Lion 'currently expected' emissions with the personnel transportation, vessels and drilling emissions removed to enable meaningful comparison with NSTA benchmark data (NSTA, 2024)	18.2	14.2	13.1

Emissions	Carbon intensity ($kgCO_2e$/boe)		
	P90 Production Case 242.3 MMstb	P50 Production Case 310.5 MMstb	P10 Production Case 336.7 MMstb
2024 NSTA benchmark for FPSO at 0 – 10 years old	20		
2024 NSTA benchmark for FPSO at 11 - 25 years old	36		

10.9.4.5.5 Comparison with projected total UK GHG emissions

The Phase 1 & 2 emissions were compared with the projected future UK emissions to provide a context within which to assess the 'severity of effect'. The AR5 GWPs (w/o cc fb) (IPPC, 2013) were used.

Comparing the direct Kyoto emissions alone, the estimated annual Phase 1 & 2 emissions will amount to 0.028 % of the UK emissions during the fourth carbon budget period (2023 - 2027), 0.077 % during the fifth period (2028 - 2032), and 0.113 % of the sixth carbon budget allowance (Table 10.79). Emissions will be higher during Stages 1, 2a & 2b than in steady state production (Stage 3) due to drilling and installation activities. During the Carbon Budget Periods six and seven, the Development will be into Stage 3 so the annual emissions will stabilise. However, due to the reducing the UK Carbon Budget allocation, the percentage contribution of Phase 1 & 2 emissions will increase.

Table 10.79: Comparison between the Phase 1 & 2 direct GHG emissions and the projected future UK direct GHG emissions[1]

UK Carbon Budget Period[2]		Number of Years	Carbon Budget ($MtCO_2e$)	Sea Lion Worst-case Scenario Emissions ($MtCO_2e$)[3]	Sea Lion Worst-case Emissions as % of UK Carbon Budget
1	2008 - 2012	5	3,018	-	-
2	2013 - 2017	5	2,782	-	-
3	2018 - 2022	5	2,554	-	-
4	2023 - 2027	5	1,950	0.545	0.028 %
5	2028 - 2032	5	1,725	1.330	0.077 %
6	2033 - 2037	5	965	1.087	0.113 %
7	2038 - 2042	5	To be set in 2025	1.102	-

[1] BEIS (now DESNZ) Energy and emissions projections (BEIS, 2022b).
[2] Carbon budget periods are as agreed under the Climate Change Act.
[3] Using AR5 GWPs without carbon climate feedback and including the contingency well tests. Emissions estimated for 5-year periods relative to the UK Carbon Budget periods, assuming the Sea Lion development starts in 2025 with production starting in 2028.

10.9.4.5.6 Comparison of NOx and SOx emissions

As can be seen in Section 10.9.4.3.1, the raw data for the emissions of NOx and SOx by the Falkland Islands are not provided. Those for the UK are provided in Section 10.9.4.3.2.1. Therefore, while the worst-case estimates of NOx and SOx emissions from the Phase 1 & 2 Development are estimated (Table 10.72 above), it is only possible to compare these to the total UK indirect emissions.

Using the data in Table 10.65 above, which indicates a decline in indirect GHG emissions, it is estimated that the worst-case average annual baseline Phase 1 & 2 NOx emission (i.e. 967 tonnes, Table 10.73 above) will amount to approximately 0.14 % of the 2021 UK total. That of SOx is estimated to 0.04 % of the 2021 UK total.

10.9.4.5.7 Comparison of emissions from combustion of sold product with global emissions

As shown in Section 10.9.4.4.8, the conservative worst-case emissions estimate for the P10 production case, assuming all the oil produced from Sea Lion is combusted, is 147.1 million tCO_2e based upon the production of 336.7 MMstb over Field Life. To put this in context, global oil demand as of December 2023 was 101.7 MMbbl per day (IEA, 2023; Section 10.9.4.3.4).

Table 10.80 shows a comparison of the daily emissions associated with the combustion of sold product (oil) from Sea Lion against those associated with projected global oil demand. Looking at the worst-case scenario (highest Sea Lion production (P10) and lowest future oil demand (Scenario 2)), the percentage contribution to global emissions ranges from 0.059 - 0.087 %. However, it should be noted that Scenario 2 is a projection based on more aggressive moves toward Net Zero than are currently expected under existing policies (Section 10.9.4.3.4). When compared with Scenario 1, which is based on oil demand expected under existing climate change policies, the contribution ranges from 0.014 – 0.055 %. As can be seen in the two selected scenarios, there is a considerable range in the future oil demand projections reflecting the uncertainty in estimating such ongoing demand. When comparing the overall average daily emissions (calculated on a like-for-like basis), emissions from combustion of the expected P10 Sea Lion production per day represents 0.031 % of global daily emissions from oil, assuming all globally produced oil is similarly combusted (Table 10.80).

Table 10.80. Showing a comparison of estimated emissions from combustion of sold product between Sea Lion[1], current global oil demand (as at December 2023 as reported by IEA) and two future demand scenarios[2]

Sea Lion Total Emissions from Combustion of Sold Product ($MtCO_2e$)								
Sea Lion Scenarios[1]	2023	2030		2035		2050	TOTAL Field Life	
	Sea Lion Average Daily Emissions from Combustion of Sold Product in 2023 ($MtCO_2e$)	Sea Lion Average Estimated Daily Emissions from Combustion of Sold Product in 2030 ($MtCO_2e/d$)[3]		Sea Lion Average Estimated Daily Emissions from Combustion of Sold Product in 2035 ($MtCO_2e/d$)[3]		Sea Lion Average Estimated Daily Emissions from Combustion of Sold Product in 2050 ($MtCO_2e/d$)[3]	Sea Lion Total Emissions from Combustion of Sold Product over full field life ($MtCO_2e$)[1,3]	Sea Lion Average Estimated Daily Emissions from Combustion of Sold Product ($MtCO_2e/d$)[1,3]
Sea Lion P90 Case	0.0	0.015		0.017		0.003	105.8	0.010
Sea Lion P50 Case	0.0	0.019		0.023		0.005	135.6	0.012
Sea Lion P10 Case	0.0	0.019		0.023		0.006	147.1	0.013
Global Emissions with Comparison to Sea Lion								
Oil Demand Scenarios[2]	2023	2030		2035		2050	Average Over Field Life	
	Estimated Daily Global Emissions from Combustion of Oil ($MtCO_2e/d$) - EIA Dec 2023[4]	Estimated Daily Global Emissions from Combustion of Oil ($MtCO_2e/d$)[4]	Sea Lion % contribution to est. global emissions from combustion of oil	Estimated Daily Global Emissions from Combustion of Oil ($MtCO_2e/d$)[4]	Sea Lion % contribution to est. global emissions from combustion of oil	Estimated Daily Global Emissions from Combustion of Oil ($MtCO_2e/d$)[4]	Sea Lion % contribution to est. global emissions from combustion of oil	Sea Lion average daily emissions from combustion of sold product as a percentage of current total estimated global daily emissions from global daily oil demand as at Dec 2023 (%)
1. World Oil Demand - Scenario IEA STEPS (MMstb/d)	43.3[5]	43.3	P90 = 0.034 % P50 = 0.045 % P10 = 0.045 %	42.2	P90 = 0.041 % P50 = 0.055 % P10 = 0.055 %	39.6	P90 = 0.009 % P50 = 0.013 % P10 = 0.014 %	P90 = 0.022 % P50 = 0.029 % P10 = 0.031 %
2. World Oil Demand - Scenario BP Net Zero (MMstb/d)	43.3	33.0	P90 = 0.045 % P50 = 0.059 % P10 = 0.059 %	26.4	P90 = 0.066 % P50 = 0.087 % P10 = 0.087 %	7.7	P90 = 0.044 % P50 = 0.067 % P10 = 0.074 %	

[1] Refer to Section 10.9.4.4.8 for description of quantification of emissions from combustion of sold product. Assumes all produced oil from the three production cases is combusted so as to represent a worst-case scenario.

[2] Two end-member future scenarios are presented which capture the range of future oil demand forecasts (refer to Section 10.9.4.3.4, **Error! Reference source not found.** for additional details).

[3] Emissions factor for combustion of crude oil from Appendix 1 of CDP (2022) guidance (based on 30.5 API oil) is 3.12 tCO_2e/tonne crude oil. Conversion factor for Sea Lion oil is 1 barrel oil = 0.1399995 tonnes oil, using specific density of the oil at Stock Tank conditions 1 atm / 60 degF = 880.5 kg/m^3.

[4] The same methodology that was used for Sea Lion has been used to estimate emissions from total daily global oil demand, assuming all oil is combusted. Emissions factor for combustion of crude oil from Appendix 1 of CDP (2022) guidance (based on 30.5 API oil) is 3.12 tCO_2e/tonne crude oil. General conversion factor for oil of unknown properties is 1 barrel oil = 0.1364 tonnes of oil (BP Conversion Factors 2021: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-approximate-conversion-factors.pdf). Refer to Section 10.9.4.3.4, **Error! Reference source not found.** above for corresponding daily oil demand figures.

[5] Emissions calculated based on daily global oil demand from IEA as at Dec 2023 (Oil Market Report - December 2023, IEA, Paris https://www.iea.org/reports/oil-marketreport-december-2023) assuming all oil is combusted and using the same methodology described above in footnote 4.

10.9.5 Industry-standard mitigation measures

10.9.5.1 Combustion emissions

The industry-standard mitigations as applied by Navitas include:

- Use of Best Available Techniques (BAT) in the Development basis of design (as described in Section 10.9.5),
- Regular monitoring and inspection of all combustion equipment and use of a Management Maintenance System with Planned Maintenance Routines to ensure all combustion equipment runs as efficiently as possible,
- Testing of fuel gas to enable analysis of composition thus improving emissions estimates,
- Metering of fuel gas used and recording of diesel use,
- Monitoring, recording and reporting all emissions,
- Auditing of third parties as part of the selection and pre-mobilisation processes, and
- Ongoing ALARP reviews throughout the Field Life which will take account all emissions monitoring outcomes.

Navitas also carries out all of its activities in line with its OMS Framework (Section 3.2). Within this, and as part of its Carbon Strategy, Navitas is committed to reducing its GHG emissions to a level that is 'As Low As Reasonably Practicable' (ALARP) and will set SMART (Specific, Measurable, Achievable, Realistic and Time-based) environmental objectives and targets each year.

10.9.5.2 F-Gas emissions

Owing to the high GWPs of many F-Gases (Table 10.60 above), all F-Gas containing equipment is subject to preventative maintenance (e.g., level checks and leak checks in accordance with legislation) to prevent losses of even small quantities of F-Gases by fugitive emission or by leaks. The frequency of maintenance and leak checks is determined by the quantity of the F-Gas contained within the equipment and the GWP of a full release. The leak test thresholds are governed by the tonnes of CO_2e of a release. The leak testing requirements are as follows. Where the release could lead to the emission of:

- <5 tonnes of CO_2e, there is no need to check the equipment for leaks,
- 5 - <50 tonnes of CO_2e, the equipment should be checked every 12 months,
- 50 to 500 tonnes of CO_2e, the equipment should be checked every six months, and
- > 500 tonnes of CO_2e, the equipment should be checked every three months.

10.9.6 Impact and risk assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities. The assessment of unplanned events includes an assessment of the 'Likelihood of Occurrence' to determine the 'Risk'.

A summary of the impact and risk assessment outcomes for this Development is tabulated in Section 10.9.12, which shows the worst-case impact / risk for each activity and receptor and details are provided below.

10.9.6.1 Impact assessment

10.9.6.1.1 Global warming and GHG emissions

As described in Section 8.5.2.1.1, the sensitivity of the global (transboundary) atmosphere as a receptor is considered to be '**Very High**'.

The worst-case average baseline annual CO_2e emissions of Kyoto GHGs during the Phase 1 & 2 Development is anticipated to be 53 % of the declared 2021 Falkland Islands emissions, 0.06 % of 2021 UK emissions and 1.50 % of the 2021 UK offshore O&G (UKCS) emissions (Table 10.77 above).

The Phase 1 & 2 emissions amount to a significant percentage of the annual Falklands Islands emissions. However, it is acknowledged that the Falkland Islands data is incomplete (Section 10.9.4.3.1) such that, after including aviation, fishing, shipping and previous offshore emissions on a like-for-like basis, the Development will comprise a much smaller percentage-increase to Falkland Islands emissions than is currently estimated. Further, it should be noted that the Phase 1 & 2 estimates (Section 10.9.4.4.4) include the worst-case and non-routine requirement for emergency flaring during process upsets and emergency blowdowns such that the emissions estimate can be considered highly conservative (see assumptions in Table 10.69).

When comparing the estimated annual Phase 1 & 2 emissions to the projected future UK emissions (2023 - 2037) (which do not, as yet, include any allowance for the Falkland Islands emissions), the conservative percentage contributions range from 0.02 - 0.11 % (Section 10.9.4.5.5). The increased contribution over the years reflects the fact the future UK NDC emissions are expected to decrease in order to meet the reducing UK emissions targets and Net Zero (Section 10.9.4.5.5).

Nonetheless, in the context of the future UK total emissions, the Phase 1 & 2 annual emissions contribution is very small. While the UK Government is currently aware that its projected future emissions are expected to exceed the carbon budget beyond 2028 (Section 10.9.4.3.3), the Phase 1 & 2 Development is a new operation and incorporates current BAT to ensure efficiency and reduce emissions per unit gain with an efficient carbon intensity (Section 10.9.4.5.4). Assuming the expected (P50) production profile, including all potential non-routine emissions and those associated with drilling, vessels and personnel transportation, the worst-case carbon intensity is 23.6 $kgCO_2e$/boe, which is less than the UKCS actual reported carbon intensity for 2023 of 24 $kgCO_2e$/boe (which does not include drilling, vessels and personnel transportation, NSTA 2023). Further, the worst-case like-for-like Sea Lion emissions intensity (i.e., with transportation, drilling and vessel emissions excluded) is 18.6 $kgCO_2e$/boe which also compares favourably to the NSTA benchmark for an FPSO of 0-10 years old (20 $kgCO_2e$/boe) (Section 10.9.4.5.4).

Therefore, the Phase 1 & 2 Development is considered to be comparatively efficient with actual emissions intensity expected to be below the UKCS average (Section 10.9.4.5.4), and it is not expected that the Phase 1 & 2 emissions will compromise the current or future UK targets and, therefore, the severity of the effect is considered to be '**Minor**'.

Therefore, the overall significance of impact from the emission of GHGs is considered to be '**Moderate (10)**'.

10.9.6.1.2 Water quality and ocean acidification

The sensitivity of water quality as a receptor is usually considered in terms of whether the receiving body of water is 'closed with no flushing' or is 'open ocean', reflecting its ability, or otherwise, to flush pollutants received from a single point source. In this context, the sensitivity of oceanic water quality as a receptor could be considered to be 'Very Low'. However, the impact of ocean acidification is directly related to the emission of CO_2 which persists for centuries in the atmosphere, is absorbed by the surface of the ocean (and so is not a single point source of release) and has a long-lived effect

(Section 10.9.4.2.2). Therefore, on balance, the sensitivity of the global (transboundary) ocean as a receptor to atmospheric emissions is considered to be '**High**'.

The amount of CO_2, NOx and SOx generated as a result of the proposed operations is very low in relation to overall UK emissions and would, in its own right, have a negligible effect on the oceans' pH. For example, the average annual Phase 1 & 2 CO_2 emission amounts to only 0.06 % of the 2021 UK CO_2 emissions (Table 10.77). Given this, and the fact that the Phase 1 & 2 Development is inherently designed to minimise emissions, the severity of the effect on water quality is considered to be '**Minor**'.

Therefore, the overall significance of the impact from the emission of CO_2 with regard to ocean acidification is considered to be '**Moderate (8)**'.

10.9.6.1.3 Emissions associated with the combustion of sold product

As described in Section 8.5.2.1.1, the sensitivity of the global (transboundary) atmosphere as a receptor is considered to be '**Very High**'.

Emissions from the use of the product once it is sold are beyond the ability of Navitas to control and are difficult to estimate accurately owing to the number of variables which may affect the end use. To ensure a worst-case estimate, it has been assumed that the entire inventory of Sea Lion crude will ultimately be combusted and the range of emissions presented in Section 10.9.4.4.8 reflects the range of potential total production (P10 – P90). The potential emissions resulting from the use of the sold product are significantly higher than the emissions which are directly within Navitas' control and influence, namely those that are directly associated with the production of the Sea Lion Field, Phase 1 & 2.

While the global community transitions to more sustainable and renewable sources of energy with the ultimate goal of Net Zero, global demand for fossil fuel is still relevant. If all 336.7 MMstb (P10, and therefore worst-case in this context) of Sea Lion oil were to be produced at once, the volume would be sufficient to meet the current global demand for three days (based on global daily oil demand of 101.7 MMstb as of December 2023 (Section 10.9.4.3.4)).

When emissions resulting from the sold Sea Lion product (assuming P10) are compared with the estimated global emissions based on two projections of future oil demand (Section 10.9.4.3.4), the estimated daily contribution made by Sea Lion over Field Life ranges from 0.014 - 0.055 % in the IEA STEPS scenario that considers current policies and announced commitments. In the more aggressive BP Net Zero scenario that considers the actions required to reach the net zero goal, the estimated daily contribution made by Sea Lion ranges from 0.059 - 0.087 %. These are based on estimates of two very different future projections, both of which will have a high level of uncertainty and assumption. When compared with the currently known global demand as at December 2023, the average Sea Lion contribution is 0.031 %. All the above estimates assume all globally produced oil is similarly combusted (Section 10.9.4.5.7).

Nonetheless, the impact of GHG emissions continues to be of concern and it must be recognised that while the average 0.031 % is a small percentage, in absolute terms the maximum (P10) estimate of emissions from combusted product is a sizeable contribution. While it is extremely unlikely that 100 % of the end product will be combusted (as assumed in this assessment), a precautionary approach must be taken and the severity of effect of emissions associated with the use of the sold product is considered to be 'Moderate'.

Therefore, the overall significance of the impact of indirect emissions resulting from the combustion of the sold product is considered to be '**Upper Moderate (15)**'.

10.9.6.2 Risk assessment

10.9.6.2.1 Emergency blowdowns and VRP failure

As described in Section 8.5.2.1.1, the sensitivity of the global (transboundary) atmosphere as a receptor is considered to be '**Very High**'.

The incremental increase resulting from combustion of gas during blowdowns and / or the venting of the HC gas blanket in the event of VRP failure is anticipated to be small such that the severity of effect of added emissions is considered to be '**Slight**'.

The significance of the impact is therefore considered to be '**Low (5)**'.

The VRP will be considered to be an environmentally critical piece of equipment within the Maintenance Management System and the likelihood of occurrence of blowdowns and VRP failure is '**Possible**'.

Therefore, the overall significance of the risk is considered to be '**Low (6)**'.

10.9.6.2.2 Release of F-Gases

As described in Section 8.5.2.1.1, the sensitivity of the global (transboundary) atmosphere as a receptor is considered to be '**Very High**'.

In the event that F-Gas containing equipment fails, there is the potential for an F-Gas to leak. Any such emissions would be one-off, finite and very limited in volume. Therefore, the severity of effect of atmospheric emissions to the global atmosphere is considered to be '**Slight**'.

The significance of the impact is therefore considered to be '**Low (5)**'.

While the F-Gas containing equipment will be subject to standard maintenance, the likelihood of the equipment malfunctioning is considered to be '**Possible**'.

Therefore, the overall significance of the risk associated with the VRP malfunctioning is considered to be '**Low (6)**'.

10.9.7 Project-specific mitigation measures

All mitigation measures intended to reduce GHG emissions to ALARP are built-in to the Phase 1 & 2 basis of design (Section 10.9.2.1) and are factored into the quantification of emissions (Section 10.9.4.4.4) albeit based upon worst-case assumptions (Section 10.9.4.4.1). These, along with the Navitas OMS, are factored into the initial impact and risk assessment. Therefore, the impacts and risks, as determined from the initial assessment, are considered to be ALARP.

An additional mitigation considered 'reasonably practicable' at this stage is to ensure tanker owners use the EEOI when developing Key Performance Indicators (KPIs) related to the CTT. However, this does not materially change the initial impact assessment at this stage.

Nonetheless, Navitas remains committed to exploring opportunities to further reduce its emissions as is indicated in the Emissions Reduction Action Plan (ERAP) for the FPSO. These investigations will occur during the Front End Engineering and Design (FEED) project and associated Reliability Availability & Maintainability (RAM) studies. Further, continual improvement will be sought throughout the life-cycle of the Sea Lion Field.

10.9.7.1 Potential mitigation measures that will be considered during FEED

The FEED process contract has been awarded to a Norwegian based company which has proven experience in reducing environment emissions in O&G projects. The investigated measures shall include, but not be limited to:

- Onshore measures as follows:
  - Exploration of electric transportation opportunities, although close dialogue will be required with FIG to ensure that the municipal power generation could accommodate an increase in the number of electric vehicles and whether or not this has a net environmental benefit,
  - The tenders for all new infrastructure (e.g., the TDF causeway upgrade, supply Base, accommodation (both housing and 'hotel')) shall request the use of:
    - Light Emitting Diode (LED) Lighting in place of higher voltage alternatives,
    - Energy efficient construction methods,
    - Energy efficient housing systems (to include but not be limited to insulation types, heating and power storage solutions), and
    - Supplementary small wind turbine units and / or solar paneling (with the understanding that this will need to be considered / approved by FIG.)
- Offshore measures as follows:
  - Review and monitoring of the technology for a ballistic ignition system for Flare Gas Recovery (FGR), allowing the pilot light to be removed while providing a reliable spark. This does, however, require a safe and robust flare monitoring system,
  - Exploration of new technologies, for example evaluating additional and novel technology for GTG Waste Heat Recovery Unit heat generation,
  - Exploration of the use of combined cycle power generation,
  - Review and challenge of the requirement for the additional steam boiler,
  - Review of the total power demand for the facility to reduce the amount of energy created to only meet with what is needed for processing fluids,
  - Review of the type of thermal insulation and its selection for process and utility pipework and vessels, and
  - Modification of the cargo oil tank steam heating system to use the most modern design and material to bring about an increased efficiency.

Please note that the above measures cannot be included within the residual impact assessment until RAM studies have proven they will be feasible.

10.9.8 Residual impacts and risks

The initial assessment takes account of all the mitigation measures which are built-in to the basis of design and while SMART goals and ALARP reviews may serve to reduce emissions in future, at this time, they cannot change the initial assessment. Therefore, the residual impact and risk assessments remain the same such that the impacts to global warming and ocean acidification remain '**Moderate**'.

Project specific mitigation measures are not applicable to the emissions associated with the combustion of sold product as these emissions are beyond the ability of Navitas to control or influence. As such, the residual impact remains '**Upper Moderate**'.

10.9.9 Cumulative impact

While no O&G activities are currently expected to occur in the NFB alongside the Phase 1 & 2 Development, both POEPL and Noble Energy Falklands Ltd. (NEFL) conducted exploration drilling campaigns in 2015. Further, the NFB supports numerous shipping activities all of which will emit GHGs from combustion which all may lead to cumulative impacts from increased 'concentration' and increased 'extent and proportion' (Section 8.9.1). It is therefore necessary to consider the Phase 1 & 2 emissions in the broader context.

Given that the key impacts of concern with regard to emissions are global warming and ocean acidification, both of which are long-term and transboundary in nature, it is not relevant to break these emissions down into yearly units when assessing the cumulative input. One measure of overall emissions over comparable timescales can be made by adding the total emissions of all known O&G activities that will have occurred in the NFB between 2015 and 2040 (Table 10.81), in addition to those of the different Falkland Islands sectors (Table 10.62). However, it is not possible to quantitatively assess cumulative impact including emissions from other Falkland Island industries due to the immaturity / incompleteness of the data noting that these do not include aviation, fishing or shipping on a like-for-like basis.

It is acknowledged that emissions from the combustion of sold product will contribute to cumulative impacts on the global receptor. However, it is difficult to quantify the extent of this without a fuller understanding of the actual uses of the sold product. In the absence of control or influence over the end uses of the product, or knowledge of any mitigation applied, the current estimates provided in Section 10.9.4.4.8 are based on the worst-case assumption that 100 % of the raw product is combusted which, in reality, is considered very unlikely.

Table 10.81: Estimated total atmospheric emissions resulting from O&G operations in the NFB during Field Life

Emissions source	Tonnes						
	CO_2	CH_4	N_2O	NOx	SO_2	CO	VOC
NEFL[1] and POEPL[2] exploration drilling campaigns CO_2e	155,605	3,187	15,694	95,741	0	1,416	766
Phase 1 & 2 Total CO_2e (32.6 years)[3]	7,101,115	181,430	30,235	-	-	-	-
O&G CO_2e total (2015 - 2040)	**7,487,266**						

[2] As estimated in the NEFL Rhea exploration well EIS (NEFL, 2015a).
[3] As estimated in the POEPL exploration campaign EIS (Premier, 2014d).
[3] See Table 10.73

10.9.10 Confidence

The duration of the Phase 1 & 2 Development is known and the associated transport for equipment, supplies and crew have been estimated on a conservative basis to provide worst-case estimates. Where possible, up-to-date emissions factors and GWPs have been used to calculate the emissions arising from the project activities.

The relationship between emissions and global warming, ocean acidification and regional air quality are well researched and documented. Therefore, level of confidence in the predictions of these impacts is considered to be '**Certain**'.

With regard to the assessment of emissions associated with the combustion of sold product, there is a great deal of uncertainty as the end uses are beyond Navitas' ability to influence (Section 10.9.4.4.8). Further, it is extremely unlikely that the entire inventory will be combusted, as has been assumed for the purposes of the worst-case assessment. Therefore, the confidence here is considered to be '**Uncertain**'.

10.9.10.1 Monitoring required

At all times, Navitas will monitor its emissions to enable reporting, which is set out by regulation and Navitas' corporate reporting standards. The Navitas monitoring strategy for emissions will be set out in the Environmental Monitoring and Management Plan (EMMP).

All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the project-specific Phase 1 & 2 EMMP (an outline EMMP is provided in Chapter 15).

Please note: while it is acknowledged that the impact associated with the combustion of sold product is considered to be '**Upper Moderate**' and '**Uncertain**' and thus triggers the need for inclusion within the EMMP, this impact is also considered to be beyond the ability of Navitas to influence such that no viable EMMP actions are considered (Table 15.2). Navitas is aware of the draft guidance issued by the UKs DESNZ for consultation in October 2024 proposed as a supplement to the UK EIA Regulations (2020) for assessing the effects of Scope 3 emissions on climate change. Upon finalisation of these guidelines, and any amendment to the FIG EIA Guidance Note (FIG, 2016e), any potential measures regarding the monitoring and management of Scope 3 emissions will be identified and discussed with FIG and the EMMP governance board and advisors (Section 15.5).

10.9.11 Offsetting

For significant residual and impact and risks ('Moderate' or above), offsetting *via* a Carbon and Biodiversity Offsetting Fund is proposed, see Section 8.11 for further details.

Of importance it is beyond Navitas' ability to influence the use of the product once it has been sold or to monitor and manage emissions, thus the end user's emissions will be their responsibility to monitor, manage and offset.

10.9.12 Findings summary

Table 10.82: Summary of the impact assessment for emissions during the Phase 1 & 2 Development

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Fuel combustion throughout Development	Emission of direct and indirect GHG	Contribution to global warming	Planned	1, 2a, 2b & 3	Very High	Minor	n/a	**Moderate (10)**	**Moderate (10)**	**Certain**	**Industry-standard:** Use of BAT in project design, Monitoring and measuring of emissions, Selection and pre-mobilisation auditing, Optimisation of operations, MMS, SMART objectives and targets, and Ongoing ALARP reviews. **Project-specific:** Use of EEOI in developing tanker KPIs, and Investigation of pilot-free flare design using automatic ignition systems. **Note:** The 'as sold' emissions are outwith Navitas' control.
	Emission of CO_2, NOx and SO_2	Contribution to ocean acidification			High	Minor	n/a	**Moderate (8)**	**Moderate (8)**	**Certain**	
Combustion of sold product	Use of product	Emissions from combustion of Sea Lion product	Planned	n/a	Very High	Moderate	n/a	**Upper Moderate (15)**	**n/a**	**Uncertain**	
Emergency blowdown / Venting of full HC gas blanket	Emissions of CO_2, NOx, SO_2, CO, VOCs and/or CH_4	Contribution to global warming and ocean acidification	Unplanned	2a, 2b & 3	Very High	Slight	Possible	**Low (6)**	**n/a**	**Certain**	
Malfunction of HVAC and fire-fighting equipment	Release of F-Gases	Contribution to global warming	Unplanned	1, 2a, 2b & 3	Very High	Slight	Possible	**Low (6)**	**n/a**	**Certain**	

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

10.10 Waste Generation and Management

Table of Contents

10.10.1 Introduction 890
10.10.1.1 Relevant legislation 892
10.10.1.1.1 Waste management Duty of Care 893
10.10.1.1.2 Transfrontier shipments of waste 893
10.10.2 Sources and categories of waste 894
10.10.2.1 Sources of waste 894
10.10.2.2 Categories of waste 894
10.10.2.2.1 Hazardous liquid wastes 895
10.10.2.2.2 Solid wastes 896
10.10.2.2.2.1 Incinerator ash 896
10.10.2.2.3 Oil spill waste 896
10.10.3 Potential receptors 898
10.10.4 Characterising and quantifying the impacts and risks associated with waste 898
10.10.4.1 Nature of the impacts and risks associated with waste 899
10.10.4.1.1 Impacts of waste 899
10.10.4.1.1.1 Shipping of waste 899
10.10.4.1.1.2 Use of regulated landfill 899
10.10.4.1.2 Risks associated with waste management 900
10.10.4.1.2.1 Loss of containment 900
10.10.4.1.2.2 Improper segregation and cross-contamination 902
10.10.4.2 Existing waste management facilities in the Falklands 902
10.10.4.2.1 Recycling and re-use 902
10.10.4.2.2 Waste recovery (waste-to-energy) 902
10.10.4.2.3 Waste treatment 903
10.10.4.2.4 Landfill facilities 903
10.10.4.3 Phase 1 & 2 waste management 903
10.10.4.3.1 Waste management objectives 903
10.10.4.3.2 Waste management options assessment 903
10.10.4.4 Quantification of Phase 1 & 2 waste 907
10.10.4.4.1 Type and volumes of planned waste expected 907
10.10.4.5 Phase 1 & 2 waste in the context of the UK 910
10.10.5 Industry-standard mitigation 911
10.10.5.1 Waste Management Plan 913
10.10.6 Impact and risk assessment 913
10.10.6.1 Impact assessment of waste generation and management 913
10.10.6.1.1 Shipment of waste 913
10.10.6.1.2 Use of regulated landfill 913
10.10.6.2 Risk assessment of unplanned and accidental events 914
10.10.6.2.1 Loss of containment 914
10.10.6.2.1.1 Impacts to landscape 914
10.10.6.2.1.2 Impacts to wildlife 914
10.10.6.2.2 Improper waste segregation 915

10.10.7 Project-specific mitigation measures 915
10.10.7.1 Mitigating impacts to landfill 916
10.10.7.2 Mitigating impacts from loss of containment 916
10.10.8 Residual impacts and risks 916
10.10.8.1 Residual impact of landfill use 916
10.10.8.2 Residual risk of loss of containment 916
10.10.9 Cumulative impact 916
10.10.9.1 Landfill use 916
10.10.9.2 Incinerator use 917
10.10.10 Confidence 917
10.10.10.1 Monitoring required 917
10.10.11 Offsetting 918
10.10.12 Findings summary 918

10.10.1 Introduction

Every activity during the Phase 1 & 2 Development will generate waste which must be managed in a safe and environmentally responsible way in accordance with the Waste Hierarchy (Figure 10-45). The Waste Hierarchy is an established principle in waste management worldwide and is part of Navitas' corporate environmental standards. The hierarchy emphasises minimisation and beneficial endpoints for waste, with disposal to landfill considered the option of last resort that is only suitable when managed in accordance with international good practice.

The disposal of waste to sea is prohibited under the London Convention (1972) and MARPOL Convention (1973/78). There are a few exceptions allowing the discharge of non-hazardous liquids (Section 10.7) but inevitably, some waste must be transferred to shore. Once ashore, modern disposal and recycling techniques can be employed to minimise the impact of waste on the environment. However, such techniques and accompanying resources are currently limited in the Falkland Islands, and waste management was identified as a concern for stakeholders during the scoping consultations (Chapter 6). The hope for improved waste management facilities in the future, both for Oil and Gas (O&G) operations and more widely, was also communicated. Navitas (formerly POEPL) has taken, and continues to take, a collaborative approach with FIG in helping to determine the most environmentally sound in-country solutions for the Phase 1 & 2 waste in as short a timescale as practicable.

This chapter assesses the impacts and risks associated with the management of solid and hazardous liquid waste streams only (Table 10.83). Waste management associated with decommissioning (Development Stage 4) will be covered in a dedicated EIA, which will be prepared in support of the decommissioning programme (Section 5.12).

Note: In the previous iteration of the project (Section 2.1.1), it was likely that an incinerator, operated by (then) POEPL's contractors, would be necessary at the onshore supply base for an initial period to observe, as far as possible, the Waste Hierarchy (see below). In the intervening period, the Falkland Islands Government's (FIG) plans for a municipal waste incinerator have progressed and there is confidence that a waste incineration plant will be operational and will have sufficient capacity for the incinerable wastes resulting from the Sea Lion Phase 1 & 2 Development. Therefore, the possibility of an incinerator at the onshore supply base is now an unlikely contingency. Should this become necessary for any reason, plans will be developed for such a plant *via* the onshore planning regime. Nevertheless, as a potential, albeit unlikely, contingency, incineration at the onshore supply base is discussed where necessary in this chapter.

Note: The impacts of discharges to sea including drill cuttings, produced water, bilge water, drainage water, grey water, galley discharges, sewage and ballast water are described elsewhere in this document, as shown in Table 10.83.

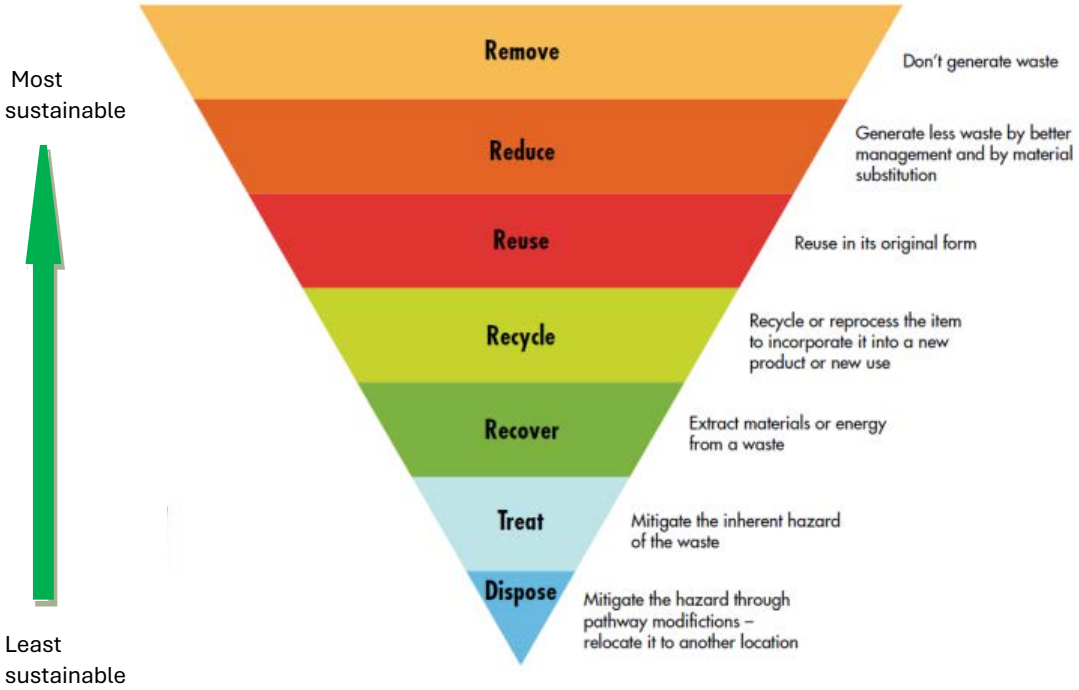


Figure 10-45: Waste Hierarchy

Table 10.83: Summary of waste streams generated by the Phase 1 & 2 Development, showing where they are assessed within this EIS

Waste stream	Generated during Stage:			Discharge to sea	Where addressed in EIS
	1	2a & b	3		
Offshore and onshore waste streams including: Containers and empty Intermediate Bulk Containers (IBCs), Metal, gas cylinders, Waste oil, including contaminated oil and oily rags, Rubber, Glass, Food waste (generated or arriving onshore), Wood, paper, cardboard, Flammable liquids, Bulk hoses, chemical sacks, Medical waste, Plastics, Low-hazard chemicals e.g., barite, Oil-based mud, Hardened cement, Non-hazardous filters, hazardous filters, Electrical waste including hazardous electrical waste, Aerosols, chemicals, Paints / solvents	✓	✓	✓	X	This chapter

Waste stream	Generated during Stage:			Discharge to sea	Where addressed in EIS
	1	2a & b	3		
Batteries, light bulbs, Tank washings, oily water, oily well-cleanup fluids, and Potential oil spill-related waste.					
Water-based mud and associated drill cuttings	✓	✓	X	✓	**Section 10.6**
Appropriately treated drill cuttings generated during drilling with NADF	✓	✓	X	✓	
Hydrotest water and well completion water (visibly clean)	✓	✓	X	✓	**Section 10.7**
Hydraulic fluids	X	✓	✓	✓	
Produced water (containing oil, heavy metals, iron etc.)	X	✓	✓	✓	
Cooling water	X	✓	✓	✓	
Domestic wastewater e.g., grey water and black water (sewage)	✓	✓	✓	✓	
Food waste	✓	✓	✓	✓	
Deck drainage water e.g., precipitation run-off	✓	✓	✓	✓	
Bilge water	✓	✓	✓	✓	
Hypersaline water from the desalination plants, which creates potable water	✓	✓	✓	✓	
Ballast water	✓	✓	✓	✓	**Section 10.12**

10.10.1.1 Relevant legislation

Currently there is limited waste-related legislation enacted in the Falkland Islands, although The Planning Ordinance 1991 has provisions for dealing with the storage, treatment or removal of any deposit or waste material. In 2023, FIG published the Falkland Islands Pollution Prevention and Waste Management Policy for consultation (FIG, 2023o). This includes the principles of Integration, Prevention, Rectification at Source, Polluter Pays, Precaution and Duty of Care, in line with the Waste Hierarchy, and sets out that a Pollution Prevention and Waste Management Ordinance will be developed.

In compliance with this Policy (under consultation) and with FIG Guidance Note 02/13 and the FIG EIA Guidance notes (FIG, 2016e), Navitas (formerly POEPL (Section 2.1.1)) has developed a Waste Management procedure which will be used to develop a project specific Waste Management Plan (WMP) for operations, to ensure that all waste is processed, stored, transported and disposed of responsibly.

Key legislation and agreements which inform the management of waste and the Development of the WMP include:

- International agreements:
  - International Convention for the Prevention of Pollution from Ships (MARPOL) 1973/78, which provides regulation on the different types of pollution and specifies whether discharge to sea is permitted:
    - Annex I - Regulations for the Prevention of Pollution by Oil,
    - Annex II - Control of pollution by noxious liquid,

    - Annex III - Prevention of pollution by harmful substances carried by sea in packaged form,
    - Annex IV - Prevention of pollution by sewage from ships, and
    - Annex V - Prevention of Pollution by Garbage from Ships.
  - The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the protocols of which apply to the onward processing of waste from the Falkland Islands to the UK. Note that the Falkland Islands are not party to the Basel Convention but a bilateral agreement is in place.
  - OECD Council Decision C (92)39/FINAL on the Control of Transfrontier Movements of Wastes Destined for Recovery Operations.
  - The London Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972, and the London Protocol 1996 amended 2006.
  - The OSPAR Convention 1992, which incorporated the Oslo Convention 1972 for the prevention of marine pollution by dumping from ships and aircraft and the Paris Convention for the prevention of marine pollution from land-based sources.
- Key UK (and retained EU) legislation:
  - Waste Shipments Regulation EC No 1013/2006 as amended by The International Waste Shipments (Amendment) (EU Exit) Regulations 2019 and The International Waste Shipments (Amendment of Regulation (EC) No 1013/2006) Regulations 2020.
  - Transfrontier Shipment of Waste (amendment) Regulations 2014.
  - Environmental Protection Act 1990.
  - The Waste (England and Wales) Regulations 2011 (as amended), and The Waste (Scotland) Regulations 2012.
  - The Controlled Waste (England and Wales) Regulations 2012 (as amended) and The Controlled Waste Regulations 1992 (as amended).
  - The Special Waste Regulations 1996 (as amended).

10.10.1.1.1 Waste management Duty of Care

'Duty of Care' is an established international principle whereby waste producers have a Duty of Care to store, transport and dispose of 'controlled waste' without harming the environment. In UK law, for example, 'controlled waste' is described in Part II of the EPA (1990) to mean household, industrial and commercial waste or any such waste, although it is not currently enacted in Falkland Islands specific legislation.

Applying the Duty of Care means it is necessary to:

- Segregate, store and transport waste appropriately and securely, making sure that no pollution or harm to human health is caused,
- Check that waste is transported and handled by people or businesses that are authorised to do so,
- Ensure completion of the appropriate paperwork to accompany the waste,
- Ensure that waste is disposed of responsibly, and
- Ensure that waste service providers are authorised.

10.10.1.1.2 Transfrontier shipments of waste

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal provides the framework for a global system that controls the movements of hazardous wastes

between countries to ensure they are managed in an environmentally sound manner. The Basel Convention was also amended in 2021 to expand on the controls for exporting plastics, stating that, in summary, certain plastics can only be exported as Green List waste if destined for recycling, and providing that such shipments are consented by the receiving government. As noted in the FIG Pollution Prevention and Waste Management Policy (FIG, 2023o), in January 2023, the Government of the United Kingdom and the Falkland Islands Government entered into a bilateral agreement for the shipment of hazardous and other wastes from the Falkland Islands to the UK. As the Falkland Islands is not party to the Basel Convention, any transboundary movements of hazardous wastes and other wastes between the Falkland Islands and the UK will be managed and regulated *via* the bilateral agreement and any relevant national legislation in force. The EIS takes this position as being the proposed solution for the project, i.e., that any wastes that cannot be disposed of in the Falkland Islands will be exported to the UK. If disposals to any other countries are proposed, this would require a separate discussion between Navitas and FIG and assurance that equivalent environmental controls were in place in line with Duty of Care principles.

In the UK, the Transfrontier Shipment of Waste Regulations (2007, as amended) includes both hazardous and non-hazardous wastes. The 'UK Plan for Shipments of Waste' (Defra, 2021) sets out the UK Government policy on the shipment of waste to and from the UK, and other countries, and takes into account the UK's obligations under international, retained EU and national legislation. Generally, shipments of waste to and from other countries for disposal (as opposed to re-use, recycling or recovery) are prohibited. However, in line with Defra (2021), imports to the UK from UK Overseas Territories (UKOT) are potentially allowed, by exemption, if there are no suitable methods of disposal available in the UKOT. This is subject to the processes laid out in Title V of the retained EU Regulation (1013/2006) and discussion with the appropriate Environmental Protection Agency.

Transfrontier waste shipment controls are expected to follow UK norms which are set out in the retained Waste Shipments Regulation EC No 1013/2006 as amended by The International Waste Shipments (Amendment) (EU Exit) Regulations 2019 and The International Waste Shipments (Amendment of Regulation (EC) No 1013/2006) Regulations 2020.

10.10.2 Sources and categories of waste

10.10.2.1 Sources of waste

Waste generation can be categorised by the following project sources:

- The Mobile Offshore Drilling Unit (MODU),
- Installation vessels,
- The Floating Production, Storage and Offloading (FPSO) Unit,
- Other offshore support vessels including (but not limited to):
  - Multi-Role Support Vessels (MRSVs),
  - Anchor Handling Tug Supply (AHTS) vessels,
  - Large Transport Vessels (LTVs) / Offshore Construction Vessels (OCVs),
  - Offshore Support Vessels (OSVs) / Platform Supply Vessels (PSVs) and,
  - Emergency Response and Rescue Vessels (ERRVs).
- Onshore operations.

10.10.2.2 Categories of waste

All industrial waste falls under the category of 'controlled waste' and can be categorised as:

- Non-Hazardous Waste which includes the following (provided they have not been cross-contaminated with hazardous wastes):
  - Paper, plastics, cans, food waste, scrap metal, rubber and wood.
- Hazardous Waste which includes any material that shares the properties of a hazardous material, for example:
  - Oily waste including waste oil, used oil filters and oily rags,
  - Waste NADF,
  - Waste chemicals i.e., those that are surplus to requirement but cannot be re-used,
  - Waste Electrical and Electronic Equipment (WEEE),
  - Empty oil / chemical containers,
  - Asbestos, batteries, paints, radioactive materials, and
  - Medical wastes.

Wastes anticipated during the Phase 1 & 2 Development, and described in this chapter, include:

- Hazardous liquid wastes:
  - Waste oil that has been separated from bilge, drainage and well completion water.
- Hazardous and non-hazardous solid wastes:
  - Office wastes e.g., paper, light bulbs, batteries, cups, ink cartridges,
  - Packaging materials e.g., wooden pallets, cardboard, dunnage, plastics, packaging bands,
  - Oil contaminated materials,
  - Scrap metals,
  - Fabrication wastes e.g., paint tins,
  - Chemical drums and containers, and
  - Ash generated from waste incineration (if the FIG incinerator is not operational and a temporary incinerator is required at the onshore base).
- Oil spill waste (only generated in the event of a spill).

Note: other waste streams e.g., drilling fluids and cuttings and operational discharges to sea & ballast water are covered in separate chapters as described in Table 10.83 above.

10.10.2.2.1 Hazardous liquid wastes

Bilge and drainage water will be passed through an oil separator before being discharged to sea in accordance with the requirements of MARPOL (Section 10.10.1.1). The oil separated from the drainage and bilge water will typically be returned to the processing facilities on the MODU and FPSO. However, occasionally the recovered oil may be sufficiently ‘off spec’ that it will not be suitable for processing offshore and in these instances it will be collected and stored in drums / transit tanks and will be shipped back to the onshore supply base. At the time of writing it is understood that the FIG Stanley incinerator will be operational by the end of 2026, which aligns with Navitas' operational schedule, and this would be the first option for accepting ‘off spec’ recovered oil. Should the FIG Stanley Incinerator not be available, in the instance of ‘off spec’ recovered oil, Navitas would:

1) Store the waste in suitable containers onshore until the FIG incinerator is once again available,
2) Store the waste in suitable containers onshore until offshore treatment on board either the MODU or FPSO is available, or

3) Store the waste in suitable containers onshore until a suitable volume is ready for export to the UK.

Similarly, during wellbore clean-up between drilling and completion phases when each well is displaced from NADF to brine, the NADF contaminated water returning to the MODU is put through a separation process. Water that has been treated to minimise oil content (such that the oil concentration is <30 mg/l and is 'visibly clean' and will produce no sheen), can be discharged offshore (Section 10.10.1.1) and any residual oil (free-oil) from the separation process will be sent to the supply base or combusted in the cuttings processing equipment if feasible.

Waste oils from the above that are returned to the shore base will be candidates for re-use, with incineration being a secondary solution (Section 5.11.1.2.2).

In the event of equipment failure offshore on the MODU / FPSO, oily waste from the MODU / FPSO may be sent onshore. This waste would be stored at the onshore base and then shipped back offshore for treatment once equipment is fixed. This backloading of waste would be done in discussion and agreement with FIG.

There will be some oily wastewater from the onshore mud plant. Such water will be decanted / stored in a bunded area away from the sewerage network. This will then be treated, incinerated or dealt with in alignment with Navitas' Waste Management Procedure. There is an option for this wastewater to be sent offshore for processing on the MODU / FPSO / *via* vessels, which would be discussed and agreed with FIG.

10.10.2.2.2 Solid wastes

All waste that is not eligible for discharge to sea will be segregated offshore, shipped back to the Temporary Dock Facility (TDF) and taken to the laydown yard in the supply base which will be designed to include a waste reception facility (Section 5.11.1.2). If necessary, the wastes will be further identified, categorised and segregated. Following this process, the waste will either be stored prior to its shipment to the UK for re-use, recovery or disposal, or, if the FIG incinerator is not operational, it will be thermally treated in-country using a temporary incinerator located in the base (Section 5.11.1.2.2).

10.10.2.2.2.1 Incinerator ash

The base-case is that project waste will be incinerated at a new Falkland Islands municipal facility, which will include suitable facilities for the disposal of ash. In the event that the new facility is not completed in time, the project will provide a temporary portable incinerator and waste ash will be temporarily securely stored at the supply base and periodically sent back to the UK along with other waste returns.

10.10.2.2.3 Oil spill waste

In the event of a spill, clean-up operations inevitably generate multiple contaminated waste streams, sometimes in great quantities. Indeed, studies undertaken by ITOPF (2012) have shown that the volume of oil clean-up materials and other debris is typically ten times the volume of oil that is spilled. Management of the waste up to the time of its final disposal, and the complete restoration of all sites, can cause major problems for response coordinators. In the highly unlikely event that a spill incident should occur, Navitas would be supported by international oil spill response contractors who have significant expertise and resources in the appropriate management of oil spill response waste. These response contractors would be deployed to the Islands in the event of a Tier 2 or 3 oil spill event.

A range of different scenarios have been modelled to gain an understanding of the likely behaviour and impact of oils spilled at sea (Sections 12.1, 12.2 and 12.3). These modelled scenarios also estimate the potential quantities of waste materials that may arise. Analysis of the crude oil has shown that it

possesses a high pour point with a high wax content (Section 5.3). Given this viscous consistency, upon contact with cold seawater, the oil solidifies and forms mobile rafts. It may also lead to the formation of tar balls. This tendency means that should any oil wash ashore, it may be more easily separated from the substrate and collected using only rudimentary techniques and equipment (CEDRE, 2017)[85].

The goal of oil spill response is to restore all sites to their previous condition as soon as possible and, to meet this goal, approaches to waste management following any spill will be consistent with:

- The Falkland Islands National Oil Spill Contingency Plan (NOSCP),
- Navitas' strategic waste management objectives, and
- The Phase 1 & 2 Development operational OPEPs which will define the agreements between Navitas and specialised service providers where necessary.

Typical methods and approaches used for the retrieval of oil spill wastes in remote and difficult-to-access areas are:

- Keep oil spill waste to a minimum,
- Avoid contaminating the surrounding environment,
- Prevent overflow, congestion and hold ups, and
- Sort waste as soon as possible.

However, the particular challenges that are faced by a clean-up operation along the Falkland Islands coastline arise as a result of the relative inaccessibility of the foreshore and the nature of the rocky shoreline. Further, where spilled materials come ashore and remain, it is likely that that the residues will be mixed with pebbles and cobbles and organic matter such as kelp.

It is intended that, in the event of a spill:

- Any oily waste that can be recovered at sea or from the shoreline will be stored on the offshore support vessels (OSVs), which will have oil spill response and waste storage capability, at the TDF (Tier 1) and in the onshore supply base facility. An appropriate dedicated bunded area for the storage of oily waste is planned within the supply base yard.
- All oily materials retrieved from the foreshore will be placed initially on lined temporary storage areas. These areas will:
    - Be in line with the requirements of the Falkland Islands NOSCP arrangements and located in an area agreed with FIG,
    - Be surfaced with an impermeable membrane and covered to ensure that no loss to the ground can occur and also to prevent rainwater ingress,
    - Provide interim storage for all recovered oil spill response materials and equipment including shoreline booms,
    - Ensure that the waste will be in a form that can be easily managed for onward transportation to other intermediate, or final, storage areas, and
    - Be easily accessible from the beach to allow rapid and daily evacuation of collected waste ensuring that:
        - Impacts to sensitive coastal areas are minimised, and
        - Manpower and resources can be focused on the initial clean-up effort.
- All wastes will be logged so that the quantities and types of materials that require further intermediate storage, or final disposal, can be readily assessed,

[85] Note that the oil spill modelling indicates a very low likelihood of shoreline oiling as described in Section 12.

- Various techniques will be used (including washing of contaminated kit) to ensure removal of the free-oil from the waste and it is envisaged that the remaining oily water fraction would be contained in drums and IBCs, and
- Final waste storage sites will also be identified as part of the contingency planning.

More details on the oil spill waste clean-up and management are detailed in Navitas' Waste Management Procedure, and will also be detailed in the project-specific WMP.

10.10.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify those receptors upon which the impacts and / or risks of waste warranted further investigation (Chapter 9). These include the impacts and risks to:

- Global atmosphere (Section 7.3.1),
- Water quality (groundwater) / seabed / soil quality,
- Marine and terrestrial biodiversity, i.e., flora and fauna including:
  - Plankton (Section 7.4.1),
  - Invertebrates and fish (Sections 7.4.3 and 7.4.4),
  - Seabirds (Section 7.4.5), and
  - Marine mammals (Section 7.4.6).
- Landfill resources (tangible property) (Section 7.7.4.5.6),
- Landscape and seascape (Section 7.7.4.6),
- Designated sites (Section 7.5.2), and
- Human population (Section 7.7.2).

The above may be impacted owing to the transport and storage of waste, waste incineration, the disposal of unrecoverable waste to landfill and by waste mismanagement, should it occur.

Note: Impacts of all emissions are assessed in Section 10.9.

10.10.4 Characterising and quantifying the impacts and risks associated with waste

When characterising and quantifying the impacts and risks associated with each waste stream, it is necessary to consider the:

- The nature of the impacts and risks associated with waste:
  - The nature of the impact of waste:
    - Shipping of waste, and
    - Use of regulated landfill.
  - Risks associated with waste management:
    - Loss of containment, and
    - Improper segregation and cross-contamination.
- Existing waste management facilities in the Falkland Islands,
- Phase 1 & 2 Development waste management:
  - Waste management objectives, and
  - Waste management options.
- Quantification of Phase 1 & 2 waste:

- Type and volumes of operational waste.
- Phase 1 & 2 waste estimates in the context of UK waste.

10.10.4.1 Nature of the impacts and risks associated with waste

10.10.4.1.1 Impacts of waste

10.10.4.1.1.1 Shipping of waste

Waste being returned to the UK[86] will be transported *via* the returning *ad hoc* freighter vessels, and, when possible, the MoD Falkland Islands Resupply Service (FIRS) freighters, the emissions of which have been assessed in Section 10.9. Although it is not anticipated that the all the *ad hoc* freighters will be under hire to Navitas on the return trip, the emissions from all freighter return trips have been assumed to ensure a worst-case assessment.

When shipping waste to the UK, Navitas will adhere to the relevant Conventions, Agreements and the Transfrontier Shipment (TFS) of waste controls (Section 10.10.1.1).

10.10.4.1.1.2 Use of regulated landfill

The potential environmental impacts of waste disposed of to landfill include:

- Direct impacts:
  - Use of a finite and unsustainable resource.
- Indirect cumulative impacts:
  - Creation of irritants such as dust, pests, noise and odour,
  - Contamination of groundwater, aquifers and soil, and
  - Production of methane as organic materials (e.g., food scraps and paper etc.) decompose.

With regard to the use of a finite resource, landfill sites in England, for example, are estimated to have a remaining capacity of 349 million cubic metres (EA, 2023). In Scotland, landfill sites had 29 million tonnes of capacity in 2022. It was estimated that 2.4 million tonnes of waste were landfilled in that year (SEPA, 2024) and many sites have lifespans of 20 years or more at their current rates of filling, though clearly other sites have shorter lifespans and ongoing new capacity is required to meet demand. While new landfill space opens every year, available space is in overall decline and forecasts to 2030 point out shortfalls expected in some areas of the UK (Suez, 2017).

The vast majority of O&G wastes in the UK are landed and disposed of in Scotland, as were wastes from the exploration drilling campaign in 2015. Waste management is an area devolved to the Scottish Government and data show that landfill capacity can be managed in the medium term. It is noted that binding targets and changing behaviours to reduce waste to landfill have reduced the quantities going to landfill year on year, reducing quantities landfilled by 50 % from 2008 to 2021 (SEPA, 2023a).

With regard to the indirect impacts, Navitas has no control or influence over the impacts of landfill any more than any other consumer. However, it will aim to minimise the amount of waste that goes to landfill and will ensure that only regulated landfills are used.

[86] At the time of writing this EIS it has been assumed that non-incinerable waste will be returned to the UK in compliance with all transfrontier shipment of waste conventions and regulations (Section 10.10.1.1). As the project matures it may prove viable to ship waste to a closer OECD country, again in accordance with relevant legislation, for re-use, recycling and / or use of regulated landfill sites. For the purposes of this assessment, the UK provides a worst-case with regard to shipping emissions and the assessments for regulated landfill use are unlikely to be affected by the site location as landfill is fundamentally an unsustainable resource (Section 10.10.6.1.2).

10.10.4.1.2 Risks associated with waste management

Both hazardous and non-hazardous waste products have the potential to impact upon the environment if they are not handled, stored, treated and recovered or disposed of appropriately. Mismanaged wastes have the potential to impact upon soil, water and groundwater quality, marine and terrestrial wildlife, resource use and human health. Navitas employs strict controls on waste management in its operations and requires any lost objects to be reported, recovered if at all possible, and corrective actions to be put in place to prevent reoccurrence.

Mismanagement of waste includes:

- Improper storage leading to loss of containment of waste, and
- Improper segregation of waste during generation offshore, transportation and storage onshore leading to cross-contamination.

10.10.4.1.2.1 Loss of containment

The potential environmental impacts of a loss of containment are:

- Loss of solid waste to sea or land which could:
  - Create unsightly litter and may impact upon landscapes / seascapes and therefore, indirectly, upon the local community and visitors to the Islands with regard to wellbeing and 'quality of experience', and
  - Be ingested by terrestrial / marine fauna or cause entanglement thus affecting the animal's fitness.
- Loss of hazardous liquid wastes to sea.

Loss of containment leading to the above impacts would be an unplanned event and as such, it is not possible to quantify the amount of waste that may be released. The industry-standard mitigation measures (Section 10.10.5) will be utilised at all times to minimise the likelihood of an incident.

Nonetheless, the loss of solid wastes to sea, plastic litter and other objects is recognised as a major source of marine pollution (Waluda and Staniland, 2013). In the event of a loss of waste, such materials are very slow to degrade and the impacts are described below.

The loss of hazardous liquids wastes to sea would be treated as a spill and reported to FIG as well as *via* Navitas' internal loss of containment and processes. Spill prevention is managed by good practice in storage, containers, tankage, pipework and bunding and also by the selection of lower hazard chemicals in operations (Section 10.7). Navitas will follow industry good practice in spill prevention such as is documented in the Energy Institute Guidelines for bunding of temporarily stored liquids offshore (Energy Institute, 2016b). Any incidents will be investigated with root causes established and addressed, and any trends tracked *via* Navitas' Key Performance Indicators (KPIs) for environmental management. Small-scale oil spills are discussed in Section 12.1.2.2 and the mitigation measures apply equally to other hazardous liquids. The prevention and mitigation of onshore losses of hazardous liquids are addressed in Section 12.3.4.3.

Impacts of waste loss and litter on landscape and human population

The Falkland Islands are very scenic and wind-blown 'litter' would be damaging visually and ecologically. While it is not possible to estimate the quantities of waste that may be blown away in the event of waste mismanagement, or to predict the destination of lost material, the Falkland Islands are suffused with beauty spots and many around Stanley, where the onshore supply base is likely to be located, could be affected. Many of these areas are highly sensitive owing to their importance for local wildlife, and in some cases, for tourism e.g., Cape Pembroke which is a National Nature Reserve (NNR) and an Important Plant Area (IPA).

Littering of these areas with lost waste is more likely to occur in the event of losses from the onshore waste laydown yard than from waste lost at sea, and may impact upon the 'quality of experience' of both the local population and visitors to the area.

Impacts to wildlife

Buoyant debris remains suspended on the sea-surface while negatively buoyant debris sinks and may remain on the seabed for years. As many man-made materials are not biodegradable, litter and lost debris has the potential to cause damage to wildlife time and again (Laist, 1987, Baulch and Perry, 2014). Therefore, all fauna may be exposed to the wastes over a wide area and over a long time (Laist, 1987). The threats of such debris are often mechanical and, in particular, the ingestion of, and entanglement or capture in, man-made debris is a potentially significant cause of injury and death in Crustacea, fish, seabirds and marine mammals (Derraik, 2002; Fowler, 1987; Laist, 1987; Huin and Croxall, 1996; Gregory, 2009; Waluda and Staniland, 2013; Baulch and Perry 2014). Entanglement can lead to drowning, injury, impaired mobility and ability to catch food or to avoid predators, leading ultimately to mortality (Laist, 1987; Weir and Prieto, 2024). The ingestion of debris may block digestion, cause internal damage or compromise feeding, leading to malnutrition, disease and reduced reproductive output, whilst exposing animals to an additional source of toxins (Laist, 1987; Baulch and Perry, 2014).

Cetaceans, from small dolphins to large baleen whales, are vulnerable to entanglement in, and ingestion of, waste materials. Weir and Prieto (2024) note three instances of live entanglement of sei whales from 2013 to 2020 in US waters, including one animal with plastic strapping around its rostrum (mouth). When entanglements 'limit the mouth opening to feed, or are sufficiently severe to limit mobility, they are highly likely to cause mortality' (Weir and Prieto, 2024). As lunge-feeders, Sei whales are more likely to accidentally ingest non-target items such as plastics and other debris.

To date ingestion of debris has been documented in 48 (56 % of) cetacean species (Baulch and Perry, 2014). Padula *et al.* (2023) record instances of marine debris ingestion in large odontocete species in southern Brazil and northern Argentina. They found 8 % of individuals studied (representing nine different species) had ingested marine debris, of which 68 % of ingested items that were made of plastic.

Further, microplastics may be present within whales' prey species, such as fish (Burkhardt-Holm and N'Guyen, 2019). Plastic ingestion may be an increasing threat, with plastic debris being recently identified in a sei whale faecal sample in Chile (Buchan, *et al.,* 2021). Stranded sei whales have been found with plastic in their stomachs in both the UK and USA (Baulch and Perry, 2014; Henry, *et al.,* 2020), with the ingestion directly contributing to mortality in the USA case. Additionally, microplastics may be trapped within baleen plates where they are a fouling risk that prevents whales feeding efficiently (Werth, *et al.,* 2019). While the above examples focus on sei whales, it should be noted that these or similar impacts have been recorded across many marine mammal species (Baulch and Perry, 2014).

Pinnipeds (such as sea lions) are particularly vulnerable to becoming entangled in loops of rope, packing bands (Page, *et al.,* 2004; Waluda and Staniland, 2013) and plastic sheeting or netting, which generally becomes stuck in the fur around the neck and slowly strangles the animal. It is generally less likely that birds will become entangled but instead may ingest small floating objects which can cause chronic impact by reducing fitness (long-term survival) and potentially breeding success. Indeed, an assessment of the impact to the local population of turkey vultures (*Cathartes aura*) in Stanley was conducted by Augé (2016). The turkey vultures feed around Eliza Cove and were investigated to determine the amount of anthropogenic debris in their diets. This was done by assessing the percentage of anthropogenic debris in the regurgitated pellets. It was found that on average, 16.1 % of the mass of each pellet was anthropogenic (mostly plastics) indicating that the birds are regularly

ingesting waste materials. Seabirds are amongst the marine vertebrates with the highest known ingestion rate of plastic and other marine debris, and this is particularly true for albatrosses and petrels. Marine debris, however, is recorded in stomach samples of many individuals of numerous seabird species. Impacts include reduced body mass and wing length of chicks, potential impacts of toxins from plastics ingested, partial endocrine disruption, and the more plastic ingested, the higher the risk of associated mortality. Nonetheless, the authors note that current plastic loads studied seem unlikely to have an impact at the population level (Phillips and Waluda, 2020).

Where a species or population is already threatened, such impacts upon fitness may have a significant effect. For example, the population of wandering albatross breeding on South Georgia, and foraging in part around the Falklands, has shown a long-term decline (Poncet, *et al.,* 2006), such that any additional pressure could exacerbate their decline.

It is understood that in recent years, the impacts of debris from the fishing industry around South Georgia, and within other CCAMLR (Commission for the Conservation of Antarctic Marine Living Resources) waters, has lessened owing to additional fishing license conditions and strict enforcement regimes (Waluda and Staniland, 2013). However, a significant number of animals are still impacted suggesting that debris also originates from outside the controlled areas. As improvements such as this can be evidenced, it is essential that any new industry in the region manages its waste responsibly.

10.10.4.1.2.2 Improper segregation and cross-contamination

In the event that wastes are not properly segregated on the MODU / FPSO at the point of waste generation and / or that waste is mixed during transportation or onshore storage, there is the risk of non-hazardous wastes becoming contaminated with hazardous wastes. Should cross-contamination occur, non-hazardous waste may need to be treated as hazardous wastes and the potential for waste recovery may be lost. The main impact of this is the loss of opportunity for waste recovery and an increase in the use of landfill.

10.10.4.2 Existing waste management facilities in the Falklands

Waste management facilities in the Falkland Islands are currently very limited. Further details on waste management options in the Falklands were documented in Smethurst (2013) and the FIG Waste Management Action Plan 2015-2017 (FIG, 2014b), while the Falkland Islands Pollution Prevention and Waste Management Policy (FIG, 2023o) recognises that a waste management framework and new facilities need to be developed. A municipal waste facility that meets the relevant regulatory standards is being developed which will allow Navitas to meet its Duty of Care commitments for the Phase 1 & 2 Development waste streams.

10.10.4.2.1 Recycling and re-use

Municipal recycling facilities are currently not available in the Falkland Islands although there is now a monthly can collection and glass is collected and recycled in Stanley. Batteries may also be recycled at collection points in local supermarkets.

10.10.4.2.2 Waste recovery (waste-to-energy)

Currently, some waste fuels are converted into heat for the hydroponics system at the Stanley Growers' site near the proposed onshore supply base and TDF in Stanley. During the last exploration campaign (under POEPL), the facility received waste oils from the drilling programme for energy recovery. This route, however, has a finite capacity and the use of waste oils from the Phase 1 & 2 Development would be subject to specific discussion and agreement with FIG. It illustrates, however, that there may be scope for waste-to-energy in the Islands.

10.10.4.2.3 Waste treatment

A new waste incineration facility that meets the relevant regulatory standards is being developed in Stanley and will be operated by FIG. This will allow Navitas to route a significant fraction of its wastes collected onshore to incineration, thereby reducing the demand on other disposal routes in line with the Waste Hierarchy (Section 10.10.1). Discussions between Navitas and FIG confirm that it is planned to be available towards the end of 2026 and will have sufficient capacity to meet the forecast incinerable waste volumes from the project.

10.10.4.2.4 Landfill facilities

The current municipal landfill sites in the Falklands, namely Eliza Cove and Mary Hill Quarry, are not suitable for landfilling of Navitas' solid wastes. It is understood from FIG that a new landfill facility that meets the relevant regulatory standards will be developed in the Islands. When this is available, it is expected to accommodate the local landfill of wastes which have no other disposal route, other than shipment overseas. This will serve to ensure compliance with the Waste Hierarchy and proximity principle on the minimisation of atmospheric emissions associated with transportation.

10.10.4.3 Phase 1 & 2 waste management

10.10.4.3.1 Waste management objectives

As a responsible operator, and in line with its OMS (Section 3.2), Navitas will implement the necessary measures to ensure that waste management is carried out without endangering human health and safety, and without harming the environment.

In line with the industry-standard, Navitas will follow the Waste Hierarchy (Section 10.10.1) to minimise waste produced throughout the Development.

- Specifically, Navitas seeks to:
- Identify, quantify and characterise all waste streams, and their volumes over the 3 Stages of the Development,
- Promote waste minimisation and segregation,
- Identify appropriate disposal options for the various waste streams and the timings required in the context of operating in the Falkland Islands, and
- Detail options and outline feasibility for the layout and specifications of potential facilities at Navitas' laydown yard.

In order to achieve this, Navitas has developed a forecast of waste quantities based on analysis of analogous projects (Section 10.10.4.4.1). Waste treatment techniques in line with the Waste Hierarchy have been identified (Section 10.10.4.3.2) with consideration given to key legislative sources and the Waste Hierarchy. Collaborative discussion will be undertaken with FIG on the most suitable waste solutions for the Phase 1 & 2 Development in the Falkland Islands context.

Navitas will develop a project-specific Waste Management Plan for operations as described Section 10.10.5.1 below.

10.10.4.3.2 Waste management options assessment

The fundamental principles of waste disposal are based on returning waste materials to the environment in a form which will have the minimal environmental impact. However, in practical terms, while there are many innovative ways to handle and process waste, there are few ultimate disposal solutions as most give rise to residues and secondary wastes that require subsequent management.

Further, waste management in a remote location without sufficient facilities to cope with the waste streams is challenging. When assessing the options, it is important to consider the varying 'trade-offs'

that exist. For example, shipment of the waste to another location will incur emissions to air and while some waste streams, such as wood or paper, may be reusable or recyclable, it is not necessarily best environmental practice to ship these a great distance for the purposes of doing so. Equally, while incineration would also result in emissions, these are offset by the reduction in emissions from waste shipment while also reducing the volume of waste that requires landfill.

A review of available options was undertaken (Filkin & Co., 2017) and the conclusions are presented in Table 10.84 below.

During the review (Table 10.84), waste management techniques and options were scoped out when:

- They were not commercially available or proven,
- The technique was energy intensive,
- They required a high order of operator competence, and / or
- There was an uncertain cost-benefit relationship.

As shown in Table 10.84, while every effort will be made to remove, reduce and re-use waste, the key options that emerged from the review were:

- Thermal treatment to mitigate the hazard of the waste, for example:
  - Treatment of NADF cuttings in line with legislation so they can be discharged to sea, and
  - Incineration of all combustible wastes to minimise waste shipments to the UK and waste to landfill.
- Use of new local municipal landfill resource when available, and
- Shipment of waste for re-use, recycling, recovery, treatment or disposal to landfill in the UK.

Shipment of waste for management in the UK has been undertaken in previous O&G operations where appropriate treatment and / or disposal infrastructure does not exist locally, and all shipments will be made in compliance with the Basel Convention and the Transfrontier Shipment of Waste Regulations (Section 10.10.1.1.2). Nonetheless, it should be noted that, the export of non-recyclable waste for disposal is not a preferred option for Navitas owing to the impact of emissions, cost and reliance on the return trips of existing commercial shipping routes and *ad hoc* freighter vessels etc. However, as this is currently the only assured means of waste disposal for the life of field, it is proposed as the base-case for disposal of all Phase 1 & 2 wastes that cannot be incinerated in the Islands.

Nonetheless, Navitas will continue to explore other options for waste management in the medium to long-term. This will include exploring the export of waste to another, geographically closer, OECD (Organisation for Economic, Co-operation and Development) country.

Table 10.84: Waste management options assessment indicating the methods that were considered both viable and in line with Navitas' objectives

Waste Hierarchy solution	Definition	Location	Navitas options	Viable option?
Remove	Don't generate waste	Falkland Islands and UK	The first way to minimise waste generated is to not create it in the first place. This will be done through consideration of waste in contracting and minimising packaging.	✓
Reduce	Generate Less waste by better management and material substitution			✓
Re-use	Re-use the material in its original form	Falkland Islands	In order to minimise the volumes of waste drilling muds, muds that have been returned to the MODU and cleaned of cuttings will be reused on subsequent wells. Should opportunities be identified to locally re-use waste materials in future, Navitas will support any suitable in-country initiatives.	✓
Recycle	Recycle or reprocess the item to incorporate it into a new product or new use	Falkland Islands	Presently there is little processing infrastructure and / or demand for the types of recyclable waste materials identified during the waste forecasting (Section 10.10.4.4). Therefore, the number of credible options for recycling in the Falklands is currently very limited. Where an opportunity is identified to locally recycle waste material in future, Navitas will support any suitable in-country initiatives.	✗
		UK	Recycling facilities are available in the UK for materials that are shipped out. It should be noted however, that for large developed economies such as the UK, many wastes collected for recycling are exported for processing abroad which then incurs further emissions.	✓
Recovery	Extract material or energy from a waste	Falkland Islands	Waste-to-energy refers to the process of generating other forms of energy (e.g., electricity and / or heat) from the primary treatment of waste. These processes include: Recovery of heat from the combustion of incinerable wastes, Combustion of oils as a fuel source e.g., the free-oil that is separated from oily waters offshore, and Use of organic wastes for composting which is a process of controlled decay enabling aerobic bacteria and other micro-organisms to decompose organic matter. If a temporary incinerator is required, Navitas will investigate the potential for waste heat recovery, with the use of this route being subject to specific discussion and agreement. Nonetheless, should any other opportunities for waste recovery emerge in the future, Navitas will support initiatives where they are considered feasible and safe and where sufficient competence can be demonstrated.	✗
		UK		✓

Waste Hierarchy solution	Definition	Location	Navitas options	Viable option?
Treat	Mitigate the inherent hazard of the waste	Falkland Islands	Thermal treatment of cuttings: A key decision is to thermally treat drill cuttings generated with NADF so that the cuttings can be discharged to sea in line with OSPAR Decision 2000/3. This greatly reduces the amount of material that would otherwise be brought onshore for treatment and disposal. Further, and as stated above, the process also enables the re-use of the base-oil in the next batch of NADF and tests have shown that the base-oil remains of sufficiently good quality through the process.	✓
	Incineration	Falkland Islands	Incineration of waste: Current facilities do not have the capacity to manage the volume of Phase 1 & 2 Development waste (Section 10.10.4.2.3), but FIG are planning to provide new incineration facilities that will meet the project requirements. If this is not possible, as a contingency, the project proposes the use of a portable incinerator at the onshore supply base. Incineration is a means of: Reducing the volume of waste that requires disposal, thus mitigating against landfill impacts, and Reducing the number of shipments of waste back the UK. Navitas recognise that incineration is not a complete management solution as it gives rise to ash and flue gases, as well as a range of maintenance wastes. These will be managed in an environmentally sound manner *via* FIG. Atmospheric emissions are somewhat offset by the fact that incineration of the waste reduces the overall volume of waste and thus reduces the number of waste shipments to the UK.	✓
		UK		✓
Dispose	Landfill	Falkland Islands	As disposal to an in-country landfill is not currently an option (Section 10.10.4.2.4), all materials that cannot be incinerated and require landfill will be returned to the UK. There are two types of landfill that may be required for the unrecoverable Phase 1 & 2 Development waste streams: Hazardous landfill for the deposit of hazardous wastes onto, or into, the land in such a way that pollution or harm to the environment is minimised, and Stable, non-reactive landfill for the deposit of inert waste that is incapable of reacting with other wastes when placed in a designated area within a landfill.	✗
		UK		✓

10.10.4.4 Quantification of Phase 1 & 2 waste

10.10.4.4.1 Type and volumes of planned waste expected

When assessing the original Sea Lion Development, POEPL commissioned a waste study and forecast (Filkin & Co., 2017) to estimate the waste streams and volumes that may result from the Development. Data sources for this study included:

- Data on wastes produced during the previous Falkland Islands exploration well campaigns,
- Data on actual waste arisings from analogous activities both onshore and offshore,
- 2020 UK waste production data, obtained from Defra (2023), and
- UKCS O&G production waste figures, obtained from UK EEMS[87] Report Data (reported in OEUK, 2023), to determine the average quantity of waste produced by all North Sea installations.

While the currently proposed Sea Lion Development has evolved slightly since the original proposal, e.g., reduced number of wells, increased Field Life etc., (Section 2.1.1) the data used in the forecast, which is benchmarked on duration of activities and personnel numbers, remains valid and provides an overview of the solid and hazardous liquid waste arisings in terms of:

- What waste types are forecast to be produced,
- What volumes of these wastes can be expected, and
- When, during the project life-cycle, can these waste types be expected to arise.

In addition to projecting the waste arising throughout the entire Field Life, the forecast was used to group wastes together that share the same, or similar, waste management characteristics. It should be noted that a large proportion of these totals will be discharged to sea, including cuttings, sewage, grey water, treated oily water and food waste, and therefore, will not require onshore treatment or disposal. These are covered in the drill cuttings and operational discharges chapters (see Sections 10.6 and 10.7 respectively).

Figure 10-46 below shows the waste that requires onshore treatment arising throughout the life of the Development, and from which activity. Figure 10-47 indicates the quantities of wastes going to the varying endpoints. The detailed waste forecast and associated disposal options are summarised in Table 10.85 and Table 10.86.

[87] The Environmental and Emissions Monitoring System (EEMS) is the environmental database of the UK O&G industry.

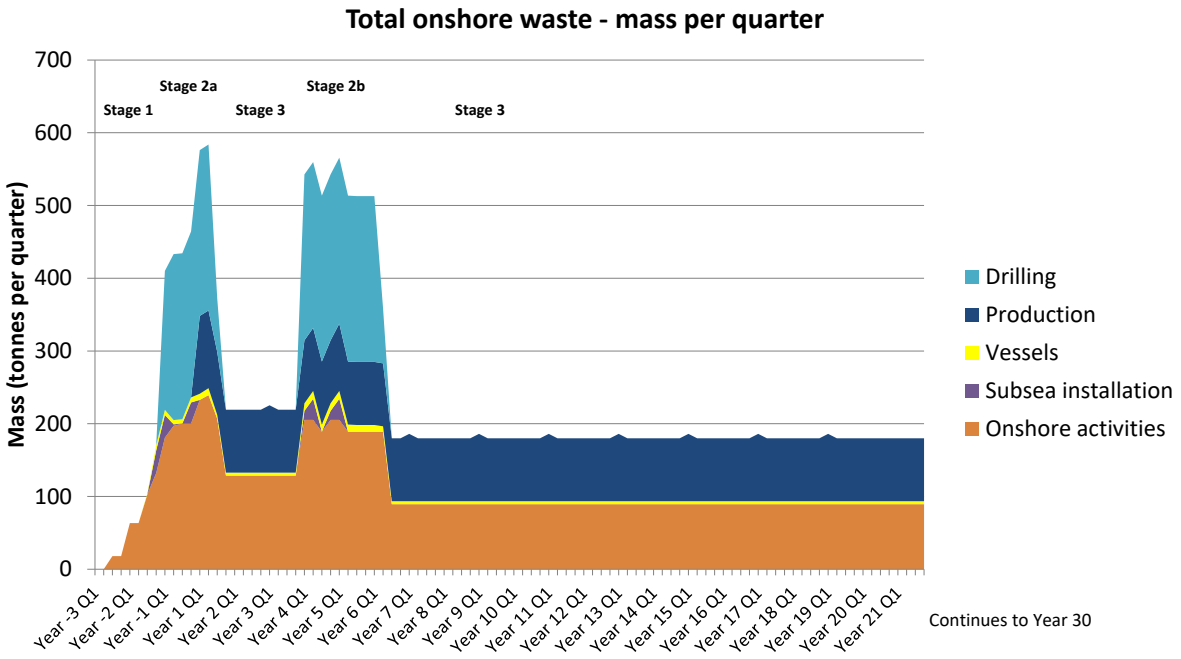


Figure 10-46: Phase 1 & 2 Development wastes managed onshore split by activity generating the waste

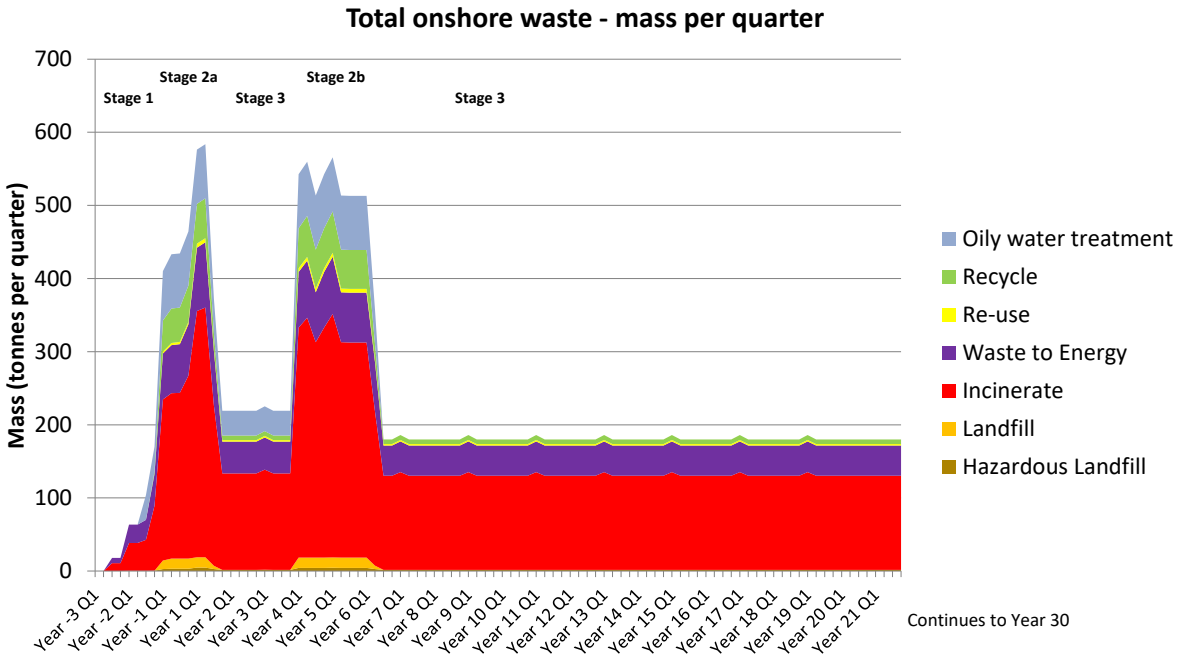


Figure 10-47: Phase 1 & 2 Development wastes managed onshore split by endpoint

Table 10.85: Forecast of hazardous and non-hazardous waste quantities that require onshore treatment, broken down by activity at different stages of the project[1]

Activity	Field life total (tonnes)	% of total	Stage 1	Stage 2a	Initial Stage 3	Stage 2b	Remaining Stage 3
Drilling	3,424	12%	1,071	293	0	2,061	0
Production	10,559	37%	108	194	789	877	8,595
Subsea installation	285	1%	154	0	0	138	0
Vessels	571	2%	42	15	36	97	386
Onshore activities	13,698	48%	1,402	442	1,153	1,941	8,743
Total	**28,537**	**100%**	**2,777**	**944**	**1,978**	**5,114**	**17,724**
% by Stage			**10%**	**3%**	**7%**	**18%**	**62%**

[1] These figures do not include the ash from the incinerator that will be operated by FIG. This waste stream, totaling 1,888 tonnes over the course of the Development, is included in Table 10.86.

Table 10.86: Disposal options for Sea Lion waste streams

Waste stream	Final destination (UK or Falklands)	Disposal method	Estimated quantity over Field Life (tonnes)	Percentage contribution over Field Life
Aerosols and gas cylinders	UK	Recycle / treatment	147	0.5 %
Aluminium and metal	UK	Recycle / re-use	1,450	5.1 %
Batteries	UK	Recycle	20	0.1 %
Bulk hoses	Falkland Islands	Incinerate [1,2]	199	0.7 %
Cardboard, paper and packaging	Falkland Islands	Incinerate [1,2]	793	2.8 %
Chemical sacks	Falkland Islands	Incinerate [1,2]	201	0.7 %
Chemicals	UK	Treatment / hazardous landfill	48	0.2 %
Containers and empty IBCs	UK	Re-use	299	1.0 %
Filters (hazardous)	UK / Falkland Islands	Hazardous landfill / incinerate [1,2]	167	0.6 %
Filters (non-hazardous)	Falkland Islands	Incinerate [1,2]	138	0.5 %
Food[3]/ packaging	Falkland Islands	Incinerate [1,2]	2,887	10.1 %
Flammable solids and solvents	Falkland Islands	Incinerate [1,2]	5,224	18.3 %
General garbage, non-hazardous	Falkland Islands	Incinerate [1,2]	4,755	16.7 %
Glass	Falkland Islands	Re-use	57	0.2 %
Hazardous electrical waste	Falkland Islands	Recover / re-use / recycle	4	0.0 %
Hazardous waste, aerosols, pipe dope	Falkland Islands	Incinerate [1,2]	133	0.5 %
Light bulbs	UK	Recycle	5	0.0 %
Medical	Falkland Islands	Incinerate [1,2]	6	0.0 %
Non-hazardous electrical	Falkland Islands	Recover / re-use / recycle	32	0.1 %

Waste stream	Final destination (UK or Falklands)	Disposal method	Estimated quantity over Field Life (tonnes)	Percentage contribution over Field Life
Oily rags, oily sludge, oily wastes, oily water and WBM washings	Falkland Islands	Incinerate [1,2]	6,510	22.8 %
Other	UK	Landfill	815	2.9 %
Plastics	Falkland Islands	Incinerate [1,2]	952	3.3 %
Printer cartridges	UK	Recycle	16	0.1 %
Slings	Falkland Islands	Incinerate [1,2]	404	1.4 %
Wood	Falkland Islands	Incinerate [1,2]	1,704	6.0 %
Oily water	Falkland Islands	Treat / incinerate	1,571	5.5 %
Total waste			**28,537**	-
Total re-used (UK)			**299**	**1.0 %**
Total recycled (UK)			**1,507**	**5.3 %**
Total incinerated or waste-to-energy (Falkland Islands)			**24,698**	**86.5 %**
Total to landfill (UK)			**462**	**1.6 %**
Total oily water treatment (Falkland Islands)			**1,571**	**5.5 %**
Secondary waste - incinerator ash to landfill[1,2]			**1,888**	-

[1] Ash from the incineration process is the responsibility of FIG.

[2] It is generally expected that ash residues from static hearth incinerators of the type proposed here can vary between 3-10 % of the mass of the input waste (Filkin & Co., 2017). As a worst-case, this assessment assumes 10 % of the mass of waste incinerated is left as ash.

[3] The majority of food waste will be discharged offshore in compliance with MARPOL (Section 10.13.5.1.2) but any food waste returning to the supply base, for example if offshore macerators are not working, would be incinerated unless future opportunities arise in collaboration with FIG for composting of such resources.

10.10.4.5 Phase 1 & 2 waste in the context of the UK

FIG plan to establish a new municipal waste facility that will take the majority of waste from the project. Waste in categories that cannot be managed in the Islands will be shipped to an international location. This section discusses the waste footprint of the entire project in the context of the UK's waste management system.

The UK generated 191.2 million tonnes of total waste in 2020, 20.6 % of which was generated by Commercial and Industrial (C&I) activities (Defra, 2023). The recycling rate was 52.3 % over the UK in 2020, and the proportion sent to landfill was 24.2 % (Defra, 2023).

A summary of the estimated Phase 1 & 2 waste is provided in Table 10.87, alongside the most recent applicable UK waste data (2018-2021 depending on the data). The Phase 1 & 2 Development is predicted to generate a total of 28,537 tonnes of waste (excluding incinerator ash which is secondary to the initial waste volume produced) over the course of the Field Life, with the relative contributions of each Stage also shown in Table 10.87. Notably, the total quantity of waste generated throughout the life of the project (c. 30 years) amounts to 0.01 % of the amount of waste generated in the UK in a single year (2020). Similarly, the Sea Lion waste which may be sent to landfill over the life of the project (462 tonnes) equates to 0.001 % of UK waste which went to landfill in 2020. Assuming that the UK 2020 waste production was to remain consistent over the life of the project, the total Phase 1 & 2 waste would amount to 0.0005 % of the total UK waste tonnage generated in 32 years. When compared to the UK C&I waste alone (Table 10.87) the total Phase 1 & 2 waste generated over 32 years amounts to 0.07 % of the amount of C&I waste generated in the UK in a single year (2020).

Detail on the fate of the North Sea O&G industry wastes is provided in Table 10.88 (OEUK, 2023). These data show 66 % of all waste was reused or recycled, with 9 % of all UK O&G wastes going to landfill as opposed to only 1.6 % of Phase 1 & 2 waste. However, it should be noted in this comparison that the O&G waste industry figures reflect a mature and well established industry so waste options that are

feasible and well-used in the UK may not be directly applicable to the same waste streams generated in the Falklands.

Table 10.87: Summary of wastes produced during the Phase 1 & 2 Development Stages 1 to 3 in comparison to total UK waste, total UK C&I waste and total UK waste to landfill

Waste source		Total Quantity (tonnes)	Average quantity per year (tonnes/year)[1]	Percentage contribution
Stage 1	Drilling, onshore construction, installation (31 months)	2,755	1,066	10 %
Stage 2a	Drilling, installation, First-Oil and initial production (7 months)	956	1,639	3 %
Stage 3 (initial)	Steady production (28 months)	1,979	848	7 %
Stage 2b	Drilling, installation, ongoing production (28 months)	5,135	2,201	18 %
Stage 3 (remaining)	Steady production (*c.* 27 years)	17,711	654	62 %
Totals		**28,537**	-	-
Total UK waste 2020[2]		**191,200,000[1]**		
Total UK commercial and industrial (C&I) waste 2020[2]		**40,400,000**		
Total UK waste that went onto or into land in 2018[2]		**46,270,400**		

[1] Note: Stage 2a is less than one year, so the total for Stage 2a is less than this figure.
[2] Note: these data are as is reported by Defra (2023).

Table 10.88: Comparison of the fate of O&G industry wastes

Fate of waste	North Sea O&G industry waste in 2022[1]		Quantity (t) of Phase 1 & 2 Development waste (excl. incinerator ash)		
	Quantity (t)	As a percentage of the North Sea 2013 total	Total waste over project life	Average waste per year	As a percentage of Sea Lion total waste for one averaged year
Re-use and Recycling	92,000	66 %	1,806	55.4	6.3 %
Waste to energy[2]	7,500	5 %	5,818	178.5	20.4 %
Incinerate	500	0.4 %	18,881	579.0	66.2 %
Landfill	13,000	9 %	462	14.2	1.6 %
Other route[3]	26,000	19 %	1,571	48.2	5.5 %
Total	**139,000**	-	**28,537**	**875**	-

[1] As extracted from OEUK HSE Report rounded to 500 tonnes (OEUK, 2023).
[2] Waste-to-energy refers to the process of generating energy in the form of electricity and / or heat from the primary treatment of waste.
[3] Other disposal routes include but are not limited to: land treatment, specially engineered landfill, biological treatment, injection. Other recovery routes include but are not limited to: use as a fuel, used oil refining, land treatment resulting in benefit to agriculture or ecological improvement (EC Regulation No 1013 / 2006 on the Shipment of Waste, Annex 1a).

10.10.5 Industry-standard mitigation

Industry-standard mitigations available include:

- Development of a voluntary 'Environmental representative / steward' (E-Rep) role among the offshore and supply base personnel,
- Waste awareness training and inclusion of a clear message in all personnel inductions,
- Segregated and coloured / clearly labelled bins,
- Signage,
- Contained waste receptacles,
- Use of netting over open skips,
- Dedicated waste laydown areas, and
- Reporting of loss of waste incidents to FIG.

An example of an educational poster is shown in Figure 10-48 which encourages the containment of waste and, in particular, the cutting of packaging bands so that they do not entangle seals and sea lions in the event that they are lost to sea.

There are also a number of standard management practices which will be followed. These are:

- Compliance with the Navitas OMS with regard to contractor management, auditing, performance monitoring and the setting of waste objectives and targets,
- Development of, and adherence to, the Waste Management Plan (see below),
- Minimisation of waste through contracting and logistics strategy,
- International Finance Corporation (2007) Environmental, Health, and Safety General Guidelines, and
- UK HSE guidance HSG71 for storage of wastes.



Figure 10-48: Example of an educational poster for placement around the MODU and FPSO

10.10.5.1 Waste Management Plan

In compliance with the FIG Guidance Note (02/13), a Waste Management Procedure has been developed, which will be used to develop the project-specific WMP has been developed and will be further refined for operations. It will provide guidance on efficient working practices for the safe handling, storage, transportation and disposal of waste generated during the Phase 1 & 2 Development.

Specifically, the WMP will detail:

- Key roles and responsibilities of Navitas personnel and contractors with regard to waste management,
- The regulatory and EMS guidelines upon which the WMP is based,
- The Waste Hierarchy used to minimise the amount of waste disposal and maximise recovery (Figure 10-45 above),
- Definition of waste types, and
- Guidance on all aspects of waste management.

10.10.6 Impact and risk assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities. Assessment of unplanned events includes an assessment of the 'Likelihood of Occurrence' to determine the 'Risk'.

A summary of the impact and risk assessment outcomes is tabulated in Section 10.10.12 which shows the worst-case impact / risk for each activity and receptor.

10.10.6.1 Impact assessment of waste generation and management

10.10.6.1.1 Shipment of waste

Arrangements for the temporary storage of waste awaiting transhipment in the Falklands will be agreed with and approved by FIG. Navitas will collaborate with FIG and other stakeholders to plan all shipments, thus maximising their efficiency. While the use of the FIG municipal incinerator should reduce the number of waste shipments to the UK, thus reducing the emissions, it has been assumed that all *ad hoc* freighter vessels will remain on hire to Navitas to return the waste to the UK to assume a worst-case. The impact of all emissions resulting from the Phase 1 & 2 Development is assessed in Section 10.9.

10.10.6.1.2 Use of regulated landfill

Landfill occupies the lowest rank in the Waste Hierarchy and it is understood that this method of waste management is ultimately unsustainable. However, as waste that cannot be incinerated in-country will be returned to the UK, and most likely Scotland which has consented landfill space available for 10-20 years (Section 10.10.4.5), the sensitivity of UK landfill sites as a receptor (tangible property) is considered to be '**High**'.

It is currently uncertain how long shipping waste back to the UK will be necessary and / or permissible. However, as is shown in Section 10.10.4.5, only 1.6 % of Phase 1 & 2 waste is expected to go to landfill, which is less than the 9 % of waste from the UKCS as a whole (Table 10.88). In addition to the efforts made to reduce and recover waste, this percentage volume has been lessened due to the incinerator which aims to minimise the volume of materials being returned to the UK. Overall, the total estimated quantity of waste from the Phase 1 & 2 Development that will be sent to landfill amounts to only 0.001 % of the UK waste sent to landfill in 2020 alone (Section 10.10.4.5), and 0.07 % of the UK C&I waste

produced in 2018. As such, this landfill use falls within the category of 'Minimal use of a finite resource throughout lifecycle of project or moderate use for finite stages of the project' and, on balance, the severity of effect on landfill resources for the duration of the Development is considered to be '**Minor**'.

Therefore, the overall significance of the transboundary impact of large amounts of waste over the Project lifetime on tangible property in the UK is assessed as '**Moderate (8)**'.

10.10.6.2 Risk assessment of unplanned and accidental events

10.10.6.2.1 Loss of containment

Given that waste mismanagement and loss of containment would be an unplanned event, it is not possible to estimate which of the potential receptors may be affected by any given event. Therefore, for the purposes of the assessment below, the most sensitive receptor is described to ensure a worst-case assessment has been made.

10.10.6.2.1.1 Impacts to landscape

Assessment of the impacts on landscapes / seascapes, and the indirect impact upon the 'quality of experience' of the human population, is very subjective and almost impossible to quantify. The sensitivity of the receptor will ultimately depend upon the volume of waste accidently lost to the environment, the waste type and the path and final destination of the waste. However, with regard to landscape and seascape, impacts of losses are only likely to result from waste mismanagement at the supply base such that the range of probable destinations would be limited (Section 10.10.4.1.2.1).

Nonetheless, waste could reach areas which are 'partially developed with non-industrial infrastructure which are used for recreational purposes and tourism' and therefore litter could 'conflict with the current use of the area'. The sensitivity of the landscape / seascape as a receptor is therefore considered to be '**High**'. Similarly, with regard to the human population as a receptor, the littering of valued and / or sensitive areas may be considered 'unacceptable to a majority of stakeholders'. Therefore, to assume the worst-case, the sensitivity of the receptors is considered to be '**High**'.

Given the transient nature of litter, the impact of lost materials in any given place may not be permanent as the material may move from place to place under the influence of wind, tide, scavenging fauna and / or may be picked up by a passer-by. Despite the temporary location of the litter however, unless it is collected and appropriately disposed of, the litter itself may be permanent unless it is biodegradable and may impact upon the view from close range. Therefore, the severity of effect in any given time and place is considered to be '**Minor**'.

The worst-case overall significance of the impact of waste mismanagement to landscape / seascape is be considered to be '**Moderate (8)**'.

Once accidentally released into the environment, it is not realistic to suggest that the lost materials can be immediately recovered and it is therefore key to prevent its release. Implementation of the WMP and the use of closed skips (Section 10.10.5) will minimise the likelihood of losses. Additionally, the implementation of the measures described in Section 10.10.5 to achieve early and sufficient containment of waste will hopefully ensure that all personnel are informed and trained on the importance of effective waste containment. The likelihood of loss of containment is considered '**Unlikely**'.

Therefore, the overall significance of the risk to landscape / seascape associated with loss of containment is therefore considered to be '**Low (6)**'.

10.10.6.2.1.2 Impacts to wildlife

As with the impacts to landscape and seascape, it is not possible to predict the fate of litter and which animals it may impact upon, or how many times. However, given that impacts may occur to a protected

species and / or those within a globally important population, which may also be long-lived species with a slow reproduction rate, or during a vulnerable life stage (e.g., during breeding), it has been estimated that the sensitivity of the receptor could be '**Very High**'.

While the effect of litter on wildlife can be fatal (Section 10.10.4.1.2.1), the impacts are likely to affect individual animals rather than groups of animals such that, in most cases, the impact would be unlikely to be detectable above background variability, or to impact upon population fitness. Therefore, the severity of effect to most receptors is likely to be 'Slight' and the overall impact significance 'Low (6)'. However, in the event that a long-lived, slow breeding species was impacted by ingestion or entanglement, such as albatross sp., there is the possibility that this could impact upon the population fitness. To take a precautionary approach therefore, the severity of effect is considered to be '**Minor**'.

Therefore, the worst-case significance of the impact of waste mismanagement is assessed to be '**Moderate (10)**'.

As described above regarding the way waste may be lost, the likelihood of loss of containment occurring is considered to be '**Unlikely**'.

The overall significance of the risk to wildlife associated with loss of containment is therefore considered to be '**Low (6)**'.

The risks of unplanned release of hazardous liquid waste are considered in Section 12.1.

10.10.6.2.2 Improper waste segregation

Assuming that normally recoverable waste was cross-contaminated with hazardous waste through poor segregation, and thus had to be disposed of (rather than recovered), this may have an effect on resource use, such as landfill. Therefore, to take a precautionary approach and assume the unnecessary use of this finite resource, the sensitivity of the receptor is considered to be '**Very High**'.

It is not possible to estimate the extent of any impact as cross-contamination may affect one piece of scrap metal, which could be cleaned, or an entire skip full of plastic packaging or wood. However, given that improper segregation would be an unplanned event and that waste management will be regularly audited in line with the OMS, it can be assumed that the quantities of cross-contaminated waste will be relatively small. Therefore, it is likely that disposal to landfill as a result of cross-contamination will have 'no or negligible use of finite resource throughout lifecycle of project' and therefore the severity of effect is likely to be '**Slight**'.

Therefore, the worst-case significance of the impact of improper segregation could be considered to be '**Low (5)**'.

Implementation of the WMP (Section 10.10.5.1) will ensure that sufficiently labelled waste skips and bins will be in place on the MODU / FPSO. Nonetheless, taking a precautionary approach given that such an incident could occur through negligence by an individual, the likelihood of the event occurring is '**Possible**'.

The overall significance of the risk associated with improper segregation is therefore considered to be '**Low (6)**'.

10.10.7 Project-specific mitigation measures

While some environmental impacts are 'Low' or 'Very Low' such that no further mitigation measures are considered necessary, the following impacts and risks were all considered to be '**Moderate**', and therefore require further mitigation efforts where possible:

- The use of landfill resource in the UK.

10.10.7.1 Mitigating impacts to landfill

Although landfill space may be available over the life of the field (Section 10.10.4.5), landfill is inherently unsustainable and occupies the lowest level in the Waste Hierarchy.

It is therefore necessary to determine ways to further reduce the volume of waste that may be destined for landfill. While the use of an incinerator has been proposed and is included within the initial impact assessment, it will always be necessary for responsible operators to identify other reasonably practicable means for reducing the waste to landfill, and indeed the overall impacts of waste.

Industry-standard practises and the OMS requirements, which aim to ensure continual improvement, are such that no additional mitigation measures are considered reasonably practical in reducing waste quantities at this time.

Note: even in the event that new landfill facilities became available in the Islands, this would not lessen the sensitivity of landfill as a receptor as disposal to landfill, wherever it is located, will always be fundamentally unsustainable.

10.10.7.2 Mitigating impacts from loss of containment

Industry-standard practises and the OMS requirements, which aim to ensure continual improvement, are such that no additional mitigation measures are considered reasonably practical in reducing risks from the loss of containment of waste at this time.

10.10.8 Residual impacts and risks

10.10.8.1 Residual impact of landfill use

There will always be some wastes that cannot be incinerated, e.g., some recyclable wastes and specialty wastes which have to go to landfill, and whether these are transported to the UK, or taken to a new in-country facility in the future, landfill will always be fundamentally unsustainable in the long-term such that the sensitivity of the receptor (landfill) must remain 'High'. The only way to reduce the impact of landfill use is to find opportunities for waste management which sit higher up in the Waste Hierarchy, thus reducing the reliance on landfill and the severity of effect.

Since there are no current plans for new landfill capacity on the Falkland Islands, the residual impact remains '**Moderate (8)**'.

10.10.8.2 Residual risk of loss of containment

Not applicable.

10.10.9 Cumulative impact

10.10.9.1 Landfill use

While application of the Waste Hierarchy will maximise the reduction, re-use, recycling and recovery of waste (including waste-to-energy), the use of landfill sites in the UK, for a proportion of the waste will still be required which may have a cumulative effect in terms of concentration, extent and duration of waste (Section 8.9.1). While the contribution to landfill from the Phase 1 & 2 Development in isolation is relatively low in the UK context (Section 10.10.4.5), and is lower than the average waste to landfill from UKCS operations, the impact significance is considered 'Moderate', primarily owing to the sensitivity of the receptor, i.e., the unsustainability of the resource.

While Navitas will endeavour to reduce this impact by minimising waste to landfill, it has very limited control over the cumulative and indirect impacts caused by landfill e.g., methane gas production from

decomposition. However, all landfill sites in the UK are governed by numerous pieces of legislation to ensure that they are managed in accordance with best practice.

10.10.9.2 Incinerator use

As stated above, FIG have approved plans for a new municipal waste facility and the project will only provide stand-alone incineration in the event that the FIG site is not available. However, with regard to air quality, the siting of the supply base incinerator is not considered to add cumulatively to any impacts already present from the FIMCO incinerator due to their relatively distant locations.

10.10.10 Confidence

The magnitude, extent, reversibility, duration and frequency of the impact of waste generation and management are well understood from previous projects.

One uncertainty in the assessment of the onshore disposal and recovery of waste is that the waste quantities are estimated based on development wells and production in the North Sea. It is also recognised that whilst the exact incinerator product to be used is not yet defined, representative proven models of the type proposed have been used for assessment purposes. To take a precautionary approach confidence in the assessment of all the impacts is considered to be '**Probable**'.

Confidence in the risk assessments for waste mismanagement is '**Certain**'.

10.10.10.1 Monitoring required

Monitoring of waste and compliance with the WMP will occur via:

- Pre-hire audit, and ongoing audits of the MODU and other project vessels to ensure tanks and pits provide flexibility for managing fluids to minimise pit cleaning or other liquids and to ensure waste segregation is being managed,
- Ensuring the contracting strategy with key suppliers incentivises waste minimisation and features in Key Performance Indicators (KPIs) e.g., *via* ISO14001 compliance,
- Weekly inspection of storage facilities in line with the WMP inspection checklists and use of the Navitas Corrective Action list where non-conformances cannot be immediately remedied,
- Monitoring of performance by the E-Rep on the MODU and FPSO and supporting ongoing waste initiatives,
- Internal Navitas waste reporting e.g., monthly provision of the Waste Disposal Logs, reporting of non-conformances or spills and corporate waste reporting and monitoring *via* KPIs,
- Waste reports will be made available to the appropriate regulatory bodies as required,
- The requirement to audit / assess waste contractors (Section 3.2.13) and track actions in corporate systems,
- Reporting any losses of waste to the environment, and
- Transfrontier shipment of waste notification controls.

Detailed monitoring requirements were established during the project-specific Phase 1 & 2 Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the EMMP. An outline EMMP is provided in Chapter 15.

10.10.11 Offsetting

For significant residual and impact and risks ('Moderate' or above), offsetting *via* a Carbon and Biodiversity Offsetting Fund is proposed, see Section 8.11 for further details.

10.10.12 Findings summary

Table 10.89: Summary of the impact assessment for waste management during the Phase 1 & 2 Development

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance a		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Offshore, inshore, onshore and at-shore operations and activities	Waste generation for disposal to landfill in the UK (worst-case)	Use of a finite resource, risks to groundwater, aquifers and soil, production of methane	Planned	1, 2a, 2b & 3	High	Minor	n/a	**Moderate (8)**	**Moderate (8)**	**Probable**	**Industry-standard:** Compliance with the Navitas OMS with regard to contractor management, auditing, performance monitoring and the setting of waste objectives and targets **Project-specific:** Use FIG facility
	Loss of containment	Impact to landscape / seascape, and quality of experience of valued sites	Unplanned	1, 2a, 2b & 3	High	Minor	Unlikely	**Low (6)**	**n/a**	**Certain**	**Industry-standard:** As above, and E-Reps scheme, waste awareness training, segregated bins, signage, netting, dedicated waste laydown areas. **Project-specific:** None proposed.
Offshore, inshore, onshore and at-shore activities	Loss of containment	Impacts to wildlife, ingestion of waste by marine fauna or entanglement	Unplanned	1, 2a, 2b & 3	Very High	Minor	Unlikely	**Low (6)**	**n/a**	**Certain**	
	Improper waste segregation	Loss of opportunity for waste recovery and increased use of landfill	Unplanned	1, 2 & 3	Very high	Slight	Possible	**Low (6)**	**n/a**	**Certain**	

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

10.11 Collision / entanglement between cetaceans, vessels and moorings

Table of Contents

10.11.1 Introduction 921
10.11.1.1 Legislation and guidelines regarding collision with marine mammals 921
10.11.2 Sources of potential risk 921
10.11.2.1 Shipping and collision risks 921
10.11.2.2 Entanglement risks 922
10.11.3 Potential receptors 923
10.11.4 Characterising and quantifying the risk of collision 923
10.11.4.1 History of cetacean collisions in the Falkland Islands 923
10.11.4.2 Potential impacts of vessel and cetacean collisions 924
10.11.4.3 Cetacean behaviour, abundance and distribution 924
10.11.4.3.1 Southern right whale 925
10.11.4.3.2 Sei whales 926
10.11.4.4 Vessel behaviour 927
10.11.4.4.1 Effect of vessel size and speed on collision impact and likelihood 927
10.11.4.4.2 Effect of vessel distribution on collision likelihood 928
10.11.4.5 Overlap in Phase 1 & 2 vessel traffic and cetacean distribution 929
10.11.5 Industry-standard mitigation measures 930
10.11.6 Risk assessment 931
10.11.6.1 Risk of collision during drilling, installation and production (offshore) 931
10.11.6.2 Risk of collision in Berkeley Sound (inshore) 932
10.11.7 Project-specific mitigation measures 932
10.11.8 Residual impacts and risks 934
10.11.8.1 Risk of collision during drilling, installation and production 934
10.11.8.2 Risk of collision during inshore operations 935
10.11.9 Cumulative impact 935
10.11.10 Confidence 935
10.11.10.1 Monitoring required 935
10.11.11 Offsetting 936
10.11.12 Findings summary 936

10.11.1 Introduction

Numerous vessels will be used throughout the three Stages of the Phase 1 & 2 Development and while the use of vessels is planned, it is necessary to consider the risk of collision with cetaceans (whales and dolphins). Internationally, it is believed that collisions between cetaceans and vessels are more frequent than previously suspected (WDCS, 2006). Such an increase in the risk of collisions is linked to a general increase in the density of shipping traffic, the number of large fast-moving vessels (Silber, *et al.,* 2009) and the continuing recovery of large cetacean populations following the cessation of whaling.

Concern about vessel collisions with marine animals is increasing worldwide. However, most publications focus on larger whales. While Schoeman *et al.* (2020) found that smaller animals are also affected and recommend the establishment of a species-specific necropsy protocol and a database for smaller species, there is a paucity of documented evidence / data on vessel collisions and smaller cetaceans generally. In the Falklands Islands, recent collisions have been reported with sei whales and a Commerson's dolphin (Falklands Conservation, 2020). However, there is little detail on the circumstances. Anecdotally the collision with the dolphin was with a fast-moving launch. According to van Waerebeek *et al.* (2007), most collisions between small cetacean and vessels tend to occur in enclosed inshore, estuarine or freshwater environments where there is a high-density of smaller fast-moving vessels. Navitas will use large ocean-going vessels in Berkeley Sound and in the Sea Lion Field and for this reason, collisions with small cetaceans are not considered further in this chapter.

This chapter specifically assesses the risk of collision between the Phase 1 & 2 Development vessels and large cetaceans. Specifically, the risk of collisions between cetaceans and vessels during the offshore operation and during transit to and from Stanley. Few vessels will visit other inshore waters e.g., Berkeley Sound. These are limited to the arrival and departure of up to four Large Transit Vessels with only two *in situ* at any one time, both of which will be stationary for the majority of the duration, and infrequent visits (*c.* 11) to the Large Transport Vessels (LTVs) by the Offshore Construction Vessels (OCVs) over the course of Stages 1 and 2.

Note: The other impacts associated with vessel use are described elsewhere in this document, as described in Table 2.2.

10.11.1.1 Legislation and guidelines regarding collision with marine mammals

Currently, there is no dedicated legislation in the UK or the Falkland Islands to protect cetaceans from ship-strike specifically. However, marine mammals are protected from deliberate harm by the:

- UK Offshore Marine Conservation (Natural Habitats & Conservation) Regulations 2001.
- Falkland Islands Marine Mammals Ordinance 1992.
- Conservation of Wildlife and Nature Ordinance (1999).
- Cetacean code of conduct for the Falkland Islands (Falklands Conservation, 2020).

10.11.2 Sources of potential risk

10.11.2.1 Shipping and collision risks

During the Phase 1 & 2 Development, shipping traffic will increase as a result of:

- Arrival and positioning of the Mobile Offshore Drilling Unit (MODU),
- Delivery and installation of the subsea moorings and production facilities,
- Arrival and positioning of the Floating Production, Storage and Offloading vessel (FPSO),
- Hook-up and commissioning of the FPSO,
- Emergency support for the MODU and FPSO,

- Supply of cargo to the Falkland Islands,
- Supply of cargo to the MODU and FPSO,
- The arrival and departure of the Large Transit Vessels (LTVs) to Berkeley Sound,
- The transit of OCV's between the LTVs in Berkeley Sound and the Sea Lion Field, and
- Conventional Trading Tankers (CTT) receiving crude oil from the FPSO at the Sea Lion Field.

A summary of vessel use during Stages 1, 2 and 3 is given in Table 10.90. A full inventory of the vessels used during Stages 1 to 3 of the Development is provided in Section 5.11.2.

The behaviour of these vessels will depend upon their specific roles e.g., cargo delivery *vs.* emergency support *vs.* oil export and the frequency of vessel movements will vary depending on the Stage of Development.

Table 10.90: Summary of the vessels to be used during each stage of the Phase 1 & 2 Development

Stage 1	Stage 2a/2b	Stage 3
MODU transit to field Anchor Handling Tug Supply (AHTSs) Vessels Multi-Role Support Vessels (MRSVs) Platform Supply Vessels (PSVs) Emergency Response and Rescue Vessel (ERRV) *Ad hoc* freighters FPSO transit to Sea Lion Field (towed by 3 tugs) Positioning and presence of FPSO on location with 1,275 m radius exclusion zone Large Transport Vessels (LTVs)[1] Offshore Construction Vessels (OCVs)[1]	MODU transit in-field AHTSs ERRV *Ad hoc* freighters PSVs FPSO on location with 1,275 m radius exclusion zone Oil export vessels: Purchaser's Conventional Trading Tanker (CTT) MRSV ERRV LTVs OCVs	FPSO on location with 1,275 m radius exclusion zone Oil export vessels: Purchaser's Conventional Trading Tanker (CTT) MRSV ERRV PSVs *Ad hoc* freighters

[1] These vessels arrive in Berkeley Sound in the final month of Stage 1 in preparation for Stage 2a.

10.11.2.2 Entanglement risks

Entanglement with marine mammals may result from the:

- Use of anchor chains offshore for the FPSO / MODU,
- Presence of risers in the water column, and
- Use of anchor chains inshore for the LTVs.

There is a good deal of literature involving cetacean entanglements, however much of this involves fixed and static fishing gears, such as various types of nets and the cables used to attach floats to lobster and crab traps (e.g., van der Hoop, *et. al*., 2016; Frisch-Jordán and López-Arzate, 2024). One of the key properties with fishing lines is that there is usually a considerable amount of slack in the lines and they are generally of a small gauge. This slack enables the lines to wrap around whale body parts, which ultimately leads to entanglement and often drowning.

However, the various mooring lines, chains and cables associated with large ships, the MODU / FPSO and subsea engineering would be taut under most circumstances and would not have enough slack to allow cetaceans to become entangled. It is understood that there are no records for entanglements with large anchor chains or indeed flow lines from sub-sea engineering to FPSOs such as risers. In addition, reviews conducted on mooring systems for offshore renewable installations have found a lack of information on entanglement (Kropp, 2013). Harnoise *et al.* (2015) defines a methodology to

compare different offshore renewable energy mooring configurations in terms of the risk of entanglement they present to marine megafauna and conclude that the absolute risk of entanglement is low, regardless of the mooring configuration. They concluded that that the taut configuration has the lowest relative risk.

Considering the gauge of anchors chains for ships (Berkeley Sound) and the MODU / FPSO (at the Sea Lion Field), and the risers to the FPSO coupled with the lack of evidence for entanglement in the literature this risk is not assessed further within this chapter.

10.11.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify the specific receptors to which the risk of collision warranted further investigation (Chapter 9). The receptors that may be subject to the risk of collision during the Phase 1 & 2 Development include a wide range of large cetacean species that are known to occur within Falkland Islands waters (Section 7.4.6).

Small cetaceans (dolphins) are fast moving and agile enough to avoid vessels travelling at moderate speed and are likely to be at greater risk from small fast-moving craft rather than those associated with the Development. Indeed, some species, such as Peale's dolphin (*Lagenorhynchus australis*) and Commerson's (*Cephalorhynchus commersonii*), are attracted to large vessels to bow-ride. There is only one mention of a collision between a vessel and a Commerson's dolphin in the 'Cetacean code of Conduct for the Falkland Islands' (Falklands Conservation, 2020) and therefore such collisions are likely to be a rare event. In addition, FIG do not maintain a cetacean collisions database and thus there are no records. For these reasons, small cetaceans are not considered further in this assessment, which explores only the risk of collisions between Phase 1 & 2 vessels and large cetaceans (whales).

10.11.4 Characterising and quantifying the risk of collision

When characterising and quantifying the risk of collisions between large cetaceans and vessels during the Phase 1 & 2 Development, it is necessary to consider:

- The history of cetacean collisions in the Falkland Islands,
- The potential impacts of vessel and cetacean collisions,
- Cetacean behaviour, population and distribution,
- Vessel size, speed, behaviour and distribution, and
- Overlap between Phase 1 & 2 vessel traffic and cetacean distribution.

10.11.4.1 History of cetacean collisions in the Falkland Islands

The Falkland Islands Species Action Plan (SAP) for Cetaceans[88] identifies a number of potential threats to cetaceans. The old SAP (FIG, 2008b) did not regard ship-strike to be a problem in the Falklands and there are no known records of fatal collisions between vessels and cetaceans in the region. However, anecdotal records of collisions (e.g., those described in Weir, 2017; Sei Whale CMP, 2024) will be considered within the new cetacean SAP which is currently being developed.

Although there are numerous records of beached cetaceans (of 26 species) (Augé, *et al.,* 2018), the likely cause of death is not recorded and it is not known how many of these animals were examined for signs of ship-strike. Equally, it is unlikely that all cetaceans that die at-sea in Falkland waters strand on Falklands beaches and given the prevalence of ship-strike elsewhere in the world, it seems likely that there will have been some incidents in the past that have gone undetected, or have not been reported.

[88] Note that this document (FIG, 2008b) expired in 2018 and a new draft is currently under development and will provide more data on collisions.

10.11.4.2 Potential impacts of vessel and cetacean collisions

Globally, collision between marine mammals and vessels has become an increasingly important issue (WDCS, 2006) with the potential to impact upon individuals and / or populations.

In the event that a collision was to occur, the individual animal may suffer:

- Lethal injury (Figure 10-49a),
- Injury leading indirectly to death e.g., owing to an inability to feed, loss of impulse to feed,
- Injury with unknown longer-term impact (Figure 10-49b), or
- Injury leading to reduced fitness e.g., breeding success.

Depending upon the health of the population, all of the above may ultimately impact upon the population of a species, and for a rare species, loss of an individual may be a significant contributor to population decline.

For example, the impact of collisions with vessels is thought to be threatening the survival of the northern right whale (*Eubalaena glacialis*), which is an IUCN (International Union for the Conservation of Nature) 'Critically Endangered' species (NMFS, 2005). Further, interactions between fin whales and ships in the Mediterranean Sea are also causing concern (Vaes and Druon, 2013) and Berman-Kowalewski *et al.* (2010) report interactions between blue whales and shipping off the coast of California.



a) Baleen whale following collision with vessel *(Source: https://friendofthesea.org)*



b) Baleen whale following ship collision *(Source: https://oceanwidescience.org/whalevessel-collision-study)*

Figure 10-49: Images of lethal and sub-lethal injuries to baleen whales following vessel collisions

10.11.4.3 Cetacean behaviour, abundance and distribution

The behaviour, abundance and distribution of individual species all affect both the impact that collisions can have, and the likelihood of occurrence. For example, where a population size is in decline, an individual strike will be of greater significance than for a population with high abundance. With regard to behaviour and distribution, a range of factors are thought to influence the likelihood of a collision (Table 10.91).

Therefore, when assessing the impact and the likelihood of cetacean collisions it is important to consider:

- The size and trends of the relevant whale populations and whether or not they are in decline, thus influencing the impact of a single collision at the population level, and

- The known behaviour of different species which can make individuals of a particular species more likely to be involved in a collision.

Large cetaceans, albeit at lower densities, can be encountered anywhere within Falkland Islands waters (White, *et al.,* 2002). However, the number of large cetaceans encountered within Falkland Islands waters varies on a seasonal basis, with highest densities encountered in the coastal waters during the summer and autumn for sei whales and winter for southern right whales.

Although the evidence is anecdotal, the number of large cetaceans in Falkland Islands waters, and elsewhere in the south-west Atlantic, appears to be increasing (Frans and Augé, 2016). While all marine mammals in Falkland Islands waters are protected and have been identified as priority conservation species (FIG, 2008a), two species that are encountered in the coastal waters of the Falklands are most likely to be susceptible to collision. These are:

- Southern right whales, due to their behaviour and abundance, and
- Sei whales owing to their abundance.

Table 10.91: Summarising the effect of cetacean behaviour and distribution on the likelihood of collision

Factor	Description
Age and condition	A high proportion of the recorded incidents relate to young animals or females with calves.
Swimming speed	Each species will display characteristic behaviour in terms of swimming speed and time spent on the surface.
Congregation	At certain times, animals may congregate in areas to feed or breed. The risk of colliding with an animal where high densities occur is increased.
Distribution	Where animals show a tendency to distribute themselves in areas which are also used by shipping traffic, the risk of colliding may increase.
Feeding / mating behaviour	Animals engaged in feeding or mating behaviour are less likely to respond to an approaching vessel. Also, many large whales feed on planktonic organisms in the surface layers of the water. Therefore, feeding animals may spend longer on or near the surface than those that are travelling. Most planktonic organisms perform a daily vertical migration, being closer to the surface at night. Therefore, cetaceans may be more vulnerable at night when feeding near the surface and undetectable by watch keepers on vessels.
Vessel habituation	Animals that are constantly subjected to vessel noise may become habituated and not respond to an approaching vessel.

10.11.4.3.1 Southern right whale

The size of the southern right whale population that breeds off the Argentine coast is well studied and tripled since 1999 to 2006. The rate of increase decreased from near 7 % in 2007 to 0.06 % and 2.30 % for total number of whales and number of calves, respectively for 2016 (Crespo, *et al.,* 2019). Until the winter of 2017, in the Falklands, southern right whales were only occasionally seen in inshore waters and even in Stanley Harbour (A. Black, *pers. obs.*; Baines and Weir, 2020). Although right whales were known to be present within Falkland Islands waters throughout the year, acoustic and visual surveys indicated that their numbers were highest in the spring and summer months, However, during the winter of 2017 an influx of southern right whales was witnessed (Section 7.4.6.3.1.1). It should be noted however, that 2017 was the year that empirical survey effort started and therefore it is difficult know what their abundances were in preceding years.

With regard to their behaviour and distribution, right whales appear to be particularly vulnerable to collision strike because they:

- Aggregate in nearshore waters around the Falklands coast during winter (but occur offshore year-round),
- Spend prolonged periods near the surface,
- Are particularly buoyant and slow moving, so can be slower to react to approaching vessels than many other whales, and
- Tend not to react to approaching vessels when engaged in some behaviours (especially mating and socialising winter aggregations).

10.11.4.3.2 Sei whales

Although the occurrence of this species has been erratic in the past (showing considerable inter-annual variation), the sei whale is by far the most numerous species of large whale in coastal waters near Stanley during the summer and autumn months (White, *et al.,* 2002; FIG, 2008b; Thomson and Munro, 2014; Weir, 2017; Baines and Weir, 2020; Weir, *et al.,* 2021; Cerchio and Weir, 2022). While the results of photo-identification are emerging (Weir, 2022) there is not sufficient survey data to determine an accurate population estimate, although there is anecdotal evidence that the number within Falklands' waters, and more generally within the south-west Atlantic, is increasing (Iñíguez, *et al.,* 2010).

Sei whales are currently listed as 'Endangered' on the IUCN Red List and are also afforded conservation status and management under CITES (Convention on the International Trade in Endangered Species) and CMS (Convention on Migratory Species).

The International Whaling Commission (IWC) indicate that mortality of >2 % of any population would be unacceptable and the loss of 1 % of the population estimate would be cause for concern (IWC, 2014b). The size of the population in Falkland Islands waters is unknown however and therefore local incidental mortality limits cannot be set.

With regard to their behaviour, while there are records from around the world of collisions between sei whales and vessels (IWC database, 2014b) they are considered to be at lower risk than most other large whale species (e.g., fin whales, sperm whales and southern right whales) (Vanderlaan and Taggart, 2007). This is primarily because they:

- Appear to respond to approaching vessels,
- Are relatively fast swimmers, and
- Tend to swim just below the surface leaving a clear trail of 'fluke prints' in their wake, which are conspicuous in calm weather (Sea Watch Foundation, 2012).

Nonetheless, the risk of collision can be increased when they:

- Occur in high densities in nearshore waters during summer and autumn, including in Berkeley Sound,
- Use nearshore waters as a foraging habitat, where their focus on feeding may make them less responsive to vessel, and
- When they surface skim- and lunge-feed (Segre, *et al.,* 2021) and spend prolonged periods moving slowly near the surface.

It should be noted that elsewhere in the world sei whales are considered to be an offshore species; however, in the Falklands this species is associated with relatively shallow inshore waters.

The initial results of observations recording the dive behaviour of sei whales (Weir, *et al.,* 2018) indicate that this species is highly mobile with estimated average speeds of 3.5 - 8.3 km/hr. Combined with relatively inconspicuous behaviour on the surface, these parameters make sei whales relatively

difficult to detect visually, which supports observations made by other observers regarding the difficulty of seeing these animals at-sea (A. Black, *pers. obs.*).

Much of Falkland Islands inshore areas are registered as a Key Biodiversity Area (KBA) (Section 7.5.2.3.4). Two major assessments have occurred to assess whether particular areas of the Falkland Islands inshore marine environment contain populations of species which trigger the global KBA criteria. This work occurred as of September 2021. The assessments were for sei whales and breeding seabirds. This process concluded that 10 species have populations which trigger global KBA criteria and, notably within this context, sei whales. For full details about the assessments for sei whales please see Weir (2020).

10.11.4.4 Vessel behaviour

10.11.4.4.1 Effect of vessel size and speed on collision impact and likelihood

In varying combinations, both the size and speed of vessels can affect the impact of a collision and the likelihood of avoiding whales once sighted.

A number of authors have investigated the lethality of ship strike. Most recently Kelley *et al.* (2020) investigated this using biophysical models. They concluded that vessels of all sizes can yield stresses that likely result in impact. Analysis by Vanderlaan and Taggart (2007) updated by Conn and Silber (2013) found a direct relationship between vessel speed and the outcome of a collision with increasing speed shown to increase the probability of lethal injury (Figure 10-50). The Conn and Silber (2013) analysis includes more incidents and shows that impacts are more likely at lower speeds than is indicated in the Vanderlaan and Taggart (2007) study. With regard to likelihood, vessel speed and size both have implications for the detection of marine mammals and the ability, or otherwise, to take effective avoidance action if a cetacean is seen ahead of a vessel (Clyne and Leaper, 1999). As shown in Figure 10-51, it can be seen that:

- Large vessels such as tankers and container ships are unable to respond quickly enough to significantly reduce the likelihood of a collision, and
- Decreased speed reduces the likelihood (and severity) of a collision in vessels of all sizes.

These data corroborate the findings of Laist *et al.* (2001) who reviewed the available data regarding collisions between vessels and cetaceans and made several interesting observations:

- Although all types and sizes of vessels may hit whales, most lethal and serious injuries to whales are caused by relatively large vessels (>80 m in length),
- Most severe and lethal injuries caused by ship-strikes appear to be caused by vessels traveling at >14 knots,
- Ship collisions probably have a negligible effect on the status and trend of most whale populations, but may have a significant effect on very small populations or discrete groups, and
- The available accounts of real events suggest that most whales hit by ships are not seen beforehand or are seen only at the last moment (Laist, *et al.,* 2001).

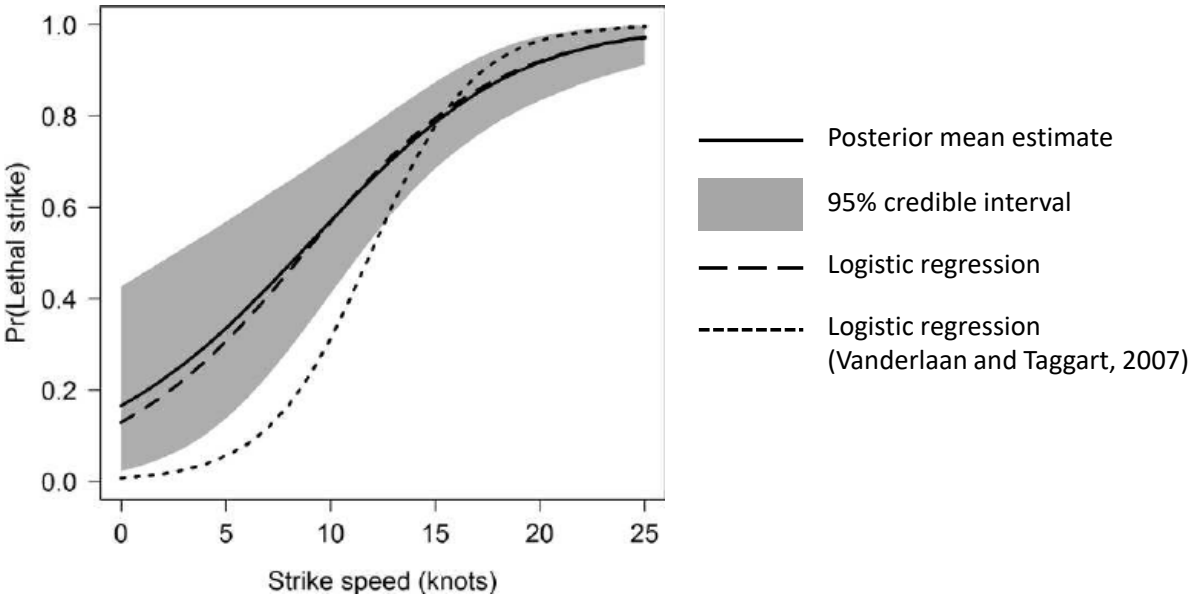


Figure 10-50: Probability of a lethal injury resulting from a vessel strike to a large whale as a function of vessel speed ***(Source: Conn and Silber, 2013)***

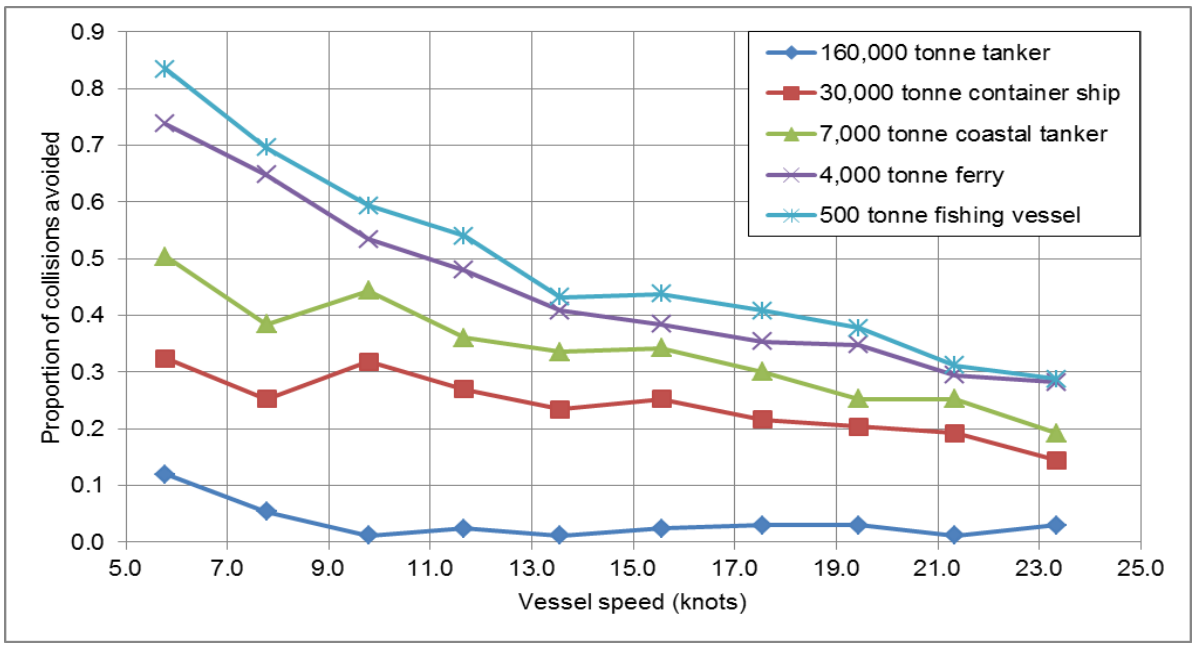


Figure 10-51: Proportion (out of one (1)) of collisions that were successfully avoided as a proportion of the total that would have occurred if no avoidance action was taken ***(Source: Clyne and Leaper, 1999)***

10.11.4.4.2 Effect of vessel distribution on collision likelihood

The location, route and behaviour of vessels influence the likelihood of a collision with regard to congregations and distribution of marine mammals. Wherever high densities of cetaceans and shipping coexist there is the potential for collisions (see Williams and O'Hara, 2010; Vaes and Druon, 2013). Where information regarding both vessel movements and cetacean populations is available, it is clear that geographic bottlenecks occur. While there are limited, but growing, data regarding cetacean distributions around the Falkland Islands, there is some very detailed information regarding shipping movements, although this has only been recorded since June 2014.

As shown in Figure 10-52 (an example of a busier fishing year), several routes are regularly used by vessels and mostly converge in Port William, Stanley and Berkeley Sound (in the north-east corner of the Islands) such that geographic bottlenecks of vessel traffic occur in these coastal waters. The band of heavy vessel activity near the 200 m isobath to the south and east of the Falklands is due to the activity of the loligo trawl fleet (Section 7.7.3.2.1.1).

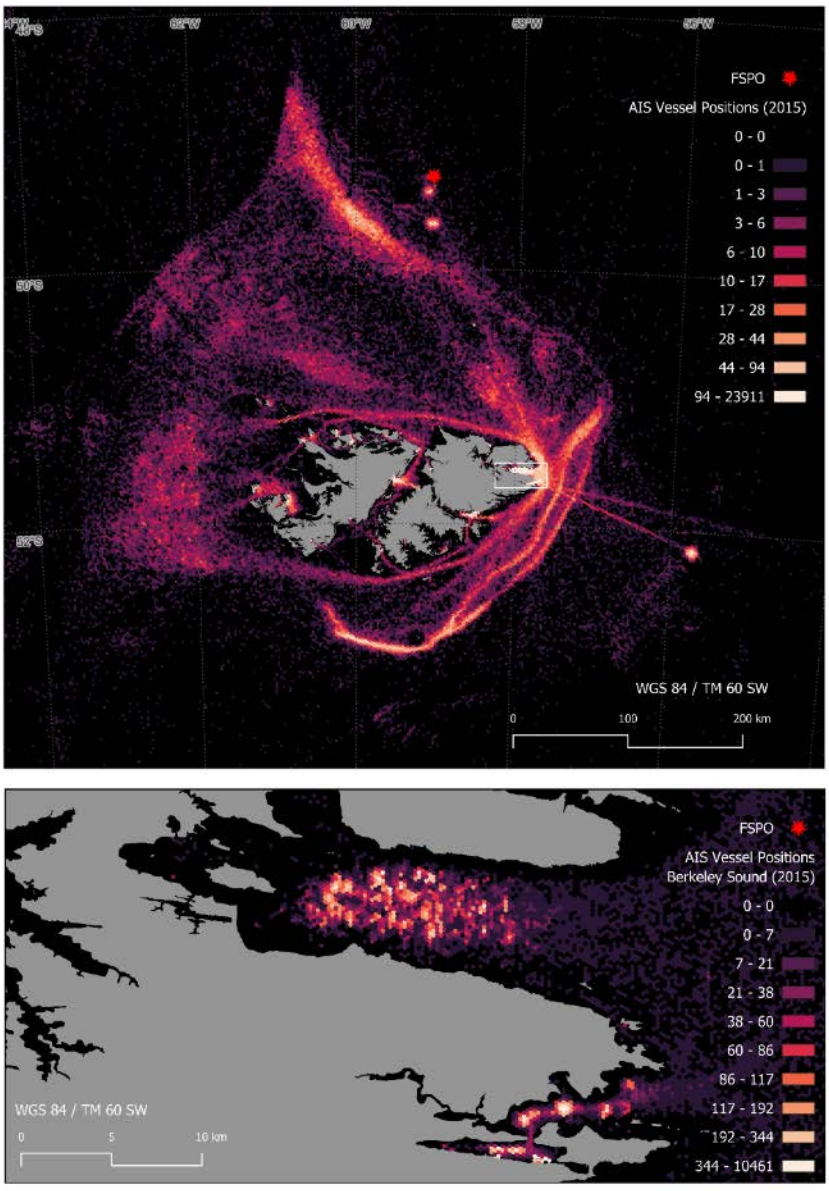


Figure 10-52: Distribution of vessel activity between June 2014 and June 2015

10.11.4.5 Overlap in Phase 1 & 2 vessel traffic and cetacean distribution

With regard to the above information, it is necessary to consider the specification and behaviour, route and location of vessels associated with the Phase 1 & 2 Development.

The exact number, type and likely routes of vessels used in the Phase 1 & 2 Development are yet to be finalised. However, specifications of typical vessels likely to be used, and their behaviour is provided in Table 10.92. The highest number of vessels will be used during Stage 1 (Table 10.92) and based upon this, the risk of collision to marine mammals will be greatest in this Stage. However, some of the vessels

(e.g., installation vessels) will be in place for a relatively short duration whereas Stage 3 (steady state production and associated vessel activity) will last for around 27 years.

With regard to the overlap in vessel activity and cetacean distribution, the distribution of right and sei whales in particular is not well understood outside of Berkeley Sound, and the north Falklands coast (Section 10.11.4.3). However, the fact that both are sighted within the NFB, Berkeley Sound and near Stanley Harbour year-round highlights that these species have spatial and temporal patterns of distribution, which overlap with shipping activity.

Table 10.92: Summary of vessel use during the Phase 1 & 2 component of the Sea Lion Development

Stage	Total number of vessels at sea at any one time in the NFB	Range of vessel lengths (m)	Mean vessel length (m)	Mean vessel speed (kn)	Main vessels locations
Vessels associated with the offshore component of the Development (drilling, installation and production)					
Stage 1	16	61 - 250	89.0	9	In-field and in transit between UK, Sea Lion Field and Falkland Islands
Stage 2a/2b	6	61 - 250	111.0	11	
Stage 3	3	61 - 250	98.0	11	
Vessels associated with the oil export component of the Development					
Stage 1	n/a	n/a	n/a	n/a	In-field and in transit
Stage 2a/2b	7	50-250	103	8	
Stage 3	7	50-250	103	8	

10.11.5 Industry-standard mitigation measures

No industry-standard mitigation measures are in place to minimise the impact or likelihood of collision with marine mammals in UK waters, or those of UK Overseas Territories. Though there are 'Guidelines' issued by the National Oceanic and Atmospheric Administration (NOAA) providing guidance on collision reduction.

Off the eastern seaboard of the U.S., this issue has posed a threat to the survival of the northern right whale and mariners are legally bound by the US Marine Mammal Protection Act (MMPA) 1972 to follow area- and time-specific measures.

Guidelines issued under the MMPA by the NOAA (2009) include:

- 'Compliance Guide for Right Whale Ship Strike Reduction Rule' which require that vessels greater than 19.8 m entering dense shipping areas reduce their speed to 10 knots,
- 'Guidelines for Mariners' detailing precautionary measures which should be taken to avoid northern right whales,
- 'Mandatory Ship Reporting System for North Atlantic Right Whales' which are relevant to key areas known to be of importance to northern right whales, and
- The measures outlined in the above include:
  - The re-alignment of traffic separations schemes,
  - The creation of areas to be avoided,
  - Mandatory ship reporting systems,
  - Advisories to mariners, and

- Speed restrictions.

As part of Navitas' operating procedures, speed restrictions will be applied to vessels entering the boundary of the Inshore KBA (Section 7.5.2.3.4); as vessels approach the inshore KBA boundary line the maximum speed permitted will be ≤10 knots.

Additionally, vessels generally will only transit the Sound during daylight hours, with daylight-only berthing and night-time departure by exception only.

10.11.6 Risk assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor', the 'Severity of Effect' and the 'Likelihood of Occurrence' to determine the overall 'Risk'. A summary of the impact and risk assessment outcomes is tabulated in Section 10.11.12, which shows the worst-case risk for each activity and receptor.

Given the difference in the behaviour and location of the vessels used during installation, drilling, production and oil export, it is considered appropriate to assess the risk of collision between cetaceans and each vessel type (grouped by location and behaviour) separately.

10.11.6.1 Risk of collision during drilling, installation and production (offshore)

Given that, for varying lengths of time, drilling, installation and production will occur over all seasons, the use of vessels will coincide with periods of highest abundance of both right whales, sei whales, and other cetacean species, in Falkland Islands waters. With regard to the sensitivity of each receptor, southern right whales are considered to be susceptible due to their behaviour (Section 10.11.4.3.1). Although the number of animals utilising Falklands waters appears to be increasing, in line with the population in the South Atlantic as a whole, and this species is listed as 'Least Concern' by IUCN. However, the SW Atlantic population *is* of regional conservation concern (IWC-CMP, 2023). The sei whale population in the south-west Atlantic is also believed to be increasing and relatively high numbers of sei whales have been encountered in inshore waters around the Falkland Islands for a number of years (Section 10.11.4.3.2). However, sei whales are listed as an IUCN 'Endangered' species. In addition sperm whales are known to occur in the NFB and are listed as an IUCN 'Vulnerable' species. Despite the differences in the international conservation status of these species, all marine mammals are conservation priority species in the Falkland Islands and therefore, the sensitivity of the receptor is considered to be '**High**'.

As shown in Section 10.11.4.5 above, the number of vessels will be highest during Stages 1 and 2a/2b of the Development which is to last for 35 months in total, with 10 months of this time being the highest levels of overlapping vessel activity. Nonetheless, while the number of vessels decreases in Stage 3, the mean vessel lengths increase and Stage 3 will last for 27.1 years (Section 10.11.4.5). Further, many of these vessels are >80 m in length and are capable of maximum speeds of >14 knots, both of which are thresholds noted by Laist *et al.* (2001) (Section 10.11.4.4.1). While it is unlikely that vessels will be operating at their maximum speeds when in-field or approaching inshore waters, a 50 % probability of lethal injury is still likely at only 9 knots (Section 10.11.4.4.1, Figure 10-50). Additionally, the larger vessels used (e.g., the LTV) would only be able to manoeuvre to avoid a collision in less than 50 % of scenarios even if the animal was observed at low speed (Figure 10-51).

Although a whale may be better able to avoid a slow-moving vessel, the kinetic energy (proportional to mass x speed) of the largest vessels employed during the Development will be higher than that of smaller vessels moving at considerably faster speeds. Therefore, the potential for injury or lethal impact is higher for the largest vessels and following a precautionary approach it is considered that any collision will lead to lethal injury.

Given the long generation time of the species concerned, any collision that could result in mortality would have a 'moderate effect in the local area'. Nonetheless, given that the populations of sei and southern right whales are believed to be increasing (Section 10.11.4.3), it anticipated that there would be a 'temporary and reversible impact on the species'. The severity of effect of collisions between ships and cetaceans is therefore considered to be '**Moderate**'.

The overall significance of the impact of collisions between vessels and cetaceans therefore is assessed as **'Upper Moderate (12)**'.

With regard to the likelihood of collision, vessels used during the offshore component of the Development (e.g., installation vessels in Stage 1 and 2, and supply vessels throughout), are most likely to be operating at very slow speeds in the field. Nevertheless, vessels will be travelling between the offshore Sea Lion Field and Stanley Harbour throughout the project and it is while steaming through inshore waters that the likelihood of encountering cetaceans is highest. However, vessel speed will decrease and watch-keeper vigilance will be heightened as vessels approach land in response to the increased risks of navigating in coastal waters, which increases the likelihood of detecting and avoiding cetaceans. Despite the lack of documented records, it is assumed that whale-strikes have occurred around the Falklands, although without further evidence these are considered to be very rare events. Given the competence standards that are required as part of the contractual process within the O&G industry, the overall likelihood of a collision has been assessed as **'Unlikely'**.

Therefore, the overall significance of the risk associated with the offshore component is considered to be **'Moderate (8)'**.

10.11.6.2 Risk of collision in Berkeley Sound (inshore)

The sensitivity of the receptor and severity of effect are as described above (Section 10.11.6.1). Therefore, the overall significance of the impact of collisions between vessels and cetaceans therefore is considered to be **'Upper Moderate (12)'**.

With regard to likelihood, some vessels (LTVs and installation vessels) are required to transit to, and manoeuvre in, inshore areas (Berkeley Sound) where there is a seasonally high likelihood of encountering large whales. However, vessel speed will be limited to ≤10 knots when they reach the inshore pMMA boundary as the vessels are heading inshore.

In addition to the lookouts posted on the forecastle of the vessels as already referred to in Section 10.11.7, all vessels will be in a state of heightened awareness due to the risks associated with mooring operations, which will aid early detection of hazards to navigation, such as non-project vessels or cetaceans. The relatively slow vessel speed (10 knots) somewhat reduces the likelihood of collisions, and the impact energy. Therefore, the overall likelihood of a collision during the inshore operations is considered to be **'Possible'.**

Therefore, the overall significance of the risk associated with vessels operating in Berkeley Sound is considered to be **'Upper Moderate (12)'.**

10.11.7 Project-specific mitigation measures

Collisions within the Falkland Islands waters between vessels and whales is considered **'Unlikely'** for offshore vessels and **'Possible'** for inshore vessels**,** and the overall significance of the risk is **'Moderate (8)'** and '**Upper Moderate (12)'**. A precautionary approach was taken during the assessment because, while collisions have not historically been a recorded around the Falkland Islands (Section 10.11.4.1), oil production and export developments and all the incumbent vessels, have not been in the area for any extended period of time either. It is therefore necessary for project-specific mitigation measures to be implemented.

The introduction of a 10 knot speed limit for the Falklands pMMA and Port William, in line with NOAA guidelines, is already considered as industry standard mitigation (Section 10.11.5) and included in the initial assessment (Section 10.11.6). To further reduce the risk of collisions in inshore waters, Navitas will limit vessel speeds to under eight (8) knots within Berkeley Sound.

Additionally, during transit in Berkeley Sound, there will be two qualified Seabird and Marine Mammal Observers (SMMOs), most likely posted to the OSVs and they will advise the Ship's Master on the bridge of the need for evasive action. The OSVs are the most common vessels transiting Berkeley Sound to pick up equipment from the LTVs.

While the US MMPA is not relevant to the waters of the Falkland Islands, a number of common-sense precautions, based on the NOAA Guidelines (2009), should also be taken to reduce the likelihood of collisions with cetaceans, as follows:

- Mariners should be made aware of the issue and how it relates to the Falkland Islands, educational materials, such as posters, will be produced to be displayed on the bridge of contracted vessels (see IFAW (2013) and Figure 10-53 below for example),
- Along with the usual duties of a watch-keeper, additional vigilance is required to detect cetaceans in inshore waters and all cetacean sightings will be logged and collated annually,
- On all vessels a lookout should be posted while transiting areas of high cetacean abundance, and
- If whales are spotted, speed should be reduced and animals given a wide berth.

While these measures may be effective in hours of daylight and calm seas they become less effective as sea state rises. Furthermore, mitigation based on visual observations is not possible during the hours of darkness when feeding baleen whales may be nearer the surface (Section 10.11.4.3, Table 10.91 above). Additionally, even where these measures can be applied, modelling suggests that collision avoidance strategies dependent on detecting and avoiding whales are ineffective for large ships with limited manoeuverability (Section 10.11.4.4.1).

Equally, to prevent collisions going unrecorded the IWC encourage mariners to report all collisions with cetaceans.

The objectives of collecting this information are to:

- Lead to more accurate estimates of the incidence of mortality and injuries, to help detect trends over time,
- Allow better modelling of risk factors (for example, vessel type, speed and size), and
- Identify high risk or unsuspected problem areas.

In addition to Navitas incident reporting and investigation, any incidents of collisions with marine mammals will be reported to FIG and the IWC via:

- FIG Environment Department, and
- The IWC web portal for reporting ship strikes - https://portal.iwc.int (see also: https://iwc.int/management-and-conservation/ship-strikes).

In addition to a programme of environmental awareness for all personnel contracted to Navitas, the use of qualified SMMOs will ensure that observations from vessels are recorded and analysed. Although it might not always be possible to take evasive action due to the slow response of a large vessel (Section 10.11.4.4.1), these observations will help to determine whether an issue exists and inform further mitigation, if required.

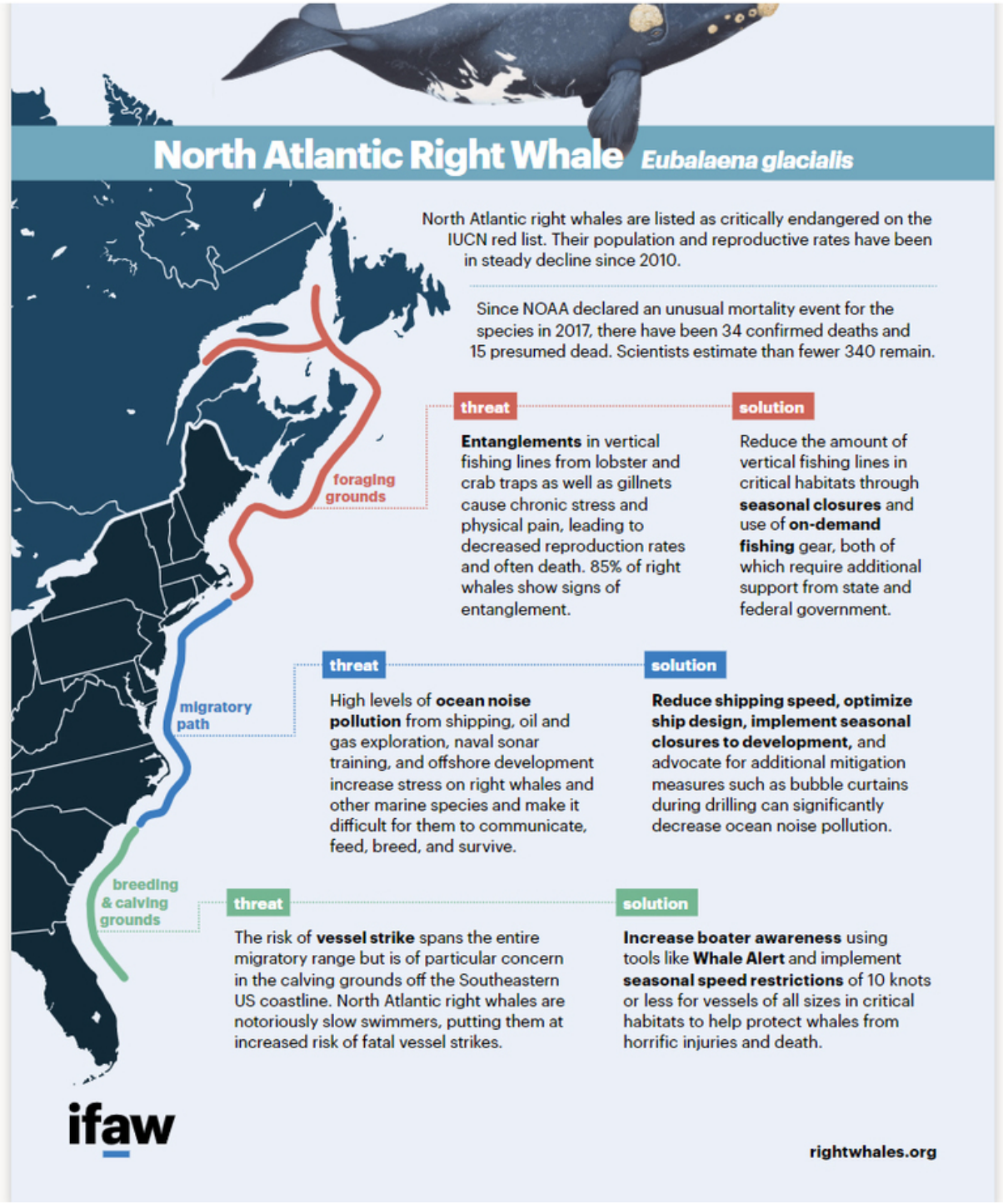


Figure 10-53. Example of educational poster on whale strikes ***(Source: IFAW, 2024)***

10.11.8 Residual impacts and risks

10.11.8.1 Risk of collision during drilling, installation and production

Increased awareness and vigilance should help to reduce the risk of collisions between vessels and cetaceans. However, there are concerns that measures that rely on visual observations are ineffective in poor observation conditions and are open to human error. Therefore, it is doubtful that the likelihood of collisions will be reduced sufficiently enough to warrant downgrading, and therefore the

likelihood remains **'Unlikely'.** The overall significance of the risk associated with the offshore component remains **'Moderate (8)'**. Vessels will be requested to report any incidents, which will help to quantify the scale of the impact and better inform future impact assessments.

10.11.8.2 Risk of collision during inshore operations

SMMOs coupled with the reduction to eight (8) knots within Berkeley Sound will reduce the likelihood of collisions between cetaceans and vessels from **'Possible'** to **'Unlikely'**. Vessel speed within Berkeley Sound will be well below that recommended in the US MMPA, however, lethal injury remains a possibility. Therefore, overall residual risk reduces to **'Moderate (8)'** for Inshore vessels.

Along with increased awareness of all personnel, the presence of qualified SMMOs will help reduce the likelihood of collisions but perhaps more importantly will provide information to better assess the interactions between vessels and cetaceans. Although there is no evidence to suggest that a problem exists around the Falklands, uncertainty surrounding the issue has resulted in this very conservative assessment.

10.11.9 Cumulative impact

As described in Section 7.7.3.2, there are already a reasonable number of fishing and other commercial vessels using Berkeley Sound, Port William and Stanley Harbour (close to 1,800 port visits in 2014, which was an unprecedented year (Figure 7-119)). Therefore, there is the potential for cumulative impacts due to increased 'concentration' and increased 'extent and proportion' (Section 8.9.1).

Existing vessel numbers peak between February and June, which also coincides with the period of highest large cetacean density (Section 7.4.6.3.3). It is estimated that the Phase 1 & 2 Development will increase the amount of vessel traffic in and out of Stanley by less than 5 % at this time. The percentage increase in vessel activity within Berkeley Sound is highly variable due to fluctuations in *Illex* catches and therefore transhipment activity.

The percentage increase in the number of vessels is not the only important factor; size, speed and behaviour of vessels is also important. Vessels associated with the Phase 1 & 2 Development within Berkeley Sound are similar in size to the largest vessels that currently use the Sound; however, the speed of project vessels in Berkeley Sound (maximum of eight knots) and their movements will be tightly controlled. Combined with vigilant observers, this should limit the risk of collisions with cetaceans.

10.11.10 Confidence

Data gaps exist regarding the inter-annual variation in density of the environmental receptors. Sei and right whales are a common sight throughout the inshore waters of the Falklands during the summer, as well as autumn for sei whales and winter for right whales. Reports of southern right whale presence around the Falklands indicate a change from previously understood spatial and temporal behaviour in Falkland Island waters. Additionally, data regarding vessel movements is not collected systematically and therefore it is not possible to accurately quantify the risk of collisions between cetaceans and vessels. It is clear that not all incidents of collisions between marine mammals and vessels are reported or even evident to the crew of the vessel. For these reasons, confidence in the risk assessment is **'Uncertain'.**

10.11.10.1 Monitoring required

The loss of cetaceans to collision with vessels is a global issue that requires further research in order to better understand and model the potential impact on the populations of cetacean species (IWC, 2011). Although it is not thought that a significant problem exists in the Falklands at present, with the advent of O&G production in the region, further investigation to establish the causes, consequences and provisions for risk management is required.

SMMOs will be based on Navitas' vessels (most likely the OSVs). The information gathered will help to verify the accuracy of this assessment and refine future policy and procedures.

A review of all SMMO reports will be carried out every six months and after the first three years of SMMO deployment to validate the EIA and to inform decisions on whether ongoing monitoring is necessary.

In addition to reporting *via* Navitas internal incident reporting systems, all vessels will be instructed to report any collisions with marine mammals to FIG and the IWC via:

- FIG, and
- The IWC web portal for reporting ship strikes - https://portal.iwc.int (see also: https://iwc.int/management-and-conservation/ship-strikes).

Detailed monitoring requirements have been established during the Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the project-specific Phase 1 & 2 EMMP (an outline EMMP is provided in Chapter 15).

10.11.11 Offsetting

For significant residual and impact and risks ('Moderate' or above), offsetting *via* a Carbon and Biodiversity Offsetting Fund is proposed, see Section 8.11 for further details.

10.11.12 Findings summary

Table 10.93: Summary of the risk assessment for collision with marine mammals during the Phase 1 & 2 Development

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Collision between vessels and cetaceans	Collision with small cetaceans	Lethal injury	Unplanned	1, 2 & 3	n/a	n/a	n/a	**n/a**	**n/a**	**n/a**	**Industry-standard:** The premise of the NOAA (2009) guidelines will be followed Increased vigilance by officer of the watch in high-risk areas, Reduced vessel speed to 10 kn at the KBA boundary **Project-specific:** Awareness training for vessel crews, Reduced vessel speed to max 8 kn in Berkeley Sound Seabird and Marine Mammal Observers on vessels All collisions will be reported to FIG and the IWC via: https://portal.iwc.int.
	Collision between cetaceans and the installation vessels, supply vessels, or ERRV offshore and *en route* to Stanley	Lethal injury	Unplanned	1, 2 & 3	High	Moderate	Unlikely	**Moderate (8)**	**Moderate (8)**	**Uncertain**	
	Collision between cetaceans and the LTVs and subsea installation vessels inshore	Lethal injury	Unplanned	1 & 2	High	Moderate	Possible	**Upper Moderate (12)**	**Moderate (8)**	**Uncertain**	

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Entanglement with subsea infrastructure	Entanglement with anchor chains / risers	Lethal injury	Unplanned	1, 2 & 3	n/a	n/a	n/a	**n/a**	**n/a**	**n/a**	n/a

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

10.12 Introduction of marine non-native species

Table of Contents

10.12.1 Introduction 941
10.12.1.1 Legislation and guidelines regarding the risk of marine species invasion 941
10.12.1.1.1 Ballast water exchange 942
10.12.1.1.1.1 Regulation D1 - IMO BWM - ballast exchange 942
10.12.1.1.1.2 Regulation D2 - IMO BWM - ballast water treatment 943
10.12.1.1.1.3 Regulation D3 - IMO BWM - ballast water management systems 943
10.12.1.1.2 Biodiversity 943
10.12.2 Sources of marine invasive species 944
10.12.3 Potential receptors 945
10.12.4 Characterising and quantifying the risk of marine invasive species 945
10.12.4.1 The process of marine species introduction and invasion 945
10.12.4.1.1 Species introduction 945
10.12.4.1.1.1 Ballast Water 945
10.12.4.1.1.2 Biofouling 946
10.12.4.1.2 Species invasion 948
10.12.4.2 Potential consequences of invasive marine species 948
10.12.4.2.1 Case studies of marine invasive species 949
10.12.4.3 Factors influencing the introduction and invasion of species 951
10.12.4.3.1 Origin and activity of Phase 1 & 2 Development vessels 951
10.12.4.4 High-risk invasive non-native species 954
10.12.5 Industry-standard mitigation measures 954
10.12.5.1 Ballast Water Management Plan 954
10.12.5.2 Biofouling Management Plan 955
10.12.5.2.1 Antifouling coatings 955
10.12.5.3 Biosecurity Management Plan 956
10.12.6 Risk assessment 956
10.12.6.1 The impact of introducing invasive species, all vessels 957
10.12.6.2 Likelihood of occurrence 957
10.12.6.2.1 Risk of invasive species introduction by Sea Lion in-field vessels 958
10.12.6.2.2 Risk of invasive species introduction by *ad hoc* freighter vessels 958
10.12.6.2.3 Risk of invasive species introduction by Large Transport Vessels 959
10.12.6.2.4 Risk of invasive species introduction by purchaser's vessels (CTTs) 959
10.12.7 Project-specific mitigation measures 959
10.12.7.1 Ballast water 960
10.12.7.2 Biofouling 960
10.12.8 Residual impacts and risks 960
10.12.8.1 Sea Lion in-field vessels 960
10.12.8.2 *Ad hoc* freighter vessels 960
10.12.8.3 Large Transport Vessels 960
10.12.8.4 CTTs 961
10.12.9 Cumulative impact 961
10.12.10 Confidence 961

10.12.10.1 Monitoring required 962
10.12.10.1.1 Ballast water sampling 962
10.12.11 Offsetting 962
10.12.12 Findings summary 962

10.12.1 Introduction

Remote islands, such as the Falkland Islands, harbor a unique biodiversity. Yet their small size and remoteness lead to vulnerability resulting from small population sizes and limited genetic variation, limited options for dispersal, narrow ecological niches, and behavioral naivety (Dawson, *et al.,* 2022). The introduction of non-native marine species to 'new' environments is a global phenomenon and is considered to be a major threat to island biodiversity (Dawson, *et al.,* 2022). In remote locations like the Falkland Islands, where the vast majority of equipment, materials and vessels have to be sourced from overseas, there is a risk of non-native marine species 'hitch-hiking' from one biogeographical region to another. If a non-native species is released into a 'new' environment, reproduces and spreads it will be regarded as invasive. Marine invasive species are difficult to detect and once established, are almost impossible to remove.

The International Union for the Conservation of Nature (IUCN) has identified the introduction of non-native species as one of the major threats to native biological diversity. Further, in 2015, a review of the Falklands Biodiversity Framework upgraded invasive species and biosecurity from a medium to high priority threat (FIG, 2016a).

Numerous vessels will be used throughout the Phase 1 & 2 Development and while the use of vessels is a planned event, the introduction of marine invasive species would be an unplanned event. It is therefore necessary to consider this as a risk. Notably, the potential for the introduction of non-native species was raised as a concern by stakeholders during scoping consultations (Chapter 6).

The Phase 1 & 2 inshore activities include the entry and anchorage of up to two Large Transport Vessels (LTVs) at any one time in Berkeley Sound, the intermittent entry of a construction vessel and supply vessels and periodic *ad hoc* freighter vessels arriving in Stanley. This chapter assesses the potential for the vessels used during the Phase 1 & 2 Development to introduce non-native marine species to the Falklands' marine environment that could, in time, become invasive.

Note: there is also a risk that native species will be transported elsewhere when vessels depart from the Falklands. However, the impact on the ecosystem of remote islands, where species have evolved in isolation, is deemed to be of greater significance than the impacts of non-native species in regions that adjoin continental land masses. Therefore, the risk of exporting species from the Falkland Islands is not considered further.

Note: the other impacts associated with vessel use are described elsewhere in this document, as described in Table 2.2.

10.12.1.1 Legislation and guidelines regarding the risk of marine species invasion

Falkland Islands strategies and framework relevant to the risks associated with the introduction of non-native species include:

- FIG Biodiversity Framework 2016-2030 (FIG, 2016a).
- The Environment Strategy (FIG, 2021a).

However, currently, specific legislation relating to the management and control of invasive species has not been established for the Falkland Islands. However, the issue of biosecurity is becoming more significant and dedicated legislation to govern marine and terrestrial biosecurity is likely to be drawn-up and enforced in the near future (D. Baigorri (Biosecurity Officer), *pers. comm.*).

Nonetheless, there is a range of international legislation and conventions relevant to invasive marine species management either through general environmental management, biodiversity protection requirements, or through more specific management requirements. These include:

- International Maritime Organisation (IMO) – International Convention for the Control and Management of Ships' Ballast Water and Sediments (the Ballast Water Management Convention).
- IMO International Convention on the Control of Harmful Anti-fouling Systems (AFS) on Ships (2001) - The AFS Convention does not address the prevention of introducing invasive aquatic species directly but focuses on the AFS used on ships and on the prevention of adverse impacts from the biocides they may contain.
- United Nations Convention on Biological Diversity (CBD) and the Kunming-Montreal Global Biodiversity Framework (GBF) which supports the achievement of the CBD Sustainable Development Goals and builds on the Convention's previous Strategic Plans.
- United Nations Convention of the 'Law of the Sea', specifically on the 'protection and preservation of the marine environment'.
- Department for Environment, Food and Rural Areas (Defra), Great Britain Non-native Species Secretariat – Invasive Non-Native Species Framework Strategy for Great Britain.
- United Kingdom Overseas Territories (UKOTs) – Biodiversity Strategy.

Under the above, there are numerous compliance requirements which will be applied within Falkland Islands waters, as described below.

Note: the IMO has also developed non-legislative guidelines for the 'Control and Management of Ships' Biofouling to Minimise the Transfer of Invasive Aquatic Species'. These are guidelines for industry-standard best practice that will be followed by Navitas and are described below in Section 10.12.5.2.

10.12.1.1.1 Ballast water exchange

IMO's Ballast Water Management (BWM) Convention came into force in September 2017. Further, the provisions of the BWM Convention are reflected in the UK by Marine Guidance Note 363 (M+F) (MCA, 2007) and at the IMO level in Marine Environment Protection Committee (MEPC) Resolution 127 (53), (IMO, 2005).

The Convention provides performance standards for the discharge of ballast water, namely standards D1 and D2 for ballast water treatment and standard D3 for a ballast water management system. Historically, vessels have normally used a D1 standard of treatment, however the BWM Convention requires all qualifying vessels to have a D2 standard of ballast water treatment by September 2024, allowing time for vessels to have an opportunity to have equipment installed in dry dock if necessary. All the vessels set out in the EIS would qualify for the D2 standard, and given the project schedule, all vessels arriving in the field will be fitted with a D2 standard ballast water treatment system, operated within a ballast water management system compliant with standard D3. Standards D1, D2 and D3 are all described below for completeness.

10.12.1.1.1.1 Regulation D1 - IMO BWM - ballast exchange

The D1 standard is for ballast water exchange and specifies the volume of water to be replaced. The standard requires that ballast water be exchanged with local water prior to entry into inshore waters as a mitigation against the introduction of non-native species.

Specifically, all ships using ballast water exchange should:

- Conduct a ballast water exchange at least 200 nautical miles from the nearest land and in water at least 200 metres in depth, taking into account the suite of Guidelines developed by the IMO to support the BWM Regulations, or

- Where the ship is unable to conduct ballast water exchange as above, the exchange should occur as far from the nearest land as possible, and in all cases at least 50 nautical miles from the nearest land and in water at least 200 metres in depth.

Ballast water exchange can either be *via* a 95 % exchange of volume or, where the tanks are continuously flushed through, by a volume equal to three times that of the tank, to take account of incomplete displacement of water during flushing.

10.12.1.1.1.2 Regulation D2 - IMO BWM - ballast water treatment

The D2 standard specifies levels of viable organisms which may be left in the ballast water after treatment and specifies approved ballast water treatment systems.

The standards for ballast water cleanliness are:

- No more than 10 viable organisms per cubic metre greater than 50 µm in size and no more than 10 viable organisms per millilitre between 10 - 50 µm in size, and
- Indicator microbes, as a human health standard and expressed as colony forming unit (cfu), shall not exceed:
  - Toxigenic *Vibrio cholerae* (serogroups O1 and O139): with less than 1 cfu per 100 millilitres or less than 1 cfu per 1 gram (wet weight) zooplankton samples,
  - *Escherichia coli*, less than 250 cfu per 100 millilitres, and
  - Intestinal Enterococci, less than 100 cfu per 100 millilitres.

In order to meet the standards described above, ballast water treatment will be required. According to the Marine and Coastguard Agency (MCA, 2012) ballast-water treatment options may include:

- Mechanical filtration and separation,
- Treatment methods such as sterilisation,
- Chemical treatment, or
- A combination of these methods.

Compliance with D2 will take time (up to five years from September 2019) to cascade through the global fleet, but, by the time of Sea Lion First-Oil, it is expected that the vast majority of vessels will have the treatment systems installed and Navitas will contract with those vessels that have the system in place.

10.12.1.1.1.3 Regulation D3 - IMO BWM - ballast water management systems

In the event that a BWM System is used to comply with the BWM Convention, Regulation D3 requires that:

- The management system must be approved by the IMO Administration taking into account the 'Guidelines for approval of ballast water management systems' (MEPC, 2008a), and
- The use of active substances shall be approved by IMO in accordance with the 'Procedure for approval of ballast water management systems that make use of Active Substances' (MEPC, 2008b) to ensure that the ballast water management system does not pose unreasonable risk to the environment, human health, property or resources.

Compliance with the above will lead to the award of the International Ballast Water Management Certificate.

10.12.1.1.2 Biodiversity

The UK ratification of the UN CBD was formally extended to the Falkland Islands on the 29th June 2016. The CBD is effectively an agreement on environmental management and best practice and originated from the 1992 Rio Conference on environment and development.

Historically the CBD set out a plan for achieving 20 targets, known as the 'Aichi Targets', which were grouped under five strategic goals. However, the Kunming-Montreal GBF is an international agreement which was developed after a long negotiation process to address weaknesses in the Aichi Targets. The GBF was adopted in December 2022 and ultimately replaces both the Aichi Targets and the Strategic Plan for Biodiversity 2011-2020 under the CBD. The GBF aims to be more ambitious than previous agreements, with a broader implementation approach that includes the private sector.

The Kunming-Montreal GBF lists targets which range from the maintenance and restoration of ecosystems through to the encouragement of sustainable consumption choices but 'Target 6' is of most relevance to this chapter and aims to reduce the introduction of invasive alien species by 50 % and minimise their impact.

More specifically Target 6 aims to:

> *'Eliminate, minimise, reduce and or mitigate the impacts of invasive alien species on biodiversity and ecosystem services by identifying and managing pathways of the introduction of alien species, preventing the introduction and establishment of priority invasive alien species, reducing the rates of introduction and establishment of other known or potential invasive alien species by at least 50 % by 2030, and eradicating or controlling invasive alien species, especially in priority sites, such as islands.'*

The CBD, and now the GBF, are supported by the FIG Biodiversity Framework 2016-2030 (FIG, 2016a), the Environment Strategy (FIG, 2021a) and supporting strategies. This Biodiversity Framework was formally endorsed by FIG in January 2016 and identifies priority conservation objectives for the Falkland Islands. Importantly, the Biodiversity Framework is a threat-based document which outlines the priorities required with regard to the wider Falkland Islands' environment. The introduction of non-native species was identified as a high priority threat.

10.12.2 Sources of marine invasive species

Throughout the different development stages, numerous vessels will be used (see Section 5.11.2) which have the potential to introduce non-native species. These include:

- Vessels contracted to Navitas:
  - Mobile Offshore Drilling Unit (MODU),
  - Anchor Handling Tug Supply (AHTS) vessels,
  - Floating Production, Storage and Offload vessel (FPSO),
  - Multi-Role Support Vessels (MRSV),
  - Emergency Rescue and Response Vessel (ERRV),
  - Offshore Construction Vessels (OCV),
  - Platform Supply Vessels (PSV),
  - *Ad hoc* freighter vessels, and
  - LTVs, used as temporary floating logistics vessels.
- Third-party vessels:
  - The purchaser's Conventional Trading Tanker (CTT).

A full inventory of the vessels used during Stages 1 to 3 of the Development is provided in Section 5.11.2.

10.12.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify the specific receptors upon which the impact / risk of marine invasive species warranted further investigation (Chapter 9). The specific receptors that may be impacted include:

- Marine flora, fauna and biodiversity of the region, and designated sites (Section 7.4).

Note: Navitas acknowledge that an unplanned introduction of marine invasive species could impact upon commercial fisheries. This is an economic impact and is considered within the Sea Lion Northern Development Area Phase 1 & 2 Socio-economic Impact Assessment which is currently being carried out by Navitas.

10.12.4 Characterising and quantifying the risk of marine invasive species

When characterising and quantifying the risk of introducing marine invasive species, it is necessary to consider the:

- Process of marine species introduction and invasion,
- Potential consequences of marine species invasion:
  - Case studies of marine invasive species.
- Factors influencing the introduction and invasion of species:
  - Origin and activity of Phase 1 & 2 Development vessels.
- High-risk invasive non-native species.

10.12.4.1 The process of marine species introduction and invasion

Two steps are involved in the process by which a non-native marine species may become invasive and impact upon an existing ecosystem:

- The species has to be transported into the region, and
- The species has to find a niche, become established and spread.

10.12.4.1.1 Species introduction

There are two main pathways by which non-native marine species are transported and introduced into new environments:

- In vessel ballast water, and / or
- Biofouling on the surfaces of vessels.

While the species that may be introduced by these routes differ, the process by which they can be introduced and / or become invasive is similar and is summarised in Table 10.94 at the end of this section. Both routes are recognised as serious issues by the IMO, which has developed guidelines to guard against such introductions (Section 10.12.4.4).

10.12.4.1.1.1 Ballast Water

Ballast is taken on-board or discharged, as necessary, to trim and stabilise a vessel. When a vessel is not carrying any cargo, it is necessary to compensate by taking on ballast water, and equally, it will be necessary to discharge ballast water when cargo is taken on board. Therefore, ballasting operations are most often required in coastal or inshore waters where cargo is loaded and unloaded. Typically, a crude tanker is ballasted with 30-35 % of its cargo capacity carried as water in the ballast tanks that are located between the inner and outer hulls in the double-hull design. Ballast water and cargo are therefore carried in separate tanks so there is no risk of cross contamination of ballast water with oil.

Ballast exchange practices are specific to each vessel but, in all vessels, planktonic organisms, larval stages, eggs, cysts and micro-organisms can be transported from one location to another in the ballast tanks. To combat the spread of non-native species, the IMO BWM Regulations (Section 10.12.1.1.1.2) will require all vessels to have D2 standard Ballast Water Treatment Systems (BWTS) in place by September 2024. Most BWTS include a primary filtration step to remove organisms larger than 20–55 µm in size, such as eggs, larvae and adults of many benthic or pelagic plankton, that are likely to survive secondary treatments such as UV irradiation, ozonation or electro-chlorination (Grob and Pollet, 2016). Regardless of the BWTS used, there is sufficient evidence to say that there is not one ballast water treatment method, or even a combination of primary and secondary methods that can guarantee a 100 % kill of all marine organisms (Grob and Pollet, 2016). However, ballast water treatment methods work to prevent unreasonable risk of introduction e.g., through a reduction in concentration of organisms.

10.12.4.1.1.2 Biofouling

Biofouling is the growth of marine organisms on man-made structures (Figure 10-54) and can be divided into:

- Hard (calcareous) fouling types e.g., barnacles, encrusting bryozoans, tube worms, mussels and other molluscs, and
- Soft (non-calcareous) fouling types e.g., seaweed, hydroids, algae and biofilms (i.e., any group of micro-organisms in which the cells stick to each other to create a 'slime' on a surface).

Together, and untreated, these two groups can encrust the hulls of vessels. Biofouling organisms can have deleterious impacts on industry; such as blocking of water intakes or increasing drag on a vessel, which then increases fuel consumption. While biofouling is often prevented with anti-fouling coatings or is mechanically removed from vessels to miminise these impacts, fouling organisms are likely to remain in 'nooks and crannies' such as the sea chest on vessels or around propeller shafts (Figure 10-55).

Therefore, these animals remain on the vessel as it transits to other regions where they can then be introduced by falling off the vessel (sometimes *via* hull cleaning) or by maturing and spawning into the new environment. Further to this, where vessels are travelling slowly (such as MODUs), mobile organisms such as fish have been known to follow a vessel to new regions (Wanless, *et al.,* 2010).

The IMO's requirements for managing biofouling organisms (Section 10.12.4.4) will greatly reduce the likelihood of introducing non-native species; however, as stated above, these guidelines do not guarantee 100 % removal of non-native species. Recently, there has been a growing recognition that biofouling is a major pathway in the introduction of non-native species, some of which may become invasive. For example, it is estimated that biofouling is responsible for approximately 75 % of non-native marine invertebrates in Hawaii and 78 % of non-native marine species in Port Phillip Bay, Australia (OGP/IPIECA, 2010).

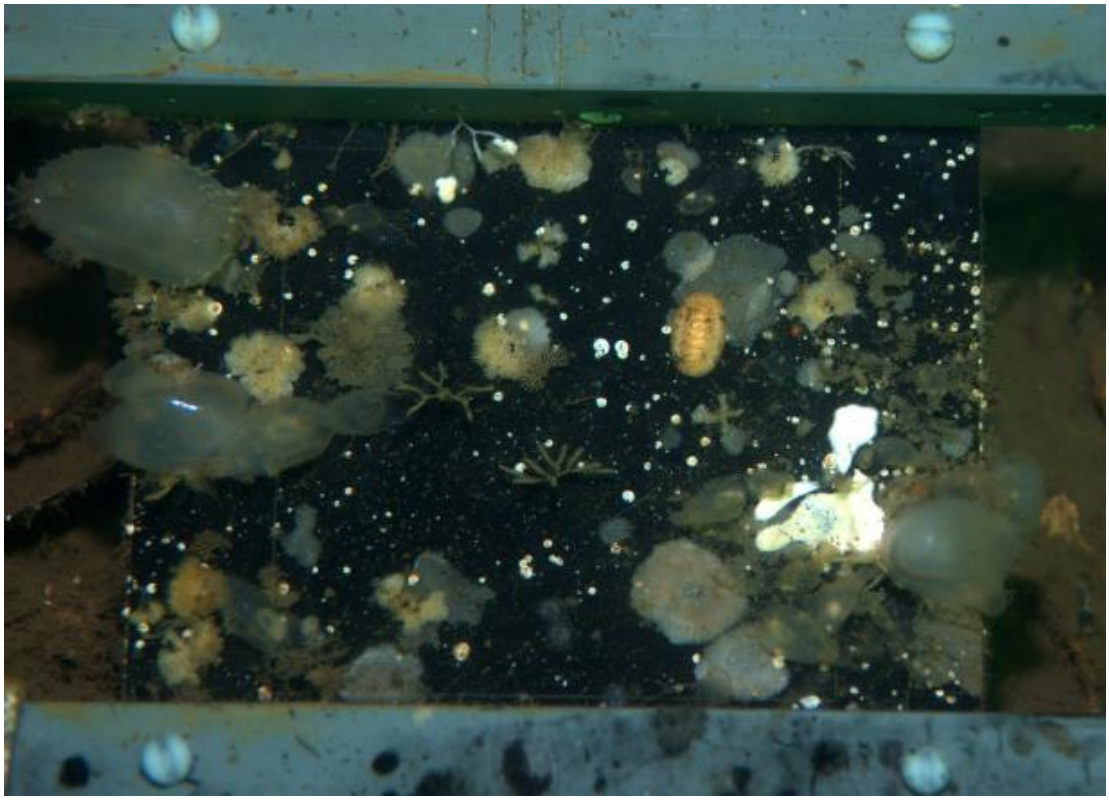


Figure 10-54: Biofouling on a settlement plate used to monitor for non-native species; note the presence of the invasive vase tunicate (*Ciona intestinalis*), transparent balloon like organisms ***(Source: SMSG)***

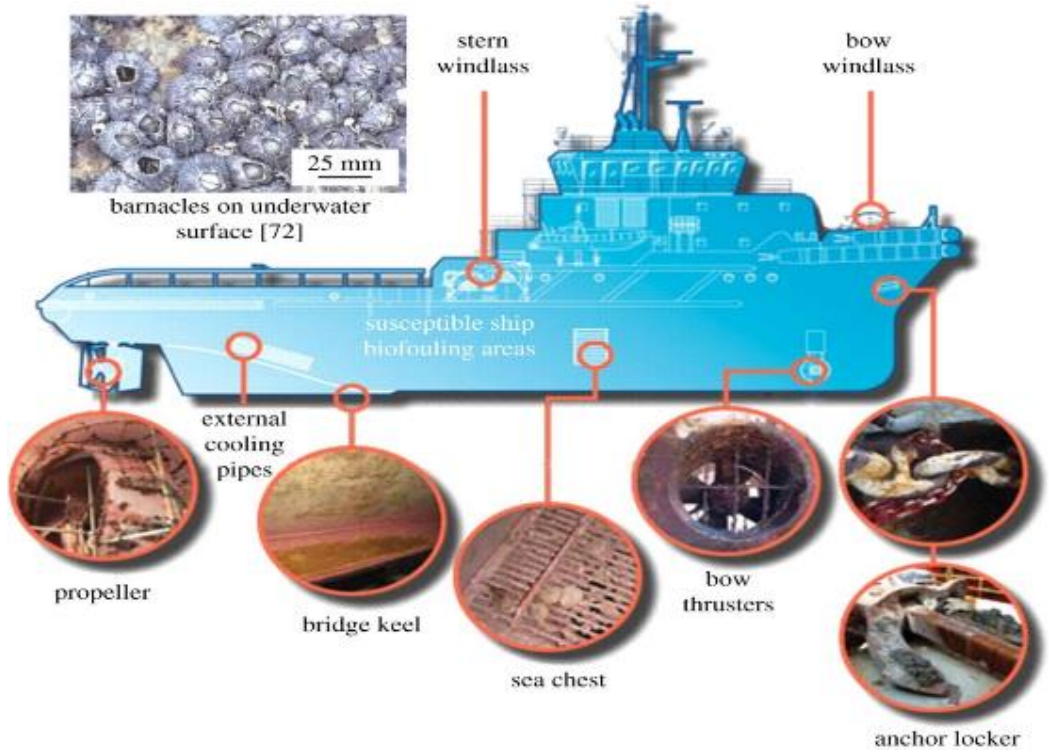


Figure 10-55: Regions on a ship that may remain fouled following mechanical cleaning ***(Source: rsta.royalsocietypublishing.org)***

10.12.4.1.2 Species invasion

Not all non-native species that arrive in the Falklands are able to survive, reproduce and spread to the point that they become invasive. For a non-native species to become invasive it is necessary for it to gain a foothold (Table 10.94), which is more likely when the recipient region is similar to the donor region with respect to parameters such as salinity and temperature.

However, many of the most prevalent invasive species can become established in many different regions of the world and share biological characteristics such as rapid reproductive capacity and fast growth, which enable them to out-compete native species. Additionally, non-native species may not have any natural predators in the receiving environment, which further aids survival and growth.

Table 10.94: The process of non-native species introduction and invasion[1]

Region	Process	Key factors	
		Ballast water	Biofouling
Donor	Colonisation of vessel	Quantity of ballast water uptake, Salinity (fresh or seawater), and Location from which ballast water is taken.	Presence or absence of anti-fouling, Age and type of anti-fouling, Hull location, and Residency period (inshore waters).
Translocation		Ballast water exchange *en route*, and Treatment of ballast water.	Voyage route, Voyage duration, and Vessel speed.
Recipient	Transfer	Ballast water exchange (inshore waters).	Residency period (inshore waters), and Defouling activity (e.g., in-water cleaning).
	Colonisation	Availability of suitable environmental conditions, Availability of suitable substrate, Biotic resistance, and Water currents.	
	Establishment	Availability of suitable substrate, Environmental conditions, Predation pressure and Control measures.	

[1] Adapted from Lewis and Coutts (2010)

10.12.4.2 Potential consequences of invasive marine species

Invasive species may impact upon biodiversity by:

- Outcompeting native species for space and resource and therefore exclude native species,
- Predating upon native species,
- Causing indirect changes to the ecosystem e.g., smothering by plankton blooms, and / or
- Causing toxicity for native species e.g., Harmful Algal Blooms (HAB).

The impacts of the above can be immense and are often irreversible (Hilliard, 2004; OGP/IPIECA, 2010). Further, impacts to biodiversity tend to be disproportionately worse for islands as compared to continents (Russell, *et al.,* 2017) and in remote island ecosystems like the Falklands, where native species have evolved in biological isolation, they can be particularly severe. Although there are cases where planktonic invasive species such as dinoflagellates or salps can impact offshore waters e.g., by HAB, most marine invasive species impact upon inshore benthic communities of native species, and the extent of the impact is often difficult to detect and monitor.

In addition, there are many examples from around the world where marine invasive species have had serious economic impacts (e.g., Lowe, *et al.,* 2004; Cuthbert, *et al.,* 2021) and OGP / IPIECA (2010)

provides a comprehensive review of the risks that the Oil and Gas (O&G) industry poses regarding the introduction of non-native species.

While there is little commercial exploitation of inshore marine species or industries such as aquaculture in the Falklands, some species that are exploited offshore do spawn in inshore waters. The species of greatest concern off the east coast of the Islands is loligo (*Doryteuthis gahi*; Section 7.7.3.2.1.1). A loss of spawning habitat (e.g., kelp beds[89]) or predation of eggs could have socio-economic impacts for the human population. While this direct impact would require the introduction of species likely to use kelp beds[1] or predate on the eggs, the introduction of any species that became invasive would impact biodiversity overall, with indirect impacts for many species.

10.12.4.2.1 Case studies of marine invasive species

Human trade and travel have frequently introduced alien species to areas like the Falklands where the native species are not adapted to the new threat. On the nearby central Patagonian coast, for example, most marine ecosystems have been modified by invasive species (Orensanz, *et al.,* 2002).

The Falkland Islands have been a strategic point for international shipping traffic for over 200 hundred years and human activity has seen both the deliberate introduction of non-native species, such as the brown trout, and unintentional introductions. Until recently however, there were no baseline environmental surveys of the Falklands, so determining those species that are native and those that are invasive is not always straightforward.

Nonetheless, it is clear that several invasive species are already established within Stanley Harbour and Mare Harbour, such as the tunicate (*Ciona intestinalis*) and the parchment tubeworm (*Chaetopterus variopedatus*, Figure 10-56), both of which have the potential to out-compete and smother native species. The 2011 Shallow Marine Surveys Group (SMSG) survey looked at a number of sites around the Falklands to determine the presence of the parchment tubeworm and results are shown in Figure 10-57 below. Results showed the species was present island-wide, although concentrations are markedly higher nearer ports of entry (SMSG, 2011). Recently (March 2023), *Undaria pinnatifida* has been found in Stanley Harbour and is one of only two seaweeds included in the Invasive Species Specialist Group list of the 100 most invasive species of the world (IUCN ISSG, 2024). Native to cold-temperate areas of the north-west Pacific (e.g., Japan, Korea, Russia, China), *Undaria* is now established across four continents. Within the San Jose Gulf (Argentina), only four years after its introduction, *Undaria* had spread across approximately 100 km of coastline where it is mixed with *Macrosystis pyrifera* kelp forest (SMSG, unpublished data).

Elsewhere in the world, the impact of invasive species has been far more dramatic. For instance, the European shore crab (*Carcinus meanus*) has been transported all over the world. Once established, they displace native species of crab and predate upon native invertebrates resulting in both the loss of native biodiversity and impacts upon crab and shellfish industries (CABI, 2014).

Another example is the sea walnut (*Mnemiopsis leidyi*) which is a stingless jellyfish-like animal (a comb-jelly) native to the Atlantic coasts of North and South America. This organism was transported to the Black Sea by ballast water and spread to the Caspian Sea. In both places, this species multiplied to form immense populations which, because they feed on zooplankton that commercial fish also consume, contributed to the collapse of local fisheries (Pang and Martindale, 2008). This comb-jelly has now also been discovered in the Mediterranean, Baltic, and North Seas (Pang and Martindale, 2008).

[89] Although kelp beds are a known spawning location for loligo, the spatial / bathymetric distribution and habitat characterisation of loligo spawning areas are not yet fully understood (Section 7.4.4.3.2.1).



Figure 10-56: Parchment worms (*Chaetopterus variopedatus*) smothering native species ***(Source: SMSG)***

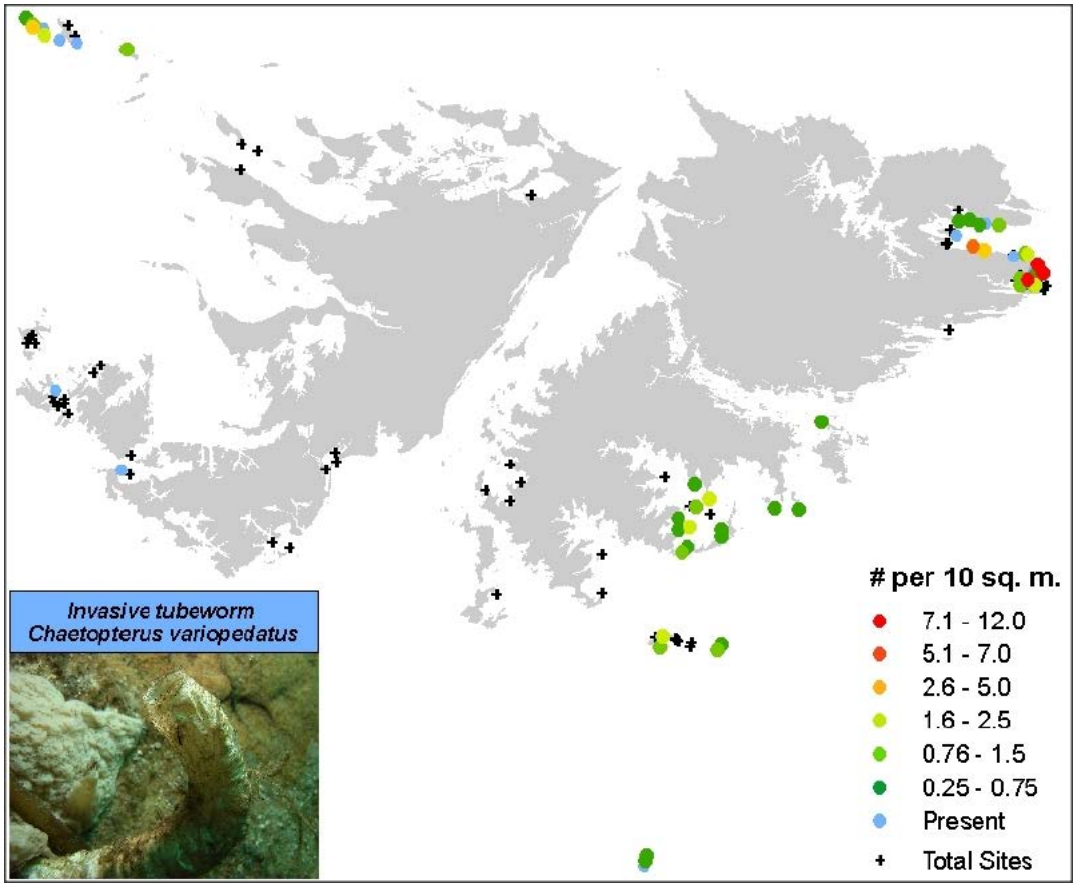


Figure 10-57: Distribution map of the parchment tubeworm ***(Source: SMSG, 2011)***

10.12.4.3 Factors influencing the introduction and invasion of species

In order to conduct an assessment of the risk posed by Phase 1 & 2 vessels introducing non-native species, and these species becoming invasive, three main factors need to be considered:

- The origin of the vessel,
- The activity of the vessel when in the region, and
- Whether or not the vessel is 'new' to the Falkland Islands.

With regard to the origin of the vessel, the geographical location of the last vessel deployment is of great importance as this will affect the likelihood of any introduced species becoming invasive. Vessels coming from temperate regions with similar climates pose the greatest risk to the Falkland Islands as the species that may be introduced are most likely to be able to survive, become established, and thus become invasive. Importantly however, the origin of the vessel can also present natural barriers to the introduction of non-native species. For example, with regard to biofouling, where vessels are travelling from a northern hemisphere temperate climate to a similar climate in the southern hemisphere, the vessel will pass through the Tropics such that the gradual changes in salinity and temperature may help to remove many biofouling organisms (Minchin and Gollasch, 2003). Although this may serve as a natural barrier to effective translocation, there are instances of species flourishing in both tropical and Falklands waters. As such, the temperature barrier is no guarantee and should not be relied upon as a means of preventing introduction. With regard to ballast water, the time that water is held in the tanks is significant such that the distance of the vessel origin from its destination is a factor. Many organisms may die *en route* while other, mostly micro-organisms, may reproduce and multiply (Gollasch, *et al.,* 2000; Grob and Pollet, 2016).

With regard to activity, vessels that spend long periods of inactivity in coastal waters (wherever these may be) are more prone to biofouling than those that are active offshore and ballast water taken onboard in coastal waters is likely to contain a far higher density of planktonic organisms than water taken onboard in offshore waters. While the risk of introducing ballast organisms is less dependent upon the location of the discharge as micro-organisms may colonise anywhere, the risk of biofouling organisms becoming established in the Falklands is greatly increased when vessels are inshore, as most biofouling species require hard substrates to attach to. Another consideration with regard to the activity of vessels is the volume of ballast water carried. Vessels arriving laden with a cargo e.g., *ad hoc* freighter vessels and LTVs, will be carrying less ballast water, while those arriving empty, or partially full, and awaiting receipt of a cargo e.g., the OCV and PSV vessels, will be carrying a larger volume of ballast water.

Finally, the greatest risk of marine species introduction is associated with the first arrival of potentially contaminated vessels which are 'new' to Falkland Islands waters. Vessels that have been in the region for extended periods of time are more likely to carry native species in their ballast water. However, biofouling organisms may continue to grow *in situ* where conditions are conducive and may eventually fall off or spawn into the environment of the recipient region

Those vessels that repeatedly leave the region and exchange ballast waters elsewhere, or have the opportunity for the hull to become recolonised elsewhere before returning to the Falklands, will be considered 'new' each time they return.

10.12.4.3.1 Origin and activity of Phase 1 & 2 Development vessels

A summary of the Phase 1 & 2 vessels' origin and behaviour is provided in Table 10.95. While all vessels pose a risk, those vessels that are 'new' each time and which come inshore (particularly for prolonged periods) are those that pose the greatest risk. Therefore, the periodic *ad hoc* freighter vessels and the LTVs are expected to pose the greatest risks (Table 10.95).

The *ad hoc* freighter vessels will arrive laden with cargo and will not be 'in-ballast' such that the greatest risk with these vessels is species introduction *via* bio-fouling. The *ad hoc* freighter vessels pose a risk because:

- They will be 'new' to the Falkland Islands on each visit having been in other biogeographical regions where they may have become colonised with flora and fauna local to the donor region,
- They will most likely originate in Europe / USA which is a compatible donor region,
- They will spend time passing thorough the Tropics, which may provide a natural barrier to the introduction of bio-fouling species, but cannot be relied upon, and
- They will spend time at the Temporary Dock Facility (TDF) and / or Falklands Interim Port And Storage System (FIPASS) to the east of Stanley while cargo is transferred and while they refuel, allowing opportunity for the transfer of bio-fouling organisms.

Similarly the LTVs are considered to pose a risk with regard to species introduction from bio-fouling because:

- They will be 'new' to the Falkland Islands, on each visit, having been in other biogeographical regions where they may have become colonised with flora and fauna local to that region,
- Regardless of their origin, they may harbour viable organisms, while those from dissimilar climates may be less able to thrive, some tropical organisms are known to be able to flourish in temperate climates, and
- The LTVs will enter Berkeley Sound where they will anchor for a period of weeks to several months, allowing time for the potential translocation of bio-fouling organisms to the substrate in the Sound.

Table 10.95: Factors that may influence species introduction and / or invasion from Phase 1 & 2 vessels

Vessel	Donor region	Influencing factors						
		Donor / recipient climates similar	Passing through dissimilar climates *en route*	Activity of vessel	Carrying ballast on arrival	Time spent inshore	'New' to region:	
							Once	Each time
MODU	Europe / Asia	Y / Unknown[1]	Y	Drilling offshore	Y	-	✓	-
FPSO	Middle East / Asia	Unknown[1]	Y	Production offshore	Y	-	✓	-
Ad hoc freighter vessels	Europe / USA	Y	Y	Delivery of cargo to TDF in Stanley	N[2]	✓	-	✓
Anchor Handling Tug Supply (AHTS) vessels	Europe	Unknown	Y	Tow of MODU to region and MODU support, may need to refuel inshore at TDF	Y	✓	✓	-
Multi-Role Supply Vessels / Emergency Rescue and Response Vessel	Europe	Unknown[2]	Y	Supply vessels operating between field & TDF, on standby for FPSO and MODU, may need to refuel inshore at TDF	Y	✓	✓	-
Offshore Construction Vessel (OCV) and Platform Support Vessels (PSV)	Norway / Europe	Y	Y	Transit back and forth between field and LTVs in Berkeley Sound to collect cargo for installation in field	Y	✓	✓	-
Large Transport Vessels	Europe / USA	Y	Y	Arrival and standby in Falkland Islands for use as floating logistics barges in Berkeley Sound	N[2]	✓	-	✓[3]
Conventional Trading Tanker	Unknown	Unknown	Unknown	Arrival and standby offshore Falkland Islands	Y	-	-	✓[4]

[1] The initial location is unknown at the time of writing and it is not possible to estimate which donor region could be considered to be worst-case as numerous factors influence the process.
[2] Vessels arriving laden with cargo are assumed to be carrying little or no ballast.
[3] Note that the individual LTVs may be changed out for other LTVs and therefore, each LTV could be 'new' to the Islands.
[4] The same CTT may make repeat trips under a long-term contract, but a variety of vessels is likely over Field Life.

10.12.4.4 High-risk invasive non-native species

Dawson *et al.* (2022) applied a 'horizon scanning' approach to identify high-risk invasive non-native species in UKOTs. High-risk species were identified according to their potential for arrival, establishment, and likely impacts on biodiversity and ecosystem function, economies, and human health. Across the UKOTs (which ranged in location and therefore local climates), 231 taxa were included on high-risk lists. The highest-ranking species were:

- The Asian green mussel (*Perna viridis*),
- Little fire ant (*Wasmannia auropunctata*),
- Brown rat (*Rattus norvegicus*), and
- Mesquite tree (*Prosopis juliflora*).

Shipping containers were identified as the introduction pathway associated with the most species.

While some of the above may not be high-risk to the Falkland Islands owing to the difference between the donor and recipient climates, the outcomes of the exercise provide a guide for remote islands and archipelagos to focus ongoing biosecurity and surveillance aimed at preventing future incursions (Dawon, *et al.,* 2022), and managing them *via* application of, for example, dedicated and project-specific Biosecurity Management Plans

10.12.5 Industry-standard mitigation measures

The most cost-effective way to avoid the adverse impacts associated with the introduction of invasive non-native species is prevention. This is most effective when high-risk non-native species are identified before arrival and introduction is prevented through biosecurity measures (Dawson, *et al.,* 2022).

In line with the legal compliance requirements and published IMO guidelines, the following will be in place for all vessels, to prevent, or minimise, the introduction of non-native species:

- Ballast Water Management Plan (BWMP), and
- Biofouling Management Plan (BFMP), and
- Biosecurity Management Plan (BMP).

Further, in line with its Contractor Management Standard (Section 3.2.15), Navitas will carry out pre-selection and / or pre-mobilisation audits. These audits will be used to ensure that all contracted vessels arriving in the Falklands are compliant with the current expectations under IMO (Section 10.12.1.1).

The use of these plans is factored into the initial risk assessment below. However, it should be noted that while the measures in the above plans will reduce the likelihood of non-native species introductions, neither can completely eliminate the risk.

Lastly, it should also be noted that FIG will implement its own biosecurity inspection and management processes and may refuse visits, or quarantine assets if it believes the biosecurity risk is too high.

10.12.5.1 Ballast Water Management Plan

The IMO BWM regulations came into force in 2019 (Section 10.12.1.1.1.3) and the requirements within are industry-standard best practice. The BWMP is key to the safe and effective exchange of ballast water. BWMPs are specific to each vessel and include a detailed description of the actions to be taken to implement the BWM requirements and supplemental practices.

The BWMP should describe:

- The duties of key shipboard control personnel undertaking ballast water exchange at-sea:

- Such personnel should be fully conversant with the IMO BWM and the safety aspects of ballast water exchange and, in particular, the method of exchange used on-board their ship.

- The need for a Ballast Water Record Book (BWRB) to record the following (in compliance with the IMO BWM Regulation D1 (Section 10.12.1.1.1.1)):
  - When and where ballast water is taken on board, circulated or treated for BWM purposes and discharged to sea,
  - When ballast water is discharged to a reception facility,
  - Accidental or other exceptional discharges of ballast water, and
  - When sediment in ballast tanks should be removed and how it is disposed of.
- Detail on the ballast water treatment (in compliance with the IMO BWM Regulation D2 (Section 10.12.1.1.1.2):
  - The method will be class-certified under the MEPC (2008a) (**Note:** Navitas will discuss with the Harbour Authority whether alternative methods would also be acceptable).

Although not a requirement of the IMO, Navitas has committed to taking samples of ballast for analysis from all vessels coming inshore and arriving 'in-ballast' as detailed in Section 10.12.10.1.1. Ongoing review of sampling results will be drawn into the EMMP (Chapter 15).

10.12.5.2 Biofouling Management Plan

The IMO Guidelines for the Control and Management of Ships' Biofouling to minimise the Transfer of Invasive Aquatic Species do not describe legal requirements but are considered to indicate best practice. These guidelines were adopted by the MEPC in 2011.

The purpose of the BFMP is to outline measures used to control and manage biofouling on vessels to minimise the transfer of non-native aquatic species.

The BFMP should provide details on:

- The AFS and operational practices or treatments used, including those for niche areas and sea chests,
- The hull locations susceptible to biofouling, schedule of planned inspections, repairs, maintenance and renewal of AFS,
- The recommended operating conditions suitable for the chosen AFS and operational practices,
- The safety of the crew, including details on the AFS used,
- The need for the use and maintenance of a Biofouling Record Book (BRB), and
- The documentation required to verify any treatments recorded in the BRB (see MEPC, 2011 - Appendix 2).

10.12.5.2.1 Antifouling coatings

Until relatively recently, the majority of the world shipping fleet used tributyltin (TBT) based antifouling treatments, which proved to be very effective but had serious environmental side-effects. Since 2008, TBT coatings have been banned (IMO, 2001) and alternative treatments are now used to prevent biofouling (see Yebra, *et al.,* 2004 for a review). One of the most effective inhibitors of marine growth is copper, which is inherently toxic to marine organisms. Copper based coatings slowly release copper into the marine environment and are effective long-term solutions to prevent biofouling (Brooks and Waldock, 2009). Although there is potential for a localised elevation in the concentration of copper,

the overall amounts released from antifouling paint are small in comparison to natural inputs (mostly runoff from sources on land).

The potential impacts of copper anti-fouling on non-target organisms have been the subject of debate (see Brooks and Waldock, 2009). Overall, copper toxicity from an antifouling source only becomes a problem in the marine environment in isolated water bodies, such as enclosed marinas and harbours that experience little water exchange, with high levels of boating activity.

An anti-fouling coating philosophy for semi-stationary and long-term objects (e.g., the FPSO and Turret Buoy) will be developed (as is indicated in the EMMP, Chapter 15) and all project vessels will be treated with IMO-compliant antifouling treatments, such as slick self-polishing polymer paints. Many of these systems include copper to inhibit marine growth, which is released slowly and is deemed compliant under the IMO standards, which consider environmental risks. Therefore, the small quantities of copper released into dynamic marine conditions are considered to pose no risk to non-target marine organisms and are not assessed further in this EIS.

10.12.5.3 Biosecurity Management Plan

An integrated management approach will be implemented and will include:

- Prevention:
  - Preventative measures include identifying potential pathways and implementing controls to minimise the impact of invasive species (e.g., through ballast water and biofouling management).
- Monitoring, detection and elimination:
  - Settlement plates will be placed in Berkeley Sound and at the TDF / Stanley Harbour prior to and during the construction phase of the project, and
  - Vermin attraction / containment / detection devices will be used on vessels to monitor pest populations and activity. Visual inspections of the devices will identify specific areas of infestation, if any, and assess the need for further action.
    - Rat guards will be used when vessels are berthed at the TDF in Stanley Harbour.
- Management and controls:
  - If a potential new marine species is detected a pathway analysis will be conducted to attempt to determine where / how the species had been brought to the Islands. If appropriate, safe and feasible, efforts will be made to eradicate the invasive species.
  - In the event of a biosecurity incident, FIG Biosecurity will be informed and asked to advise on required treatment and disposal (if practicable), and
  - Awareness campaigns and training will be used to highlight biosecurity risks.
- Regulatory inspections:
  - If a vessel with an observed / documented fouled hull arrives to be offloaded at the TDF, the TDF Operator will coordinate the relevant governmental agencies / regulatory bodies to ensure appropriate measures are taken. However, under the BMP and vessel vetting process, a vessel berthing at the TDF with a fouled hull is considered unlikely.

10.12.6 Risk assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect'. Assessment of unplanned events includes an assessment of the overall impact followed by an assessment of the 'Likelihood of Occurrence' to determine the 'Risk'.

A summary of the risk assessment outcomes for this Development is tabulated in Section 10.12.12, which shows the worst-case impact / risk for each activity.

As identified in Section 10.12.4.3 (and Table 10.95), not all vessels present an equal risk of introducing invasive species and the *ad hoc* freighter vessels and the LTVs are those considered to pose the greatest risk with regard to bio-fouling. Nonetheless, for the purposes of the risk assessment, the Phase 1 & 2 vessels can be broadly split into four groups:

- Sea Lion in-field vessels that visit the Falklands once and work within the Falklands Conservation Zones e.g., the MODU, FPSO, MODU / FPSO offshore support vessels, etc.,
- *Ad hoc* freighter vessels that may visit the Falklands several times a year from varying donor regions and will enter inshore waters, but carry little or no ballast water,
- Semi-stationary floating storage vessels (LTVs) that visit the Falklands once and anchor temporarily in inshore waters (for a combined period of up to 13 non-consecutive months), and
- CTT vessels that will visit the offshore FPSO multiple times per year carrying large quantities of ballast water.

The impact of marine invasive species would be the same for all the vessel types above, however the likelihood of introducing the non-native species differs depending upon the influencing factors described in Section 10.12.4.3 above such that the associated risks may differ. Therefore, the impact of species introduction is assessed once for all vessels while the likelihoods, and therefore the risks, are considered separately below.

10.12.6.1 The impact of introducing invasive species, all vessels

With regard to the sensitivity of receptor, the immediate impact may be to one species only, however broader impacts could exist for the biodiversity and ecosystem as a whole which are difficult to estimate with so many variables in the process. Equally, it is not easy to determine the zone of influence of the Development as this would depend upon the proliferation of the invading species. While the impact would greatly depend upon which species were introduced (Section 10.12.4.1), the potential for impacts to marine biodiversity as a whole could be such that the sensitivity of the receptor is considered to be '**High**'.

If invasive species were introduced during the Phase 1 & 2 Development the impact on the ecology of the Islands may not be evident for a number of years. However, the long-term implications for the Islands' marine ecology could be severe and irreversible (Section 10.12.4.2). Given the potential impact of invasive species, as seen in previous case studies around the world (Section 10.12.4.2.1), there is the possibility that invasive species could have an 'extensive effect over a large (regional) area with the potential for long-term irreversible damage to species / regional population / habitat / ecosystem'. Therefore, following the precautionary principle, the severity of the impact is considered to be '**Major**'.

Therefore, overall the significance of the potential impact is assessed as '**High (20)**'.

10.12.6.2 Likelihood of occurrence

Given the number of vessels that visit Stanley from all around the world (e.g., fishing vessels and cruise ships) and the apparently few invasive species in the Harbour (SMSG, 2011), the introduction of invasive species appears to have been an uncommon event thus far. However, introduction of invasive species has happened both in the Falklands a number of times and by the O&G industry elsewhere.

The following assessment of the likelihood of the introduction of marine invasive species by different vessels assumes that industry-standard IMO guidelines are followed (Section 10.12.4.4). Phase 1 & 2

vessels will comply with the BWMC and the associated culture change across the whole shipping industry will reduce the overall likelihood of introducing non-native species in ballast water.

Nonetheless, when assessing the likelihood of marine species invasion, it is important to consider:

- The process by which species become invasive (Section 10.12.4.1),
- The factors that influence the likelihood of species introduction / invasion (Section 10.12.4.3), and
- How these apply to the Phase 1 & 2 vessels (Section 10.12.4.3.1).

After all, not all species that are introduced *via* biofouling or ballast water will become invasive and therefore, the likelihood of species introduction is not the same as the likelihood of species invasion and both outcomes must be taken into account. However, it is important to note that while these influencing factors are taken into account for each of the assessments below, the likelihoods rarely differ enough to justify a lower category of likelihood according to the definitions provided in the EIA methodology (Section 8.6.2).

10.12.6.2.1 Risk of invasive species introduction by Sea Lion in-field vessels

As described above, the significance of the impact of species introduction is considered to be '**High (20)**'.

The origin of some of the in-field vessels remains unknown but it is likely that they will arrive with cargo and therefore little ballast water (Table 10.95 above) although there is a risk that vessels could be carrying bio-fouling organisms on arrival. However, as these vessels will be under direct charter to Navitas the maintenance history of biofouling and hull cleaning will be known. Importantly, these vessels will remain within Falklands waters while supporting the Development and therefore the risk of transporting non-native species is further reduced. However, while these influencing factors may somewhat reduce the likelihood (Section 10.12.4.3), some potential does remain and therefore, to take a precautionary approach, the likelihood of in-field vessels introducing potentially invasive species is considered to be '**Unlikely**'.

Therefore, the overall significance of the risk of introducing non-native marine species *via* Sea Lion in-field vessels, which may then go on to become invasive is considered to be '**Moderate (10)**'.

10.12.6.2.2 Risk of invasive species introduction by ad hoc freighter vessels

As described above, the significance of the impact of species introduction is considered to be '**High (20)**'.

It is likely that *ad hoc* freighter vessels will be shipping from temperate climates of northern Europe / USA throughout all three Stages of the Phase 1 & 2 Development such that the 'donor climate' may be compatible with the Falkland Islands climate (Table 10.95 above). While these vessels will travel through the potential natural barrier of the Tropics and will be carrying little ballast, each vessel will be 'new' to the Islands with each return trip. Therefore, the *ad hoc* freighter vessels can present multiple pathways for the introduction of non-native species, especially in regard to biofouling organisms. While these influencing factors may, on balance, reduce the likelihood (Section 10.12.4.3), some potential does remain and therefore, to take a precautionary approach, the likelihood of coaster vessels introducing marine non-native species that go on to become invasive is considered to be '**Unlikely**'.

Therefore, the overall significance of the risk of introducing non-native marine species *via ad hoc* freighters, which may then go on to become invasive is considered to be '**Moderate (10)**'.

10.12.6.2.3 Risk of invasive species introduction by Large Transport Vessels (LTVs)

As described above, the significance of the impact of species introduction is considered to be '**High (20)**'.

Up to four LTVs (and a maximum of two at any one time) will be used inshore in Berkeley Sound to act as floating logistics vessels to store equipment before it is required to be installed offshore. The subsea construction schedule dictates that up to two LTVs will be present for a cumulative total of 13 months (Section 5.5.1). It is likely that these vessels will travel from European / USA ports (Table 10.95 above) and therefore the donor climate may be compatible with the Falklands. Further, although these vessels will be laden with cargo on arrival (therefore carrying minimal ballast water), a prolonged stay in inshore waters may give any biofouling organisms the opportunity to be transferred or to spawn. Further, the LTVs will be changed out over the duration such that vessels which are 'new' to the Islands arrive more than once. While these influencing factors may balance out to reduce the likelihood (Section 10.12.4.3), the likelihood does remain and therefore, to take a precautionary approach, the likelihood of LTVs introducing marine non-native species that go on to become invasive is considered to be '**Possible**'.

Therefore, the overall significance of the risk of introducing non-native marine species *via* LTVs, which may then go on to become invasive is considered to be '**Upper Moderate (15)**'.

10.12.6.2.4 Risk of invasive species introduction by purchaser's vessels (CTTs)

As described above, the significance of the impact of species introduction is considered to be '**High (20)**'

CTTs will arrive at the FPSO for direct offtake of the crude oil at regular intervals throughout Stages 2a, 2b and 3 of the Phase 1 & 2 Development from, as yet, unknown locations. While the CTT may travel from a tropical climate, it is still possible for non-native species in the ballast water or fouling on the hull to take hold (Section 10.12.4.3). Notably, the vessel will be carrying a large volume of ballast water and each visit by a CTT will be 'new', thus representing a new pathway for the transport of potentially invasive species (Table 10.95 above). Given the use of standard flushing procedures and treatment (Section 10.12.4.4), the resulting likelihood of introducing non-native species in ballast water will be reduced. Further, Navitas will apply a vetting system whereby the Oil Companies International Marine Forum (OCIMF) Ship Inspection Report Programme (SIRE) process is applied, which requires the inspector to verify that the vessel complies with the BWMC and that ballast water management plans, record books, certificates and biofouling management plans are in place and up to date for the incoming CTTs. However, while these influencing factors and mitigations may somewhat reduce the likelihood (Section 10.12.4.3), the likelihood does remain and therefore, to take a precautionary approach, the likelihood of the CTT introducing marine non-native species which then go on to become invasive is considered to be '**Unlikely**'.

Therefore, the overall significance of the risk of introducing non-native marine species *via* CTTs, which may then go on to become invasive is considered to be '**Moderate (10)**'.

10.12.7 Project-specific mitigation measures

The changes in legislation to regulate ballast water management practices and guidelines to manage biofouling outlined above (Section 10.12.4.4) will greatly reduce the likelihood of introduction. However, although these measures are likely to reduce the risk to ALARP, the true impact of these changes is currently unknown as the Convention only came into force in September 2019. Therefore, the initial assessment presented above remains very precautionary; largely due to the potential for long-term (irreversible) impact and the history of non-native species introductions by shipping around the world.

Given that the risks of introducing marine invasive species are considered to be **'Moderate (10)'** and **'Upper Moderate (15)'** despite the legislation and use of industry-standard mitigations, it is necessary to consider project-specific mitigation measures for all vessels and both types of species introduction. As it can be almost impossible to remove invasive marine species, the focus of mitigation should be on prevention.

10.12.7.1 Ballast water

All vessels will operate a D3 ballast water management plan with a D2 level of ballast water treatment, which will be vetted prior to hire of vessels (Section 10.12.5.1). This is considered to lower the risk to ALARP so no additional mitigation measures for impacts from ballast water discharges are proposed.

10.12.7.2 Biofouling

It is recognised that the initial risk assessments for all vessel types are considered to be significant. However, due to the physical difficulty of accessing and monitoring the niche spaces where biofouling organisms are most likely to persist, the introduction of non-native species *via* biofouling is arguably more difficult to mitigate than introduction through ballast water. The risk posed by each vessel is linked to its previous history (geographical location and activity), maintenance schedule (dry-docking and condition of antifouling coatings) and residence time. For these reasons, the risk posed by each vessel should be assessed on a case-by-case basis.

In order to specifically mitigate the **'Upper Moderate'** risk of species introduction *via* bio-fouling which is posed by the LTVs used as floating logistics barges, these vessels will be required to have a hull inspection prior to transport to Berkeley Sound and consideration will be given to hull cleaning, depending on the results of the survey. If hull cleaning is required, this would not be done in Falklands waters. Further, the standard used will be agreed in collaboration with FIG, with reference to, for example, the IMO 2023 Biofouling Guidelines (Table 1 - Rating Scale) as appropriate.

10.12.8 Residual impacts and risks

10.12.8.1 Sea Lion in-field vessels

Given that the risk posed by in-field vessels is a one-off and Navitas is likely to have stricter control of auditing and maintenance procedures prior to deployment, the initial assessment is considered to be ALARP. Project-specific measures are largely based on monitoring which may help to detect any breaches of biosecurity but do not warrant a change in the likelihood. Therefore, it is considered appropriate and precautionary, for the overall significance of the risk to remain '**Moderate (10)**'.

10.12.8.2 *Ad hoc* freighter vessels

Throughout the course of Field Life, the project-specific measures cannot eliminate the risk entirely and introduction of invasive species world-wide is a frequent occurrence. Further, given the number of 'unknowns' within the assessment, it is considered appropriate and precautionary, for the overall significance of the risk to remain '**Moderate (10)**'. Outcomes of sampling and monitoring throughout Field Life (Section 10.12.10.1) will enable this assessment to be 'ground-truthed' throughout the Development.

10.12.8.3 Large Transport Vessels

Hull inspections for potentially invasive species for LTVs prior to departure for the Falklands, together with appropriate action if required, will reduce the likelihood of introducing biofouling non-native species. However, hull inspections and treatments are still limited in the extent to which they can eliminate biofouling and therefore, the post mitigation likelihood of introducing invasive species can only be reduced from '**Possible**' to '**Unlikely**'. Therefore, with a '**High**' impact and a likelihood rating of '**Unlikely**', the residual risk for in-field vessels is only lowered to '**Moderate (10)**'.

10.12.8.4 CTTs

CTTs arriving at the Sea Lion field to load cargo and discharge ballast water will have undergone a vetting process to ensure compliance with the Biosecurity Management Plan which will include compliance with their BWMP and BFMP. These mitigations are already factored in as industry standard (section 10.12.5.1), so the post mitigation likelihood of introducing invasive species cannot be reduced and remains '**Unlikely**'. Therefore, with a '**High**' impact and a likelihood rating of '**Unlikely**', the residual risk for in-field vessels remains '**Moderate (10)**'.

10.12.9 Cumulative impact

Numerous vessels arrive in Stanley Harbour and Berkeley Sound from all over the world and there is the potential for this to lead to cumulative impacts through increased 'concentration' and increased 'extent and proportion' (Section 8.9.1). To varying degrees (according to the influencing factors described in Section 10.12.4.3 above), all of these vessels, which may not have stringent management systems in place, have the potential to introduce non-native species.

Vessels that spend prolonged periods laid-up in ports have the greatest potential as vectors for non-native species, especially biofouling. However, vessels associated with the Phase 1 & 2 Development will increase the number of introductory pathways for non-native species, which adds to the existing threat from other vessels. Between 2010 and 2022 an average of 304 vessels visited Berkeley Sound annually. In support of the Stage 1 and 2 subsea construction campaigns, up to two LTVs will be anchored in Berkeley Sound for a combined period of up to 13 months with the OCV / PSV visiting regularly to transport subsea equipment offshore. There will also be *c.* 12 *ad hoc* freighter visits to the Islands. These vessel visits all lead to cumulative impacts through increased 'concentration'.

There is also potential for vessels based in the Islands to accelerate the spread of invasive species that are already present in the region. For example, the invasive vase tunicate (*Ciona intestinalis*) was historically introduced to Stanley Harbour and Mare Harbour (SMSG, 2011). This species has a high potential for natural dispersion and is known to be established in Port William and may have reached Berkeley Sound already (P. Brickle, *pers. comm.*). Vessels based in Stanley Harbour but travelling elsewhere have the potential to accelerate the natural spread of this, and potentially other invasive species, to other parts of the archipelago. It may be too late to prevent the further spread of the invasive vase tunicate to Berkeley Sound but future monitoring should focus on the potential pathways to spread invasive species within the Islands and identify pre-existing non-native species and trends. Although this is not solely an O&G issue, Navitas has committed to monitoring of non-natives connected with their activities (Section 10.12.10.1).

At present, there is limited exploitation of inshore resources and aquaculture in the Falklands but this could develop in the future and the introduction of parasites, disease, competitors or predators could impact these industries.

10.12.10 Confidence

While the nature of the impact of invasive species on the marine environment will depend on the species involved, it is understood that the introduction, and potential invasion, of any non-native species can be detrimental and the impacts are well documented.

However, predicting the likelihood of introducing a species, the likelihood of it becoming invasive and then the extent of the impact of any particular invasive species on the local environment is very difficult. The likelihood of vessels carrying potentially invasive species is very vessel-specific and depends on a number of factors (as described in Section 10.12.4.3), many of which are currently unknown e.g., origin and history of vessels etc. Therefore, while, the mitigation practices proposed are used internationally and are regarded as best-practice, the number of unknowns is such that the confidence in the overall assessment is considered to be **'Uncertain'** such that monitoring is required.

10.12.10.1 Monitoring required

The vetting of third-party vessels will require scrutiny of ballast water exchange logs, BMPs and BRBs during pre-selection and pre-mobilisation audits (Section 10.12.4.4).

While the IMO requirements implement preventative mitigation against the introduction of non-native species, experience in other regions, such as parts of the UK, has shown that it is still prudent to undertake monitoring. This should be carried out to:

- Identify 'background' levels of non-native species so that existing problems or trends are not inappropriately attributed to the Phase 1 & 2 Development,
- Confirm that valuable sites are not being put at risk from non-native species resulting from the proposed Development, and
- Confirm that non-native species are not being introduced by the proposed operation in general.

Monitoring specifically related to this project requires:

- The deployment of settlement plates in Stanley Harbour, Berkeley Sound and other appropriate locations,
- The use of metagenomic[90] technology to detect genetic material from non-native species in the environment (water samples), and
- In the event that marine invasives are found, pathway analyses will be conducted to determine where / how invasives are being brought into the Islands.

10.12.10.1.1 Ballast water sampling

While sampling of each discharge is not required by IMO, to ensure assessment of ballast waters against IMO Regulation D2 (Section 10.12.10.1), Navitas will ensure samples are taken of discharges in Berkeley Sound when the OCVs/PSVs arrive in the Sound. As a precaution and due to the potentially significant impacts of introducing marine invasives species, even though these vessels will have conducted a ballast exchange operation at the 200 nm limit, in compliance with IMO, they will be discharging this ballast into Berkeley Sound as they take on cargo from the LTVs. These samples will be analysed in a specialist laboratory for monitoring purposes and results shared with FIG Biosecurity. While the length of time required for transporting and analysing the sample means the results are not known until after the ballasting operation, the results are used as a guide to future operations, and to confirm the ballast exchange operations are effective.

10.12.11 Offsetting

For significant residual and impact and risks ('Moderate' or above), offsetting *via* a Carbon and Biodiversity Offsetting Fund is proposed, see Section 8.11 for further details.

10.12.12 Findings summary

[90] The study of the structure and function of entire nucleotide sequences isolated and analysed from all the organisms (typically microbes) in a bulk sample.

Table 10.96: Summary of the residual risk assessment for the introduction of invasive marine species during the Phase 1 & 2 Development

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Introduction of invasive species by Navitas' Sea Lion in-field vessels	Marine Invasive species (biosecurity)	Introduction of marine invasive species through ballast water or biofouling Potential to have irreversible impact on biodiversity and designated sites	Unplanned	1	High	Major	Unlikely	**Moderate (10)**	**Moderate (10)**	**Uncertain**	**Industry-standard:** Pre-selection and pre-mobilisation audits. Compliance with BWMC requirements - Exchange of ballast water *en route* or D2 treatment process. Vessel specific BMP and audit prior to leaving shipyard for to Falkland Islands. OCIMF SIRE Programme will be applied to audit BWMP and the BFMP and all records, Implementation of a reviewed BMP. **Project-specific:** LTVs used as floating logistics vessels will have their hulls inspected prior to departure for the Falklands, Non-natives species monitoring programme and ballast sampling.
Introduction of invasive species inshore by *ad hoc* freighter vessels			Unplanned	1, 2a, 2b & 3	High	Major	Unlikely	**Moderate (10)**	**Moderate (10)**	**Uncertain**	
Introduction of invasive species inshore by the LTVs			Unplanned	1, 2a & 2b	High	Major	Possible	**Upper Moderate (15)**	**Moderate (10)**	**Uncertain**	
Introduction of invasive species offshore by CTTs			Unplanned	2a, 2b & 3	High	Major	Unlikely	**Moderate (10)**	**Moderate (10)**	**Uncertain**	

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

10.13 Introduction of terrestrial non-native species

Table of Contents

10.13.1 Introduction 965
10.13.1.1 Falkland Islands legislation and guidelines 965
10.13.2 Sources of non-native species introduction 966
10.13.2.1 Importation of materials and equipment 966
10.13.2.2 Importation of foodstuff 966
10.13.2.2.1 Importing fruit and vegetables 966
10.13.2.2.2 Importing Food of Animal Origin (FOAO) 967
10.13.2.3 Disposal of International catering waste 967
10.13.3 Potential receptors 967
10.13.4 Characterising and quantifying the risk of non-native species 967
10.13.4.1 Potential consequences of species introduction 967
10.13.4.1.1 Previous examples of non-native terrestrial species introduction 968
10.13.4.1.2 Previous biosecurity 'near misses' in the Falklands O&G industry 968
10.13.4.2 Cargo delivery routes 969
10.13.5 Industry-standard mitigation 969
10.13.5.1 TDF Biosecurity Management Plan 970
10.13.5.1.1 Planning and preparation 970
10.13.5.1.2 Importation of food and food waste disposal 971
10.13.6 Risk assessment 971
10.13.6.1 Introducing terrestrial non-native species in marine or air freight 971
10.13.6.2 Introducing disease or pathogens in food of animal origin 972
10.13.7 Project-specific mitigation 972
10.13.7.1 Introduction of terrestrial non-native species in marine or air freight 972
10.13.8 Residual risk 973
10.13.8.1 Introducing terrestrial non-native species 973
10.13.9 Cumulative effects 973
10.13.10 Confidence 973
10.13.10.1 Monitoring required 973
10.13.11 Offsetting 973
10.13.12 Findings summary 973

10.13.1 Introduction

Numerous vessels and charter flights will be used throughout Stages 1, 2a, 2b and 3 of the Phase 1 & 2 Development to deliver supplies to the Falklands. While the delivery of cargo is a planned event, the introduction of non-native terrestrial species associated with cargo would be an unplanned event and it is therefore necessary to consider this risk. The potential for the introduction of non-native species was also raised as a concern by stakeholders during scoping consultations (Chapter 6).

Historically, many species have been introduced to the terrestrial environment of the Falklands, some intentionally and some unintentionally. Species introduced from similar climates and which have the potential to flourish in the Falkland Islands are of particular concern. For example, ecologically, the terrestrial habitat of the Falklands is comparable with that of the UK and species that may be transported from the UK are very likely to survive and potentially become established in the Falklands (*c.f.* European earwig, see Section 10.13.4.1.1).

Introduced species can impact on native species through predation, competition and habitat loss which can affect the biodiversity of the Islands. Russell *et al.* (2017) noted that impacts to biodiversity tend to be disproportionately worse for islands, as compared to continents, due to the relatively high number of endemic species. In 2015, a review of the Falklands Biodiversity Framework upgraded invasive species and biosecurity from a medium to high priority threat (FIG, 2016a). In addition, invasive species are mentioned extensively in FIG's Environment Strategy as a high priority (FIG, 2021a).

Equally, micro-organisms could introduce disease to Falklands' livestock. Since 2002, the Falklands Islands have been EU accredited for the exportation of mutton and lamb and approval to export beef has recently been achieved. Countries to which these products are exported must be assured that the goods received are free from pests and disease and therefore biosecurity plays a key role in safeguarding the export industry. In recent years, there has been a concerted effort by FIG to reduce the risk of materials arriving on the Islands unintentionally introducing more non-native species and consequently, biosecurity procedures have become more stringent.

This chapter specifically assesses the risk of introducing non-native species to the terrestrial environment *via* cargo deliveries associated with the Sea Lion Phase 1 & 2 Development.

Note: the risk of introducing non-native species to the marine environment is assessed in Section 10.12 and other impacts associated with vessel use and fixed-wing flights are described elsewhere in this document, as described in Table 2.2.

10.13.1.1 Falkland Islands legislation and guidelines

The import of goods that potentially pose a biosecurity risk is to some extent controlled by:

- The Plant Disease Regulation and Plant Import Regulation Ordinance.
- The Prohibited Goods Ordinance 1992.
- Animal Health (Emergency Measures for Outbreaks of Infectious Diseases) Order 2022.

As FIG officials, Biosecurity Officers are also invested with the powers of Customs Officers, which allows them to work under the Customs Ordinance 2003.

Additionally, preventative guidelines are provided in:

- 'Falkland Islands Biosecurity, protecting our home, environment and economy' (FIG, 2015c).

The Falklands rely on imported goods, which are categorised into groups depending on their perceived biosecurity threat. The import of higher risk items is controlled to ensure that threats to the Islands' biosecurity are minimised. Some categories of import may require an Import Permit such as live

animals, meat, dairy products, eggs and plant materials, which include fruit and vegetables. FIG (2015r) specifies the requirement for importers to notify the Biosecurity Officer of arrivals in advance so that inspections can be arranged. All cargo is inspected for 'pests, diseases and invasive species' prior to being released.

Further, in compliance with the FIG biosecurity declaration, all visitors to the Falklands, whether by air or sea, are briefed on what is / is not allowed to be imported to the Islands. Each passenger must sign a declaration to the effect that they are complying with the regulations. Additionally, visiting vessels are also briefed on the disposal of organic waste, and other waste streams, *via* the 'Falkland Islands Ports and Harbours Information' (FIG, 2024a).

10.13.2 Sources of non-native species introduction

The key potential source of non-native species introduction associated with the Phase 1 & 2 Development is the delivery of cargo to the Falkland Islands. Any cargo arriving from outside the Islands in support of the Sea Lion Development poses a risk of unintentionally introducing non-native species. Deliveries of cargo will occur via:

- Initial import / arrival of the offshore support vessels (i.e., the AHTS, ERRV, PSV, MRSV),
- *Ad hoc* freighter vessels, and
- Charter flights.

A full inventory of the vessels used during Stages 1 to 3 of the Development is provided in Section 5.11.2.

Non-native species may be found within the intended cargo, within the associated packaging or within inadvertently adhered material e.g., mud from the site of origin on the bottom of a container. With regard to cargo therefore, introduction of species can result from the:

- Importation of materials and equipment,
- Importation of food stuffs:
  - Fruit and vegetables, and
  - Food Of Animal Origin (FOAO).
- Disposal of international catering waste.

10.13.2.1 Importation of materials and equipment

All non-food materials related to the Development are likely to be extensively packaged in containers, wood and plastics, all of which can be contaminated with invertebrates, seeds and soil (containing micro-organisms) that can adhere to the outside of packaging and / or may be hidden within cargo.

10.13.2.2 Importation of foodstuff

10.13.2.2.1 Importing fruit and vegetables

It is anticipated that fresh fruit and vegetables will be imported into the Falkland Islands on the charter flights utilised during the Development. While fresh fruit and vegetables entering the local market *via* this route has been welcomed by local residents during previous exploration campaigns and was considered a positive impact during informal consultations on the Phase 1 & 2 Development (Chapter 5), it also represents one of the greatest risks of introducing non-native species within the produce, adhering soil or packaging.

Additionally, it may be necessary to air freight other cargo from the UK to Mount Pleasant *via* the charter flight. While this is not the preferred method for importing materials to the Islands, it may be used if urgent supplies are required.

10.13.2.2.2 Importing Food of Animal Origin (FOAO)

During previous exploration campaigns frozen meat for human consumption was acquired from outside the EU (albeit EU certified) and was imported to the Falklands as 'in-transit' goods. In accordance with the Falklands biosecurity policy, these in-transit goods were kept secure (under Customs seal) on land and were transferred to the drilling rig support vessel under supervision from the Biosecurity Officer or Customs.

All FOAO supplied during the Phase 1 & 2 Development will be contractually required to meet UK / EU standards and will be certified as such.

10.13.2.3 Disposal of International catering waste

If any food stuff arrives on-board vessels or is imported from outside the Falklands, passing through the Islands in-transit, there is the potential for the introduction of harmful pathogens within the food or packaging. This is an important consideration when managing waste (Section 10.10).

10.13.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify the specific receptors upon which the risks of terrestrial invasive species warranted further investigation (Chapter 9). The specific receptors that may be impacted include:

- All terrestrial flora and fauna, and therefore biodiversity in general, including designated sites (Section 7.4 and Section 7.5),
- Livestock and agriculture (Section 7.7.2.4), and
- Human population (Section 7.7.2).

The above may be affected in the event that:

- Non-native species which thrive to the point of becoming invasive tend to outcompete or depredate native species (although the precise receptor species would depend on the species introduced),
- The introduction of agricultural disease or pests impacted on livestock (Tangible Property) and associated exports with socio-economic implications, and
- Agricultural export became unviable which would indirectly affect the culture or 'way of life' on the Islands.

10.13.4 Characterising and quantifying the risk of non-native species

When characterising and quantifying the risks of non-native terrestrial species introduction, it is necessary to assess the:

- Potential consequences of species introduction,
  - Previous examples of species introduction.
- Cargo delivery routes.

10.13.4.1 Potential consequences of species introduction

All invasive species have the potential to impact dramatically on both biodiversity and tangible property with regard to livestock. With regard to the potential impact of non-native species introduction there are three main outcomes:

1. The species arrives on the Islands but is noticed immediately upon arrival and is removed *via* containment and treatment,

2. The species is unintentionally introduced to the Islands, is not noticed immediately and begins to 'take hold' but is effectively removed and disposed of once its presence is discovered, or
3. The species is unintentionally introduced, finds a niche and becomes established within the Falkland Islands and is thus considered 'invasive'.

While all species might fall under any of the categories above, it is generally understood that small mobile organisms (such as invertebrates), pathogens (micro-organisms) and plants are the most difficult to detect and are the most difficult or costly to eradicate once established. Eradication of invasive species on islands is possible in the early stages of introduction, particularly for mammals, but for other invasives, control may be the only option (Russell, *et al.,* 2017).

With regard to pathogens, it is possible that FOAO can harbour disease or pathogens that could be disastrous for the agriculture in the Islands. For example, if foot and mouth disease were to be introduced, it could result in large numbers of animals being destroyed and devastate the meat export industry.

10.13.4.1.1 Previous examples of non-native terrestrial species introduction

There are numerous examples in the Islands where invasive species have had both socio-economic impacts and impacts on the biodiversity of the Islands. For example, brown rats (*Rattus norvegicus*) arrived in the Islands with early visitors, became established and spread to many islands in the Falklands archipelago. These rats are known to be detrimental to native birds (e.g., Cobb's wrens, *Troglodytes cobbi*, and tussac birds, *Cinclodes antarcticus*) and recent studies have shown that islands with invasive rats show a reduction in species richness and a different community structure within the bird species than on islands on which rats have not become established (Tabak, *et al.,* 2016).

More recently, the invasion by the European earwig (*Forficula auricularia*) in Stanley is a timely reminder of the risks posed by non-native species. It is understood that European earwigs were first accidentally introduced to Stanley between 1990 and the early 2000s (anecdotal). Since then, they have spread throughout the town and to outlying settlements and increased hugely in number. These pests have had a number of consequences for the residents of Stanley such as:

- A direct nuisance from home invasions,
- The loss or damage of fruit and vegetable crops, eaten by earwigs, and
- The long-term indirect impact on native invertebrates from the use of chemical pesticide treatments.

The implications for the Islands should earwigs spread beyond settlements are unknown. To date FIG has expended much time and resource to combat the spread of earwigs with limited success. A trial to conduct biological control, with a parasitic fly, was undertaken. While this method had the potential to control (but not eradicate) earwigs without impacts on other environmental receptors (CABI, 2013), the project was not progressed. Recently a new PhD programme has started with the aim of examining the invasion ecology of earwigs in order to inform potential future biological control (P. Brickle, *pers. comm.*).

10.13.4.1.2 Previous biosecurity 'near misses' in the Falklands O&G industry

There have been cases of non-native species arriving on cargo associated with the previous exploration drilling campaigns. During the 2015 campaign, three biosecurity incidents were reported:

- Contaminated dunnage (packaging wood) was delivered with a certificate to state it had been treated; however, an infestation of beetle larvae was clear upon arrival. The dunnage was segregated and treated by a local company under advice from the FIG Biosecurity Officer,

- The 'Snoozebox' intended for use as temporary accommodation was delivered with mud from its previous location still compacted to the base, and
- A second-hand imported vehicle was delivered with mud and road grime (including vegetation) on the under axel. In this instance, the trailer was washed down by a pressure washer on the supply base in the designated washing area with approval and advice from the FIG Biosecurity Officer (S. Cockwell, *pers. comm.*, 2015).

These incidents were reported to the FIG Biosecurity Officer and treatment was applied to remove the possibility of non-native species spreading and becoming established.

10.13.4.2 Cargo delivery routes

Cargo associated with the Phase 1 & 2 Development will be delivered to the Falkland Islands *via* marine and air freight (Section 10.13.2), each of which may have the potential to introduce non-native species:

- LTVs will be used during offshore construction to deliver the subsea infrastructure that requires installation on the seabed. Up to two LTVs at any one time will carry down the installation equipment and anchor in Berkeley Sound acting as floating storage vessels while the installation processes take place.
- *Ad hoc* freighter vessels will arrive in Stanley, from global locations (including the UK, EU and USA) throughout the life of the Development. During Stages 1 to 3, it is anticipated that 12 *ad hoc* freighters will deliver cargo to Stanley. Each vessel will carry a range of cargo to facilitate all aspects of the Phase 1 & 2 Sea Lion Development. During Stage 3, steady production, it is anticipated that all support goods will come into the country on the existing sea and air services.
- Charter flights will arrive regularly throughout the Development to deliver personnel, each flight may carry a shipment of fresh fruit and vegetables.

Detailed cargo manifests are not yet available but will include items such as:

- Subsea equipment for installation during Stages 1, 2a & 2b:
- Drilling equipment and supplies during Stages 1, 2a & 2b,
- Bulk chemicals during all stages, and
- Food during all stages.

As described in Section 10.13.2, all the above may carry non-native species if not inspected and treated appropriately at the point of shipment, and may introduce species if the material itself and the associated packaging is not managed appropriately.

It is clear that many species have been introduced in the past. However, quantifying the risk is not straight-forward. It is likely that many cargos arriving in the Falklands may be harbouring some non-native species. However, whether these become invasive depends upon whether the species is:

- Exposed to the wider environment,
- Able to survive and breed, and
- Find a niche to exploit in the Falklands.

Therefore, the impact of any introduction should be assessed on a case-by-case basis.

10.13.5 Industry-standard mitigation

As part of the planning consent for the Temporary Dock Facility (TDF), a Biosecurity Management Plan (BMP) was developed and implemented by Noble Energy Falklands Ltd. and POEPL (BSP, NEFL, 2015b, 021-15-EHSR-BSP-PA-T4) and has continued to develop over the lifetime of the facility.

The biosecurity procedures followed by Navitas will adhere to the guidelines drawn-up by Noble Energy (NEFL, 2015b), with a review to incorporate lessons learned from the 'near misses' described above (Section 10.13.4.1.2), to cover onshore operations during the Phase 1 & 2 Development.

10.13.5.1 Biosecurity Management Plan

10.13.5.1.1 Planning and preparation

An integrated management approach will be implemented and will include:

- Prevention:
  - Prevention is the most effective way to avoid impacts to the ecosystem. Preventative measures include identifying potential pathways and implementing controls to minimise the impact of invasive species, and
  - All imported goods / cargo will be inspected and treated prior to departure from their point of loading.
- Monitoring, detection and elimination:
  - Personnel in Stanley will be made aware of the importance of biosecurity and inspect cargo as it is unloaded,
  - The onshore supply base will have a dedicated biosecurity area where non-conforming cargo can be quarantined, inspected and treated. Equipment will be available to clean any cargo that does not meet the specified standards and a biosecurity bin will be available in the supply yard waste area to ensure appropriate segregation and disposal. Any waste generated from this exercise will be dealt with in accordance with the Waste Management Procedure,
  - Adequate schedules for monitoring will be set,
  - The TDF Operator will ensure steam / pressure washing equipment is installed and available at the TDF. This will be utilised in cases where it is necessary to mechanically clean material or equipment that is being offloaded at the TDF, and
  - Vermin attraction / containment / detection devices will be used on vessels to monitor pest populations and activity. Visual inspections of the devices will identify specific areas of infestation, if any, and assess the need for further action.
- Management and controls:
  - Controls to minimise the potential for invasive species incursion, including pest infestation controls and eradication measures. Additionally, if a potential infestation is identified a risk / impact assessment will be conducted for the specific non-native species involved. This will ensure the most appropriate mitigation measures are identified, selected and implemented,
  - In the event of a biosecurity incident, FIG Biosecurity will be informed and asked to advise on required treatment and disposal, and
  - Prior to the loading of any material or equipment (intended for transport to the Falkland Islands), appropriate pre-treatment activities will be conducted. These measures include:
    - Wood / dunnage material will be heat treated or fumigated with pesticides and marked with an accredited seal, when applicable,
    - Equipment will be steam / pressure washed and cleaned thoroughly,
    - Any container destined for offloading in the Falkland Islands will be fumigated prior to being secured for transport,

- Rat guards will be used when vessels are berthed at the TDF in Stanley Harbour, and
- Pesticides may be applied if pest / insect populations exceed an acceptable level and will be applied if an infestation is observed prior to arriving at the TDF.

o Awareness campaigns and training will be used to highlight biosecurity risks.

- Regulatory inspections:
  - o If a vessel with an observed / documented infestation arrives to be offloaded at the TDF, the TDF Operator will coordinate the relevant governmental agencies / regulatory bodies to ensure appropriate measures are taken.

10.13.5.1.2 Importation of food and food waste disposal

The importation of all goods and food stuffs will follow the guidelines outlined in FIG's 'Falkland Islands biosecurity: protecting our home, environment and economy: A guide to importing goods' (FIG, 2015c).

During the 2015 exploration campaign, there were some issues regarding in-transit FOAO. As in-transit products have not been through the usual importation procedures and may be sourced from outside the EU they may pose a risk of introducing disease or pathogens to the Falklands. The long-term storage of food in-transit is not appropriate as it requires continuous supervision; FIG officials are present every time in-transit food is moved. This issue can be easily mitigated by procuring meat that is UK / EU certified as it can therefore go through the usual import process, or source meat locally, which is also EU certified. The next revision of the BMP will detail these improvements, with greater focus on pre-export improvements.

Food, galley waste and associated packaging sourced from outside the Falkland Islands EEZ are termed International Catering Waste (ICW). ICW carries a risk of introducing pests and diseases and must be disposed of accordingly. At-sea, food waste may be disposed of in accordance with MARPOL regulations and discharged to sea (Section 10.10.1.1.) but packaging and associated wastes will be returned to shore for incineration in accordance with the Waste Management Plan (Section 10.10).

10.13.6 Risk assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor', the 'Severity of Effect' and the 'Likelihood of Occurrence' to determine the overall 'Risk'.

A summary of the risk assessment outcomes for this Development is tabulated in Section 10.13.12 which shows the worst-case risk for each activity.

10.13.6.1 Introducing terrestrial non-native species in marine or air freight

If invasive species were introduced during the Phase 1 & 2 Development the impact on the ecology of the Islands through parasites, disease, competitors or predators may not be immediately evident but may have long-term implications. Initially the impact would be felt locally, however, once established invasive species may spread 'naturally' or with anthropogenic assistance to other parts of the Falklands archipelago. There is potential to have an impact on a national scale and therefore the sensitivity of the receptors to invasive species is considered to be '**High**'.

If found, potentially invasive species can be removed and disposed of before becoming established. However, detecting microscopic or small mobile organisms (such as invertebrates) is very difficult once onshore. If such non-native species become invasive, the long-term implications for the Islands could be severe and difficult to reverse. In the terrestrial environment the possibility of detecting invasive species, and eradicating them to reverse the effect, is feasible but may be costly, in both time and money. On this basis, the severity of effect is initially considered to be 'Serious'. However, taking into

account the measures implemented as part of the Biosecurity Management Plan (BMP), the severity of effect is considered to be '**Moderate**'.

Therefore, the worst-case significance of the impact has been assessed as '**Upper Moderate (12)**'.

Vessels and charter flights will be arriving in Stanley throughout the life of the Development and a large amount of cargo will be taken onshore. The transportation of invasive species to the Falklands has happened in recent years, and the introduction of invasive species has occurred in the Oil and Gas (O&G) industry elsewhere in the world. Indeed, non-native species (with the potential to become invasive) arrived in the Falklands in cargo associated with the 2015 exploration drilling campaign, although they were detected and recorded as 'near misses' (Section 10.13.4.1.2). Nonetheless, while the biosecurity incidents were detected and remedial action taken, no biosecurity plan is absolutely fool-proof and it is possible that other minor breaches went undetected. Therefore, despite improvements to biosecurity procedures, the likelihood of invasive species becoming established as a result of the Sea Lion Field Development is considered to be '**Possible**'.

The movement of large quantities of cargo has discernible environmental and social risks in terms of the potential to introduce non-native species. While there are means of reducing the risk (Section 10.13.5), the overall significance of the risk of introducing non-native terrestrial species has been assessed as '**Upper Moderate (12)**'.

10.13.6.2 Introducing disease or pathogens in food of animal origin

As described in Section 10.13.4.1, the consequences of introducing a pathogen from FOAO could be disastrous. The Tangible Property receptor (agriculture) has little or no capacity to absorb change on this scale and this situation would be unacceptable to all stakeholders. Therefore, the sensitivity of receptor impacted by the introduction of animal disease or pathogens is considered to be '**Very High**'.

Although an outbreak of disease may be recoverable over time, the resulting loss in confidence from consumers (i.e., foreign buyers of meat products) could be very long-lasting and potentially jeopardise the industry. Therefore, the potential for a long-term negative effect on livelihood means that the severity of effect is initially considered to be 'Serious'. However, taking into account the measures implemented as part of the Biosecurity Management Plan (BMP), the severity of effect is considered to be '**Moderate**'.

Overall, the significance of the impact of introducing disease or pathogens that could infect livestock has been assessed as '**Upper Moderate (15)**'.

Ensuring that all FOAO is acquired from UK/EU certified sources and goes through the usual import permitting process for FOAO entering the Falklands, the likelihood of introducing pathogens is reduced to '**Very Unlikely**', and the residual risk is reduced to '**Low (4)**'.

10.13.7 Project-specific mitigation

10.13.7.1 Introduction of terrestrial non-native species in marine or air freight

All industry-standard and legally required mitigation measures available to reduce the risk of introducing terrestrial non-natives to ALARP are already in place (development of the BMP and adherence to FIG biosecurity guidelines), although it is acknowledged that improvements will be made to the BMP wherever possible during its development. This, along with the Navitas OMS, are factored into the initial risk assessment. Therefore, the impacts and risks, as determined from the initial assessment, are considered to be ALARP.

10.13.8 Residual risk

10.13.8.1 Introducing terrestrial non-native species

The initial assessment of the introduction of non-native species through marine or air freight takes account of all the mitigation measures which are built-in to the basis of design and while improvements may serve to reduce risks in future, at this time, they cannot change the initial assessment. Further, given the number of 'unknowns' within the assessment, it is considered appropriate and precautionary for the significance of the risk of introduction of invasive species by marine or air freight to remain '**Upper Moderate (12)**'.

10.13.9 Cumulative effects

The Sea Lion Development will add to the existing risk of introducing invasive species to the Falkland Islands and there is the potential for this to lead to cumulative impacts through increased 'concentration' (Section 8.9.1). Any cargo coming into the Falklands has the potential to transport non-native species into the Islands. The risk posed by each vessel will be related to the type of cargo carried, the origin of that cargo and the condition of the cargo when loaded (clean or soiled / contaminated). Pre-loading preparation and checks of cargo are critical factors but very open to human error, which introduces a degree of uncertainty. It is assumed that each vessel associated with the Sea Lion Field Development will be carrying similar cargo and therefore each vessel will pose a similar risk of introducing non-native species. The risk of each vessel introducing non-native species may be low; however, with each vessel arriving, the probability of introducing non-native species increases (i.e., each load of cargo coming ashore increases the risk of introducing 'hitch hiking' non-native species).

10.13.10 Confidence

The nature of the impact of currently established invasive species on the terrestrial environment of the Falklands is understood. It is known that during the 2015 exploration drilling campaign the O&G industry brought non-native species to the Islands. However, it is difficult to predict the impact of the arrival of additional non-native species, as it will depend on the species involved and measures taken to remove them, and this is acknowledged as a data gap. Additionally, many of the mitigation measures rely on the diligence of the personnel handling the cargo, which is prone to human error. Therefore, there is a degree of uncertainty regarding the sensitivity of environment receptors. Confidence in the assessment is therefore assessed as '**Probable**'.

10.13.10.1 Monitoring required

Monitoring will be an inherent part of the project-specific BMP. Monitoring as cargo is prepared and loaded, and of incoming cargo, will help to evaluate the efficacy of the biosecurity protocols and indicate if revision is required. Detailed monitoring requirements have been established during the Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the project-specific Phase 1 & 2 EMMP (an outline EMMP is provided in Chapter 15).

10.13.11 Offsetting

For significant residual and impact and risks ('Moderate' or above), offsetting *via* a Carbon and Biodiversity Offsetting Fund is proposed, see Section 8.11 for further details.

10.13.12 Findings summary

Table 10.97: Summary of the risk assessment for the introduction of invasive terrestrial species during the Phase 1 & 2 Development

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Introduction of terrestrial non-native species by marine and air freight	Terrestrial biosecurity	Introduction of invasive species with potential to negatively impact biodiversity and designated sites	Unplanned	1, 2a, 2b & 3	High	Moderate	Possible	**Upper Moderate (12)**	**Upper Moderate (12)**	**Probable**	**Industry-standard:** Implementation of a reviewed Biosecurity Management Plan (BMP) **Project-specific:** None proposed
Introduction of pathogens species in FOAO	Terrestrial biosecurity	Introduction of disease or pathogens *via* food of animal origin to negatively impact tangible property e.g., agricultural livestock	Unplanned	1, 2a, 2b & 3	Very High	Moderate	Very Unlikely	**Low (4)**	**Low (4)**	**Probable**	**Industry-standard:** Implementation of a reviewed Biosecurity Management Plan (BMP) Source food of animal origin from UK / EU certified sources and from within the UK / EU. **Project-specific:** None proposed

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

11 SOCIAL IMPACT AND RISK ASSESSMENT

Table of Contents

11.1 Other Users of the Sea - Offshore 976
11.2 Other users of the sea – Inshore 994
11.3 Competition for resources – Accommodation 1016
11.4 Competition for resources – Freshwater 1028
11.5 Competition for resources – Electricity 1047
11.6 Competition for resources – Air links 1059
11.7 Competition for resources – Road networks 1065
11.8 Disturbance to human population - Light 1085
11.9 Disturbance to human population – Helicopters and Noise 1096

11.1 Other Users of the Sea - Offshore

Table of Contents

11.1.1 Introduction 977
11.1.1.1 Relevant legislation 977
11.1.1.1.1 Navigation compliance ('Rules of the Sea') 978
11.1.1.1.2 Offshore exclusion zones (safety zones) 978
11.1.1.1.3 Decommissioning 979
11.1.2 Sources of disturbance to other users of the sea 979
11.1.2.1 Physical presence of offshore installations 979
11.1.2.2 Offshore exclusion zones 979
11.1.2.3 Additional vessels 980
11.1.3 Potential receptors 981
11.1.4 Characterising and quantifying the impact 981
11.1.4.1 Type, location and behaviour of Phase 1 & 2 vessels offshore 981
11.1.4.2 Impact of offshore exclusion zones on fisheries 982
11.1.4.2.1 Potential for loss of fishing ground 982
11.1.4.3 Potential for interference between fishing gear and subsea infrastructure 983
11.1.4.3.1 Overtrawlability studies 984
11.1.4.4 Modelling of third-party vessel collisions with the FPSO 984
11.1.4.4.1 Identification of shipping routes passing the Phase 1 & 2 location 985
11.1.4.4.2 Estimation of vessel activity in the Sea Lion Field 987
11.1.4.4.3 Estimation of offshore vessel collision frequencies 987
11.1.4.4.4 Consequences of a collision 988
11.1.5 Industry standard mitigations 989
11.1.5.1 Exclusion zones 989
11.1.5.2 Interference between fishing gear and subsea infrastructure 989
11.1.5.3 Vessel operations 989
11.1.6 Impact and risk assessment 990
11.1.6.1 Impact assessment of offshore activities 990
11.1.6.1.1 Impact of offshore exclusion zones on fisheries 990
11.1.6.2 Risk assessment of offshore activities 991
11.1.6.2.1 Risk of interference between fishing gear and subsea infrastructure 991
11.1.6.2.2 Risk of third-party vessel collision risk with the FPSO / MODU 991
11.1.7 Project-specific mitigation measures 992
11.1.8 Residual impacts and risks 992
11.1.9 Cumulative impact 992
11.1.10 Confidence assessment 992
11.1.10.1 Monitoring required 992
11.1.11 Offsetting 992
11.1.12 Findings summary 992

11.1.1 Introduction

The development of The Sea Lion Field Northern Development Area will require the placement of installations offshore (both topside and subsea) and will lead to a long-term increase in vessel traffic throughout these waters.

The waters of the North Falkland Basin (NFB) are used for commercial fisheries. Therefore, the presence of Navitas installations and their supporting vessels may lead to disturbance of other users of the sea and / or an increased risk of collisions offshore. The presence of subsea infrastructure could lead to the snagging of fishing gear, which alongside damage to tangible property could lead to environmental impact such as oil spill (Section 12.1). The use of exclusion zones around offshore installations is a key mitigation against such risks as snagging and collisions but may lead to impacts in their own right in terms of fisheries and shipping lanes. Impact on other users of the sea was raised by stakeholders during scoping consultations held in 2014, 2015 and 2016 (Chapter 6).

Owing to the differences in the proposed use of the offshore and inshore locations and the variety of potential impacts and risks, the assessment on other users has been split into two sections (offshore and inshore) as shown in Table 11.1.

This chapter assesses the impacts and risks to the Human Population and Tangible Property during the offshore activities, and focusses on other users of:

- The offshore, Sea Lion Phase 1 & 2 Development location (the Sea Lion Field), and,
- The shipping routes between the Sea Lion Field and inshore operations.

Note: the other impacts associated with vessel use, competition for resource and the installation of subsea infrastructure etc. are described elsewhere in this document, as described in Table 2.2.

Table 11.1: Summary of potential impacts and risks to other users of the sea

Location	Receptor	Potential impact	Potential risk	Assessed in
Offshore	Vessels on passage	Requirement for vessels to navigate around exclusion zones	Vessel collisions with FPSO[1] and / or MODU[2]	This chapter
	Fishing vessels	Fishing prohibition within the exclusion zones may impact upon fisheries revenue	Exclusion zones are not respected resulting in snagging on subsea infrastructure and potential for loss of vessel and / or gear	This chapter
Stanley Harbour	Fishing, Reefer, Cruise, Cargo and Recreational vessels	Competition for berthing space in Stanley Harbour	Potential for collision between vessels in confined waters	Section 11.2
Port William		Competition for anchorage space		
Berkeley Sound				

[1] Floating Production, Storage and Offloading Vessel.
[2] Mobile Offshore Drilling Unit.

11.1.1.1 Relevant legislation

Legislation relevant to the potential for disturbance to other sea users includes:

International conventions:

- United Nations Convention on the Law of the Sea (UNCLOS), 1982.
- International Convention for the Safety of Life at Sea (SOLAS, 1974, as amended).
- Standards for Training, Certification, and Watch-keeping (STCW), 1978.
- International Regulations for Preventing Collisions at Sea (Collision Regulations or ColRegs). 1972.
- Maritime Pollution Regulations (MARPOL), 1973.
- International Convention on Maritime Search and Rescue (SAR), 1979.

UK legislation:

- Petroleum Act 1987.
- Petroleum Act 1998 (as amended by the Energy Act 2008).

Falkland Islands specific maritime legislation and guidelines:

- The Offshore Minerals Ordinance (1994) specifies the requirement for an exclusion (safety) zone of 500 m radius around offshore installations.

Note: while the use of exclusion zones is required by legislation, no legislation exists with regard to minimising the impacts of these on other users of the sea.

- OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations.

11.1.1.1.1 Navigation compliance ('Rules of the Sea')

The International Regulations for Preventing Collisions at Sea 1972 (ColRegs) are published by the International Maritime Organisation (IMO) and set out, among other things, the 'Rules of the Sea' or navigation rules to be followed by ships and other vessels at sea to prevent collisions between two or more vessels. All vessels should conduct themselves in the following manner:

- Every vessel shall at all times maintain a proper look-out by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision,
- Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions, and
- Vessels must use all available means to determine the risk of a collision, including the use of radar (if available) to get early warning of the risk of collision by radar plotting or equivalent systematic observation of detection.

11.1.1.1.2 Offshore exclusion zones (safety zones)

Exclusion zones are required under the Petroleum Act (1987) and the Falkland Islands' Offshore Minerals Ordinance (1994). An offshore exclusion (safety) zone is an area extending a minimum 500 m from any part of offshore O&G installations and is established automatically around all installations which project above the sea at any state of the tide.

Under the Ordinance, subsea installations also require exclusion zones to protect them. Offshore exclusion (safety) zones are 500 m radius from a central point and vessels of all nations are required to respect them. It is an offence (under Section 23 of the Petroleum Act 1987) to enter an exclusion zone except under the special circumstances (HSE, 2008).

Details of exclusion (safety) zones will be promulgated *via* Maritime Safety Information (MSI) under Coastal State obligations.

Further, under the Falkland Islands' Offshore Minerals Ordinance (1994), any fishing vessel that strayed into the exclusion zone would be committing a legal offence and the owner and Master of the vessel would be liable to a fine without limit.

11.1.1.1.3 Decommissioning

Under the Petroleum Act 1998 and OSPAR Decision 98/3 it is necessary to remove all subsea pipelines and installations at the end of Field Life. While comparative assessments may be used to justify the leaving of certain pipelines *in situ*, and Derogation from the OSPAR requirement to remove installations may be sought under very specific circumstances (OSPAR, 1998), all Phase 1 & 2 installations will be constructed with a view to complete removal (Section 5.12).

Therefore, at the end of Field Life all subsea equipment associated with the Phase 1 & 2 wells SPS (Subsea Production System), which includes subsea manifolds, and Subsea Umbilical, Risers and Flowlines (SURF), will be removed so that nothing is left in place which may pose a risk to other users of the sea. Where necessary, and in line with the legislation, equipment placed beneath the seabed e.g., well conductors, will be cut to a depth which will ensure that the object will remain below the level of the seabed in the face of prevailing currents.

Note: impacts and risks associated with decommissioning will be covered by a dedicated EIA, which will be written towards the end of Field Life and in support of the Decommissioning Programme (Section 5.12).

11.1.2 Sources of disturbance to other users of the sea

Sources of impact and risk to other users of the sea offshore include:

- The physical presence of offshore infrastructure including:
  - Short-term anchored installations e.g., the Mobile Offshore Drilling Unit (MODU),
  - Long-term anchored installations e.g., the Floating Production, Storage and Offloading (FPSO) vessel, and
  - Subsea infrastructure e.g., anchor arrays, manifolds, wellheads, flowlines etc.
- 500 m exclusion zones around the MODU,
- 1,275 m exclusion zone around the FPSO,
- Additional vessel traffic in:
  - The Falklands Conservation Zones, and
  - In transit between the Sea Lion Field and Stanley Harbour and also between the Sea Lion Field, Stanley Harbour and Berkeley Sound (during the offshore construction phase).

11.1.2.1 Physical presence of offshore installations

Offshore installations associated with the Sea Lion Development will present a navigational obstacle to vessels on passage through the NFB for the entire duration of their presence. During Stage 1 there will be a construction phase with a number of vessels on location in the Field. Drilling will commence in Stage 1 with a MODU and support vessels *in situ*. In Stages 2a, 2b & 3, production will be underway with the FPSO and its support vessels. During Stages 2a & 2b there will be periods of Simultaneous Operations (SIMOPS) where both the MODU and the FPSO will be in operation in the Field.

11.1.2.2 Offshore exclusion zones

In line with the requirements of the Petroleum Act 1987 (HSE, 2008) and FIG's Offshore Minerals Ordinance (1994), a 500 m exclusion (safety) zone will be established around installation extremities. For the FPSO this includes the length of hose connecting the FPSO and the export tanker, and the tanker itself such that the exclusion zone will extend to 1,275 m around the FPSO. All anchors, mooring

lines and flowlines will be surrounded by a 200 m exclusion zone as per industry accepted best practice. The overall extent of the offshore exclusion (safety) zone is illustrated in Figure 11-1, third-party vessels, such as fishing vessels, will be prohibited from entry into the exclusion area.

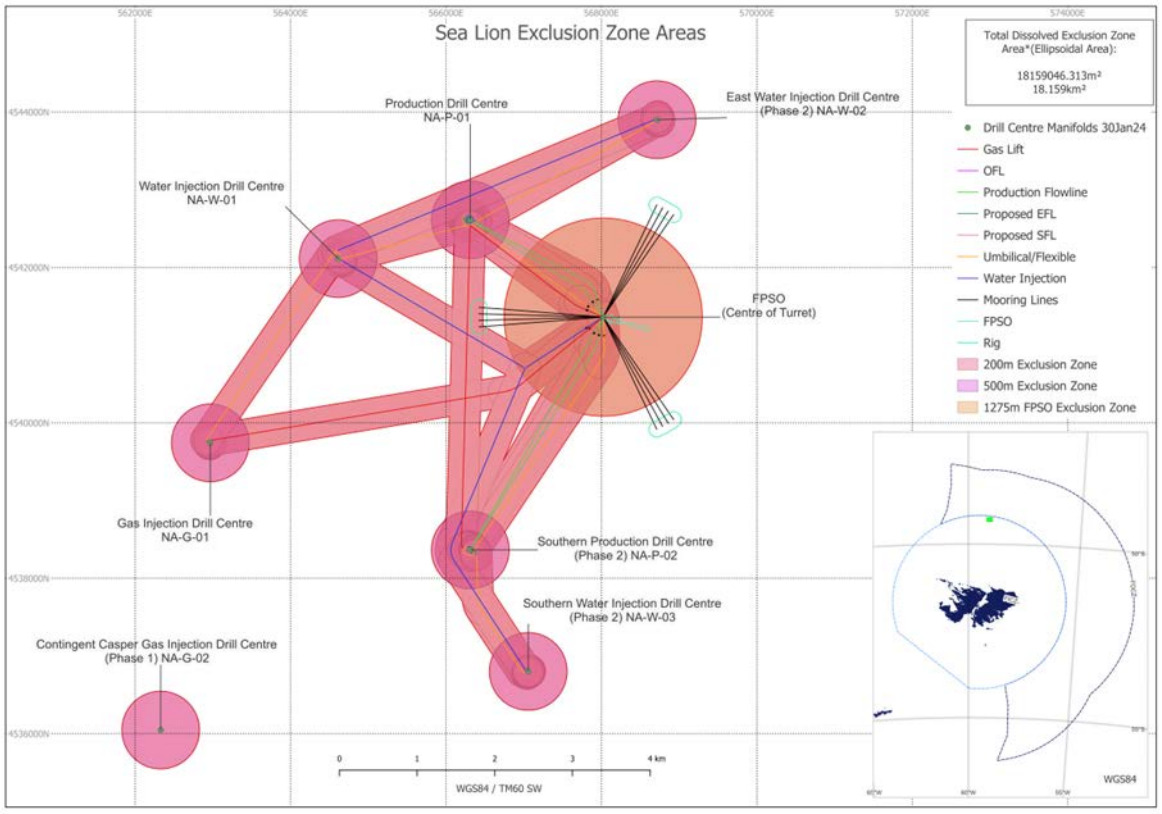


Figure 11-1: Offshore exclusion zones associated with the Sea Lion Development

11.1.2.3 Additional vessels

Numerous different vessels will be deployed offshore for specific tasks during the life of the Phase 1 & 2 Development. These range from the use of installation vessels i.e., Offshore Construction Vessels (OCVs) and supporting Platform Supply Vessels (PSV), drilling vessels (the MODU) and its supporting Emergency Rescue Response Vessel (ERRV) and Anchor Handling Tug Supply (AHTS) vessels during Stages 1, 2a & 2b, to the use of an ERRV / Multi-Role Support Vessel (MRSV) and AHTS to support the FPSO throughout Field's production life.

A detailed inventory of all vessels required is provided in Section 5.11.2 and a summary for the purposes of this chapter, with division according to the locations of the vessel activity, is provided in Section 11.1.4.1.

While at-sea, all Navitas project vessels which are not at anchor (i.e., they are on passage or waiting to attend the FPSO or MODU) will continue to maintain 24-hour watch-keeping using radar, AIS and visual sightings. If a third-party vessel is detected on a collision course, they will follow the international collision regulations and give way if appropriate, like any other sea-going vessel. Therefore, this source of risk should be similar to that posed by any vessel steaming at-sea and has not been considered further.

11.1.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify the specific receptors upon which the impacts and / or risks to other users of the sea warranted further investigation (Chapter 9). The specific receptors that may be impacted include:

- Vessels licensed to fish the waters surrounding Sea Lion Development (Section 7.7.3.1.1.1):
  - Fishing vessels targeting *Illex* squid.
- Vessels transiting through the NFB (Section 11.1.4.4.1):
  - Fishing vessels,
  - Cargo vessels,
  - Tankers, and
  - Cruise ships.

11.1.4 Characterising and quantifying the impact

When characterising and quantifying the impacts and risks to other users of the NFB, it is necessary to consider the:

- Type, location and behaviour of Phase 1 & 2 vessels used offshore,
- Impact of offshore exclusion zones on fisheries in the Sea Lion Field:
  - Potential for loss of fishing grounds.
- Potential for interference between fishing vessels and offshore subsea infrastructure:
  - Overtrawlability studies.
- Modelling of third-party vessel collisions with the FPSO which includes:
  - Identification of the shipping routes passing the Phase 1 & 2 location,
  - Estimation of the Phase 1 & 2 infield vessel activity,
  - Estimation of the offshore vessel and FPSO collision risk frequencies, and
  - Estimation of the consequences of a collision.

11.1.4.1 Type, location and behaviour of Phase 1 & 2 vessels offshore

In order to inform the assessment of impacts and risks, it is necessary to have an appreciation of the additional offshore vessel traffic incurred as a result of the proposed Phase 1 & 2 Development. A detailed inventory of the offshore vessels used is provided in Section 5.11.2 and a summary of the vessel type, purpose and specification is provided in Table 11.2.

Table 11.2: Summary of the type, purpose and behaviour of offshore Phase 1 & 2 vessels used to inform the impact and risk assessment

Vessel / installation type	Vessel purpose	Analogous Vessel	Vessel specification			Total number of operations / visits		
			Length (m)	GRT (tonnes)	Max. speed (kn)	Stage 1 (31 months)	Stage 2a & 2b (35 months)	Stage 3 (*c.* 27 years)
MODU's AHTS	MODU tow, supply and ERRV	*Pacific Champion*	86	3,330	15	99	108	4
MODU's ERRV	Supply and ERRV	*Esvagt Don*	56.4	1,863	12	90	99	n/a
OCV	Offshore construction	*Skandi Skansen*	107	4982	15	39	26	n/a
PSV	Offshore construction	*Pacific Leader*	97.3	5,260	16	52	26	n/a
MODU (anchored)	Drilling	*Stena Don* (moored)	122	42,570	0	500 m exclusion zones around main well clusters		n/a
Subsea	Production	n/a	n/a	n/a	n/a	500 m exclusion zone around installation extremities (see Figure 11-1)		
FPSO	Production	*FPSO Aoka Mizu*	284	88,059	0	n/a	Anchored on site with 1,275 m exclusion zone	
FPSO's AHTS / ERRV	Supply and ERRV	*Nor Solan*	97	5,179	14	56	151	1,398
FPSO's MRSV / ERRV	Supply and ERRV	*Nor Solan*	97	5,179	14	56	151	1,398

11.1.4.2 Impact of offshore exclusion zones on fisheries

The presence of exclusion zones around the surface and subsea infrastructure (Figure 11-1) has the potential to lessen the availability of fishing grounds.

The Falkland Islands Fisheries Department (FIFD) closely monitors all vessels licensed to fish within Falkland Islands waters. An average of 176 fishing vessels pass through the Sea Lion area annually (Anatec, 2024a). The data show that most vessels passing through the area were travelling at speed and so were not actually engaged in fishing in this region. Therefore, it is recognised that the Sea Lion Field is located in the centre of a route well used by fishing vessels on passage from the high seas to / from the main harbours of the Falklands. Vessels which were engaged in fishing were located approximately 30 nm to the south and west of the Sea Lion Field along the 200 m depth contour at the edge of the continental shelf which is known as a productive fishing ground (see Figure 11-2 below).

11.1.4.2.1 Potential for loss of fishing ground

The drill centre for the Phase 1 & 2 Sea Lion Field Development is located within FIFD grid square XFAK, approximately 20 to 37 nautical miles north-east of the 200 m depth contour line, in water approximately 450 m deep. The fisheries statistical square surrounding the Sea Lion Development

(XFAK) has only been open to vessels with Type B licences[91]. The B licence allows vessels (jiggers) to fish for Argentine shortfin squid and, rarely, for the sevenstar flying squid (*Martialia hyadesii*). Data extracted from the Fisheries department database in 2023 (Section 7.7.3.1.1.1) indicate that both jiggers and trawlers have fished the area, but there is considerable inter-annual variation in fishing effort and catch in the area. Catches and fishing effort in the grid square occupied by the Sea Lion Field (XFAK) is relatively low (FIG, 2023n). Exceptionally high catches of *Illex* squid were made in 2014, 2017 and 2022 reflecting high catches throughout the zone during these seasons. Nonetheless, the data indicate that generally the area of the Sea Lion Field is rarely fished.

Therefore, while fishing vessels may prospect in the area, the region of the Sea Lion Field is not considered to be a regular fishing ground such that no impacts upon future fish catches are anticipated.

11.1.4.2.2 Stakeholder comments

Stakeholders from the fishing industry were consulted as part of the 2016 scoping consultation, in 2020 during the last full consultation of the Sea Lion Development EIS, and most recently during the 2023 scoping consultation (Chapter 6). FIFCA (Falkland Islands Fishing Companies Association) have facilitated consultation with local fishing companies (who are in some cases vessel owners) and vessel agents throughout the evolution of the Sea Lion project. The nature of the Falklands' fishing industry is such that ship's captains are not particularly accessible (they spend limited, if any time onshore, and often do not speak English) so direct consultation with captains has not been possible. Competition between sea users and the associated risk of collision has been brought up by stakeholders during each consultation, though this was mostly in relation to the use of Berkeley Sound (which is discussed in Section 11.2).

11.1.4.3 Potential for interference between fishing gear and subsea infrastructure

Illex jiggers use powerful lights and light weight 'jigging' lures to lure squid to the surface and are not believed to be a risk to, or at risk from, subsea installations. In the past some trawlers targeted *Illex*, however the B licences for trawlers were removed in 2023 (P. Brickle, *pers comm.*).

Given that the behaviour of fishing vessels can be unpredictable, it is not uncommon for vessels to fish in areas where they are not permitted. In the unlikely event that vessels were to ignore exclusion zones with the intent to operate in the vicinity of the Phase 1 & 2 Development they would be deterred by installation guard vessels (ERRV/AHTS/MRSVs). However, if unchallenged, fishing gear has the potential to interfere with the:

- Subsea Production System (SPS), the Subsea Umbilicals, Risers and Flowlines (SURF), the wellheads, X-mas trees and the Drill Centres which will, in total, cover a total combined area of 0.024 km^2, spanning an area of approximately 18 km^2,

Snagging of fishing gear from trawlers specifically could result in:

- Damage to the subsea infrastructure,
- Loss of the fishing gear (Tangible Property), and
- The potential for damage to the fishing vessel and injury / loss of life to crew.

Note: importantly, it is out with the scope of this EIA to assess the safety implications with regard to the injury or loss of life on fishing vessels. Safety implications will be addressed by other Navitas processes, other legislation and other industry good practices, while the EIS is focused on the environmental impacts and risks.

[91] The B licence allows vessels (jiggers) to fish for Argentine shortfin squid and, rarely, for the sevenstar flying squid (*Martialia hyadesii*).

11.1.4.3.1 Overtrawlability studies

The previous operator of the Sea Lion Field (POEPL) and their JV partner commissioned three separate studies which aimed to define the level of fishing activity in the Sea Lion area and to recommend the type of mitigation required to protect subsea equipment and flowlines as well as fishing vessels and their trawling gear.

These studies comprised the:

- AGR Petroleum Services screening study - Falkland Islands fisheries and risk to subsea infrastructure (AGR, 2012),
- Pale Maiden Consulting Ltd - Fishing Activity Report that uses VMS data (Pale Maiden, 2013), and
- Jee Subsea Consultants - Sea Lion Development: Fishing and trawl risk assessment (Jee, 2013) based on published Falkland Islands fishery statistics and the results of the above studies (Jee, 2013).

The AGR (2012) report utilised pre-2006 fishing data, which due to changes in licence conditions, is now regarded to be out-of-date. The Pale Maiden report (2013) used more recent data (up to 2012) to assess the level of fishing activity in the Sea Lion area. However, during this EIA, discrepancies between the reported position of vessels (i.e., the statistical square) and the actual position of vessels (derived from VMS data) were since identified, which place doubt on the fishing effort reported for the area in the Pale Maiden document. Nonetheless, the demersal trawler activity within the Sea Lion Field, as described in the Pale Maiden report, was confirmed by VMS data in 2012. The Jee report utilised information from the AGR and Pale Maiden reports alongside additional scoping with all interest groups. Further, during the recent Collision Risk Assessment, Anatec confirmed that no fishing vessels recorded as broadcasting on AIS appeared to be actively fishing in the area during 2022 and 2023 (*J. Campbell, pers comm., 2024*).

In summary, the Jee report (2013) concluded that there is negligible risk of snagging with subsea infrastructure and that there is therefore no need to make the subsea infrastructure overtrawlable. The Jee report (2013) recommended that further monitoring is conducted to ensure that the situation does not change in the future. More recent AIS data from the Anatec (2024a) study confirms fishing activity to be very low within the area. The Jee (2013) report concluded that the most appropriate way to safeguard subsea infrastructure, and to prevent the loss of fishing vessels (and all incumbent consequences) is *via* reliance upon exclusion zones and the use of a designated guard vessel once installation commences.

11.1.4.4 Modelling of third-party vessel collisions with the FPSO

With regard to the impact on other users of the sea, Navitas commissioned Anatec Ltd. to calculate the risk of collisions between the FPSO and third-party vessels passing the Sea Lion Field (both powered vessels and drifting vessels). Note that this model is also used to assess the likelihood of collisions between Navitas vessels in the offshore oil spill assessment (Section 12.1).

The modelling uses the Health and Safety Executive (HSE) research methodology together with:

- Site-specific inputs for the Sea Lion FPSO,
- Site-specific inputs for the MODU, and
- The use of a dedicated ERRV with both AIS and radar ship tracking.

Note: during Stages 1, 2 a & 2b the MODU will be stationed in the Sea Lion Field at several different locations. Only one location for the MODU has been modelled although it will move around the field during Stages 1, 2a & 2b.

11.1.4.4.1 Identification of shipping routes passing the Phase 1 & 2 location

Details of all of the shipping routes passing close to the Sea Lion Field were identified using detailed analysis of AIS (Automatic Identification System) data (Anatec, 2024a). AIS is an automated tracking system used on ships and by vessel traffic services for identifying and locating vessels through the electronic exchange of data (e.g., unique identification, position, course and speed) with nearby ships, AIS base stations and satellites. The IMO's International Convention for the Safety of Life at Sea (SOLAS) requires AIS to be fitted onboard international voyaging vessels with a gross tonnage of > 300 t.

Although the Sea Lion Field lies on the shipping routes between Stanley and both the fishing grounds and the South American mainland, the number of vessels using these routes is consistent with areas of low shipping activity (Anatec, 2024a). The nearest area of high-density shipping activity is found approximately 30 - 50 nautical miles to the south-west of the Sea Lion Field (Figure 11-2). As shown, these vessels are primarily engaged in fishing activity (trawling) and generally move back and forth at low speeds (approximately four knots).

Looking more closely, there are eight main shipping routes that pass within 15 nm of the Sea Lion Field, with a total of 216 ships per year travelling on these routes (Figure 11-3a; Table 11.3). This is equivalent to between zero and one vessel passing the Field every day. The types of vessel using each of the eight routes shown in Figure 11-3a are quite distinct and are described in Table 11.3. The number of vessel-hours that each square nautical mile surrounding the Sea Lion Field is exposed to on an annual basis is provided in Figure 11-3b.

The majority of vessel traffic comprises fishing vessels travelling to and from fishing grounds (routes 1, 3, 4, 5, 7 & 8 Figure 11-3a), although it should be noted that there is likely to be considerable inter-annual variation in the number of these vessels. Route 2 is used by a small number (4 % of all vessel traffic) of large vessels (tankers and bulk carriers) exceeding 15,000 Dead Weight Tonnes (DWT). Vessels using Route 6 are typically cruise ships which are large fast-moving vessels but generally have a lower mass than large cargo vessels.

The impact energy of a collision is related to the squared speed and mass of the vessels involved and is measured in Mega Joules (MJ). DWT is a measure of how much mass a ship is carrying or can safely carry.

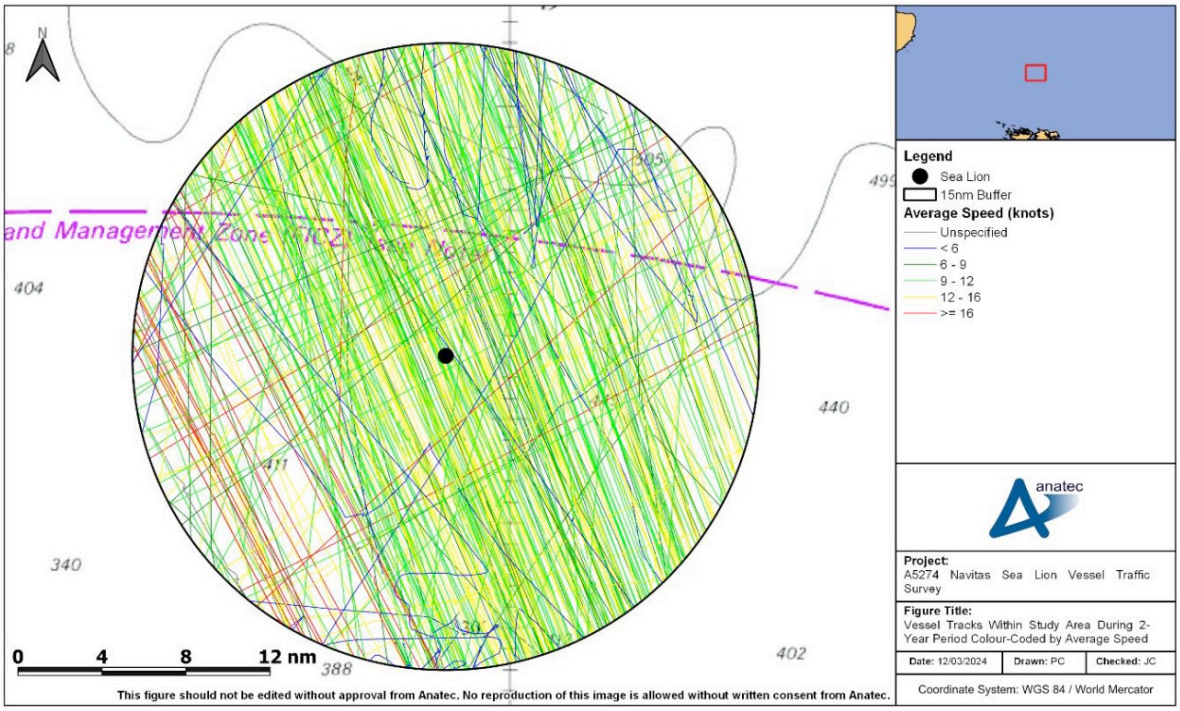
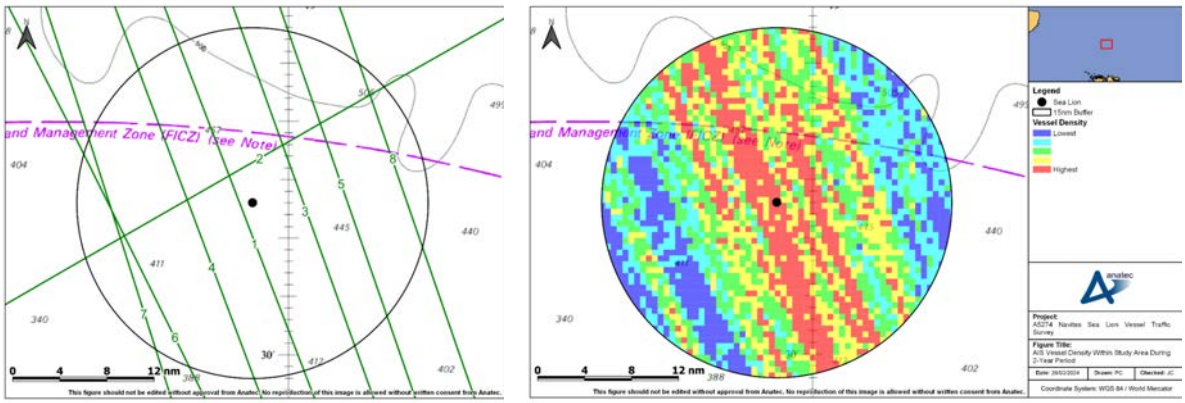


Figure 11-2: Overview of AIS shipping data for the Sea Lion Location (2022-23) ***(Source: Anatec, 2024a)***

Table 11.3: Ship Routes Passing within 15 nautical miles of the Sea Lion Field ***(Source: Anatec, 2024a)***[1]

Route No.	Description	Type of vessel	CPA (nm)a	Bearing (°)	Vessels per year	% of Total
1	Fishing grounds – Falkland Islands	Fishing vessels	1.0	249	51	24 %
2	South America – South Africa	Tankers	3.0	331	9	4 %
3	East Asia – Fishing grounds	Fishing vessels	4.1	70	40	19 %
4	Falkland Islands – Fishing grounds	Fishing vessels	5.1	249	40	19 %
5	Falkland Islands – Fishing grounds	Fishing vessels	7.7	70	31	14 %
6	Stanley – Puerto Madryn	Cruise ships	11.0	245	16	7 %
7	East Asia – Fishing grounds	Fishing vessels	11.6	252	8	4 %
8	Fishing grounds – Falkland Islands	Fishing vessels	12.5	70	21	10 %
Total					**216**	**100 %**

[1] Where two or more routes have identical Closest Point of Approach (CPA) and bearing they have been grouped together. In this case, the description lists the sub-route with the most ships per year.



a) Averaged shipping routes within 15 nm

b) Vessel shipping density withing 15 nm

Figure 11-3: Averaged shipping routes and vessel shipping density within 15 nautical miles of the Sea Lion FPSO (see Table 11.4 below for detail on the shipping type associated with each route number) ***(Source: Anatec, 2024a)***

11.1.4.4.2 Estimation of vessel activity in the Sea Lion Field

At the time of the Anatec assessment (2024b), detail on the specific vessels likely to be used was unknown. At the time of the modelling, the analogous vessels were based on typical vessels used in the UK North Sea and West of Shetland. Detail on the MODU and FPSO analogies assumed for the Anatec model is presented in Table 11.4.

Table 11.4: Details of the analogous vessels used in the modelling ***(Source: Anatec, 2024b)***

Vessel Type	Analogous vessel	Length (m)	Width (m)	Dead Weight Tonnage (DWT)	Estimated attendance
MODU	*Stena Don*	95.5	81	-	All year round
FPSO	*Aoka Mizu*	248.1	42	-	All year round
ERRV	*Biscay Sentinel*	62	15.5	1,500	Permanently on stand-by
Supply	*Pacific Leader*	97.3	20	5,260	Every 4 days

11.1.4.4.3 Estimation of offshore vessel collision frequencies

The COLLRISK model was used to estimate collision risks on an annual basis (Anatec, 2024b). The consequence of collisions was estimated by taking into account impact energy based on the size and speed of respective vessel types (Section 11.1.4.4.4).

The model is based on the premise that the collision frequency is proportional to the volume of traffic interacting with the FPSO / MODU. This stems from a review of historical data, which indicated that failure in watch-keeping systems tends to be the cause of collisions between passing vessels and offshore installations.

The following provides only the detail required to enable appreciation of the results in the context of third-party vessel collisions with the FPSO and MODU. Details on the specific parameters used within the COLLRISK model with regard to metocean data are provided in Section 7.3.5.

A summary of the main assumptions used in the model and the analysis, and the estimated collision frequencies between third-party vessels and the FPSO is provided in Table 11.5.

Table 11.5: Summary of the assumptions and results of the COLLRISK collision frequency model
(Source: Anatec, 2024b)

Vessel type	COLLRISK Model basis and assumptions	Estimated collision frequency between vessel and FPSO / MODU
Third-party passing powered vessels	Vessels operating on these routes have ample room available to increase their passing distance from the Sea Lion Development. With no nearby offshore installations or exclusion zones in place the vessels have space to transit the area safely; this can be observed from the AIS data, where the routes taken by vessels are relatively diverse across the area. If vessels do increase their mean passing distance, the effect on navigation is expected to be negligible.	Due to the low levels of shipping in the area of the Sea Lion Field the potential frequency of events is low. Passing powered collision frequency is 2.6×10^{-7} collisions / year (an equivalent of one collision in 3.8 million years) for the MODU and 5.8×10^{-7} (one in 1.7 million years) for the FPSO.
Third-party passing drifting vessels	The model for calculating passing drifting collision risk is based on the premise that the engine(s) on a vessel must fail before a vessel will drift. The model takes account of the likelihood of vessels having multiple engines based on fleet data for different ship types and sizes. Using this information it is possible to estimate the overall rate of breakdown in proximity to the location. The probability of a vessel drifting towards the installation and the drift speed are estimated using the wind rose for the area. Finally, the probability of a ship being repaired before reaching the location is estimated based on the time available. Ships that are not repaired within the time it takes to reach the FPSO / MODU are assumed to collide. Figure 11-3b above illustrates the number of vessel-hours that each square nautical mile surrounding the Sea Lion Field is exposed to on an annual basis. These data are used to model the risk of passing ships losing power and drifting into the Sea Lion Field and takes into account vessels within a 10 nautical mile radius.	Passing drifting collision frequency is 1.9×10^{-6} collisions / year (or once in 535,000 years) for the MODU and 6.4×10^{-7} (once in 1.5 million years) for the FPSO.
Attendant vessel	Vessel collisions involving attendant (visiting) vessels tend to be more frequent than passing vessels due to their ongoing proximity. The consequences associated with these types of impacts generally tend to be less severe due to the size and speed of the vessels. During SIMOPS the ERRV will be permanently supporting the MODU and the FPSO and will normally be located between them, approaching each installation for close standby when required for operational purposes. For supply operations, a supply vessel will visit the FPSO every 4 days. The duration of visits is estimated to be 4 hours (i.e., within the 500m exclusion zone.)	The total vessel collision frequency for the MODU is estimated to be 2.2×10^{-2} per year (once in 46 years), with the majority of collisions generating total energies below 14 MJ; The total vessel collision frequency for the FPSO is estimated to be 9.2×10^{-3} per year (once every 109 years), with the majority of collisions generating total energies below 50 MJ.

11.1.4.4.4 Consequences of a collision

The relationship between predicted damage to the FPSO and collision impact energy is presented in Table 11.6. This assessment is based on research into collision resistance of structures, professional judgment and the experience of other FPSOs and MODUs (Anatec, 2024b).

Table 11.7 summarises the estimated collision frequencies for different vessel types and different energy levels. According to the model, ship collisions involving infield vessels may be more frequent

than for passing ships due to their ongoing proximity, however, the consequences associated with these types of impacts tend to be less severe due to the speed of the vessels and the associated energy of the strike.

Table 11.6: Impact energy and predicted consequences ***(Source: Anatec, 2013)***

Energy	Description
<50 MJ	Due to the size of FPSO vessels, it is considered that events of this scale will not jeopardise the FPSO's integrity. Localised damage is likely to be experienced. Due to relatively small size, damage to the third-party colliding vessel may be more substantial.
50-200 MJ	Due to the size of FPSO vessels, it is considered that events of this scale will not jeopardise the FPSO's integrity. However, there is the potential for damage to topside equipment, which may lead to hydrocarbon release, particularly if the impact is direct. Due to their relative size, collisions of this scale are likely to result in serious damage or loss of the smaller classes of potential third-party colliding vessel.
>200 MJ	These are catastrophic events which could lead to significant levels of damage to the FPSO. These impacts are likely to threaten the integrity of the entire installation and evacuation is likely to be necessary.

Table 11.7: Vessel, MODU and FPSO collision frequencies (per year) at different impact energies ***(Source: Anatec, 2024b)***

Impact Energy (MJ)	Annual Collision Frequency			
	Passing Powered	Passing Drifting	Attendant Vessel	Total
MODU				
0-14	1.1E-07	1.8E-06	2.1E-02	**2.1E-02**
14-50	1.0E-07	4.5E-08	7.8E-04	**7.8E-04**
50 -100	1.7E-08	2.0E-08	4.3E-06	**4.3E-06**
100-200	7.3E-09	1.6E-08	Negligible[1]	**2.4E-08**
≥200	3.1E-08	4.1E-09	Negligible[1]	**3.5E-08**
Total	2.6E-07	1.9E-06	2.2E-02	**2.2E-02**
FPSO				
0-50	4.6E-07	6.3E-07	9.3E-03	**9.3E-03**
50 -100	2.2E-08	4.6E-09	1.7E-06	**1.7E-06**
100-200	1.8E-08	3.6E-09	Negligible[1]	**2.2E-08**
≥200	5.0E-08	9.0E-10	Negligible[1]	**5.1E-08**
Total	**5.8E-07**	**6.4E-07**	**9.2E-03**	**9.2E-03**

[1] where negligible = <1.0E-10.

11.1.5 Industry standard mitigations

11.1.5.1 Exclusion zones

The use of exclusion zones is a legal requirement and is therefore a mitigation in itself against the risks of collision. No other industry-standard mitigations are required to minimise the impact of these on other users of the sea.

11.1.5.2 Interference between fishing gear and subsea infrastructure

No industry-standard mitigations are required to prevent the snagging of fishing gear over and above an ALARP demonstration of the risks and as per the legislative requirements described in Section 11.1.1.1.1.

11.1.5.3 Vessel operations

In addition to the legislative requirements above, the following will be used as industry-standard to minimise the risk of collision:

- Installation of AIS in the field vessels (in combination with radar and visual lookout) to provide early detection of passing vessels, and improved information to aid in the management of this hazard. Systems will be installed on the FPSO, MODU, AHTS/ERRV and MRSV/ERRV,
- Availability of chart displays to monitor third-party vessel positions relative to the FPSO and MODU with alarm functionality:
  - It will also be considered beneficial, when possible, to relay the data to shore for use in both routine marine traffic management and emergency response.
- Use of field-specific AIS data to establish collision risk management procedures at Sea Lion giving account of the traffic pattern and the evacuation requirements on the installation:
  - Use of alarms which will be set by 'Time to the Closest Point of Approach' and 'Closest Point of Approach'.
- Installation of an AIS aid to navigation on the FPSO and MODU to ensure identification of the FPSO to passing vessels,
- Operational control:
  - Development of a full Marine Operations Manual for the Sea Lion Field including factors such as vessel selection and inspection, crewing and competency, and
  - Site-specific procedures for AHTS/ERRV and MRSV/ERRV watchkeeping and emergency response.

Note: many of the industry-standard mitigations listed above were not assumed to be in place by the Anatec model such that the model can be considered to be precautionary in its results.

11.1.6 Impact and risk assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities. The assessment of unplanned events includes an assessment of the 'Likelihood of Occurrence' to determine the 'Risk'.

A summary of the impact and risk assessment outcomes for this Development is tabulated in Section 11.1.12, which shows the worst-case impact / risk for each activity and receptor and details are provided below.

11.1.6.1 Impact assessment of offshore activities

11.1.6.1.1 Impact of offshore exclusion zones on fisheries

The Sea Lion Phase 1 & 2 Development sits within the fisheries statistical square XFAK that has historically been the subject of very low fishing effort (Section 11.1.4.3). Currently, the area is only open to vessels licensed to fish for *Illex* squid and is rarely fished (Section 11.1.4.3) such that few receptors (fishers) are likely to be exposed. In terms of impact on squid catch, the declaration of a 1,275 m exclusion zone around the Development FPSO, 500 m exclusion zones around the MODU and drill centres and 200 m either side of subsea infrastructure would therefore be insignificant to the fishing vessels concerned. The human population (fishing industry) is able to tolerate a change on this scale and it is anticipated that the exclusion zones will be acceptable to all stakeholders. Therefore, the sensitivity of the receptor Is considered to be '**Very Low**'.

The application of monetary fines could be incurred if exclusion zones are ignored or strayed into (Section 11.1.1.1). However, this would occur only in the event that all communication on the presence of exclusion zones was ignored, which is out with Navitas' control. With regard to impact upon catch, the historical level of fishing effort in the Sea Lion Field is such that the prohibition on fishing within

the exclusion zone is anticipated to have no impact on the livelihood of fishers and the severity of effect is considered to be '**Slight**'.

Therefore, the overall significance of the impact of the exclusion zone on the human population is assessed as '**Very Low (1)**'.

11.1.6.2 Risk assessment of offshore activities

11.1.6.2.1 Risk of interference between fishing gear and subsea infrastructure

Under 'normal' fishing conditions, the loss of fishing gear is not an unusual event. Therefore it is anticipated that the human population (fishers) would have a moderate capacity to absorb the loss of gear and the sensitivity of the receptor is considered to be '**Moderate**'.

If a demersal trawl net became snagged on subsea infrastructure, the fishing gear could be extensively damaged and possibly lost. Additionally, there could be damage to the seabed infrastructure, with consequential legal implications. Assuming a worst-case event involving the loss of fishing gear, the severity of effect would be expected to have a medium-term impact on livelihood and therefore the severity of effect on the human population is considered to be '**Moderate**'.

The significance of the impact of a fishing vessel snagging gear on subsea infrastructure is therefore assessed as '**Moderate (9)**'.

Since 2013, statistical square XFAK has only been open to vessels with Type B (*Illex*) licenses, and since 2023, only to jiggers. If a vessel was to approach the exclusion zone, it would almost certainly be detected and intercepted by the MRSV/ERRV or AHTS/ERRV before interfering with subsea infrastructure. Therefore the likelihood of occurrence of fishing gear becoming snagged on subsea infrastructure in considered '**Unlikely**'.

Therefore the significance of the risk is assessed as '**Low (6)**'.

11.1.6.2.2 Risk of third-party vessel collision risk with the FPSO / MODU

With any collision incident between passing powered or passing drifting vessels there is a range of possible outcomes, dependent on the size, speed and angle of approach of the vessels concerned (Section 11.1.4.4.4). While the majority of these scenarios are unlikely to generate critical energies sufficient to cause an environmental impact (Section 11.1.4.4.4) all have the potential to cause damage to the FPSO or MODU and would therefore, almost certainly, result in damage to, and possible loss, of a smaller third-party vessel. It is anticipated that such loss would be unacceptable to all stakeholders and therefore the sensitivity of the receptor to such an incident is considered to be '**Very High**'.

Following this worst-case scenario, the effect on the livelihood of the receptor could be long-term and the severity of effect on the human population is considered to be '**Serious**'.

Therefore, the overall significance of the impact of a collision between a third-party vessel and the FPSO or MODU is assessed as '**High (20)**'.

The analysis of collision frequency undertaken by Anatec (2024b) and summarised above (Section 11.1.4.4.3) indicates that the likelihood of any collision is extremely low and is lower still for an event resulting in catastrophic damage (Section 11.1.4.4.4). Incidents on this scale have occurred very rarely in the industry and the failure of numerous operational controls would be required. Further, as described above, the Anatec model does not take account of all the industry-standard mitigation practices such that it is very precautionary. Taking account of the modelling outcomes and the industry-standard mitigations described above, the likelihood of occurrence is considered to be '**Very Unlikely**'.

Therefore, the significance of the risk is considered to be '**Low (5**)'.

11.1.7 Project-specific mitigation measures

With legislation and industry-standard mitigations applied, the impacts and risks assessed above are considered to be 'Low' or 'Very Low' and therefore project-specific mitigation is not proposed.

11.1.8 Residual impacts and risks

Not applicable.

11.1.9 Cumulative impact

The activities of Navitas' vessels will add to the existing vessel traffic within Falkland Islands waters, leading to an increase in the 'concentration' of shipping activity (Section 8.9.1). The offshore Sea Lion Development is situated in an area where shipping traffic is relatively low. With no nearby offshore installations or exclusion zones in place, all vessels have space to transit the area safely. Vessels operating on these routes have ample room available to increase their passing distance around the Development site and therefore there is expected to be little cumulative impact.

11.1.10 Confidence assessment

Owing to the use of data on historical fishing effort, the assessment of the impact of exclusion zones offshore is considered to be '**Certain**'.

Much of this assessment is informed by AIS data and collision risk modelling that is widely used and accepted. Although the data used are representative, there is considerable inter-annual variation in vessel traffic, largely due to variations in *Illex* squid abundance.

Stakeholders within FIG and from the fishing industry were consulted as part of the 2016 scoping consultation, in 2020 during the last full consultation of the Sea Lion Development EIS, and most recently during the 2023 scoping consultation (Chapter 6). Their views have been taken into consideration and therefore confidence in the assessment is considered to be '**Probable**' and further monitoring of vessel movements and analysis will help to improve confidence in this assessment.

11.1.10.1 Monitoring required

An AIS based survey will be carried out at the location of the Sea Lion Development to confirm the shipping traffic pattern in the area once the exclusion zone is in place. The presence of Development infrastructure, project vessels and exclusion zones may have an influence on shipping routes, as vessels may deviate from established routes to avoid potential risks. This is a very low-cost method of improving the confidence in collision risk analysis and understanding shipping behaviour.

Navitas will also report and investigate all incidents and near misses.

Detailed monitoring requirements have been established during the Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the project-specific Phase 1 & 2 EMMP (an outline EMMP is provided in Chapter 15).

11.1.11 Offsetting

As no residual impacts or risks identified in this section are considered significant, i.e., Moderate or above, offsetting is not considered necessary for this impact (see Section 8.11).

11.1.12 Findings summary

Table 11.8: Summary of the impact and risk assessment for other users of the sea at the Sea Lion Field

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Offshore exclusion zones	Disruption to activities of other users of the sea	Reduction in the area available to *Illex* vessels and resultant impact on catch	Planned	1, 2a, 2b & 3	Very Low	Slight	n/a	**Very Low (1)**	**n/a**	**Certain**	**Industry-standard:** Exclusion zones promulgated *via* MSI under Coastal State obligation **Project-specific:** None proposed.
Interference between fishing gear and subsea infrastructure	Snagging of fishing gear	Loss of fishing gear and potential subsea damage	Unplanned	2a, 2b & 3	Moderate	Moderate	Unlikely	**Low (6)**	**n/a**	**Probable**	**Industry-standard:** Exclusion zones, Permanent presence of ERRV, Amended Admiralty charts, AIS and radio broadcasts, and Collision risk management procedures. **Project-specific:** None proposed
Offshore vessel collision	Third-party vessel collision	Damage to vessels and FPSO or MODU	Unplanned	1, 2a, 2b & 3	Very High	Serious	Very Unlikely	**Low (5)**	**n/a**	**Probable**	

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

11.2 Other users of the sea – Inshore

Table of Contents

11.2.1 Introduction 996
11.2.1.1 Relevant legislation 997
11.2.1.1.1 FIPASS Ordinance (1989) 997
11.2.1.1.2 Falkland Islands Harbour Regulations 997
11.2.2 Sources of disturbance to inshore users of the sea 997
11.2.2.1 Additional vessels 998
11.2.2.2 LTV presence in Berkeley Sound 998
11.2.3 Potential receptors 999
11.2.4 Characterising and quantifying the impacts and risks 999
11.2.4.1 Quantification of inshore Phase 1 & 2 activities 1000
11.2.4.1.1 Phase 1 & 2 vessels / infrastructure inshore 1000
11.2.4.1.2 Phase 1 & 2 use of amenities in Stanley Harbour 1001
11.2.4.2 Quantification of inshore third-party activity 1001
11.2.4.2.1 Number, type and behaviour of third-party vessels inshore 1001
11.2.4.2.1.1 Stanley Harbour 1001
11.2.4.2.1.2 Berkeley Sound 1002
11.2.4.2.2 History of incidents in inshore waters 1004
11.2.4.2.2.1 Stanley Harbour 1004
11.2.4.2.2.2 Berkeley Sound 1005
11.2.4.3 Stakeholder comments and third-party vessel behaviour 1005
11.2.4.4 Nature of the impacts and risks of exclusion zones in Berkeley Sound 1006
11.2.4.4.1 Exclusion zones 1006
11.2.4.4.1.1 Reduced anchorage availability 1006
11.2.4.4.1.2 Reduced sea room and increased risk of collision / grounding 1006
11.2.4.4.1.3 Stakeholder opinion on exclusion zones 1008
11.2.5 Industry standard mitigations 1009
11.2.5.1 Exclusion zones 1009
11.2.5.2 Vessel operations 1009
11.2.6 Impact and risk assessment 1009
11.2.6.1 Impact assessment of inshore activities 1009
11.2.6.1.1 Disturbance to other users within Stanley Harbour 1009
11.2.6.1.2 Loss of anchorage space due to exclusion zones in Berkeley Sound 1010
11.2.6.1.3 Potential positive impact of the presence of Phase 1 & 2 Vessels 1010
11.2.6.2 Risk assessment of collisions during inshore activities 1010
11.2.6.2.1 Collisions in Stanley Harbour 1010
11.2.6.2.2 Collision due to reduced sea room from temporary exclusion zones 1011
11.2.7 Project-specific mitigation 1011
11.2.8 Residual impacts and risks 1011
11.2.9 Cumulative effects 1012
11.2.9.1 Stanley Harbour 1012
11.2.9.2 Berkeley Sound 1012

11.2.10 Confidence assessment 1012
11.2.10.1 Disturbance to other users within Stanley Harbour 1012
11.2.10.2 Impacts and risks associated with exclusion zones in Berkeley Sound 1012
11.2.10.3 Risk of collisions between vessels 1012
11.2.10.4 Monitoring required 1012
11.2.11 Offsetting 1013
11.2.12 Findings summary 1013

11.2.1 Introduction

The inshore waters of the Falkland Islands, and the amenities in Stanley Harbour, are used extensively for commercial operations (e.g., vessels associated with fisheries, trade and tourism), for Ministry of Defence (MoD) activities and for recreational use by visiting yachts and the general public. The development of the Oil and Gas (O&G) industry will lead to a long-term increase in vessel traffic throughout these waters in Stanley Harbour and short-term increases in Berkeley Sound.

The presence of the Sea Lion Field Northern Development Area, Phase 1 & 2 (hereafter referred to the Phase 1 & 2 Development) vessels may lead to disturbance of other users of the sea in Berkeley Sound and Stanley Harbour and / or an increased risk of collisions inshore. Further, the use of exclusion zones around the temporary Large Transport Vessel (LTV) operations, which themselves are a base-case mitigation against collision risks, may lead to impacts and risks in their own right in terms of fisheries and shipping lanes. Impacts on other users of the sea, and Berkeley Sound in particular, were raised by stakeholders during scoping consultations held in 2014, 2015 and 2016 (Chapter 6)[92].

Owing to the differences in the proposed use of the offshore and inshore locations and the variety of potential impacts and risks, the assessment of impacts and risks on other users has been split into two sections (offshore and inshore) as shown in Table 11.9.

This chapter assesses the impacts and risks to the Human Population and Tangible Property during the inshore activities, and focuses on other users of:

- Stanley Harbour (including FIPASS), and
- The LTV site in Berkeley Sound.

Note: The other impacts associated with vessel use e.g., emissions are described elsewhere in this document, as described in Table 2.2.

Table 11.9: Summary of potential impacts and risks to other users of the sea

Location		Receptor	Potential impact	Potential risk	Assessed in
Offshore		Vessels on passage	Requirement for vessels to navigate around exclusion zones.	Vessel collisions with FPSO[1] and / or MODU[2]	Section 11.1
		Fishing vessels	Fishing prohibition within the exclusion zones may impact upon fisheries revenue.	Snagging on subsea infrastructure and potential for loss of vessel and / or gear	Section 11.1
Inshore	Stanley Harbour	Fishing, Cruise, Cargo and Recreational vessels	Competition for berthing space in Stanley Harbour (including FIPASS)	Potential for collision between vessels in confined waters	This chapter
	Port William	Fishing, Reefer, Cruise, Cargo and Recreational vessels	Competition for anchorage space	Potential for collisions between vessels in confined waters	This chapter
	Berkeley Sound	Fishing, Reefer, Tanker vessels, Cruise ships and Recreational vessels	Reduction in available sea room due to exclusion zones and competition for anchorage space	Potential for collisions between vessels in confined waters	This chapter

[1] Floating Production, Storage and Offloading Vessel.
[2] Mobile Offshore Drilling Unit.

[92] The concerns about project activity in Berkeley Sound in particular were raised by stakeholders at a time when the project was considering inshore Ship-to-Ship transfer of crude oil between tankers. This aspect of the project has been superseded by direct offshore transfer (Section 2.1.1 and Section 4.3.2.2).

11.2.1.1 Relevant legislation

Legislation relevant to the potential for disturbance to other sea users inshore is the same as that for the offshore activities and is described in Section 11.1.1.1 above.

Additional Falkland Islands legislation relevant to the inshore operations alone are:

- Maritime Ordinance 2017.
- Maritime (Amendment) Ordinance 2019.
- Maritime (Port State Control) Regulations 2021.
- Harbour and Ports Ordinance 2017.
- FIPASS Ordinance (1989).
- Falkland Islands Harbour Regulations.

11.2.1.1.1 FIPASS Ordinance (1989)

The Harbour Master[ibid] and FIPASS Manager have powers under the provisions of the FIPASS Ordinance 1989 to regulate shipping within FIPASS waters, which are defined as those waters within one nautical mile from FIPASS.

11.2.1.1.2 Falkland Islands Harbour Regulations

Under the Falkland Islands Harbour Regulations it is an offence for vessels within Falklands harbours (including Berkeley Sound) to:

- Spill or discharge oil or oily mixtures into the harbour,
- Dump garbage or refuse into the harbour, and
- Supply bunkers to another vessel if they are unlicensed to do so by Stanley Services Ltd. within the Territorial Waters of the Falkland Islands.

Further, all vessels using the harbours should be correctly marked with their name on port and starboard bow and at the stern with name and port of registry.

11.2.2 Sources of disturbance to inshore users of the sea

It is the intention of Navitas to use the Temporary Dock Facility (TDF), which was used for the exploration drilling campaigns, to support Sea Lion Phase 1 & 2 activities. Further, Navitas shall propose modifications to improve the Dock's functionality. As described in Section 5.11.1.1.1, proposals to upgrade the TDF facilities will have to go through the planning process, and may require a full EIA, as advised by FIG.

For the purposes of this EIS however, it is assumed that operations at the TDF, and FIPASS, will continue on the same basis as in the 2015 exploration campaign.

Sources of impact and risk to other users of the sea inshore include:

- Additional vessel traffic in:
  - Stanley Harbour (including at FIPASS),
  - Port William, and
  - Berkeley Sound.
- The presence of LTVs anchored in Berkeley Sound (for a total combined and non-consecutive duration of 13 months), the associated exclusion zones and the intermittently attendant Offshore Construction Vessels (OCVs) and Platform Supply Vessels (PSVs).

11.2.2.1 Additional vessels

Numerous different vessels will be deployed inshore for specific tasks during the life of the Phase 1 & 2 Development. Support vessels such as *ad hoc* freighters and offshore support vessels will use Stanley Harbour and FIPASS (for bunkers in the event a fuel line is not added to the TDF) and are further quantified in Section 11.2.4.1.2 below.

11.2.2.2 LTV presence in Berkeley Sound

The LTVs will be required to transport the subsea equipment and the FPSO mooring infrastructure from various parts of the world to the Falkland Islands. The LTV specifications will range from 110 - 160 m in length and 20 - 28 m in beam with a Gross Registered Tonnage (GRT) ranging from 9,000 – 15,000 tonnes. All vessels will have two large cranes.

Upon arrival, they will be anchored in Berkeley Sound and will act as floating logistics vessels for up to a maximum (and non-consecutive) period of 13 months, spread over a 5.5 year period (approximately). At this time, the LTVs will be used to store equipment during the construction process with OCVs and PSVs visiting to collect the infrastructure for transportation to its installation location offshore (Section 5.11.2).

Each vessel will have its own individual 500 m exclusion zone (Table 11.10) and Navitas will work with the Falkland Islands Harbour Master and the Falkland Islands Maritime Authority (FIMA) to identify optimum locations within Berkeley Sound that will cause the least disruption to other users during periods of high marine traffic in the Sound. Enforcement and management of the exclusion zones will be agreed in discussion with FIMA (e.g., the use of guard vessels etc.). Although the exact location of the LTVs and associated exclusion zones are not yet agreed (Section 5.5.1), indicative locations are shown below in Figure 11-4.

Depending on transport opportunities and pick-up locations, up to four different LTVs may be required over the course of the installation period to transport all the equipment, but a maximum of only two vessels will be anchored in the Sound at any one time and other users will be advised of the location to prevent any conflict.

Table 11.10: Exclusion zones applying to Phase 1 & 2 Development LTVs in Berkeley Sound

Location	Facility	Stages	Permanent	Temporary
Inshore in Berkeley Sound	LTV movements and placements	1, 2a & 2b	n/a	500 m radius each (for up to thirteen months)

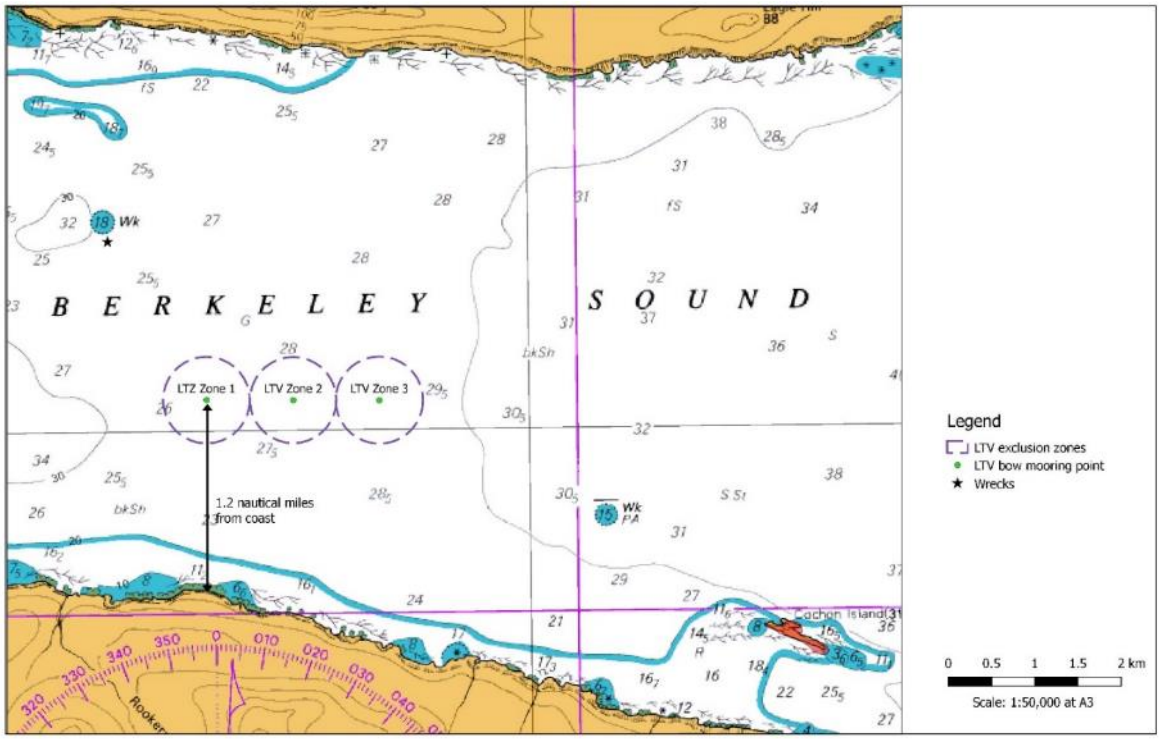


Figure 11-4: Indicative locations of LTVs and associated exclusion zones (three potential locations shown, maximum two LTVs anchored at any one time)

11.2.3 Potential receptors

The Environmental Impact IDentification (ENVIID) workshop was used to identify the specific receptors upon which the impacts and risks to other users of the sea warranted further investigation (Chapter 9). The specific inshore receptors that may be impacted include:

- Users of Stanley Harbour (Section 7.7.4.1.2):
  - Fishing vessels,
  - Cargo vessels,
  - Cruise ships,
  - MoD, and
  - Recreational craft.
- Users of Berkeley Sound (Section 7.7.3.2):
  - Primarily vessels associated with the fishing industry (fishing vessels, reefers and bunkering tankers).

11.2.4 Characterising and quantifying the impacts and risks

When characterising and quantifying the impacts and risks to other users of the sea in inshore waters, it is necessary to consider the:

- Quantification of inshore Phase 1 & 2 activities:
  - Type, location and behaviour of Phase 1 & 2 vessels / infrastructure used inshore, and
  - Phase 1 & 2 use of amenities in Stanley Harbour.
- Quantification of inshore third-party activity:

- The number, type and behaviour of third-party vessels in Stanley Harbour and Berkeley Sound, and
- History of third-party vessel incidents in Stanley Harbour and Berkeley Sound.

- Stakeholder comments and third-party vessel behaviour, and
- Nature of the impacts and risks associated with the Phase 1 & 2 exclusion zones.

11.2.4.1 Quantification of inshore Phase 1 & 2 activities

11.2.4.1.1 Phase 1 & 2 vessels / infrastructure inshore

In order to inform the assessment of the impacts and risks, it is necessary to have an appreciation of the additional inshore vessel traffic incurred as a result of the proposed Phase 1 & 2 Development.

A detailed inventory of the vessels used is provided in Section 5.11.2. A summary of the inshore vessel type, purpose and specification, segregated by location, is provided in Table 11.11.

Table 11.11: Summary of the type, purpose and behaviour of inshore Phase 1 & 2 vessels used to inform the impact and risk assessment

Vessel type	Purpose	Analogous Vessel	Vessel specification			Total number of operations / visits		
			Length (m)	GRT (tonnes)	Max. speed (kn)	Stage 1 (31 months)	Stage 2a & 2b (35 months)	Stage 3 (*c.* 27 years)
Stanley Harbour								
Ad hoc freighters	Cargo operations	HHL Congo	138	9,616	14	5	4	3
MODU's AHTS	Refuelling and resupply	Pacific Champion	86	3,330	15	99	108	4
MODU's ERRV	Refuelling and resupply	Esvagt Don	56.4	1,863	12	90	99	n/a
PSV	Refuelling, cargo operations	Pacific Leader	97.3	5,260	16	52	26	n/a
FPSO's AHTS / ERRV	Cargo operations and refuelling	Nor Solan	97	5,179	14	56	151	1,398
FPSO's MRSV / ERRV	Cargo operations and refuelling	Nor Solan	97	5,179	14	56	151	1,398
Berkeley Sound								
Large Transport Vessels (LTV)	Transport of infrastructure to Falklands and floating logistics barge	Jumbo Fairplayer (typical LTV / HLV)	144	15,000	17	Up to two vessels for up to 7 months	Up to two vessels for up to 5 months	Up to two vessels for up to 1 month
OCV[1]	Visiting LTVs to collect infrastructure for installation offshore	Seven Arctic Inst vessel	163	TBC	15	39	26	n/a
PSV		Seven Arctic Inst vessel	163	TBC	15	52	26	n/a

[1] The OCV will likely be refuelled in the field by the PSV so will not come into Stanley Harbour.

11.2.4.1.2 Phase 1 & 2 use of amenities in Stanley Harbour

As described above (Section 11.2.2), the TDF will be upgraded to improve operability. During this upgrade it is planned to install a fuel line to the TDF which would mitigate against impacts on the use of amenities in Stanley Harbour. However, as a worst-case scenario for the current EIA, it is assumed that refuelling of Sea Lion Phase 1 & 2 related vessels using the TDF will take place at FIPASS.

In order to quantify the number of times the Phase 1 & 2 vessels will refuel at FIPASS, some assumptions have been made. It is assumed that *ad hoc* freighters, AHTS, MRSVs, ERRVs and PSVs will refuel every second time they visit the TDF. All other vessels will re-fuel in the field. Based on these assumptions, the estimated number of refuelling visits during each Stage of the Phase 1 & 2 Development by vessel type is shown on a monthly basis in Table 11.12.

Table 11.12: Estimate of the monthly number of refuelling visits to FIPASS

Vessel Type	Total number of refuelling operations (visits to FIPASS) per month		
	Stage 1	Stage 2	Stage 3
Ad hoc freighter	0.08	0.06	0
AHTS/ERRV/MRSV	4.85	7.25	4.31
PSV	0.83	0.37	0
Total	**5.77**	**7.67**	**4.31**

11.2.4.2 Quantification of inshore third-party activity

11.2.4.2.1 Number, type and behaviour of third-party vessels inshore

11.2.4.2.1.1 Stanley Harbour

On entering, and exiting Stanley Harbour *via* Port William, vessels are required to report to the Harbour Master[ibid] stating their intended movements. Information collected over recent years gives a good indication of the movements of vessels into and out of the Harbour, by type and on a seasonal basis (Table 11.13). The greatest seasonal variation in vessel numbers occurs in February due to an influx of jiggers into the Harbour for licence inspections. Excluding jiggers and O&G related vessels, the number of vessel visits averaged 38 per month during 2014, 36 per month during 2018, and a much lower 6 per month in 2022, which can partly be attributed to the Covid-19 pandemic. In 2023, the average vessels per month (all vessels) was 24 per month (Table 11.13).

Section 11.2.4.1.2 shows the predicted number of Phase 1 & 2 vessel visits to Stanley Harbour during each Stage of the project. The monthly average number of visits will vary between Stages of the project. Assuming that vessel activity will be evenly distributed throughout the year, it is estimated that the following average number of Navitas vessels will visit Stanley Harbour to re-fuel per month:

- Stage 1 – 5.77 vessel visits per month,
- Stage 2 – 7.67 vessel visits per month, and
- Stage 3 – 4.31 vessel visits per month.

Although at times this will add significantly to the number of vessels, traffic within the Harbour will remain at a low level throughout the year.

Table 11.13: Number of vessels entering Stanley Harbour during 2014, 2018, 2022[1] and 2023[2]

Vessel Type	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Cargo	2014	4	2	5	5	3	2	5	4	1	2	2	3	**38**
	2018	2	2	3	3	2	3	2	5	4	3	5	3	**37**
	2022	0	0	0	0	0	0	1	0	0	0	0	0	**1**
Cruise ship	2014	9	12	8	1	0	0	0	0	0	6	14	14	**64**

Vessel Type	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
	2018	21	5	9	1	0	0	0	0	0	5	18	12	**71**
	2022	3	1	1	0	0	0	0	0	1	6	12	13	**37**
Jigger	2014	0	92	15	3	1	0	0	0	0	0	0	0	**111**
	2018	0	103	4	6	1	0	0	0	0	0	0	0	**114**
	2022	1	89	0	0	0	0	0	0	0	0	0	0	**90**
Longliner	2014	1	4	5	3	1	5	7	9	3	4	4	1	**47**
	2018	3	3	4	6	3	3	3	6	4	2	3	1	**41**
	2022	1	0	1	0	1	1	0	0	8	0	0	0	**12**
Naval vessel	2014	0	3	0	2	0	3	0	0	0	1	1	2	**12**
	2018	0	2	0	0	1	1	0	0	0	0	0	1	**5**
	2022	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Patrol vessel	2014	1	4	2	3	3	4	4	5	3	3	3	8	**43**
	2018	3	5	5	5	4	3	2	3	3	3	8	4	**48**
	2022	0	0	0	1	0	2	0	0	1	2	0	1	**7**
Research	2014	1	2	1	1	0	0	0	0	0	0	1	1	**7**
	2018	1	1	4	3	3	2	0	0	0	0	1	1	**16**
	2022	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Tanker	2014	2	1	1	3	3	1	2	1	1	1	1	0	**17**
	2018	1	0	1	1	1	2	0	1	2	1	0	1	**11**
	2022	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Trawler	2014	3	17	13	14	12	3	16	11	6	16	6	0	**117**
	2018	4	14	14	8	16	3	10	12	15	10	3	2	**111**
	2022	0	5	0	1	0	0	5	1	1	0	0	0	**13**
Tug	2014	0	0	3	2	0	1	0	0	0	3	5	2	**16**
	2018	0	1	0	0	0	1	0	0	0	0	0	2	**4**
	2022	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Yacht	2014	8	6	11	7	1	0	1	1	3	6	4	13	**61**
	2018	9	7	13	6	2	2	0	1	3	6	14	8	**71**
	2022	0	1	1	0	0	0	0	0	1	1	1	0	**5**
Total	**2014**	**38**	**149**	**68**	**46**	**26**	**19**	**35**	**31**	**17**	**44**	**46**	**47**	**566**
	2018	**51**	**146**	**59**	**42**	**33**	**20**	**17**	**28**	**31**	**31**	**55**	**38**	**551**
	2022	**5**	**96**	**3**	**2**	**1**	**3**	**6**	**1**	**12**	**9**	**13**	**14**	**165**
	2023	**40**	**102**	**21**	**20**	**2**	**0**	**10**	**12**	**17**	**11**	**24**	**19**	**287**

(Source: FIG fisheries department data (FIG, 2015b), Vessel Movements Database (DNR, 2019) and FIMA data 2023 and 2024)

[1] Note 2022 was a COVID year so vessel numbers are lower than would be expected in a normal year

[2] 2023 data was not available by vessel type but a total for each month is included at the bottom for comparison with previous years.

11.2.4.2.1.2 Berkeley Sound

Detail on existing vessel types and activity in Berkeley Sound are provided in the Environmental and Social Baseline (Section 7.7.3.2) and are presented here as appropriate to this particular impact and risk assessment.

Vessel traffic data for Berkeley Sound has been supplied by the FIG Department[93] of Natural Resources for the years 2010 to 2022 and is summarised in (Table 11.14). The data indicate that there was considerable inter-annual variation in the total number of ship visits between 2010 and 2022. The 2014-15 *Illex* seasons represent the peak in activity in recent years; as such 2014-15 data represents 'worst-case' anticipated vessel traffic in Berkeley Sound.

The main types of vessels visiting Berkeley Sound in 2015 were:

[93] Now the Directorate of Natural Resources (as at 2023).

- Jiggers – Far Eastern fishing vessels that use artificial light to catch *Illex* squid. These had a median size of 955 gross tonnage (GT). There were 122 individual vessels, making an average of four visits per vessel year, typically two weeks apart, mainly during the fishing season of February-May. There is considerable inter-annual variation in the number of jigger visits, depending on the quantity of squid caught,
- Reefers – refrigerated storage vessels for the catch from the jigger fleet. These had a median size of 8,500 GT. There were 59 individual vessels, making an average of 1.7 visits per vessel year, mainly during the fishing season of February-May,
- Trawlers – vessels fishing for finfish and loligo squid. These had a median size of 870 GT. There were only 23 individual vessels, making an average of two visits per vessel year,
- Tankers - of the tanker visits, 54 were by two 3,978 GT vessels, MV Sealion and MV Jason. There were also two visits by an 11,000 GT fishing fleet tanker, and three by 7,600 GT tankers,
- Cargo vessels - in total, there were nine visits by other cargo vessels, including one 34,000 GT bulk carrier, one 23,000 GT cargo ship, one 9,600 GT cargo ship, and six visits by a 2,600 GT cargo ships, and
- Other vessels - the only other vessel of note was a 6,500 GT passenger ship. There were just four other small vessel visits, with a median size of 2,000 GT.

Therefore, it can be seen that Berkeley Sound is utilised predominantly by fishing vessels and associated support vessels (reefers and tankers), which use the Sound as an anchorage for the trans-shipment of fish and squid, and to bunker fuel. The number of fishing and fisheries support vessels present varies considerably on a seasonal and annual basis. Seasonally the number of vessels peaks between March and June (Figure 11-5), while the annual variation is related to the catch recorded in the *Illex* jigging fishery which has varied hugely over the past ten years; from almost 358,000 tonnes in 2015 to around 2,000 in 2016 (FIG, 2023n) (Table 11.15).

Table 11.14: The number of vessel visits to Berkeley Sound recorded from 2010 to 2022

Ship type	No. of ship visits to Berkeley Sound by year												
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Bulk carrier	0	0	0	0	0	1	0	0	0	0	0	0	0
Cargo	7	5	9	8	8	8	6	5	7	4	5	1	2
Cruise	1	0	0	1	1	1	1	0	3	0	2	0	1
Jigger	21	166	72	243	538	491	28	67	46	64	60	283	146
Longliner	0	0	1	0	0	6	0	4	1	0	0	1	0
Patrol/Chase Boat	8	6	3	7	3	3	3	3	0	4	3	3	3
Supply	2	4	8	10	2	0	1	0	0	0	0	0	0
Reefer	36	42	52	56	121	102	20	34	43	22	19	45	33
Standby	0	0	1	0	0	1	1	0	0	0	0	0	0
Survey/Seismic	0	3	0	6	2	0	0	0	0	0	3	1	1
Tanker	23	18	45	40	42	59	18	35	36	48	18	25	33
Trawler	32	28	34	34	67	52	7	26	67	24	21	21	14
Tug	0	1	1	0	0	0	1	0	0	0	2	0	0
Warship	4	4	2	10	5	0	5	1	3	2	5	0	0
Yacht	1	0	0	0	1	0	0	0	0	0	0	0	0
Totals	**135**	**277**	**228**	**415**	**790**	**724**	**91**	**175**	**206**	**168**	**138**	**380**	**233**

(Source: FIG fisheries department data (FIG, 2015b), Vessel Movements Database (DNR, 2019) and FIMA data 2023 and 2024)

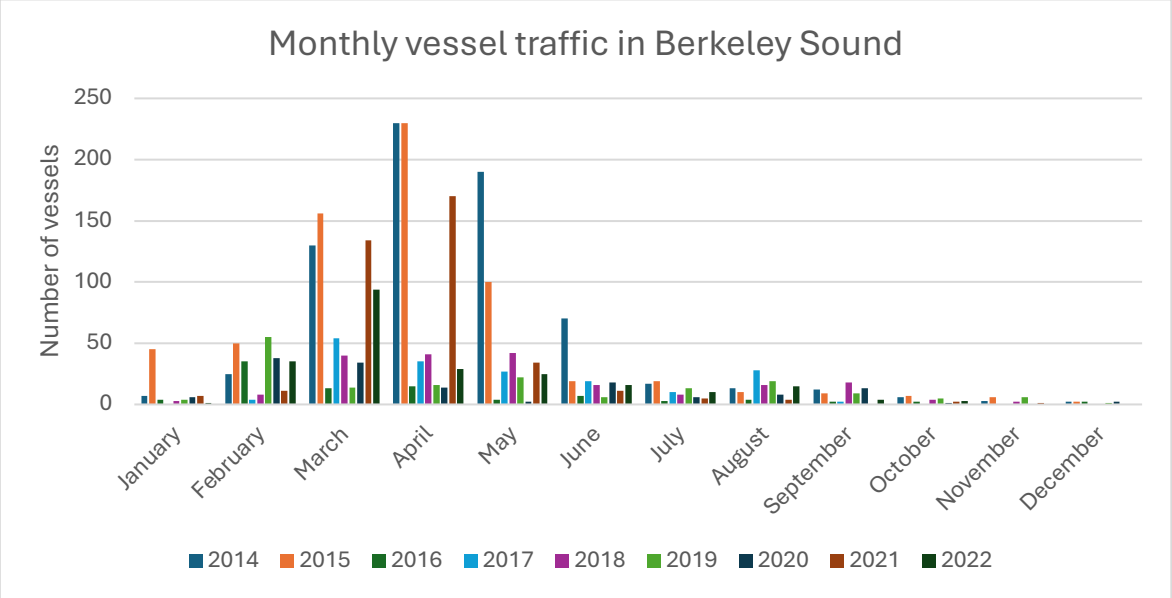


Figure 11-5: Monthly vessel traffic in Berkeley Sound 2014 - 2022

Table 11.15: Annual *Illex* catch

Year	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Catch (tonnes)	142,619	306,111	357,722	2,360	67,445	54,405	43,449	62,663	172,537	73,053

11.2.4.2.2 History of incidents in inshore waters

11.2.4.2.2.1 Stanley Harbour

Space for vessel manoeuvres in Stanley Harbour and through the passage into Port William (The Narrows) is restricted and there have been a number of incidents involving vessel collisions and groundings within these areas (M. Jamieson, *pers. comm.*). No wrecks have been noted since 2019 (N. Port, *pers. comm.*). Although an official record does not exist, anecdotal reports of some of these incidents in recent years are listed in Table 11.16. It is believed that the majority of these incidents were due to human error and / or mechanical failure.

Table 11.16: Anecdotal data on incidents involving vessels in Stanley Harbour and Port William[1]

Date	Vessel type	Type of incident	Outcome	Environmental impact
Unknown	Tanker	Grounding Stanley Harbour	Refloated	None
Unknown	Tanker and research vessel	Collision at FIPASS	Damage to research vessel above the water line	None
Unknown	Jigger	Grounding Stanley Harbour	Refloated	None
Unknown	Reefer	Grounding Port William	Refloated	None
Feb 2014	Jigger	Grounding Port William	Refloated	None
Apr 2014	Trawler	Grounding Port William	Refloated	None
Feb 2017	Jigger	Grounding Stanley Harbour	Refloated	None
Feb 2017	Jigger	Grounding Stanley Harbour	Refloated	None
July 2017	Trawler	Grounding, Port William	Refloated	3 m^3 MGO released to sea.
Feb 2017	Jigger	Collision Stanley Harbour; 2 jiggers coming into contact	Slight damage	None
September 2019	Trawler	Collision with FIPASS	Damage to vessel and FIPASS	Not reported
Unknown	Numerous vessels	Heavy contact with FIPASS	Slight damage to FIPASS and vessels	None

[1] M. Jamieson, *pers. comm.* and A. Black, *pers. obs.*

11.2.4.2.2.2 Berkeley Sound

Historically, there have been a number of incidents within Berkeley Sound (Table 11.17). Several fishing and reefer vessels have either collided with rocks or experienced fires while in Berkeley Sound and following these events, fuel oil leaked from ruptured tanks or sunken vessels, which resulted in environmental impacts.

Table 11.17: Anecdotal data on incidents involving vessels in Berkeley Sound

Date	Vessel type	Type of incident	Outcome	Environmental impact
April 2005	Reefer	Grounding in Berkeley Sound (Cochon Island)	Refloated with damage to hull	Fuel oil leak
May 2008	Trawler (Ocean 8)	Fire in Berkeley Sound	Vessel eventually sank	Fuel oil leaks (*c.*137 Tonnes)
Unknown	Jigger	Struck a rock and sank	Vessel sank	Fuel oil leaks

11.2.4.3 Stakeholder comments and third-party vessel behaviour

Scoping consultations conducted in previous years by the previous operator (POEPL) are summarised in Chapter 6. Of relevance to this section, in August 2016, consultations were held with representatives of FIG's Fisheries Department and the fishing industry regarding all aspects of the project. During these sessions, a number of comments were made regarding the seamanship displayed by the jigging fleet in Berkeley Sound. There are often language problems and insufficient or out-of-date charts on board these vessels, officers on watch are often exhausted and have been known to fall asleep, and electronic

and mechanical equipment is not always in good working order (A. Black, *pers. obs.).* Furthermore, there is a history of non-compliance with regulations within this fleet.

FIFCA (Falkland Islands Fishing Companies Association) have facilitated consultation with local fishing companies (who are in some cases vessel owners) and vessel agents throughout the evolution of the Sea Lion project. The nature of the Falklands' fishing industry is such that ship's captains are not particularly accessible (they spend limited, if any time onshore, and often do not speak English) so direct consultation with captains has not been possible. Competition between sea users, particularly the management of Berkeley Sound, exclusion zones and collision risk has been noted during each consultation.

11.2.4.4 Nature of the impacts and risks associated with Phase 1 & 2 exclusion zones in Berkeley Sound

11.2.4.4.1 Exclusion zones

In order to mitigate against the risk of the collisions between third-party vessels and Phase 1 & 2 vessels, temporary exclusion zones will be implemented within Berkeley Sound according to the ongoing activity (Section 11.2.2.2). Navitas shall work closely with FIMA throughout the planning and execution stages of the development to ensure that:

- Final positions for the LTV anchorage sites are agreed and well communicated to mariners and other users of the sea,
- Activity Specific Operating Guidelines (ASOGs) are developed for the vessels operating in the area,
- FIMA is advised of all vessels planning to operate in the area, and
- FIMA is advised of the activities and equipment / product transferred between vessels.

However, exclusion zones bring impacts and risks of their own with regard to:

- Reduced anchorage availability, and
- Reduced sea room and increased risk of collisions / groundings of third-party vessels.

The following sections describe the nature of the above in terms of the restrictions that exclusion zones place on third-party vessels operating within Berkeley Sound. Restrictions and management of exclusion zones in Berkeley Sound was noted as a stakeholder concern (Section 11.1.4.2.2).

11.2.4.4.1.1 Reduced anchorage availability

Numerous vessels anchor within Berkeley Sound for the purposes of fuel bunkering, the transfer of fish catches and to shelter in adverse weather (noting that sheltering vessels will not always anchor) (Section 7.7.3.2.1). When in use, the temporary exclusion zones associated with the LTVs have the potential to restrict, or be seen to restrict, the available space in the Sound during peak seasons.

11.2.4.4.1.2 Reduced sea room and increased risk of collision / grounding of third-party vessels

Collisions are most frequently caused by a navigational failure of one or both vessels involved in the collision. The main factor that influences collision frequency is the density of vessel traffic and the probability of a collision increases with the vessel density squared (i.e., if the density doubles, the probability of a collision quadruples, DNV, 2010).

Groundings are effectively collisions with land, the likelihood of which is related to the proximity of a vessel to land or subsea hazards (such as rocks).

Other factors that influence the collision or grounding frequency include:

- Non-compliance with regulations (e.g., ColRegs) – education issues,

- Poor communication between vessels,
- Visibility (rain, snow, fog),
- Restricted maneuverability,
- Metocean conditions (wind, tide, swell),
- Lack of navigational aids (shore-based radar, marked channels),
- Mechanical failure (black-out, steering failure), and
- Vessel standard (hardware and software).

The use of exclusion zones effectively reduces the space available to other users of Berkeley Sound to the north and south of the LTVs. This may force vessels into closer proximity to each other and to the coastline and therefore increases the risk of collisions and groundings.

To date, vessels using Berkeley Sound generally do not venture within 1.5 km of land for safety reasons and the area utilised by vessels covers approximately 100 km^2 (Figure 11-6). However, it is recognised that restricting the sea-room available to vessels may increase the likelihood of third-party incidents.

Effect on vessel density

If the maximum number of LTVs (i.e., two) are in the Sound at any one time, the area required for the two 500 m exclusion zones (Figure 11-6) is 2.36 km^2, which is <3 % of the area used by other vessels. The LTV exclusion zones make little difference to the area available to third-party shipping and the increase in the risk of collision or grounding is likely to be insignificant (Table 11.18).

The density of vessels within the remainder of the Sound will increase by a factor of 1.02, which increases the risk of collision by a factor of 1.04. The area occupied by the LTV exclusion zones will force vessels to use a slightly narrower channel to the north of the anchorage.

Data from 2014 (a very busy year, Section 11.2.4.2.1.2) was used as a worst-case example to illustrate the influence of the exclusion zones on vessel density (Table 11.18). However, it should be noted that this data refers to all visits during each month and not all vessels will be present at any one time.

Table 11.18 indicates that the influence of the exclusion zones in Berkeley Sound will mostly be felt in the months where the most vessels are present i.e., from March – June, so during those months vessels will have less sea room than at other times of year.

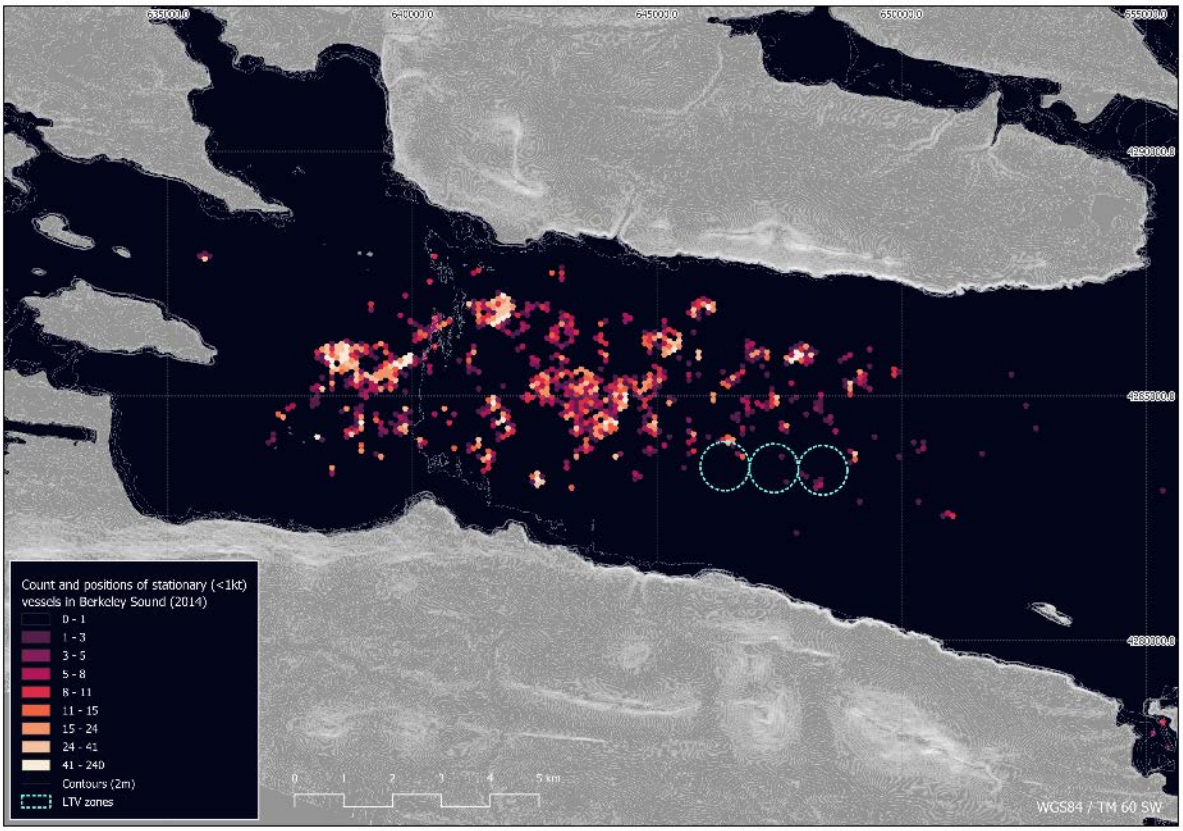


Figure 11-6: The extent of the exclusion zones associated with the anticipated LTV site in relation to the position of all vessels (from AIS) between May 2014 and May 2015 (a particularly busy year)

Table 11.18: The influence of exclusion zones on vessel 'density[1]' on a monthly basis, data from 2014

Scenario	Month											
	J	F	M	A[2]	M[2]	J	J	A	S	O	N	D
No. of vessels	6	25	137	270	225	75	18	12	11	6	3	2
Vessels / km^2 no exclusion zones	0.06	0.25	1.37	2.70	2.25	0.75	0.18	0.12	0.11	0.06	0.03	0.02
Vessels / km^2 with LTV 500 m exclusion zone	0.06	0.26	1.40	2.77	2.30	0.77	0.18	0.12	0.11	0.06	0.03	0.02

[1] Densities are rounded to two decimal places.
[2] Navitas shall use best endeavours to avoid using Berkeley Sound during peak fishing months.

11.2.4.4.1.3 Stakeholder opinion on exclusion zones

Responses from stakeholders to the proposed exclusion zones within Berkeley Sound were mixed with some positive and some negative representations made during scoping consultations (Chapter 6). However, it should be noted that these representations were made in response to the previously proposed larger, and more enduring, Inshore Transfer-related exclusion zones (which is no longer planned, Section 4.3.2.2). The LTV operations and associated exclusion zones proposed were not discussed explicitly during the 2016 scoping consultations but have been shared during subsequent consultations in 2018 and 2023.

Specifically, concern expressed in 2016 in relation to the Inshore Transfer operation was regarding the space available to other users of Berkeley Sound and the unpredictable behaviour of, and communication with, the fishing fleet was highlighted as an issue. However, the overall consensus was that the anticipated tighter regulation and management would be positive for all users of the Sound, although, while all agents of vessels operating in the Sound were consulted *via* FIFCA, it should be noted that not all the vessel Captains or vessel owners were consulted directly.

11.2.5 Industry standard mitigations

11.2.5.1 Exclusion zones

The use of temporary exclusion zones for the LTV operation is a mitigation in itself against the risks of collision. No industry-standard mitigations are required to minimise the impact of these on other users of the sea.

11.2.5.2 Vessel operations

The industry-standard mitigations used to prevent collisions between vessels inshore are the same as those described in Section 11.2.1.1 above.

Additionally, a Falkland Islands Berthing Master / Pilot will accompany the LTVs prior to entering Berkeley Sound. The Pilot will be trained in navigation of the Sound and local use of the area.

Falkland Islands ports and harbours information (FIMA, 2023) was produced to assist the Masters of all vessels using the Designated Ports around Stanley. These information sheets are available for Berkeley Sound, Port William and Stanley Harbour. In addition, a Harbour Management Plan will be developed by Navitas to facilitate vessel operations in Stanley Harbour (Section 3.2.18.1).

11.2.6 Impact and risk assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities. Assessment of unplanned events includes an assessment of the 'Likelihood of Occurrence' to determine the 'Risk'.

A summary of the impact and risk assessment outcomes for this Development is tabulated in Section 11.2.12, which shows the worst-case impact / risk for each activity and receptor and details are provided below.

11.2.6.1 Impact assessment of inshore activities

11.2.6.1.1 Disturbance to other users within Stanley Harbour

Disruption to the activities of other vessels in Stanley Harbour may occur but is considered to be minimal. The human population (fishing, tourism and shipping industries) are tolerant to a change on this scale and it is anticipated that occasional use of FIPASS (Section 11.2.4.1.2) will be acceptable to the majority of stakeholders. Therefore, the sensitivity of the receptor is considered to be '**Low**'.

As described above, it is assumed that refuelling of Navitas vessels will take place at FIPASS (if a dedicated fuel line is not added to the TDF). At times of high demand, berthing space at FIPASS can be oversubscribed and vessels have to wait for a berth to become available. Navitas' use of FIPASS may further exacerbate this issue. However, while the impact will be short-term with minor effects on livelihood (due to possible delayed berthing), this may be considered unacceptable to a minority of stakeholders. The severity of effect is therefore considered to be '**Minor**'.

Therefore, the overall significance of the impact on resource use in Stanley Harbour is assessed as '**Low (4)**'.

11.2.6.1.2 Loss of anchorage space due to exclusion zones in Berkeley Sound

Berkeley Sound is heavily utilised by other users of the sea (the fishing industry) on a seasonal basis, with highest activity between March and June (Section 11.2.4.2.1.2). Navitas will endeavour to avoid these winter months for offshore installation and thus avoid the periods with the most other users of Berkeley Sound. However, even with the exclusion zones in place, there is ample space available for vessels wishing to anchor and transit through the Sound in comparison with harbours elsewhere in the world. Vessels using the anchorage in Berkeley Sound are tolerant of change on this scale without detriment to its character and therefore the sensitivity of the receptor is considered to be '**Low**'.

The temporary 500 m exclusion zones surrounding the LTVs do not significantly restrict the area available to other vessels for anchoring or manoeuvering (Section 11.2.4.4.1). Any inconvenience caused is expected to be relatively short-term and minor, although this may be unacceptable to some stakeholders. The temporary exclusion zones represent a moderate use of a finite resource for limited but predictable periods and, therefore, the severity of effect is considered to be '**Minor**'.

Therefore, the overall significance of the impact of the exclusion zones on the human population is assessed as '**Low (4)**'.

11.2.6.1.3 Potential positive impact of the presence of Phase 1 & 2 Vessels

In addition to the negative impacts and risks described above, the presence of the O&G industry may also offer potential benefits to other users of the sea. In particular, the presence of large ocean-going supply vessels may be useful in the event of emergency situations that require salvage, rescue or an oil spill response. As was observed during November 2015 following a fire onboard a cruise ship, vessels with the capability to aid rescue may help to prevent environmental damage, loss of property and loss of life at-sea (A. Black, *pers. comm.*).

11.2.6.2 Risk assessment of collisions during inshore activities

11.2.6.2.1 Collisions in Stanley Harbour

The Phase 1 & 2 vessels will increase the number of vessels using Stanley Harbour but it will remain a relatively quiet port with notable busy periods during cruise ship and fishing seasons. Nonetheless, a Harbour Management Plan shall be developed prior to Sea Lion Field operations in order to manage vessel movements and other users of the Harbour are tolerant to change on the scale proposed. Therefore, the sensitivity of receptors is considered to be '**Low**'.

As a worst-case scenario, a collision between vessels has been assumed. To date, incidents of this type are rare within the Harbour and have resulted in medium term inconvenience and expense due to the necessary repairs. Here as a worst-case, we assume a similar impact and therefore severity of effect is considered to be '**Moderate**'.

Therefore, the significance of the impact on other users of Stanley Harbour is assessed as '**Moderate (6)**'.

The available information suggests that collisions or contact between third-party vessels in Stanley Harbour do occur. However, while there have been a number of single vessel incidents, most of these have been due to human error or mechanical failure. The vessels used by Navitas will be technologically advanced and manned by highly trained, competent crew, which reduces the likelihood of mechanical breakdown or human error leading to incidents. The base-case for the Phase 1 & 2 Development is for all project vessels to dock at the TDF (or anchor) whenever visiting Stanley Harbour. This will separate the activities of Phase 1 & 2 vessels and other users of the Harbour and therefore reduce the potential for incidents. Although Navitas may upgrade the TDF for operational flexibility and to include a fuel line, this proposal is yet to go through the planning process and therefore it is assumed as a worst-case

that refuelling will take place at FIPASS as it did during the 2015 exploration and appraisal campaign. On rare occasions, there have been collisions between vessels using FIPASS, therefore the likelihood of occurrence of a major incident (such as collision) between Navitas vessels and other users is considered to be '**Unlikely**'.

Therefore, the significance of the risk to other users of Stanley Harbour is assessed as '**Low (6)**'.

11.2.6.2.2 Collision due to reduced sea room from temporary exclusion zones in Berkeley Sound

The temporary exclusion zones for the LTVs may lead vessels to navigate closer to the shoreline of Berkeley Sound than they would normally choose to (i.e., sea room is restricted). This increases the risk of watch-keeper error or problems in the event of a mechanical breakdown, which as a worst-case could lead to a vessel grounding. If a vessel grounds, it could result in significant damage to, or loss of, the vessel. Due to the size of the Sound, the other users of Berkeley Sound have moderate capacity to absorb change without significantly altering their present operations, although some stakeholders may find this unacceptable. Therefore, the sensitivity of the receptor is considered to be '**Moderate**'.

If a vessel were to run aground, the salvage and repair could have a long-term effect on livelihood and therefore the severity of effect is considered to be '**Serious**'.

The significance of the impact of restricted sea room is assessed as '**Upper Moderate (12)**'.

Given the circumstances described in Section 11.2.4.3 above, it is difficult to estimate the likelihood of collisions that may result from reduced space caused by the LTV temporary exclusion zones. Although Berkeley Sound is a large open bay, watch-keeping and mechanical failures have resulted in vessels grounding in the past 20 years (Section 11.2.4.2.2.2). The temporary LTV exclusion zones will reduce the space available to vessels and therefore may increase the likelihood of accidental events in the future. However, the zones do not limit sea room extensively and will only be in place for up to 13 months in total, spread over a period of around 5.5 years. The anticipated improved regulation in the Sound may serve to lessen the likelihood of collisions, and even alter behaviours. Therefore, on balance the likelihood of restricted sea room leading to vessel groundings is considered to be '**Very Unlikely**'.

Therefore, the overall significance of the risk associated with reduced sea room is assessed as '**Low (4)**'.

11.2.7 Project-specific mitigation

With legislation and industry-standard mitigations applied, the impacts and risks assessed above are considered to be '**Low**' such that project-specific mitigation is not actually required. However, the above assessment assumes that all third-party vessels using the Sound will operate within the 'Rules of the Sea' which, ordinarily, should be sufficient for vessels to adapt to the proposed changes without any negative impact.

However, experience has shown that this cannot be taken for granted when dealing with the fishing fleet. Scoping consultations in August 2016 highlighted several issues with vessels using Berkeley Sound regarding communication and compliance as major concerns (Section 11.2.4.3). In order to help communicate the positions and restrictions associated with the exclusion zones, briefing notes will be issued in the first languages of the vessel Captains.

11.2.8 Residual impacts and risks

The impacts and risks are unchanged from the initial assessment.

11.2.9 Cumulative effects

11.2.9.1 Stanley Harbour

The Sea Lion Development will increase the amount of vessel traffic within Stanley Harbour; however, the Port will remain relatively quiet compared with ports elsewhere in the world. Nonetheless, facilities within the Harbour are under-developed and competition for space may be an issue, potentially leading to cumulative impacts through increased 'concentration' (Section 8.9.1). Any upgrade of the TDF (Section 5.11.1.1.1) will reduce the project's reliance on FIPASS but may not completely negate the requirement for Navitas project vessels to use FIPASS. Therefore, it is anticipated that there may be some cumulative impact to users of Stanley Harbour.

11.2.9.2 Berkeley Sound

Although there are no other official exclusion zones in place within Falklands waters, any vessel at anchor effectively has an exclusion zone around it (in essence, the laws of the sea mean vessels will maintain a safe distance around vessels at anchor). Cumulative impact e.g., from increased 'concentration' (Section 8.9.1), will vary on a monthly and annual basis depending on the number of other users within Berkeley Sound.

11.2.10 Confidence assessment

11.2.10.1 Disturbance to other users within Stanley Harbour

The use of amenities in Stanley Harbour is possible to predict based on the known operation and therefore the confidence in the assessment is considered to be '**Certain**'.

11.2.10.2 Impacts and risks associated with exclusion zones in Berkeley Sound

The nature of the impact is reasonably well understood but the unpredictable behaviour of the receptors (fishing vessels) introduces an element of uncertainty. This is particularly true for vessels using the area around the LTV site in Berkeley Sound where space is a limited resource. Therefore, the level of confidence in the predictions of these impacts is considered to be '**Probable**'.

11.2.10.3 Risk of collisions between vessels

Previous collision risk modelling conducted by POEPL (now Navitas) with regards to the previously proposed Inshore Transfer operations (which is now discounted) was used to inform this assessment and was based on short-term poor quality AIS data, collected between 2010 and 2014. There is considerable inter-annual variation in vessel traffic, largely due to variations in *Illex* squid abundance but 2014-15 was demonstrably a peak *Illex* fishing season, and as such represents a worst-case in respect of expected vessel traffic and associated collision risk.

Stakeholders within FIG and from the fishing industry have been consulted as part of the scoping process for this EIA (Chapter 6). Their views have been taken into consideration and therefore confidence in the assessment is considered to be '**Probable**' and further monitoring of vessel movements and analysis will help to improve confidence in this assessment.

11.2.10.4 Monitoring required

The activities within Berkeley Sound are expected to be managed more rigorously than they have been in the past, with the aid of AIS monitoring. It is likely that this initiative will be driven by FIG.

Detailed monitoring requirements have been established during the Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the project-specific Phase 1 & 2 EMMP (an outline EMMP is provided in Chapter 15).

11.2.11 Offsetting

As no residual impacts or risks identified in this section are considered significant, i.e., Moderate or above, offsetting is not considered necessary for this impact (see Section 8.11).

11.2.12 Findings summary

Table 11.19: Summary of the impact and risk assessment on other users of the sea inshore

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Presence of vessels	Use of amenities in Stanley Harbour	Disturbance to other users of Stanley Harbour (e.g., competition for space at FIPASS)	Planned	1, 2a, 2b & 3	Low	Minor	n/a	**Low (4)**	**n/a**	**Certain**	**Industry-standard:** Vessels will adhere to the Stanley Harbour Management Plan. **Project-specific:** None proposed.
Inshore exclusion zones	Reduction in the area available to navigating and anchoring vessels	Loss of potential anchorage	Planned	1, 2a & 2b	Low	Minor	n/a	**Low (4)**	**n/a**	**Probable**	**Industry-standard:** Use of local pilots for Navitas managed vessels in Berkeley Sound, and Status issued in 'Notes to Mariners' and on radio. **Project-specific:** Briefing documents issued in the language of the Captain.
Increased vessel traffic due to addition of	Collision in Stanley Harbour	Damage to vessels	Unplanned	1, 2a, 2b & 3	Low	Moderate	Unlikely	**Low (6)**	**n/a**	**Probable**	**Industry-standard:** Vessels will adhere to the Stanley

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Phase 1 & 2 vessels											Harbour Management Plan. **Project-specific:** None proposed.
Temporary exclusion zone/s in Berkeley Sound and reduction in sea room	Collisions between vessels or vessels grounding	Damage to vessels	Unplanned	1, 2a & 2b	Moderate	Serious	Very Unlikely	**Low (4)**	**n/a**	**Probable**	**Industry-standard:** Aim to avoid peak months, Use of local pilots for Navitas managed vessels in Berkeley Sound, Use of exclusion zones, 'Notes to Mariners', and Collision risk management procedures. **Project-specific:** Briefing documents issued to the Captain.

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

11.3 Competition for resources – Accommodation

Table of Contents

11.3.1 Introduction 1017
11.3.1.1 Relevant legislation 1017
11.3.1.1.1 Competition for resources assessment 1017
11.3.1.1.1.1 Stanley Town planning 1017
11.3.2 Sources of impact and risk 1018
11.3.3 Potential receptors 1018
11.3.4 Characterising and quantifying the impact 1019
11.3.4.1 Nature of potential impact 1019
11.3.4.2 Quantifying the impact 1019
11.3.4.2.1 Available accommodation in Stanley 1019
11.3.4.2.2 Phase 1 & 2 accommodation requirements 1020
11.3.4.2.3 Navitas provision of accommodation 1022
11.3.4.2.3.1 In-transit, routine and surge accommodation provision 1022
11.3.4.2.3.2 Use of locally based personnel 1023
11.3.4.2.3.3 Proposals for accommodating long-term onshore personnel 1023
11.3.4.2.4 Opinions of stakeholders 1024
11.3.5 Industry standard mitigations 1024
11.3.6 Impact assessment 1024
11.3.6.1 Impact assessment 1024
11.3.6.1.1 In-transit, routine and surge accommodation 1024
11.3.6.1.2 Impact of onshore personnel on Stanley's housing stock 1025
11.3.6.2 Risk assessment 1025
11.3.6.2.1 Contingency accommodation needs 1025
11.3.7 Project-specific mitigation 1025
11.3.8 Residual impact assessment 1026
11.3.9 Cumulative effects 1026
11.3.10 Confidence 1026
11.3.10.1 Monitoring required 1026
11.3.11 Offsetting 1026
11.3.12 Findings summary 1026

11.3.1 Introduction

The onshore and offshore personnel associated with the Phase 1 & 2 Development will require temporary and longer-term accommodation in the Falkland Islands. This chapter investigates the requirement for personnel accommodation in comparison to the current level of housing stock, overnight bed accommodations and proposed levels of new housing provision in Stanley. The forecast difference between development need and the current excess capacity determines the level of competition and the sensitivity of the receptor.

As described in Section 6.2.2.1.1, socio-*economic* impacts are out of scope for this EIS and Navitas are conducting a separate Socio-economic Impact Assessment (SIA), building on and updating the previous work undertaken for FIG and Rockhopper by Regeneris (2013; 2015), Plexus Energy (2012), and POEPL (Maplecroft, 2019) for pre-sanction consideration alongside this EIS. Therefore, this assessment focuses on the social impact of resource competition and not the secondary implications of such competition which may be socio-economic in nature e.g., competition on accommodation rental values.

Both the carrying capacity of existing infrastructure and competition for resources were raised as a concern during the scoping consultations (Chapter 6).

Note: impacts related to competition for other resources e.g., freshwater, electricity etc. are described elsewhere in this document, as described in Table 2.2.

11.3.1.1 Relevant legislation

Resource competition is not legislated for within any specific Ordinance or Regulation. No statutory limits are defined through legislation.

Nonetheless, Falkland Islands legislation that is relevant to environmental and social impact assessments are as follows:

- Offshore Minerals Ordinance 1994 (1997 and 2011 Amendments).
- Planning Ordinance 1991.

11.3.1.1.1 Competition for resources assessment

As was agreed during the consultee scoping workshop with FIG in 2015 (Chapter 6), the social impacts of competition for resources such as accommodation was considered to be within the scope of the EIS as defined by the EIA Guidance Note (FIG, 2016e).

11.3.1.1.1.1 Stanley Town planning

Aspects of resource competition are implicit within hierarchical planning legislation and planning policy that guides development and assessment of planning applications, setting them within an overall framework to achieve strategic development aims.

Planning policy is one of the key tools available to achieve the stated FIG aim of sustainable development. The Development Plan is a statutory document and provides a framework for the future spatial development of the Islands. It is made up of the Islands-wide Structure Plan, which provides the overall strategic approach, and Local Plans, such as the Stanley Town Plan, which provide more detail and land-use zoning for specific areas within the Islands (FIG, 2015d).

The Stanley Town Plan recognises and makes provision for the consideration of service utility capacity and housing needs. Prioritised and addressed within the Stanley Town Plan are:

- Expansion of housing stock,
- Diversification of accommodation types with specific reference to O&G requirements for transit-type accommodation, and

- Land-use zoning to encourage and facilitate appropriate development.

11.3.2 Sources of impact and risk

Any activity or asset that requires personnel is a potential source of competition for accommodation resources. The personnel requirements of the project, whether based offshore and transiting through the Falkland Islands, or whether based onshore in a support and logistical capacity, will determine the level of accommodation needed and thus the level of competition.

Sources of demand for accommodation, and thus competition for resource, during the Phase 1 & 2 Development include:

- Onshore / at-shore personnel:
  - Onshore baseline accommodation:
    - Port facility personnel (TDF),
    - Onshore laydown yard personnel,
    - Logistical support and office staff,
    - Accommodation / hospitality / domestic support staff, and
    - Helicopter pilots and aviation support staff / ground crew.
  - Transit accommodation outwith normal rotations:
    - Fixed-wing flight crew lay-over, and
    - Technicians for specialist onshore work or awaiting transfer offshore for specific technical tasks outside standard crew exchanges.
  - Onshore visitor accommodation:
    - Management utilising hotel accommodation.
- Offshore / near-shore personnel:
  - In-transit accommodation for crew exchange between the:
    - Mobile Offshore Drilling Unit (MODU) (Stage 1, 2a & 2b),
    - Floating Production, Storage and Offloading (FPSO) unit (Stage 2a, 2b and 3),
    - Supply Vessels (Stages 1, 2a, 2b and 3),
    - Offshore Construction Vessels (OCVs) (Stages 2a & 2b), and
    - Large Transport Vessels (LTVs) (Stage 1, 2a & 2b).
- Contingency accommodation requirements:
  - Offshore down manning of MODU or FPSO, and
  - Major incident response.

11.3.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify those receptors upon which the impacts of resource competition warranted further investigation (Chapter 9).

Receptors that may be impacted by accommodation resource usage associated with the Phase 1 & 2 Development include:

- Human Population (in Stanley) (Section 7.7.2), and
- Tangible Property (including utility services and infrastructure (Section 7.7.4).

Any impact on utility infrastructure (e.g., provision of water utility services to residential accommodation), which may be classed as tangible property, will additionally impact upon the human population that is reliant upon it.

Further, inshore logistical support and associated accommodation requirements will be based within close proximity to Stanley, which is home to around 80 % of the Falkland Islands' population and the only location serviced by public utilities. Therefore, the assessment is based upon the human population of Stanley within the area covered by the Stanley Town Plan.

The assessment assumes a worst-case accommodation requirement being resourced from within Stanley where the greatest levels of domestic competition are likely located. Personnel figures and the need for accommodation will continually be reassessed through the project's phases and accommodation requirements may decline as operational logistics are finalised, also the potential for locally recruited staff would also reduce additional accommodation requirements. Current figures are assumed as a worst-case scenario.

11.3.4 Characterising and quantifying the impact

11.3.4.1 Nature of potential impact

Adequate accommodation is a basic human need and a necessity for all residents.

Within the scope of the current assessment, only the level of competition for housing resources will be considered. Whilst increased competition for housing undoubtedly has additional knock-on effects these are primarily socio-economic in nature, and further detail is not provided here. A fuller assessment of these associated impacts are covered by the Navitas SIA, as described in Section 7.6.4.

11.3.4.2 Quantifying the impact

In order to quantify the impacts of the Phase 1 & 2 accommodation needs on the Human Population and Tangible Property, it is necessary to have an understanding of the accommodation currently available in Stanley and to compare this to the Navitas requirements, taking account of the accommodation that Navitas intend to provide.

Full detail on the baseline Stanley accommodation is provided in the Environmental and Social baseline (Section 7.7.4.5.1) and details on the Phase 1 & 2 Development needs and provisions are given in the Development Description (Section 5.11.4.1). The key data are summarised below:

- Available accommodation in Stanley,
- Phase 1 & 2 accommodation requirements,
- Navitas provision of accommodation:
  - In-transit, routine and surge accommodation provision,
  - Use of locally based personnel,
  - Proposals for accommodating long-term onshore personnel, and
  - Development of new housing.
- Stakeholder opinion.

11.3.4.2.1 Available accommodation in Stanley

Following the 2021 Census (FIG, 2023l), the rental market in Stanley accounts for 40.2 % (481 households) of the housing stock whilst owner occupancy, including mortgaged premises, accounts for 54 % of the housing stock. The occupancy of these existing houses is relatively low at only 2.3 people / unit; and 72 % of the housing stock is detached housing units (FIG, 2021c).

It is recognised that existing Stanley housing stock cannot meet either the volume or type of personnel accommodation needs of the Sea Lion Phase 1 & 2 Development due to:

- Low number of rental properties,

- Low density of existing housing type with predominance of detached properties, and
- Lack of flats and catered hostel type accommodation to suit and the needs of the Oil and Gas (O&G) sector.

Within the exploration and appraisal drilling campaigns, which were of a temporary nature, the accommodation of 'long-term' onshore personnel was fulfilled through private rentals within existing rental stock, which did serve to increase rental competition. At present, FIG housing lists are at capacity and residential building plots that have been released at Sappers Hill and Bennet's Paddock to date are fully subscribed (Section 7.7.4.5). It is considered that there is an on-going shortage of affordable housing for purchase and rental, and that lack of housing provision already limits economic growth (Regeneris, 2013; Maplecroft, 2019).

Current hotel bed-space is approximately 142 beds (Section 7.7.4.5.1.3) and while hotels could be utilised to partially meet Navitas needs, this would seriously impact tourism and other business sectors.

Further, in addition to the needs of the long-term resident population there is a significant existing demand from Work Permit Holders (WPH) who require rental accommodation for the duration of their contract. WPH are essential to the economy of the Falklands and fill many specialist management, technical, education and service sector posts across both the public and private sectors.

It is recognised by Navitas that the existing accommodation is not sufficient to meet the needs for the Phase 1 & 2 Development, and thus has the potential to be a limiting factor with associated social impacts.

11.3.4.2.2 Phase 1 & 2 accommodation requirements

The peak demands for accommodation throughout Phase 1 & 2 are detailed in Table 11.20 below, alongside a description of the proposal for how these needs will be met. For the purposes of assessment, the maximum in-flux personnel from overseas is assumed in order to represent the worst-case scenario as the level of local recruitment for posts cannot be accurately quantified at this stage.

It is likely that a proportion of onshore personnel will be recruited locally in both permanent and temporary positions. The effect of local employment on accommodation provision is detailed in Section 11.3.4.2.2.

There is likely to be a central core requirement for accommodation throughout the field's life for onshore personnel, crew change delay and down-manning. Additional requirements to meet peak demands in Stage 1, Stage 2a and Stage 2b may be removable. However, the exact configuration of accommodation is subject to solutions put forward through the contracting strategy and tender process. The fate and/or decommissioning of this additional surge accommodation once needs reduce is not yet confirmed and will be determined at that time.

Table 11.20: Estimated maximum accommodation requirement for personnel required to support the Sea Lion Phase 1 & 2 Development

Personnel type	Accommodation Requirement[1]	Stage 1		Stage 2a &2b:		Stage 3:		Base-case provision of accommodation by Navitas[2]
		31 months		35 months		27 years		
		Max no. people[2]	% Stanley pop[3]	Max no. people[2]	% Stanley pop[3]	Max no. people[2]	% Stanley pop[3]	
Permanent onshore personnel who live in Stanley (office, supply base, heliport)	The ability to accommodate all onshore personnel will be required four - six months prior to the start of drilling activity and will endure for the duration of the Sea Lion Field life	26	1.02	24	0.95	24	0.95	Housing strategy to encourage private sector provision
Temporary rotational onshore personnel required during high intensity periods or stand-by personnel who live in Stanley for a few weeks to a few months	Routine and surge hostel-type accommodation for personnel employed onshore within support yards and logistics (on a 28 x 28 day rotation), who are on stand-by, and overnighting fixed wing air crew.	74	2.92	70	2.76	13	0.51	Temporary modular accommodation units initially provided by Navitas, supplemented by local hotels. Transferring to in-transit accommodation as soon as available.
Offshore personnel (in transit) requiring accommodation prior to going offshore	Overnight hostel-type accommodation for personnel at the beginning and end of offshore rotations	62	2.44	62	2.44	60	2.36	In-transit accommodation unit provided by Navitas.
Personnel down-manned to shore in the event of an emergency	Short term contingency accommodation in the event of an emergency down manning of the drilling rig or the FPSO. Required for Field Life[4]	140	5.52	140	5.52	100	3.94	Above accommodation facilities can be double occupancy for up to three days
Visiting senior personnel	*Ad hoc* hotel accommodation	Not estimated as yet but anticipated to be similar to the exploration campaign						None
Total requiring accommodation at any time		**302**	**11.9**	**296**	**11.66**	**197**	**7.76**	

[1] Based on Navitas' Sea Lion Phase 1 & 2 Development projections.
[2] See Development Description (Section 5.11.4.1) for detail.
[3] Stanley population from the last census, 2,538 usually resident and present (FIG, 2023l).
[4] Figures provided by Navitas Logistics and Infrastructure Overview.

11.3.4.2.3 Navitas provision of accommodation

11.3.4.2.3.1 In-transit, routine and surge accommodation provision

Recognising the current pressure on housing stock and hotel accommodation, Navitas is committed to provide accommodation that will meet the needs of:

- Rotational onshore personnel,
- Offshore personnel in transit, and
- Contingency accommodation in the event of a crew change delay or an emergency.

The contracting strategy will align with the Falkland Islands Local Content Code of Practice and accommodation provision will be tendered.

It is hoped that innovative solutions will be driven by the private sector and it is likely that all of the above accommodation needs may be serviced by 'hostel-type' accommodation. The location of new accommodation will take into account access and servicing requirements. Ideally the facility will have easy access to the By-pass / Airport Road to remove the need for transit through town and to provide easy access to the Temporary Dock Facility (TDF) and logistical bases, however this will be determined through tender and the Planning Permission process.

The hostel-type accommodation will be sufficient to provide contingency accommodation in the event of a crew change delay or an emergency because:

- Down-manning of the MODU or FPSO would be unlikely to occur coincidentally to crew change (2 days every fortnight) and hence transit accommodation would be available for down-manned personnel,
- All accommodation will be based on single room occupancy in normal conditions but will be equipped with a second fold-down bed to double accommodation capacity thus meeting full down-manning requirements,
- Durations of contingency accommodation requirement would be short as if an extended duration of down-manning occurs, it is likely that crew would be flown out of the islands and repatriated on a specially chartered flight, and
- Use of additional vessel assets and third manning in rooms is feasible, though would not normally be required.

Planning policy is supportive of the provision of dedicated accommodation specifically designed for the requirements of the oil sector (FIG, 2015d). The Stanley Town Plan recognises the need to diversify the range of accommodation and supports, in principle, proposals for permanent structures to provide 'in-transit' and short-term surge accommodation on land identified and zoned for light industrial uses (FIG, 2015d).

Further, existing Stanley hotel accommodation will only be utilised for a small number of short visits e.g., by management, where hostel-type accommodation may not be suitable. This is foreseen to be at similar rates to those already experienced during previous exploration and appraisal campaigns.

Therefore, at present, and as shown in Table 11.20, only longer-term onshore personnel, numbering approximately 26 at peak, are not covered by the bespoke accommodation provision. A specific housing strategy focused at promoting private sector provision will be adopted during sourcing processes and will be influenced by the degree of local versus expatriate personnel fulfilling these roles. In a worst-case scenario this amounts to a 6 % rise in the number of WPH's requiring accommodation needs within Stanley.

11.3.4.2.3.2 Use of locally based personnel

Long-term residents holding either 'Permanent Resident Permit' or who have 'Falkland Islands Status' will already have access to accommodation. Therefore, the use of local personnel and transfer of employment might be considered as having no net effect on competition for accommodation. However, transferal of employment from a local position to the Sea Lion Phase 1 & 2 project may require the local employer to source a WPH to fill the resultant vacancy. With less than 1 % unemployment, and around 17 % of the working population having double employment, there is a limited capacity for employers to recruit locally (FIG, 2023l). Further, it is likely that those moving to the Seal Lion project will be skilled and internationally certified; and therefore the capacity to replace them from the local workforce may be limited. Therefore, it may be necessary for local employers to recruit externally if there is a significant movement of local personnel to the oil sector.

Ultimately, this would still result in a need for additional accommodation in Stanley, albeit now one-stage removed in impact from the O&G sector.

If, due to local recruitment into the O&G sector (rather than an influx of expatriate personnel), there is an increase in WPH accommodation requirements from third-party employers, the increase in competition may be greater in this case as occupancy rates would be lower resulting in a greater number of housing units being required.

In the worst-case scenario all 26 permanent onshore posts will result in the need for more rental accommodation.

11.3.4.2.3.3 Proposals for accommodating long-term onshore personnel

With regard to the 26 onshore posts it is likely that some of these will be suited to more permanent housing rather than the purpose-built communal hostel units. Navitas recognise that hostel-type accommodation may be less suitable for the low number of senior managers and longer-term technicians for whom self-contained flat accommodation, or housing accommodation shared by two personnel may be more appropriate. This would include:

- Navitas Stanley office staff,
- Management staff of port facilities and yards,
- Contractor management staff,
- Helicopter personnel, and
- Component of onshore personnel remaining during Stage 3 Field Life.

In addition, hotel or upgraded hostel accommodation may be appropriate for some staff that may be on a working rotation with only temporary periods of residence.

Development of new housing

Navitas is committed to increase local housing supply to meet Sea Lion needs and will enter into a contract or contracts for the construction of *c.* 20 management housing units. Since the Phase 1 & 2 Field Development is long-term in nature, and thus more attractive to capital investment, it is expected that the private sector will support new build investment to fulfil these needs, encouraged and facilitated by the Navitas contracting strategy in accordance with the Falkland Islands Local Content Code of Practice.

The Stanley Town Plan (FIG, 2015d) includes zoning for housing and residential areas with a potential capacity for up to 768 building plots identified (FIG, 2015d). Thus, the availability of land for residential building plots is not considered limiting for a demand of a maximum of 30 single units or 15 shared units (occupancy by two personnel) that may be of higher density incorporating flat or semi-detached properties.

Navitas will encourage private sector market response through new development, rather than the use of existing housing stock, through pre-notification of housing needs to the private sector. An Expression of Interest exercise conducted in Q1 2024 demonstrated market appetite for the provision of housing. The long-term contracting strategy will allow internal appraisal of whether tenderers / service contract providers can meet needs without potential impacts on the local market. The willingness of the private sector to meet such demands is already indicated by a number of outline planning applications for flats and mixed-use development that have already been progressed to Outline Planning Permission (including Dairy Paddock, Old Butchery / Mink Park, Moody Brook, Butchery Paddocks / ESRO Station and Old Filtration Plant / Moody Brook).

In summary, Navitas will contract the construction / provision of transit accommodation (Section 11.3.4.2.3.1) and will also issue Invitations to Tender for the construction and provision of additional housing units suitable for oil and gas needs.

11.3.4.2.4 Opinions of stakeholders

A review of stakeholder consultations with respect to scoping concerns is provided in Chapter 6. In general, queries relating to competition for resources and specifically accommodation related to information requests to provide further clarifications on personnel numbers whilst highlighting the current limited housing capacity available.

Further concerns were raised regarding timelines of construction and the need for aggregate, building supplies and construction labour if multiple infrastructure projects were to be progressed simultaneously. This fine scale planning detail is not available at present and lies outwith the scope of the current EIA (Section 6.2.2.1.1), which is concerned only with development operations. Accommodation facilities will be subject to planning approval.

11.3.5 Industry standard mitigations

Within larger economies, competition for resources is not generally considered to be significant as there is a country-wide network with the capacity to absorb and respond to increased demand. Therefore, no acceptable or permissible limits are set through industry codes of practice.

11.3.6 Impact assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities. The assessment of unplanned events includes an assessment of the 'Likelihood of Occurrence' to determine the 'Risk'.

A summary of the impact and risk assessment outcomes is tabulated in Section 11.3.12, which shows the worst-case impact / risk for each activity and receptor.

11.3.6.1 Impact assessment

11.3.6.1.1 In-transit, routine and surge accommodation

Navitas appreciates that accommodation may be a limiting factor with regard to community resources.

As described above, the project basis of design includes the provision of high-density hostel-type accommodation units to house 'in-transit' and rotating onshore personnel within the planning and contracting scope of the Development. These units are factored in to the impact assessment such that the arrival of 'in-transit' and rotating onshore personnel are expected to have no impacts with regards to competition for accommodation, as need will be met by a dedicated accommodation solution. As the accommodation provision will be separate from domestic housing the sensitivity of the receptor (of both Tangible Property and the Human Population) is considered to be '**Low**'.

As capacity will be designed to meet full onshore and transiting offshore personnel needs the severity of effect (on both Tangible Property and the Human Population) is considered to be '**Slight**'.

Therefore, the overall impact is considered to be '**Very Low (2)**'.

11.3.6.1.2 Impact of onshore (expatriate or local) personnel on Stanley's housing stock

Given current housing in Stanley, there is limited capacity to absorb additional accommodation needs (Section 7.7.4.5.1). Only a small number of personnel (*c.* 26) will be required to permanently live in Stanley and these needs will be met by a contracting strategy that will promote and encourage housing built by the private sector. Dual occupancy or flat accommodation will reduce unit needs for expatriate personnel. FIG also noted that by the end of 2022 they would be introducing 'incentives to encourage the private sector to develop new affordable rental housing' (FIG, 2021c). It is understood this work is ongoing (R. Cordeiro, *pers. comm.*). Therefore, reliance on the existing housing stock is expected to be minimal and short-term in nature until the private sector responds to increase supply and is not considered to be unmanageable or unsustainable. Further, the population is likely to be tolerant of the change without detriment to its character. Therefore, the sensitivity of the receptor (of both Tangible Property and the Human Population) is considered to be '**Low**'.

The provision of accommodation by the private sector will be actively promoted and managed within the Development programme to ensure that the solutions are largely based upon bespoke accommodation rather than existing housing stock. However, there will be some short-term competition for rental accommodation in the early stages of Development (early onshore construction), until the market responds and supply increases to meet demand. Therefore, the severity of effect (on both Tangible Property and the Human Population) is considered to be '**Minor**'.

Therefore, the overall significance of the impact of competition for accommodation on the resource of housing stock within Stanley is considered to be '**Low (4)**'.

11.3.6.2 Risk assessment

11.3.6.2.1 Contingency accommodation needs

The design of the purpose-built accommodation is such that it incorporates full capacity requirements for contingency accommodation in the event of a down-manning or environmental incident (Section 11.3.4.2.3).

Therefore, existing transit, routine and surge accommodation could be used to accommodate sufficient numbers of personnel in the short-term and there is anticipated to be no risk of impact from Phase 1 & 2 emergency events should they occur.

11.3.7 Project-specific mitigation

As the impact of Sea Lion Phase 1 & 2 Development accommodation needs on Stanley's housing stock (Tangible Property) and the Human Population is considered to be '**Low**', project-specific mitigation measures are not proposed at this stage. Rather, monitoring of accommodation use and socio-economic impact on the rental market will be incorporated within both the FIG Social Effects Monitoring Programme and Navitas Socio-Economic Monitoring and Management Plan.

At present, Navitas is reliant upon the private sector responding to the Invitation to Tender for the construction of a small number of single flat-type units. Given the duration of the Sea Lion Development it is highly likely that this will occur; if it doesn't, private investment and development can be further stimulated by the contracting strategy and accommodation tender specification to encourage new provision over existing housing stock.

11.3.8 Residual impact assessment

Not applicable.

11.3.9 Cumulative effects

The assessment considers all direct project personnel and their accommodation needs. Included within the assessment is the potential effect of personnel drift from the local labour market to the O&G sector. This is considered an indirect impact as, were an external person on a work permit basis required to back-fill the post (vacated by the local individual) they will then have a requirement for local accommodation. It is assumed that market forces of supply and demand should respond to such needs. However, as demand levels (e.g., 'concentration', see Section 8.9.1) are harder to forecast given the uncertainty in the likely level of local recruitment, it is expected that, at least in the short-term, some level of negative socio-economic impact may occur with respect to rental availability and values until markets respond.

With increased personnel active and passing through the Falkland Islands, there will be associated expansion in economic activity and other service sectors, this will undoubtedly require a commensurate increase in population and the amount of accommodation required. However, any impact of wider increased economic activity is outwith the scope of the current assessment. Such an assessment has previously been undertaken by FIG (Regeneris, 2013), is included as a component within the Regeneris SEMMP (Regeneris, 2015) and will be considered further in the forthcoming update to the SIA.

11.3.10 Confidence

Personnel accommodation needs have been conservatively defined. Planning policy is specifically supportive of hostel-style accommodation on land zoned for light industrial use and similar, temporary accommodation during exploration rounds has been approved and proven to be acceptable. Higher density flat accommodation has been identified as appropriate for residential areas and a number of speculative planning applications have been approved for outline planning permission. This shows the proactive willingness of the private sector to respond to accommodation demands.

However, at the time of writing the accommodation contracting process has not yet been initiated and thus the final designs have not yet been confirmed nor progressed through planning controls by the contracted service provider. While assumptions can be made regarding private sector uptake of opportunities for rental development, these discussions have still to be conducted.

The level of confidence in the impact / risk predictions and mitigation is therefore '**Probable**'.

11.3.10.1 Monitoring required

For a small proportion of the accommodation needs of onshore personnel, Navitas is reliant upon the private sector rental market to respond to contracting strategy calls for development of rental accommodation units. Monitoring of private rental use and indicators of rental competition are ways in which this can be monitored. If monitoring shows that competition may become an issue, private investment and development can be further stimulated by the contracting strategy and accommodation tender specification to encourage further new provision over existing housing stock. All monitoring requirements agreed by Navitas will be recorded and managed *via* the project-specific Phase 1 & 2 Socio-Economic Monitoring and Management Plan (SEMMP).

11.3.11 Offsetting

As no residual impacts or risks identified in this section are considered significant, i.e., Moderate or above, offsetting is not considered necessary for this impact (see Section 8.11).

11.3.12 Findings summary

Table 11.21: Summary of the impact assessment for accommodation resource competition

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Accommodation for onshore surge personnel, in transit personnel and down-manning contingency provision	Need to accommodate transitory personnel	Competition with domestic housing needs	Planned	1, 2a, 2b & 3	Low	Slight	n/a	**Very Low (2)**	**n/a**	**Probable**	**Industry-standard:** None. **Project-specific:** None proposed.
Accommodation for semi-permanent, management and technical onshore personnel	Need to accommodate permanent personnel	Competition with domestic housing needs	Planned	1, 2a, 2b & 3	Low	Minor	n/a	**Low (4)**	**n/a**	**Probable**	**Industry-standard:** None. **Project-specific:** Contracting strategy encouraging construction of additional housing.

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

11.4 Competition for resources – Freshwater

Table of Contents

11.4.1 Introduction 1029
11.4.1.1 Relevant legislation 1029
11.4.2 Sources of freshwater use and competition for resource 1029
11.4.2.1 Drilling 1030
11.4.2.2 Use of vessels 1030
11.4.2.3 Onshore / at-shore usage 1030
11.4.3 Potential receptors 1031
11.4.4 Characterising and quantifying the impact of competition for water 1031
11.4.4.1 Nature of potential impact 1031
11.4.4.1.1 Potential for water shortages 1031
11.4.4.1.2 Nuisance to other users 1032
11.4.4.2 Quantifying the impact 1032
11.4.4.2.1 Current freshwater supply versus current recent demand trends 1033
11.4.4.2.1.1 Current Stanley water operating system 1033
11.4.4.2.1.2 Stanley water use 1033
11.4.4.2.1.3 Impact of past exploration drilling campaigns 1033
11.4.4.2.2 Phase 1 & 2 base-case mitigations 1034
11.4.4.2.3 Forecast Phase 1 & 2 freshwater usage 1037
11.4.4.2.3.1 Estimated volume demand 1037
11.4.4.2.3.2 Estimated rate demands 1041
11.4.5 Industry-standard mitigation 1041
11.4.5.1 FIG water prioritisation 1041
11.4.6 Impact assessment 1041
11.4.6.1 Impact assessment assuming current Stanley operating system 1042
11.4.6.1.1 Water use during Stage 1 and Stages 2a & 2b 1042
11.4.6.1.2 Water use during Stage 3 1043
11.4.7 Project-specific mitigation measures 1043
11.4.7.1 Offshore planning & supply logistics 1044
11.4.8 Residual impacts and risks 1044
11.4.8.1 Stage 1, Stage 2a & 2b residual impacts 1044
11.4.8.2 Stage 3 residual impacts 1044
11.4.9 Cumulative impact 1045
11.4.10 Confidence 1045
11.4.10.1 Monitoring required 1045
11.4.11 Offsetting 1045
11.4.12 Findings summary 1045

11.4.1 Introduction

Onshore infrastructure associated with the Sea Lion Field Northern Development Area, Phase 1 and 2 will require connection to the existing Stanley water utilities. In addition, the onshore water supply will provide a proportion of the water required by offshore assets including offshore support vessels and the Mobile Offshore Drilling Unit's (MODU) drilling requirements for muds, cements, brines and domestic use.

The Falkland Islands Government (FIG) is the single water utility supplier and the Stanley water filtration plant has a fixed capacity, limited by the existing infrastructure. Fresh potable water is therefore considered a limited resource and any use of fresh water above the current baseline usage has the potential to lead to competition with the local users in Stanley. Both the carrying capacity of existing infrastructure and competition for resources were raised as a concern during the scoping consultations (Chapter 6).

This chapter assesses the impact of the Phase 1 & 2 Development by comparing the forecast water use with the level of water available. The forecast difference between development demand and the current excess capacity determines the level of competition. The assessment relates to fresh potable water processed and supplied through the Stanley filtration plant. Some process usage and drilling does not require potable water, however as all freshwater supplied from shore in Stanley is from a potable main and no alternative unprocessed freshwater main system is available; all reference to water is assumed to be potable fresh water unless stated otherwise.

Note: as described in Section 6.2.2.1.1, socio-*economic* impacts are out of scope for this EIS. The previous operator of the Sea Lion Field (POEPL) conducted a separate Socio-economic Impact Assessment (SIA), building on and updating the previous work undertaken for FIG and Rockhopper by Regeneris (2013; 2015) and Plexus Energy (2012). This is now being updated again by Navitas, with the support of HATCH. Therefore, this assessment focuses on the social impact of competition for water on the human population and tangible property as receptors, and not any secondary, economic, implications of such competition or use of property.

Note: impacts related to competition for other resources e.g., accommodation, electricity etc. are described elsewhere in this document, as described in Table 2.2.

11.4.1.1 Relevant legislation

Resource competition specifically is not legislated for within any Ordinance or Regulation. However, as was agreed during the consultee scoping workshop with FIG in 2015 (Chapter 6), the impacts of competition for resources such as water was considered to be within the scope of the EIS as defined by the FIG EIA Guidance Note (FIG, 2016e)).

11.4.2 Sources of freshwater use and competition for resource

Water may be used onshore by support services activity and infrastructure, or provided through the Temporary Dock Facility (TDF) to the offshore support vessels for offshore use. Specific sources of freshwater use during the Phase 1 & 2 Development include:

- Drilling offshore by the MODU (Section 5.4),
- Use of vessels (Section 5.11.2):
  - Anchor Handling Tug Supply (AHTS) vessels, Emergency Response and Rescue Vessel (ERRV), Platform Supply Vessels (PSV), used as Mobile Offshore Drilling Unit (MODU) and Floating Production, Storage and Offloading (FPSO) unit supply vessels for the movement of materials and equipment,
  - Construction and installation vessels,

- *Ad hoc* freighter vessels, and,
- Large Transport Vessels (LTVs).

- Onshore / At-shore usage:
  - TDF, which is the point of delivery for offshore usage, although there will be minimal water usage by the TDF directly (Section 5.11.1.1.1),
  - Onshore supply base(s) and warehouses, Liquid Mud and Bulk Facility and associated offices (Section 5.11.1.2), and
  - Personnel accommodation (Section 5.11.4.1.1).

Note: during production, the FPSO will require water for domestic use and marine and topsides systems. It is estimated that the FPSO will require 30 m^3/day and to meet this need it will carry a water-maker. It is anticipated that the FPSO will be able to produce enough water to meet its own demand and thus be self-sufficient in water. Since water availability is critical for the process, water-maker volume requirements and redundancy will be incorporated within the FPSO design. In the event of complete failure of the water-makers, it is likely that water could be sourced, in the short-term, from other vessel water makers and / or a large standby of bottled water from the supply base. Failing this, the FPSO would shut down until the water-makers could be reinstated. Therefore, process water use on the FPSO is not factored into the following impact assessment with regard to competition for Stanley water resources.

11.4.2.1 Drilling

The MODU will require water for domestic use as well as for the drilling and cementing process, the mixing of drilling muds, brines and cement, well suspension, sweeps and completion. Freshwater used for drilling activity does not require to be potable and buffer storage in the TDF tanks that may not be certified for potable water storage is permissible.

It is anticipated that the MODU will be equipped with a desalination plant (water-maker), as was the *Eirik Raude* used during the 2015 drilling campaign. However, the water-maker is intended mainly for rig utilities and accommodation and is not sufficient to meet water needs required for drilling fluids. Indeed, the experience of exploration drilling campaigns suggests that allowance for drilling requirements should be made from onshore freshwater sources.

Note: while some drilling muds may be mixed onshore for shipment to the MODU by a supply vessel, this does not modify total usage.

11.4.2.2 Use of vessels

The vessels required throughout the different stages of the Phase 1 & 2 Development will all require water for onboard domestic and vessel use. It is anticipated that the majority of vessels will have water-makers on board, though at times some net deficit and opportunistic tank top-up would be expected. Therefore, it is likely that these vessels will take on water at the TDF for delivery to the FPSO for domestic use in the event of water-maker failure and / or to supply the MODU in the event of water-maker failure. A nominal amount based upon the exploration experience has been assumed for vessel usage and included within the assessment.

11.4.2.3 Onshore / at-shore usage

The resources onshore will require water for domestic and general usage such as cleaning. However, with the exception of the muds and brine plant that is included within offshore drilling estimates (Stages 1, 2a & 2b), no major onshore process use is expected. As described above, the TDF will act as a conduit supplying shore-side water to offshore assets *via* the supply vessels when necessary.

11.4.3 Potential receptors

The ENVironmental Impact Identification (ENVIID) workshop was used to identify those receptors upon which the impacts of resource competition warranted further investigation (Chapter 9).

Receptors that may be impacted by the use of the Stanley freshwater supply during the Phase 1 & 2 Development include:

- Human Population in Stanley (Section 7.7.2), and
- Tangible Property (e.g., fresh (potable) mains water supply (Section 7.7.4.5.2)

Interdependence exists between the two receptors. Any impact on the water supply will additionally impact upon the human population that is reliant upon it.

The onshore logistical support services (e.g., the TDF, supply base, Liquid Mud Plant, offices etc.) and associated accommodation will be based within close proximity to Stanley which is the only location serviced by public utilities and where the majority of the population resides. Therefore, the following assessment is based upon the human population of Stanley and confined to the area within the coverage of the Stanley Town Plan and the public mains supply system.

11.4.4 Characterising and quantifying the impact of competition for water

11.4.4.1 Nature of potential impact

Water is an essential human requirement and access to clean fresh water can be considered as a basic human need and right.

As is detailed in the Environmental and Social Baseline Description (Section 7.7.4.5.2), potable water supply is provided to Stanley through a single source water filtration plant. To safeguard against single point system failure, the Public Works Department (PWD) are remitted to hold 2 - 3 days water supply in storage tanks. However, no alternative supply is available and water usage has been increasing in Stanley since 1980 (Section 7.7.4.5.2.1).

The untreated water (i.e., rain) supply line from Moody Brook, where the dual catchments join, to the central Stanley filtration plant, was installed in *c.* 1989. But between 1986 and 2021, the number of Stanley households has increased to 1,148 (FIG, 2023l). The overarching trend indicates that Stanley water consumption is increasing with population growth.

Therefore, in practical terms, water must be treated as a limited finite resource.

11.4.4.1.1 Potential for water shortages

With a single point supply which is limited by a finite supply rate and thus a finite supply volume, the provision of potable water to Stanley residents and other commercial users is vulnerable to any increase in demand. Specifically, impacts to the local users may arise from:

- Increases in the volume of demand,
- Increases in the rate of demand, and
- Significant reduction in rainfall patterns.

Increased volume of demand (m^3) may cause:

- Deficits leading to temporary water restrictions to residents and commercial users,
- Draw down of storage tanks and loss of contingency reserves making users vulnerable to any short-term interruption to the water supply (PWD are remitted to hold 2 - 3 days of water supply to safeguard against single point system failure). Of note:

  - Without excess processing capacity, subsequent recharge of reserve tank storage may take an extended time, and
  - There may be a loss of water quality if tanks are fully drawn down and tank and system sediment enters the system.
- Increased wear and tear of filtration plant infrastructure if it operates at capacity for extended periods in a system vulnerable to single point failure,
- Increased demand rates (m^3/hr) may cause:
  - Draw down of storage tanks if demand extraction rate exceeds processing refill rates, leading to possible water quality contamination through re-suspension of tank sediments and staining, and
  - Loss of water mains pressure to other users on a series spur main in extreme cases as water takes the path of least resistance to the greatest outlet.

11.4.4.1.2 Nuisance to other users

In addition to domestic users, commercial and high-volume users which may be affected by the above include:

- Falklands Interim Port and Storage System (FIPASS),
- Abattoir,
- Fish processing plants,
- Stanley Growers market garden (horticulture),
- Hotels,
- Public houses, and
- Car washes.

Nuisance to domestic users, and logistical and financial implications for commercial users, may be caused by:

- Restriction in volume of water available,
- Reduction in mains pressure,
- Reduction in supply rate, and
- Reduction in water quality and clarity.

11.4.4.2 Quantifying the impact

When quantifying the potential for water shortage, and therefore impacts to other users, it is necessary to consider the:

- Current freshwater supply *versus* current Stanley demand:
  - Stanley freshwater operating system,
  - Stanley freshwater use, and
  - Impact of past exploration drilling campaigns.
- Phase 1 & 2 freshwater provision and mitigations, and
- Estimated Phase 1 & 2 net water demand:
  - Estimated volume demands, and
  - Estimated rate demands.

11.4.4.2.1 Current freshwater supply versus current recent demand trends

11.4.4.2.1.1 Current Stanley water operating system

Within the current Stanley water system, rainfall catchment is not considered to be a limiting factor and the source of supply is considered secure and continuous year-round. The Stanley water system can 'produce' about 73 m^3 of water per hour or around 1,100 m^3 per day, assuming a 15 hour day is worked. However, due to backwashes and dumps a more realistic figure is a production rate of *c.* 1,000 m^3 per day (Z. Stephenson, *pers. comm.*).

Note: FIG note that with capital funding commitments there will be significant changes to the water provision by 2025/26 (C. Summers, *pers. comm.*).

11.4.4.2.1.2 Stanley water use

Over the 22-year period between 1995 and 2017, annual average Stanley water consumption rose by 74 %; from 492 m^3/day to 865 m^3/day. Stanley thus exhibits a long-term increase in water usage of approximately 3.5 % per annum (FIG Environment Department, *pers. comm*.). Water use peaked in 2015 during oil exploration activities at 946 m^3/day and subsequently dropped back in 2016 and 2017 to 860 m^3/day, lower than the 2015 peak but in-line with the underlying average increasing trend in Stanley water usage.

More recent water forecasts have been difficult to determine (Z. Stephenson, *pers. comm.*). However, the year-on-year increase in Stanley consumption has continued into the present with increases of *c.* 3.5 % p.a. resulting in a baseline maximum annual water use of 335,070 m^3 (i.e., 918 m^3/day) in 2023 (Figure 11-7).

With a daily supply currently limited to 1,000 m^3/day under standard working conditions the 2023 usage figure of 918 m^3/day shows that there is only 82 m^3/day of excess production capacity. With continued increases in water demand of 2-3 % p.a., the baseline water usage can be expected to exceed current working practice limits by 2027 (Section 7.7.4.5.2.2).

11.4.4.2.1.3 Impact of past exploration drilling campaigns

During previous drilling campaigns the baseline water capacity of the Stanley system was around 870 m^3/day[94]. Relating to past exploration rounds, annual average daily consumption figures for Stanley show peaks in 1998-99, 2010-12 and 2015 (Figure 11-7). Previous estimates by FIG suggest that the *Ocean Guardian* (2010-12) and *Leiv Eiriksson* (2012) drilling campaigns resulted in increases over the baseline water demand of *c.* 10-16 %. The spike in demand between 2014 and 2015 when the *Eirik Raude* was active was 24 % (183 m^3/day) over the baseline supply. While these overall figures represent all economic activity and may not be wholly attributable to oil development, they do serve to provide an indication of the likely overall trend associated with increasing Oil and Gas (O&G) activities. However, even if not attributed to, and not associated with O&G activity, the additional increase in demand would still represent an increase in Stanley domestic usage that would limit available excess capacity for O&G development usage.

During the last oil exploration campaign in 2015-16 the current standard filtration capacity (870 m^3/day at the time) was surpassed for the first time, leading to an average daily consumption of 946 m^3/day in 2015 (Figure 11-7).

This signifies that for periods of time, despite the base-case mitigations used within the exploration rounds, it was necessary to extend the working day and pumping durations of the filtration plant and to operate the Dairy Paddock Reservoir (DPR) with a temporary daily deficit.

[94] Since the improvements to the water system in Stanley and improved working practices have increased the available capacity of the system; baseline water capacity of the system is now (as at 2024) around 1,000m^3/day.

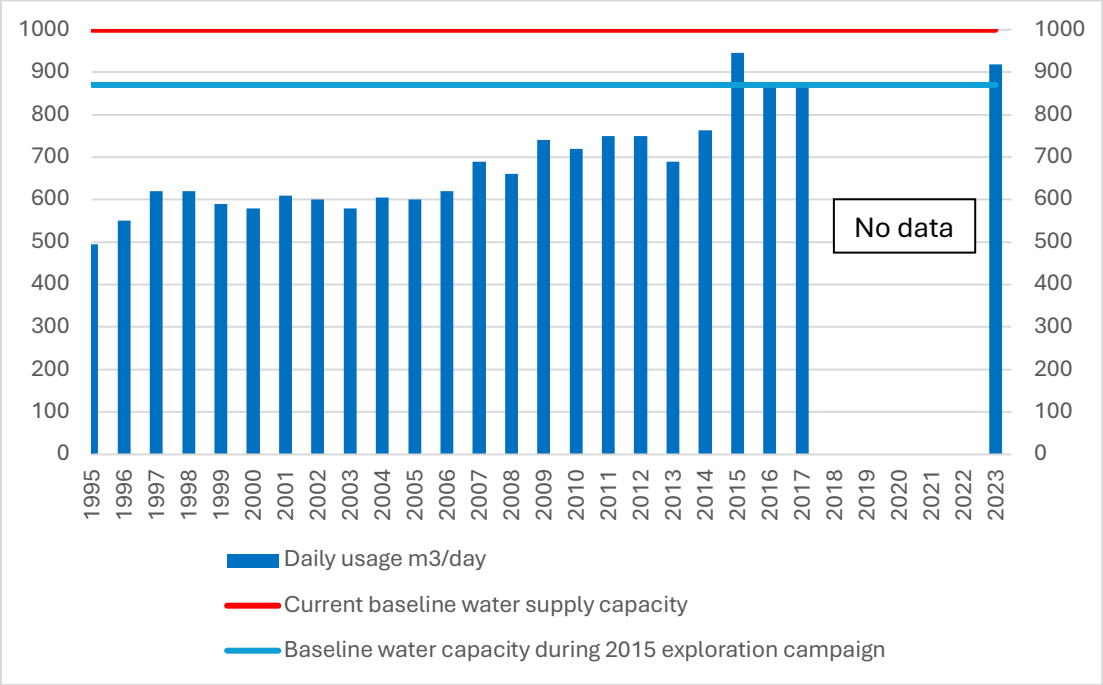


Figure 11-7: Average daily water consumption (m^3/day) in Stanley by year from 1995 to 2023. Note: water usage figures between 2018 and 2022 were unavailable

11.4.4.2.2 Phase 1 & 2 base-case mitigations

A number of measures have been built-in to the basis of design for the Phase 1 & 2 Development with regard to minimising the reliance on water from local resources. These are similar to those that were used for the 2015 exploration drilling campaign. However, it should be noted that while these mitigations can serve to reduce the water demands of any O&G campaign, they do not serve to eliminate the need for 'top-up' from the local water supply, as is evidenced by the above. A description of the base-case mitigations, and the potential limitations of these measures is described in Table 11.22. These mitigations are factored into the initial impact assessment (Section 11.4.6.1).

Table 11.22: Mitigations built-in to the Phase 1 & 2 Development basis of design

Built-in mitigation	Location	Background and description	Benefits and limitations in practice
MODU water-makers	MODU	All offshore assets will be equipped with desalination plants. Capacities and redundancy will be incorporated within design and contracting requirements, such that all should be largely self-sufficient in water provision. As described in Section 11.4.2, the FPSO is the greatest long-term user of fresh water which is critical for both onboard processing and safety systems. Complete failure of water systems would result in shut-down of processing rather than drawing upon onshore resources.	While full offshore requirements need not be met by the Stanley supply, exploration usage would suggest a precautionary approach is required. Therefore, a contingency to take on water for vessel tank top up and the drilling needs of the MODU is included, as was required during the exploration drilling campaign (Section 11.4.4.2.3.1). These estimated figures for drilling requirements are however lower than were observed during the exploration campaigns mainly due to use of Non-Aqueous Drilling Fluids. Shut-down of the FPSO in the event of complete failure of water-makers and all other water sources would impact upon the operation but not upon onshore supplies.
FPSO water-makers	FPSO		
Vessel water-makers	All vessels		
Construction of a freshwater holding and header tank	Bulk water storage incorporated within, TDF hull tanks, mud/bulk plant header, and/or dedicated buffer tank in at-shore tank farm adjacent to the TDF causeway	The design assumption is that the header tank will have sufficient capacity to balance demand such that needs can be levelled off to a steady daily requirement. The project will likely incorporate a minimum of 3.5 days storage plus a contingency, based upon two vessel visits a week. The exact combination and volumes of the tanks will be determined within FEED.	Storage tanks do not reduce the overall quantity of water required. Storage only levels daily demand to the averaged constant demand such that daily spikes in demand, e.g., a vessel taking on 400 m^3, can be excluded from the consideration and only average demand assessed. The volumes of the tanks have yet to be confirmed and this will determine which of the three bulk storage options are used. The potential use of three storage options will provide flexibility to balance demand. Storage within the TDF is limited to non-potable process water for drilling. Further analysis of needs will determine whether this measure should be extended to give sufficient supply for the contingency of two vessels berthing in close proximity to take on water.

Built-in mitigation	Location	Background and description	Benefits and limitations in practice
Voluntary restrictions i.e., daily limits to store and buffer against water draw-down.	TDF	During the previous exploration and appraisal drilling campaigns, a voluntary limit of 100 m^3/day at a supply rate of 10 m^3/hr was applied. TDF usage during exploration was sporadic and determined by the number of vessel visits. A volume of >100 m^3 of water was drawn on 24 % of days, whilst zero water was drawn on 42 % of days. Therefore, it can be seen that there is the potential to store a proportion of the 100 m^3 daily limit on days when full volume is not required, and thus buffer the drawdown against demand spikes. This has additional benefits as tanks can be refilled at the lower rate of 10 m^3/hr as a 'trickle' feed (which safeguards against a mains pressure drop to other users and against Stanley header tank level drawdown), but pumped to vessels above mains rates to reduce berthing durations. Water volumes are thus accumulated in advance at sustainable rates.	A close working relationship with the water department is required and a daily update of forecast water needs must be provided to assist with demand planning and Stanley header tank volume balancing. Through this liaison the voluntary limit may be exceeded on occasion if supply conditions permit. In consultation with FIG, appropriate limits and a liaison procedure can be established.
Sustainable design	Supply base, accommodation units	Potential to incorporate sustainable design features including: Water conservation design (low volume showers and toilet flush, shut-off timers, visible overflows so leaks are detected, etc.) and grey water recovery.	A *Per capita* consumption of 300 litres / person / day is assumed. This is a conservative estimate and with water efficient design it is hoped to reduce domestic water use to the lower UK equivalent of 150 litres / person / day.
Salt-water substitution	Offshore drilling	Offshore drilling estimates assume use of process freshwater for drilling, cementing, well suspension and completion. However there is the potential to use salt-water in some components such as sweeps.	The investigation of where salt-water is appropriate for use will be continued through FEED and this will reduce offshore water demand for drilling activities from shore sources.
Alternative water sources	TDF and offshore	Whilst drilling usage requires freshwater it does not necessarily require fully treated potable water. In extenuating circumstances it may be possible to source raw untreated freshwater from alternative sources (for example the dual catchments sustain greater volumes than is supplied to Stanley) and to transfer raw water to the TDF by tanker. Any vessels coming into Falkland Island waters can do so with full water tanks	Stanley water filtration plant is the only source of treated potable water available on-island however pumping from raw water reservoir catchment source to a tanker may substitute for process water needs in extenuating circumstances.

11.4.4.2.3 Forecast Phase 1 & 2 freshwater usage

The Phase 1 & 2 Development freshwater usage has been estimated with consideration of water usage data from the 2015 exploration campaign. A breakdown of the net water usage data from the 2015 exploration drilling campaign has been undertaken.

In forecasting the Phase 1 & 2 Stanley water usage, the use of construction batch plant buffering, the mud plant header-tank, TDF barge storage and possible dedicated buffer tank storage (if calculated volumes demand) (Section 11.4.4.2.2) will allow daily water use to be buffered and levelled to the average daily water use. It is therefore possible to ignore peak single day usage that occurred during exploration (e.g., a vessel taking on water) and consider only average figures.

In addition to average use figures over the entire period or during each Development Stage, peak period data are also considered. Peak period figures are distinct from single day usage spikes as they consider the average daily use over a period of a month and take the highest expected monthly daily usage within each Development Stage. Due to the extended period of a month it is not possible to fully buffer against extended supply deficit and thus water supply must be able to cope with the demands of the highest demand period within each Stage.

Estimates were made for:

- Water volumes required by the Phase 1 & 2 Development, and
- Water usage rates during the Phase 1 & 2 Development.

11.4.4.2.3.1 Estimated volume demand

Both the highest average water demand and peak periods of direct water demand occur during Stages 1 (pre-First-Oil drilling) and 2a & 2b (simultaneous drilling and production operations), as would be expected during times of active drilling and higher personnel numbers. During Stages 1 and 2, average water demand from the main onshore centres and offshore assets ranges from 99.5 – 112.5 m^3/day, which is just over the excess Stanley capacity of 82 m^3/day that would be available for O&G development. Peak period usage ranges between 162.5 – 236.58 m^3/day, which would exceed current capacity (Table 11.23).

During Stage 3 (steady state production), direct water use drops to 44 – 77 m^3/day and is within sustainable limits for supply.

In addition to the water use by the main onshore centres, a range of indirect uses could further increase demand such as:

- Increased water use by supply and services (e.g., laundry, heli-ops, etc.) as a result of increased personnel in Stanley, and / or
- Coincidental increases in water use due to other economic sectors or diversification.

During exploration, these associated services accounted for an average of 81 m^3/day over and above the directly attributable and metered centres. During the *Eirik Raude* campaign in 2015, the allocated O&G usage increased the overall Stanley water usage by 13-18 %. However, the overall Stanley usage spike during the same period was 24 % such that an additional 11 % increase in water usage may be attributable to activities associated with O&G. However, there is a degree of uncertainty in the data regarding unattributed sources of water use.

Nonetheless, whilst the exact contribution of O&G activities to wider water use is unknown, all unrelated and domestic sources of increase to baseline water usage would still reduce the excess water capacity available in Stanley.

In summary, while it is not possible to fully attribute associated water use, if levels during the Phase 1 & 2 Development, are similar to those observed during exploration, then average water use will exceed current capacities in Stage 1, 2a & 2b, and will likely exceed that in Stage 3 also. Additionally, within the current system spare capacity will decrease each year as Stanley exhibits an increasing water use trend (Section 11.4.4.2.1.2) so extrapolation to Stage 3 may not be fully accurate.

Table 11.23: Estimated shore water used by the Sea Lion Development by activity centre

Activity	Exploration 2015		Assessment	Stage 1		Stage 2 (a & b)		Stage 3	
	Average (m^3/day)	Peak[1] (m^3/day)		Average (m^3/day)	Peak[1] (m^3/day)	Average (m^3/day)	Peak[1] (m^3/day)	Average (m^3/day)	Peak[1] (m^3/day)
Offshore Demand (supplied from TDF)									
MODU drilling requirements inc. bulks, mud and brines	69	90	Drilling estimates[2]	19	37	20	21	0	0
Vessel requirements			Tank-top up allowance	10	10	10	10	10	10
FPSO (30 m^3/day)	n/a	n/a	Self-sufficient @ 30 m^3/day	0	0	0	0	0	0
Total offshore demand				**29**	**47**	**30**	**31**	**10**	**10**
Onshore Demands									
Onshore construction	n/a	n/a	Estimates based on other construction projects	8	44	n/a	n/a	n/a	n/a
Laydown yards and warehousing	2.2	2.2	Exploration with proportional increase	5.5	5.5	5.5	5.5	2	2
Bulk, mud & brine storage	0	0	Included in offshore drill estimates	0	0	0	0	n/a	n/a
Personnel and accommodation	31	48	*Per capita* rate of 300 l/pp/day[3]	70	140	64	126	32	65
Total inshore demand				**83.5**	**189.5**	**69.5**	**131.5**	**34**	**67**
Total demand *vs.* supply capacity									
Total O&G Demand	102	140	-	112.5	236.5	99.5	162.5	44	77
Percentage increase in Stanley usage (%)	13	18	-	12	-	11	-	5	-
Unallocated associated activity demand (**Note:** Only a proportion of this may be directly attributable to O&G activity)	81	-	Based on observed 2014 - 15 exploration total usage increase of 183 m^3/day (24 %)	81	-	81	-	81	-
Total forecast demand	183	-	-	193.5	-	180.5	-	125	-

Activity	Exploration 2015		Assessment	Stage 1		Stage 2 (a & b)		Stage 3	
	Average (m^3/day)	Peak[1] (m^3/day)		Average (m^3/day)	Peak[1] (m^3/day)	Average (m^3/day)	Peak[1] (m^3/day)	Average (m^3/day)	Peak[1] (m^3/day)
Maximum Available Spare Capacity (for comparative purposes)	107[4]	-	-	82	-	82	-	82[5]	-

[1] Peak usage relates to the month with the highest daily average usage during drilling and includes accommodation during peak in-transit crew exchanges.

[2] Note that water usage estimates for the development wells are lower than the exploration wells as the development wells will be drilled with NADF, whereas the exploration wells were drilled with WBM. NADF uses less water per well, see Table 11.22.

[3] This is a high estimate and is used to account for the observed direct and indirect increase in demand during the last exploration well campaign. This may be reduced to 150 litres per day using sustainable design (Section 11.4.4.2.2) but is kept at 300 litres per day to assume a worst-case.

[4] 107 m^3/day was the available spare capacity during the 2015 exploration drilling campaign; this has now reduced to 82 m^3/day available spare capacity in the Stanley water system.

[5] Note the available spare capacity will decrease each year as Stanley exhibits an increasing water use trend (Section 11.4.4.2.1.2) so extrapolation to Stage 3 may not be fully accurate.

11.4.4.2.3.2 Estimated rate demands

In addition to total average consumption, consideration of daily spikes in water use (m^3/day) and usage rate (m^3/hr) can also be important.

During the 2015 exploration campaign, whilst the TDF showed an overall average utilisation of 55 m^3/day, periods of higher daily usage were recorded. Daily usage ranged from 433 m^3/day (a single incident of accidental leakage caused by human error) or 306 m^3/day (actual operational peak demand), to zero when vessels were absent. During a number of periods extending for up to 21 days the average water use increased to 137 m^3/day, and monthly daily averages reached 90 m^3/day.

A voluntary limit of 100 m^3/day was applied during exploration with greater volumes requiring specific authorisation from the water section. Greater than 100 m^3 of water was drawn on 24 % of days and zero water was drawn on 42 % of days.

To reduce pressure from daily spikes in water usage, Navitas has committed to the use of buffer storage tanks (Section 11.4.4.2.2). Buffer storage can be provided within the TDF hull tanks, and as a header tank to the mud plant with the potential for additional dedicated buffer tanks in the at-shore bulk supply base. The necessary capacity of the tanks will be calculated based on the average daily demand which should ensure that daily spikes can be accommodated. Therefore, spikes in usage and the associated risks to supply can be excluded from the assessment.

11.4.5 Industry-standard mitigation

Within larger economies there is generally a country-wide water supply network with the capacity to absorb and respond to increased demand. This is especially true of water distribution that works within a national supply grid. As competition for resources is not generally significant, no industry-standard mitigations or Codes of Practice exist. Nonetheless, within the Falkland Islands, FIG operate systems to safeguard the water supply for domestic and commercial users in Stanley.

11.4.5.1 FIG water prioritisation

Regardless of trends in supply *versus* demand, the FIG Water Section is tasked with maintaining a two-day supply of stored potable water. To safeguard emergency services and domestic users in the event of a production failure, a system of user prioritisation would be applied.

Light-industrial use is prioritised at the lowest level and would be the first to have supply restricted. The likely order of restriction would be TDF, FIPASS, Public Works Department's site, Megabid.

As such, security of water supply is a greater risk to Phase 1 & 2 Development activity than it will be to domestic users. If water usage was excessive at any time, the supply to the Development infrastructure would be cut before there was any impact to the domestic sector.

However, it should be noted that while this mitigation safeguards the human population, it may not be sustainable as a valid or reliable long-term 'mitigation' with regards to the Phase 1 & 2 Development if water demands cannot reliably be met.

11.4.6 Impact assessment

Assessment of the impact of water use at this time may not be representative as it is understood that improvements to the water system are planned by FIG by 2025/26 (C. Summers, *pers comm.*), which could effectively alter the baseline against which this assessment is made. However, this is outwith Navitas' control and the below assesses water use against the existing baseline.

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities.

A summary of the impact assessment outcomes for this Development is tabulated in Section 11.4.12 which shows the worst-case impact for each activity and receptor and details are provided below.

11.4.6.1 Impact assessment assuming current Stanley operating system

11.4.6.1.1 Water use during Stage 1 and Stages 2a & 2b

Stages 1 and 2 (a & b) are assessed together as both incorporate active drilling and increased personnel, and the forecasted average water demands are similar (Section 11.4.4.2.3).

Without improvements to the system, the Stanley water supply is already at near capacity. The forecasted average water use by the Development during Stages 1 and 2 (a & b) is 106 m^3/day and the peak daily use is 236.5 m^3/day (Section 11.4.4.2.3.1). The excess capacity in the Stanley water supply is estimated at only 82 m^3/day (Section 11.4.4.2.1.2), and while the Phase 1 & 2 usage estimates are conservative, the Development demand is expected to exceed supply. This is supported by the fact that usage did indeed exceed supply in the 2015 exploration campaign (Section 11.4.4.2.1.3) and required a responsive change in FIG working practices to meet the short-term increased demands. Adding to this, the indirect and unallocated water use was *c.* 81 m^3/day during the 2015 exploration (Section 11.4.4.2.3.1), it is likely that the capacity of the system will be exceeded.

Furthermore, with the number of households in Stanley increasing (Section 11.4.4.2.1.2) along with general diversification of the economy, there is a long-term trend of increasing annual water usage of 3.5 % per annum. Recent usage figures from 2023 show that current baseline water demand is 918 m^3/day so that the system is already close to capacity (*c.* 1,000 m^3/day) under current working practices.

While the Stanley population and other water consumers will be prioritised by FIG in the event of water shortage or system malfunction (Section 11.4.5.1) and the use of buffer tanks will reduce the risk of any daily demand spikes and associated drawdown in mains header tanks, there is still the potential for nuisance to other users (Section 11.4.4.1.2). Further, the above shows that with the ever-increasing Stanley usage, the existing water supply may not sustain the Development in the long-term. Therefore, the sensitivity of the receptors (Human Population and Tangible property) is considered to be **'Very High'**.

Restriction in supply or reduction in water quality through tainting caused by tank drawdown (Section 11.4.4.1.1) would be considered negatively. The consumers most likely to be impacted would currently be those on the low-level mains system predominantly in central Stanley, along the harbour front and FIPASS that share the same low-level supply tanks at Murray Heights as the TDF. However, since the whole of Stanley is reliant on a single filtration plant with potential single point failure, any significant issue could have wider 'knock-on' effects. These effects would generally be short-term and reversible, however with supply / demand in equilibrium, any unplanned usage or human error could cause impacts and following tank-draw down, the system may take several days or weeks to be fully recharged to capacity. Anecdotally, during exploration the accidental drawdown of one header tank took over a month to refill due to the equilibrium between demand and supply and insufficient excess to refill the tank (S.Cockwell, *pers. comm.*).

While development usage through Stages 1, 2a & 2b is not significantly different from exploration usage (offshore demands decrease but onshore demands increase relative to exploration), the system is currently operating at near capacity and average daily demand exceeded supply during the previous exploration campaign (Section 11.4.4.2.1.3). The ability to respond to increased demand or recover from tank drawdown is limited and the ability to maintain 2 - 3 full days' supply at all times may be restricted. Options to regulate demand (buffer storage) and reduce use have been identified, and the use of buffer storage has been committed to by Navitas (Section 11.4.4.2.2). However, as full analysis

of required tank volumes has not been confirmed, and since tank storage does not change the overall used volume but only buffers against demand spikes, the inherent capacities of the production system remain valid. Since it is currently FIG operating policy to restrict water supply to light industrial uses before any effect is transferred to domestic users, there is a degree of insulation from impact. However, if sustained deficit occurs, this restriction may not be sustainable for either the human population or the Development needs beyond a short-term response to temporary shortage. Therefore, the severity of effect of water usage on the Human population and the effect on Tangible property is considered to be '**Serious**'.

The overall significance of the impact of water use on the Human population and the impact on Tangible property during Stages 1, 2a & 2b is therefore considered to be '**High (20)**', and consequently project-specific mitigation measures to reduce the significance will be developed and implemented.

11.4.6.1.2 Water use during Stage 3

The impact assessment of Stage 3 must look forward *c.* 30 years and with uncertain predictions for the future growth of Stanley and associated increased water usage, all predictions become less certain (Section 11.4.4.2.1.2).

The sensitivity of the receptor is the same as described above. Water use by the Development will have decreased but Stanley usage may well have increased in line with ongoing trends (Section 11.4.4.2.1.2) and therefore there is uncertainty in the level of buffering capacity. Therefore, the sensitivity of the receptors (Human population and Tangible property) is considered to be '**Very High**'.

At commencement of Stage 3, upon cessation of drilling operations and simultaneous operations, the offshore water requirements drop to only vessel top-up and the onshore personnel numbers also reduce. However, whilst forecasted water demand drops, it is likely that Stanley usage will continue to increase over the intervening years. Since supply and demand are predicted to become matched in 2027, the forecast direct and indirect total for Stage 3 usage of 125 m^3/day will still exceed supply (Section 11.4.4.2.1.3). However it should be noted that with the historical trend of 3.5 % per annum increase in Stanley usage, the current capacity of 1,000 m^3/day will be surpassed with or without the addition of the Development demand. As such, FIG have already committed capital funding to improve the water supply system by 2025/26 (C. Summers, *pers.comm.*). The supply will therefore have changed relative to the demand making all predictions uncertain. This is addressed within the Cumulative Impacts section below (Section 11.4.9)

Given the closer equilibrium between forecasted supply and the forecasted demand during steady state production, any deficit is likely to be of short duration, most likely associated to crew changes within a two day period thus allowing time to accumulate water in the storage tanks. This ensures there will be some buffer against nuisance to the human population (Section 11.4.4.1.2). Therefore, the severity of effect of water usage on the Human population and the effect on Tangible property is considered to be '**Moderate**'.

The overall significance of the impact of water use on the Human Population and the impact upon Tangible Property during Stage 3 is therefore considered to be '**Upper Moderate (15)**' and consequently project-specific mitigation measures to reduce the significance will be developed and implemented.

11.4.7 Project-specific mitigation measures

Navitas will work closely with FIG to ensure that water utilities are developed and water use is suitably controlled. This will require liaison and cooperation between the public utility sections of FIG and Navitas in order to best meet increased demands without impacting domestic residential supplies or commercial sector usage.

Project-specific mitigation that is within Navitas' control is primarily based around planning and logistics.

11.4.7.1 Offshore planning & supply logistics

All planning will remain cognisant of the need to minimise water requirements and will continue to identify where water efficiency can be improved and usage minimised. There are many actual and potential measures within Navitas' control that can be instigated to balance or offset demand at peak times, including:

- Ensure reliability of water supplies is built into project design premise and operational processes/contingencies, to avoid environmental impacts from unnecessary shutdowns or slowdowns.
- Put in place, and monitor, offtake limits to the Supply Base and TDF (daily average volume and instantaneous rate, precise figures to be agreed with FIG),
- Communicate to FIG water department significant demand points within the overall schedule,
- Replacement of potable water with seawater where possible (e.g., tophole sweeps), this will significantly reduce drilling fresh water demands (Section 5.11.4.2.7),
- Potential to have the MODU pre-supplied with full water on delivery and use of storage capacity onboard the MODU,
- Importation of water to the MODU using additional incoming vessels that arrive with full freshwater tankage onboard, and
- Specify that some items will come pre-filled with inhibited water during subsea installation to reduce additional flushing needs. In some applications, seawater can be used in replacement for fresh water.

11.4.8 Residual impacts and risks

11.4.8.1 Stage 1, Stage 2a & 2b residual impacts

While the added project-specific mitigations may lessen reliance on the Stanley water system, additional mitigation focused on reduced use does not actually change the inherent sensitivity of the receptors (Human population and Tangible property) which remains **'Very High'**.

However, as regards the severity of effect, the further reductions that will be identified through the FEED process in offshore logistics will reduce reliance on shore supplies further. This will insulate current domestic usage from impact. Although not specifically a mitigation measure, monitoring of water use will highlight any issues early and allow water use to be restricted early prior to any widespread effect occurring. Furthermore, by reducing usage further, the duration of any effect will be less as the supply will be able to recover faster. Therefore, the severity of effect of competition for water usage will reduce to **'Moderate'**.

The overall significance of the impact of water competition on the human population is therefore reduced to **'Upper Moderate (15)'**.

11.4.8.2 Stage 3 residual impacts

All additional project-specific mitigation measures address planning and logistics to reduce water use during the drilling and construction phases such that there is no change to the assessment within Stage 3 and the significance of the impact remains **'Upper Moderate' (15)**.

11.4.9 Cumulative impact

Competition for water as a resource is not only incurred by O&G activities and there is the potential for cumulative impacts *via* increased 'concentration' (Section 8.9.1). Indeed, even if oil development usage remains constant, competition may still increase if domestic or other economic sector usage increases. Between 1995 to 2017, Stanley usage has increased by 74 % from 492 m^3/day to 860 m^3/day and continues to rise with a daily usage of 918 m^3/day in 2023. Forecast growth in water usage is difficult to predict and will depend upon socio-economic factors, but long-term historic trends would suggest an annual increase in water demand of between 3.5 % per annum. Further, past exploration rounds have shown an approximate 6 – 8 % increase in water use above base levels that cannot be directly attributed to O&G infrastructure use but may relate to associated services and increased economic activity.

It can be assumed that O&G development will bring associated wider economic growth that will in turn result in greater water demands. With a finite cap on water volumes available, competition is likely to increase over the duration of the project even if direct water use within the project remains constant. However, this will be buffered against once steady state production is reached (Stage 3) and water demands decrease. In the absence water usage during drilling, the offshore demand will almost cease with only contingency for support vessel top-up. The peak demand of the Phase 1 & 2 development is relatively short-term, during a period of approximately 5.5 years in Stages 1, 2a & 2b.

11.4.10 Confidence

There are a number of uncertainties within the above assessment. These are as follows:

- While the requirement for a buffer storage capacity has been included within the base-case mitigations, the tank volumes have not yet been defined and although they will be based upon the forecast (and conservative) daily averages, their efficacy will depend upon the accuracy of the forecast,
- While the yard area and accommodation bed capacities have been determined, the final design and incorporation of sustainable technologies, which may lessen water demands, have not been finalised,
- The cause of unallocated water use increase and the proportional contribution that may be associated to the wider O&G stimulated activity is difficult to quantify with certainty, and
- The Stage 3 assessment is based on the assumption of continued growth in water usage of *c.* 3.5 % p.a. which may change.

Therefore, the level of confidence in the impact assessment and the efficacy of mitigation is therefore considered to be '**Uncertain**'.

11.4.10.1 Monitoring required

Use of onshore water supply will be monitored at all infrastructure locations and will be included within the Environmental Monitoring and Management Plan (EMMP) for on-going assessment to identify any emerging issues at an early stage. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the project-specific Phase 1 & 2 EMMP (an outline EMMP is provided in Chapter 15).

11.4.11 Offsetting

For significant residual and impact and risks ('Moderate' or above), offsetting *via* a Carbon and Biodiversity Offsetting Fund is proposed, see Section 8.11 for further details.

11.4.12 Findings summary

Table 11.24: Summary of the impact assessment for water use resource competition during the Sea Lion Phase 1 & 2 Development

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Water use for MODU drilling, vessel top-up, onshore yards and accommodation	Competition for water resources	Restriction of water supply and/or quality	Planned	1, 2a & 2b	Very High	Serious	n/a	**High (20)**	**Upper Moderate (15)**	**Uncertain**	**Industry-standard:** End user prioritisation, Buffer tank capacity and voluntary restrictions, and Offshore desalination, **Project-specific:** Sustainable design, and Offshore planning.
Water use for offshore vessel top-up, onshore yards and accommodation			Planned	3	Very High	Moderate	n/a	**Upper Moderate (15)**	**Upper Moderate (15)**	**Uncertain**	

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

11.5 Competition for resources – Electricity

Table of Contents

11.5.1 Introduction....1048
11.5.1.1 Relevant legislation....1048
11.5.2 Sources of onshore energy use....1048
11.5.3 Potential receptors....1048
11.5.4 Characterising and quantifying the impact of onshore energy use....1049
11.5.4.1 Nature of potential Impact....1049
11.5.4.2 Quantification of energy use....1049
11.5.4.2.1 Current energy use (including exploration drilling campaigns)....1050
11.5.4.2.2 Forecast Phase 1 & 2 energy use relative to existing supply....1050
11.5.4.2.2.1 Data sources....1050
11.5.4.2.2.2 Energy use during exploration rounds....1050
11.5.4.2.2.3 Forecasted Phase 1 & 2 Development energy usage....1051
11.5.4.2.3 Peak Phase 1 & 2 power demand *vs.* output....1052
11.5.4.2.3.1 Stanley power generation capacity....1052
11.5.4.2.3.2 Stanley peak power demand (including exploration campaigns)....1052
11.5.4.2.3.3 Phase 1 & 2 forecast peak power demand....1053
11.5.5 Industry-standard mitigation....1053
11.5.6 Impact assessment....1053
11.5.6.1 Impact of power use of the Phase 1 & 2 Development....1054
11.5.7 Project-specific mitigation measures....1054
11.5.7.1 Sustainable design....1054
11.5.7.2 Off-peak power utilisation....1055
11.5.7.3 Use of a diesel generators for electricity generation....1055
11.5.7.3.1 Noise and electricity monitoring....1055
11.5.8 Residual impacts....1055
11.5.8.1 Impact of power use from the Phase 1 & 2 Development....1055
11.5.9 Cumulative impact....1056
11.5.10 Confidence....1056
11.5.10.1 Monitoring required....1057
11.5.11 Offsetting....1057
11.5.12 Findings summary....1057

11.5.1 Introduction

Onshore and at-shore infrastructure in support of the Phase 1 & 2 Development will require connection to the existing electrical power grid of Stanley for energy requirements. Stanley power station (owned and managed by FIG) is the single energy utility supplier and has a fixed power capacity from a finite number of generators and a series of wind turbines. Energy can thus be considered a limited resource and both the carrying capacity of existing infrastructure and competition for resources were raised as a concern during the scoping consultations (Chapter 6).

This chapter investigates the forecasted energy use and compares it to the power capacity and current level of Stanley energy demand. The forecast difference between Phase 1 & 2 Development demand and the current excess power capacity is used to inform the assessment.

Note: impacts related to competition for other resources e.g., accommodation, water etc. are described elsewhere in this document as described in Table 2.2.

11.5.1.1 Relevant legislation

Resource competition is not legislated for specifically within any Ordinance or Regulation and therefore no statutory limits are defined through legislation.

However, as was agreed during the consultee scoping workshop with FIG in 2015 (Chapter 6), the social impacts of competition for resources such as electricity was considered to be within the scope of the EIS as defined by the EIS Guidance Note (FIG, 2016e).

11.5.2 Sources of onshore energy use

Sources of energy use and thus sources of resource competition during the Phase 1 & 2 Development include:

- Use of the Temporary Dock Facility (TDF) (Section 5.11.1.1.1),
- Use of the onshore laydown yards, storage bases and associated offices (Section 5.11.1.2),
- Use of accommodation (Section 5.11.4.1):
  - Transit accommodation, and
  - Rental accommodation.
- Heliport aviation (Section 5.11.3.1.2).

11.5.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify those receptors upon which the impacts of resource competition warranted further investigation (Chapter 9).

Receptors that may be directly and indirectly impacted by power usage associated with the Phase 1 & 2 Development include:

- Tangible Property (finite power supply) (Section 7.7.4.5.5), and
- Human Population (in Stanley) (Section 7.7.2).

A degree of interdependence exists between the receptors as any impact upon power utilities (Tangible Property) will also impact upon the Human Population that is reliant upon it.

This assessment is based upon the human population of Stanley and is confined to the area within the coverage of the Stanley Town Plan and Stanley power station supply. Onshore and at-shore logistical support services, and associated accommodation, are or are most likely to be, based within close proximity to Stanley.

11.5.4 Characterising and quantifying the impact of onshore energy use

11.5.4.1 Nature of potential Impact

Electrical energy is provided to Stanley through a single power and distribution network. No alternative supply is available. Power and energy usage is therefore capped by the existing generator capacity and thus, in a practical sense, electricity can be considered as a finite resource (Section 7.7.4.5.5).

To ensure a worst-case is assessed, the contribution of wind-power is discounted from this assessment as it is dependent upon meteorological conditions and cannot be fully relied upon. If there is no wind there is no power so it is necessary for the diesel generator capacity to be sufficient to meet needs.

With a single point supply and finite capacity, energy provision to Stanley residents and other commercial users is vulnerable to increased or excessive demand. Unlike water where buffer storage capacity may insulate users from temporary supply issues, any interruption or over-load to the electrical system will cause immediate impact.

Increased demand may cause:

- Increased wear and tear of generator infrastructure if it is operating at capacity for extended periods (it is an aging system which is vulnerable to single point failure),
- Operating at, or near, capacity removes spare stand-by generator capacity to buffer against generator drop-out or demand spikes, potentially causing temporary black-out or power surges,
- Spikes in power use within the distribution grid may cause over-load of distribution transformer boxes and / or generator surge causing black-out to users on a shared electrical main, and
- Power surge and drop out may damage modern electronics; computers, communications and even domestic appliances (such as kerosene heating and gas cooking) now largely rely upon an electric power source for operation.

All of the above may impact upon the availably of the finite resource (electricity) to the end user, thus impacting upon Tangible Property and the Human Population.

11.5.4.2 Quantification of energy use

In order to assess the sensitivity of the power grid to increased demands it is necessary to understand the baseline electrical capacity. To quantify the baseline, it is necessary to consider both the overall amount of energy available (kWh), as well as the peak power (kW) available at any given time. Therefore, electrical capacity needs to be considered in terms of the:

- ‘Overall energy use’ - this is the total energy (power use over time) used over the course of the day and is measured in KiloWatt hours (kWh) or units (1 kWh = 1 unit), and
- ‘Peak power demand’ - this is the maximum amount of power required at any given moment in a day and is measured in KiloWatts (kW).

Overall energy use is the metric used to understand the difference between normal electrical usage and the increased overall use when Oil and Gas (O&G) operations are occurring. However, as a metric, ‘overall energy use’ cannot tell us the whole story as it is also necessary to understand how much electrical power may be available at any one moment in time. As electricity must be supplied instantaneously with no storage potential, and since energy use is not uniform through the day, it is the increase in peak power demand that is critical to assessing the ability of a system, and the available generators, to supply enough electricity.

The question is: if all users 'switched the lights on at the same time', could the capacity of the existing Stanley power supply cope with the total demand?

Therefore, in order to inform the impact assessment, the following section describes:

- Current overall energy use in Stanley (i.e., the baseline usage, here including the exploration drilling campaigns),
- Forecast Phase 1 & 2 energy use relative to existing supply use, and
- Peak Phase 1 & 2 power demands and output.

11.5.4.2.1 Current energy use (including exploration drilling campaigns)

The average daily energy use over the last ten years (2013-2023) was 48,889 kWh/day.

Within the ten-year data set, the lowest average daily energy use (averaged over the year) was 44,308 kWh/day in 2013-14, during which there was no oil exploration activity. The highest, over a time which did have exploration drilling, was 51,162 kWh/day in 2015-16 which saw eight months of exploration activity. This shows that past exploration campaigns have resulted in an increase of *c.* 16 % (rounded up) of the overall daily average Stanley energy usage from the immediately preceeding year without exploration (Table 11.25). More recent figures show a continued increasing trend with a 2022/23 daily use of 53,481 kWh/day, a 21 % increase over 2013/14 Stanley usage and a 5 % increase over total energy use during the last exploration campaign in 2015. 2022/23 is the first year that Stanley energy use alone (53,481 kWh/day) has exceeded energy use of both Stanley and the O&G industry during the last drilling campaign in 2015 (51,162 kWh/day).

As such, some caution must be exercised when attributing increased energy use and power demand to oil exploration activities only. Whilst there was a 16 % increase in overall energy usage between 2013-14 (without exploration) and 2015-16 (with exploration), in subsequent years usage did not return to former levels. Indeed they continued to increase, surpassing energy used in 2015, suggesting that a component of the increases is also due to increasing residential and economic diversification activities. However, to provide a conservative and 'worst-case' scenario the current assessment assumes that the full increase (16 %) was attributable to the direct and indirect effects of oil exploration activities.

11.5.4.2.2 Forecast Phase 1 & 2 energy use relative to existing supply

11.5.4.2.2.1 Data sources

The data used to forecast energy use during the Phase 1 & 2 Development are largely based upon recorded energy use during the 2015 *Eirik Raude* exploration drilling campaign. These data were extrapolated according to the expected changes in land area used and personnel numbers during the Development. Full detail on the forecast figures for energy use are presented in Section 5.11.4.3 and summarised below (Table 11.25).

11.5.4.2.2.2 Energy use during exploration rounds

During exploration, direct usage by the four main exploration infrastructure centres (TDF, laydown yards, accommodation unit, and heliops hanger) had an average total daily usage of 3,025 kWh, representing a 7 % increase in pre-exploration Stanley usage (Table 11.25 below). However, as described above, overall Stanley usage increased by 16 % during the 2015 drilling campaign.

For the purposes of this assessment it is presumed that the remaining 9 % (rounded up to 10 % for this assessment) increase in usage can be attributed to contracted services (such as laundry, rental accommodation, offices) and associated increases in wider economic activity (hotels, restaurants, general services, water pumping, etc.), which may or may not have been fully associated with the exploration campaign. A proportion of the increase may have been down to an unrelated residential

and economic activity such as fishing industry cold-storage. Despite this unknown, it is prudent to consider a contingency for such usage within the impact assessment. An overall increase in utility use of *c.* 16 % would appear consistent with other services such as water usage that increased by comparable amounts (Section 11.4.4.2.1.3).

11.5.4.2.2.3 Forecasted Phase 1 & 2 Development energy usage

While the Development infrastructure centres will essentially be the same as those used during exploration, there are three main differences:

- During Stages 1, 2a & b, the onshore supply base will be approximately 2.5 times larger than that used during the exploration campaign and will be in place for approximately five and a half years, and
- During Stage 3, steady state production, the onshore supply base will decrease in size to approximately 40 % of the area used during the exploration campaign.

Based upon the overall increases to the supply base, accommodation requirements and heliops base, Phase 1 & 2 energy usage may total 19 % (9 % of which is directly attributable) of current Stanley usage in Stages 1 and 2, and 16 % (6 % of which is directly attributable) in Stage 3 (Table 11.25). It should be noted that as the population of Stanley grows, so will electricity demand, meaning the percentage overall spare capacity may be lower (assuming there is no increase to available electricity supplies, such as the new power station, for the duration of the Sea Lion project).

As described above, and to take a precautionary approach, an additional 10 % has been added to the attributable total to account for the additional, but unattributed, power use in contracted services and wider economic activity that may result from O&G activity. It could be argued that these unassociated increases should be proportional to the Phase 1 & 2 Development increase, however, as the exact cause of the extra 9 % usage increase observed during exploration is not known, a nominal addition is made.

Table 11.25: Summary of exploration use and forecast Phase 1 & 2 energy use

Facility	Exploration usage (kWh / day)		Proportionate increase in development usage expected	Forecast Phase 1 & 2 usage	
	kWh / day	% Increase to Stanley usage[1]		kWh / day	% Increase to Stanley usage[2]
Stages 1, 2a & 2b					
TDF base load	125	0.3	None	125	0.2
Laydown yards	358	0.8	Increase in area x 2.5	895	1.7
Accommodation facility	1,653	3.7	Increase in maximum personnel numbers x 2	3,150	5.9
Heliops base	889	2	None	889	1.7
Attributable total	**3,025**	**7 %**	**Attributable total**	**5,059**	**9 %**
Unattributable contribution[3]	-	9 %	Unattributable contribution	-	10 %
Total	**-**	**16 %**	**Precautionary total**	**-**	**19 %**
Stage 3					
TDF base load	125	0.3	None	125	0.2
Laydown yards	358	0.8	40 % of exploration yard area	142	0.3
Accommodation facility	1,653	3.7	Small increase in personnel numbers x 1.14	1,886	3.5
Heliops base	889	2	None	889	1.7
Attributable total	**3,025**	**7 %**	**Attributable total**	**3,044**	**6 %**
Unattributable contribution[3]	-	9 %	Unattributable contribution	-	10 %

Facility	Exploration usage (kWh / day)		Proportionate increase in development usage expected	Forecast Phase 1 & 2 usage	
	kWh / day	% Increase to Stanley usage[1]		kWh / day	% Increase to Stanley usage[2]
Total	-	**16 %**	**Precautionary total**	-	**16 %**

[1] Compared to Stanley usage in year immediately preceding O&G operations: 44,308 kWh/day in 2013/14

[2] Compared to Stanley usage in most recent year without O&G exploration: 53,481 kWh/day in 2022/23.

[3] Unattributable usage may not be directly related to O&G activity, however any wider increase in Stanley usage, even if unrelated, will also reduce any excess capacity so a nominal additional increase is included to cover associated and unassociated increases.

11.5.4.2.3 Peak Phase 1 & 2 power demand vs. output

As described above, it is necessary to understand the peak power demands to determine whether or not the Stanley power station will be impacted by the O&G operation making power demands at the same time as other local users.

11.5.4.2.3.1 Stanley power generation capacity

Details on the current Stanley power generation are provided in the Baseline Description (Section 7.7.4.5.5). In summary, the FIG Power Station is the electrical distribution hub and balances supply from the generators and the Sand Bay wind farm. The power station currently uses eleven generators of differing capacity. However, very importantly, the amount of power available at any given time depends upon the combination of generators that are in use, on standby or under deep maintenance.

While varying combinations of generator status exist, the maximum power capacity is around 3,200 kW (J. Greenland, *pers comm.*).

It is recognised within capital project planning and the Stanley Town Plan (FIG, 2015d) that eight of the current 11 diesel generators are reaching the end of their design life with resultant issues for capacity, reliability and maintenance costs. Three additional high-speed sets have provided an interim solution and contingency planning is progressing towards a new power station in a new location for the long term. FIG note that with capital funding commitments there will be significant change to energy provision in Stanley by 2025/6 (C. Summers, *pers. comm.*).

As these improvements are outwith Navitas' control, the following assesses the impact of Phase 1 & 2 energy use against the current Stanley baseline.

11.5.4.2.3.2 Stanley peak power demand (including exploration campaigns)

Stanley power demand varies depending upon:

- The time of year (generally higher in winter),
- The time of day (peaks late-morning / midday with lesser peak in early evening and off-peak overnight),
- Whether it is a weekend or a week-day, and
- Whether O&G activity is on-going.

Typically, energy demand is higher in the winter and higher during the day with lowest use (or off-peak use) falling between 2300 - 0600 hrs.

Peak power demand during exploration was 3,320 kW while the average peak demand without exploration was 2,756 kW (in 2013-14, the year preceding exploration). This amounts to an estimated increase of 564 kW power demand during the 2015 exploration campaign. The FIG Public Works Department (PWD) power section estimated that, on average, the total impact on Stanley power load from oil exploration was *c.* 500 kW (i.e., *c.* 18 % above non-exploration) (G. Ross, *pers. comm.*).

11.5.4.2.3.3 Phase 1 & 2 forecast peak power demand

The individual demands of exploration infrastructure centres, alongside the extrapolated Phase 1 & 2 demands, are given in Table 11.26 and approximately match expected estimates if the unattributable services (such as those described above) are also considered. However, it should be noted that it is extremely unlikely that each infrastructure facility would peak at the same time. For example, accommodation demand may be higher when yard or heliport demand was lower, and thus the likely contribution of unattributed sources is more significant than the data would initially suggest. Indeed, the unattributed sources increase the power demand to the equivalence of all facilities operating at peak. Table 11.27 shows the peak power demand as it compares to the average Stanley power demand and shows that at peak, overall demand from Stanley plus the Phase 1 & 2 Development has the potential to exceed the available capacity in the system.

Note: as stated before, the current assessment assumes a conservative worst-case scenario with all facilities peaking at once and applies it to the current *status quo* of power generation. That this approach suggests a deficit of *c.* 179 kW may occur at critical times without mitigation should be considered alongside the proposed FIG improvements to the energy supply in Stanley, which is expected to be online in 2025/26 (C. Summers, *pers. comm.*).

Table 11.26: Contribution of exploration infrastructures to power demand

Facility	Peak Power (kW) use during exploration	Smoothed 24 hour average power equivalence (kW)	Estimated Phase 1 & 2 peak power (kW)
Heliops hanger	250[1]	37[2]	250
Accommodation facility	120 – 140[1]	69[2]	137 - 160
TDF (estimate)	25	5[2]	25
Laydown yards (estimate)	75	15[2]	188
Total attributable load	470 - 490	126	600-623

[1] PWD figures (G Ross, *pers. comm.*).
[2] Figures derived from average kWh/day meter readings.

Table 11.27: Current Stanley power demand with forecast O&G development demands versus current baseline capacity

Average Stanley power demand (non-exploration) (kW)		Peak potential Phase 1 & 2 demand (kW)	Potential overall demand (kW)	Current baseline capacity (kW)[1]	Excess Capacity (kW)
Total demand of all activities if operating at the same time					
Stanley typical maximum power demand	2,756	623	3,379	3,200	(-179)

[1] Baseline Stanley power station generator capacity (J. Greenland, *pers comm.*).

11.5.5 Industry-standard mitigation

Within larger economies there is generally a national network with the capacity to absorb and respond to increased demand and therefore, no industry-standard mitigation or Codes of Practice exist.

11.5.6 Impact assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities.

Assessment of the impact of energy use is challenging as it is understood that the Stanley baseline in terms of energy availability may change within the next few years. However, this is outwith Navitas' control and, therefore, the following assessment is based on the current baseline.

A summary of the impact assessment outcomes for this Development is tabulated in Section 11.5.12 which shows the worst-case impact for each activity and receptor, and details are provided below.

11.5.6.1 Impact of power use of the Phase 1 & 2 Development

Electricity is an essential utility upon which almost all daily activity depends in an increasingly electronic age, from heating controllers, lighting, refrigeration, to computers and communications. Whilst emergency services are protected with auxiliary generators, any interruption in supply would be immediately noticed and cause high levels of inconvenience and nuisance within the Human Population. Unlike water, where a buffer storage capacity may insulate the population from immediate impacts, the effect of electrical supply issues would be immediate. Further, with regard to electricity as a Tangible Property, Stanley's current baseline capacity is such that it may be unable to sustain peak demand spikes in the short-term and therefore must be considered a finite resource which has the potential to be unsustainable in the immediate term (Section 11.5.4.2.3.1). Notwithstanding the fact that any interruption would be restored, the sensitivity of the receptor (Tangible Property) is considered to be '**High**'.

Overall energy demand from the Sea Lion development is limited to onshore assets and infrastructure. It is expected that the Phase 1 & 2 usage will be similar in nature to the exploration campaigns, with increases in power usage being proportional to the size of infrastructure and increases in personnel numbers. These increases may result in a worst-case 19 % increase in Stanley electrical energy usage during Stages 1 and 2 (Section 11.5.4.2.3.3). Further, at peak, overall demand from Stanley plus the Phase 1 & 2 Development has the potential to exceed the available capacity in the system (Table 11.27). As the use of the finite resource has the potential to be extensive but infrequent as it is only peak power usage that will exceed capacity, the worst-case severity of effect (to Tangible Property) of daytime power use is considered to be '**Serious'**.

The overall significance of the impact of competition for electrical energy during daytime hours is therefore assessed as '**High (16)**'. Consequently project-specific mitigation measures to monitor and, where possible, reduce the significance will be considered.

11.5.7 Project-specific mitigation measures

Navitas will liaise closely with FIG in preparation for 'oil readiness' to ensure that energy supply and demand are in balance. These discussions will include those based on future FIG development of power capacity (Section 7.7.4.5.5.3), not least because minimising risks of loss in energy continuity is important to the Phase 1 & 2 Development as well as to the human population.

However, while future improvements to the FIG power station may alter the impact assessment by altering the baseline (e.g., by lessening the sensitivity of the receptor as a finite resource and the severity of effect by lowering the Phase 1 & 2 demand as a percentage of the available power), these changes are outwith Navitas' control and cannot be used as a mitigation within this assessment.

Nonetheless, a number of mitigating and ameliorating strategies that *are* within Navitas' control will be incorporated into the Phase 1 & 2 Development during the FEED process. These include:

- Sustainable and energy efficient design,
- Off-peak power utilisation, and
- Presence of a small diesel fueled electricity generators at the onshore base:
    - Noise monitoring alongside the generator use.

11.5.7.1 Sustainable design

Where feasible, sustainable design and energy efficiency will be included in infrastructure and asset design, this may include where appropriate:

- Lighting set at minimum levels (which are still appropriate for safety),
- Low energy types and photosensitive light switching utilised where appropriate,
- Energy efficiency incorporated within buildings through insulation, heating systems, thermostats, timer switches, etc., and
- Back-up emergency generators and switchgear will be provided for essential systems (allowing disconnection from grid in the event of an emergency).

Optimal energy use will be incorporated within all design considerations through the FEED process, as will lessons learned during the exploration campaigns. For example, the shorter-term exploration activities relied upon modular and / or temporary built assets. The modular buildings tended to rely to a greater extent on electrical heating and usage. It is assumed that permanent buildings will be more efficient in energy design and that kerosene, water and forced air heating may be feasible options to reduce *per capita* electrical energy use. Space heating through electrical forced air heaters was the greatest power demand at the exploration heliops hangar accounting for 96 % of the peak 250 kW load.

11.5.7.2 Off-peak power utilisation

Highest power demands occur between 08:00 – 18:00 hours with an approximate mid-day peak and lower energy use at night. Therefore, there is the potential to minimise impacts by taking advantage of off-peak periods for high power use activities and processes, where possible. Such use would average overall demand through the 24-hour period and reduce the likelihood of any capacity issues or impacts through the day when domestic demand is highest. Overall energy usage (Section 11.5.4.2.1) may not drop but, as it would be utilised during a period when other demands are lower, the impacts on peak demand could be minimised.

11.5.7.3 Use of a diesel generators for electricity generation

While electrical power for the laydown yard will be sourced from the municipal supply, some small diesel fueled generators within the laydown yard may be required. In the event of power failure, contingency power will be provided by these standby generators. This is proposed as a back-up to the local supply and to prevent any domestic grid overload on Stanley supply; development of this facility will be made in consultation with PWD.

11.5.7.3.1 Noise and electricity monitoring

As is described in Chapter 15, monitoring will be carried out to assess any impacts of noise associated with the generator use and Navitas will have a formal complaints process in place, with a member of staff assigned to respond. In the event that monitoring indicates noise is an issue for local residents and that monitoring of power use through the night indicates any problem with capacity, other solutions may be sought to mitigate against both power use and noise.

11.5.8 Residual impacts

11.5.8.1 Impact of power use from the Phase 1 & 2 Development

The above project-specific mitigations (e.g., low energy buildings and the optimal use of off-peak periods) may lessen the sensitivity of the Stanley power supply (Tangible Property) as a finite resource and therefore would lessen the likelihood of the Human Population being subjected to downtime in power availability. Therefore, the sensitivity of the receptor (Tangible Property) can be reduced to '**Moderate**'.

The mitigations described above incorporate use of off-peak periods, energy optimisation and the monitoring of energy use to identify any emerging issues early. This provides for the ability to respond by modifying work practices or upgrading capacity. Energy efficiency in design will be promoted

throughout the FEED stage of the project and it is expected that savings can be made relative to exploration usage upon which the Phase 1 & 2 estimates were based. It is believed that through close attention to energy use, power needs could be further reduced below the threshold level of 3,200 kW. However, because the energy savings cannot be quantified at this stage, and to take a precautionary approach given that there is no excess capacity within the system once peak Phase 1 & 2 activities are added, the severity of effect cannot be reduced and remains 'Serious'.

The overall significance of the impact of competition for electrical energy on the human population of the Falkland Islands is therefore assessed as '**Upper Moderate (12)**'.

11.5.9 Cumulative impact

The current assessment deals specifically with the electricity usage of the Development assets and infrastructure centres. Cumulative socioeconomic impacts from wider economic activity will be further assessed within the separate Socio-economic Impact Assessment (Section 6.2.2.1.1).

However, to be conservative a component of cumulative impact is already incorporated within the assessment. The disparity between direct O&G sector usage by infrastructure centres and the overall increase in Stanley usage exhibited during exploration illustrates the cumulative effect in energy use of the overall increase in economic activity. Unattributed cumulative usage contributed an additional 9 % in usage (Section 11.5.4.2.2.2) that was considered and included in calculations. It should however be noted that as the population of Stanley grows, so will electricity demand. Consequently, the excess capacity available for O&G activity will decrease unless additional infrastructure is developed to cover the additional usage.

Note: FIG note that with capital funding commitments there will be significant changes to energy provision in Stanley by 2025/26 (C. Summers, *pers. comm.*).

11.5.10 Confidence

The scale of Development activity is defined by area and personnel, both of which are known. A degree of uncertainty exists within some of the baseline figures and exploration figures have been used to provide the basis of the assessment. These actual-use figures have been scaled by any expected changes between the level of exploration activity and development activity. Energy use (kWh) is metered and recorded however instantaneous power use which is the most critical parameter in matching development peak demands to generator capacity is not recorded at infrastructure centres and is based upon estimates. There is therefore a degree of uncertainty in figures and within the extrapolated estimates.

Overall, Stanley demand was estimated including uses directly attributable to the O&G operations, as well as noting that there were additional uses that could not be directly attributable. However exact quantification of how this is split between service sectors and how much is directly associated to O&G activity as opposed to a general increasing trend in Stanley usage remains unclear.

Liaison between Navitas and FIG, as the service utility provider, is on-going. A number of utility infrastructure upgrades are already incorporated within FIG planning and are progressing, and significant improvements to energy provision in Stanley are anticipated by 2025/26 (C. Summers, *pers comm.*). However, although this is progressing it is not within the control of Navitas and thus no assumption based on these plans were included within the assessment.

Based on the above, on balance, the level of confidence in the impact assessment is considered to be '**Uncertain**'.

11.5.10.1 Monitoring required

Energy use will be monitored and reported to measure environmental and social impacts and to identify any emerging issues early. Detailed monitoring requirements have been established during the Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the project-specific Phase 1 & 2 Socio-Economic Monitoring and Management Plan (SEMMP).

11.5.11 Offsetting

For significant residual and impact and risks ('Moderate' or above), offsetting *via* a Carbon and Biodiversity Offsetting Fund is proposed, see Section 8.11 for further details.

11.5.12 Findings summary

Table 11.28: Summary of the impact assessment of energy use on the competition for resources

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Electrical energy use onshore by the TDF, laydown yards, accommodation facilities & heliops	Competition with domestic energy needs	Overloading of current capacity	Planned	1, 2a, 2b & 3	High	Serious	n/a	**High (16)**	**Upper moderate (12)**	**Uncertain**	**Industry-standard:** None. **Project-specific:** Sustainable design, Off-peak power utilization, and Back-up generators

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

11.6 Competition for resources – Air links

Table of Contents

11.6.1 Introduction....1060
11.6.1.1 Relevant legislation....1060
11.6.2 Sources of air transportation competition....1060
11.6.3 Potential receptors....1060
11.6.4 Characterising and quantifying the impact of service competition....1061
11.6.4.1 Seat availability on standard air-links....1061
11.6.4.2 Navitas transportation requirements and provision....1061
11.6.5 Industry-standard mitigation....1062
11.6.6 Impact assessment....1062
11.6.6.1 Use of air-links....1062
11.6.6.2 Provision of air-links....1063
11.6.7 Project-specific mitigation measures....1063
11.6.8 Residual impacts and risks....1063
11.6.9 Cumulative impact....1063
11.6.10 Confidence....1063
11.6.10.1 Monitoring required....1063
11.6.11 Offsetting....1063
11.6.12 Findings summary....1063

11.6.1 Introduction

In addition to the use of accommodation, freshwater and electricity, the Phase 1 & 2 Development will require the use of air-links to the Islands in order to transport personnel and cargo throughout Field Life. The Falkland Islands have limited international air-links / flights and therefore, additional and regular requirements have the potential to impact upon the availability of seats for local residents and other visitors. The level of resource competition is determined by the forecast difference between the Sea Lion Development demand, and the current excess capacity in available seats.

Both the carrying capacity of existing infrastructure and competition for resources were raised as a concern during the scoping consultations (Chapter 6).

This chapter investigates air-link provision and specifically, the competition for seat availability on international flights.

Note: other impacts related to the competition for resource e.g., accommodation, water, electricity and roads, and those associated with the use of transportation e.g., emissions etc. are described elsewhere in this document, see Table 2.2.

11.6.1.1 Relevant legislation

Resource competition is not legislated for within any specific Ordinance or Regulation and therefore, no statutory limits are defined through legislation. However, as was agreed during the consultee scoping workshop with FIG in 2015 (Chapter 6), the social impacts of competition for resources, such as the use of air-links, was considered to be within the scope of the EIS as defined by the FIG EIA Guidance Note (FIG, 2016e).

11.6.2 Sources of air transportation competition

All expatriate (expat) personnel involved during the Phase 1 & 2 Development, both onshore or offshore, will require air transportation to the Falkland Islands at the beginning and end of their contract periods. A small number of technicians, managerial and administrative personnel may also be required to visit independently of offshore work programmes and crew exchanges. The sources of competition for seats on air-links are therefore the same as those for accommodation listed in Section 11.3 above.

11.6.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify those receptors upon which the impacts of resource competition warranted further investigation.

Receptors that may be impacted by air-link usage associated with the Phase 1 & 2 Development include:

- Human Population (Section 7.7.2), and
- Tangible Property (Section 7.7.4).

In particular, the use of existing air-links by the Sea Lion Phase 1 & 2 Development for personnel movements could significantly impact upon seat availability, thus limiting seat availability for:

- Resident travel and flexibility (including children in education),
- Commercial interests of other sectors such as:
  - Land-based tourism (land based and rural development),
  - Cruise ship tourism (passenger exchange), and
  - Fishing (crew exchange and business travel).
- Medical flight planning and capacity, and

- Veteran visits.

11.6.4 Characterising and quantifying the impact of service competition

When characterising and quantifying the impact of competition with regard to air-links to the Falkland Islands, it is necessary to consider the following:

- Availability of seats on standard air-links, and
- Navitas personnel transportation requirements.

11.6.4.1 Seat availability on standard air-links

As is detailed in the Environmental and Social Baseline (Section 7.7.4.3), the standard air-links to the Falkland Islands are currently limited to a twice weekly Ministry of Defence (MoD) flight from the UK (i.e., the air-bridge), and once weekly LATAM flights scheduled between the Islands and Chile.

On average, unallocated seat capacity is 103 seats / week (nine seats / week on the air-bridge and 94 seats / flight on the LATAM flights) (Section 7.7.4.3).

However, seat availability is highly seasonal and the unallocated seats may be used by:

- Students during school and college recesses,
- Summer tourism demand,
- Cruise vessel passenger exchanges,
- Medical flight requirements, and
- Occasional MoD operational and mobilisation requirements.

Taking the above into account, almost all air-bridge flights and around five LATAM flights per annum may be full to capacity such that the availability of excess seats for additional needs, e.g., those of Navitas, is expected to be limited and unreliable.

Furthermore, due to scheduling efficiency, Navitas has a preference for increased standards of seating-class options in certain situations. This efficiency would be reduced in the case of the MoD air-bridge which is provided with only economy class seating provision.

11.6.4.2 Navitas transportation requirements and provision

The Phase 1 & 2 Development will require available and reliable fixed-wing flights to transport all expat personnel to and from the Falkland Islands for the entire duration of the Sea Lion Field life. The forecast requirement for exchange of personnel peaks at approximately 110 people per week during Stage 1, Stage 2a and Stage 2b when simultaneous activities of the Floating Production, Storage and Offloading (FPSO) unit commissioning and continued drilling run in parallel (Table 11.29).

Recognising the limited capacity, variable seat availability and limited seating-class options within existing air-links, Navitas has committed to a dedicated charter flight to meet personnel flight requirements when drilling commences. Dedicated charter flights assume that there will not be increased commercial air-links to the Falkland Islands with sufficient capacity within the initial timeframe of the Sea Lion Development peak loading. If this changes, Navitas will assess any newly available airlinks, taking into consideration competition for seats and seat availability.

During drilling (Stages 1, 2a & 2b) of the Development, dedicated charter flights will fly fortnightly.

Following the completion of Sea Lion drilling activity and the entry of the project into steady state production operations (Stage 3), the number of personnel that need to be routinely moved to and from the Falklands reduces to a maximum of 20 per week (Table 11.29). The need for the dedicated charter flight will be reviewed at this time to determine whether or not existing commercial flights could be used without detriment to the receptors listed above (Section 11.6.3).

A dedicated charter flight is the current base-case given current available air links and seat capacity. Additional air-link initiatives and potential transfer through South America will be continually monitored at all stages to determine whether this may supplement or provide an alternative to dedicated charter flights. If other routes open up in the future these will only reduce pressure on existing routes.

In addition to charter flights for routine personnel exchange, insurances will be in place for use of an air ambulance link to hospitals in South America or outside of the Falkland Islands to facilitate the evacuation of personnel with injuries which require treatment that is not available at the King Edwards Memorial Hospital.

Table 11.29: Air-link seat capacity requirements during the three stages of the Sea Lion Phase 1 & 2 Development

Development Stage	Offshore personnel (transiting through the Falklands at beginning or end of their rotations) per month	Onshore personnel rotation per month[1]	Total per month
Stage 1: Onshore Infrastructure Construction Pre-First-Oil Drilling, FPSO Moorings (Duration = *c.* 2.5 years)	495	24	519
Stage 2a & 2b: Post First-Oil Drilling, Offshore Construction and Production (Duration = *c.* 3 years)	495	22	517
Stage 3: Steady State Production (per annum) (Duration = *c.* 27 years)	85	13	98

[1] The management staff recruited from overseas will be employed on an unaccompanied basis and so will not require regular flights for dependents. Any Sea Lion management personnel recruited locally, and their dependents are assumed to be already resident and therefore their demand for flights is included within the current baseline flight demand.

11.6.5 Industry-standard mitigation

No industry-standard mitigation, threshold levels, or codes of practice are applicable to air-link resource competition. No acceptable or permissible limits are set through industry codes of practice.

11.6.6 Impact assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities.

A summary of the impact assessment outcomes for this Development is tabulated in Section 11.6.12 which shows the worst-case impact for each activity and receptor and details are provided below.

11.6.6.1 Use of air-links

As described above, the Falkland Islands currently have limited air-link capacity and rely upon these links as the sole means of international travel into and out of the Islands. Whilst there is some excess capacity in the number of seats available (Section 11.6.4.1), this is variable through the year and insufficient for the requirements of the project without restrictive block-booking agreements which could be to the detriment of the Human Population. Therefore, the sensitivity of receptor is considered to be '**High**'.

With the Phase 1 & 2 base-case commitment to provide a dedicated charter flight to meet its transportation needs, the existing air-link capacities would only be used for a small number of *ad hoc* business unit, administrative or technician visits that may be necessary from time to time between fortnightly scheduled flights. Therefore, the severity of effect is considered to be '**Slight**'.

Therefore, the overall significance of impact upon air-link provision is '**Low (4)**'.

11.6.6.2 Provision of air-links

No commitment as to whether any Sea Lion charter flights will be available for resident or third-party use has yet been made. During exploration dedicated charter flights provided an additional option for residents' travel and freight. Should such a provision be agreed, there is the potential for a '**Beneficial**' impact.

11.6.7 Project-specific mitigation measures

With the provision of a dedicated charter flight as the base-case to meet Navitas transportation needs during peak periods, the impacts is considered to be '**Low**' such that no additional project-specific mitigation measures are proposed at this time. As described above, the need for a charter flight during steady state production will be reviewed during Stage 3.

11.6.8 Residual impacts and risks

Not applicable.

11.6.9 Cumulative impact

No cumulative impacts within the scope of the assessment are identified as, for example, any increase in cruise vessel passenger exchange would utilise existing scheduled air-link capacity and remain separate from the provided charter flights.

It is assumed that additional and potentially concurrent future exploration or development is not included within the scope of the current assessment. Assessment and any mitigation of impact would lie within that future activity's environmental assessment, should sufficient spare capacity on existing links not be available. Any options would have to be assessed at such a time and no commitments can currently be made as to the most efficient solution. Navitas will continue to review all available air-links, air-frame capacities and air-link charter partnerships if appropriate.

11.6.10 Confidence

Whilst exact air-frame capacities and fly-route have yet to be confirmed, a similar service was operated during the various oil exploration phases without problem. Confidence in the assessment is therefore '**Certain**'. Confidence in the assessment of the beneficial impact is '**Uncertain**'.

11.6.10.1 Monitoring required

Any incidental usage of existing air-links will be recorded. All monitoring required will be recorded within the project-specific Phase 1 & 2 Socio-Economic Monitoring and Management Plan (SEMMP).

Whilst not specifically required for environmental monitoring, data on anticipated personnel movements and seat occupancy on all flights may prove beneficial to FIG and FIDC in demonstrating the business case for additional commercial airlinks scheduled flights and will be shared as necessary.

11.6.11 Offsetting

As no residual impacts or risks identified in this section are considered significant, i.e., Moderate or above, offsetting is not considered necessary for this impact (see Section 8.11).

11.6.12 Findings summary

Table 11.30: Summary of the impact assessment on the competition for air-link resources

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
International movement of personnel to and from the Falkland Islands	Air-link resource competition for seat availability	Lack of seat availability for residents and third-party economic sectors	Planned	1, 2a, 2b & 3[2]	High	Slight	n/a	**Low (4)**	**n/a**	**Certain**	**Industry-standard:** A dedicated charter flight provisionally up to a fortnightly frequency, or as required depending upon personnel needs and on availability of other air links, will be provided to meet all personnel travel requirements. **Project-specific:** None proposed, although Navitas will continue to monitor and assess for use potential new air-link options and potential additional air-links as they may arise.
	Provision of additional air-link to the Falkland Islands	Potential for extra seat availability for third-party use	Planned[3]	1, 2a, 2b & 3	n/a			**Beneficial**	**n/a**	**Uncertain**	

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.
[2] The ongoing need for a dedicated charter flight will be reviewed once into steady state production (Stage 3) to determine whether or not it is still required.
[3] Note that the availability of excess seating for use by third-parties will be reviewed and confirmed during the FEED process.

11.7 Competition for resources – Road networks

Table of Contents

11.7.1 Introduction 1066
11.7.1.1 Relevant legislation 1066
11.7.2 Sources of road and transport use 1066
11.7.2.1 Crew rotations, freight haulage and use of the MPC road 1067
11.7.2.2 Daily commute from accommodation to workplace / heliport 1067
11.7.2.3 Haulage of freight 1067
11.7.2.3.1 Between TDF and laydown yards 1067
11.7.2.3.2 Air-freight haulage from MPC 1068
11.7.2.3.3 Freight haulage from other sea ports 1068
11.7.2.4 Waste haulage 1068
11.7.2.5 On-call personnel and domestic supplies 1068
11.7.3 Potential receptors 1069
11.7.4 Characterising and quantifying resource competition in road transits 1069
11.7.4.1 Location and types of road 1070
11.7.4.2 Existing road usage 1071
11.7.4.3 Nature of the impacts to human population and tangible property 1073
11.7.4.3.1 MPC and camp roads 1074
11.7.4.3.2 Airport Road and Bypass 1074
11.7.4.3.3 Coastel Road and Boxer Bridge Road 1074
11.7.4.3.4 Stanley roads 1075
11.7.4.4 Estimated Phase 1 & 2 Development road usage 1076
11.7.4.4.1 MPC Road and air-link personnel movements 1076
11.7.4.4.2 Airport Road usage for transport from accommodation to workplace 1077
11.7.4.4.3 Coastel Road and Boxer Bridge Road 1079
11.7.4.4.4 Central Stanley 1079
11.7.4.5 Base-case mitigations 1080
11.7.5 Industry-standard mitigation 1080
11.7.6 Impact assessment 1081
11.7.6.1 Congestion from road use 1081
11.7.6.2 Road degradation from increased vehicle use 1082
11.7.7 Project-specific mitigation measures 1082
11.7.8 Residual impacts and risks 1083
11.7.9 Cumulative impact 1083
11.7.10 Confidence 1083
11.7.10.1 Monitoring required 1083
11.7.11 Offsetting 1083
11.7.12 Findings summary 1083

11.7.1 Introduction

All stages of the Sea Lion Phase 1 & 2 Development will require the use of the existing road network for the movement of personnel to and within Stanley, haulage of equipment, and transport of supplies and waste between a range of different locations.

The Falkland Islands Government (FIG) Public Works Department (PWD) Highways Section is responsible for the construction and maintenance of the road network and surfaces. Whilst road capacity cannot be accurately quantified, increased utilisation may be detrimental to the road surface and may result in increased necessity for remedial repairs. Therefore, increased road usage may impinge upon both the capacity of FIG to conduct repairs, and on other road users. Indeed, both the carrying capacity of existing infrastructure and competition for resources were raised as a concern during the historical scoping consultations (Chapter 6).

As described in Section 6.2.2.1.1, socio-*economic* impacts are out of scope for this EIS. A separate Socio-economic Impact Assessment (SIA), building and updating the previous work undertaken for FIG and Rockhopper by Regeneris (2013; 2015) and Plexus Energy (2012), is being conducted by Navitas. This chapter focuses on the increase in road usage above the existing baseline to inform the assessment of impacts upon the road infrastructure and other road users. As wear and tear on the road network is proportional to vehicle passes and axle weight, it is considered that any impact will be proportional to the increase in traffic and haulage weights.

11.7.1.1 Relevant legislation

Relevant Falkland Islands legislation includes:

- The Offshore Minerals Ordinance 1994 Part VI,
- The Road Traffic Ordinance, and
- Highways (Weight Limits) Ordinance 2004.

Under the EIA Ordinance, the Hydrocarbons Environmental Impact Assessment Guidance Note 187/15 (FIG, 2016e) provides guidance on the content of an EIS. This includes Section 3.7 which suggests that impacts on infrastructure, such as wear and tear on the road network, may be a relevant part of an EIA, guided by how they are described in the National Infrastructure Plan. This was agreed during the consultee scoping workshop with FIG in 2015 (Chapter 6).

All roads have designated speed limits and maximum axle and gross load capacities, with exemptions required for any heavier loads. An annual vehicle tax is levied on all road-going vehicles.

Navitas operates a Health and Safety Transportation Policy; travel on company business is mostly limited to capped (sealed) roads within Stanley and requires a driving safety induction to have been completed.

- Key UK Legislation:
    - The Road Vehicles (Construction and Use) Regulations 1986 (as amended), and
    - Code of Practice Lighting and Marking for Abnormal Load Self escorting vehicles incorporating Operating guidance.

11.7.2 Sources of road and transport use

The activities that will result in the use of vehicles are:

- Crew rotations - transportation to and from Mount Pleasant Complex (MPC) for the charter flight,
- Daily commute from accommodation to the supply base, TDF and Stanley Airport heli-ops by minibus / coach,

- Haulage of freight:
  - Between TDF and laydown yards,
  - Air-freight from fortnightly charter aircraft, and
  - Occasional sea-freight if ports or shipping services other than TDF are used.
- Waste haulage to waste disposal site,
- On-call technician and management vehicles, and
- Domestic supply deliveries.

It is likely that the majority of the project accommodation will be centralised, and transportation from this accommodation to the place of work will be by shared communal transport such as a minibus.

Vehicle use outside of Stanley on uncapped (unsealed) roads will comprise the short section of uncapped Coastel Road between the Airport Road, Lay-down yards and the TDF. Other travel on unsealed roads will require strong justification, will be subject to journey management plans and will therefore be limited.

11.7.2.1 Crew rotations, freight haulage and use of the MPC road

The MPC road will be utilised for transfer of rotational personnel to the fortnightly air-link charter for crew exchanges. It is anticipated that transportation will be *via* minibus or coach.

11.7.2.2 Daily commute from accommodation to workplace / heliport

The Airport Road and Bypass in Stanley is the primary route that will be used to transport onshore personnel from accommodation to the supply base and TDF for shift pattern work and is the primary road giving access to Stanley Airport. It is anticipated that the selected location for the accommodation facility will have easy access to the Airport and Bypass Roads. This will eliminate transit and through traffic within Stanley.

11.7.2.3 Haulage of freight

11.7.2.3.1 Between TDF and laydown yards

The majority of all consumables and equipment will arrive at the TDF by *ad hoc* freighter vessels and will require initial movement to the lay-down yards for storage, and then redelivery to the TDF for loading to the support vessels. The majority of all port transfer and HGV usage will be limited to the short interconnecting road between the TDF and lay-down yards, locally known as Boxer Bridge Road and Coastel Road. Dependent upon the final location and layout of yards and yard access points, this will vary up to approximately 1 km transit along public roads.

During Stages 1, 2a & 2b of the Development, transfer of drilling materials will entail HGV use with high axle loads throughout the year for around five years. In Stage 3 during steady state production, bulk process chemicals e.g., methanol and pour point depressants (Section 5.9.1) may increase in volume but drilling consumables and bulks will no longer be required and overall materials will decrease. Although it may be possible to store some bulk drilling materials (dry or liquid) adjacent to the TDF access causeway, the majority are expected to be stored in the yard and will require road transportation for the short distance to and from the TDF. Logistics vessels located in Berkeley Sound will handle a large amount of heavy equipment for subsea installation and heavy lift objects such as X-mas trees. Any movement of abnormal loads, where the laden vehicle is above 38.5 tonnes, is expected to require special authorisation from the FIG Highways Section. This will be subject to restrictions on overall dimensions and individual axle weights, which would be discussed in detail relevant to each circumstance with a view to ensuring that stresses on roads and road structures are within acceptable limits.

Operation of the supply base is continuous. Staffing is expected to reduce at night during steady state production but during Stages 1, 2a & 2b activity levels will require day and night operations and vessel availability may also dictate night-time operations with some consequent vehicle movements. The main scenarios for night-time activities are drilling and installation support whereby vehicle movements would be between the supply base and TDF i.e., relatively short distances and avoiding residential areas. All non-critical activities will be efficiently coordinated with the aim that associated traffic movement will most likely occur between 7am to 7pm Monday to Friday and 7am to 4pm on Saturdays.

11.7.2.3.2 Air-freight haulage from MPC

It is likely that the fortnightly charter flights will carry a small quantity of air-freight (Section 5.11.3.1.1) that would likely be transported at the same time as exchanging crew within a Light Goods Vehicle (LGV) and would not add significantly to vehicle transits.

11.7.2.3.3 Freight haulage from other sea ports

Whilst the base-case assumes that sea-freight will be supplied through *ad hoc* freighter vessels to the TDF, it is possible that small levels of freight may be received, on an occasional basis, at Mare Harbour on the MoD charter service or *via* the regular SAAS vessel. If this were to occur this would also require transfer to Stanley supply bases. At present this is not considered to be in significant quantity or frequency and is not considered further as the current base-case or within the assessment. If at some point greater cargos were to be transported by this route and / or reception facilities at Mare Harbour are required, the implications with respect to planning consents and environmental assessment including transport impacts would be discussed with FIG.

11.7.2.4 Waste haulage

As described in Section 10.10, it is anticipated that the Falkland Island municipal waste facilities will become available in time for the project (currently anticipated to be commissioned by the end of 2026 (C. Summers, *pers. comm.*). The current proposed site for the FIG Waste Reception facility is at Megabid on the Airport / Bypass Road. It is anticipated that these new facilities will be used during the Sea Lion Development and haulage of waste would be required from the TDF / laydown yards to the location of the new waste facilities and is likely to require transit along the Airport / Bypass Road.

Where use of the municipal facility is not possible, or if the FIG facility is not available in time for operations, waste may be incinerated at the supply base (Section 5.11.4.4) or may be shipped out from the TDF to another country (Section 10.10). The latter events would not significantly contribute to on-island road use except for the short distance from the yard to the TDF.

An assessment of waste arisings (Section 10.10) undertaken for the Development predicts that onshore wastes being handled will peak at 241 tonnes per month during Stage 2a of the project, dropping to 59 tonnes per month in Stage 3 during steady state production. Assuming that the largest allowable HGV (38.5 tonnes gross vehicle weight) would be used, and that each could carry a payload of 28 tonnes *and* that waste will be stored and manipulated to minimise the number of trips, this would give potentially nine vehicle movements per month at peak falling to around two movements per month during production. However, since their destination is uncertain and there may be multiple endpoints if waste outlets are located in different sites (e.g., landfill, incineration, waste to energy and water treatment), an overall estimate would be of 3-4 movements every working week at peak falling to one movement every week during steady production.

11.7.2.5 On-call personnel and domestic supplies

On-call technicians and operatives; senior management; and permanent personnel based in rental accommodation, will require access to self-drive vehicles for flexibility for out-of-hour call outs and

requirements outside the shuttle-bus transit routes or scheduled times. An allowance for 30 vehicles making four daily return journeys along the Airport Road is included within the assessment. It is expected that some level of car-pooling between staff, and rotation of vehicles between on-call staff, will be possible, which may reduce overall vehicle number requirements. This component of transport will also have impacts within Stanley for meetings, office logistics, shopping and access to rental accommodation (depending upon where this is located).

The degree of local supply of goods and services will depend upon the level of success of the local businesses in the competitive procurement process, balanced against security of supplies for the local resident community. It is not possible to determine at this stage the degree of supply that will be sourced locally and the level which will be out-sourced and arrive in conjunction with Navitas freight supply to the TDF. Undoubtedly there will be a level of increase in local supply and economic activity serving the O&G sector including, but not limited to, supply to:

- General retail sales serving personnel in rental accommodation,
- Food and consumables to transit accommodation, and
- Fuel and consumable deliveries to heliops, yards, etc.

This will cause a resultant increase in deliveries, retail stocking and thus vehicle movements in general retail, supply and service sectors. This would predominantly be within the vicinity of Stanley but may also impact the MPC road if importation of third-party private sector goods were imported through Mare Harbour shipping links.

11.7.3 Potential receptors

The ENvironmental Impact IDentification (ENVIID) workshop was used to identify those receptors upon which the impacts of road use warranted further investigation (Chapter 9).

Receptors that may be impacted by increased road use during the Phase 1 & 2 Development include:

- Human Population (Section 7.7.2),
- Tangible Property - road networks (Section 7.7.4), and
- Air quality if emissions and increased dust are close to residential areas.

Note: impacts on regional and local air quality from particulate matter suspended by the use of uncapped roads was scoped out during the ENVIID and was not considered further see Chapter 9.

11.7.4 Characterising and quantifying resource competition in road transits

When characterising and quantifying the impact of road use on road infrastructure and other users, it is necessary to identify the key roads likely to be used and to consider the expected usage rates in comparison to the existing baseline usage.

Therefore, the following section describes:

- Location and types of road,
- Existing road usage,
- Nature of the impact in relation to the human population and tangible property,
- Base-case mitigations, and
- Estimation of road usage during the Phase 1 & 2 Development.

11.7.4.1 Location and types of road

Detail on the existing road infrastructure is provided in Section 7.7.4.2 which details the system of road classification on the basis of its strategic importance. The main roads which will be used during the proposed Phase 1 & 2 development will be:

- The capped MPC Road between MPC and Stanley,
- The capped Airport / Bypass Road in Stanley which runs between the MPC road and FIGAS,
- The uncapped Boxer Bridge Road and Coastel Road which runs between Boxer Bridge, the Airport Road and the FIPASS turn off, and
- The capped Stanley roads.

The main arterial road network of the Falkland Islands extends to approximately 862 km in total, with 489 km on East Falkland and 373 km on West Falkland. Roads outside of Stanley, and those around the MPC, are predominantly uncapped and of variable surface quality.

In 2012 FIG introduced a Highways Asset Management Plan which categorises the Islands road network on the basis of each roads' strategic importance, and prioritises maintenance in respect of this (Table 11.31).

At present the expectation is that all activity related to the Phase 1 & 2 Development will occur within the vicinity of Stanley and between the infrastructure centres of Stanley and MPC. As such, almost all transit and transportation will occur on Class A roads (Table 11.31) which are prioritised for maintenance as a primary national asset. Use of the road network is therefore limited to roads that are already subject to on-going routine maintenance and prioritised work schedules such that duration of any degradation that may cause nuisance is minimised through remedial works as soon as weather and plant permit.

The main road usage requirements are shown diagrammatically in Figure 11-8.

Note: during the initial construction period (pre-drilling), there will be construction work at the Heliport while the Heliport is built meaning potentially some HGVs between Stanley and the Heliport, but this will be short-term in nature.

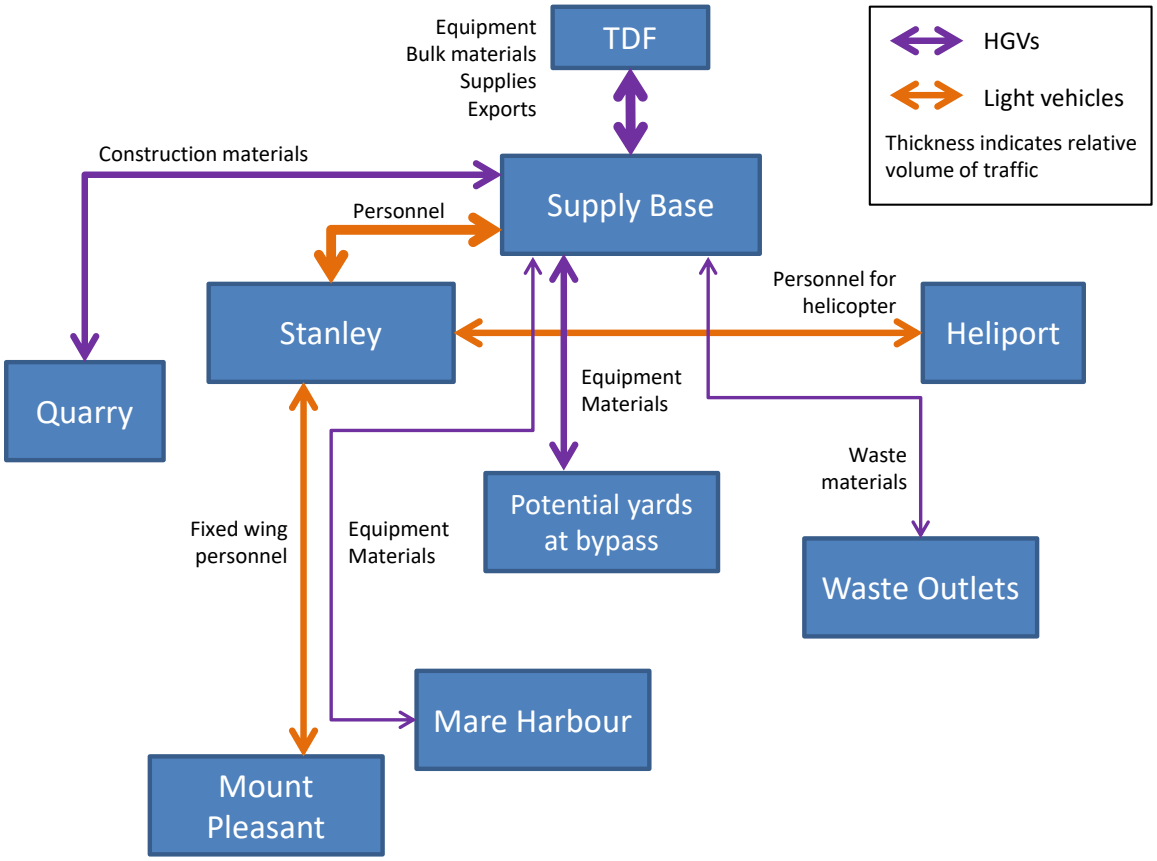


Figure 11-8: Key elements of road transport required

Table 11.31: Highways Asset Management Plan Road Classification ***(Source: FIG, 2012a; Executive Council Paper 39/12)***

Road Classification	Description	Example
Class A Road	Primary link road between major national assets. Greatest traffic use by volume and weight.	Stanley to MPC MPC to New Haven ferry terminal Port Howard ferry terminal to Fox Bay
Class B Road	Link road between all Class A and Class C roads Major tourist destinations Major supply route to abattoir	North Camp road Goose green to North Arm
Class C Road	All other roads	Link roads to individual farms or a series of 2 – 3 farms on a single branch road

11.7.4.2 Existing road usage

The FIG PWD Highways Section has previously deployed pressure activated vehicle loggers at a number of sites to determine the number of vehicle passes as well as the class, weight and speed of the vehicles.

Average daily usage on the MPC road over the three sampled periods (two locations) averaged 483 vehicle passes / day (Table 11.32). As shown in Table 11.32, the majority of these vehicles were cars, 4x4, minibuses or Light Goods Vehicles (LGV) with these groups accounting for 87.2 % of transit in 2015.

Daily usage on the Airport Road (measured between the Chandlery and Stanley Growers Market Garden), over a single sampled period, averaged at 1,755 vehicle passes / day (Table 11.32). Again, the majority of vehicles were cars, 4x4s, minibuses or LGVs with these groups accounting for 92.2 % of transit in 2015 (Table 11.33).

MPC Road usage has generally increased significantly year on year, however exact recent trends are not certain and road usage may have stabilised (Table 11.34). There has not been a full usage survey since 2015 (C. Summers, *pers. comm.*, 2023) although the population in Stanley rose by 3 % from 2016 – 2021 suggesting there has likely been an increase in traffic around the town to correlate with the increase in population (FIG, 2023l).

Table 11.32: Vehicle passes recorded by vehicle loggers

Sample Location	Providing access to	Sampling Start Date	Sampling End Date	Sampling Period (Days)	Total Vehicle Passes	Daily Average
MPC Road Sapper Hill[1]	Quarry, abattoir, wind farm, Camp Road network (north and south) and onwards to MPC and New Haven ferry terminal	19/12/2011	05/02/2012	48	30,799	642
MPC Road Sapper Hill[2]	Quarry, abattoir, wind farm, Camp Road network (north and south) and onwards to MPC and New Haven ferry terminal	29/10/2014	21/01/2015	84	32,414	386
MPC Road by Mt Kent Fuel Tanks[2]	On the MPC Road at the junction with the East Falkland North Camp road network	02/03/2015	05/04/2015	34	14,317	421
Airport Road (Chandlery / Market Garden)[2]	Access between Stanley and FIPASS, Boxer Bridge Road, TDF, laydown yards, PWD Megabid municipal supplies, Stanley Airport and heliops and recreational access to Cape Pembroke and Surf Bay.	02/03/2015	08/04/2015	37	64,938	1,755

[1] Invenio (2013) Safety Review & Statistical Analysis Stanley-Darwin (MPC) Road. Data derived from FIG.
[2] Data supplied by C. Summers October 2016.

Table 11.33: Vehicle categories logged

2011/12		2015/16		
Vehicle category	MPC Road Sappers Hill (2011/12)[1] (% passes)	Vehicle category	MPC Road Sappers Hill (2014/15)[2] (% passes)	Airport Road (2015)[2] (% passes)
1. Very Short Bicycle or Motorcycle	0.8	1 (C)	0.1	0.1
2. Short Sedan, 4WD, Light Van	83.2	2 (O)	0.2	0.3
3. Short 4x4 Towing Trailer	1.8	3 (Car)	19.2	21.6
4. Two Axle Truck or Bus	8.8	4 (LGV)	68.0	70.6
5. Three Axle Truck or Bus	2.8	5 (R2)	4.3	4.0
6. Four Axle Truck	1.1	6 (R3)	3.5	1.0
7. Three Axle Articulated Vehicle	0.1	7 (R4)	0.7	0.1
8. Four Axle Articulated Vehicle	0.5	8 (A3)	2.4	0.7
9. Five Axle Articulated Vehicle or Rigid and Trailer	0.5	9 (A4)	0	0
10. Six Axle Articulated Vehicle	0.3	10 (A5+)	1.2	0.4
11. B Double or Heavy Truck and Trailer	0.0	11 (Bus)	0.4	0.2
12. Double or Triple Road Train	0.0	12	n/a	1.0

[1] Invenio (2013) Safety Review & Statistical Analysis Stanley-Darwin (MPC) Road. Data derived from FIG.
[2] Data supplied by C. Summers October 2016.

Table 11.34: MPC Road known historical road use *(Source: Invenio, 2013)*

Year	Average daily number of journeys	Increase since previous measure	% increase since previous measure	Average rise year on year
1988[1]	90	n/a	n/a	n/a
1998[1]	125	35	39	3.8
2010[1]	289	164	131	10.9
2013[1]	550	261	91	30.2
2015[2]	*c.* 386 - 421	not calculated	not calculated	not calculated

[1] Invenio (2013) Safety Review & Statistical Analysis Stanley-Darwin (MPC) Road. Data derived from FIG.
[2] Data supplied by C. Summers October 2016.

11.7.4.3 Nature of the impacts to human population and tangible property

The nature of the potential impacts is as follows:

- Degradation in air quality due to diesel particulates,
- Potential nuisance impacts to the human population:
  - Nuisance to other road users from, for example, increased 'congestion', reduced ease of use if surface degraded or more time is spent on maintaining the roads, and
  - Disturbance caused by noise if there is increased use of HGVs close to residential areas.
- Potential impacts to the Tangible property:
  - Degradation of cappings / road surface of road networks, and
  - Wear and tear on other users' vehicles if road surfaces are degraded.

The extent of the above impacts will vary according to the location and type of road.

In general, axle weight and frequency of loading are the most important considerations in determining the stress and degradation placed on roads from vehicle traffic. Axle weights can be expressed as a load equivalency factor to determine pavement wear which typically increases exponentially with axle weight. Other factors such as the quality of suspension are also important, and many such parameters are governed by controls on permissible vehicle types (e.g., following Highways (Weight Limits) Ordinance 2004 and the UK 'Construction and Use' Regulations) and mandatory inspections and testing. Research typically finds a 'fourth power law' relationship between axle load and pavement wear (e.g., NVF committee Vehicles and Transports, 2008), which translates, for example into pavement wear being around three times worse for a 38 tonne HGV compared with an 18 tonne two-axle truck or an 18 tonne large bus, with cars being negligible. Pavement wear is therefore significantly driven by movements of HGVs with axle loads up to around 10 tonnes; to a lesser extent by medium sized vehicles such as buses or smaller lorries; and virtually no impact from cars or minibuses.

11.7.4.3.1 MPC and camp roads

With regard to impacts on the human population, dust, noise, air quality and nuisance are not considered significant due to the remoteness of the road from any significant concentration of human habitation / residential area. The length of the road in comparison to the number of daily vehicle transits also signifies that vehicle density is low and that congestion, such as to increase journey time, should not be an issue.

With regard to impacts on the road as tangible property, the MPC and wider camp road network was initially designed as 'all-weather track' for predominantly low axle weight 4x4 light passenger vehicles. Degradation of the road surface (both capped and uncapped sections) may occur, especially in winter when weather conditions and the inability to conduct routine maintenance programmes combine to reduce surface quality. The existing use of HGV's, for example to transport civilian freight from Mare Harbour to Stanley, livestock to the abattoir and camp fuel supplies, has been noted as contributing to deterioration of road condition. This is recognised as an on-going issue (FIG, 2012a) even in the absence of O&G development. The MPC road is ranked as a Category A road with the highest priority for on-going maintenance and has recently (March 2024) been fully capped from MPC to Stanley (FIG, 2012a).

11.7.4.3.2 Airport Road and Bypass

With regard to impacts, the proximity to residential areas is such that there may be some concern over air quality and noise, especially from HGVs, affecting neighbouring residents, although the road is to a large extent bunded where residential properties are adjacent. Bunding assists in reducing visual and noise intrusion. The impact of noise from the Phase 1 & 2 Development on residents is more specifically assessed in Section 11.9. The Airport Road and Bypass Roads are generally free-flowing in traffic and would accommodate increased traffic levels without detrimental levels of congestion being noticeable.

With regard to impacts on tangible property, the Airport Road and Bypass is fully capped and is thus more resistant to degradation. As detailed previously the significance of wear and tear to the surface will be proportional to the forecast increased usage in relation to current baseline usage. Capping also removes any consideration of dust impacts from passing vehicles to air-quality.

11.7.4.3.3 Coastel Road and Boxer Bridge Road

With regard to impacts to the human population, these roads are located in a light industrial area, without residential development and prevailing westerly winds are such that dust, suspension of particulate matter and noise from transportation are not likely to be significant.

In general, the Coastel Road and Boxer Bridge Road in the vicinity of the Gordon Lines area are not used as primary through-transit routes to other areas. Vehicles would generally bypass the area along

the Airport Road. Alternative diversion is possible *via* the Airport Road on capped surfaces around the whole site and the Coastel Road and Boxer Bridge Road need only be used if accessing the TDF. As such it is not a transit route that by necessity need impinge on other domestic users if congestion or degradation were to occur.

The TDF is located at the approximate mid-point of the Coastel Road. Light industrial and warehouse sites to the west of the TDF (including RSK's Construction supply base, various fishing companies and agencies linked to FIPASS and general light industry / storage) would generally access third-party sites from the west (FIPASS Road) and depart to the west, thus transport servicing these areas would not reach or transit past the TDF shore frontage. There are third-party sites towards the east corner of Boxer Bridge Road and Coastel Road, including RBC, Polar Seafish and Fortuna.

Sites to the east of the TDF or for access to the Canache, Boxer Bridge and Cape Pembroke would generally enter from the Airport Road to the east. Therefore, the middle section of the Coastel Road at the TDF access point is only relatively lightly used.

With regard to impacts on tangible property, these roads are uncapped and there are currently no plans for the surfaces to be capped. Currently no special authorisation is needed for vehicles of up to 38.5 mt gross load to use these roads. Individual axle weight is also an important consideration, and in the UK for example special authorisation is needed for axle loads greater than 10 tonnes for a non-driving axle, and 11.5 tonnes for a driving axle. Some upgrade of the road was conducted prior to the 2015 exploration drilling campaign to ensure the load capacity of the central section and to minimise spreading of road material which can create 'soft' edges. Degradation of the road surface did occur during the exploration activity and it is likely that Oil and Gas (O&G) movements comprised the majority of heavy transits and increased the rate of degradation. Salting of the clay road surfaces to maintain safety of work in winter may also have contributed to some breakdown of surface.

During Stages 1, 2a & 2b of the proposed Phase 1 & 2 Development, when transfer of drilling materials in particular will entail HGV use, it is anticipated that movements may have a detrimental impact upon the road surface above the wear and tear of existing users. However, the overall impact is likely to be low due to the:

- Relatively low existing use of this section by other road users and public,
- Location of the road within a generally light industrial area,
- Lack of necessity for other adjacent users to transit the area to the east of the warehousing sites which supply FIPASS,
- Presence of alternative routes to by-pass the area *via* Airport Road for other users, and
- Relatively short road length and its proximity to PWD plant storage and quarry aggregates making it easily accessible which minimises logistics if routine repair is required.

11.7.4.3.4 Stanley roads

As described in Section 11.7.2, general personnel working on a rotation basis will not normally have access to individual vehicles for personal use. The use of Stanley roads will therefore be limited to on-call technicians, managers and permanent onshore personnel. Transport from personnel accommodation and to central sites in Stanley will be conducted by shuttle bus or taxi services and are not expected to significantly increase congestion.

Whilst no site has yet been determined for the accommodation unit, it is expected that it will be built in a location with easy access to the Airport / Bypass Road. Therefore, daily traffic can be diverted around Stanley and should not cause additional through-traffic along the east-west routes within Stanley that may be congested at peak times relating to the start and end of the working day and at lunchtime. However, it is believed that parking, with the resultant impact on traffic flow, is perhaps a

greater issue in Stanley than the actual increase in vehicular traffic. As is detailed within the accommodation chapter (Section 11.3) some or all accommodation for the additional *c.* 26 permanent staff who will live in Stanley may be achieved by new build, and any new build will come with the provision of off-street parking in line with planning regulations. The aim of this section is to consider tangible property i.e., wear and tear on roads, and parking is considered a socio-economic impact and so is not considered further here.

11.7.4.4 Estimated Phase 1 & 2 Development road usage

11.7.4.4.1 MPC Road and air-link personnel movements

The capped MPC Road will be used for:

- Fortnightly crew exchange,
- Miscellaneous passenger exchange outside of crew rotations,
- Air-freight fortnightly, and
- Occasional sea-freight if alternative freight or coaster is utilised (not current base-case).

Crew transfer logistics will be finalised through tender processes accompanied by a risk assessment of options and therefore, the exact specification of vehicles and seat capacities cannot be confirmed at this time. The assessment is based on minibuses of 15 seat capacity that were used during the 2015 exploration campaign. However, with differing personnel numbers it may be that larger capacity options may be utilised and be more efficient in both fuel and vehicle passes for people moved. This would likely reduce impact.

While the larger buses would be heavier and have a greater impact on road surfaces they would require fewer trips and perhaps be most appropriate to passenger exchange when larger numbers must be moved to meet a single fixed check-in time. In contrast, a minibus would require a greater number of repeat trips contributing to congestion. Therefore, to assess the worst-case, use of a 15 seat minibus has been assumed in this EIA. Further, rotation crew moving offshore are restricted to 15 kg baggage allowance and therefore additional luggage capacity is not a significant concern, however an additional allowance of one luggage van per 45 personnel has been allowed for.

As is shown in Table 11.35, a maximum 0.65 % increase in daily MPC road usage would occur during the Phase 1 & 2 Development. In Stage 3, once personnel requirements decline, passenger movements would account for only 0.35 % of MPC road usage.

Even taking into account the inevitable uncertainties in estimates and timings of trips, these levels are not considered significant to road maintenance schedules or wear and tear of road surfaces and are significantly below past historical year on year increases in road usage observed in the Falkland Islands (Section 11.7.2.3.2, Table 11.34 above). Even recognising that use is a fortnightly pulse of vehicles to meet the air-charter, it is unlikely that congestion would occur given that the legal speed limit is set at 40 mph and that minibuses would not be impeding other road users who should also be travelling at below that speed.

Even with nominal additional allowance for air-freight or sea-freight transfer, the usage of the MPC road is not considered significant.

Table 11.35: Vehicle transit requirements based upon air-link capacity requirements during the three stages of the Phase 1 & 2 Development

Statistic	Stage 1	Stage 2a & 2b	Stage 3
Maximum air-link capacity requirement for crew exchange	110	110	60 / fortnight
Minibus requirement based on 15 seat capacity	8	8	4
Luggage van requirement based on 45 personnel	3	3	2
Total number of vehicles	11	11	6
Number of bus trips (based on two return trips (four passes) required per exchange for arrival and departure)	44	44	24
Number of days between air-links (fortnightly)	14	14	14
Equivalent average daily usage transits	3	3	2
Increase in MPC road usage based on current average usage of *c.* 483 vehicles/day	0.65 %	0.65 %	0.35 %

11.7.4.4.2 Airport Road usage for transport from accommodation to workplace

The capped Airport Road & Bypass Road in Stanley for:

- Crew exchange fortnightly,
- Shuttle-bus for rotational onshore personnel and heliport,
- Miscellaneous local supply deliveries, and
- Waste disposal to municipal waste processing facility.

Transportation needs are assumed based on a 12-hour shift pattern and 12-hour working day. This would necessitate all personnel being transported to work at the commencement of the day and returning at the end. At start and termination all movement would be in one direction with minibuses at capacity delivering personnel and returning empty for the next load.

A 24/7 working programme is planned. On the basis of a 12-hour dual-shift pattern, within a given maximum personnel, this would actually decrease (by approximately half) the transportation needs at commencement and end of shifts. In this scenario, half the personnel would be commencing as half the personnel were finishing and minibuses would be full in both directions.

Transport provision will be tendered and exact vehicle capacities and schedules are currently unknown. Based on the transportation used during the 2015 exploration drilling campaign, a worst and extremely precautionary case can be assumed:

- Move all personnel at 06:00 to start shift,
- Schedule of circular shuttle-bus at 30 minute departures 06:30 – 11:30 for any personnel needing to return to accommodation / Stanley,
- Move all personnel to messing facility at 12:00 (start lunch),
- Move all personnel to site at 13:00 (end lunch),
- Schedule of circular shuttle-bus at 30 minute departures 13:30 – 17:30 for any personnel needing to return to accommodation / Stanley,
- Move all personnel at 18:00 (end shift), and
- All long-term onshore personnel have individual vehicles undertaking 4 return trips / day.

Second 12 hour shift vehicle movements on the same basis.

Using these assumptions transportation needs are detailed in Table 11.36.

Requirements would be highest during Stage 1, 2a & 2b with a potential for a 17 % increase in vehicle transit by car and LGV minibus. The main increase results from car transit by permanent personnel positions rather than the shuttlebus service. In Stage 3, use would decline as the shuttle service would cease and the increased usage of 11 % would be wholly due to permanent staff vehicles.

Although the vehicle use would incorporate only car and LGV usage of low axle weight, such increases may have long-term un-quantifiable significance to road capping wear and tear. However, this wear and tear is not considered to be significant to maintenance schedules. Impact upon other road users is thought to be low.

In reality transportation needs would likely be less and not all permanent personnel are likely to have permanent access to a vehicle of single person use.

Table 11.36: Transportation requirements during the Phase 1 & 2 Development

Description		Stage 1	Stage 2a & 2b	Stage 3
Permanent / management personnel with access to self-drive vehicles				
Number of personnel	It is unlikely that all would have access to vehicles and car-pooling and vehicle rotation to the on-call person would occur. The estimate of 30 associated vehicles is conservative	26	24	24
Daily return trips	One return trip is equivalent to two vehicle passes per trip	4	4	4
Number of vehicle passes per day		**208**	**208**	**192**
Rotational onshore personnel shuttle bus requirements				
Maximum number of personnel	The maximum number of personnel would be split between 2 shifts for 24 hour working	63	63	0
06:00 return trips	Shift change over. One shift arriving and one shift returning on same return trip. Based on 15 seat minibus to move all personnel.	4	4	Not required as capacity within self-drive vehicles
06:30 – 11:30 shuttle bus departures at 30-minute intervals	30-minute one-way departures 06:30: Accom. – Yards 07:00: Yards – Accom. 07:30: Accom. – Yards 08:00: Yards – Accom., etc.	5.5	5.5	-
12:00 return trips	Based on 15 seat minibus to move all on shift day personnel for mid-shift meal.	4	4	-
13:00 return trips	Based on 15 seat minibus to move all on shift day personnel for mid-shift meal.	4	4	-
13:30 – 17:30 shuttle bus departures at 30-minute intervals	30-minute one-way departures 13:30: Yards – Accom. 14:00: Accom. – Yards 14:30: Yards – Accom. 15:00: Accom. – Yards, etc.	4.5	4.5	Not required as capacity within self-drive vehicles
18:00 return trips	Shift change over. One shift arriving and one shift returning on same return trip. Based on 15 seat minibus to move all personnel.	4	4	-
18:30 – 23:30 shuttle bus	One-way shuttle bus departures at 30-minute intervals as before	5.5	5.5	-
00:00 return trips	Based on 15 seat minibus to move all on shift night personnel for mid-shift meal.	4	4	-

Description		Stage 1	Stage 2a & 2b	Stage 3
01:00 return trips	Based on 15 seat minibus to move all on shift night personnel for mid-shift meal	4	4	-
01:30 – 05:30	One-way shuttle bus departures at 30-minute intervals as before	4.5	4.5	-
Total return trips per day		**47**	**74**	**0**
Number vehicle passes per day		**93.5**	**93.5**	**0**
Total figures				
Total daily vehicle passes	**Individual vehicles and shuttle buses**	**296**	**296**	**192**
Increase to current baseline vehicle passes	**Based upon current baseline level of 1,755 vehicle passes**	**17 %**	**17 %**	**11 %**

11.7.4.4.3 Coastel Road and Boxer Bridge Road

The uncapped Boxer Bridge Road and Coastel Road will be used for:

- Access to laydown yards and TDF,
- Transit loads between laydown yards and TDF, and
- Internal movements within yards (excluded as they do not utilise public roads).

The main bulk of all materials movement and HGV usage will be confined to the short 160 – 870 m transit between TDF access and the potential location of entrances to the lay-down yards.

The main movements of bulk materials and equipment occurs during drilling, i.e., Stages 1, 2a & 2b and is a relatively steady level of activity. The majority of HGV traffic is between the TDF and the supply base, and peak levels are related to the capacity of incoming vessels and rate of offloading. It is anticipated that these parameters will be similar to those experienced in the drilling campaign for exploration wells. Basing traffic numbers on those levels, it is anticipated that 20 two-way HGV movements could be expected over a four to six hour period related to a single vessel, before the next spell of activity. This equates to a maximum rate of 5 two-way movements per hour.

11.7.4.4.4 Central Stanley

The capped Stanley roads for:

- Potential shuttle bus from accommodation to central Stanley, and
- Limited number of self-drive vehicles for technicians, managers and office support.

As stated above, it is expected that the location of the accommodation for rotational onshore personnel during Stages 1, 2a & 2b of the Development will be located with easy access to the Bypass / Airport Road. This will remove transit and through traffic from central Stanley and prevent any increase in congestion at peak times of 08:00, lunchtime and 16:30 relating to the domestic working day.

During the 2015 exploration campaign, four return shuttle buses took personnel to Stanley during the lunchtime period. In addition, there was an additional allowance for minibus runs to central Stanley and the leisure centre in the early evening (*c.* 18:00 hrs) after the end of the working day, although the utilisation of this on-call service in comparisons to taxi use is not available.

The greatest influence on traffic within central Stanley will be the location of the rental accommodation used for the 26 permanent staff, which may increase through-traffic within central Stanley or further limit parking provision. However, any newer accommodation, or new-build accommodation is likely to have two off-street parking spaces (as required by planning guidelines), so that Sea Lion project use of such properties would not additionally limit available parking provision. At

the time of writing, the location of such accommodation is unknown, such that it is not possible to quantify the impacts of associated vehicle use.

11.7.4.5 Base-case mitigations

In addition to adherence to legal speed and vehicle weight limits (Section 11.7.1.1), a number of mitigations will be put in place to minimise impacts to the road surface from the Phase 1 & 2 Development. These are listed in Table 11.37.

Table 11.37: Base-case mitigations which will serve to minimise impacts from road use

Item / Vehicle	Location	Background and description
Crew and personnel transfers		
Minibus / coach	MPC Road and Airport Road	The most efficient transport system will be assessed through tender and subject to a risk assessment, and The transport system that achieves the best compromise between number of transit (seating capacity), axle weight (wear and tear) and safety will be selected. This is currently thought to be a mid-sized minibus or coach that would maintain axle weight within an LGV category.
Onshore rotation personnel		
Shuttlebus	Bypass & Airport Roads	No sole-use vehicles provided except in case of on-call workers or senior employees, Transfers made by scheduled shuttle-bus service to increase efficiency and minimise transits, and Accommodation is expected to be located with easy access to Bypass and Airport Roads to remove any through traffic and transit from central Stanley.
Permanent onshore personnel		
Individual Vehicles	Bypass and Airport Roads Central Stanley	HSE driving policy and risk assessment that limits vehicle trips, especially out of town and on gravel surfaces, to absolute minimum, All drivers will undergo local training on driving techniques and driving etiquette to minimise impacts, Vehicles proportional to need, car-pooling will be applied where appropriate, and Location of private rental accommodation is not yet confirmed but off-street parking will be a preference.
TDF and lay-down yards haulage		
HGV, Haulage and transfer of materials	Boxer Bridge Road & Coastel Road	The use of logistics vessels in Berkeley Sound will minimise heavy load items being brought ashore, Appropriate de-icing chemicals or grit administered by FIG – Navitas will work in liaison with FIG in respect of routes and timing of vehicle movements, Driver training and vehicle maintenance (minimise breaking, wash-boarding, etc.), and Escort vehicle or road side safety flashing lights when appropriate to warn of abnormal load movements.

11.7.5 Industry-standard mitigation

Vehicles used will conform to vehicle design regulations including the UK Road Vehicles (Construction and Use) Regulations 1986, with the exception of abnormal load trailers, which will be specifically designed for the load and road structures.

The movement of abnormal loads will comply with the Code of Practice Lighting and Marking for Abnormal Load Self escorting vehicles incorporating Operating guidance (Highways England, 2016) or similar requirements agreed with the FIG PWD Highways Section.

As per during the exploration campaign, Navitas will implement the following industry-standard mitigation measures:

- Specific applications for abnormal road movements, and
- HSE driving policy, risk assessment and local training.

11.7.6 Impact assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities.

A summary of the impact and risk assessment outcomes for this Development is tabulated in Section 11.7.12, which shows the worst-case impact / risk for each activity and receptor and details are provided below.

11.7.6.1 Degradation in air quality

As stated above, the impacts of noise on the human population are assessed in Section 11.9 and therefore this section assesses the impact of a degradation in air quality from diesel particulates due to increased traffic.

Most traffic associated with the project will be concentrated between the TDF and supply base and the accommodation, with the most likely route being the Airport / Bypass Road. This is noted as currently the most frequently used road in and around Stanley by FIG PWD Highways Section and is in close proximity to residential areas (Section 7.7.2). However, air quality from road use has not been raised as a concern by local stakeholders (Chapter 6). While roads and air quality were not raised specifically, it can be assumed that degradation in air quality for residents may be unacceptable to the majority of stakeholders such that, to take a precautionary approach, the sensitivity of the receptors (Human Population) is considered to be '**Moderate**'.

During the Phase 1 & 2 Development, the Airport Road will be used for the transportation of onshore personnel from accommodation to the supply base, TDF and the heli-ops at Stanley airport. As shown in Section 11.7.4.4.2, this use could result in an increase in traffic of up to 17 % in Stage 1, 2a & 2b, and 11 % in Stage 3. This could result in slight degradation of air quality. Therefore, the severity of effect of congestion to the Human Population is considered to be '**Slight**'.

The overall significance of the impact of degradation of air quality on the human population is therefore considered to be '**Low (3)**'.

11.7.6.2 Congestion from road use

As stated above, the impacts of noise on the human population are assessed in Section 11.9 and therefore this section assesses the impacts of congestion and associated nuisance.

Most Project HGV traffic will be concentrated between the TDF and onshore supply base and while this will be frequent at times, it has relatively low public use and such use is consistent with the designation of the area and the design of road junctions.

According to the data gathered by the FIG PWD Highways Section, the most frequently used road in and around Stanley is the Airport / Bypass Road. This road is used by residents for access to the airport and areas to the east of Stanley (Section 7.7.4.2) and is in close proximity to residential areas (Section 7.7.2). Further, the carrying capacity of existing infrastructure was raised as a concern by stakeholders on numerous occasions (Chapter 6). While roads were not raised specifically, it can be assumed that

congestion on the Airport Road and / or vehicles parked in Stanley may be unacceptable to the majority of stakeholders such that, to take a precautionary approach, the sensitivity of the receptors (Human Population) is considered to be '**Moderate**'.

During the Phase 1 & 2 Development, the Airport Road will be used for the transportation of onshore personnel from accommodation to the supply base, TDF and the heli-ops at Stanley airport. As shown in Section 11.7.4.4.2, this use could result in an increase in traffic of up to 17 % in Stage 1, 2a & 2b, and 11 % in Stage 3. This could result in some degree of congestion at peak times which may cause some inconvenience. Therefore, the severity of effect of congestion to the Human Population is considered to be '**Minor**'.

The overall significance of the impact of road use on the human population is therefore assessed as '**Moderate (6)**'.

11.7.6.3 Road degradation from increased vehicle use

As stated above, the impacts of particulate matter from uncapped road use on air quality were scoped out at the ENVIID (Chapter 9) and therefore this section assesses the impacts of degradation of road surfaces i.e., on the tangible property itself.

With regard to surface degradation, the most sensitive roads are those which are uncapped (Section 7.7.4.2). The Coastel and Boxer Bridge Roads are uncapped and will be used during the Phase 1 & 2 Development. The greatest impact on road usage and road surfaces is considered to be in the vicinity of the TDF and laydown yards located in the Boxer Bridge and Coastel Road area. The largest proportion of all supply materials, chemicals and bulks will be handled and / or transferred between these two sites. Nonetheless, given that use of the roads is sustainable and the stretch of road is short and not used by many others, the sensitivity of the receptor (Tangible Property) is considered to be '**Low**'.

Whilst impacts will occur to the road surface in this area, the length of roadway that will be impacted is short at less than a kilometre in total length from Airport Road to the TDF. Given expected use during the Phase 1 & 2 Development, this length of road may require more frequent maintenance than at present. However due to the short length and accessible location it is not considered that this would place critical restrictions on road maintenance schedules. The area is not a major transit road required for access to onward sites and thus knock-on impacts and inconvenience to other users should not be restrictive. Therefore, the severity of effect of road use to the Tangible Property is considered to be '**Minor**'.

The overall significance of the impact of road use on Tangible Property is therefore considered to be '**Low (4)**', and consequently further additional mitigations are not considered necessary.

11.7.7 Project-specific mitigation measures

A TDF / supply base traffic management plan will be put in place for operations, as has been done for exploration well activities, to minimise the impacts and risks from operational road use in this area. This will highlight operating hours, signage, allowable routes, warning devices, clothing and pedestrian precautions.

Accommodation for permanent onshore personnel within Stanley with off-street parking will be a preference.

These mitigation measures are considered sufficient to reduce impacts to ALARP and additional mitigation measures are not considered further at this point.

11.7.8 Residual impacts and risks

Residual impacts remain the same as considered for the initial assessment such the significance of the residual impacts of road use is considered to be **Low (3)** for degradation in air quality, **Moderate (6)** for nuisance and **Low (4)** for degradation of the road surface.

11.7.9 Cumulative impact

Cumulative impacts of increased traffic, or 'increased concentration' (Section 8.9.1) is most likely to occur within Stanley. Central Stanley is limited in available parking and this can, at times, cause limitations on cars travelling through Stanley. However, as described above, any new developments built for rental to permanent personnel must follow planning regulations and provide off-street parking which will mitigate against cumulative impacts.

11.7.10 Confidence

The transport and laydown yard tenders have yet to be defined and released. Alternative transport and haulage tenders will be assessed against the Supply Base Tender's Scope of Work and will require demonstration of safety risk assessment. The exact specification and capacities of vehicles is therefore not defined at this stage. However similar systems were in place during exploration activity without major incident and can be used as a template on which to base the assessment.

The level of confidence in the impact and risk predictions and efficacy of mitigation is therefore '**Probable**'.

11.7.10.1 Monitoring required

Use of roads will be monitored and will be included within the EMMP for on-going assessment to identify any emerging issues at an early stage.

11.7.11 Offsetting

For significant residual and impact and risks ('Moderate' or above), offsetting *via* a Carbon and Biodiversity Offsetting Fund is proposed, see Section 8.11 for further details.

11.7.12 Findings summary

Table 11.38: Summary of the impact assessment for use of road network during the Sea Lion Phase 1 & 2 Development

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity[1]	Severity[1]	Likelihood[1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Use of existing road network	Increased number of vehicles and use of infrastructure	Degradation in air quality	Planned	1, 2a, 2b & 3	Moderate	Slight	n/a	**Low (3)**	**Low (3)**	**Probable**	**Industry-standard:** Adherence to vehicle and road statutory requirements. Specific applications for abnormal road movements including signage and warning devices. HSE driving policy, risk assessment and local training. All non-critical activities coordinated to avoid peak periods. **Project-specific:** Traffic Management Plan. Accommodation with off-street parking will be a preference.
		Potential for nuisance to human population e.g., congestion	Planned	1, 2a, 2b & 3	Moderate	Minor	n/a	**Moderate (6)**	**Moderate (6)**	**Probable**	
		Degradation of road surfaces			Low	Minor	n/a	**Low (4)**	**Low (4)**		

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

11.8 Disturbance to human population - Light

Table of Contents

11.8.1 Introduction....1086
11.8.1.1 Relevant legislation....1086
11.8.1.1.1 The Nuisance Provisions: Disturbance from light....1086
11.8.2 Sources of light disturbance to Falkland Island residents....1086
11.8.3 Potential receptors....1087
11.8.4 Characterising and quantifying the impact of light disturbance....1087
11.8.4.1 Nature of the impact....1087
11.8.4.1.1 Opinion of stakeholders....1088
11.8.4.2 Quantification of the disturbance....1088
11.8.4.2.1 Light in Stanley....1088
11.8.4.2.1.1 Source and duration of light exposure....1088
11.8.4.2.1.2 Location of light sources....1088
11.8.4.2.1.3 Number of lights....1089
11.8.4.2.1.4 Orientation of lights....1089
11.8.4.2.2 Light in Berkeley Sound....1089
11.8.4.2.2.1 Sources and duration of light exposure....1089
11.8.4.2.2.2 Location of light sources....1090
11.8.4.2.2.3 Number of lights....1090
11.8.4.2.2.4 Orientation of lights....1090
11.8.5 Industry-standard mitigation....1090
11.8.6 Impact assessment....1091
11.8.6.1 Impact assessment of light in Stanley....1091
11.8.6.2 Impact assessment of light in Berkeley Sound....1091
11.8.7 Project-specific mitigation measures....1091
11.8.7.1 Light impact in Stanley....1091
11.8.7.2 Light impact in Berkeley Sound....1092
11.8.8 Residual impacts and risks....1092
11.8.8.1 Light impact in Stanley....1092
11.8.8.2 Light impact in Berkeley Sound....1092
11.8.9 Cumulative impact....1092
11.8.9.1 Stanley....1092
11.8.9.2 Berkeley Sound....1093
11.8.10 Confidence....1093
11.8.10.1 Monitoring required....1093
11.8.10.1.1 Understanding the baseline....1093
11.8.10.1.2 Understanding tolerance of local residents....1093
11.8.11 Offsetting....1094
11.8.12 Findings summary....1094

11.8.1 Introduction

The Phase 1 & 2 Development will use the supply base and Temporary Dock Facility (TDF) in Stanley. Additionally, Berkeley Sound will be used to host up to two Large Transport Vessels (LTVs) at any one time as storage and supply vessels for a total combined and non-consecutive duration of 13 months during the installation phase. All of these inshore, onshore and at-shore activities have the potential to create light pollution for the local residents. As shown in Chapter 6, lighting levels during operations were raised by stakeholders during informal scoping consultations.

This chapter specifically assesses the potential for artificial light to disturb the residents of Stanley and Berkeley Sound.

Note: Other impacts associated with the LTV storage and supply vessels, activities at the supply base and TDF are described elsewhere in this document, as described in Table 2.2.

11.8.1.1 Relevant legislation

There is currently no legislation in the Falklands relevant to light as a nuisance or disturbance.

The main piece of legislation concerning light pollution in the UK is:

- Environmental Protection Act 1990 (EPA '90), Part III: The Nuisance Provisions.

Also, while not directly related to the impact of artificial light, it is important to understand during this assessment that mitigation measures will be limited by the need to ensure the use of sufficient lighting for safety reasons. Specifically, offshore installations are required to be lit in line with the:

- International Regulations for the Prevention of Collisions at Sea (ColRegs) (Rule 22 and Annex 1).

11.8.1.1.1 The Nuisance Provisions: Disturbance from light

Under the Environmental Protection Act 1990 (EPA '90), a 'statutory nuisance' is defined based on its ability to cause disturbance. In order for an activity to cause disturbance, it must do one of the following:

- Unreasonably and substantially interfere with the use or enjoyment of a home or other premises,
- Present a long-term and sustained impact to local residents' quality of life, and / or
- Injure health or be likely to injure health.

With regard to light from the Sea Lion Development activities, it is recognised that only the first two definitions above may apply.

11.8.2 Sources of light disturbance to Falkland Island residents

The following Phase 1 & 2 activities have the potential to cause disturbance to local residents:

- Use of the onshore supply base at Gordon Lines in Stanley,
- Use of the TDF in east Stanley, and
- Mooring of up to two LTVs at any one time in Berkeley Sound to support the installation operation.

The sources of light disturbance at various stages of the Development are presented in Table 11.39 below.

Table 11.39: Sources of light disturbance from operations in Stanley and Berkeley Sound during the three stages of the Development

Location of disturbance	Source of light	Stage 1	Stage 2a&b	Stage 3
Stanley	Vessel deck lighting and navigation lights, both on vessels and on the TDF, Deck and office lighting on the TDF, and Yard and office lighting at the supply base.	✓	✓	✓
Berkeley Sound	Deck lights on the LTVs used as floating logistics vessels anchored in inshore waters in Berkeley Sound.	✓	✓	

11.8.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshops were used to identify the specific receptors upon which the impacts and / or risks of light disturbance warranted further investigation (Chapter 9). This chapter, focusing on the human population, identified the following receptors that may be impacted during the Phase 1 & 2 Development:

- Human population (Section 7.7.2):
  - Residents living in the vicinity of the TDF and supply base (Stanley):
    - The east end of Stanley (Gordon Lines area), where the TDF and supply base are located is generally an industrial area although there are a small number of houses in the vicinity (*c.* 1 km to the west).
  - Residents living in the vicinity of the proposed LTV site (Berkeley Sound) (Section 7.7.2.3):
    - There are four settlements / farmsteads around the Sound (*c.* 9 km from the proposed LTV location), with residents living and working in the area, as well as visitors and tourists.

11.8.4 Characterising and quantifying the impact of light disturbance

When characterising and quantifying the impact of light disturbance it is necessary to consider the:

- Nature of the impacts upon the human population,
  - Opinion of stakeholders.
- Quantification of the disturbance in both Stanley and in Berkeley Sound e.g.:
  - The number of sources of light (e.g., sites) and duration of exposure,
  - The location of sources of light (e.g., site),
  - The number of lights at each site, and
  - Orientation of lights at each site.

11.8.4.1 Nature of the impact

Light pollution is the alteration of natural light levels in the night environment produced by the introduction of artificial light. Exposure to light at night has been shown to disrupt melatonin levels, which can impact on sleep and blood pressure, along with a number of other health issues (Falchi, *et al.,* 2011). There are no set thresholds above which light can be considered a statutory nuisance in the UK (Section 11.8.1.1.1). However, guidelines (Section 11.8.5) suggest that acceptable levels of artificial light are dependent on the level of light found at the location prior to the artificial lights being introduced (Defra, 2015). For example, in areas that are 'intrinsically dark', people are less tolerant of artificial light being introduced, compared to large towns or city centres with high levels of nighttime activity (Scottish Executive, 2007).

Light pollution can also affect our enjoyment of the night sky when observing the stars, planets and galaxies (CIRES, 2016). The New World Atlas of Artificial Brightness shows that the Falklands are a relatively dark sky area, with the majority of the population living with very little light pollution (CIRES, 2016).

Regardless of the above however, the impact of light is largely subjective and it is therefore useful to consider the input of local residents and stakeholders (i.e., those that may be affected).

11.8.4.1.1 Opinion of stakeholders

Light pollution in Stanley did not come up as a specific issue during scoping for the Sea Lion development in August 2016 or December 2023 (Chapter 6) but it was noted during previous exploration scoping consultations that light from the TDF, vessels and yard is noticeable to Stanley residents. A community complaint was also made to POEPL during the 2015 exploration drilling campaign regarding the lighting from vessels moored up at the TDF at night.

The issue of light, particularly in Berkeley Sound, was discussed during the scoping consultations held by POEPL in 2016 and Navitas in 2023 (Chapter 6). The majority of stakeholders noted that the current levels of light in Berkeley Sound are quite high in jigger season (Section 7.7.3.2.1.2) and complaints about light from jiggers have been noted.

11.8.4.2 Quantification of the disturbance

11.8.4.2.1 Light in Stanley

11.8.4.2.1.1 Source and duration of light exposure

POEPL (now Navitas) made a successful application in January 2018 to the Falkland Islands Government (FIG) to vary the planning consent for the TDF to cover the duration of the Phase 1 & 2 activities. Navitas may propose further modifications to improve the dock's functionality in the future (Section 5.11.1.1.1) and any further proposals to upgrade TDF facilities will have to go through the process of planning consent, which may, at the planning officer's discretion, be accompanied by a full EIA. At this time however, it is assumed that the TDF operations will be similar to operations during the 2015 exploration campaign.

Therefore, it is estimated that light sources at the TDF and supply base will include:

- Deck and navigation lights from vessels at the TDF,
- Deck and navigation lights from the TDF,
- Office lighting on the TDF,
- Crane lights on the TDF,
- Street lighting along the TDF causeway,
- Floodlights at the supply base, and
- Office lighting at the supply base.

All of these light sources will be required throughout the Phase 1 & 2 Development (*c.* 30 years).

Both the TDF and supply bases may be operational 24 / 7 and will be illuminated during the hours of darkness.

11.8.4.2.1.2 Location of light sources

The TDF is located east of FIPASS, over one kilometre from the nearest residences (see Section 11.8.1.1.1). Vessel activity at the TDF will be limited to a maximum of two vessels berthing at any one time, due to space constraints.

The supply base is likely to be based in close proximity to the TDF, although the specific area has not yet been defined.

11.8.4.2.1.3 Number of lights

At the time of writing the specific lighting arrangements are not known for the supply base but are likely to be very similar to the lighting arrangements at the yards used during the exploration drilling campaigns. Lighting arrangements at the TDF are already in place.

The supply base will be larger in Stages 1 & 2 than the yard that was used during the 2015 exploration drilling campaign (Section 5.11.1.2). However, in Stage 3, steady state production, the overall yard space used will be smaller than that used during the 2015 exploration campaign. For the purposes of this EIS, it has been assumed that the number of lights will be proportional to the area of the yard. The yard will be similarly lit to the 2015 exploration campaign yard and it has been assumed that lights will be evenly spaced throughout. The area used for the exploration yard covered an area of 51,000 m^2 and the increase in area of the yards during each Stage of the Phase 1 & 2 Development is shown below in Table 11.40.

Owing to the differences in the areas of yard space required during the different stages, it is estimated that during Stage 1 and 2, the number of lights will be greater than residents have been used to during drilling and that during Stage 3, the lit areas will reduce in proportion. It should also be noted that much of the yard space, as with the yards used during the 2015 exploration campaign, will be covered sheds. As such the whole area will not be floodlit, only those areas outside the covered areas.

The lighting on the TDF will remain the same throughout the Phase 1 & 2 development, with a maximum of two vessels (e.g., two supply vessels) berthing at the TDF at any one time due to berthing space.

Table 11.40: Proposed area of yard space required for the Phase 1 & 2 Development in comparison to 2015 exploration drilling campaign yard space

Stage (and duration)	Area required (m^2)[1]	Difference in area to 2015 exploration yard area (51,000 m^2)	Comparison to 2015 exploration yard area
1, 2 a & 2b (*c.* 5 years)	127,500	76,500 m^2 more	Approximately 2.5 times greater
3 (*c.* 27 years)	20,000	31,000 m^2 less	*c.* 2/5th of the area

[1] Note that the area required for the specialised storage of explosives, NORM and radioactive sources (required throughout Field Life) is as yet unknown.

11.8.4.2.1.4 Orientation of lights

Some lights, such as office lighting, are not likely to be intrusive as the lights will be of a low level and inside buildings. These will be comparable to other residences and offices in Stanley.

The highest intensity lights will be the TDF deck and yard floodlights, which are generally orientated to illuminate any operational activity being undertaken on the deck of the TDF or in the yard.

11.8.4.2.2 Light in Berkeley Sound

11.8.4.2.2.1 Sources and duration of light exposure

The short-term sources of light that will be present in Berkeley Sound over the various stages of the Phase 1 & 2 Development are shown below in Table 11.41.

.

Table 11.41: Source and duration of lights in Berkeley Sound during the Phase 1 & 2 Development

Phase 1 & 2 Development Stage	Activity in Berkeley Sound	Duration of Presence in Berkeley Sound	Approximate number of light sources in Berkeley Sound
Stage 1: Mobilisation and installation of materials and equipment to support pre-First-Oil drilling by MODU[1], FPSO[2] moorings installation and construction	Up to 2 LTVs anchored in Berkeley Sound at any one time. 2 x Offshore Construction Vessels (OCVs) transiting between the LTVs in Berkeley Sound and the field location.	Ability to maintain a 24 hr operation over a total of seven months (in two periods) as and when operationally required	Deck lighting and navigation lights from installation vessels and LTVs (up to two vessels *in situ* at any time)
Stage 2a & 2b: Post First-Oil drilling by the MODU, concurrent production operations by the FPSO, oil export and construction	2 x LTVs anchored in Berkeley Sound 2 x OCVs transiting between the LTVs in Berkeley Sound and the field location.	Ability to maintain a 24 hr operation over a total of six months as and when operationally required	Deck lighting and navigation lights from installation vessels and LTVs (up two vessels *in situ* at any time)

[1] Floating Production, Storage and Offloading Vessel.
[2] Mobile Offshore Drilling Unit.

11.8.4.2.2.2 Location of light sources

Most of the installation vessel activity that requires deck lighting will be based around the LTVs in Berkeley Sound and each vessel will have its own individual 500m exclusion zone as described in Section 5.5. The construction vessels will spend minimal amounts of time in the Sound while they collect equipment from the LTVs. While on-station, deck lighting will have to be maintained by all vessels throughout the 24hr operation to provide a safe working environment.

11.8.4.2.2.3 Number of lights

The intensity of light emitted by each vessel will vary depending on activity. At the time of writing, the identity of the specific vessels involved is unknown. Nonetheless, some comparisons can be made with other vessels operating in Berkeley Sound and it is expected that lighting arrangements on the LTVs will be similar to the supply vessels utilised during the exploration drilling campaign.

11.8.4.2.2.4 Orientation of lights

Some lights, such as navigation lights, are designed to be seen by other vessels and therefore are orientated to face out-board. However, these are usually low intensity lights.

The highest intensity lights are the deck floodlights, which are generally orientated to illuminate:

- Any operational activity being undertaken on the deck of the vessel,
- To assist safe access and egress, and
- The surrounding water.

11.8.5 Industry-standard mitigation

Various guidance is available on minimising light pollution:

- Scottish Executive 'Controlling Light Pollution and Reducing Lighting Energy Consumption' (2007),
- The Institute of Lighting Professionals Guidance Notes (ILP, 2021), and
- International Commission on Illumination (CIE) Report 150: Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations (CIE, 2003).

- Department for Environment, Food and Rural Affairs (Defra) Guidance: Artificial Light Nuisances, How Councils Deal with Complaints (Defra, 2015).

In Stanley at the TDF and supply bases, light will be minimised where possible by design, through good working practice and the use of black out blinds, which aim to reduce potential nuisance to local residents.

With regard to Berkeley Sound, good working practice and design will help to limit the amount of light the vessels emit, particularly the design of vessels' lighting arrangements and use of black out blinds. The vast majority of light emitted will be focused on the vessel decks and immediate area surrounding the vessels.

11.8.6 Impact assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities.

A summary of the impact assessment outcomes for this Development is tabulated in Section 11.8.12 which shows the worst-case impact for each activity and receptor and details are provided below.

11.8.6.1 Impact assessment of light in Stanley

Light was raised as an issue during the earlier scoping consultations (pre-2016) and a single complaint was been received during the 2015 exploration campaign, relating to the lighting of vessels at the TDF. However, there are already lights in the Gordon Lines industrial area at the east end of Stanley. Therefore, on balance, the sensitivity of receptor is considered to be '**Moderate**'.

Lighting used at the TDF will result in very similar levels of light experienced during the exploration campaign in 2015. However, the yard space will be 2.5 times greater (Section 11.8.4.2.1.3), albeit for a short time, before reducing to an area approximately 40 % of that used for the exploration campaign. As such, lighting is expected to increase initially for a short period (approximately five years) before decreasing during steady state operations. Therefore, on balance, the severity of effect is considered to be '**Minor**'.

Therefore, the overall significance of the impact is considered to be '**Moderate (6)**', and project-specific mitigation measures to reduce the significance will be developed and implemented.

11.8.6.2 Impact assessment of light in Berkeley Sound

There are a number of light sources in Berkeley Sound from both fishing vessels and permanent navigation lights. While the fishing vessels are seasonal, complaints have been noted about the light pollution. The issue of light was also raised by stakeholders during the pre-2016 scoping consultations and therefore, on balance, the sensitivity of receptor is considered to be '**Moderate**'.

The relatively short-term nature of the light impact from the LTV operation combined with the distance of residences to the light source (greater than 10 km) indicate the severity of effect is considered to be '**Minor**'.

Therefore, the overall significance of the impact of light disturbance in Berkeley Sound from the LTV operation is considered to be '**Moderate (6)**'.

11.8.7 Project-specific mitigation measures

11.8.7.1 Light impact in Stanley

Minimum levels of lighting are required on the TDF and at the supply base to ensure a safe operation. However, it will be normal practice to switch off any operational lighting that is not required. For example, operational and office lights will be switched off each evening once operations have finished

for the day. The following measures will be taken, where possible, to reduce the light impacts from the supply base, TDF and vessels alongside the TDF:

- Deck lights and yard lights will face inwards, and
- Vessel lights to be turned off when not required, particularly deck lighting.

11.8.7.2 Light impact in Berkeley Sound

Minimum levels of lighting are required on the LTVs to ensure a safe operation and in line with legislation (Section 11.8.1.1). However, the following measures will be taken, where possible, to reduce the light impacts from the LTVs:

- Deck lights will face inwards, and
- Vessel lights to be turned off when not required, particularly deck lighting.

11.8.8 Residual impacts and risks

11.8.8.1 Light impact in Stanley

Implementing the proposed mitigations to reduce the impact of light nuisance from the supply base, TDF and vessels moored at the TDF have the potential to lessen the severity of effect. However, these mitigations were implemented during the 2015 exploration drilling campaign and a complaint was still received.

As such, even with project-specific mitigation measures in place, the significance of the residual impact of light in Stanley remains '**Moderate (6)**'.

11.8.8.2 Light impact in Berkeley Sound

Implementing the proposed mitigations to the LTVs anchored in Berkeley Sound has the potential to lessen the severity of effect. However, it is unclear whether these will have the desired effect and the LTVs will be *in situ* for longer than jigger vessels in the Berkeley Sound area and are likely to be present out-with jigger season, so the duration of impact is not changed.

As such, with the proposed project-specific mitigation measures in place, the significance of the residual impact of light in Berkeley Sound remains '**Moderate (6)**'.

11.8.9 Cumulative impact

Places of human settlement and industry ashore represent permanent, or at least regular, sources of light. In the Falklands, these are primarily associated with the two major population centres, Stanley and Mount Pleasant (MPC). Additionally, Berkeley Sound (the LTV site) is used as an anchorage for the trans-shipment of fish and so is also a significant seasonal source of light pollution.

11.8.9.1 Stanley

Sources of existing anthropogenic light in Stanley include all housing, industry and human activity in the town. At the east end of Stanley, where the TDF and supply base will be operating, the area is already designated for 'a mixture of heavy and light industrial, warehousing and storage' within the Stanley Town Plan (FIG, 2015d). The area is currently used as yard space and the TDF is already in place, although, at the time of writing, not in operation.

The peak of activity in Stages 1, 2 (a & 2b), will add in 'concentration' (Section 8.9.1) to the light in the area, particularly from vessels visiting the TDF. This period will last approximately five years, in two tranches of approximately 2.5 years each.

Once into steady state operations the activity, and hence light, will reduce to below levels experienced during the exploration drilling campaign, though these are still above the baseline levels experienced in Stanley on a day-to-day basis.

11.8.9.2 Berkeley Sound

Sources of existing anthropogenic light within Berkeley Sound are summarised in the chapter on the environmental (as opposed to social) impacts of artificial light (Section 10.1.9.2). Notably, the jiggers utilise Berkeley Sound to trans-ship their catches to reefer vessels and to refuel. Although the full rig of jigging lights are not deployed in Berkeley Sound, there is a considerable amount of light emitted from these vessels, the glow from which can be seen from Stanley (A. Black, *pers. obs.*). In addition to the jiggers, other vessels use Berkeley Sound as an anchorage, primarily for the trans-shipment of fish catches.

Although vessels can be present in all months of the year, activity peaks between March and June, when tens of vessels can be present, but this varies considerably from year-to-year. Combined, these vessels represent a large source of anthropogenic light. Navitas plan to avoid peak fishing season as much as practicable to avoid competition for sea room (Section 5.5.1). At peak times, the LTVs and construction vessels will have less of a cumulative impact as they will be one of many vessels in the Sound (adding to the concentration). At other times of the year, there may be very few vessels using Berkeley Sound and therefore, darker skies (Section 11.8.4.1). The LTVs and construction vessels will be in place for up to 7 months in Stage 1 and around 6 months in Stages 2a & 2b, adding considerably to the ambient level of light pollution (increasing the duration of the impact) albeit that the level of light will be far less than residents are accustomed to when jiggers are present.

11.8.10 Confidence

While the approximate timing of activities and type of vessels used during the Phase 1 & 2 Development of the Sea Lion Field is known, the intensity and orientation of lights on the vessels and supply base are not quantified, and analogous examples have been used in this assessment.

The nature of the impact on the receptor (people) is understood, however, it is very subjective and so it is difficult to predict the impact. The pre-2016 scoping consultations highlighted that light may be considered an issue by some and a complaint was received during the previous exploration drilling campaign.

With the available data, the level of confidence in the impact predictions (in terms of the nature of the impact and its level of significance) is considered to be **'Probable'**. Additionally, the data gaps are not considered to have the potential to significantly change the outcome of the assessment.

11.8.10.1 Monitoring required

The two key areas where monitoring will be focused is:

- Understanding the baseline, and
- Understanding tolerance of the local residents.

11.8.10.1.1 Understanding the baseline

Further monitoring of light will be conducted to establish baseline levels.

During operations, periodic site environmental monitoring will include community and site surveys.

11.8.10.1.2 Understanding tolerance of local residents

Performance of key activities that have the potential to lead to disturbance will be monitored and managed through periodic monitoring at relevant sites.

Further, during Phase 1 & 2, Navitas will develop and implement a complaints mechanism, whereby members of the public can make a complaint, comment or observation directly. A point of contact will be identified in the Islands to receive any complaints and act as community liaison.

Complaints will be monitored and reported to FIG on a monthly basis (at a minimum). If it is determined that any complaints have similar contributing factors, or a trend is identified, the most appropriate mitigation measure will be identified and implemented using the Navitas Management of Change process (Section 3.2.16).

All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the project-specific Phase 1 & 2 SEMMP.

11.8.11 Offsetting

For significant residual and impact and risks ('Moderate' or above), offsetting *via* a Carbon and Biodiversity Offsetting Fund is proposed, see Section 8.11 for further details.

11.8.12 Findings summary

Table 11.42: Summary of the of the social impact assessment for light disturbance during the Sea Lion Phase 1 & 2 Development

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity[1]	Severity[1]	Likelihood[1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Operations at the TDF and supply base	Vessels, TDF and yard lighting	Annoyance, sleep disturbance to Stanley residents	Planned	1, 2a, 2b & 3	Moderate	Minor	n/a	**Moderate (6)**	**Moderate (6)**	**Probable**	**Industry-standard:** Good working practice and design, and Black-out blinds will be used on the vessels, TDF offices and yard offices. **Project-specific:** Deck lights and yard lights will face inwards, and Vessel lights to be turned off when not required, particularly deck lighting.
LTV operations	Deck and accommodation lights	Annoyance, sleep disturbance, impairment of dark skies	Planned	1, 2a & 2b	Moderate	Minor	n/a	**Moderate (6)**	**Moderate (6)**	**Probable**	**Industry-standard:** Good working practice and design e.g., focusing deck lighting, and Black-out blinds will be used on the vessels. **Project-specific:** Deck lights will face inwards, and Vessel lights to be turned off when not required, particularly deck lighting.

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

11.9 Disturbance to human population – Helicopters and Noise

Table of Contents

11.9.1 Introduction 1098
11.9.1.1 Relevant legislation 1098
11.9.1.1.1 Helicopter use 1098
11.9.1.1.2 Noise legislation 1098
11.9.1.1.2.1 Disturbance from noise 1098
11.9.2 Sources of noise disturbance 1098
11.9.3 Potential receptors 1099
11.9.4 Characterising and quantifying the impact of noise disturbance 1100
11.9.4.1 Nature of the impacts 1100
11.9.4.1.1 Human population 1100
11.9.4.1.2 Livestock 1101
11.9.4.1.3 Opinion of stakeholders 1101
11.9.4.2 Baseline levels of noise in Stanley and Berkeley Sound 1102
11.9.4.2.1 Baseline noise in Stanley 1102
11.9.4.2.2 Baseline noise in Berkeley Sound 1102
11.9.4.3 Quantification of disturbance from helicopter use 1103
11.9.4.3.1 Proposed helicopter activity during the Development 1103
11.9.4.3.2 Helicopter noise levels 1104
11.9.4.3.3 The distribution of the potentially affected residents and livestock 1105
11.9.4.3.4 Overlap between helicopter flight and residential and livestock areas 1105
11.9.4.3.4.1 Flights to the Sea Lion Field 1105
11.9.4.3.4.2 Flights to the CTT 1105
11.9.4.3.4.3 SAR Test Flights 1105
11.9.4.4 Quantification of other Phase 1 & 2 noise sources in Stanley 1106
11.9.4.4.1 Type, location and timing of Phase 1 & 2 noise sources near Stanley 1106
11.9.4.4.2 Comparison of noise with 2015 exploration campaign 1107
11.9.4.4.3 Estimation of Phase 1 & 2 noise levels near Stanley 1108
11.9.4.5 Quantification of other Phase 1 & 2 noise sources in Berkeley Sound 1109
11.9.4.5.1 Location and timing of noise sources in Berkeley Sound 1109
11.9.4.5.2 Number of noise sources in Berkeley Sound 1109
11.9.4.5.3 Airborne noise modelling 1110
11.9.4.5.3.1 Modelling assumptions 1110
11.9.4.5.3.2 Modelling of vessel noise in Berkeley Sound 1111
11.9.4.5.3.3 Summary of modelling results 1111
11.9.5 Industry-standard mitigation 1112
11.9.5.1 Mitigating the impact of helicopter use on livestock 1112
11.9.6 Impact assessment 1113
11.9.6.1 Impacts of helicopter use 1113
11.9.6.1.1 Disturbance to human population 1113
11.9.6.1.2 Disturbance to livestock 1113
11.9.6.2 Impact of noise disturbance in Stanley 1114
11.9.6.3 Impact of noise disturbance in Berkeley Sound 1114

11.9.7 Project-specific mitigation measures 1114
11.9.7.1 Impact of helicopter use 1114
11.9.7.2 Noise impact in Stanley 1114
11.9.7.3 Noise impact in Berkeley Sound 1115
11.9.8 Residual impacts 1115
11.9.8.1 Impact of helicopters 1115
11.9.8.2 Noise impact in Stanley 1115
11.9.8.3 Noise impact in Berkeley Sound 1115
11.9.9 Cumulative impact 1115
11.9.9.1 Stanley 1115
11.9.9.2 Berkeley Sound 1116
11.9.10 Confidence 1116
11.9.10.1 Helicopter use 1116
11.9.10.2 Noise in Stanley and Berkeley Sound 1116
11.9.10.3 Monitoring required 1117
11.9.11 Offsetting 1117
11.9.12 Findings summary 1117

11.9.1 Introduction

Throughout the Phase 1 & 2 Development it will be necessary to use helicopters, the supply base and port facilities in Stanley, and also Berkeley Sound for the Large Transport Vessels (LTVs) and Offshore Construction Vessels (OCV's). All of these activities have the potential to create a noise nuisance. As shown in Chapter 6, noise from operations and helicopter overflights were raised by stakeholders during the informal scoping consultations.

This chapter assesses the potential for noise to impact upon local residents and livestock specifically. The impacts of helicopter noise on wildlife are assessed in Section 10.2.

11.9.1.1 Relevant legislation

11.9.1.1.1 Helicopter use

There are numerous pieces of International and Overseas Territory legislation in place to govern air safety, which are outwith the scope of this EIA.

As is also described in Section 10.2, aviation activities within the Falklands are overseen by Falkland Islands Civil Aviation Department (FICAD). Their work is principally governed by the following:

- Air Navigation (Overseas Territories) Order (AN(OT)O) (2013), and
- International Conventions and Standards ('Rules of the Air').

While no legislation is in place specifically with regards to the social impacts of noise disturbance, due to concern over disturbance to wildlife and livestock from low flying aircraft, guidelines have been developed in the Falklands, and elsewhere, to minimise the impact. These are described in Section 11.9.5.1 below as Industry-Standard mitigations.

11.9.1.1.2 Noise legislation

The main pieces of legislation governing noise pollution in the UK are:

- The Nuisance Provisions, under part III of the Environmental Protection Act 1990 (EPA 1990).
- The Environmental Noise (England) Regulations (2006).
- The Noise Abatement Act (1960).
- MARPOL Convention on the International Regulations for Preventing Collisions at Sea, (ColRegs) (1972).

11.9.1.1.2.1 Disturbance from noise

Disturbance in general is based on the definition of a 'statutory nuisance' in the Environmental Protection Act (EPA) 1990. For an activity to qualify as a source of disturbance it must do one of the following:

- Unreasonably and substantially interfere with the use or enjoyment of a home or other premises,
- Present a long-term and sustained impact to local residents' quality of life by an otherwise unwanted aspect, and / or
- Injure health or be likely to injure health.

With regard to the type of noise exposure anticipated in the Phase 1 & 2 Development, it is recognised that only the first two definitions above may apply.

11.9.2 Sources of noise disturbance

The following activities have the potential to cause disturbance to local residents:

- Use of helicopters:

- To carry personnel and / or equipment to and from the Mobile Offshore Drilling Unit (MODU) and the Floating Production, Storage and Offloading (FPSO) vessel,
- To carry a Falkland's marine pilot to and from the purchaser's Conventional Trading Tanker (CTT) prior to approaching the FPSO, and
- For Search and Rescue (SAR) exercises, test flights and any SAR response required.

- Use of the onshore supply bases and accommodation in the Stanley area,
- Use of the Temporary Dock Facility (TDF) in east Stanley, and
- Anchoring of up to two LTVs at any one time in Berkeley Sound to support the subsea and FPSO installation operation using OCVs.

The specific sources of noise disturbance as they apply during the various stages of the Development are presented in Table 11.43 below.

Table 11.43: Sources of noise disturbance from helicopter operations, operations in Stanley and operations in Berkeley Sound during the three stages of the Development

Location of disturbance	Source of noise	Stage 1	Stage 2a &b	Stage 3
Under flight paths	Helicopter engine noise.	✓	✓	✓
Stanley	Operation of the TDF: engine noise from vessels, vehicles, cranes, generators, lifting and loading of cargo from the TDF onto vessels and *vice versa*.	✓	✓	✓
	Operation of the supply bases: engine noise from vehicles, generators, forklifts, reversing alarms on vehicles.	✓	✓	✓
Berkeley Sound	Engine noise from the LTVs during anchoring.	✓	✓	-
	Noise from the LTVs during crane-lifting of infrastructure onto the associated OCVs.	✓	✓	-
	Engine and pump noise from LTVs and OCVs.	✓	✓	-

11.9.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify the specific receptors upon which the impacts of noise disturbance warranted further investigation (Chapter 9). This chapter, focusing on the human population, identified the following receptors that may be impacted during the Phase 1 & 2 Development:

- Human population:
  - Residents living in the vicinity of the TDF and supply base (east Stanley) (Section 7.7.2):
    - The population of the Falklands is concentrated within Stanley with the heliport located within Stanley Airport, approximately 3.5 km from the nearest housing,
    - The Gordon Lines area to the east end of Stanley, where the TDF and supply base are located, is generally an industrial area although there are a number of houses in the vicinity, albeit >1 km away, and
    - The north of East Falkland is dotted with small settlements and farms on potential flight routes.
  - Residents living in the vicinity of the proposed OCVs / LTV site in Berkeley Sound (Section 7.7.2.3):
    - There are four settlements / farmsteads around the Sound, with residents living and working in the area, as well as visitors and tourists.
- Aggregations of livestock (Section 7.7.4.7):

- Following the austral winter, local farmers are concerned about the condition of their livestock and the likelihood of a poor lambing season (mid-September to end October). Further, livestock is corralled during the shearing season that runs from November to February, potentially making it more vulnerable to disturbance (FILFH, 2024).

11.9.4 Characterising and quantifying the impact of noise disturbance

When characterising and quantifying the impact of noise disturbance on the local population and livestock, it is necessary to consider the:

- Nature of the impact upon the human population and livestock,
- Baseline noise levels in Stanley and Berkeley Sound,
- Quantification of disturbance from helicopters during Phase 1 & 2,
- Quantification of disturbance from other Phase 1 & 2 noise sources in Stanley, and
- Quantification of disturbance from other Phase 1 & 2 noise sources in Berkeley Sound.

11.9.4.1 Nature of the impacts

Noise disturbance may affect the human population by directly impacting upon residents and / or by impacting upon livestock.

11.9.4.1.1 Human population

The most commonly reported effects of noise exposure are annoyance and sleep disturbance, both of which can impact on quality of life (WHO, 1999). Unlike many other pollutants, noise pollution depends not just on the physical impact of the sound itself, but also the human reaction to it (Defra, 2010).

Annoyance is defined by WHO (1999) as:

> *'a feeling of displeasure, associated with any agent or condition, known or believed by an individual or group to adversely affect them'.*

Factors determining how 'annoying' the noise is to humans include:

- The individual's attitude to the noise source,
- The tonality, impulsivity, and intermittency of a noise,
- When the noise is occurring, and
- A feeling that the noise could be avoided.

Different levels and types of noise can cause different magnitudes of annoyance in different individuals depending upon their hearing and tolerance. To account for this, British Standard 4142 and the WHO add 'penalty' decibels (dBs) to measurements to account for those noises that are particularly annoying. For example, an intermittent sound that is clearly perceptible is considered in BS 4142 to be more annoying than a continuous noise at the same level and thus incurs a penalty of +3 dB (BS4142, 2014).

Additionally, studies have shown that much greater annoyance results when sleep is disturbed compared with daytime activities (Passchier and Passchier, 2000; NoMEPorts, 2008). As such, there are different exposure thresholds for noise to reflect the varying sensitivity to noise during the day and at night. To ensure a 'good night's sleep' the WHO (1999) recommend that continuous background noise levels should not exceed 40 dB(A). The '(A)' refers to an 'A-weighting' which is applied to sounds that have been measured by instruments in an effort to account for the loudness, as perceived by the human ear. Essentially, between 500 Hz and 6 kHz, the human ear is much more sensitive, but above and below these frequencies, the human ear is not particularly sensitive and the 'A-weighting' takes these sensitivities into account.

The WHO recommend that sound levels during the evening and night should be 5-10 dB(A) lower than during the day (WHO, 1999) (Table 11.44). As sound levels vary over the course of a day, an average ambient sound level is normally used for determining acceptable thresholds; this is referred to as the Equivalent Continuous Level. Most commonly this is 'A-weighted' (to account for human perception) and is expressed as the 'LAeq' (NoiseNet, 2008).

The WHO Guidelines for Community Noise (1999) state that during the day:

> *'few people are highly annoyed' at LAeq levels below 55 dB(A), and 'few are moderately annoyed' at LAeq levels below 50 dB(A)'*

These WHO thresholds are used to determine the noise levels that should not be exceeded in various settings (Table 11.44).

To summarise the above:

- A penalty (in dB) is added to account for the particular annoyance of different types of sound e.g., tonality, intermittent *vs.* continuous,
- An A-weighting (e.g., dB(A)) accounts for the sensitivity of human hearing, and
- The LAeq refers to the average ambient noise level over the course of a day to enable comparisons between the dB(A) of noise during the night-time, when people are less tolerant, with that of the daytime.

Table 11.44: WHO guideline thresholds for noise in specific environments[1]

Specific environment	Critical nuisance effects	LAeq dB(A)
Outdoor living area	Serious annoyance daytime and evening	55
Outdoor living area	Moderate annoyance daytime and evening	50
Outside bedrooms	Sleep disturbance, window open (outside value)	40

[1] **Note:** WHO (1999 & 2009) do not give guideline thresholds for 'no annoyance'.

11.9.4.1.2 Livestock

Generally, in the Falkland Islands, livestock is widely spread at low densities and therefore a small proportion of animals would be subject to disturbance from helicopters at any one time. However, when animals are corralled, the reaction by livestock that have been startled by aircraft is similar in nature to that of wildlife and is one of mass panic, which can lead to animals being trampled or to reduced lambing success (FILFH, 2024). Further, corralling of livestock is usually associated with times when animals may already be experiencing stress, such as during lambing or shearing. Given that the same animals are unlikely to be exposed to repeated overflights and may only experience helicopters when corralled in certain locations, it is unlikely that animals exposed to such disturbance events will become habituated and thus de-sensitised.

11.9.4.1.3 Opinion of stakeholders

Noise was noted during scoping consultations carried out by the previous operator (POEPL); stakeholders also mentioned that activities in Berkeley Sound can already be heard by local residents and complaints are made about noise when incumbent boats are loading and offloading.

Noise as a potential disturbance from the TDF and supply base in Stanley was noted during the 2015 exploration drilling scoping consultations, though not during those for the Sea Lion Development in 2014, 2016 or 2023 (Chapter 6).

During the scoping consultations it was noted that livestock are disturbed by helicopters but also that they may become habituated to the sound. There was also concern raised as to whether the guidelines in the Falkland Islands Low Flying Handbook are followed by all pilots.

11.9.4.2 Baseline levels of noise in Stanley and Berkeley Sound

As detailed in the Environmental and Social Baseline chapter (Section 7.7.5.1.1) noise measurements were previously conducted in Stanley on behalf of:

- Workboat Services Ltd. in March 2013, and
- Noble Energy Falklands Ltd. in March 2014.

POEPL also conducted a short noise survey in August 2016 for a period of 48 hours and some additional spot measurements in February 2017. Locations of the Workboat (2013), Noble Energy (2014) and POEPL (2016) surveys are shown in Figure 11-9.

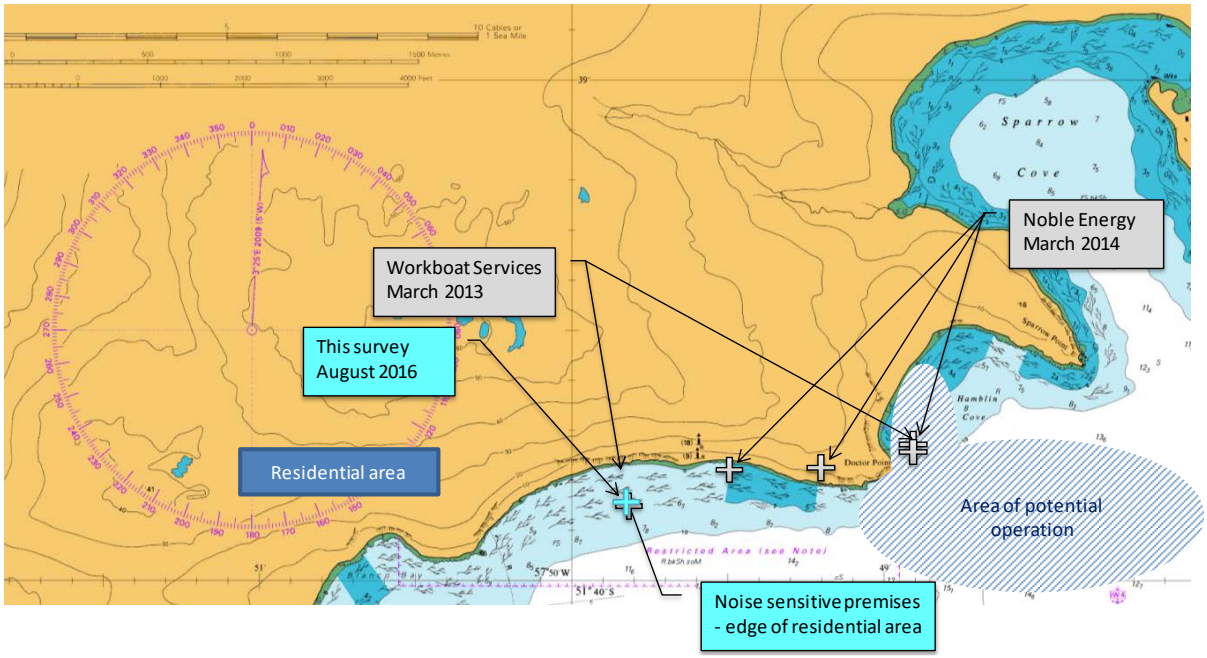


Figure 11-9: Location of noise monitoring points in Stanley. Note: 'This Survey' refers to the 2016 survey carried out by POEPL (Section 7.7.5.1.1.1)

11.9.4.2.1 Baseline noise in Stanley

In summary, wind and traffic play key roles in the noise profile in Stanley. Sound levels rarely dip below 40 dB(A) either during the day or at night, with an average noise level over the 2016 measurement period of 41.7 dB(A). The quietest period is between 11 pm and 6 am. Peaks in noise level reflect daily activities, with increases in noise levels between 6 am and 9 am and again between 3 pm and 5:30 pm. The minimum noise level recorded was 31.9 dB(A) and the highest was 106.3 dB(A), during a military overflight. The highest noise level spot measurements were recorded outside the power station (72.5 dB).

More detail on noise baseline monitoring in Stanley is available in the Environmental Baseline Description (Section 7.7.5.1.1).

11.9.4.2.2 Baseline noise in Berkeley Sound

Noise measurements were taken in Berkeley Sound near Long Island Farm, facing the Sound, over a period of 30 hours. Unfortunately, the initial recording was affected by wind. By convention, noise measurements taken above wind speeds of 5 m/s are not deemed reliable for noise assessments due to the effect of wind on ambient noise levels and, more specifically, the effect of buffeting on the microphone.

A second monitoring period at Long Island Farm was conducted in February 2017 which measured baseline noise levels in the absence of strong winds. Although winds were not monitored continuously, they were subjectively very low at the start and end of the measurement and no significant changes in weather were noted at the time. This reflects conditions when added noise from the proposed Project activities may cause the most annoyance. In this area, wind noise is a common and very apparent feature most of the time, and it was difficult to identify a period of more than a few hours when winds were low. The results should be read in this context, that they represent unusually 'quiet' conditions and do not reflect long term averages.

Daytime noise levels average around 40 dB(A), and night-time background levels averaging around 30 dB(A) for significant periods were recorded. Periodic loud noise events are observed lasting for 1-2 minutes. These are unidentified, but are unlikely to be passing local vehicles given the location of the meter and would be consistent with passing aircraft.

11.9.4.3 Quantification of disturbance from helicopter use

When quantifying the potential impacts of helicopter noise, it is necessary to consider the following:

- The proposed helicopter activity during the Development,
- Helicopter noise levels,
- The distribution of the susceptible residents and livestock, and
- The overlap between helicopter flight paths and residential and livestock areas.

11.9.4.3.1 Proposed helicopter activity during the Phase 1 & 2 Sea Lion Development

The level of helicopter activity throughout the Development is described in detail in Section 10.2.4.2.1. However, Table 11.45 is repeated below as a summary. The distribution of human and livestock receptors and the overlap between these and flightpaths are described below in Section 11.9.4.3.4.

Table 11.45: Number of helicopter flights during the Phase 1 & 2 Development

Helicopter activity[1]	Stage 1 (31 months, 942 days)		Stage 2a & b (35 months, 1,064 days)		Stage 3 (325 months, *c.* 27 years)	
	Frequency of flights	Number of flights[1]	Frequency of flights	Number of flights[1]	Frequency of flights	Number of flights[1]
Crew change to MODU	10 / fortnight	670	10 / fortnight	750	-	-
Crew change to FPSO					2 / week	2,795
Berthing crew transfer to CTT	n/a	n/a	Per direct offtake (average every 10 days)	106	Per direct offtake (average of 36 / year over Field Life)	972
SAR training	6.7 / month[2]	208	6.7 / month[2]	235	6.7 / month[2]	2,178
Total number of flights per Stage	**-**	**878**	**-**	**1,091**	**-**	**5,945**
Total	**7,914**					

[1] Based on an average of 30.4 days per month, and an average of 4.3 weeks per month.
[2] Based upon 20 hours flying per month and an average of 4.3 weeks per month.

11.9.4.3.2 Helicopter noise levels

Detail on the sound levels generated are described in Section 10.2.4.2.2. However, a summary of the sound levels, as well as noise levels of day-to-day activities for comparison, are repeated below in Table 11.46.

Table 11.46: Sound level from helicopter activity experienced at ground level *(adapted from Norske Olje and Gass, 2014; BMT, 2005)*

Activity	Maximum sound level at distance from sound source (dB(A))[1]			
	Equivalent at 1 m	Approx. 100 m	600 m	3,500 m
Super Puma EC225[2] (idling)	>114	-	*c.* 68	*c.* 43
Sikorsky S92 (idling)	>110	-	*c.* 54	*c.* 39
EC155 (overflight)	133	-	77	48
Sikorsky S61[2] taking off (recorded at MPN)	-	145	-	-
FIGAS Britten-Norman Islander (recorded at Stanley Airport)	-	148	-	-
Comparison with typical noise levels experienced by the public[3]	Chainsaw (120 dB)	-	Conversation (60 dB) Small penguin colony (65 – 69 dB)	Street in the evening (41 dB)

[1] An 'A-weighting' is normally applied to sounds measured by instruments in an effort to account for the 'loudness' as it is perceived by the human ear. Essentially, between 500 Hz and 6 kHz the human ear is much more sensitive, but below and above these frequencies the human ear is not particularly sensitive and the 'A-weighting' takes these sensitivities into account.
[2] Superpumas and S-61s are no longer used in the O&G industry.
[3] After NoMEPorts, 2008.

11.9.4.3.3 The distribution of the potentially affected residents and livestock

The only notable areas of dense human habitation in the Falkland Islands are found in Stanley and Mount Pleasant Complex (MPC). Heliports will be[95] located close to these communities and therefore air traffic and the human population converge here.

The distribution of Camp settlements and farms on the north of East Falkland is shown in Figure 11-10. Although livestock is widely spread at low density throughout much of the year, livestock corrals are generally associated with the settlements.

11.9.4.3.4 Overlap between helicopter flight paths and residential and livestock areas

Figure 11-10 highlights the distribution of sensitive environmental receptors and community settlements in the north of East Falkland.

11.9.4.3.4.1 Flights to the Sea Lion Field

Direct flightpaths between the two main heliports and the Sea Lion Field are indicated by the arrows. The flightpath from Stanley to the Sea Lion Field is on a bearing of 340° (I. Ewen, *pers. comm.*).

Direct routes to the Sea Lion Field from both Stanley and Mount Pleasant Airport (MPN), and between the two, will pass over three farms and settlements (Figure 11-10).

11.9.4.3.4.2 Flights to the CTT

A berthing crew will be transported from Stanley Airport by helicopter to the CTT at a safe distance from the FPSO and at least 12 nm from the Falkland Islands, using a similar approach route to that anticipated for normal FPSO crew change flights.

11.9.4.3.4.3 SAR Test Flights

SAR test flights may occur from MPN or from Stanley Airport, as occurred during the 2015 exploration campaign.

[95] Navitas intends to develop a heliport at Stanley airport in conjunction with FIG and this will be constructed in time to support Sea Lion Phase 1 & 2 operations. Stanley Airport has previously supported helicopter operations for the various exploration drilling campaigns.

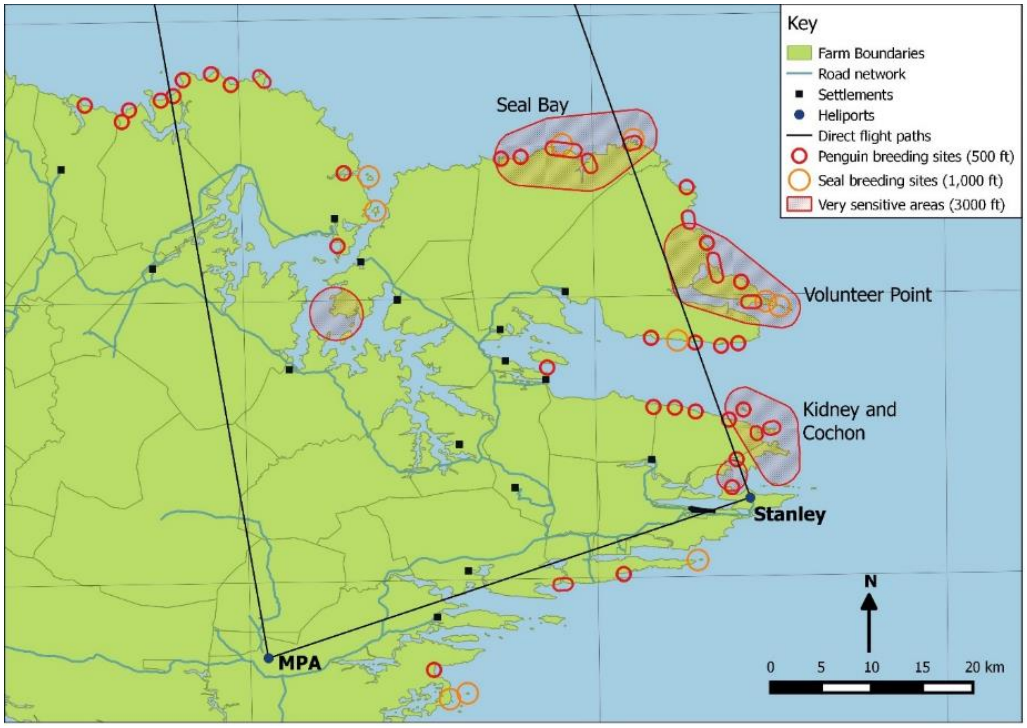


Figure 11-10: The distribution of sensitive wildlife receptors (see Section 10.2) and settlements in relation to the most direct helicopter flightpaths. Note: the arrows heading out to sea ultimately converge at the Sea Lion Field 220 km offshore. MPA refers to Mount Pleasant Airport

11.9.4.4 Quantification of other Phase 1 & 2 noise sources in Stanley

When characterising and quantifying the impact of noise in Stanley it is necessary to consider the:

- Type, location and timing of the Phase 1 & 2 noise sources near Stanley,
- Comparison of Phase 1 & 2 noise sources and duration with 2015 exploration campaign, and
- Estimation of Phase 1 & 2 noise levels near Stanley.

11.9.4.4.1 Type, location and timing of Phase 1 & 2 noise sources near Stanley

Noise types at the TDF and supply base during Phase 1 & 2 might include:

- Vessel engine noise,
- Lifting and loading at the TDF,
- Operation of the drilling mud and bulk mixing plant,
- Vehicles in the yard, including reversing alarms, and
- Lifting and moving equipment in the yard.

The previous operator of the Sea Lion Field, POEPL, made a successful application in January 2018 to the Falkland Islands Government (FIG) to vary the planning consent for the TDF to cover the duration of expected Phase 1 & 2 activities. Navitas is proposing future modifications to improve the dock's functionality. As described in Section 5.11.1.1.1, any proposals to upgrade the TDF facilities will have to go through the planning consent process. At the Planning Officer's discretion such applications may be accompanied by a full EIA. For the purposes of this EIS however, it is assumed that the TDF operations will be the same as they were during the 2015 exploration campaign.

The supply base is likely to be based in close proximity to the TDF, and outline planning permission has been granted by FIG as described in Section 5.11.1.2.

Both the TDF and supply bases may be operational 24 / 7 and thus may generate noise during the night.

A summary of the location and timing of Phase 1 & 2 noise sources, as compared to the 2015 exploration campaign is provided in Table 11.47 below.

11.9.4.4.2 Comparison of noise with 2015 exploration campaign

Specific data on anticipated Phase 1 & 2 noise levels from the varying sources are not available. Therefore, a comparison with the number and duration of noise sources during the 2015 exploration drilling campaign was made as it is assumed that the types of activity carried out during the Phase 1 & 2 Development activities at the TDF and the supply bases will be similar. Table 11.47 below summarises the number of sources and duration of noise at the TDF and at the supply base during the Phase 1 & 2 Development as they compare to the 2015 exploration campaign.

Following extrapolation of the number of vessels required and the area of yard space used during the 2015 exploration campaign, it is anticipated that during Stages 1 2a & 2b of the Phase 1 & 2 Development, the sources of noise from the yards could be greater, albeit not proportionally (Table 11.47). This will be for a period of approximately five and a half years. When the project progresses into steady state production (Stage 3), noise is likely to be less than that experienced during the exploration campaign.

Table 11.47: Source and duration of noise at the TDF and in the supply base during the Phase 1 & 2 Development as compared to the 2015 exploration campaign

Operation	Duration	Location	Activity at TDF and supply base	Comparison with 2015 exploration campaign	Potential implications for noise levels
Exploration drilling campaign					
2015	12 months	Current TDF location	2 supply vessels, 1 tug and 10 coasters (6 one way, 4 also counted on the return)	n/a	n/a
		Exploration drilling yard	51,000 m^2 of yard space		
Phase 1 & 2 Development					
Stage 1: Mobilisation and installation of materials and equipment, pre-First-Oil drilling by MODU, installation, HUC of the FPSO and 'First-Oil'	*c.* 2.5 years	Current TDF location	*c.* 10 vessels transiting to and from TDF	0.8 times number of vessels (including engine noise, lifting, loading and unloading from the TDF)	Vessel activity at the TDF is limited to 2 vessels, such that the noise level at any given time is unlikely to differ
		Operations Base location	127,500 m^2 of yard space	*c.* 2.5 times more yard space (including noise from vehicles, cranes, reversing alarms)	Potential for noise levels to be higher than during the 2015 campaign
Stage 2a & 2b: Post First-Oil drilling by the MODU (up to 15 wells), and concurrent production	*c.* 3 years	Current TDF location	*c.* 9 vessels transiting to and from TDF	0.7 times number of vessels (including engine noise, lifting, loading and unloading from the TDF)	Vessel activity at the TDF is limited to 2 vessels, such that the noise level at any given time is unlikely to differ

Operation	Duration	Location	Activity at TDF and supply base	Comparison with 2015 exploration campaign	Potential implications for noise levels
operations by the FPSO and oil export		Operations Base location	127,500 m^2 of yard space	*c.* 2.5 times more yard space (including noise from vehicles, cranes, reversing alarms)	Potential for noise levels to be higher than during the 2015 campaign
Stage 3: Steady phase production	*c.* 27 years	Current TDF location	*c.* 7 vessels transiting to and from the TDF per annum	*c.* 0.5 the number of vessels (including engine noise, lifting, loading and unloading from the TDF)	Potential for noise levels to be lower than during the 2015 campaign
		Operations Base location	20,000 m^2 of yard space	*c.* 0.5 the yard space (including noise from vehicles, cranes, reversing alarms)	Potential for noise levels to be lower than during the 2015 campaign

11.9.4.4.3 Estimation of Phase 1 & 2 noise levels near Stanley

In order to predict whether noise levels at the TDF and supply base might be acceptable based on commonly accepted standards (BS4142) (Section 11.9.4.1.1), noise attenuation calculations were undertaken. These were used to predict the attenuation that would be expected over a *c.* 1 km distance from the nearest residential location to the supply base / TDF, using appropriate assumptions for sound and environmental properties (Table 11.48).

These calculations show, for example, that a noise source with a sound power level of 110 dB(A), such as a diesel generator at the supply base, would result in a received noise level at the residential properties of 36.6 dB(A). A 6 dB(A) penalty for any potentially annoying characteristics of the sound tonality is added, giving a total received noise level at the residential properties of 42.6 dB(A). This is 0.9 dB above the average noise level during night and day (41.7 dB) measured by POEPL at Liberty Lodge (Section 11.9.4.2).

The British Standard 4142 states that if the commercial / industrial noise is around 5 dB higher than the background noise level, then this activity should be avoided (remembering that decibels are on a logarithmic scale such that an increase in sound level of 10 dB is equivalent to a doubling in the sound level). It also notes that if the noise is lower than the background, this is normally acceptable. An increase in background levels of around 0.9 dB therefore, may be acceptable to some but may disturb others (BS 4142). It is acknowledged that this is a guide only as, due to the subjective nature of disturbance from noise, some noises may still give rise to disturbance, despite being below the threshold.

Although all the received sound levels are below the WHO LAeq threshold of 50 dB(A), and as such are below the level likely to cause 'moderate annoyance in daytime and evening' (Section 11.9.4.1.1), the results in Table 11.48 indicate that unmitigated noise levels from certain activities could be near to 50 dB(A) and therefore could give rise to nuisance. Similarly, those that exceed the WHO night-time LAeq of 40 dB(A) could be more inclined to cause disturbance (Table 11.48).

Table 11.48: Example noise sources[1] from the supply base and TDF and the calculated received sound at nearest residences

Source example	Main frequency (Hz)	Sound power level (dB(A))	Received sound pressure level at nearby residences (dB(A))[2]	Received sound pressure level at nearby residences (dB(A)) + 6dB(A) penalty[3]	Difference to measured average background noise level (dB(A))	Potential outcome
75 kVA Diesel generator (BS5228-1:2009)	100	110	36.6	42.6	+2.1	Low to adverse impact
Inshore support vessels (as above)	63-100	96.8	23.4	29.4	-11.1	Low impact, normally acceptable
7.5 kW water pump (BS5228-1:2009)	125	106	32.5	38.5	-2	Low impact, normally acceptable
Reversing alarm (medium duty, manufacturer data)	1,000	114	40.2	46.2	+5.7	Adverse impact, should be avoided, if possible

[1] Note that there will be other smaller sources of noise from the supply base and TDF operations such as, for example, cars, lorries, tipper trucks and forklifts.
[2] Results calculated for 20 °C, 70 % humidity, mixed ground cover, no elevation difference.
[3] Although a 6 dB(A) penalty has been assumed, the penalty can be higher or lower depending on any specific unpleasant characteristics.

11.9.4.5 Quantification of other Phase 1 & 2 noise sources in Berkeley Sound

When characterising and quantifying the impact of noise in Berkeley Sound it is necessary to consider the:

- Location and timing of the noise sources in Berkeley Sound,
- Number of noise sources and duration of exposure in Berkeley Sound, and
- Airborne noise modelling.

11.9.4.5.1 Location and timing of noise sources in Berkeley Sound

Most of the OCV activity will be based around the LTVs in Berkeley Sound; each vessel will have its own individual 500 m exclusion zone. Navitas will work with FIG / Fisheries to identify optimum locations within Berkeley Sound that will cause the least disruption to other users and will strive to avoid periods of high marine traffic in the Sound. The OCVs will spend minimal amounts of time in the Sound while they collect equipment from the LTVs.

11.9.4.5.2 Number of noise sources in Berkeley Sound

The expected sources and duration of noise in Berkeley Sound during the Phase 1 & 2 Development are shown below in Table 11.49.

Table 11.49: Number, source and duration of noise in Berkeley Sound during the Phase 1 & 2 Development

Phase 1 & 2 Development Stage	Activity in Berkeley Sound	Duration of Presence in Berkeley Sound	Approximate number of noise sources in Berkeley Sound
Stage 1: Mobilisation and installation of materials and equipment, pre-First-Oil drilling by MODU, installation, HUC of the FPSO and 'First-Oil'	Up to 2 x LTVs anchored in Berkeley Sound 2 x OCVs transiting to and from the LTVs in Berkeley Sound	7 months	4 vessels (engine noise and lifting and loading noise from OCVs and LTVs)
Stage 2b: Post First-Oil drilling by the MODU, and concurrent production operations by the FPSO and oil export	Up to 2 x LTVs anchored in Berkeley Sound 2 x OCVs transiting to and from the LTVs in Berkeley Sound	5 months	4 vessels (engine noise and lifting and loading noise from OCVs and LTVs)
Stage 3: Steady state production		1 month[1]	

[1] Note the 1 month of this activity in Stage 3 happens in the 'interim Stage 3' between Stages 2a & 2b such that it directly precedes the 5 months of LTV activity in Stage 2b.

11.9.4.5.3 Airborne noise modelling

Noise modelling was carried out in Berkeley Sound as there is no point of comparison for the O&G industry as there is for Stanley, which has experienced noise from previous drilling campaigns. The activities planned for Berkeley Sound that may create additional noise are associated with the LTVs that will be anchored there and the associated visits of the OCV.

To enable brevity, the following sections provide only the information required to ensure appreciation and understanding of the modelling results and the impact assessment.

The following sections describe the:

- Modelling assumptions,
- Modelling of vessel noise around the proposed LTV anchorage location, and
- Summary of results.

11.9.4.5.3.1 Modelling assumptions

Given the standardisation of many vessel types according to their function and class requirements, it is possible to achieve reasonable correlations for noise output by different vessel classes. Therefore, a corresponding frequency profile was drawn from the Danish Ministry of the Environment (2010) which gives a noise profile from a Wartsila W6L32 engine exhaust stack. This type of engine is considered representative of the types of the vessels likely to be used. While there will be some noise from lifting and loading on the vessels, the majority of noise is generated by these engines. Table 11.50 provides a summary of the assumptions used in the model and the levels of noise modelled for each vessel.

Table 11.50: Main source assumptions used for modelling

Description	OCV[1]	LTV[1]
X coordinate (km) relative to the LTV anchorage	0.000	0.000
Y coordinate (km) relative to the LTV anchorage	0.000	-0.050
Elevation (m)	30	30
Source Noise Level, broadband sound power level dB(A)[2]	112.7	112.7

[1] OCV = Offshore Construction Vessel, LTV = Large Transport Vessel.
[2] Source levels are calculated from correlations in Danish Ministry of the Environment (2010).

11.9.4.5.3.2 Modelling of vessel noise in Berkeley Sound

Figure 11-11 plots the predicted noise levels (in dB(A)) from all vessels over an area 12 km by 24 km wide including the north and south shorelines of Berkeley Sound and receptors in line-of-sight to the west (Long Island Farm). Modelling shows that received levels from vessel noise are predicted to be up to 38 dB(A) at either shoreline and, since this is similar to existing vessel noise, and is below the WHO LAeq of 50 dB(A), it has been assumed that there would be no specifically annoying characteristics. The noise levels for assessment are 12 dB(A) lower than the level at which people experience 'moderate annoyance during the day', and 2 dB(A) lower than the WHO night-time level for sleep disturbance (Table 11.44 above). At the closest residence in this area (Long Island Farm), received noise levels from vessels are predicted to be around 24 dB(A).

Further, it should be noted that the noise modelling uses an attenuation method (ISO9613-2) that is widely used over open ground but which does not take account of topographical barriers. Relatively steep hills of around 100 m elevation or more exist to the north and south of Berkeley Sound which would dramatically attenuate (lessen) the noise heard in those directions e.g., towards Murrell Farm and Stanley. As such, noise levels in those directions are considered to be substantially less than those modelled at Long Island Farm.

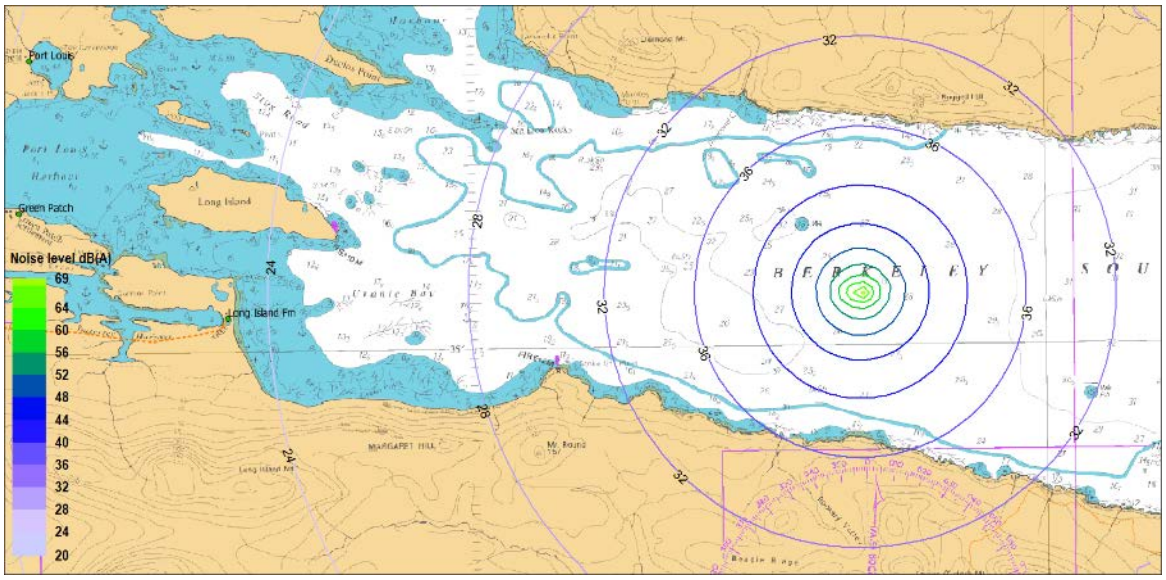


Figure 11-11: Received noise levels at a height of 1.5 m above ground from vessels operating around the proposed LTV Anchorage

11.9.4.5.3.3 Summary of modelling results

Table 11.51 compares the noise of the vessels operating, to the WHO Guidelines for Community Noise (1999) and the WHO Night Noise Guidelines for Europe (2009) (Section 11.9.5).

The noise levels received from the vessels at the Berkeley Sound shoreline and at Long Island Farm do not exceed the day or night-time thresholds. It is therefore considered unlikely that the current proposed operation will cause disturbance.

To further confirm whether noise sources in Berkeley Sound are acceptable or otherwise based on the WHO standards, further noise monitoring of the baseline in Berkeley Sound will be conducted throughout the Development and the results compared again to the WHO standards as per Table 11.51. For further detail on this monitoring, see Section 11.9.10.3.

Table 11.51: Berkeley Sound noise modelling results in comparison to WHO recommended levels

Noise Source	Modelled noise level received at Berkeley Sound shoreline	Modelled noise level received at Long Farm	WHO recommended level for daytime (WHO, 1999)	WHO recommended level for night-time (WHO, 1999 and WHO, 2009)
Vessels at the LTV Anchorage	38 dB(A)	24 dB(A)	50-55 dB(A)	40 dB(A)

11.9.5 Industry-standard mitigation

Relevant guidance on noise pollution includes:

- The International Finance Corporation (IFC) Environmental, Health and Safety (EHS) Guidelines: Noise Management (IFC, 2007a),
- Noise Management in European Ports (NoMEPorts): Good Practice Guide on Port Area Noise Mapping and Management (NoMEPorts, 2008),
- World Health Organisation (WHO) Guidelines for Community Noise (WHO, 1999),
- WHO Night Noise Guidelines for Europe (WHO, 2009),
- British Standard 4142:2014: Methods for rating and assessing industrial and commercial sound (BS4142, 2014),
- British Standard 5228:2009: Noise and Vibration Control on Construction and Open Sites (BS5228, 2009),
- Falkland Islands Low Flying Handbook (FILFH) Guidance (FILFH, 2024), and
- The Ministry of Defence's (MoD's) Falkland Islands Range and Avoidance Areas (5-GSGS) map (MoD, 2014).

Good working practice, in accordance with the above, will help to limit the amount of noise from the LTV operation as well as operations at the supply base e.g., maintaining vessel engines, design and layout of the base. Similarly, the design and working practices of the LTVs anchored in Berkeley Sound for the installation phase will aim to reduce any potential nuisance to local residents.

11.9.5.1 Mitigating the impact of helicopter use on livestock

While no industry-standard mitigations exist with regard to helicopter use in the O&G industry specifically, the FILFH Guidelines listed above which are specific to overflights have been developed in the Falklands to minimise the environmental impacts of disturbance from helicopters.

As described in Section 10.2, the simplest and most effective way to mitigate the effects of noise from helicopter overflights is to route helicopters away from aggregations of livestock. Following the example set by the MoD (MoD, 2014), and on other islands such as South Georgia, impact reduction methods (e.g., flight avoidance maps) can be used, which generally have a history of successful use and acceptance.

The key livestock avoidance areas are marked on the FILFH avoidance maps and the FILFH (2024) lists the following guidance:

- Sheep and Livestock Avoids - all aircrew, and particularly helicopter aircrew, are to be aware of the locals' concerns and are to avoid unnecessary over flight of livestock or known livestock grazing areas.

It is understood that during shearing season large flocks of sheep are gathered in preparation for shearing. The Military will invite landowners to notify HQ BFSAI (Mount Pleasant) of these areas of sheep concentrations and then promulgate them as temporary Notices To Airmen (NOTAMs), which

will be followed by Navitas' helicopters. Further, as the above is considered standard within the Falklands, Navitas will develop an approved project-specific flight plan which should be sufficient to mitigate the impact of helicopter disturbance to livestock (Section 11.9.4.1.2). Navitas will use the flight avoidance map as the basis for flight planning, following the Falkland Islands Low Flying Handbook Guidance (FILFH, 2024). All helicopter pilots will:

- Be briefed on flight avoidance protocols for sensitive areas prior to flying,
- Sign a document indicating that that the FILFH (2024) has been read and understood,
- Be accompanied by a pilot experienced in the area on their first flight, and
- Be issued with an approved flight path.

The above mitigation measures are taken into account during the initial impact assessment of helicopter noise described below (Section 11.9.6.1.2).

11.9.6 Impact assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of planned activities.

A summary of the impact assessment outcomes for this Development is tabulated in Section 11.9.12 which shows the worst-case impact for each activity and receptor and details are provided below.

11.9.6.1 Impacts of helicopter use

11.9.6.1.1 Disturbance to human population

Direct flight lines between MPN and the Sea Lion location, and those between MPN and Stanley Airport will pass over three settlements. However, the use of aircraft to transport passengers is an everyday occurrence in the Falklands so there is already a high degree of tolerance from people subjected to mild noise disturbance. Based upon the level of exposure, the sensitivity of the local population as a receptor to helicopter disturbance is therefore considered to be '**Low**'.

Stanley airport is sufficiently far from the nearest housing to negate the effect of helicopter noise. At times, it may be possible to hear the helicopters but the sound level experienced will be comparable with background noise. Equally, the SAR test flights may be carried out around MPN or around Stanley. Therefore, there should be no need for helicopters to overfly Stanley during normal operations, although this may happen in the case of a medivac situation when delivering patients to the King Edward VII Memorial Hospital (KEMH).

While every effort will be made to ensure that helicopters do not fly unnecessarily close to settlements, the impact of helicopter noise will be localised and short-term resulting in a barely detectable impact on the local population. Therefore, the severity of effect on Falklands' residents is considered to be '**Minor**'.

The overall significance of the impact of helicopter noise on Falklands' residents is therefore assessed as '**Low (4)**'.

11.9.6.1.2 Disturbance to livestock

Where animals are gathered e.g., for shearing or lambing, there is the potential to impact a high proportion of any one farms' livestock (Section 11.9.4.1.2). Direct flight lines from MPN to the Sea Lion Field and between MPN and Stanley Airport would also pass directly over, or close to, three settlements at which livestock may be corralled (Figure 11-10). Therefore, the sensitivity of receptor could be considered to be 'Very High'. However, as a flight plan, in line with the FILFH (Section 11.9.5.1), will be in place to ensure the avoidance of areas containing corralled livestock, the animals

will not actually be exposed to the helicopter noise. Therefore, the sensitivity of the receptor to the impact of helicopter noise can be considered to be '**Low**'.

As the FILFH compliant flight plan will prevent one-off or chronic exposure of corralled livestock to helicopter noise, the severity of effect of helicopter disturbance on livestock is considered to be '**Minor**'.

The overall significance of the impact of helicopter noise on livestock is therefore assessed as '**Low (4)**'.

11.9.6.2 Impact of noise disturbance in Stanley

While there is already a certain level of noise in the Gordon Lines area of Stanley (Section 11.9.4.1.1), noise was raised as an issue during the scoping consultations and it was noted that there have been complaints when boats are loading and unloading at FIPASS. Therefore, the sensitivity of receptor is considered to be '**Moderate**'.

Noise levels during the Sea Lion Phase 1 & 2 will be highest during the drilling and installation periods (Stages 1, 2a & 2b) when there will be the highest levels of vessel traffic in Stanley Harbour and most activity at the supply base (Section 11.9.4.1.1). Stages 1, 2a &2b will last for approximately five and a half years. Once into steady state production (Stage 3) which is the longest Stage of the operation, noise levels will decrease and level out. Therefore, on balance, the severity of effect is considered to be '**Minor**'.

Therefore, the overall significance of impact is '**Moderate (6)**', and project-specific mitigation measures to reduce the significance will be developed and implemented.

11.9.6.3 Impact of noise disturbance in Berkeley Sound

There are currently a variety of noise sources in Berkeley Sound from the fishing vessels and other vessels that use the Sound. However, noise was raised during the scoping consultations as a potential issue, and it was noted that there have been complaints about noise in the past. Therefore, the sensitivity of receptor is considered to be '**Moderate**'.

Noise modelling shows that the noise from the vessels involved is unlikely to pose a disturbance to the local residents as the sound of the vessels at the shoreline is lower than the WHO daytime and night-time thresholds (Section 11.9.4.1.1 above). The noise from the LTVs and associated operations will be short-term and intermittent however, the exact location of the LTVs is, as yet, undecided and therefore, to ensure a precautionary approach the Severity of Effect is considered to be '**Minor**'.

Therefore, the overall significance of impact is '**Moderate (6)**', and project-specific mitigation measures to reduce the significance will be developed and implemented.

11.9.7 Project-specific mitigation measures

11.9.7.1 Impact of helicopter use

As the impact of helicopter noise on humans and livestock is considered to be '**Low (4)**', there is no need to consider any additional project-specific mitigation measures.

11.9.7.2 Noise impact in Stanley

The introduction of operations at the TDF and the supply bases in east Stanley will increase noise levels in the area, particularly during the early stages of the Development. The following measures will be taken, where possible, to reduce noise impacts from the supply base, TDF and vessels alongside the TDF:

- Optimising the layout of the supply base to minimise sound propagation towards Stanley,

- Designing and managing construction and operations to minimise noise sources e.g., choice of site layout to minimise the travel of reversing alarm sounds or the use of white-noise reversing alarms,
- Application of specific mitigations for site equipment, based on noise calculations e.g., engine specification, enclosure and shielding of engines, auto-adjusting reversing alarms which alter output to suit the ambient noise level, or 'night-shift' alarms with lower output,
- Restrictions on the types of operations that can be undertaken at night to minimise night-time disturbance, and
- Loading of cargoes at the TDF will be prioritised for daytime operations.

11.9.7.3 Noise impact in Berkeley Sound

It is likely that the noise impact of the LTVs and associated operations will be minimal. However, the initial impact assessment retains a conclusion of '**Moderate (6)**' as a precautionary approach given that the final location of the LTVs is currently undecided. Therefore, noise impact from these operations shall be mitigated using the following methods:

- LTV engine use will be minimised,
- OCVs will, by preference, moor to the LTVs for cargo transfer, and avoid the use of dynamic positioning, and
- Cargo transfer operations will avoid, where practicable, between the hours of 11pm to 6am.

11.9.8 Residual impacts

11.9.8.1 Impact of helicopters

No residual assessment was carried out for impacts to the human population or livestock for which the impact assessments were considered to be '**Low (4)**'.

11.9.8.2 Noise impact in Stanley

The minimisation of noise where possible at the TDF and supply bases will reduce the severity of the impact to '**Slight**'.

With project-specific mitigation measures in place therefore, the significance of the residual impact of noise disturbance in Stanley is reduced to '**Very Low (3)**'.

11.9.8.3 Noise impact in Berkeley Sound

The minimisation of noise where possible within Berkeley Sound will reduce the severity of the impact to '**Slight**'.

With project-specific mitigation measures in place therefore, the significance of the residual impact of noise disturbance in Stanley is reduced to '**Very Low (3)**'.

11.9.9 Cumulative impact

Human settlements and industry onshore will always be sources of noise pollution. In the Falklands, these are primarily associated with the two major population centres, Stanley and MPC. Additionally, Berkeley Sound (the proposed LTV site) is used as an anchorage for the trans-shipment of fish and is also a seasonal source of noise. The following sections assess the potential for cumulative impacts at these two sites.

11.9.9.1 Stanley

Sources of existing anthropogenic noise in Stanley include all housing, industry and human activity in the town. At the east end of Stanley, where the TDF and supply base will be operating, the area is

already designated for 'a mixture of heavy and light Industrial, warehousing and storage' within the Stanley Town Plan (FIG, 2015d). The area proposed as the Operation Base is located adjacent to other operating yards and the TDF is already in place, although, at the time of writing, not in operation.

The peak of activity in Stages 1, 2a & 2b, will add in 'concentration' (Section 8.9.1) to the noise in the area. This period will last for approximately five and a half years.

Once into steady state operations (Stage 3) the activity, and hence noise, will reduce to below levels experienced during the 2015 exploration drilling campaign.

11.9.9.2 Berkeley Sound

Sources of existing anthropogenic noise within Berkeley Sound are summarised in Section 11.9.4.2.2. It was noted during the scoping consultations that the jiggers can be heard from local settlements around Berkeley Sound. In addition to the jiggers, other vessels use Berkeley Sound as an anchorage, primarily for the trans-shipment of fish catches.

Although vessels can be present in all months of the year, activity peaks between March and June, when tens of vessels can be present, but this varies considerably from year-to-year (Section 7.7.3.2.4). The LTVs and OCVs will, where practicable, avoid this period and so will not add to this in terms of 'increased concentration' and 'increased extent and proportion' (Section 8.9.1). This approach will however lead to an 'increased duration' (Section 8.9.1). At peak times, Navitas' activities will have less of an impact over and above the existing baseline as they will be one of many vessels in the Sound. At other times of the year, there may be very few vessels using Berkeley Sound and therefore Navitas' activities will add incrementally to the current baseline noise level and thus may have a more discernible impact.

11.9.10 Confidence

11.9.10.1 Helicopter use

The project activities are clearly defined in terms of the:

- Start and end points of flights,
- Frequency of flights, and
- Adherence to project-specific flight plans.

Equally, the locations of receptors (e.g., human populations and corralled livestock) are known.

Nonetheless the impact of noise on the human population is highly subjective such that the confidence in the assessment of impacts to humans is considered to be '**Probable**'.

While the long-term consequences of the impact of noise on livestock are not fully understood, the use of the flight plan will take account of tried and tested mitigation measures such that the confidence in the assessment of impacts to livestock is considered to be '**Certain**'.

11.9.10.2 Noise in Stanley and Berkeley Sound

The approximate timing of activities and type of vessels anticipated for use during the different options for the Phase 1 & 2 Development of the Sea Lion Field are well understood whilst the noise that may be emitted from the LTVs, supply base and TDF is not.

The nature of the potential impact on the receptor (people) is understood but it is a very subjective issue and is therefore difficult to predict. Scoping consultations highlighted that noise may be considered an issue by some. Further consultations may be required to better understand the sensitivity of local residents to noise and, once operations start, a clear complaints procedure will be in place, as well as a monitoring programme to record baseline noise levels (Section 11.9.10.3 below).

There is some uncertainty in the modelling conducted in that there are certain rare weather conditions, i.e., temperature inversions over water, in which sound levels may be higher than predicted by the model and it is not known how often these weather conditions may occur.

With the available data, the level of confidence in the impact predictions (in terms of the nature of the impact and its level of significance) is considered to be '**Probable**'.

11.9.10.3 Monitoring required

In order to confirm whether noise sources at the TDF, supply base and Berkeley Sound might be acceptable based on commonly accepted standards (BS4142), further noise monitoring of baselines and typical noise levels created by normal activities at the TDF, supply base and Berkeley Sound will be conducted. Further baseline monitoring will be undertaken to strengthen the basis of the assessment and to inform operations and monitoring programmes.

Performance of key activities that have the potential to lead to disturbance will be monitored and managed through periodic monitoring at relevant sites as is described in the Disturbance from Light chapter (see Section 11.8).

Detailed monitoring requirements have been established during the Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the project-specific Phase 1 & 2 EMMP (an outline EMMP is provided in Chapter 15).

11.9.11 Offsetting

For significant residual and impact and risks ('Moderate' or above), offsetting *via* a Carbon and Biodiversity Offsetting Fund is proposed, see Section 8.11 for further details.

11.9.12 Findings summary

Table 11.52: Summary of the of the social impact assessment for noise disturbance during the Sea Lion Phase 1 & 2 Development

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity[1]	Severity[1]	Likelihood[1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Helicopter use	Helicopter noise	Annoyance, sleep disturbance	Planned	1, 2a, 2b & 3	Low	Minor	n/a	**Low (4)**	**Low (4)**	**Probable**	**Industry standard:** Flight plan Follow FILFH Guidelines Be accompanied by an experienced pilot on their first flight **Project-specific:** n/a
		Disturbance to livestock			Low	Minor	n/a	**Low (4)**	**Low (4)**	**Certain**	
Operations at the TDF and supply base	Vessel, TDF and yard noise	Annoyance, sleep disturbance to Stanley residents	Planned	1, 2a, 2b & 3	Moderate	Minor	n/a	**Moderate (6)**	**Very Low (3)**	**Probable**	**Industry-standard:** Good working practice and design e.g. Maintaining engines, design and layout of the base. **Project-specific:** Optimising layout to minimise noise disturbance, Equipment specifications to minimise noise, and Daytime loading of cargoes at the TDF prioritised.
LTV / OCV operations	Vessel noise	Annoyance, sleep disturbance	Planned	1 & 2	Moderate	Minor	n/a	**Moderate (6)**	**Very Low (3)**	**Probable**	**Industry-standard:** Good working practice and design e.g., Maintaining vessel engines, **Project-specific:** Engine use minimised,

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity[1]	Severity[1]	Likelihood[1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
											Vessels coming alongside rather than using DP, and Cargo transfers striving to avoid 11 pm – 6 am

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

12 ACCIDENTAL AND CHRONIC OIL POLLUTION IMPACT AND RISK ASSESSMENT

Table of Contents

12.1 Accidental and chronic oil pollution offshore 1121
12.2 Inshore fuel oil spill 1234
12.3 At-shore and onshore fuel oil and chemical spills 1266

12.1 Accidental and chronic oil pollution offshore

Table of Contents

12.1 Accidental and chronic oil pollution offshore 1121
12.1.1 Introduction 1124
12.1.1.1 Legislation relevant to oil and diesel spills 1124
12.1.1.1.1 National Oil Spill Contingency Plan (NOSCP) 1125
12.1.1.1.2 Offshore Oil Spill Strategy 1125
12.1.1.1.3 Oil Pollution Emergency Plan (OPEP) 1125
12.1.1.1.4 Wildlife Response 1126
12.1.1.1.5 Spill reporting and the PON8 1126
12.1.2 Sources of potential offshore oil spills 1127
12.1.2.1 Large oil spills 1127
12.1.2.1.1 Scenario 1: subsea well blow-out 1127
12.1.2.1.2 Scenario 2: loss of the FPSO crude oil inventory 1127
12.1.2.1.3 Scenario 3: crude oil transfer spill 1127
12.1.2.1.4 Scenario 4: loss of the MODU MGO inventory 1128
12.1.2.1.5 Scenario 5: MGO bunkering spill 1128
12.1.2.2 Small scale releases 1128
12.1.2.3 Loss of MODU riser contents containing NADF 1128
12.1.3 Potential environmental receptors 1128
12.1.4 Characterising and quantifying the risk of oil spills 1129
12.1.4.1 Influencing factors 1129
12.1.4.1.1 Oil type and behaviour 1129
12.1.4.1.1.1 Sea Lion crude 1129
12.1.4.1.1.2 Marine diesel or Marine Gas Oil (MGO) 1136
12.1.4.1.1.3 Non-Aqueous Drilling Fluids 1136
12.1.4.1.2 Fate of oil in the marine environment 1137
12.1.4.2 Nature of the impacts 1138
12.1.4.2.1 Plankton 1139
12.1.4.2.2 Benthic communities 1140
12.1.4.2.3 Fish and squid 1140
12.1.4.2.3.1 Displacement from feeding grounds 1140
12.1.4.2.3.2 Contamination of fish and squid 1141
12.1.4.2.4 Seabirds 1142
12.1.4.2.4.1 Direct contamination 1143
12.1.4.2.4.2 Ingestion 1144
12.1.4.2.4.3 Seabird vulnerability to oil pollution 1144
12.1.4.2.5 Marine mammals 1146
12.1.4.2.5.1 Pinnipeds 1146
12.1.4.2.5.2 Cetaceans 1146
12.1.4.2.6 Coastal impacts 1147
12.1.4.2.7 Fisheries (Human population) 1148
12.1.4.2.7.1 Spawning aggregations 1148
12.1.4.2.7.2 Tainting and contamination of fish and squid 1149
12.1.4.2.8 Tourism 1150

12.1.4.3 Oil spill modelling 1150
12.1.4.3.1 The OSCAR modelling approach 1150
12.1.4.3.2 Discharge parameters and assumptions used in the modelling 1151
12.1.4.3.3 Reporting thresholds defined in the model 1153
12.1.4.3.3.1 Thickness / density of oil on the surface 1153
12.1.4.3.3.2 Total water column concentration 1153
12.1.4.3.3.3 Sediment concentration 1154
12.1.4.3.4 Understanding the model 1154
12.1.4.3.4.1 Model parameters 1155
12.1.4.4 Scenario 1: Subsea well blow-out - modelling results 1156
12.1.4.4.1 Predicted behaviour of oil 1156
12.1.4.4.2 Subsea Well Blow-Out - Surface results 1157
12.1.4.4.2.1 Model predictions after oil has been at sea for long periods 1158
12.1.4.4.3 Subsea Well Blow-Out - Water column results 1163
12.1.4.4.4 Subsea Well Blow-Out - Shoreline results 1165
12.1.4.4.5 Subsea Well Blow-Out – Sediment concentration 1168
12.1.4.4.6 Subsea Well Blow-Out - Effect of oil spill response measures 1168
12.1.4.5 Scenario 2: Loss of FPSO crude oil inventory - modelling results 1170
12.1.4.5.1 Predicted behaviour of oil 1170
12.1.4.5.2 FPSO crude inventory Loss - Surface results 1171
12.1.4.5.3 FPSO crude inventory Loss - Water column results 1176
12.1.4.5.4 FPSO crude inventory Loss - Shoreline results 1178
12.1.4.5.5 FPSO crude inventory Loss – Sediment concentration 1181
12.1.4.5.6 FPSO crude inventory Loss - Effect of oil spill response measures 1181
12.1.4.6 Scenario 3: Crude oil transfer spill - modelling results 1183
12.1.4.6.1 Predicted behaviour of oil 1183
12.1.4.6.2 Crude oil transfer spill - Surface results 1184
12.1.4.6.3 Crude oil transfer spill - Water column results 1185
12.1.4.6.4 Crude oil transfer spill - Shoreline results 1185
12.1.4.6.5 Crude oil transfer spill – Sediment concentration 1187
12.1.4.6.6 Crude oil transfer spill - Effect of oil spill response measures 1187
12.1.4.7 Scenario 4: Loss of MODU MGO inventory - modelling results 1187
12.1.4.7.1 Predicted behaviour of oil 1187
12.1.4.7.2 Loss of MODU MGO inventory - Surface results 1188
12.1.4.7.3 Loss of MODU MGO inventory - Water column results 1190
12.1.4.7.4 Loss of MODU MGO inventory - Shoreline results 1190
12.1.4.7.5 Loss of MODU MGO inventory - Effect of oil spill response measures 1191
12.1.4.8 Scenario 5: MGO bunkering spill - modelling results 1192
12.1.4.8.1 Predicted behaviour of oil 1192
12.1.4.8.2 MGO bunkering spill - Surface results 1192
12.1.4.8.3 MGO bunkering spill - Water column results 1195
12.1.4.8.4 MGO bunkering spill - Shoreline results 1195
12.1.4.8.5 MGO bunkering spill - Effect of oil spill response measures 1195
12.1.4.9 Small scale releases 1195
12.1.4.10 Loss of riser contents 1196

12.1.5 Industry-standard mitigation measures 1196
12.1.6 Risk Assessment 1199
12.1.6.1 Scenario 1: Subsea well blow-out 1199
12.1.6.1.1 Sensitivity of receptor and severity of effect (impact assessment) 1199
12.1.6.1.2 Likelihood of occurrence 1200
12.1.6.1.3 Overall risk significance 1201
12.1.6.2 Scenario 2: Loss of FPSO crude oil inventory 1206
12.1.6.2.1 Sensitivity of receptor and severity of effect (impact assessment) 1206
12.1.6.2.2 Likelihood of occurrence 1206
12.1.6.2.3 Overall risk significance 1207
12.1.6.3 Scenario 3: Crude oil transfer spill 1210
12.1.6.3.1 Sensitivity of receptor and severity of effect (impact assessment) 1210
12.1.6.3.2 Likelihood of occurrence 1210
12.1.6.3.3 Overall risk significance 1211
12.1.6.4 Scenario 4: Loss of MODU MGO inventory 1214
12.1.6.4.1 Sensitivity of receptor and severity of effect (impact assessment) 1214
12.1.6.4.2 Likelihood of occurrence 1214
12.1.6.4.3 Overall risk significance 1214
12.1.6.5 Scenario 5: MGO bunkering spill 1218
12.1.6.5.1 Sensitivity of receptor and severity of effect (impact assessment) 1218
12.1.6.5.2 Likelihood of occurrence 1218
12.1.6.5.3 Overall risk significance 1218
12.1.6.6 Small scale releases of oil 1221
12.1.6.6.1 Sensitivity of receptor and severity of effect (impact assessment) 1221
12.1.6.6.2 Likelihood of occurrence 1221
12.1.6.6.3 Overall risk significance 1221
12.1.6.7 Loss of riser contents 1221
12.1.6.7.1 Sensitivity of receptor and severity of effect (impact assessment) 1221
12.1.6.7.2 Likelihood of occurrence 1222
12.1.6.7.3 Overall risk significance 1222
12.1.7 Project-specific mitigation measures 1222
12.1.8 Residual impacts and risks 1222
12.1.9 Cumulative impact 1223
12.1.10 Confidence 1223
12.1.10.1.1 Monitoring required 1225
12.1.11 Offsetting 1225
12.1.12 Findings summary 1225

12.1.1 Introduction

The marine environment is contaminated with both anthropogenic (man-made) and natural sources of hydrocarbons. The main anthropogenic inputs include direct spills of petroleum products and atmospheric deposition from combustion. Natural sources include atmospheric deposition from forest fires and volcanic eruptions. Oil pollutants have greater impacts in enclosed and semi-enclosed marine environments than in the open sea.

Along with the potential environmental impacts from planned development activities, impacts may arise from unplanned / accidental events and this was raised as a concern by stakeholders during the 2014, 2015 & 2016 scoping consultations (Chapter 6). Crude oil and fuel spills are unplanned events, which would result in environmental impacts if they occurred. The nature, extent and significance of these impacts will depend on a number of variables associated with the event, including, for example, the properties of the oil released, the size of spills, prevailing weather conditions and the sensitivity, density and distribution of environmental receptors in relation to the spill.

This chapter assesses the risks and potential impacts on environmental receptors in the offshore marine environment of seven scenarios, including five specific oil spill scenarios as well as those associated with low-level but chronic oil pollution and a loss of marine riser contents during drilling.

Note: the impacts associated with other discharges to sea are described elsewhere in this document, as outlined in Table 2.2.

Note: oil spill waste and the procedure for dealing with oil spill clean-up waste is described in Section 10.10.2.2.3.

12.1.1.1 Legislation relevant to oil and diesel spills

Much of the legislation applied to the Oil and Gas (O&G) industry is in place to prevent accidental events and is therefore relevant to oil spills. More specifically, the following legislation is related directly to discharges and spills in the marine environment.

- International legislation:
  - International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC Convention).
  - International Regulations for Preventing Collisions at Sea (ColRegs) (1972).
  - International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78 Annex I on the Prevention of Pollution by Oil.
- UK legislation:
  - The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 2020.
  - The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended Regulations 2011).
  - Offshore Installations (Emergency Pollution Control) Regulations 2002.
  - Merchant Shipping (Oil Pollution Preparedness, Response & Co-operation Convention) Regulations 2015.
- Falkland Islands legislation:
  - Maritime Ordinance 2017 (and Amendments).
  - Maritime (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 2019.
  - Harbours and Ports Ordinance 2017.

- Merchant Shipping (Regulation of Ships) Regulations 2001.
- Offshore Petroleum (Licensing) Regulations 1995.
- Offshore Petroleum (Licensing) Regulations 2000 (as amended).
- Offshore Minerals Ordinance 1994 (as amended).
- Oil in Territorial Waters Ordinance 1960.
- Maritime (Ship to Ship Transfer) Regulations 2023.
- PON 08 Oil Pollution, requires that all release of oil to the sea must be reported as soon as possible to:
  - The Department of Mineral Resources as regulator, and
  - The Falkland Islands Maritime Authority (FIMA) as incident commander under the National Oil Spill Contingency Plan (NOSCP).

12.1.1.1.1 National Oil Spill Contingency Plan (NOSCP)

The FIMA is the lead agency charged with the safety of seafarers, the safety of ships and protection of the marine environment, as well as responding to marine oil spills within the 12 nautical mile (nm) territorial limit and 200 nm Exclusive Economic Zone (EEZ). The NOSCP currently reflects the most likely type of spill expected, namely minor spills within the harbours. Oil spill response equipment is stored at the Falklands Interim Port And Storage System (FIPASS) to counter this risk. Offshore, the NOSCP (FIG, 2022b) relies on the use of dispersants providing that the oil and environmental conditions are suitable.

Due to the limited response capability in the Falkland Islands, O&G operators are obliged to provide equipment and contingency plans to mount an effective response to oil spilled from their facilities. Oil Spill Emergency Plans (OPEPs) submitted to the Falkland Islands Government (FIG) are required to be compatible with the NOSCP.

12.1.1.1.2 Offshore Oil Spill Strategy

An Offshore Oil Spill Strategy for the Sea Lion Development was previously developed (Premier, 2019b), which identified the essential components of spill response for the project.

12.1.1.1.3 Oil Pollution Emergency Plan (OPEP)

Navitas will submit an OPEP as a separate document, which contains specific operational information such as detailed action lists and contact details for personnel. As described below, the OPEP will outline the responsibilities, actions, reporting requirements and resources available to ensure the effective and timely management of an accidental spill, and will be compatible with the NOSCP.

The OPEP will consist of a tiered response framework that is related to the magnitude of any spill event. Response and preparedness levels will be organised according to the International Petroleum Industry Environmental Conservation Association (IPIECA) / IMO international standard model of 'Tiered preparedness and response', defined as follows:

- **Tier 1 Spills:** An oil spill that will be mitigated solely using the local offshore response resources held by Navitas as defined within the OPEP.
  - Tier 1 spills will either be contained using local recovery equipment or monitored as it dissipates. A boom system and a skimmer[96] will be deployed on the Multi Role Support Vessel (MRSV) and Anchor Handling Tug Supply (AHTS) vessels, also referred to as an

[96] Note that the CEDRE investigation into the Sea Lion crude concluded that neither oleophilic nor weir skimmers would be effective for Sea Lion crude and that belt skimmers should be considered the most appropriate equipment (CEDRE, 2017). Oleophilic weir skimmers will only be deployed for response to MGO spills.

Anchor Handling Vessels (AHVs). Recovered oil will be stored in storage bladders and returned *via* a specifically mobilised recovery tanker for final disposal. Surveillance will be carried out either using aerostat balloons, drones and / or helicopter.

- **Tier 2 Spills:** An oil spill requiring support and resources from other local Navitas resources, oil operators / stakeholders in the Falkland Islands. The spill will be reported and Navitas will consult with the FIG NOSCP incident command, as required.
  - Tier 2 spills will be contained using the Tier 1 and 2 local equipment as described in Section 5.11.1.2.3. These resources will be supported by an *additional* AHTS or MRSV. Assuming that one Navitas vessel is already engaged in response, the Tier 2 response will be drawn from the remaining 1-3 Navitas MRSV / AHTS vessels present in the area. All such vessels would be classified to operate in the offshore location and equipped with identical specification response equipment, and
  - Surveillance will be carried out either using aerostat balloons or helicopter (MGO only). For Sea Lion crude, long-wave infra-red surveillance equipment, and satellite surveillance will be made available for use.
- **Tier 3 Spills:** An oil spill incident requiring international resources. The FIG NOSCP will be activated with national and, where necessary, international resources being deployed. These resources will be made available from the appointed international spill response provider stockpile within 96 hours of request; personnel might be deployed more quickly. In addition to the Tier 1 and Tier 2 resources already described, Navitas will have arrangements in place to mobilise resources from international oil spill response providers and local contractors if necessary to:
  - Supply offshore containment and recovery services: at sea recovery may not always be feasible in the Falkland Islands due to prevailing sea conditions,
  - Request satellite surveillance and conduct oil spill modelling,
  - Prepare for any shoreline response, if required: equipment is available for shoreline protection and clean-up, and
  - Aerial surveillance would be conducted using local aviation resources but might be bolstered by experienced observers from international oil spill providers.
- All spills are reported *via* a PON8 (Section 12.1.1.1.5).

12.1.1.1.4 Wildlife Response

Navitas has previously investigated optimal arrangements and providers for wildlife response and the OPEP will detail these arrangements. A wildlife response plan will also be developed and be in place before commencement of operations.

12.1.1.1.5 Spill reporting and the PON8

In line with the Offshore Petroleum (Licensing) Regulations 1995 and 2000 (Model Clause 21(8) of Schedule 2), the PON8 sets out the requirements for notifying the authorities of any oil spill (regardless of size) and provides a *pro forma* template, with contact details, to be completed.

In summary, spills of any size must be reported, *via* the PON 8 to the:

- FIG Department of Mineral Resources as regulator, and
- FIG FIMA as incident command for the NOSCP.

Note that the PON8 also requires information on oil sheens associated with produced water to be reported (Section 3.1.7.4).

12.1.2 Sources of potential offshore oil spills

Sources of oil pollution from the O&G industry are many and varied and include catastrophic spill events as well as small scale and chronic releases.

During the ENVironmental Impact Identification (ENVIID) workshop, a number of oil spill scenarios were identified and selected for further assessment. These include:

- Large oil spills:
  - Scenario 1: A subsea well blow-out,
  - Scenario 2: The complete loss of the Floating Production, Storage and Offloading (FPSO) vessel's crude oil inventory plus two tanks of the offload tanker,
  - Scenario 3: A crude oil transfer spill during FPSO offloading to the purchaser's Conventional Trading Tanker (CTT),
  - Scenario 4: The loss of the Mobile Offshore Drilling Unit's (MODU's) diesel (or Marine Gas Oil (MGO)) inventory, and
  - Scenario 5: An MGO bunkering spill.
- Small scale / chronic oil releases, and
- Loss of MODU riser contents containing NADF.

12.1.2.1 Large oil spills

12.1.2.1.1 Scenario 1: subsea well blow-out

In the unlikely event that all the preventative industry-standard safeguards and controls fail (Section 12.1.5), it is possible that crude oil could 'kick' into the wellbore leading to an uncontrolled release or 'blow-out'. Once drilling finishes the likelihood that a well blow-out may occur decreases (Section 5.4.9).

12.1.2.1.2 Scenario 2: loss of the FPSO crude oil inventory

While it is possible that extreme and freak weather conditions could impact the FPSO, the FPSO will be designed to ensure it is able to withstand the range of environmental conditions in the North Falkland Basin (NFB).

In addition, the FPSO will be anchored *via* a detachable turret and therefore, will be able to move off-station, if considered necessary. Therefore, although highly unlikely to occur, the only credible events that could lead to a scenario in which the FPSO loses its entire crude oil inventory would be a collision with a large vessel transiting through the area (Section 11.1) or a collision with an iceberg. Collision risk assessments have been conducted for both of these scenarios and are presented in Anatec (2024b) 'Sea Lion Offshore Development Vessel Collision Risk Assessment' (Ref: A5274-NVP-VCRA-1). Navitas will also have an Iceberg Management Plan in place prior to commencement of operations.

UK OPEP Guidelines (BEIS, 2022a) have been followed which requires that loss of the full FPSO inventory has been assessed.

12.1.2.1.3 Scenario 3: crude oil transfer spill

Following production and processing, crude oil will be stored on the FPSO. Once full, it will be necessary to offload the crude from the FPSO to a CTT. Offloading to the CTT may occur twice in any given export cycle to ensure that the CTT is full prior to its departure.

While offloading operations are a planned activity, there is the potential for a failure of the transfer hose and the resultant loss of crude at the offshore location during the transfer process. While such

spills would most likely be small as the offloading process would cease as soon as any leak or spill was detected.

The likelihood of any failure modes that can lead to a hose failure are discussed further below (Section 12.1.6.3.2) and a potential worst-case is assessed in this chapter.

12.1.2.1.4 Scenario 4: loss of the MODU MGO inventory

As with the FPSO in Scenario 3, the only credible scenarios which could lead to the loss of the entire MGO inventory from the rig would involve a catastrophic impact from a large vessel or iceberg. This scenario could equally apply to the FPSO; however, the MODU was modelled as it has a larger MGO inventory.

12.1.2.1.5 Scenario 5: MGO bunkering spill

While all industry-standard safeguards will be in place (Section 12.1.5), there is the potential for spills of MGO to occur during bunkering operations. While such spills would most likely be small as the bunkering process would cease as soon as any leak or spill was detected, this chapter assesses the potential worst-case scenario.

12.1.2.2 Small scale releases

Chronic oil pollution refers to the accumulation of oil from numerous sources (NRC,1985 and 2003).

Specifically, chronic oil pollution can result from:

- Legally compliant operational discharges with low-level oil in water (OiW) concentrations e.g., drainage, bilge and produced water discharges,
- Discharge of off-specification operational discharges between samples, and
- Small and discrete accidental oil spills.

Note: the potential impacts of oil sheens forming from legally compliant or off-spec operational discharges, and their contribution to chronic oil pollution, are described in Section 10.7.

12.1.2.3 Loss of MODU riser contents containing NADF

During the 2015 exploration drilling campaign, the MODU lost station due to failure of the Dynamic Positioning (DP) system which resulted in the loss of the riser contents to the sea. This resulted in the loss of 450 kg of Water-based Mud (WBM) to sea. Some sections of the Phase 1 & 2 Development wells will be drilled with a Non-Aqueous Drilling Fluid (NADF), which would cause greater environmental impact than WBM if released. However, the MODU will be anchored to the seabed and will not be maintained on station by DP. The risk of losing station is therefore greatly reduced and the loss of riser contents due to an emergency disconnect has been scoped out of this assessment as is indicated in the ENVIID report (Chapter 9).

Nonetheless, it is possible that the contents of the riser (approximately 60 m^3 of NADF) may be lost due to other reasons and as such, is included in the assessment below.

12.1.3 Potential environmental receptors

The ENVIID workshop was used to identify those receptors upon which the impacts and / or risks of oil spills warranted further investigation (Chapter 9). These include:

- Water quality and plankton (Section 7.4.1),
- Sediment quality and benthic communities (Section 7.4.3),
- Fish and squid (Section 7.4.4),
- Seabirds (Section 7.4.6),

- Marine mammals (Section 7.4.5),
- Coastal communities / ecology including marine flora (Section 7.6),
- Fisheries (Human population) (Section 7.7.3.1), and
- Tourism (Human population) (Section 7.7.4.6).

These receptors may be impacted upon as they either exist in, or spend time in, the area that could be influenced by an accidental release of oil into the marine environment.

12.1.4 Characterising and quantifying the risk of oil spills

When characterising and quantifying the impacts of oil spills, it is necessary to consider the following:

- Influencing factors:
  - Type and composition of oil, and
  - The fate of oil in the marine environment.
- The nature of the impact on each of the different receptors (Section 12.1.3),
- Spill modelling parameters, and
- Spill modelling results for:
  - Scenario 1: Well blow-out,
  - Scenario 2: Loss of FPSO crude inventory,
  - Scenario 3: Spill during crude oil transfer,
  - Scenario 4: Loss of MODU MGO inventory, and
  - Scenario 5: MGO bunkering spill.

12.1.4.1 Influencing factors

12.1.4.1.1 Oil type and behaviour

The type of oil can influence the nature of the impact to receptors. Some receptors are more vulnerable to the physical impacts of heavier crudes, others to chemical toxicity of lighter oils and NADFs, while others still are relatively resilient.

In general, heavier crude oil is more likely to cause fouling but is less toxic than refined oils. Toxic effects occur when oil components are bioavailable to the organisms being exposed. Volatile aromatic compounds, such as benzene, toluene and Poly-Aromatic Hydrocarbons (PAH), are highly toxic, can cause internal damage and can bioaccumulate in food chains. In the water column they are relatively short-lived, e.g., 98 - 99.9 % biodegradation of dissolved PAH in 28 days (SINTEF oil weathering database), whereas once in sediments, they can persist for much longer. In coastal waters, PAHs are concentrated in marine sediments where squid and other molluscs are particularly subject to exposure, and PAHs can be persistent in marine sediments or in the tissues of some animals.

12.1.4.1.1.1 Sea Lion crude

Sea Lion crude is an atypical oil given its extremely high wax content (42.3 % (Section 5.3)), which is greater than any analogue in the oil weathering databases held by the international research centres at CEDRE and SINTEF. Crude oils with high wax contents tend to solidify rapidly on release as the oil cools to ambient temperatures. Tests were undertaken to determine the weathering, behaviour and potential impacts of Sea Lion crude. A summary of results (Table 12.1) and some representative images are presented below (Figure 12-1). For full details see CEDRE (2017).

The behaviour of oil / wax particles resulting from a release were tested at CEDRE in simulated conditions of the NFB marine environment over a seven day period, and also with breaking wave conditions for a further three days. The oil masses that initially formed from pouring the oil into cold

water were in the size range of centimetres and showed little breakdown in particle size over time (CEDRE, 2017). The initial conditions of any release will determine the initial size and shape of cooled oil masses. For example:

- A subsea blow-out will tend to result in small oil masses due to the high turbulence and shear forces including gas at the wellhead (seen in small scale trials (CEDRE, 2017)),
- Small spills similarly may result in small oil masses (CEDRE, 2017), and
- Large spills will tend to form larger masses.

Table 12.1: Summary of results of CEDRE Sea Lion crude oil tests (CEDRE, 2017)

Aspect	Test results	Implication for risk assessment and / or spill response
Specific Gravity (s.g.)	S.g. is 0.833, i.e., the density is 0.833 tonnes per cubic metre	Less dense than seawater (s.g. 1.027) and readily floats
Wax content	Very high wax content of 42.3 % measured by the wax crystallization method	The crude is solid at ambient temperature and resists physical breakup into smaller particles
Pour point	Oil remains solid until heated to 36 °C	The crude is solid at ambient temperature and on the sea surface and does not spread once cooled. It must be heated to >36 °C to flow under the action of gravity. At higher pressures it can be pumped at lower temperatures e.g., 25°C for oil recovery.
Physical state when in contact with water / ambient air temperature	Immediately solidifies in contact with water at Falklands seawater temperature (Figure 12-1).	As above. Individual oil masses do not tend to coagulate together once cooled.
Evaporation	True Boiling Point data indicate that at 140 °C up to 2.8 % volume of the crude evaporates (this is extrapolated to the fraction lost over a weathering period of approximately 0.5 – 1 day in reality). The maximum evaporation was found to be 11.7 % volume, which represents evaporation over 3-7 days weathering in reality.	In the event of a spill, very little will evaporate so the mass of oil spilled will not reduce greatly as the crude weathers at sea. The density of the oil will increase slightly by evaporation, but not enough to sink in seawater.
Dispersion	In a test environment, the oil was released in simulated open sea conditions: Approximated to Beaufort sea state 3 (corresponding parameters in the 'polludrome' (test environment) were wave height 20 cm, mean period 3 seconds, current speed 40 cm/s, wind speed 5 m/s, volume of seawater 7 m^3), Sea temperature 8 °C, Solar energy was created using UV light, and Water was continuously circulated for 7 days. No dispersion of the oil into the water column, or significant breakup of the oil masses, was recorded. The test environment energy was then increased to breaking wave conditions for 3 days, and no difference in the oil behaviour was observed.	Masses of oil from an oil spill would not break up after weathering at sea but remain in discrete clumps.
Response to chemical dispersion	The oil does not respond to chemical dispersants. Dispersants did not penetrate the surface of cooled oil.	Chemical dispersants will not be effective on spilled Sea Lion crude oil and are not recommended.

Aspect	Test results	Implication for risk assessment and / or spill response
Biodegradation	The high alkane content of the oil means it will biodegrade but due to the high wax content this is expected to take some time.	If not recovered, the oil would remain in the environment as solid components (for at least seven days) until eventually breaking up and biodegrading.
Interaction with suspended solids	Tests at 5 and 100 parts per million (ppm) showed that after 5 days there was no interaction between the oil and the suspended solids at 5 ppm, and some particles were adsorbed onto the surface of the oil at 100 ppm, but the oil remained floating.	This indicates that at low concentrations such as at sea, the oil is unlikely to interact with suspended solids and fall into the water column. At much higher concentrations there will be some interaction, and over long periods of exposure to suspended solids e.g., near beaches, the oil may eventually sink to the seabed.
Adhesion to feathers	Adhesion of oil to feathers (Figure 12-1) was tested for nine species found around the Falklands. These were: black-browed albatross, sooty shearwater, thin-billed prion, Antarctic fulmar, Wilson's storm-petrel, South American tern, imperial shag, king penguin and gentoo penguin. For each species, the adhesion of oil to feathers was assessed in respect of two oil spill scenarios and one produced water discharge scenario: **Spill scenarios:** Feathers were dipped into a concentration of 100g/m^2 oil in seawater: No oil was adsorbed by feathers, and No structural damage was observed. At a concentration of 1 kg/m^2: All feathers were stained by the oil and two species (thin-billed prion and imperial shag) had microparticles stick to them, but No structural damage was observed. **Produced water scenario:** At a concentration of dispersed oil at 10 mg/l with oil droplets of *c.* 100 microns: Oil particles were observed on all feathers, All species adsorbed similar amounts of oil, but No structural damage was observed.	In the event of a spill, the concentration of oil will affect the amount of oil adsorbed by birds' feathers. At concentrations of 1kg/m^2 all species tested were stained but thin-billed prion and imperial shag feathers showed a greater degree of oil adhesion, suggesting these species may be more susceptible once exposed Emulation of produced water discharge caused adhesion of oil particles to all species of feathers tested. However, in all scenarios tested, no structural damage to the feathers was observed although the barbules (the 'feathery' linkages in between the feather structure) were dis-arranged. The above tests were also completed for an alternative crude oil with a lower pour point and indicated a much higher adhesion of oil to the feathers.
Pelt and fur adhesion	Tests are planned for pelt and fur adhesion (Section 15.7.6).	Gives greater confidence in response decision-making around oiled birds and mammals.
Sheen formation and visibility	Hot oil (55°C) released into 18°C calm seawater resulted in a slight sheen being observed by the naked eye for approximately ten minutes. The oil could be perceived by an infrared camera even when cooled, though sheens were not	Sheen formation is very limited around a spill of Sea Lion crude and would only be visible in very calm conditions. It is possible that the temperature of the seawater during

Aspect	Test results	Implication for risk assessment and / or spill response
	easily identifiable with the camera and could only be seen in the early stages of the spill. Testing of water samples did not show any difference between the samples collected after the oil release (near the oil patches) and the background level of the basin.	the test (18°C) could have influenced the creation of a sheen and the water temperatures in the NFB are considerably lower (8°C). While the outdoor test basin was warmer than NFB, CEDRE drew a firm conclusion from the experiment that sheens were very limited, and the longer-term behaviour in the form of waxy masses was shown in the 9-day flume test at 8 °C (see above). Calm conditions at the Sea Lion field are anticipated to occur <3 % of the time and in wave conditions, sheens will be dispersed.
Emulsification	See above test conditions for 'Dispersion'. Around 5 % emulsification was observed, although in the form of water trapped in solid oil rather than a true emulsion.	During release, and to some extent during dispersion, the volume of oil is likely to increase by around 5 % due to water trapped in the oil. This is a relatively lower value – many oils emulsify to a much larger extent, significantly increasing their volume in the marine environment (e.g., by up to 5x).
Dissolved fractions in the water column	See above test conditions for 'Dispersion'. No PAH dissolved into the water column after seven days of monitoring.	Water column impacts are more likely to arise from ingestion of oil rather than contamination of the water column from any dissolved components of the oil. Low risk to shellfish which tend to accumulate PAH.
Ecotoxicity (diatoms)	Tests on the marine algae *Skeletonema costatum* were carried out for 72 hours to determine the concentration which results in 50 % (EC_{50}) inhibition of growth rate. Diatom growth was not affected by Sea Lion crude.	Sea Lion crude is unlikely to impact upon phytoplankton.
Ecotoxicity (copepods)	Tests on the copepod *Arcatia tonsa* were carried out for 48 hours to determine the lethal toxicity of the crude to copepods. 20,700 mg/l of Sea Lion crude in seawater is the concentration at which 50 % of test organisms died when compared to a control. This is expressed as 'LC_{50} 48 hours > 20,700 mg/l'.	This indicates that Sea Lion crude may impact upon zooplankton in the water column in the event of a spill, dependent on the concentration of oil - e.g., there could be 50 % mortality of organisms if exposed to >20,700 mg/l for 48 hours.
Ecotoxicity (amphipods)	Tests on the amphipod *Corophium sp*. were carried out for 10 days to determine the lethal toxicity (LC_{50}) of the crude to amphipods. 392 mg/kg of oil in sediments is the concentration at which 50 % of the test organisms died when compared to a control. This is expressed as 'LC_{50} 10 days >392 mg/kg'.	This indicates that Sea Lion crude may impact upon benthic assemblages in the event of a spill, but at a relatively high concentration of oil in the sediments.

Aspect	Test results	Implication for risk assessment and / or spill response
		Amphipods are recognised as good indicators of oil pollution.
Ecotoxicity (fish eggs)	Tests on embryonic zebra fish (*Danio rerio*) were carried out for 96 hours to determine the LC_{50} of the crude to fish eggs. At all concentrations tested no toxic effects were observed on the fish eggs when compared to a control. Slight subacute toxicity (<3 %) was noted.	This indicates that Sea Lion crude is unlikely to impact fish eggs in the event of a spill.
Adhesion to seaweed	Three types of seaweed were tested for oil adhesion. These were: sea lettuce (Ulva), *Laminaria* and *Fucus* (Figure 12-1). Adhesion to the three seaweeds was tested with hot oil to emulate a spill of crude directly onto the beach at low tide, though it should be noted that this scenario is very unrealistic as any spills at sea would mean the oil solidifies before reaching the shore, even in the case of a tanker grounding, the vessel would ground a distance from the shore due to its hull depth. Oil that had solidified and cooled having been spilled to sea (to emulate a spill which had drifted onto the beach at high tide) was also tested. Adhesion of hot oil to the seaweed at low tide can be substantial but at high tide interaction was very limited. At high hide, the hot oil remained on the surface of the water and did not stick to the seaweed. For cold oil, adhesion to sea lettuce and *Laminaria* was strong but less so with *Fucus*. Hot oil directly applied to the seaweed adhered well to sea lettuce and *Fucus* but not as much to *Laminaria*, with the roughness of the seaweed being an important factor in the amount of oil adhesion.	Spills that are direct to the beach, and with the oil still hot, would mean substantial adhesion to seaweed, however, this scenario is very unrealistic. Spills to water, which then drift onto the beach are unlikely to adhere to the seaweed if they reach the shore at high tide or if they reach seaweed that is permanently immersed in seawater. If cold oil reaches shallow water at the shore at low tide (i.e., where waves are mixing oil and seaweed on a beach) it may strongly adhere to exposed sea lettuce and *Laminaria*. Roughness of the seaweed plays a role in the adhesion of the oil.
Adhesion to shoreline	Tests were carried out to assess the oil adhesion to different substrates (Figure 12-1). These simulated hot oil being discharged onto or near the shoreline, although this is not a credible scenario within the current proposals. Nevertheless the behaviour of solidified crude reaching a shoreline can still be inferred. When the hot crude was spilled at high tide (i.e., to water), the oil solidified on contact with the water and no contact occurred between the oil and sediments. After two tidal cycles, no adhesion was observed and the oil stayed on the water's surface.	Oil approaching the coastline will be solidified and will predominantly stay on the surface of the water with little adhesion to the shoreline.

Aspect	Test results	Implication for risk assessment and / or spill response
	When the hot crude was spilled at low tide (i.e., directly onto the substrate which, as noted above is very unrealistic) the oil stayed stuck to the rocky and cobbled shores and was laid on the sandy sediment. After three hours, the oil lifted off the sandy sediments but stayed stuck to the rocky and cobbled shores. After one week a small amount of oil resurfaced from the rocky sediment but the majority of oil stayed stuck. After one week the majority of oil resurfaced from the cobbled sediment but a small portion remained stuck. After one week no adhesion was observed to the sandy sediment and all oil remained on the surface of the water. A sample of the oil face in contact with sediment was also taken and it was identified that sediment had penetrated the surface; a 5 g sample showed 31 % of the sample by weight was sediment.	
Removal of oil from rocky shores	Hot oil was spread onto standardised granite tiles manually and allowed to cool. Pressure washing was carried out at 15 °C, 50 °C and 50 bar and 100 bar pressures. Pressure did not seem to play an important role for any of the oils but hot water was much more efficient. Cleaning efficiency seemed to be slightly better for the Sea Lion crude oil than more commonly encountered oils of a similar density.	If spilled directly on rocks (very unlikely), the Sea Lion crude oil could be efficiently treated by using a high pressure water washer by using hot water (50 °C). It should be noted that, in real conditions, rocks are not totally cleaned and an oil film will remain, to be weathered over time.

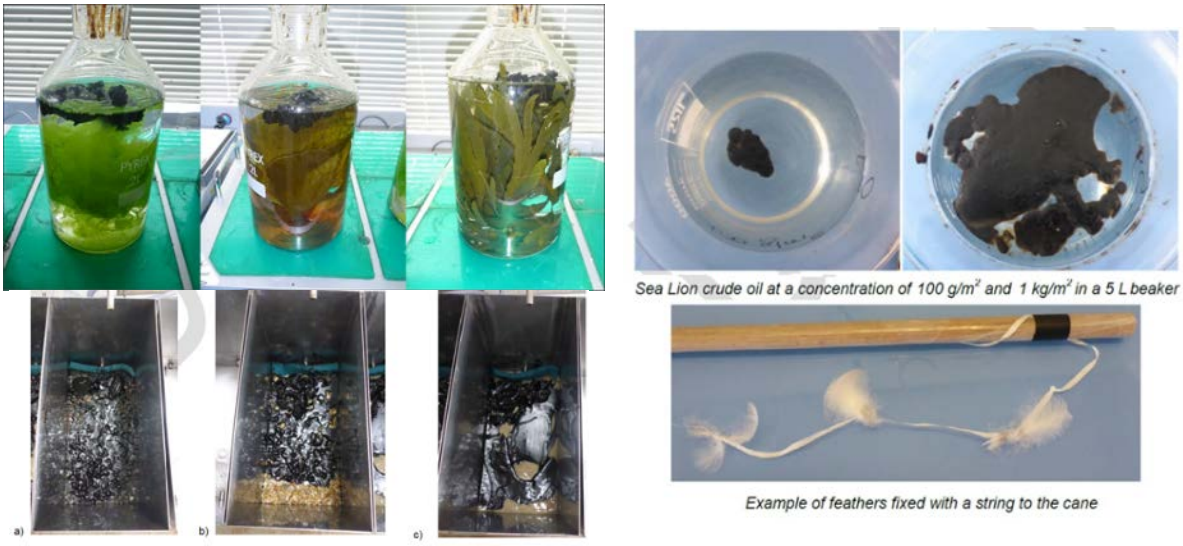


Figure 12-1: Examples of testing images from tests on seaweed, shoreline and feathers (CEDRE, 2017)

12.1.4.1.1.2 Marine diesel or Marine Gas Oil (MGO)

The project vessels will use MGO as fuel, sometimes referred to as marine diesel. MGO contains a much higher proportion of light volatile hydrocarbons than heavier crude oils and therefore evaporates and dissolves more readily when spilled on water, MGO spreads very quickly to a thin film that can manifest as dull or dark colors or as a rainbow and silver sheen as the layer thins.

MGO is less dense than water and therefore it is not possible for diesel to sink and accumulate on the seafloor as pooled or free oil unless adsorption occurs with sediment. However, it is possible for the diesel oil that is dispersed by wave action to form droplets that are small enough be kept in suspension and moved by the currents. When diesel dispersed in the water column does adhere to fine-grained suspended particles, these can settle out and reach the seafloor, although this is less likely to occur in open marine settings.

In terms of toxicity to water-column organisms, diesel is considered to be one of the most acutely toxic oil types. Diesel fuels, such as MGO, contain volatile aromatic compounds, some of which, including alkylbenzenes, toluene, naphthalenes, and PAH, are known to have acute toxic effects on marine life in the water column. Given its volatile nature however, diesel breaks down more rapidly than crude oil and generally poses shorter exposure risk to environmental receptors. Nonetheless, potential impacts on vertebrates include damage to the liver, kidneys, heart, lungs, and the nervous system. Increased rates of cancer, immunological, reproductive, fetotoxic, genotoxic effects have been associated with diesel contamination (Irwin, *et al.,* 1997). PAHs are relatively long-lived in the environment and bioaccumulate in the fatty tissues of animals, resulting in vital organ malfunction (particularly the liver and kidney).

12.1.4.1.1.3 Non-Aqueous Drilling Fluids

The most likely place for a failure of the riser, which could lead to a loss of NADF and any associated cuttings in circulation, is at the base of the riser at the lower marine riser package as this section experiences the most stress from the rig moving above and loading from currents. If disconnection happens whilst drilling with NADF, the drilling fluid will flow out over the seabed around the well and in a relatively cohesive mixture (a result of the drilling fluid being specifically designed to prevent separation of oil, water and solids). The NADF is quite dense and would disperse very little into the water column.

The area directly covered by the NADF will be impacted as the mud itself would be very toxic to local sediments and benthic communities. There is also likely to be an element of smothering, although less so than with cuttings piles as the NADF liquid is assumed to settle out to *c.* 1 cm thickness.

The NADF would biodegrade over time and release particles into the water column but this will be a slow steady process. The components of NADF are somewhat biodegradable and have to pass CEFAS (Centre for Environment, Fisheries and Aquaculture Science) tests so it would be reasonable to expect the area would recover after a number of years. Deposits of NADF and associated cuttings are well studied in the North Sea. Breuer *et al.* (1999) noted that eight years after NADF cuttings piles were deposited, biological effects were still noticeable. Change of benthic habitat has also been seen on and around NADF cuttings piles near historic North Sea wells over a period of years (Olsgard and Gray, 1995).

12.1.4.1.2 Fate of oil in the marine environment

As oil is released into the sea it undergoes a number of physical and chemical changes (Figure 12-2). These changes are dependent on the type and quantities of oil spilled and the meteorological and oceanic conditions to which the oil is exposed over time. Detail on the processes which influence the behaviour and fate of oil at sea following a spill are described in Table 12.2.

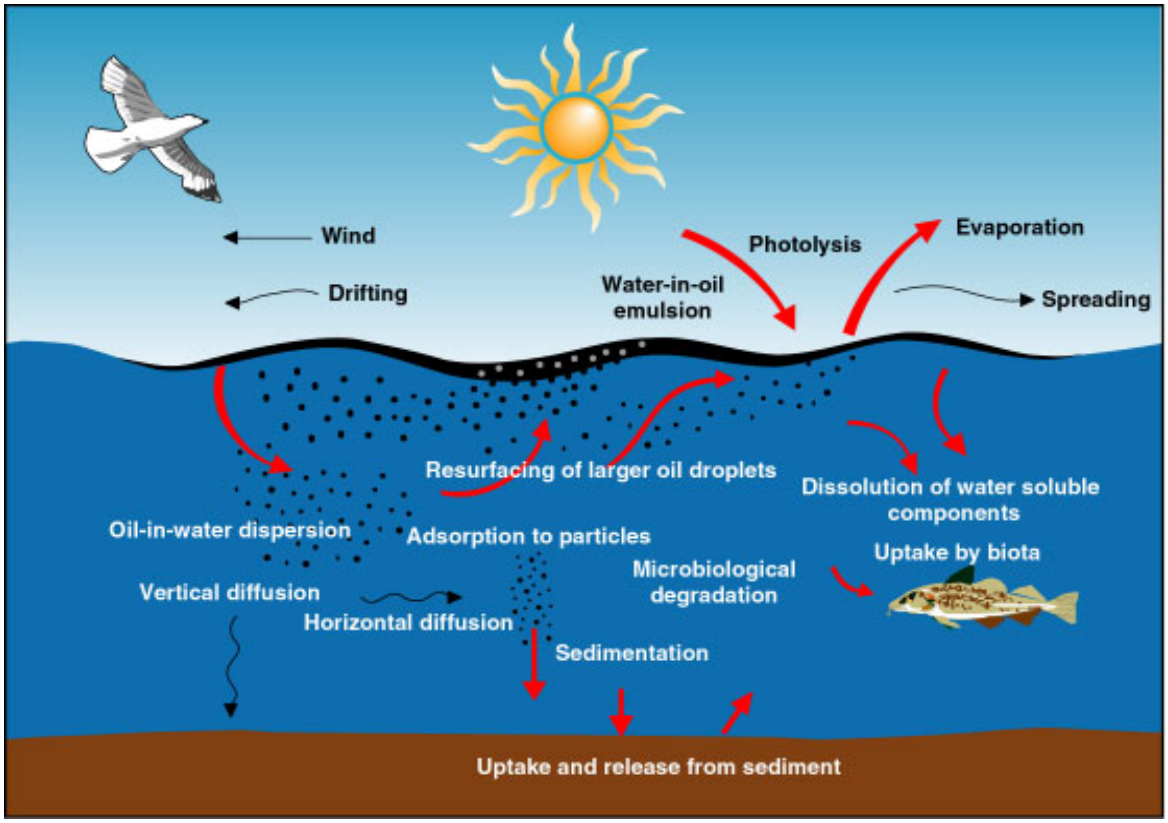


Figure 12-2: Behaviour and fate of oil in the marine environment (after Andreassen and Sørheim, 2013)

Table 12.2: Fate of oil in the marine environment

Oil behaviour	Description
Spreading and advection	When spilled at the surface, oil spreads out on the surface of the water. This increases the surface area of the oil but reduces the thickness. Sea Lion crude is unlikely to spread out thinly as a 'normal' oil. From behaviour observed during testing of the crude, a 'terminal film thickness' of between 1 and 5 mm has been assumed, dependent on the type of spill (see Section 12.1.4.1.1.1).
Evaporation	Evaporation is the main mechanism by which the mass of oil is reduced immediately after a spill and is enhanced by warm air temperatures and moderate winds. It also causes considerable changes in the density, viscosity and volume of the spill over time. The light fractions of the oil (aromatic compounds such as benzene and toluene) evaporate quickly. As noted above (Section 12.1.4.1.1.1), a large percentage of Sea Lion crude is not expected to evaporate (CEDRE, 2017).
Dissolution	Some of the lighter components of the oil will go into solution in the surrounding water; however, this only accounts for a very small proportion of the overall spill. As noted above (Section 12.1.4.1.1.1), in the CEDRE tests no PAH were observed dissolving into the water column from Sea Lion crude after 7 days (CEDRE, 2017).
Natural dispersion	Once the lighter fractions have evaporated from the oil spill the evaporation process slows down and natural dispersion becomes the dominant mechanism in reducing surface oil volume. Dependent upon sea surface turbulence, and therefore weather conditions, oil breaks up into droplets in the water beneath the surface oil and disperses in the water column. As noted above (Section 12.1.4.1.1.1), Sea Lion crude is not expected to naturally disperse to any great extent (CEDRE, 2017).
Emulsification	Oil and water combine to form a mousse. The tendency to emulsify depends on the asphaltene content of the oil. Sea Lion crude is likely to absorb around 5 % water (see Section 12.1.4.1.1.1) (CEDRE, 2017).
Photo-oxidation	Sunlight transforms some oil components into new by-products, which may be more toxic and water-soluble than the original components.
Sedimentation	Oil adheres to particles in the water column and sinks to settle in the sediment. Once in the sediment, further degradation slows. As noted above (Section 12.1.4.1.1.1), Sea Lion crude is unlikely to interact with particles at sea, but may interact with them in the water column at particle concentrations of around 100 ppm e.g., at beaches, and increase in density over a period of days and weeks (CEDRE, 2017).
Stranding	Oil that reaches the shore-line is said to have stranded.
Biodegradation	Biodegradation can occur at the surface, in the water column and within sediments. Oil is slowly broken down by resident bacteria, and other microbes, into water and carbon dioxide. The microbes concerned rapidly multiply in the presence of excess food and produce by-products that can themselves be toxic to other marine organisms. Sea Lion crude is expected to biodegrade eventually but it is thought this will take a long time (see Section 12.1.4.1.1.1) (CEDRE, 2017).

12.1.4.2 Nature of the impacts

The impacts of oil spills on marine organisms are well documented and have been the focus of numerous studies, and extensive review (e.g., Moore and Dwyer, 1974; Burger, 1993; Gubbay and Earll, 2000; Kingston, 2002; Barron, 2012; Beyer, *et al.,* 2016).

There are four main routes of oil contamination. These include:

- Direct contact,
- Ingestion,
- Inhalation, and
- Absorption through skin or respiratory membranes.

The extent of oil spill impacts will be influenced by the environmental conditions and the spreading and dispersion of oil experienced in the period following any spill. Further, the size of a spill is not necessarily the most important factor influencing the extent of impacts on environmental receptors. Small spills can impact disproportionately large numbers of individual receptors if they are present in the affected area at the time. The nature and significance of impacts at a population-level will differ across the range of environmental receptors, and will depend on the type of oil (Section 12.1.4.1.1) and the distribution, density, ecological and life-history attributes and the behaviour of each of the receptors at the time of a spill.

12.1.4.2.1 Plankton

Plankton plays a critical role in marine food web dynamics, biogeochemical cycling and fisheries recruitment. Despite their importance in the marine environment our knowledge of the interactions between plankton and anthropogenic pollutants is limited.

Although it is known that low concentrations of hydrocarbons (<0.05 mg/l) may stimulate phytoplankton growth (for some species), higher concentrations are likely to inhibit growth or kill phytoplankton (Boyd, *et al.,* 2001). Given that phytoplankton form the base of the food chain, bioaccumulation of hydrocarbons through the planktonic food web would increase exposure of higher trophic-level organisms (Meador, 2003). Further, lethal contamination could change the distribution and reduce the abundance of plankton communities, and hence the availability of food sources up the food chain.

The oceanography and topography of the southern Patagonian Shelf creates an area of very high zooplankton productivity immediately to the north of the Islands (Section 7.4.1). While the distribution and abundance of plankton in the waters of the Falkland Islands varies on a seasonal basis, it is expected that any impacts of oil spill will be greatest during summer when the area of the shelf-break to the south of the Sea Lion Field supports higher densities of plankton. *Themisto gaudichaudii* provides an important ecological link between small zooplankton and top consumers around the Falkland Islands. *Themisto gaudichaudii* is a voracious predator of anything smaller than itself, and occasionally of animals its own size or larger with adults preferentially consuming prey in the size range 1 to 4 mm (Pakhomov and Perissinotto, 1996). Other important plankton species in the Falklands include species in the order Euphausiacea (e.g., *Euphausia lucens*, *E. vallentini* and *Thysanosessa gregaria*) and lobster-krill (*Grimothea gregaria*) (Agnew, 2002; van de Grient, *et al.,* 2023).

Further, eggs and larvae in the zooplankton appear seasonally and many have been shown to be vulnerable to oil during laboratory experiments (Almeda, *et al.,* 2013) as the latter can ingest oil droplets directly (Lee, *et al.,* 2012; Almeda, *et al.,* 2014). For eggs, on the other hand, only small molecules can cross the outermost membrane around the embryo such that these are less vulnerable than zooplankton. Testing of the Sea Lion crude (Section 12.1.4.1.1.1) on zooplankton (*Acartia tonsa*) and phytoplankton (*Skeletonema costatum*) indicates that the crude is unlikely to impact upon the phytoplankton species tested but that concentrations of around 20,700 mg/l will have lethal effects on up to 50 % of zooplankton organisms tested after 48 hours of exposure (CEDRE, 2017).

There are three main types of interactions between zooplankton and pollutants:

- Pollutants can have direct toxic effects on zooplankton, which may have lethal or sub-lethal consequences (Walsh, 1978),
- Zooplankton may influence the physicochemical characteristics of the pollutants in the water column by absorption, transformation and elimination (Walsh, 1978; Fisk, *et al.,* 2001; Muschenheim and Lee, 2002), and / or

- Zooplankton may play an important role in the bioaccumulation of pollutants in food chains and webs.

Therefore, understanding the interactions between pollutants and zooplankton is crucial to understanding the fate of pollution in the pelagic zone and its impacts on marine environments.

Further, in all of the potential impacts described, there is increasing evidence that sunlight, mainly ultra violet radiation, can increase the toxicity of petroleum hydrocarbons to marine organisms (e.g., Alloy, *et al.,* 2016; Almeda, *et al.,* 2016).

12.1.4.2.2 Benthic communities

Contamination of the benthos in a low energy environment may have long-lasting impacts, as physical breakdown and biodegradation are reduced. Invertebrates vary greatly in their sensitivity to oil contamination, but it is known that many are unable to metabolise petroleum (NOAA and API, 1994) and may therefore accumulate toxins in their bodies.

Among the invertebrates, corals are known to be one of the most sensitive groups. Similarly, shellfish may accumulate oil residues with attendant secondary effects, particularly relating to health (OSPAR, 2009a). Infaunal organisms (i.e., those actually living within sediments) are particularly susceptible to oiling whereas some barnacles and limpets may withstand a degree of oiling. The sub-lethal effects of contamination on the above may include growth reduction, feeding impairment, and behavioural changes. For vertebrates that might be in physical contact with hydrocarbons on the seabed, such as skates, the impacts are generally sub-lethal, including changes in feeding, growth, development, and recruitment (Boyd, *et al.,* 2001).

To date, surveys in the Sea Lion Field have indicated that the benthic environment is fairly uniform, in terms of habitat classification (Section 7.4.3.2). The results of surveys, in the Isobel / Elaine area approximately 40 km south of the Phase 1 & 2 Development, indicate that there are some very localised differences in the habitats and species encountered in the NFB, which are largely due to the presence of erratic rocks (iceberg drop stones) that provide habitat for corals and other encrusting organisms (Section 7.4.3.2).

12.1.4.2.3 Fish and squid

Impacts on fish and squid from oil spills may include:

- Displacement of adults from feeding grounds, and
- Contamination of adult fish, eggs, larvae and juvenile stages.

12.1.4.2.3.1 Displacement from feeding grounds

Typically, adult fish are considered sensitive to impacts of oil spills however, they are mobile and are able to detect areas of heavy contamination or poor water quality and avoid them, particularly in the open ocean (Hjermann, *et al*., 2007). However, such avoidance behaviour may serve to displace them from important feeding areas. The Phase 1 & 2 Development is situated within the Falkland Islands Northern Slope habitat zone which has been identified as an important feeding area for a number of fish species, whose abundance varies with season (Section 7.4.4.2.2). As a spill could occur at any time throughout the operations, it could coincide with recorded high abundances of numerous fish species (Section 7.4.4.2.2).

Cephalopods are sensitive to environmental conditions, which can affect their abundance and distribution widely (Pierce, *et al.,* 2008; Arkhipkin, *et al.,* 2004a). Squid exhibit high growth rates and the majority have short life spans such that the accumulation of pollutants in their tissues can reflect the pollutant bioavailability in the immediate environment over a relatively short time period. Therefore, in addition to the importance of squid in commercial fisheries and as prey and predators in

the marine environment, they have the potential to act as bioindicator species in environmental monitoring studies. However, the mobile nature of some species can limit their potential as bioindicators, as may the fact that, for example, superbull loligo males can provide temporal connectivity that arises through phenotypic plasticity[97] enabling them to live longer, thus connecting cohorts. Please note however, that such males represent a small proportion of the population (Jones, *et al.,* 2019).

It is important to note that in relative terms, there is a small fraction of fishing effort in the Sea Lion area. There are years where catches have been reported in XFAK. However, analysis has shown that although catch by a few vessels have been attributed to XFAK with either their mid-day or midnight position, in actual fact the vessels did not enter this grid square at all, as evidenced from Marine Satellite -based AIS. These are likely to be rare, accidental misreportings. Almost all of the fishing effort is based around the shelf break at 200m.

12.1.4.2.3.2 Contamination of adult fish and squid, eggs, larvae and juvenile stages

The ability to avoid areas of oil contamination does not negate the sensitivity of fish to associated ecosystem and long-term effects (Balk, *et al*., 2011; Ainsworth, *et al*., 2018; Cave and Kajiura, 2018; Grosell and Pasparakis, 2021).

For example, a biogeochemical ecosystem model that was used to assess the impacts from the Deepwater Horizon oil spill on fish suggested that the biomass of large reef fish decreased by 25-50 %, and large demersal fish by 40-70 % (Ainsworth, *et al*., 2018). This was a result of the impacts on reef and demersal foraging areas leading to starvation. Similarly, in the North Sea Balk *et al.* (2011) found that haddock and Atlantic cod populations were under significant environmental stress due to the chronic effects of oil-related pollution. Studies carried out in control areas (e.g., a North Sea area without oil production and remote Icelandic waters) indicated significant background pollution in the North Sea. However, as a light and more volatile crude, the characteristics of the oil in the Deepwater Horizon incident were very different to those of the Sea Lion crude. Further, the chronic pollution levels in the North Sea are more likely attributable to > 40 years of produced water discharge from numerous installations than to the impact of oil spills. Of importance, the base-case design of the Sea Lion Development is to reinject, rather than discharge, produced water (Section 5.8.5.8 and Section 10.7).

Adverse impacts of oil spills on adult fish are most likely to be observed in the shallow coastal areas of the sea where oil could accumulate and the potential to 'escape' is limited by the land and / or the species' habitat requirements. Fish eggs and larvae are considered to be more susceptible to the toxic effects of oil than adults, due to their reduced ability to avoid contaminated water. However, testing the impact of Sea Lion crude on a test organism (zebra fish (*Danio rerio*) eggs) found that the crude is unlikely to impact these fish eggs in the event of a spill (CEDRE, 2017).

If contaminated, adult fish are able to metabolise small quantities of hydrocarbons, although the toxic effects of the ingested oil may lead to organ damage (OSPAR, 2009a). In particular, fish are susceptible to the water-soluble fractions of oil, such as Benzene, Toluene Ethylbenzene and Xylenes (BTEX), which have been shown to cause cardio-edema in larval fish (Incardona, *et al.,* 2013). Other toxic components in crude oil such as the PAHs can be mutagenic and carcinogenic in fish. Testing of the Sea Lion crude has shown that PAHs were not observed dissolving into the water column during the seven days of monitoring following the simulated spill, so are unlikely to be present in high concentrations after a spill to sea (CEDRE, 2017). Although squid are unable to metabolise oils, there is little evidence of direct mortality of adult squid following contamination.

[97] The ability of an organism to change its phenotype in response to environmental conditions. This can include changes in behavior, physiology, morphology, growth, and life history.

Cephalopods have received some attention on account of their capacity to accumulate contaminants and the resultant implications for human health (Gomes, *et al.,* 2013; Morais, *et al.,* 2013; Section 12.1.4.2.3.2). In particular, PAHs are of note due to the potential cytotoxic, mutagenic and carcinogenic properties of these chemicals.

Although these components may not be present initially after a spill (CEDRE, 2017), they could dissolve into the water column later if all oil is not recovered. PAHs can be absorbed into the water column from waterborne compounds and contaminated sediments but predominantly *via* the food chain. In marine food chains, molluscs (including squid) have the poorest capacity to metabolise PAHs, crustaceans are intermediate with fish displaying the best capacity (Gomes, *et al.,* 2013). The natural content of PAHs in fish tissues is lower than that in squid because fish are able to oxidise and further metabolise PAHs to water soluble compounds, which can be excreted *via* gall or urine. In squid, the highest concentrations of PAHs are found in the digestive glands but these compounds are found in all tissues.

The Northern Slope is used by many species of ecological importance, such as *Moroteuthopsis ingens* squid, myctophids and Falkland sprat (*Sprattus fuegensis*). These species are important food sources for predatory fish, seabirds and marine mammals. Grenadiers also occur in this area, particularly *Macrourus carinatus* and *Coelorinchus fasciatus*, the former of which is considered a potential fisheries resource for the Falkland Islands (Payá, 2009). Other species are resident within the Phase 1 & 2 zone of influence although, many of these, such as skate and eelpout, do not have planktonic egg or larval stages.

12.1.4.2.4 Seabirds

Seabirds are particularly susceptible to oil floating on the surface of the sea and millions of seabirds have been killed globally by oil pollution (e.g., Goldsworthy, *et al.,* 2000; García Borboroglu, *et al.,* 2006; 2010; Wolfaardt, *et al.,* 2009). Seabirds tend to be the most conspicuous group affected during oil spill events. When considering the impacts of oil spills on seabird populations, the volume of oil released is not necessarily the most important factor (Hunt, 1987; Tasker and Pienkowski, 1987; Burger, 1993), but rather the location of the spill relative to concentrations of vulnerable seabirds. A relatively small spill in close proximity to large numbers of vulnerable seabirds will likely have a much more severe impact than a larger spill in an area with few seabirds. Indeed, tens of thousands of birds can be killed by a relatively minor spill (e.g., Barrett, 1979). Equally, chronic oil pollution from operational discharges (Section 10.7) and small spills may have severe long-term effects on seabird populations (e.g., García Borboroglu, *et al.,* 2006). About half of the input of oil into the marine environment is due to chronic oil pollution (GESAMP, 2007), highlighting its potential to impact seabirds.

The effects of oil on birds include both immediate impacts on survival, and longer-term sub-lethal impacts that could affect individual birds and populations over many years (e.g., Camphuysen, *et al.,* 2005; Perez, *et al.,* 2009).

Impacts of large oil spills and / or small-scale unplanned but chronic releases include:

- Direct contamination and fouled plumage,
- Ingestion:
  - Direct ingestion e.g., from preening contaminated feathers, and / or
  - Indirect ingestion e.g., from consuming contaminated prey (Committee on Oil in the Sea, 2003).

The consequences of the above also depend upon the vulnerability of bird species, their behaviour and the feasibility of post-contamination treatment.

12.1.4.2.4.1 Direct contamination

Fouled plumage is recognised as the primary cause of mortality and stress in oiled birds (NRC, 1985; Leighton, 1991; there is a good deal of literature on this subject however for a recent review see King, *et al.,* 2021). Direct contact between seabirds and oil can contaminate feathers such that the barbules become bound together by oil which leads to a loss of feather condition and function. Plumage is essential for flight, heat insulation and waterproofing, and even small effects on any of these functions can compromise survival. Waterlogging and loss of buoyancy in oiled birds further exacerbate oil impacts and can rapidly lead to drowning. Additionally, oil can also directly affect reproductive success as eggs contaminated with oil from fouled feathers can have lethal effects on the embryo (King, *et al.,* 2021).

Along with environmental factors; such as sea state, the chemical and physical properties of the specific type of oil discharged will influence how the oil behaves in the environment and the effects it is likely to have on seabirds (Section 12.1.4.1.1).

Most of our knowledge of how oil spills contaminate seabirds is based on experiences with fluid oils that form slicks or sheens (O'Hara and Morandin, 2010). Observations from such incidents are not directly applicable to the current assessment however, because they do not reflect the waxy oil type found in the Sea Lion Field. The initial testing indicates that the highly waxy crude may pose less of a risk to seabirds in respect of feather contamination when compared to other crude oils tested in the same way (CEDRE, 2017). Testing of Sea Lion crude oil adhesion to feathers showed that adhesion was determined by the concentration of oil, with no oil adsorbed by feathers dipped into a concentration of 100 g/m^2 but staining and microparticles were observed at a concentration of 1 kg/m^2 (CEDRE, 2017). No structural damage was observed to any feathers tested, although the barbules were noted as 'messy' (CEDRE, 2017).

With regard to the far lighter diesel oils, seabirds can be oiled by direct contact although the higher volatility of diesel (MGO) means that the oil remains on the surface for a relatively short time, which may influence the number of birds affected. However, as described by O'Hara and Morandin (2010), the potential for these impacts to occur largely depends upon the degree of oil fouling, which is affected by the:

- Thickness of the sheen and the area of sheen that comes into contact with the bird,
- Oil type,
- Patchiness of the oil,
- Movement patterns of the bird at the sea surface, and
- Preening capacity.

While there are limited data on the thickness of sheen required to affect the microstructure of feathers in practice, it is believed that small quantities of oil contamination could have lethal consequences (O'Hara and Morandin, 2010). Laboratory based experiments determined that exposure to oil sheens at a thickness of only 0.1 µm could result in measurable oil transfer to feathers and thus impact upon their microstructure. Further, it was concluded that lethal consequences could result from a bird being exposed to as little as 10 ml of oil (O'Hara and Morandin, 2010). In order to become contaminated with 10 ml of oil, it is estimated by O'Hara and Morandin (2010) that a bird would have to swim through approximately 100 m^2 of a sheen of 0.1 µm thickness. Although hypothermia due to matted feathers does occur, the toxicity of MGO means that mortality is most commonly caused by ingestion during preening (NOAA, 2014).

Although the oil in water (OiW) concentrations of operational discharges are tightly controlled by legislation, chronic oil pollution, in the form of rainbow effects, and blue / silver / gray discoloration

(Fraser, *et al.,* 2006), may occur even at OiW concentrations of 25 mg/l when discharged on calm days (Wills, 2000). Potential sources of chronic oil pollution from legally compliant operational discharges e.g., produced water, are assessed in Section 10.7 while the contribution of small accidental spills are assessed here.

Once attached, oil of either form can be ingested, either directly, or through preening, leading to a number of toxic effects that compromise the health of the animal, and may eventually lead to its death.

12.1.4.2.4.2 Ingestion

It is likely that seabirds may ingest floating waxy oil masses (pellets), in much the same way that they ingest floating particles of plastic (BirdLife International, 2008). Whereas penguins and other seabirds that spend a lot of their time at the surface and dive to obtain their prey are particularly vulnerable to plumage contamination and ingestion of the oil, surface foraging Procellariiformes (albatrosses and petrels) would be particularly susceptible to ingesting the floating wax pellets, especially as many of the birds in this group habitually congregate around offshore vessels / structures. This stems from their scavenging nature, which also predisposes them to misdirected foraging - ingesting the wax pellets which they mistake for food. The wax pellets may also be ingested incidentally with prey in the same way fur seals ingest plastic incidentally *via* myctophid fish (Ryan, *et al*., 2016). Smaller petrels, such as prions and storm-petrels, filter feed or pick at planktonic organisms. These birds will all be vulnerable to ingesting oil masses of differing sizes and therefore the range of species potentially impacted will change as the oil masses break down and spread.

Although the issue of ingesting plastic and other debris, such as tar balls, is known to occur amongst a wide range of seabird species, there has been limited research to quantify the impacts of such ingestion (BirdLife International, 2008). However, the ingestion (through preening, consumption of contaminated prey and of oil) or inhalation of hydrocarbons has been documented, mostly through experimental studies, to cause a number of lethal and sub-lethal toxicological effects on seabirds. These include:

- Gastrointestinal irritation,
- Pulmonary congestion,
- Adrenocortical hyperplasia,
- Fluid and electrolyte loss,
- Detrimental effects on salt glands and osmoregulation, and
- Fatty liver and mutagenic (cancer causing) effects.

Further, the absorption of toxic components from the oil can lead to damage of the liver, pancreas and kidneys, amongst other organs. Where sub-lethal, these impacts may reduce reproductive rates, leave the animal open to secondary infection and act synergistically with other environmental stressors, leading to reduced survival in the medium to long-term (Boyd, *et al.,* 2001; Wolfaardt, *et al.,* 2008; 2009; King, *et al.,* 2021). On the basis of studies investigating the impacts of ingested plastic on seabirds, species that seldom regurgitate indigestible stomach contents and therefore accumulate large debris loads, are most susceptible to the adverse effects of ingesting these items. For example, immature petrels that would not be feeding chicks would be particularly vulnerable as they cannot offload their accumulated load (Drewery and Wolfaardt, 2017). Oil can also indirectly influence the survival or reproductive success of seabirds by affecting the distribution and / or abundance or availability of prey but this is much more difficult to assess.

12.1.4.2.4.3 Seabird vulnerability to oil pollution

Seabird species in the waters around the Falkland Islands differ in their susceptibility to contamination from oil pollution due to differences in foraging ecology, geographical distribution and other life history

traits, such as reproductive biology. Although a wide variety of seabirds may be affected, the greatest impact is generally observed in those species that spend a large amount of time at the sea surface, such as penguins and shags. Additionally, the behavioural traits of some species increase the likelihood that they will be attracted to vessels; due to the presence of artificial light (Section 10.1.4.2) discharged wastewater and food (Section 10.10); or simply to investigate a novel object in an otherwise uniform environment.

Although there are gaps in the data, a general picture of seabird distribution within the NFB has been, and continues to be, acquired through a combination of satellite tracking and visual surveys. However, the presence of the vessels associated with the Sea Lion Development will attract birds (see Wiese, *et al.,* 2001; Munro, 2011), which distorts the natural distribution of these species. This will result in elevated numbers of sensitive species in an area of high risk, in the immediate vicinity of Navitas chartered vessels, and it is these birds that are at greatest risk of being impacted by spilled MGO or other oils.

Albatrosses are the most threatened group of birds in the world (Croxall, *et al.,* 2012) and large numbers use the waters of the Falkland Islands. Although the most recent archipelago-wide surveys of black-browed albatross and southern giant petrel breeding in the Falkland Islands reveal that these populations are currently increasing, the populations of most ACAP (Agreement on the Conservation of Albatrosses and Petrels) listed species have declined significantly and continue to do so (e.g., Poncet, *et al.,* 2006; Poncet, *et al.,* 2017; Section 7.4.5.2.3). Moreover, several species that breed elsewhere, including wandering, southern and northern royal albatrosses, are regular visitors to the waters of the Falkland Islands (White, *et al.,* 2002). Albatrosses and petrels are therefore of considerable, and international, conservation concern, which is exacerbated by their life-history traits, such as: a long life-span, high adult survival rates, delayed sexual maturity and low fecundity. Given these extreme life-history attributes, impacts that contribute to adult mortality, such as oil contamination, have a significant influence on population trajectories, because the ability of these populations to recover quickly from such impacts is limited. Nonetheless, in respect of the numbers of birds affected, the impacts of oil spills on albatrosses and petrels appear lower compared with other seabirds, such as penguins, although birds oiled at-sea may go unobserved and unrecorded. In addition, pelagic seabirds, such as albatrosses and petrels are generally less successfully rehabilitated following oil spill events than penguins, such that it may not be possible to treat and rehabilitate many of the procellariiform species that occur around the Falklands.

To date, the birds most affected directly by oil pollution in the southern hemisphere have been penguins and shags (García Borboroglu, *et al.,* 2006; 2008; Altwegg, *et al.,* 2008; Wolfaardt, *et al.,* 2009). Although less likely to associate with vessels, at certain times the area of the NFB is utilised by several penguin species (Section 7.4.5.2.2). Given their foraging behaviour and ecology, and especially the amount of time they spend at the sea surface, penguins are particularly susceptible to becoming contaminated following an oil spill. There are five species of penguin breeding in the Falklands, although the macaroni penguin occurs in very small numbers. Amongst the four major penguin species breeding in the Falkland Islands, the rockhopper penguin is the species of greatest conservation concern (Section 7.4.5.2.3). The global population has exhibited a long-term decline. The species is currently classified as 'Vulnerable' under the IUCN threat designations and has been highlighted as a species of priority conservation concern (Crofts, 2014).

A preliminary assessment of seasonal vulnerability of seabirds to oil contamination within Falkland Islands waters was performed on data collected by the Joint Nature Conservation Committee (JNCC) to produce an Oil Vulnerability Atlas, (White, *et al.,* 2001). Further information and vulnerability maps from the Atlas are provided in Section 7.4.5.6. The area around the Sea Lion Field was not considered to be of 'very high' vulnerability during any period of the year, although adjacent areas of the

continental shelf - to the south, in January, and the south-west in September - were of 'very high' vulnerability.

12.1.4.2.5 Marine mammals

All marine mammals are afforded priority conservation status. Both pinnipeds (seals) and cetaceans (whales and dolphins) may be affected by oil spills in numerous ways. These include:

- Direct contamination through contact,
- Ingestion, and
- Inhalation of toxic fumes.

12.1.4.2.5.1 Pinnipeds

Like seabirds, pinnipeds (seals) may be impacted directly through contact with, or ingestion of, hydrocarbon pollution or indirectly through impacts to prey at lower trophic levels.

Marine mammals that rely on fur for insulation, such as fur seals, are vulnerable to oil contamination of their coats, which could lead to hypothermia. Fur seals groom extensively to maintain their coats and are therefore more likely to ingest hydrocarbons than other seals. The latter may not result in mortality in all but the most severe cases. However, it may lead to short-term disruption of breeding (Atlantic OCS, 1988) and to some level of bioaccumulation of trace metals and intermediate metabolites (Ridoux, *et al.,* 2004).

Phocids (true seals) are generally considered less sensitive to the effects of direct hydrocarbon fouling than otariids (eared seals - fur seals and sea lions) and seabirds. Although the pelage of phocids can be coated / fouled with oil, it is the sub-dermal fat layer that provides most of their insulation.

Besides hypothermia, there are a number of other potential impacts of oil pollution on seals. Exposure may cause severe eye watering (lacrimation), conjunctivitis, and corneal abrasions and ulcers if debris becomes mixed with encrusted oil. This may subside if exposure is short but prolonged exposure could result in more permanent damage (Atlantic OCS, 1988; Salazar, 2003). Severe fouling of their pelage may lead to an inflammatory response in the dermis and to skin ulcers following contamination but with subsequent recovery if contamination is of short duration (Atlantic OCS, 1988; Salazar, 2003). The greatest risk of mortality may result from inhalation of toxic volatile compounds from the surface of oil spills, which will be exacerbated if the animal is already stressed from the secondary effects of the spill and disturbance associated with response operations (Atlantic OCS, 1988; Jenssen, 1996).

12.1.4.2.5.2 Cetaceans

Cetaceans can be exposed to oil and oil-derived compounds through multiple pathways, including direct contact with the skin, ingestion of oil or contaminated prey, inhalation of volatilised or aerosolised oil components, and aspiration of oil into the lungs. There is a body of information highlighting the potential impacts of oil spills on cetaceans (Gubbay and Earll, 2000; Matkin, *et al.,* 2008; Schwacke, *et al.,* 2014; Venn-Watson, *et al.,* 2015; Frasier, *et al.,* 2020; Schwacke, *et al.,* 2022; Marques, *et al.,* 2023). Documented effects include poor body condition, calcium imbalance, inflammation, reproductive failure, organ damage (such as lung disease and failure, as well as adrenal gland dysfunction), altered hepatobiliary function, immune system changes leading to increased susceptibility to infections, impaired stress responses, and mortality.

Observations of cetaceans indicate that they are aware of slicks but the animals do not necessarily avoid contact with them. Compared to seabirds and pinnipeds, cetaceans generally spend longer periods submerged than at the surface of the water where contaminants are likely to be more concentrated. The behaviour, diet and habitat use of cetaceans will determine their level of contact with an oil spill (Wursig, 1988). Species that forage in mid- or deep-waters will be at lower risk than species that feed at the surface. Species such as right whales and rorquals that surface skim or lunge

feed, respectively, are therefore more sensitive and likely to consume surface oil directly than species that feed in deeper waters. This may also be true for some dolphins that 'chase' prey to the surface. Ingestion of oil by marine mammals can cause damage to the digestive system or affect the functioning of the liver and kidneys.

Of note, a recent set of tests involving whale baleen and six petroleum-based oils (Werth, *et al.,* 2019) indicated that whale baleen is oleophobic and does not adsorb oil, and that oil is readily rinsed from the baleen by flowing water. There was minimal wrinkling or peeling of the baleen's cortical keratin layers in the tests and filter porosity was not appreciably affected. Oil ingestion risks remain although particle capture studies suggest potentially greater danger to mysticetes (baleen whales) from plastic pollution than oil.

Where oil is in contact with the skin there is the potential for it to cause irritation to the eyes or to burn mucous membranes. Moreover, all cetaceans can be fouled or inhale the volatile components of hydrocarbons when they surface to breath and rest. In cetaceans, the respiration of volatile chemicals at the surface of a slick or the ingestion of oil may be lethal or chronic affecting longer-term foraging performance and susceptibility to disease, which may ultimately affect survival (Schwacke, *et al.,* 2014). The lighter BTEX fractions of crude are the most volatile (evaporate readily) and are also the most toxic. If inhaled, such hydrocarbons can impact the respiratory system, which is also a pathway for chemicals to enter the circulatory system. PAHs tend not to be accumulated in marine mammals but certain metallic trace elements present in oil can be transferred and bioaccumulate.

To date, the most comprehensive and detailed information on the impacts of oil exposure in cetaceans comes from research following the 2010 Deepwater Horizon oil spill in the northern Gulf of Mexico, which resulted from a drilling platform explosion (see Godard-Codding and Collier, 2018). However, Sea Lion Crude differs significantly from the Deepwater Horizon crude in several key ways. It is waxy and solid at ambient temperatures, making it unlikely to adhere to cetacean skin. Additionally, Sea Lion Crude is far less volatile than the Deepwater crude, reducing the likelihood of inhalation exposure to toxic vapours.

Nonetheless, many species of cetacean are late to mature and reproduce at a slow rate. Combined with complex social group structures, such as that displayed by killer whales, the loss of relatively few adult animals can lead to long-lasting impacts on family groups or sub-populations (Matkin, *et al.,* 2008).

Numerous species of cetacean have been recorded in the NFB. Species of note include the sperm whale (IUCN 'Vulnerable') and fin whale (IUCN 'Vulnerable') which were recorded acoustically throughout the year in the NFB, and sei whales (IUCN 'Endangered') are known to be seasonal visitors (Section 7.4.6.2).

A description of the spatial and temporal distribution of marine mammals in the NFB can be found in Section 7.4.6.2.2.1.

12.1.4.2.6 Coastal impacts

POEPL (now Navitas) conducted an environmental assessment of the sensitivity of the north Falklands coastline to the potential impacts of an oil spill (Premier, 2014a). This study used oil spill modelling (not the same as that described later in this chapter) to ascertain the potential distribution of oil in the unlikely event of a worst-case oil spill from the proposed Sea Lion Field Development. The North Falklands Coastline Environmental Sensitivity study has been used to identify the most sensitive sites along the north Falklands coastline in the event that a shoreline oil spill response operation needs to be initiated. The Environmental Sensitivity classification does not take into account sensitivity of the specific wildlife at the sites but is a more general ranking of sensitivity based on the physical

characteristics of the shoreline - ranging from high energy rocky shores to sandy beaches, mud flats and wetlands. These sites have been outlined in Section 7.6.

Throughout the year, inshore and coastal waters are important feeding grounds for numerous species. Inshore waters support large quantities of lobster krill and loligo squid, which in turn are major food resources for higher predators. At certain times of the year marine animals return to land to breed or moult, increasing the densities of vulnerable species in the coastal waters during these times. Further, inshore waters support seabird assemblages that were assessed by White, *et al.* (2001) as being of very high vulnerability to the potential impacts of oil pollution throughout the year (Section 7.4.5.6).

Section 7.5.2.3.1 identifies Important Bird Area (IBAs) around the Falkland Islands coastline. Of particular note are the Volunteer Point IBA and Seal Bay IBA on the North Falkland coastline, which are at a low risk of oil reaching shore as predicted in the following sections, and which contain bird species that use the inter-tidal area. In addition, the inshore area three nautical miles from the baseline is a proposed MMA (pMMA) and much of this area is also a Key Biodiversity Area (KBA) for sei whales and has KBA elements for a number of seabird and coastal bird species (see Section 7.5.2.3.4). The northern coastline of East Falkland is considered an IMMA for southern right whales and all of the Falklands inshore waters out to 100 m is considered a KBA for sei whales.

Laboratory results (CEDRE, 2017) and experience indicate that while tar balls are normally possible with waxy oils, they would take a long time to form as the cold oil shows little affinity for suspended solids or shoreline sediments and remains buoyant after losses to evaporation. Tar balls that do form over time will sink to near the seabed where they will move much more slowly, potentially travelling for long distances. While they do so they have relatively little interaction with the environment. Tar balls can then emerge on shorelines a long time after the initial release, where they cause nuisance and can break down in higher temperatures. Most reports of tar balls focus on their interference with human activities at coastlines when they adhere to shoes and clothes, and it is conceivable that other large mammals or seabirds (such as penguins and steamer ducks) could be impacted by smearing and ingestion on the shoreline. The likelihood of any oil reaching the shore remains very low, however, and oil would be significantly weathered. Tar balls are normally quite visible and affected areas can typically be manually cleaned without further damage.

Oil and diesel spills are known to modify macrobenthic assemblages at the intertidal zone (Zhou, *et. al*., 2019). However, as noted above, testing of the Sea Lion crude indicated that the crude may stick to seaweed if spilled directly onto the coastline (i.e., hot oil), although it is considered that this is not a realistic scenario given planned operations. Nonetheless, if oil were to reach the coast following a spill at sea it would no longer be hot and the adhesion will be limited, although roughness of the seaweed, for example if bryzoan colonies are attached to the kelp creating rough patches, means the oil is more likely to stick (see Section 12.1.4.1.1.1). Testing also indicated that oil reaching the coast from a spill at sea is not likely to stick to the shoreline; if oil spilled directly onto the coast (again not considered realistic), it will likely stick to rocky and cobbled shores (CEDRE, 2017).

12.1.4.2.7 Fisheries (Human population)

12.1.4.2.7.1 Spawning aggregations

Knowledge of the timing and distribution of spawning aggregations and egg and larval transport *via* oceanographic features is critical to understanding the potential impact of oil spills on fisheries in the Falkland Islands. While the understanding and knowledge of spawning grounds in the Falkland Islands is poor, many of the commercially fished species exploit Falklands waters for feeding rather than spawning (Arkhipkin, *et al.,* 2012b). Nonetheless, the following spawning sites have been identified:

- Loligo squid spawn in inshore waters around the Islands (especially the east coast),

- Southern blue whiting and red cod spawning sites south of Cape Meredith (Arkhipkin, *et al.,* 2010; Brickle, *et al.,* 2011), and
- Toothfish spawning on the southern and eastern parts of the Burdwood Bank (Laptikhovsky, *et al.,* 2006; Collins, *et al.,* 2010).

While the Development is therefore not located in areas that are known to be significant for spawning for commercial species, it is located in the broader area of the Northern Slope which is an important feeding area for numerous commercially important species (Section 7.4.4.2.2). Moreover, oil released into the marine environment would disperse and may overlap with the distribution of major finfish and *Illex* squid fishing grounds on the edge of the continental shelf.

12.1.4.2.7.2 Tainting and contamination of fish and squid

Pelagic fish that swim with their mouths open to maintain a continuous current of water across their gills (e.g., scombrid fish; Klinger, *et al.,* 2015) could experience increased oil exposure from suspended or sinking waxy crude (Drewery and Wolfaardt, 2017) and ingestion of hydrocarbons by fish can lead to tainting of the flesh. The degree of tainting depends on the type of oil, the species concerned and the exposure time but can persist even after the source of the contamination is removed. Unlike vertebrates, invertebrates, such as shellfish or squid, are less able to metabolise hydrocarbons (Section 12.1.4.2.3.2) and therefore tainting can persist for longer periods. In finfish, which have the enzyme systems necessary to metabolise petroleum (NOAA and API, 1994); tainting is not believed to persist for more than a few days following exposure (Boyd, *et al.,* 2001). However, even if it does not persist within finfish, the public perception of tainting may last longer and may have implications for commercial markets. Moreover, concentrations that do not lead to tainting may still affect the physiology of the fish.

The accumulation of hydrocarbons in squid tissue has implications for tainting and human health. In recognition of the risk of potential contamination of the human food chain, the European Union (EC Regulation 208/2005) established a maximum level of 5.0 µg/kg wet weight for benzo(a)pyrene (the marker used for PAHs carcinogenic risks) in cephalopods. Some studies have been carried out to look at the background level of contamination in several cephalopod fisheries around the world (Gomes, *et al.,* 2013; Morais, *et al.,* 2013), which found relatively high background levels in Loligo squid from the South Atlantic. Consequently, should a significant oil spill overlap with squid fisheries, this would pose a risk to human health. The impact may also be cycled through the food chain due to squid's pivotal role as a consumer and prey species. However, as noted above, the CEDRE analysis of the Sea Lion crude indicates that PAHs did not dissolve into the water column during the seven day monitoring period. As described above, PAHs could potentially dissolve into the water column over longer periods of time, but the intrinsic levels of PAH in the crude are still relatively low (0.15 % versus 0.3-0.5 % for many crudes).

Nonetheless, the persistence of these chemicals, which can be subject to long-range transport impacting areas a considerable distance from the point of discharge, may lead to long-lasting impacts to the fishing industry, including fishery closures and reduced confidence from consumers.

Although there is little direct fishing effort in the immediate vicinity of the Sea Lion Field (Section 7.7.3.1.1.1), the Field sits between two major fishing areas. Deeper waters (>600 m) to the north and north-east are subject to a longline fishery for Patagonian toothfish. Waters on the edge of the Continental Shelf to the south and south-west of the Development are targeted by finfish trawlers. The catch of these vessels is mixed but comprises predominantly Patagonian rock cod, hake, hoki and skate (Section 7.7.3.1.1.1). However, the commercially targeted Argentine shortfin squid migrates into deeper water in May and June, to access the Falkland Islands current to aid passage to their northerly spawning migrations (Arkhipkin, *et al.,* 2015), and a significant proportion of the South Patagonian Stock passes through the Northern Slope.

12.1.4.2.8 Tourism

The natural environment and abundant wildlife are amongst the main attributes that draw tourists to the Falkland Islands. Even if oil does not reach the coast following a spill, news of an oil spill in what is perceived to be a remote and wild destination will result in negative publicity. In a wildlife destination like the Falklands, this could adversely impact public perception and experience of the Islands and undermine its status as an internationally renowned eco- and wildlife destination.

12.1.4.3 Oil spill modelling

In order to assess the potential impacts of large oil spills on environmental receptors, five oil spill, or release, scenarios have been modelled.

The main aims of the modelling were to understand the:

- Probability of hydrocarbons accumulating on the surface or reaching the shore,
- Characteristics of hydrocarbons dissolved in the water column,
- Fate of the hydrocarbons in terms of the relative amounts dispersed, evaporated, beached, biodegraded and deposited in sediments, and
- Overall likely transport of oil at sea in terms of density, direction and time.

For the Sea Lion Phase 1 & 2 Development, using the most accurate oil properties and metocean data available, it is predicted that the Falkland Islands coastline is on the fringe of the maximum area that could potentially be reached by oil from a large release. The likelihood of such an outcome has a very low probability and consequently quite subtle changes in metocean data, location and release size can have apparently large effects on shoreline impacts. The predictions consistently show low (if any) probabilities and oil masses. A blow-out (Scenario 1) is predicted to result in a very small mass of oil to shore in 4 % of the metocean conditions modelled. It is predicted that an FPSO loss (Scenario 2) could also reach the coast of the Falkland Islands in 5.8 % of the metocean conditions modelled.

12.1.4.3.1 The OSCAR modelling approach

The SINTEF OSCAR software is a sophisticated multifunction model that computes surface and subsurface transport, behaviour, weathering and fate of oil, as well as potential ecological impacts. The OSCAR model has been developed by SINTEF, an independent Norwegian research organisation founded in 1950 that specialises in oil behaviour with extensive oil testing laboratories. The suite of models to which OSCAR belongs has been the subject of verification and calibration by numerous field experiments both on surface spills and subsea releases in offshore and nearshore locations, e.g., as described in Reed *et al.* (1995; 1996), Johansen *et al.* (2001), Hayes and Galley (2012), de Susanne (2015) and Niu *et al.* (2016). This validation confirms the model as a state-of-the-art method for predicting oil behaviour at sea. Since the modelling draws in a number of different datasets (currents, winds, bathymetry, shoreline types, oil characteristics and others), the outputs should be viewed as giving the best possible indication of oil behaviour that are reliable for drawing overall conclusions, while bearing in mind that there is an uncertainty around specific numerical outputs.

The OSCAR model was primarily written to predict the physical behaviour of Newtonian fluids, which includes the majority of crude oils. However, it is possible to input specified measured parameters for individual crude oils including the hydrocarbon characterisation and weathering parameters, which now includes Sea Lion Crude, following crude oil tests undertaken by CEDRE (2017).

The following describes only the information required to ensure appreciation and understanding of the modelling results. Of note, release 14.1 of OSCAR was the current version when the modelling was undertaken and was used for the modelling described below.

12.1.4.3.2 Discharge parameters and assumptions used in the modelling

The release parameters used in the oil spill dispersion modelling for each scenario are summarised in Table 12.3. These parameters are based on worst-case scenarios so as to set an upper boundary in relation to the potential effects.

Of note, there will probably be an upper limit in terms of the thermal properties of the release, i.e., a large mass of hot oil released will remain fluid potentially for some minutes, float and flow into a thinner layer, but it is expected that such a layer would not be strong enough to withstand wave action. To reflect this behavior, during the modelling undertaken for Sea Lion crude releases:

- The initial oil droplet size was set as large as possible, in the range of centimetres,
- The 'terminal film thickness' parameter was modified to prevent oil from continuing to spread on the sea surface,
- For subsea releases (e.g., a well blow-out) and smaller surface releases (e.g., crude oil transfer spill), the initial surface film thickness was set to 20 mm thickness and spreading was limited to 1 mm thickness, and
- For larger losses of inventory (e.g., loss of FPSO inventory), the initial surface film thickness was set to 50 mm and spreading is limited to 5 mm thickness.

Table 12.3: Parameters included in the oil dispersion modelling for the oil and diesel spill scenarios

Scenario	Fluids discharged	Release parameters					Model run duration	Worst-case assumptions
		Volume (tonnes)	Duration	Location	Temp. (°C)	Diameter		
1: Well blow-out scenario	Sea Lion crude oil	Worst-case declining rate: 1,980 – 1,291 t/d (32,295 tonnes total)	21 days[1]	Seabed	68	230 mm	111 days	Release duration assumes 21 days to employ a well capping device. Worst-case declining flow rate used.
2: FPSO crude oil inventory loss	Sea Lion crude oil	80,080	1 day	Surface release	60	n/a	91 days	Release volume based on total loss of FPSO inventory (605,000 bbl) at 60°C storage temperature over one day.
3: Crude oil transfer spill	Sea Lion crude oil	70	10 minutes	Surface release	60	n/a	30 days	Volume and duration reflect the fact that operations would cease as soon as a leak / spill was detected. Hose volume reflects the largest comparable spill recorded.
4: Diesel inventory loss (MODU)	MGO	3,936	1 hour	Surface release	8 (ambient)	n/a	14 days	Release volume based on total loss from an analogue MODU.
5: Diesel bunkering spill	MGO	20	10 minutes	Surface release	8 (ambient)	n/a	14 days	Volume and duration reflect the fact that operations would cease as soon as a leak / spill was detected.

[1] 21 days is calculated by Navitas on the basis of the upper durations estimated for the following tasks (i) decision to deploy capping stack; (ii) deploy Capping Stack by air to Falkland Islands; (iii) mobilise well control team; (iv) prepare Capping Stack for deployment offshore; (v) deploy Installation Vessel to field; (vi) deploy Capping Stack to field; and (vii) cap well.

12.1.4.3.3 Reporting thresholds defined in the model

In order to give meaning to the models, it is necessary to determine thresholds (based on industry best practice), below which the predicted levels of contamination are insignificant. Once a threshold is reached, the model terminates oil particles (assuming loss of mass to evaporation, decay or deposition) or ceases recording them.

The spill properties to which the thresholds apply include:

- Thickness / density of oil on the surface, and
- Total water column concentration.

The model generates output data (maximum oil concentrations, surface thickness etc.) by tracking numerous particles placed throughout a specified grid that is manually selected in the locality of the release site. Typically, this grid will be set to capture the majority of the plume as it disperses across the sea.

12.1.4.3.3.1 Thickness / density of oil on the surface

Significant, and relevant, surface thicknesses depend on the specific properties of the oil under consideration.

Sea Lion Crude

For the Sea Lion crude oil type, the overwhelming properties of the wax components mean that a surface thickness parameter is not meaningful, and a scale has therefore been devised to reflect the density of waxy oil droplets on the sea surface.

The scale of oil density chosen to represent the results is 1, 10, 100, and 1,000 grams per square metre (g/m^2). This unit has been used previously for similarly waxy crudes, for example, oil pollution emergency plans following the Montara oil spill in the Timor Sea in 2009 used a density of 10 g/m^2 (PTTEP, 2016). Here the chosen threshold is 1 g/m^2 and below this value the oil ceases to be shown in model outputs, although it remains present in the calculations in the model (Table 12.4). Importantly, the scale selected here is not intended to imply significance in terms of the impact assessment below, but to convey factual information regarding the model predictions and allow a means of visualising the results.

It is noted that in the laboratory tests, feathers exposed to 100 g/m^2 of oil showed no oil being adsorbed by the feathers, and no structural damage was observed. At an oil concentration of 1,000 g/m^2, all the feathers were stained by oil, and for two bird species, micro particles of oil adhered.

Diesel (Marine Gas Oil)

While there are some data on the effects on feathers of thicknesses of sheens or slicks from liquid oils such as MGO (Section 12.1.4.2.4.1), there is no consensus on thicknesses of surface oil that corresponds to impacts on the whole animal or on populations. For the MGO spill scenarios that have been modelled in this study, a surface thickness threshold of 0.3 µm has been adopted as a way of judging the onset of impacts (Table 12.4). Under the Bonn Agreement 'Oil Appearance Code of oil thicknesses' (Bonn Agreement, 2009), this thickness value corresponds to a rainbow sheen and any surface oil thickness below this value is unlikely to be visible.

12.1.4.3.3.2 Total water column concentration

Water column concentrations refer to dissolved hydrocarbons plus droplets. A threshold of 25 parts per billion (ppb) has been used in the models for all spill scenarios and oil types, below which the oil in the water column is not expected to have acute toxic effects (Table 12.4). This threshold reflects a worst-case and it is noted that 50 pbb is the lowest Predicted No Effect Concentration (PNEC) for acute

toxicity of the oil components in the OSCAR database and is also the mid-range of the concentrations of crude oil found to give sub-lethal effects (Patin, 2004).

12.1.4.3.3.3 Sediment concentration

Oil can reach the sediments either directly if a release is near to the seabed in turbulent water conditions or it can sink to the seabed if it adsorbs to suspended solids within the water column, thus becoming denser. The latter method has not been included within the modelling (Section 12.1.4.3.4.1).

Tests of Sea Lion crude on benthic organisms (*Corophium* sp. (Amphipod)) indicated that at concentrations of >392 mg/kg oil in the sediment, the oil is lethal to 50 % of organisms tested after 10 days (Table 12.1 above, CEDRE, 2017). A level of 50 mg/kg is a more general level of oil contamination where toxic effects may be discernible, referenced in OSPAR Recommendation 2006/5 on the management of drill cuttings piles and a more precautionary threshold of 10 mg/kg is put forward in Patin (2004) as being the zone of No Observable Effect Concentrations (NOEC) of crude oils (Table 12.4).

Table 12.4: Oil density thresholds used in the Sea Lion development oil spill modelling study

Scenario	Oil type discharged	Surface threshold	Water column concentration threshold	Sediment threshold
1: Subsea well blow-out	Sea Lion crude oil	1 g/m^2	25 ppb	>392 mg/kg[1] 50 mg/kg[2] 10 mg/kg[3]
2: FPSO inventory loss				
3: Crude transfer spill				
4: Diesel inventory loss	MGO	0.3 µm	25 ppb	n/a
5: Diesel bunkering spill				n/a

[1] Tests on the amphipod *Corophium sp*. were carried out for 10 days to determine the lethal toxicity (LC_{50}) of the crude to amphipods. 392 mg/kg of oil in sediments is the concentration at which 50 % of the test organisms died when compared to a control (Table 12.1).
[2] OSPAR Recommendation 2006/5 on the management of drill cuttings piles.
[3] Indicated by Patin (2004) as the zone of NOEC.

12.1.4.3.4 Understanding the model

Oil spill modelling incorporates the following two types of model run:

- **Stochastic modelling** - carried out by running individual discharge scenarios multiple times over different time periods (thereby utilising different wind and current conditions) and aggregating the results in order to report behaviour in some probabilistic or statistical manner. For each oil spill scenario, the aggregated stochastic modelling results present:
  - The probability (%) of hydrocarbons accumulating to levels above the stated thresholds:
    - On the sea surface,
    - In the water column, and
    - On any shorelines.
  - The minimum times taken (days) for hydrocarbons to arrive at any location at levels above the stated thresholds:
    - On the sea surface,
    - In the water column, and
    - On any shorelines.

- The maximum length of time (days) any area is exposed to oil at levels above the stated thresholds:
  - On the sea surface,
  - In the water column, and
  - On any shorelines.

- **Deterministic modelling** - conducted over a particular time frame which is selected based on the results of the stochastic model results, deterministic modelling is used to highlight hydrocarbon behaviour over a specific time frame. The time period for each deterministic run was selected to highlight either the worst-case mass of oil arriving on shore, or the largest mass of oil on the sea surface both of which are predicted by the stochastic modelling results. For each oil spill scenario, the deterministic modelling results present:
  - The predicted worst-case shoreline oiling concentrations (kg/m^2) (if applicable),
  - The maximum surface area affected by levels above the stated thresholds for a single spill scenario, and
  - The total hydrocarbon concentration (ppb) in the water column for a single spill scenario.

12.1.4.3.4.1 Model parameters

To assist the interpretation of model outputs and the conclusions drawn, the following points are noted.

Sedimentation of oil

There are two mechanisms by which oil can contaminate sediments. One is where oil in the water column becomes absorbed directly into seabed sediments through close contact near the seabed and occurs particularly when the water column is turbulent. Inclusion of this mechanism was not available in previous versions of the OSCAR modelling software but is now included within version 14.1 (used in this assessment).

The second mechanism is where oil in the water column attaches to suspended solid particles also in the water column. This makes the oil more dense so that it sinks more quickly to the seabed. The OSCAR model (version 14.1) allows for the entry of an ambient suspended solids concentration to account for this mechanism. However, this has not been applied in the modelling here because there are little data on suspended solids in the region, and laboratory testing indicated little uptake of suspended solids by the Sea Lion oil. By omitting it, there is confidence that the amount of oil in other compartments (e.g., surface layers or the water column) is not underestimated.

Emulsification of oil

In the scenario narratives below, the model outputs present oil masses that include a water content in the oil that is predicted by the model physics. This means the reported mass of oil across all compartments is slightly higher than the released mass.

Grid selection

Model results are collated and reported *via* a 3D grid, and for each scenario the grid layout has been chosen that maximises the accuracy of the outputs by focusing on the area occupied by the vast majority of oil particles for the period when they are most likely to present significant environmental impacts. Given available computing power, it is possible to increase the definition of outputs for the deterministic model, and in particular the resolution of the water column grid is increased so that the presence of oil in the water column can be reported at a higher resolution.

Where model particles exit the grid, such as to the north of the area for the blowout and FPSO inventory loss scenarios, they are recorded as 'outside grid'. The northern boundary for these two

scenarios has been chosen to be as far north as possible within the high-resolution NEMO PS4 currents dataset, and by the time oil exits this area, its environmental properties are known and relatively stable and conclusions on impacts can be drawn.

Model duration

Extensive modelling of potential offshore releases, including the results presented here, confirms that oil can reach the edge of the model domain in 30 days, and takes 60 days in the majority of cases. It is therefore considered conservative to allow a model run period of 90 days after the end of the release. For the smaller scenarios, a duration of 30 days is used for the crude transfer spill and 14 days for the MGO scenarios in proportion to the volume and persistence of the oil. Using 102 stochastic scenarios, the individual runs are spaced at approximately 10 day intervals across the 3-year metocean dataset, and periods being modelled overlap very significantly. For the blowout scenario, this means that oil is released at every time interval within the model dataset with subsequently at least 90 days to disperse to identify all possible trajectories. Experience has also shown that increasing the number of stochastic runs beyond this number does not significantly alter the results, which complies with UK government recommendations (BEIS, 2022a). This can be seen by the projection that while four scenarios for well blow-out reach the shore, they all occupy the same set of north winds in the metocean record, i.e., increasing the number of runs would not alter the proportion that occupy this set of winds.

12.1.4.4 Scenario 1: Subsea well blow-out - modelling results

12.1.4.4.1 Predicted behaviour of oil

The behaviour of Sea Lion crude released due to a well blow-out (worst-case 32,295 tonnes) is shown in Figure 12-3. These results represent the scenario giving rise to the maximum oil coming ashore and are also representative of the general oil behavior over a wide range of conditions. The ‘spikiness’ of the surface and dispersed oil values reflects periods of rough and calm weather, when oil moves between surface and water column, resurfacing when calm.

Since the well blow-out discharge is assumed to occur on the seabed, crude oil is not immediately present on the sea surface. However, due to the buoyancy of the oil, it is predicted to surface very quickly after it has been discharged. The modelling predicts that after 20 days from the start of the discharge, 35,250 tonnes of oil is accounted for (including emulsified water): 71 % (25,030 tonnes) will be found on the sea surface, 16 % (5,599 tonnes) will be dispersed in the water column, 7 % (2,537 tonnes) will have evaporated, and 2 % (673 tonnes) will have biodegraded. A maximum of 110 tonnes is predicted to be present in sediments at the end of the simulation (<1 %).

After approximately 60 days, model particles begin to leave the modelling grid. Model particles were only observed to leave the modelling grid initially *via* the northern boundary due to the strong northerly currents and then later also *via* the eastern boundary. It is expected that any oil that has travelled this far will be insignificant as it will be in a highly dispersed state, having been at sea for a minimum of 30 days. Thus, any oil that leaves the model grid is not expected to significantly affect the overall conclusions of the model predictions. It should also be noted that extending the model grid northwards is not practical since this boundary is set to coincide with the boundary of the NEMO PS4 currents grid. However, it is important to note that once the oil starts to leave the model grid, the fate of oil is unknown, therefore the total masses of oil in each fate category beyond 60 days may be larger than those shown in Figure 12-3 as the oil that leaves the modelling grid is not accounted for.

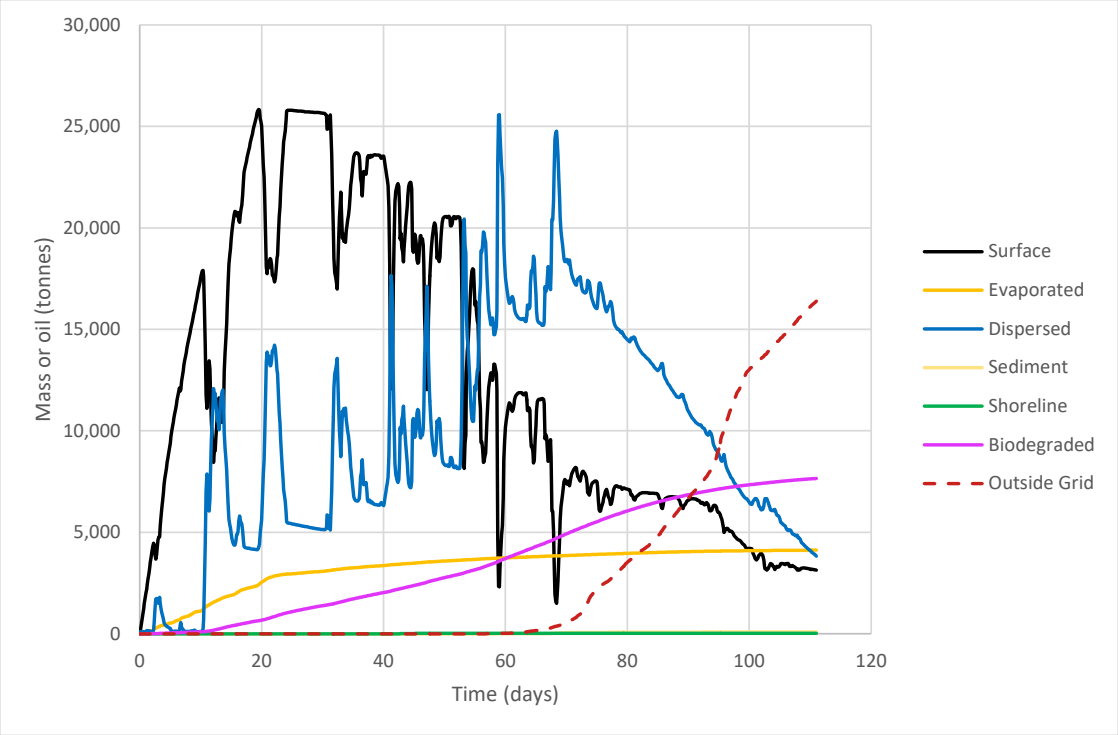


Figure 12-3: Behaviour of oil over time during the modelled blow-out

12.1.4.4.2 Subsea Well Blow-Out - Surface results

Figure 12-4 below shows the probability of oil appearing on the sea surface above the threshold of 1 g/m^2 following a subsea well blow-out throughout the whole model run. Because Sea Lion crude is a low density oil, and the oil masses that form after the oil is discharged to the marine environment are buoyant, there is a high probability that oil will appear on the sea surface above the threshold. There is a large area of the sea surface that has 100 % probability of surface oil above 1 g/m^2 (Figure 12-4). The oil is predicted to travel on the sea surface primarily in a northerly direction due to the predominant surface current direction. Some wax is also likely to be found to the south-east of the discharge location, as a result of wind driven Ekman currents. It is predicted that there is approximately a 4 % probability of oil reaching the coastline of the Falklands *via* the sea surface – that is, four out of 102 cases, oil is predicted to reach the shoreline, while in 98 out of 102 cases, no oil is predicted to reach the shore.

Figure 12-5 shows the minimum arrival times of Sea Lion crude above the threshold of 1 g/m^2 on the sea surface. In most conditions, the Sea Lion crude can potentially travel up to 30 km within one day of being discharged, 105 km within 5 days, and up to 260 km within 10 days. Although the crude oil can potentially travel very long distances within a relatively short period of time, it is predicted that after 10 days the oil will be in a highly dispersed state. The oil rises quickly to the surface and spends little time in the zone of strongest currents which is around 30 m below the surface, and after surfacing is driven by winds and prevailing currents. Oil takes at least 7.5 days to reach the outer boundary of the FOCZ.

Figure 12-6 shows the maximum time that any sea surface location is exposed to Sea Lion crude above the surface density threshold of 1 g/m^2. The sea surface around and to the east of the well blow-out discharge location can potentially be exposed to Sea Lion crude oil for up to 30 days. At locations further away from the discharge, the maximum exposure times decrease as the oil spreads and the likelihood of oil above 1 g/m^2 on the sea surface decreases. At locations outside of the FOCZ boundary

it is unlikely that the surface will be exposed to oil above the 1 g/m^2 threshold for more than three days and will probably be less than a day.

All of the outputs shown in these figures are based on an aggregation of results from all the stochastic model runs and therefore do not represent a single spill scenario, and certainly do not reflect the manifestation of oil on the sea surface at any single instance in time.

Tests on oiling of feathers were conducted at CEDRE (2017) looking at densities of 100 g/m^2 and 1,000 g/m^2; minor changes to barbules were noted at 100 g/m^2, and adhesion of oil and some feather staining was observed at 1,000 g/m^2 surface density.

In the blow-out scenario, very little area is predicted to be exposed to a concentration of more than 10 g/m^2 and there are no sustained areas predicted to be above 100 g/m^2 (Figure 12-7). Levels of 1,000 g/m^2 were necessary in the laboratory to induce oil staining and adhesion, with minor changes to barbules noted at 100 g/m^2 (Section 12.1.4.1.1.1). Note that due to averaging and contouring functions in the stochastic model, some individual cells may exhibit a transient concentration of above 100 g/m^2 but remain absent from the plots, which can be seen in the deterministic example in Figure 12-8 very close to the release. The conclusion remains that there is a negligible area of sea at risk of > 100 g/m^2 of crude oil on the surface at this scale.

Based on the stochastic simulation results of the worst-case well blow-out scenario, a single deterministic model run was conducted to demonstrate the predicted total impacted surface area for a single, worst-case, scenario. Figure 12-8a shows the total impacted surface area for the single deterministic model run, and shows the maximum oil densities on the sea surface that were observed at each geographical location throughout the whole model run duration of 137 days. This graphic illustrates every location where wax might be found throughout the entire model period. Again, this is not reflective of the extent of wax distribution at a single point in time. An example typical snapshot of surface wax densities for the single deterministic well blow-out model run is shown in Figure 12-8b.

12.1.4.4.2.1 Model predictions after oil has been at sea for long periods

It is normal to run scenarios for the entire duration of a blow-out, and for some time following the cessation of the release, to determine the behaviour and location of oil before taking a view on whether this poses a risk to receptors. There are reasons to view the longer-term surface predictions as conservative, as the particles at sea will eventually be biodegraded or combine with suspended solids and sink. It is also not certain that the model physics for very weathered oil masses is representative. The representation of the oil as a density, which appears to evenly cover grid cells of 2 km^2 in the well blow-out model run, is a reasonable way to envisage it during the early stages of a release but may lose relevance when the oil masses are extremely small and widely dispersed. It is possible to employ a higher threshold to 'screen out' smaller concentrations, but this has not been done in the interest of transparency.

Overall, the interpretation of results over long timescales should be done with caution and experience, and, in general, the model results may exaggerate the apparent impact of dispersed oil and are therefore considered to be conservative.

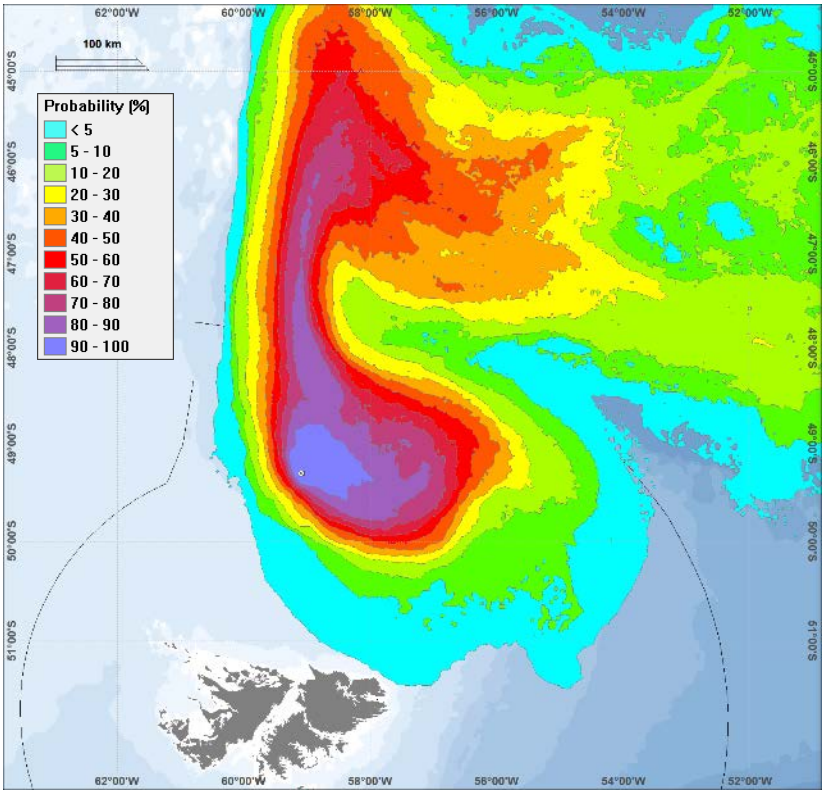


Figure 12-4: Probability of surface contamination above threshold of 1 g/m^2 for worst-case well blow-out scenario

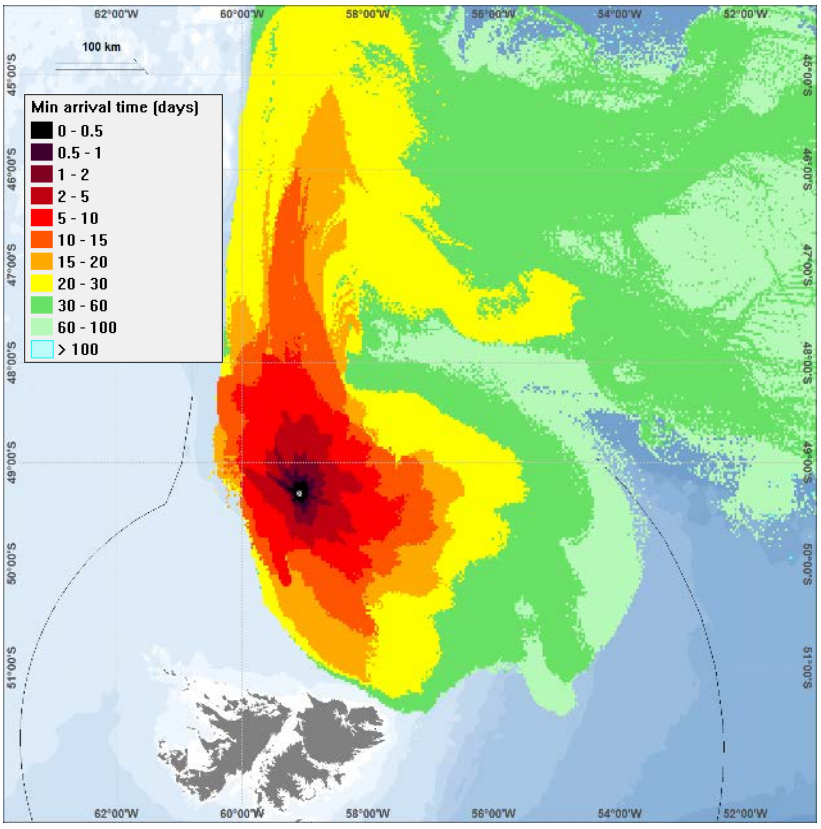


Figure 12-5: Minimum arrival times of Sea Lion crude above 1 g/m^2 on the surface

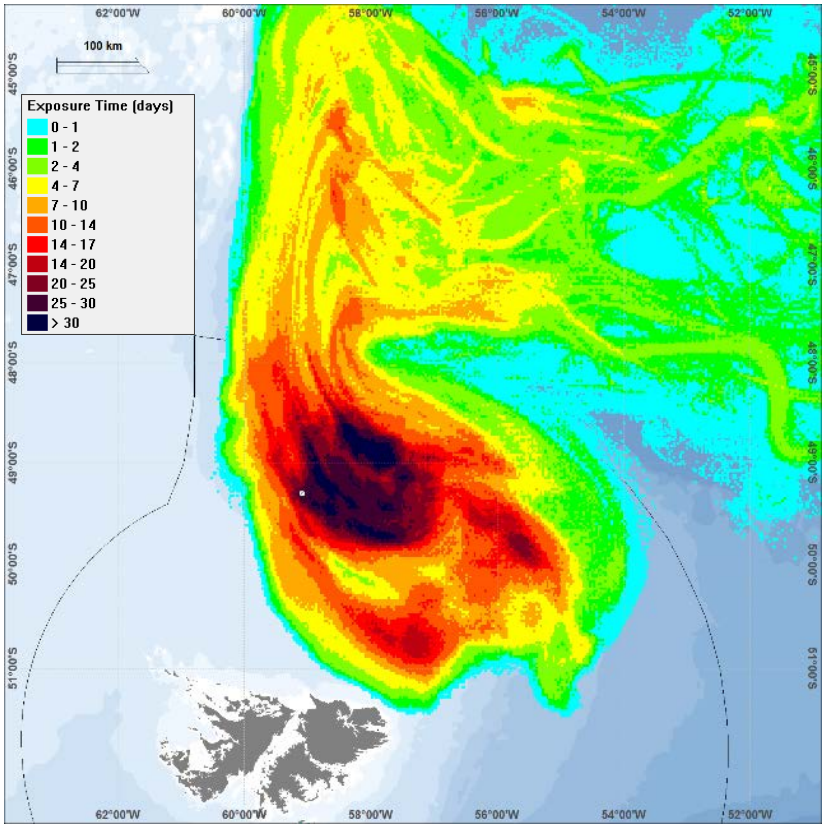
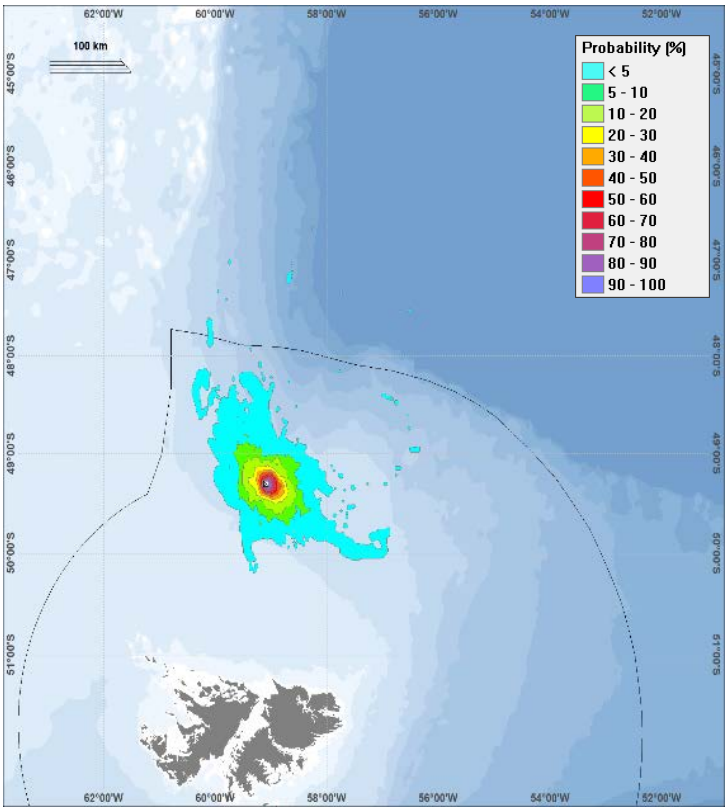
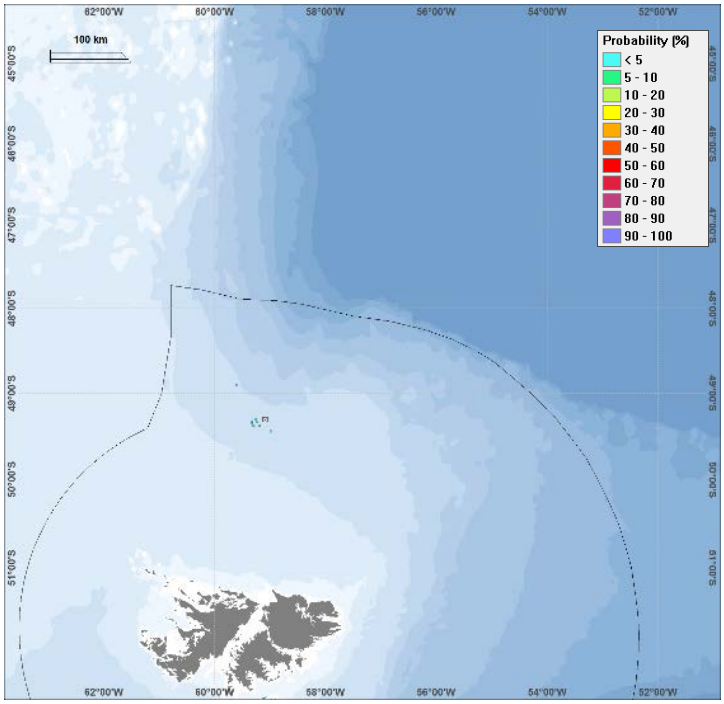


Figure 12-6: Maximum time surface is exposed to Sea Lion crude above 1 g/m^2

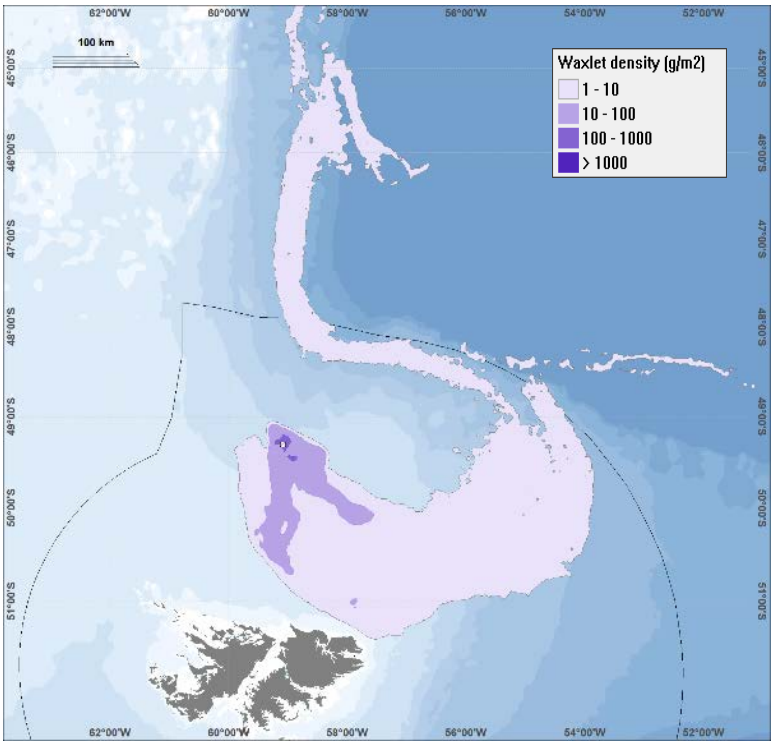


(a) Probability >10 g/m^2

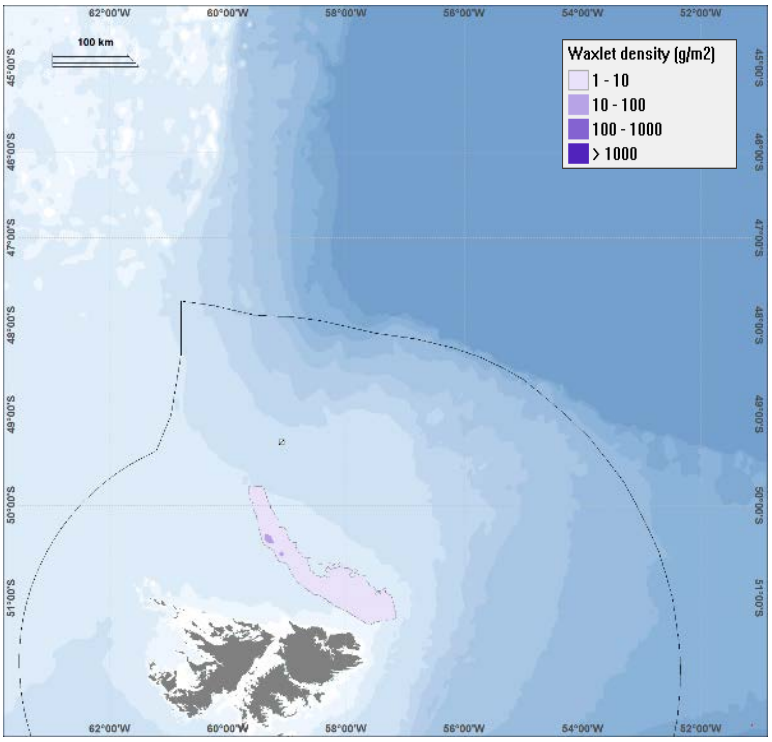


(b) Probability >100 g/m^2

Figure 12-7: Probability of Surface Oiling at Differing Oil Densities for Subsea Blow-out (stochastic). Note: No results are reported for 1,000 g/m^2



a) Total impacted surface area above threshold of 1 g/m^2 for single deterministic model run



b) Example snapshot of surface wax above 1 g/m^2 (at 30 days)

Figure 12-8: Surface results (deterministic) for worst-case well blow-out

12.1.4.4.3 Subsea Well Blow-Out - Water column results

Figure 12-9 shows the probability of oil accumulating in the water column above the threshold of 25 ppb for the worst-case well blow-out scenario. As expected, since the release is modelled to occur subsea for a duration of 21 days prior to being capped, there is a high probability that the water column will be exposed to crude oil above the concentration threshold of 25 ppb. The crude oil is predicted to travel predominantly in northerly and south-easterly directions, which is likely caused by currents and the predominant winds from the north-west dispersing surface oil into the water column. The oil released at the seabed is expected to rise through the water column quickly and there is a high probability that it will accumulate in the topmost layer (<60 m) of the water column in concentrations above 25 ppb.

Figure 12-10 shows the maximum times the water column will be exposed to >25 ppb, showing clearly that there are longer exposure times near the blow-out location.

A cumulative plot of water column concentrations of dissolved oil and oil droplets for the worst-case well blow-out is shown in Figure 12-11a. Figure 12-11b shows a cross section of the same results. However, given the very low solubility of Sea Lion crude, these concentrations are almost all small wax particles, and very little of the oil is present in the more hazardous dissolved form.

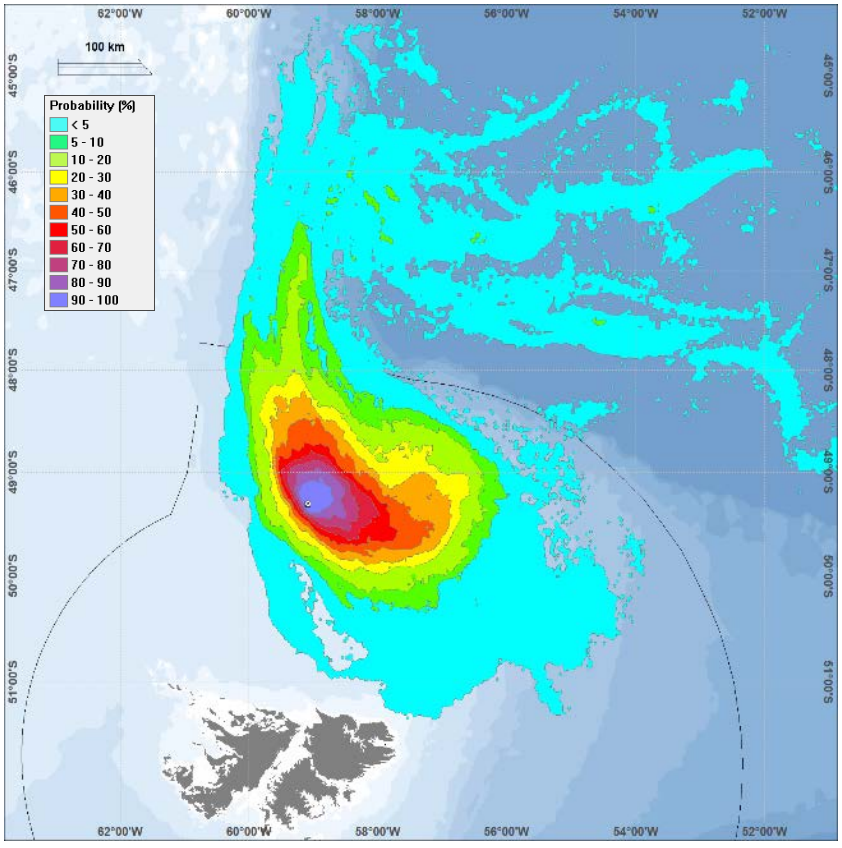


Figure 12-9: Probability of water column concentrations of >25 ppb in a worst-case blow-out

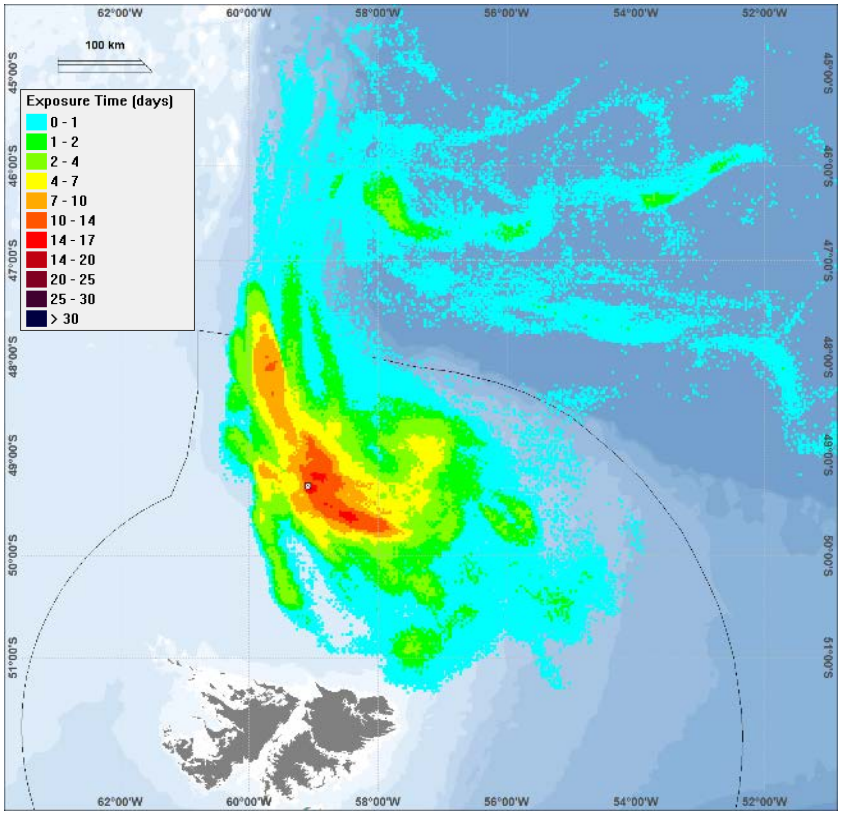
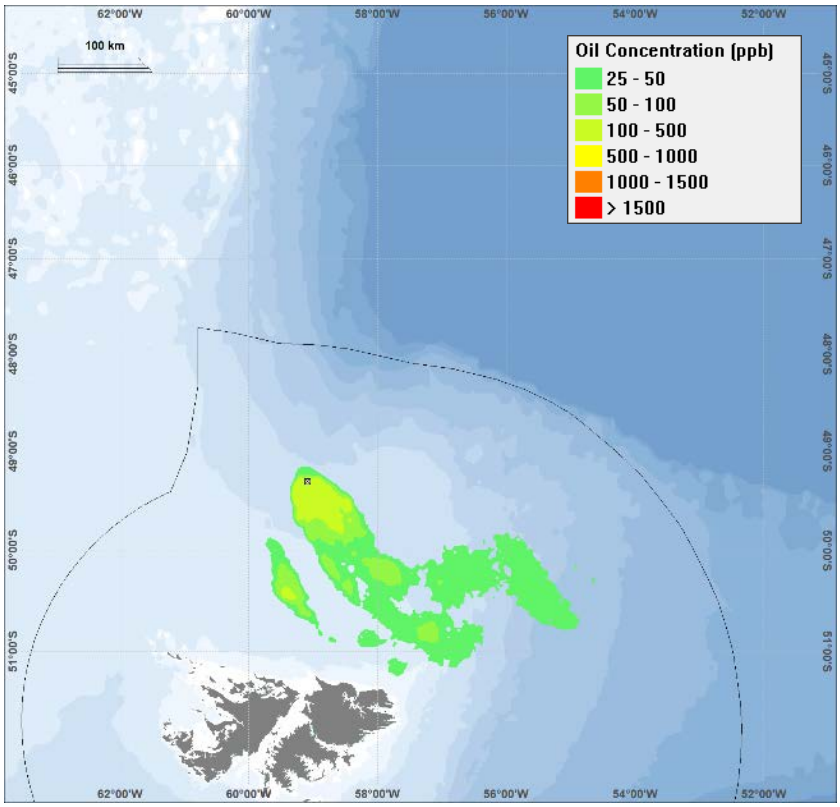
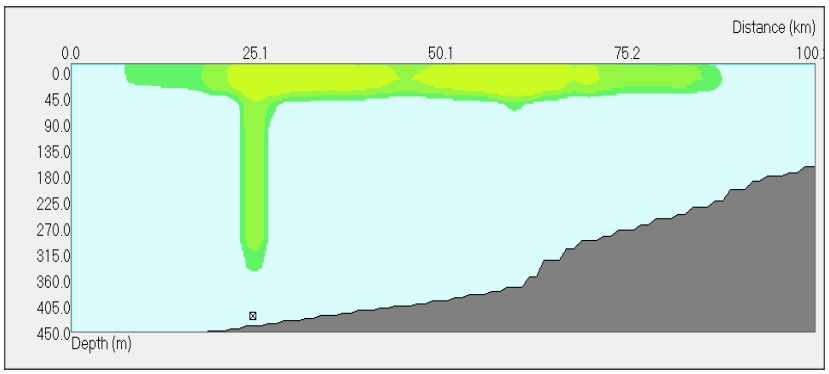


Figure 12-10: Water column maximum exposure time >25 ppb



a) Cumulative water column concentration dissolved oil and oil droplets



b) Cross-section of cumulative water column concentration dissolved oil and oil droplets

Figure 12-11: Cumulative water column concentrations from a worst-case blow-out

12.1.4.4.4 Subsea Well Blow-Out - Shoreline results

Figure 12-12 shows the probability of oil reaching the Falklands coastline after a worst-case blow-out by identifying the initial beaching locations. The modelling results indicate that there is a low probability of crude oil reaching the shoreline. The northern coastline of East Falkland is predicted to be the most likely place where oil could beach and there is no possibility for any international beaching events. The greatest probability of shoreline oiling was observed to be 4 %, indicating that only four of the 102 individual stochastic simulations resulted in crude oil reaching the Falklands coastline. Examining the metocean record, this only occurs when there is a prolonged period of northerly winds for some weeks, and this has occurred only once in the record. Four scenarios had this weather episode

within their duration for long enough for oil to reach the coast. Consequently, in the event of a worst-case blow-out, shoreline oiling is possible, but highly unlikely. In 98 out of 102 cases, no oil is predicted to reach the shore.

Figure 12-13 shows the minimum arrival times for shoreline oiling for a worst-case blow-out indicating that, in the unlikely combination of conditions where oil is blown towards the Falkland Islands, arrival times are 32-52 days to reach the northern coast of East Falkland, with an average of 41 days.

Figure 12-14 shows the concentration of oiling on the shore for a deterministic scenario to predict the worst-case oiling on the shore. The maximum volume of oil predicted to reach the coastline is approximately 29 tonnes and the average amount of oil on shore (in the 4 % of scenarios in which oil does reach the shoreline) of 16.5 tonnes.

Figure 12-15 shows the forecast for any oil to reach the shoreline in terms of the mass of oil over time. It is predicted that any crude oil that eventually reaches the Falklands coastline would be in a highly dispersed state due to it having been at-sea for over 30 days before reaching the coastline. It is therefore likely that the oil would reach the shoreline as small masses and might not be easily detectable.

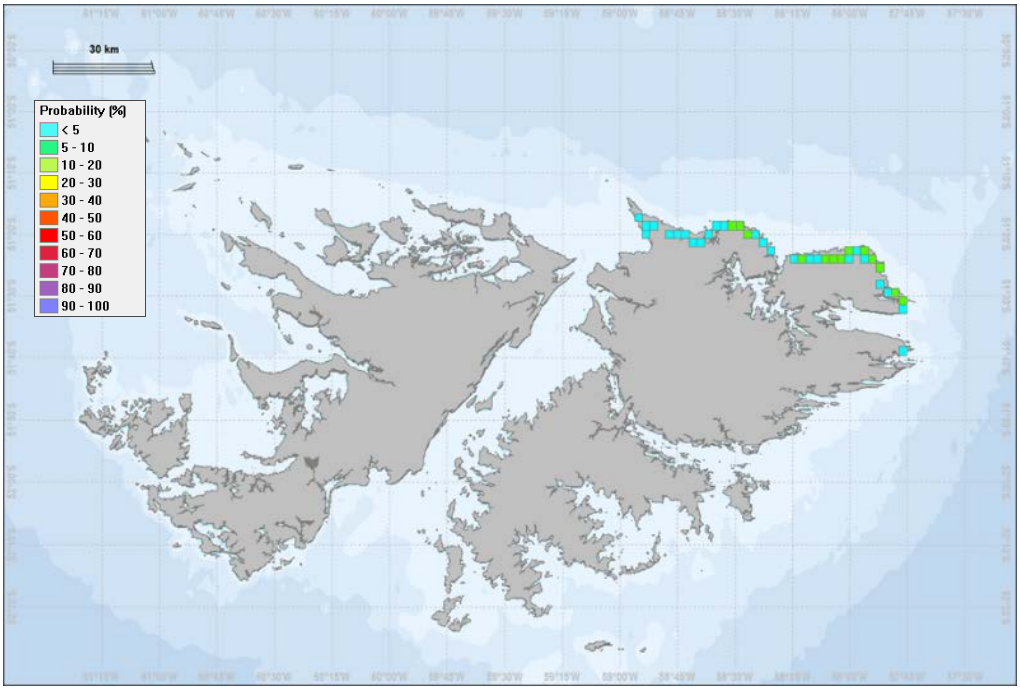


Figure 12-12: Probability of shoreline oiling for the model runs where oil does reach the shore, for a worst-case blow-out

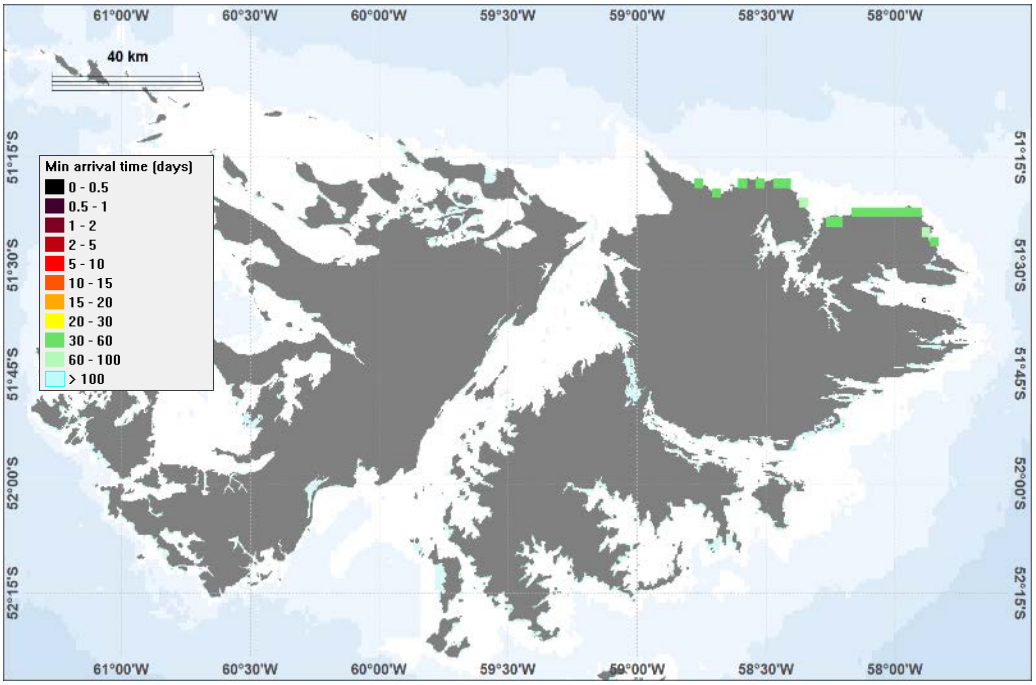


Figure 12-13: Minimum arrival times for shoreline oiling for a worst-case blow-out

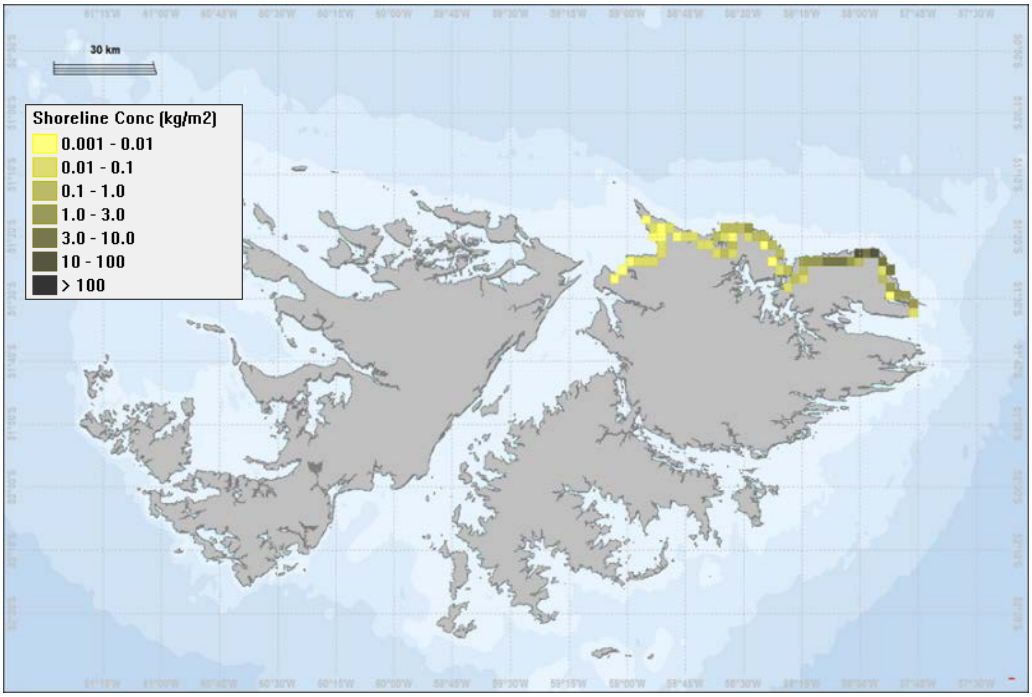


Figure 12-14: Concentration of oiling on the shoreline for a worst-case blow-out (deterministic)

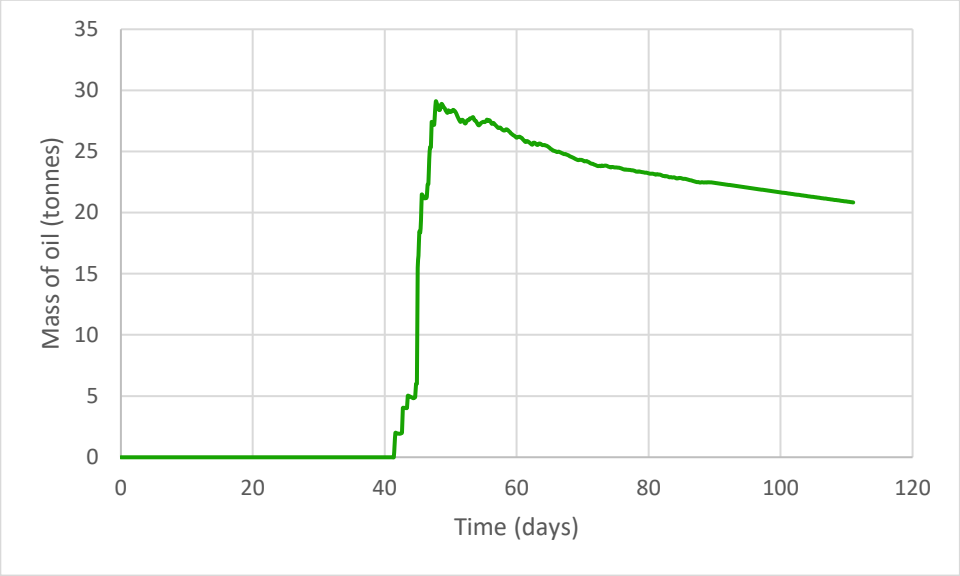


Figure 12-15: Forecast of oil arriving onshore in a worst-case blow-out scenario

12.1.4.4.5 Subsea Well Blow-Out – Sediment concentration

Tests on the Sea Lion crude indicate that a spill would impact upon on benthic species tested at concentrations >392 mg/kg in the sediments (Section 12.1.4.1.1.1). This is not predicted to occur anywhere following a well blow-out. A level of 50 mg/kg is a more general level of oil contamination where toxic effects may be discernible (Table 12.4 above). No predicted levels are above this threshold. A more precautionary threshold of 10 mg/kg is put forward in Patin (2004) as being the zone of NOEC, and 644 km^2 of seabed could be above this concentration, the maximum level predicted being 29.3 mg/kg assuming oil is mixed over a 5 cm layer.

12.1.4.4.6 Subsea Well Blow-Out - Effect of oil spill response measures

The OSCAR model has been used to predict the effectiveness of oil spill response measures. Oil containment and recovery is the principal means of response, as dispersants are ineffective (Table 12.1 above) and burning has not been evaluated. Oil containment and recovery has limited efficacy in offshore sea states where significant wave height is >2 m but the necessary resources for response will be available on support vessels, as will be described in the operational OPEP (Section 12.1.1.1.3). The assumptions around response resources are as follows.

- In the case of a blow-out, it is assumed that any vessels present would support rescue of personnel or source control activities for the first 24 hours, and there would be no immediate recovery,
- After that, it is assumed that two recovery units would be available using a boom system,
- Each recovery unit would have a boom encounter width of 15 m and a single skimmer[98] capable of recovering 30 tonnes per hour (if that much oil is encountered by the boom) and could operate at a wave height of up to 2 m,
- Each recovery unit would store 200 tonnes of oil and take two hours to offload into bladders or onto a suitable vessel,
- After 10 days, five recovery vessels contracted from the spot market in South America arrive on site, and it is assumed that each is able to recover 30 tonnes per hour, and

[98] Note that the CEDRE investigation into the Sea Lion crude concluded that neither oleophilic nor weir skimmers would be effective and that belt skimmers should be considered the most appropriate equipment (CEDRE, 2017).

- After 20 days, a further five recovery vessels contracted from the spot market in Africa arrive on site, and it is assumed that each is able to recover 30 tonnes per hour.

Note: recovered oil will initially be stored in bladders while a specific recovery tanker is mobilised (a Vessel Of Opportunity (VOO)).

In reality, more resources may be available depending on other activities and vessels of opportunity. During production, the MRSV/ERRV and AHTS/EERV will be available with spill response capability or if any other vessel were available offshore, tanks could be offloaded more quickly. For the purposes of the assessment, the predicted recovery is seen as conservatively small. There are also many uncertainties in these predictions, both potentially positive and negative.

Applying these resources to the spill scenario, a new set of outputs is obtained. Key comparison data are provided in Table 12.5. In this example, the response resources do not alter the shoreline oiling outcomes within the tolerances of the model. Figure 12-16 shows that the two recovery units initially on-site (labelled AHV1 and AHV2) are able to recover almost 1,000 tonnes of oil each, while the multiple third-party oil spill response vessels recover less. This is due to their later arrival time, and the fact that the blowout ceases at day 21 and thereafter, the oil present is more and more dispersed and difficult to recover. This helps to show the critical parameters for defining the oil spill response resources.

Although the assumed response has a very modest effect and recovers 6.3 % (2,231 tonnes) of the oil, it represents realistic recovery assumptions under challenging sea conditions. In an actual spill, the recovery units could likely be tasked more intelligently to tackle oil that was more likely to reach shorelines, rather than using the simple model algorithms. It should be noted that for a smaller volume spill, the available recovery rate remains the same and so the operation would be likely to recover a greater fraction of the oil. Actual recovery rates for 30 large oil spill incidents are reviewed in Etkin and Nedwed (2021), which concludes that 2-6 % mechanical recovery is experienced in practice.

Table 12.5: Summary of oil spill response effectiveness for worst-case shoreline oil

Parameter	No response	With response
Mass of oil on shore	60 -70 tonnes	60 -70 tonnes
Mass of oil recovered	-	2,231 tonnes
Proportion of oil recovered	-	6.3 %

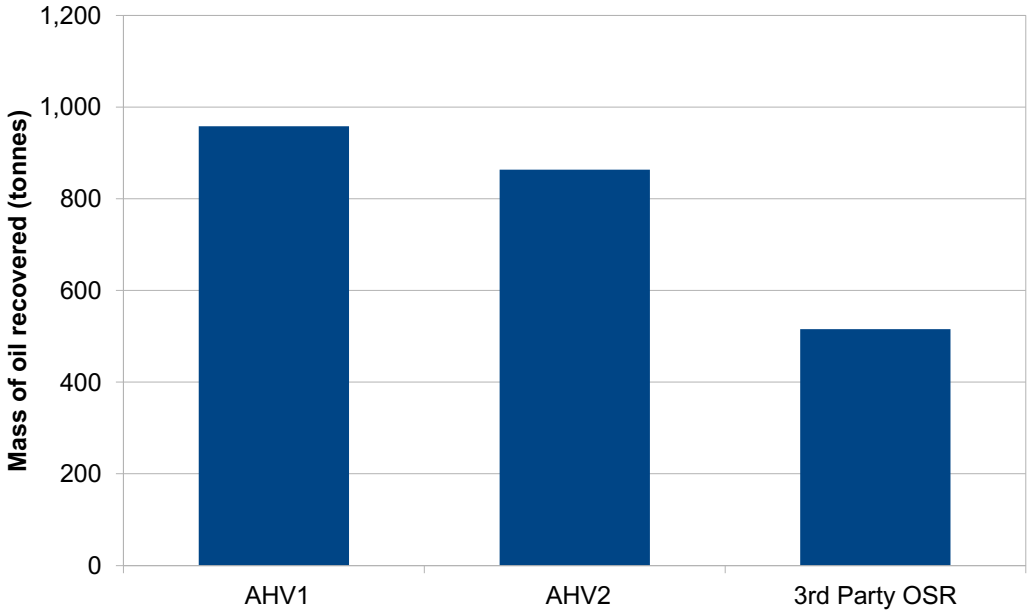


Figure 12-16: Mass of oil recovered by modelled response units

12.1.4.5 Scenario 2: Loss of FPSO crude oil inventory - modelling results

12.1.4.5.1 Predicted behaviour of oil

The predicted overall behaviour and fate of Sea Lion crude after a FPSO crude inventory loss (worst-case 80,080 tonnes) is shown in Figure 12-17. These results represent the scenario giving rise to the maximum oil on shore and are also representative of the general oil behavior over a wide range of conditions.

Initially, the largest proportion of Sea Lion crude is found on the sea surface, however this will start to decrease after the discharge ceases, as the oil disperses in the water column and evaporates. The modelling predicts that after 20 days from the start of the discharge, 71 % (25,030 tonnes) of the oil will remain on the sea surface, approximately 16 % (5,599 tonnes) will be dispersed in the water column, and 7 % (2,537 tonnes) is expected to have evaporated. A maximum of 18 tonnes is predicted to be present in sediments at the end of the simulation (<0.5 %).

Similar to the well blow-out scenario, Figure 12-17 indicates that crude oil begins to move outside the modelling grid after approximately 40 days. However, the fact that oil goes beyond the modelling grid does not affect the overall conclusions drawn from the model.

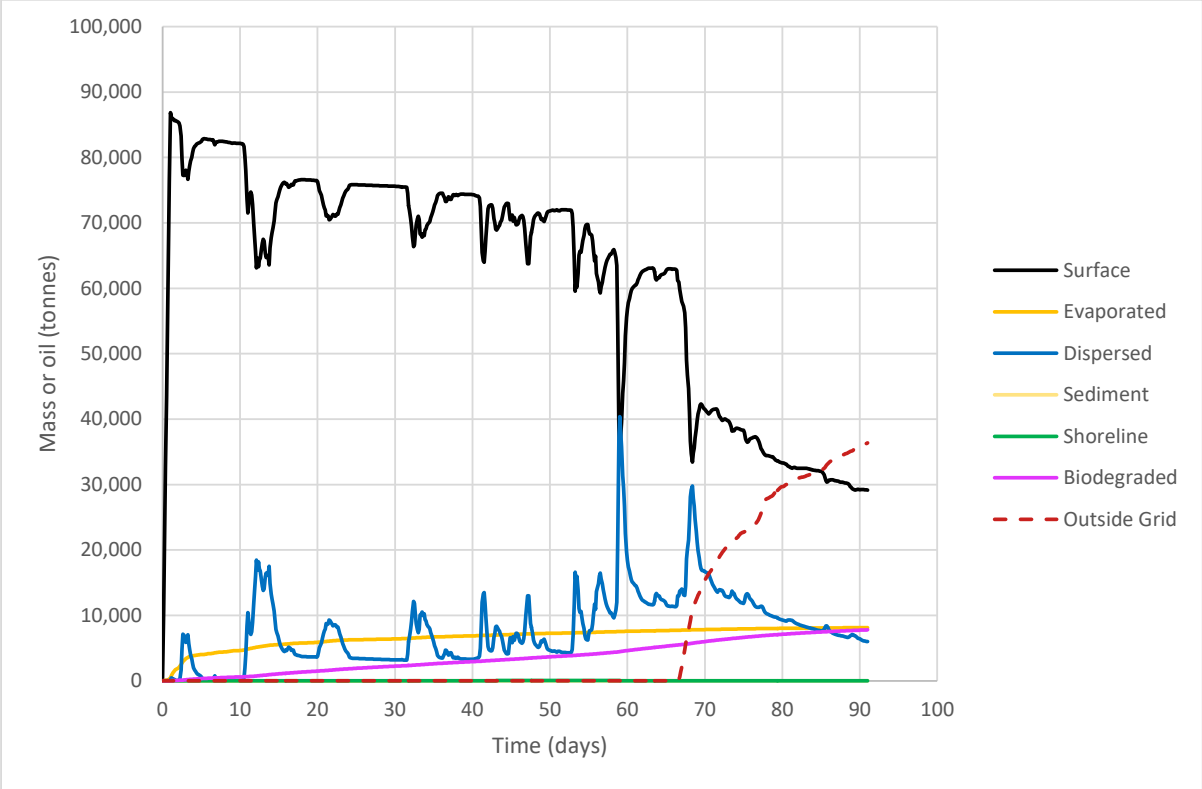


Figure 12-17: Predicted overall behaviour of Sea Lion crude oil after FPSO inventory loss

12.1.4.5.2 FPSO crude inventory Loss - Surface results

Figure 12-18 shows the probability of Sea Lion crude oil occurring above the threshold of 1 g/m^2 on the sea surface at any time throughout the entire model period. Because Sea Lion is such a low density waxy crude oil that is persistent and does not biodegrade quickly, there is a high probability that wax will be found on the sea surface at large distances from the initial discharge location. The modelling predicts that there is a greater than 90 % probability that wax could be found up to 220 km north of the FPSO location, and that surface oil is more likely to spread in a northerly direction from the FPSO. This is due to the predominant currents around the Sea Lion location, which travel in a northerly direction. Surface oil is also predicted to appear at locations to the south-east of the FPSO location, which is likely due to wind driven surface currents. The modelling predicts that, in the unlikely event of a full FPSO inventory loss, there is a high probability (above 90 %) that the crude oil will travel on the sea surface outside of the FOCZ and into international waters.

Figure 12-19 shows the predicted minimum time taken for oil above the threshold of 1 g/m^2 to arrive at any location on the sea surface after a full FPSO inventory loss. Due to the persistence and low biodegradation rate of Sea Lion crude, the oil can potentially travel very long distances. In the most mobile of conditions, the crude oil can travel up to 35 km within one day, 97 km within five days, and up to 350 km within 15 days from the start of the discharge. However, it is predicted that after 15 days the oil will be in a highly dispersed state. In the event of the loss of the full FPSO crude inventory, it is predicted that it would take at least five days for oil to cross the FOCZ boundary.

Figure 12-20 shows the maximum time that any sea surface location is exposed to crude oil above the surface threshold of 1 g/m^2. At locations close to the FPSO location, the sea surface could be exposed to oil for up to 23 days. Further away from the discharge location, the maximum exposure time decreases as the oil becomes dispersed due to wave action and weather conditions.

Figure 12-21 compares the probabilities that different levels of oil concentration are exceeded. The CEDRE laboratory results showed that oil adhesion to feathers was absent below 100 g/m^2, and some adhesion was usually observed above 1,000 g/m^2 (Section 12.1.4.1.1.1). It can be seen that the areas potentially affected at these two thresholds are far smaller than the area shown at 1 g/m^2, indicating that the potential for negative impacts on plumage is limited to an area much closer to the release – e.g., the 50 % probability contour extends to around 5 km for 100 g/m^2 level and is extremely localised to the release site for the 1,000 g/m^2 level.

The results in Figure 12-21 are based on an aggregation of results from all the stochastic model runs and therefore do not represent a single spill scenario.

Therefore, a single deterministic model run of the FPSO inventory loss scenario was conducted to show the behaviour of discharged oil for a single, worst-case, spill scenario. The total impacted surface area above the threshold of 1 g/m^2 is shown in Figure 12-22a, in which the maximum oil densities observed at any location throughout the whole modelling duration of 120 days are presented. An example snapshot of the surface wax after three days from the start of the discharge is shown in Figure 12-22b.

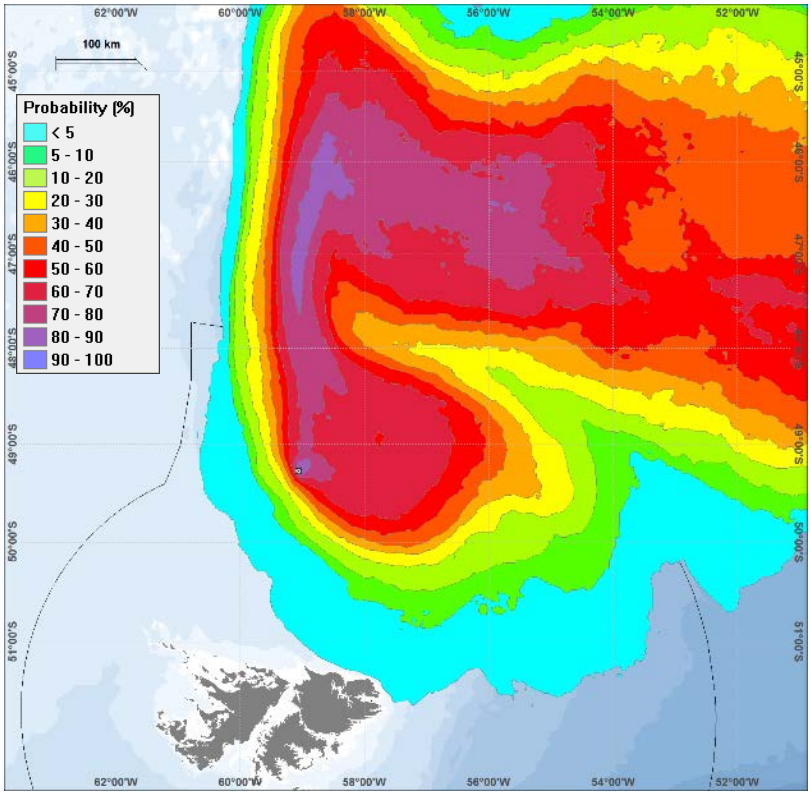


Figure 12-18: Probability of surface contamination above threshold of 1 g/m^2 following FPSO inventory loss

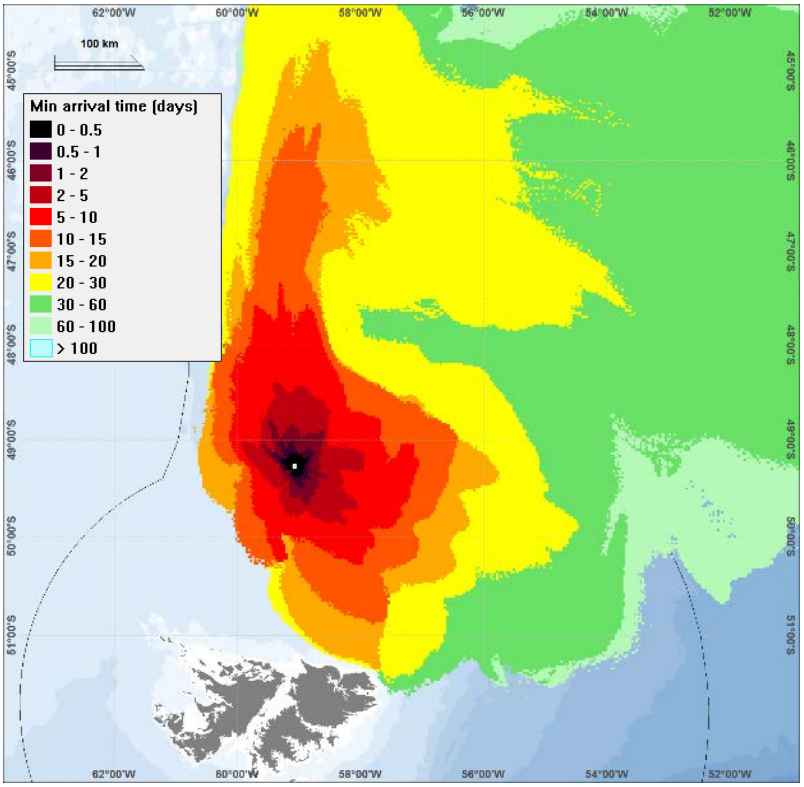


Figure 12-19: Minimum arrival times of Sea Lion crude above 1 g/m^2 on the surface following FPSO inventory loss

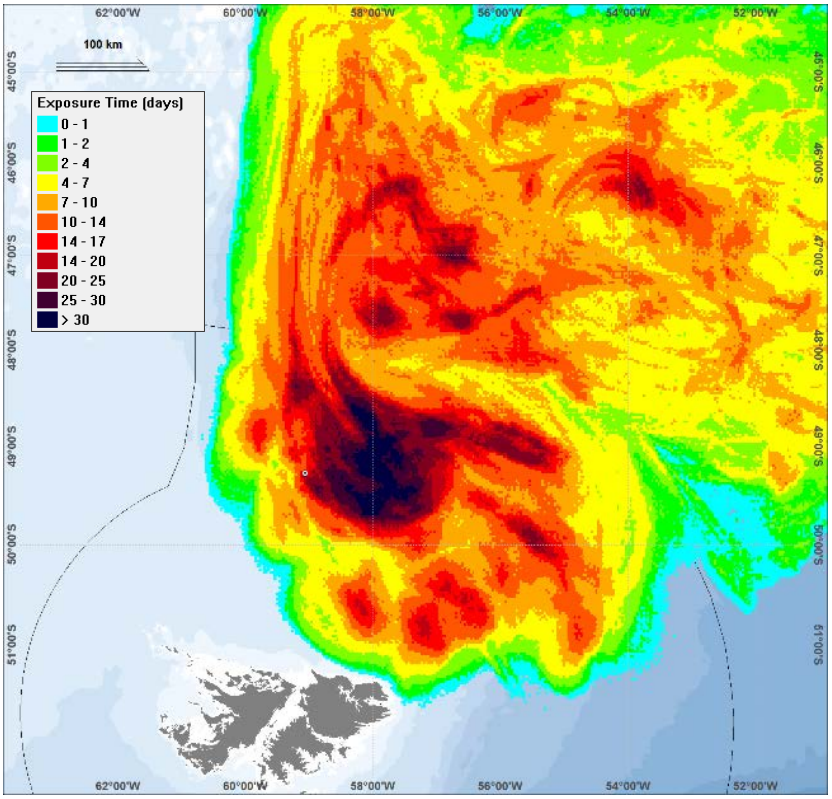
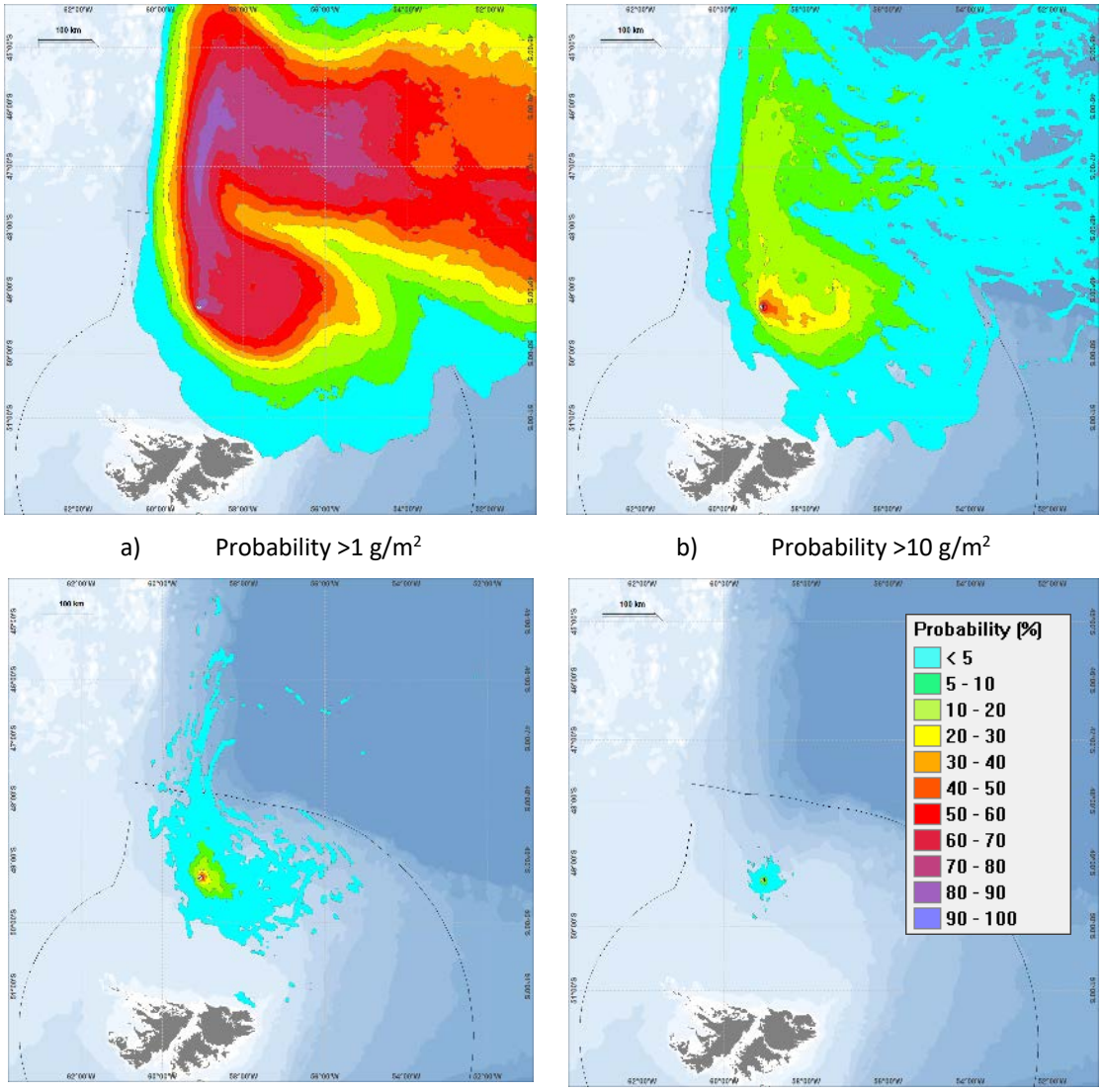


Figure 12-20: Maximum time surface is exposed to Sea Lion crude above 1 g/m^2 following FPSO inventory loss



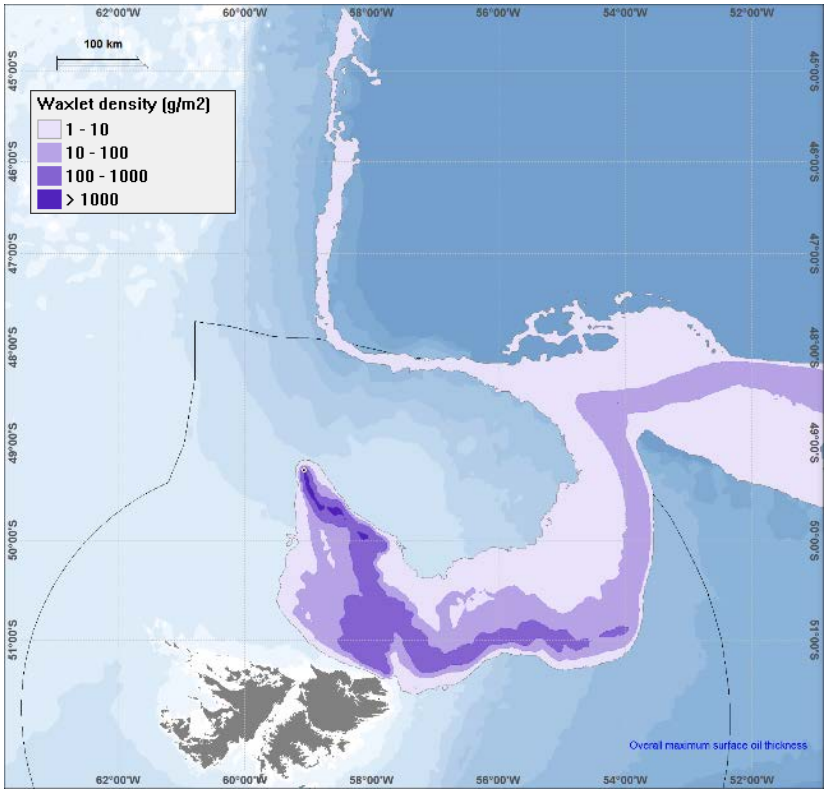
a) Probability >1 g/m^2

b) Probability >10 g/m^2

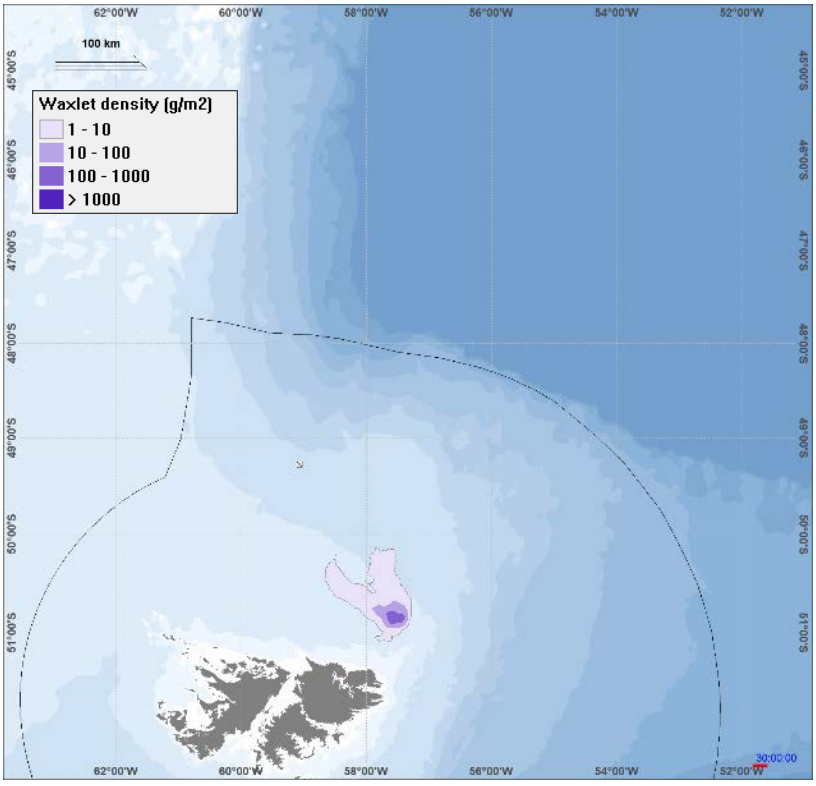
c) Probability >100 g/m^2

d) Probability >1,000 g/m^2

Figure 12-21: Probability of Surface Oiling at Differing Oil Densities following FPSO inventory loss



a) Total impacted surface area above threshold of 1 g/m^2 for single deterministic model run



b) Example snapshot of surface wax above 1 g/m^2

Figure 12-22: Surface results (deterministic) for FPSO inventory loss (at 30 days)

12.1.4.5.3 FPSO crude inventory Loss - Water column results

The probability of oil occurring in the water column above the threshold of 25 ppb is presented in Figure 12-23. The model predicts that in the event of the entire FPSO crude inventory being lost, there is high probability that large areas of the water column will have concentrations of crude oil above the 25 ppb threshold. The crude oil is carried predominantly northwards through the water column by the strong underlying Falklands Current (Figure 12-23).

It is predicted that a large volume of water around the discharge location will be exposed to water column concentrations exceeding 25 ppb for up to 16.5 days (Figure 12-24). At distances further from the discharge location, the water column exposure time declines significantly as the crude oil becomes more dispersed through wave action and sea conditions.

The probability and maximum water column exposure times shown in Figure 12-23 and Figure 12-24 represent the aggregation of results from the stochastic simulations that cover a wide range of metocean conditions, which influence the transport of released crude oil through the water column. These results should therefore not be misinterpreted as being representative of a single spill scenario.

A deterministic model was conducted to predict the total area in which the threshold of 25 ppb would be exceeded for a single run, based on the worst-case metocean conditions identified from the stochastic modelling. Figure 12-25a illustrates the maximum total water column concentrations that were observed at any time during the deterministic model run period of 91 days. The model predicts that, at some time after the start of the release, areas of the water column close to the discharge location could be subjected to water column concentrations in excess of 1,000 ppb (1 ppm). The cross-sectional plot in Figure 12-25b shows that crude oil is typically expected to reach depths of 50 m. Figure 12-25b shows a snapshot of the water column concentrations at a single instance in time.

The model also clearly shows that the water column concentrations of dissolved oils are contributing very little to concentrations of oil in the water column.

It is predicted that initial oil concentrations in the water column shortly after the release will be in the tens of parts per million. Such high concentrations result from the model setting the FPSO inventory loss / discharge to just one day, and the initial release of water-soluble components from the surface of the oil. It is predicted that the maximum oil concentrations in the water column will very rapidly decrease after this initial period of high concentrations.

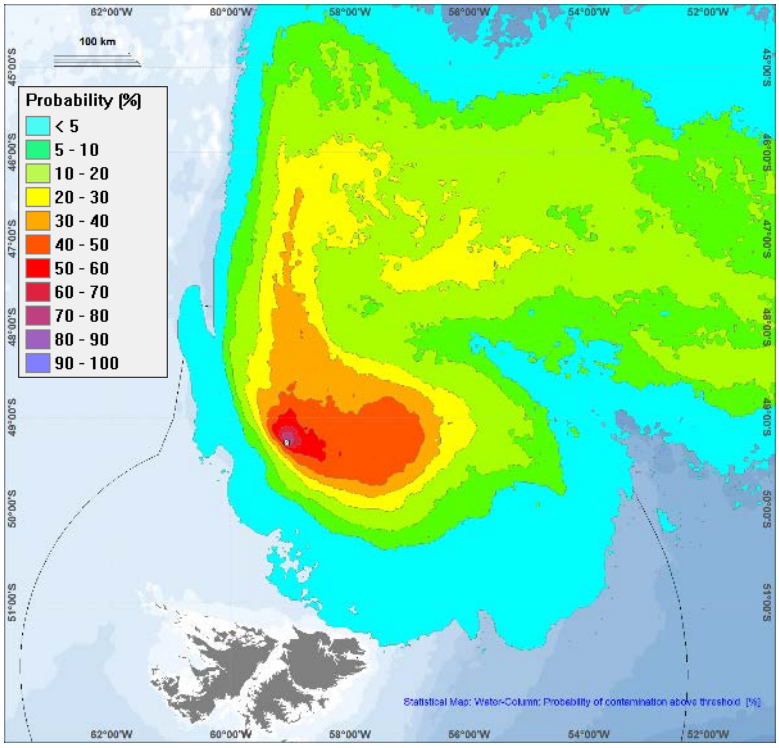


Figure 12-23: Probability of water column contamination above threshold of 25 ppb (stochastic) for FPSO inventory loss

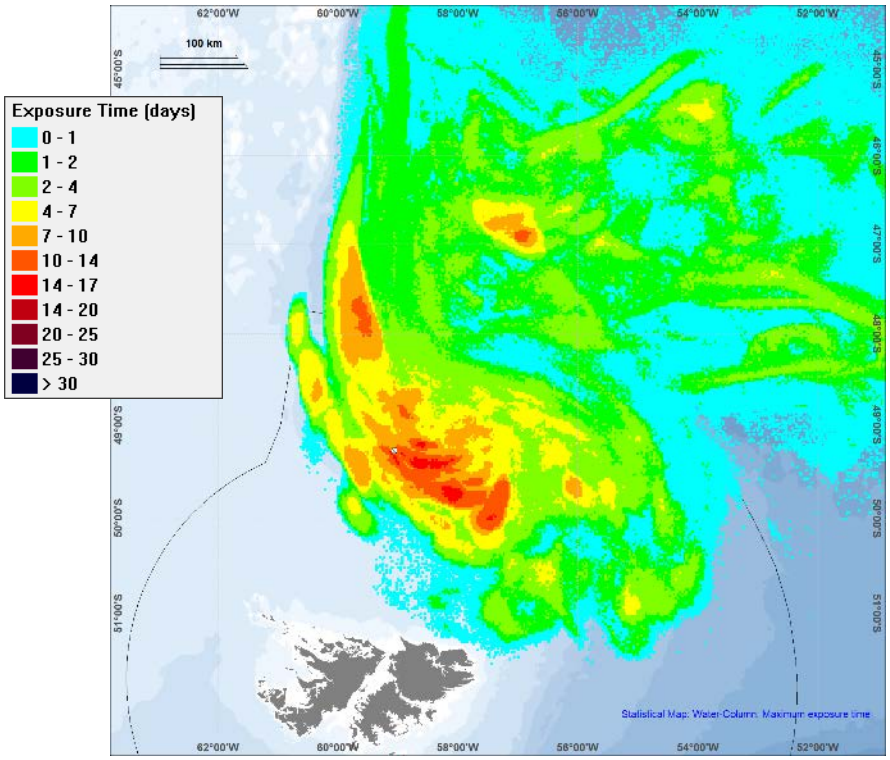
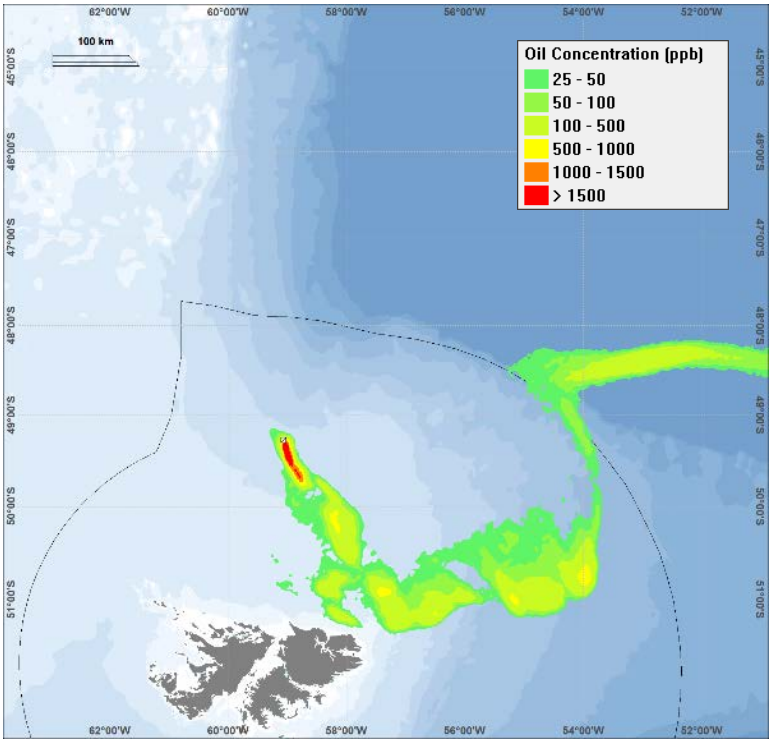
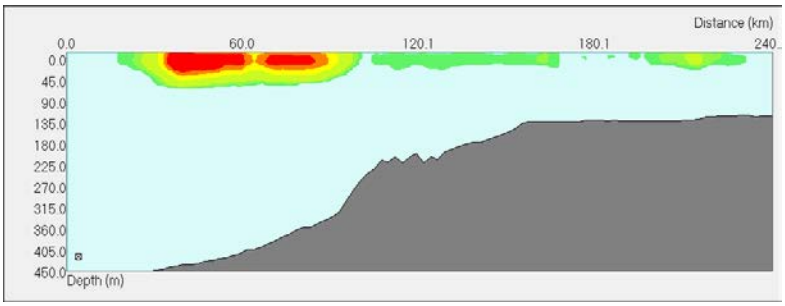


Figure 12-24: Maximum time water column is exposed above threshold of 25 ppb (stochastic) for FPSO inventory loss



a) Cumulative water column concentration dissolved oil and oil droplets



b) Cross-section of cumulative water column concentration dissolved oil and oil droplets

Figure 12-25: Cumulative water column concentrations from an FPSO inventory loss

12.1.4.5.4 FPSO crude inventory Loss - Shoreline results

Figure 12-26 shows the probability of oil reaching the Falklands coastline after the loss of the entire FPSO crude oil inventory by identifying the initial beaching locations. The modelling results indicate that there is a low probability of crude oil reaching the shoreline and there is no possibility for any international beaching events. The northern coastline of East Falkland is predicted to be the most likely place where oil could beach. However, the greatest probability of shoreline oiling was observed to be 5.8 %, indicating that only three of the 51 individual stochastic simulations resulted in crude oil reaching the Falklands coastline. Consequently, in the event of the complete loss of the FPSO crude oil inventory, shoreline oiling is possible, but highly unlikely. The maximum mass of oil on shore was predicted to be 36 tonnes, and the average was 34 tonnes. Given the highly dispersed state of the oil when encountering shore and the long length of coast over which the oil is predicted to arrive, it is possible that this would not be detectable.

Figure 12-27 shows the minimum time taken for any oil to reach the shoreline in the worst-case oil beaching scenario, which was observed to be approximately 66 days. It is predicted that any crude oil that eventually reaches the Falklands coastline would be in a highly dispersed state due to it having

been at-sea for at least 66 days before reaching the coastline. It is therefore likely that only small individual masses of oil would reach the shoreline.

A single deterministic run of the FPSO crude inventory loss scenario was conducted to further investigate shoreline oiling. The time frame for this single deterministic run was selected to coincide with the stochastic simulation that resulted in the worst-case mass of oil arriving onshore. The predicted worst-case shoreline oiling is shown in Figure 12-28. The worst-case shoreline concentration at this instance in time was predicted to be 0.23 kg/m^2.

Figure 12-29 shows the temporal pattern of oil arriving onshore for the deterministic scenario for the most oil beaching. Again, this illustrates that only an extremely small proportion of the total mass discharged eventually reaches the shoreline. Note that there are some small differences between the stochastic and deterministic plots, which are a product of slightly simplified algorithms used in the stochastic runs and the sensitivity of the model to the very small amount of oil reaching shore in this case.

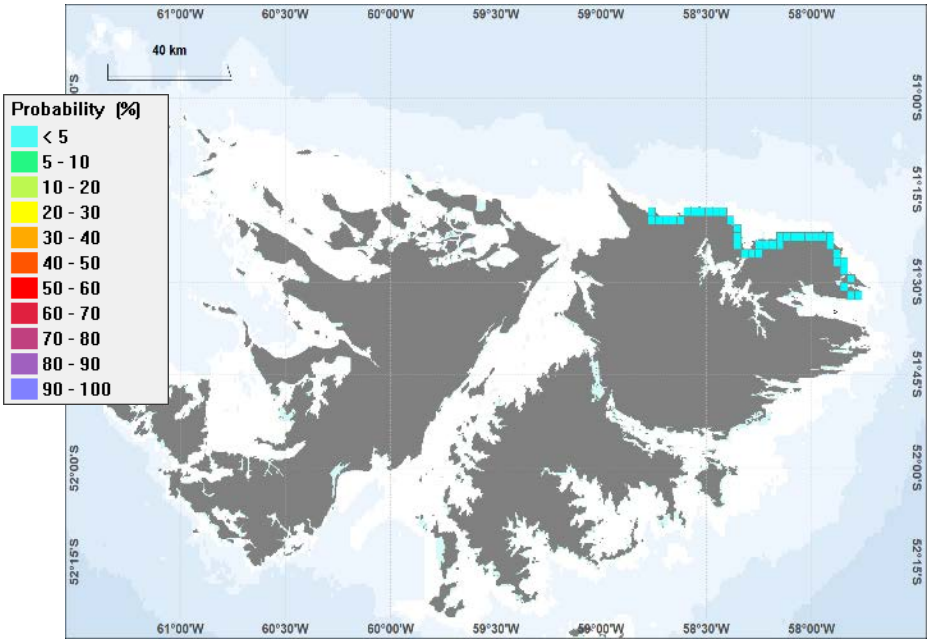


Figure 12-26: Probability of shoreline oiling for an FPSO inventory loss

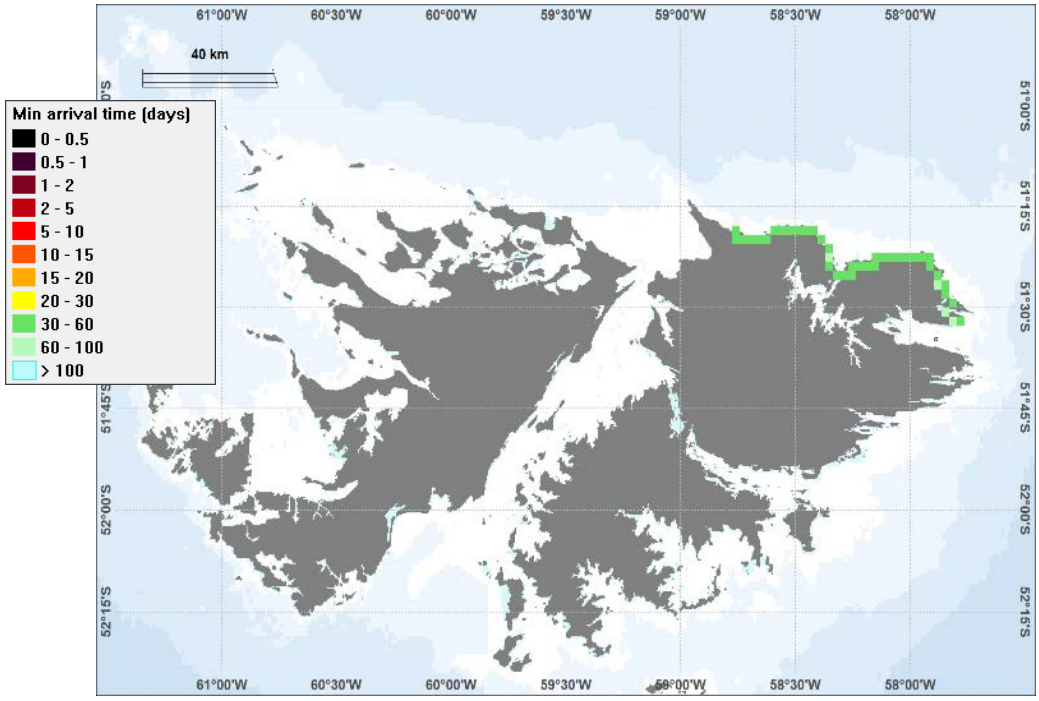


Figure 12-27: Minimum arrival times for shoreline oiling for an FPSO inventory loss

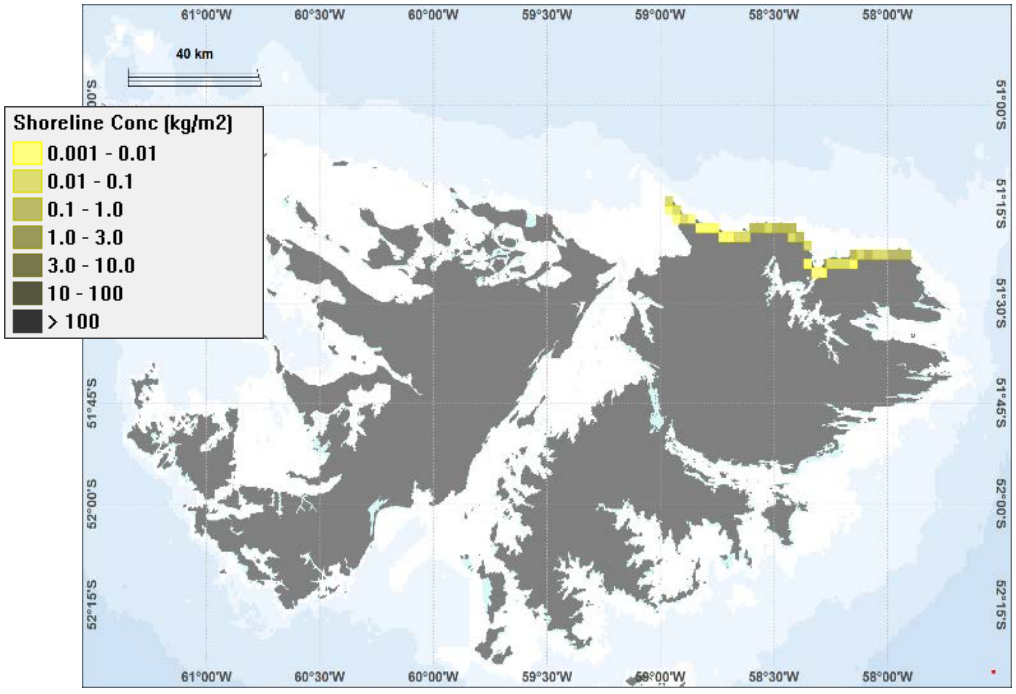


Figure 12-28: Concentration of oiling on the shoreline for an FPSO inventory loss (deterministic)

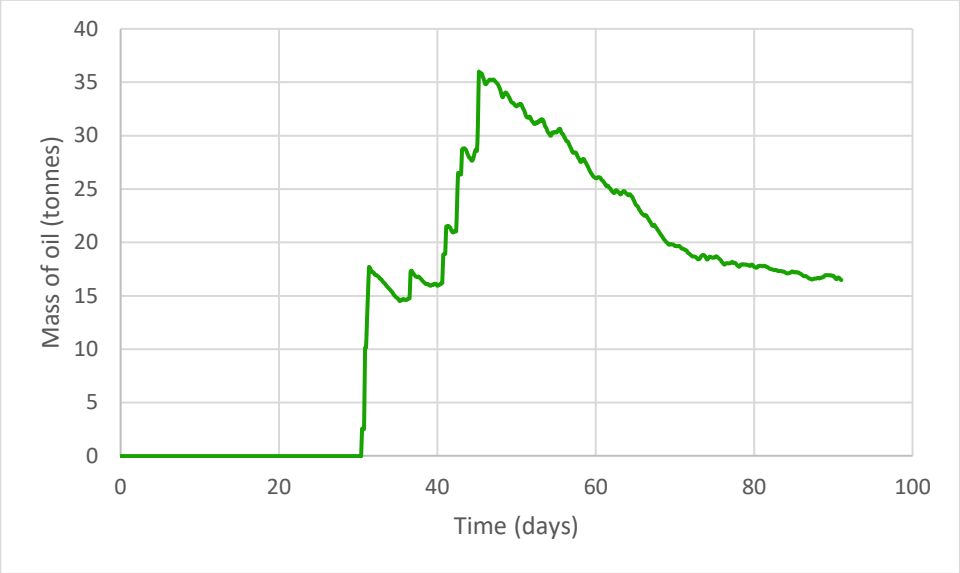


Figure 12-29: Time evolution of oil on shoreline for FPSO inventory loss (deterministic)

12.1.4.5.5 FPSO crude inventory Loss – Sediment concentration

The maximum predicted deposition concentration over a 5 cm mixed layer in the model grid is 1-2 mg/kg thus breaching none of the thresholds indicated in Section 12.1.4.3.3.

12.1.4.5.6 FPSO crude inventory Loss - Effect of oil spill response measures

The assumptions around response resources are the same as for the blowout scenario above (Section 12.1.4.4.5).

Applying these resources to the FPSO spill scenario, a new set of outputs is obtained. Key comparison data is given in Table 12.6 and a graphical comparison of surface oil probability and the path of the surface oil in the deterministic case is shown in Figure 12-30.

Although the assumed response has a very modest effect and recovers <2 % (1,146 tonnes) of the oil on average, it does improve the outcomes. The estimated recovery is close to the range of 2-6 % concluded by Etkin and Nedwed (2021) for large oil spills internationally and represents realistic recovery assumptions under challenging sea conditions. Recovery for this case is proportionally smaller because the inventory loss volume is much larger than the well blow-out volume and because the oil is largely dispersed by the time the Oil Spill Response (OSR) recovery vessels arrive. In this example, the response resources affect the shoreline oiling outcomes. Figure 12-31 shows that the two recovery units initially on-site (labelled AHV1 and AHV2) are able to recover around 300 tonnes of oil each. The multiple third-party oil spill response vessels recover over 500 tonnes, although since there are more such units it means their effectiveness per unit is much lower. The reason there is a lower recovery rate for this scenario than the blowout appears to be due to the response units having to follow the oil long distances while dispersion continues, whereas in the blowout case the oil is surfacing in a localised area for the first 21 days. The logistics of offloading oil, finding oil to recover and transiting to the location of the oil are therefore critical issues in improving performance. As for a blowout, if the release were smaller, the available recovery rate remains the same and so the operation would be likely to recover a greater fraction of the oil.

The improvement in shoreline oiling outcomes can be seen in Figure 12-30, whereby a smaller length of coastline is affected.

Table 12.6: Summary of oil spill response effectiveness for worst-case shoreline oil

Parameter	No response	With response
Maximum mass of oil onshore	30 - 40 tonnes	20 - 30 tonnes
Mass of oil recovered	-	1,146 tonnes
Proportion of oil recovered	-	1.43 %

Note: Due to the particle motion physics, response modelling can result in fragmentation of large oil masses and a larger number of small particles in the model which are available to reach more shoreline cells, and therefore occasionally more scenarios will reach shore when response is applied. This is an artefact of the model and overall the response modelling shows that response reduces the maximum and average volume of oil reaching shore.

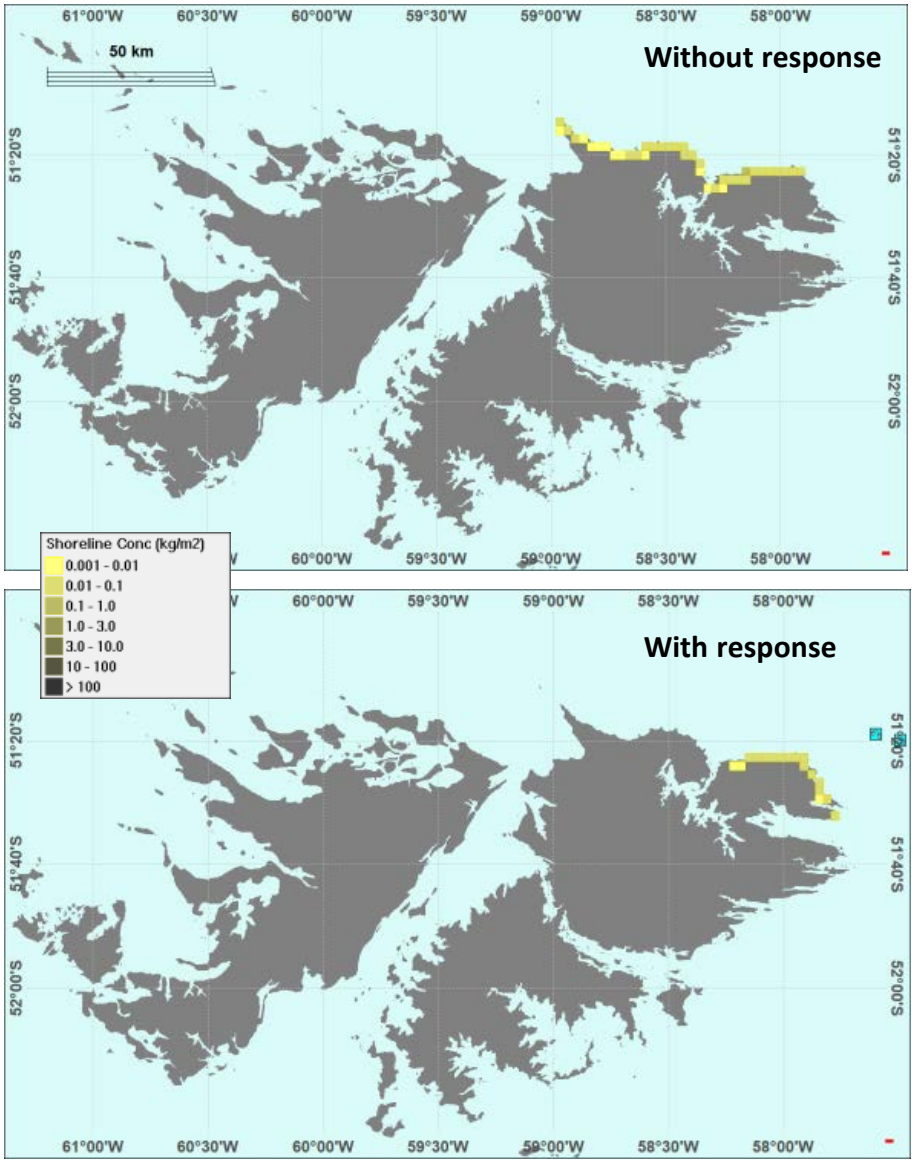


Figure 12-30: Comparison of shoreline oiling with and without oil spill response

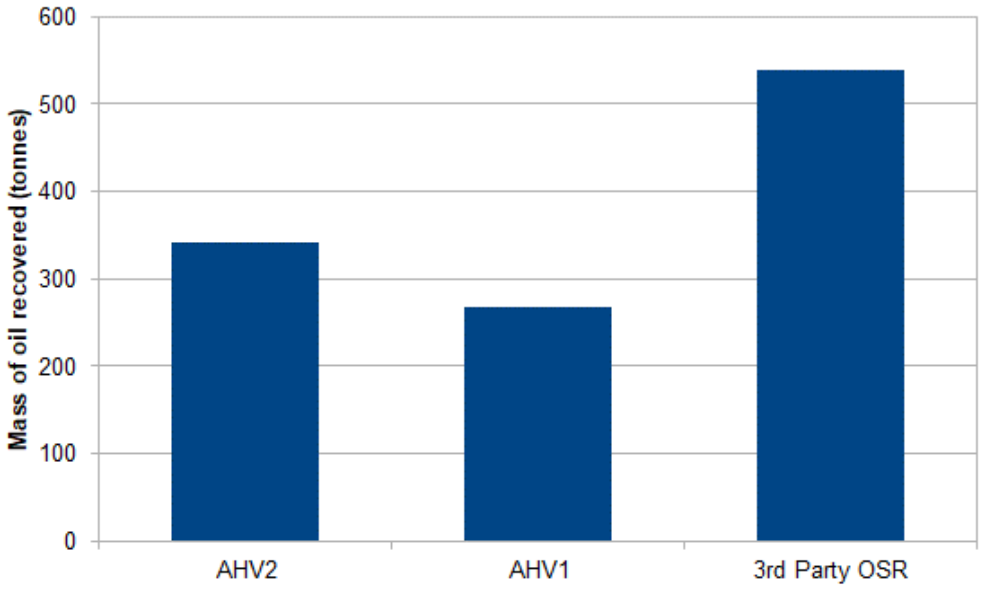


Figure 12-31: Mass of oil recovered offshore by modelled response units

12.1.4.6 Scenario 3: Crude oil transfer spill - modelling results

12.1.4.6.1 Predicted behaviour of oil

The predicted overall behaviour of the Sea Lion crude after an offshore crude transfer spill (worst-case 70 tonnes) is shown in Figure 12-32. The results here have been obtained by averaging masses over all the stochastic modelling runs. These results therefore do not represent a single model run, but serve to illustrate the expected overall behaviour of the discharged oil.

The discharge has been set to occur on the sea surface, so this is where the highest mass of crude oil will initially be found. After release, the crude oil is predicted to begin to evaporate from the surface, as well as being dispersed in the water column. Five days after the start of the discharge it is predicted that 95 % (66 tonnes) of the discharge will be left on the sea surface, with <1 % (0.3 tonnes) dispersed in the water column, and 5 % (3 tonnes) evaporated. Due to the Sea Lion oil being a persistent waxy crude, it is predicted that biodegradation will occur at a very slow rate. By the end of the model run duration (14 days), it is predicted that 89 % (62 tonnes) of the Sea Lion crude will still be on the surface at increasingly low densities, 6 % (4 tonnes) will have evaporated, 4 % (3 tonnes) will be in the water column, and biodegradation will have risen to 1 % (0.6 tonnes). A negligible amount is predicted to be present in sediments. This trend in behaviour would continue for many days with periodic enhancement in dispersion during higher sea states.

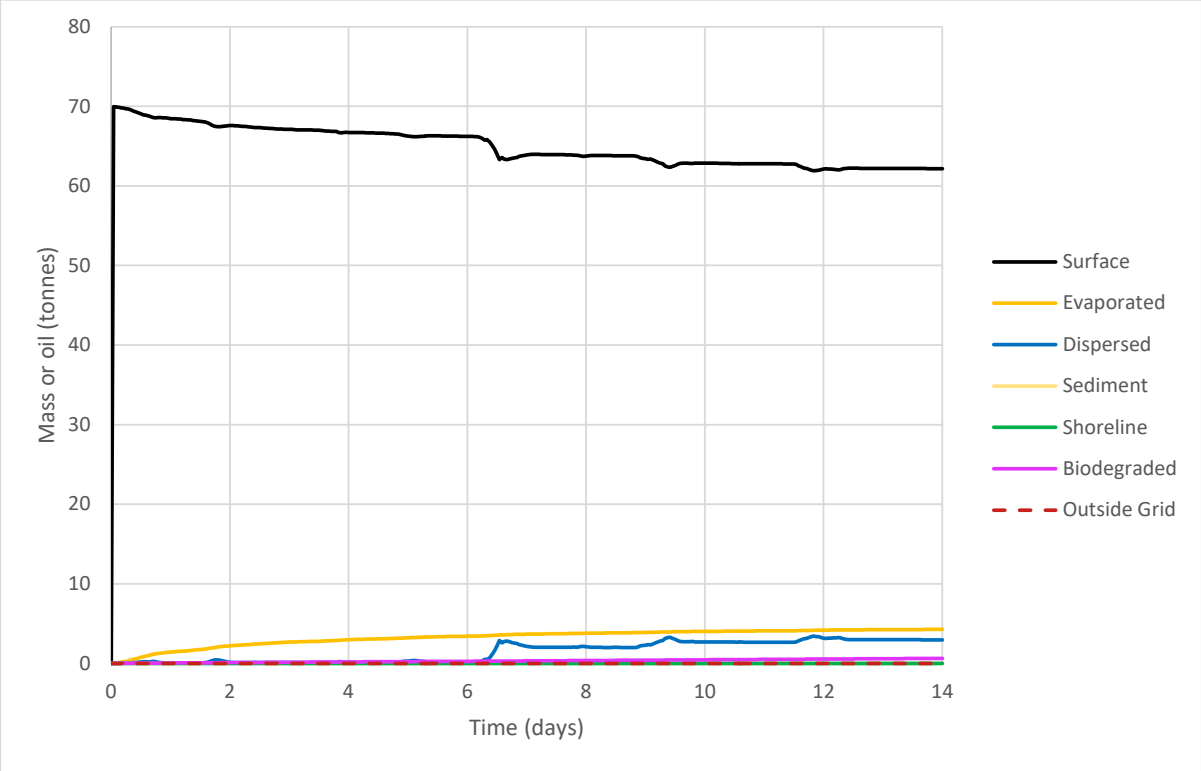


Figure 12-32: Predicted overall behaviour of Sea Lion crude oil after a crude transfer spill

12.1.4.6.2 Crude oil transfer spill - Surface results

Figure 12-33 shows the probability of oil contamination on the sea surface, the minimum time taken for oil to disperse on the sea surface, and the maximum time that any surface location is exposed to oil above the threshold of 1 g/m^2. These maps are based on the aggregation of results from different stochastic modelling runs and are not indicative of a single model output.

The probability of Sea Lion crude accumulating on the sea surface above the threshold of 1 g/m^2 is relatively low (Figure 12-33a), particularly in comparison with the larger well blow-out and FPSO inventory loss scenarios presented and discussed in the previous sections. The low probabilities illustrate that the relatively small volume of crude oil discharged (70 tonnes) is expected to disperse very quickly in the water column (see Figure 12-32 above), and a small fraction will evaporate from the surface.

Figure 12-33b shows the minimum time taken for oil from a crude transfer spill to arrive at any location on the modelling grid. In the most mobile of conditions, the Sea Lion crude oil could potentially disperse up to 20 km within one day, and up to 45 km within four days. The model predicts that after four days, most of the crude oil on the sea surface will either have evaporated or have been dispersed in the water column (Figure 12-33c).

Figure 12-34 shows the total surface area impacted above the threshold of 1 g/m^2 for a single deterministic run of the crude transfer spill scenario. This graphic shows the typical area that will be affected after a crude transfer spill of 70 tonnes. During calm weather, the oil would be amenable to recovery given the buoyant nature of the wax masses. Unlike the major scenarios of a blowout or an FPSO inventory loss, in the case of a crude transfer spill, the attendant vessels with spill response equipment would likely be able to deploy boom and skimmer equipment very quickly and achieve recovery of some of the oil.

12.1.4.6.3 Crude oil transfer spill - Water column results

None of the stochastic simulations resulted in oil concentrations in the water column exceeding the threshold of 25 ppb at any point during the model run duration (30 days). Water column concentrations are expected to decrease rapidly after the end of the discharge, with concentrations typically decreasing back to ambient conditions after a few days.

12.1.4.6.4 Crude oil transfer spill - Shoreline results

No shoreline oiling was predicted during any of the stochastic simulations of the crude oil transfer spill scenario. Due to the small volume of oil being discharged, and the large distance between the discharge location and the Falklands coastline, it is extremely unlikely that such a spill would result in any oil reaching the coastline of the Falkland Islands.

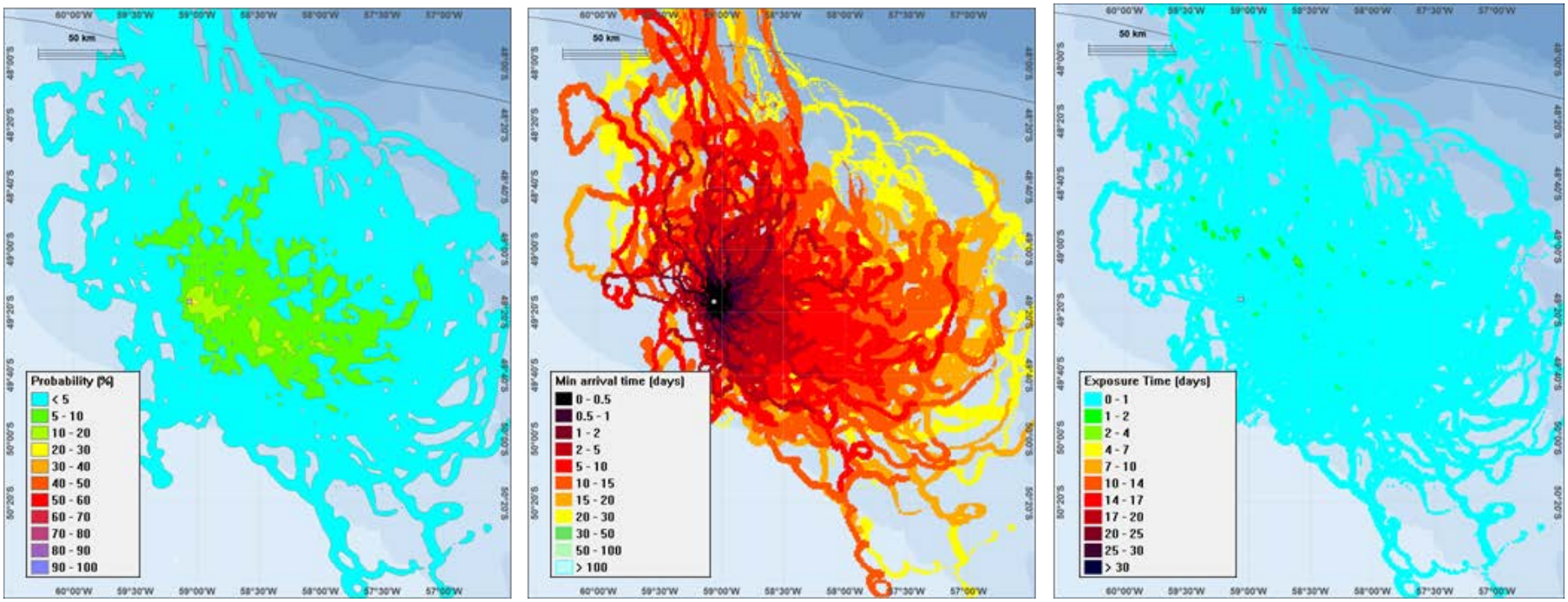


Figure 12-33: Surface results (stochastic) for crude transfer spill

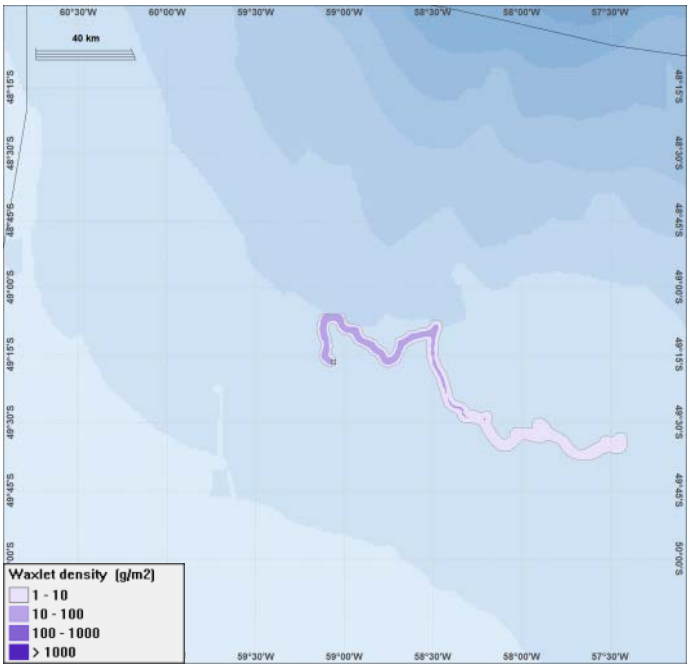


Figure 12-34: Total impacted surface area above threshold of 1 g/m² for single deterministic model run of crude oil transfer spill scenario

12.1.4.6.5 Crude oil transfer spill – Sediment concentration

Concentrations of oil in the sediment following a crude transfer spill were negligible such that impacts to benthic communities are not considered further.

12.1.4.6.6 Crude oil transfer spill - Effect of oil spill response measures

In this scenario, response has not been modelled as conclusions can be drawn on oil spill response effectiveness using observations from the previous cases and empirical data.

In this case, the incident itself is unlikely to trigger a personnel safety issue and so the MRSV/AHTS and ERRV/AHTS vessels that are equipped with oil recovery equipment will be able to attend to the spill very quickly and recover oil before it becomes significantly spread and dispersed over the sea surface. Further, the recovered oil is unlikely to fill the tanks of a single vessel, and so the vessel does not have to cease recovery in order to unload the tanks. Thirdly, the recovery operation is likely to be completed quickly while the oil is still close to the release point and so search and transit times are a much smaller factor and actual recovery time can be maximised.

These considerations mean that oil recovery is likely to be much higher in such an incident, and incidents of this size are also much more representative of a spill that might occur during the lifetime of the field. An example of oil spill response effectiveness in such a situation is documented in Engen (2005). In that case, an unplanned release of 500 - 800 m^3 of heavy oil in Norway waters was responded to by a vessel equipped with recovery equipment. 180 m^3 of oil was recovered mechanically by the vessel representing 30 - 60 % of the seaborne oil after evaporative losses were deducted.

12.1.4.7 Scenario 4: Loss of MODU MGO inventory - modelling results

12.1.4.7.1 Predicted behaviour of oil

Figure 12-35 shows the predicted behaviour and fate of MGO following the accidental loss of the full MODU inventory (worst-case 3,936 tonnes). These results are based on 99 stochastic model runs of the MGO inventory loss scenario.

Initially, most of the MGO will be found on the sea surface, after which it is likely to be quickly dispersed in the water column and evaporated or biodegraded from the sea surface owing to its higher volatility (Section 12.1.4.1.1.2). The modelling predicts that after 10 days, none of the discharged MGO will be left on the sea surface as 50 % (1,976 tonnes) of it will have evaporated, and 27 % (1,066 tonnes) of the total discharge will have biodegraded. Given the water depth, there is no predicted oil in sediments.

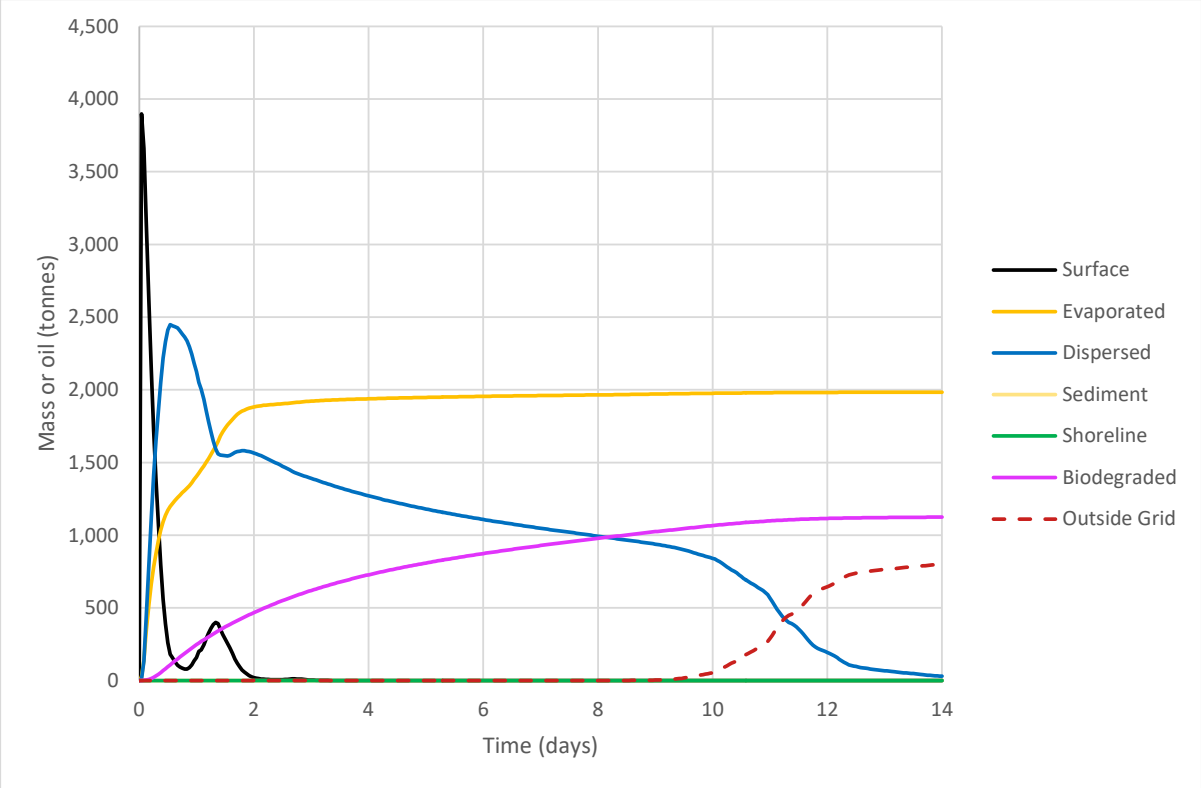


Figure 12-35: Predicted overall behaviour of MGO after full inventory loss

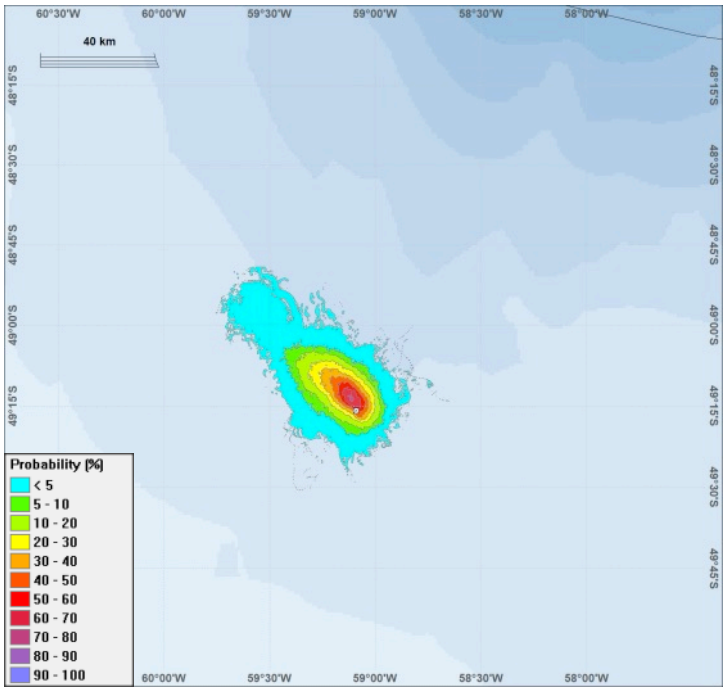
12.1.4.7.2 Loss of MODU MGO inventory - Surface results

Figure 12-36a shows the probability of diesel occurring above the threshold of 0.3 µm on the sea surface. The probabilities vary from 20-30 % near the discharge location to less than 5 % at locations further from the discharge site (beyond approximately 30 km). The low probabilities of MGO occurring above 0.3 µm on the sea surface is due to the diesel evaporating quickly and also being dispersed in the water column. The results in Figure 12-36a show that there is zero percent probability of MGO crossing the outer boundary of the FOCZ. In the most mobile of conditions, the diesel can travel up to 30 km within one day, up to 50 km within two days, and up to 90 km within five days. After approximately seven days, it is predicted that no MGO will remain on the sea surface.

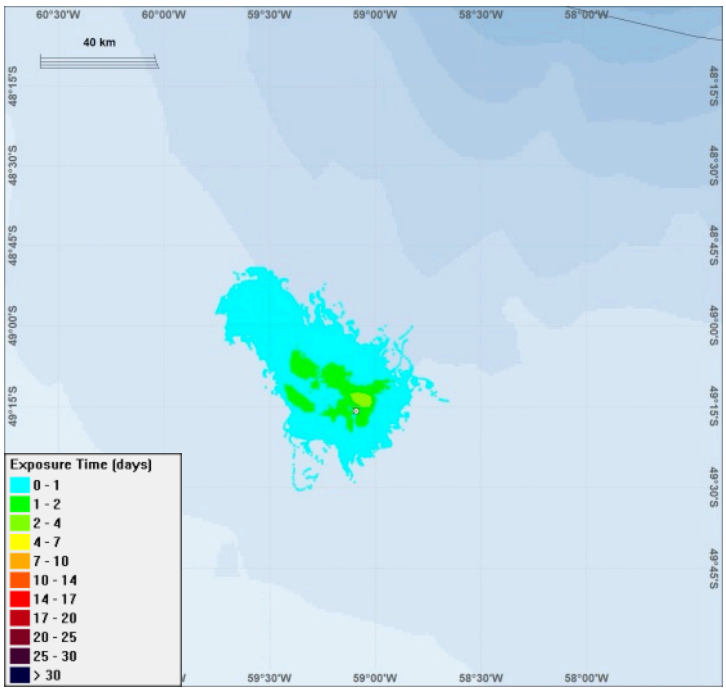
Figure 12-36b shows the maximum length of time that any location is exposed to MGO above the thickness threshold of 0.3 µm. The model predicts that in the event of a catastrophic discharge of the MODU's full MGO inventory, no surface location will be exposed to MGO for more than three days.

The results presented in Figure 12-36 are based on an aggregation of results from all the stochastic model runs and therefore do not represent a single spill scenario. To show the predicted surface area that will be impacted by a single spill scenario, a deterministic model run of the MGO inventory loss was conducted using the worst-case metocean conditions from the stochastic modelling. The total surface area predicted to be impacted by a single spill is shown in Figure 12-37 (note the much smaller

area of a single incident compared with the envelope in Figure 12-36). In the case of a single spill, it is predicted that a continuous sheen above the 0.3µm threshold will form in the immediate vicinity of the discharge location (approximately 55 km^2 at the maximum extent).



a) Probability of surface contamination above threshold of 0.3 µm



b) Maximum time surface is exposed to oil above threshold of 0.3 µm

Figure 12-36: Surface results (stochastic) for MGO inventory loss

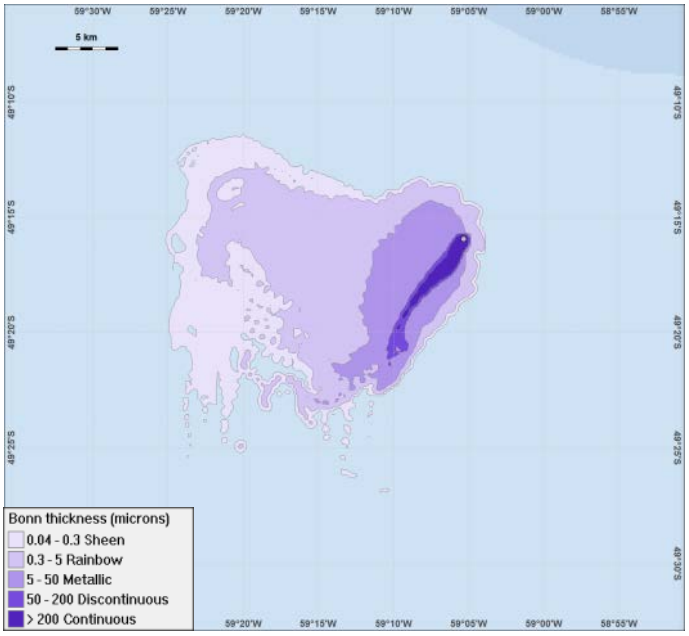


Figure 12-37: Total impacted surface area above threshold of 0.3 µm for a single deterministic model run of the MGO inventory loss scenario

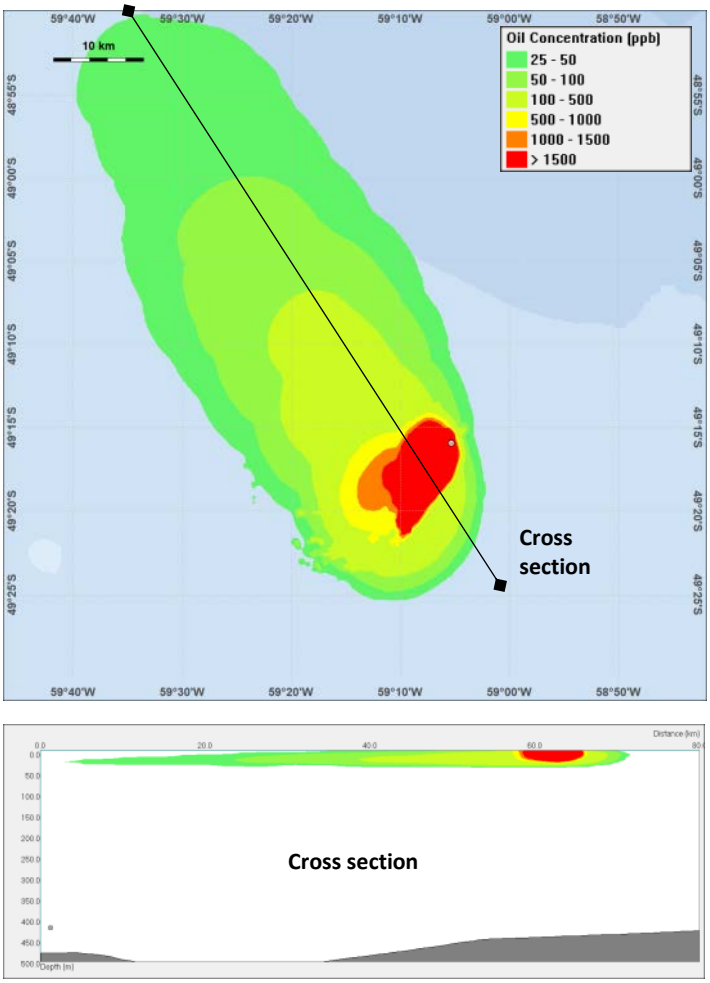
12.1.4.7.3 Loss of MODU MGO inventory - Water column results

A single deterministic model run of the MGO inventory loss scenario was conducted to show the total impacted water column for a single, worst-case, spill scenario. The maximum concentrations that were observed at any point during this run are shown in Figure 12-38. In the event of the MODU's full MGO inventory being discharged, water column concentrations exceeding 1,000 ppb (1 ppm) could be observed at locations near the discharge site. However, these concentrations would only be present for a short period of time after the discharge.

As shown in the plan and cross-sectional plot in Figure 12-38, MGO is most likely to occur in the water column above the threshold value (25 ppb) in the top 100 m of the water column. In the immediate vicinity of the discharge location and down to depths of 60 m, the water column could be exposed to concentrations in excess of 25 ppb for up to six days.

12.1.4.7.4 Loss of MODU MGO inventory - Shoreline results

No shoreline oiling was predicted from any of the stochastic simulations of the MGO inventory loss scenario. With the discharge occurring so far from the Falkland Islands, it is not credible that any MGO discharged will reach the coastline of the Falkland Islands.



a) Total impacted area above a threshold of 25 ppb for a single deterministic model run

Figure 12-38: Water column results (deterministic) for MGO inventory loss

12.1.4.7.5 Loss of MODU MGO inventory - Effect of oil spill response measures

In the case of an oil such as MGO that spreads rapidly on the surface, mechanical recovery is ineffective. It is also likely that prevailing sea states will break up surface oil into progressively smaller patches that hinder mechanical recovery, and dispersion into the water column will progress quickly as shown in Figure 12-35. Application of dispersants by aerial means or from a vessel are possible response measures which will accelerate the dispersion into the water column, but the natural dispersion processes are already rapid and dispersants themselves have environmental impacts that need to be considered.

The modelling suggests that natural dispersion processes will remove surface oil relatively quickly thereby minimising effects on seabirds that use the sea surface, and that recovery or dispersant intervention would not significantly alter this outcome. Biodegradation then breaks down the oil significantly over a timescale of days and weeks. Therefore, applying oil spill response measures is unlikely to alter the environmental impacts of such a scenario.

12.1.4.8 Scenario 5: MGO bunkering spill - modelling results

12.1.4.8.1 Predicted behaviour of oil

The predicted overall behaviour of MGO after it has been discharged to the sea following a bunkering spill (worst-case 20 tonnes) is shown in Figure 12-39. These results are based on the aggregated outputs of all the stochastic modelling runs, and do not therefore represent a single model run (spill scenario).

The overall behaviour of the discharged MGO is broadly similar to the larger MGO inventory loss scenario described above, but on a much smaller scale. It is predicted that a large proportion of the MGO will be on the sea surface immediately following the spill. However, this surface MGO is expected to decline very quickly, as it gets dispersed by wave action and also evaporates and biodegrades. The model predicts that after two days from the discharge, no MGO will remain on the sea surface. By four days, 31 % (6 tonnes) will have evaporated, 25 % (5 tonnes) will have biodegraded, and the remainder of the discharge will either be dispersed in the water column or dissolved. MGO also starts to exit the modelling grid at four days, and the trend of dispersed oil being biodegraded continues in the water column beyond this point, with no MGO predicted in sediments. See Section 12.1.4.3.4.1 for detail on model parameters and note that owing to the volatility of MGO and the highly dynamic environment at the Sea Lion location regarding wind and wave action, the grid size is selected to demonstrate the worst-case outcome of the MGO bunkering spill scenario.

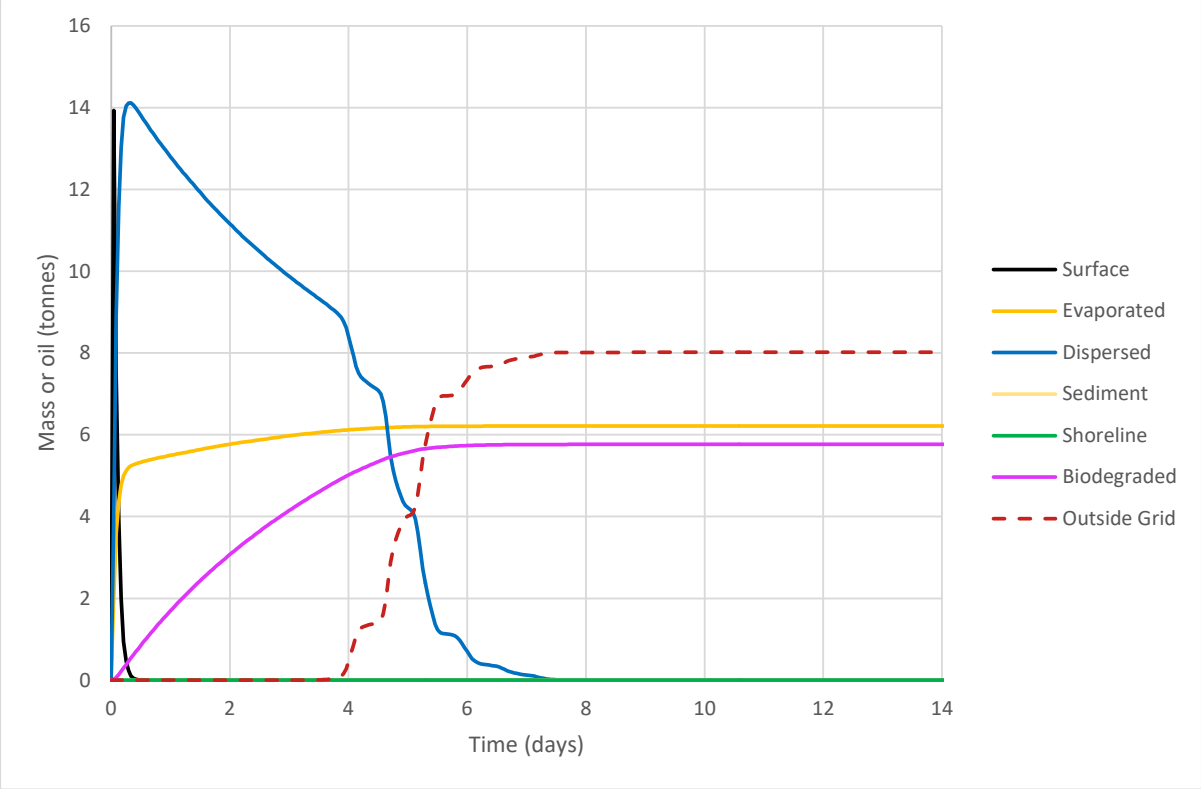


Figure 12-39: Predicted overall behaviour of MGO after a bunkering spill

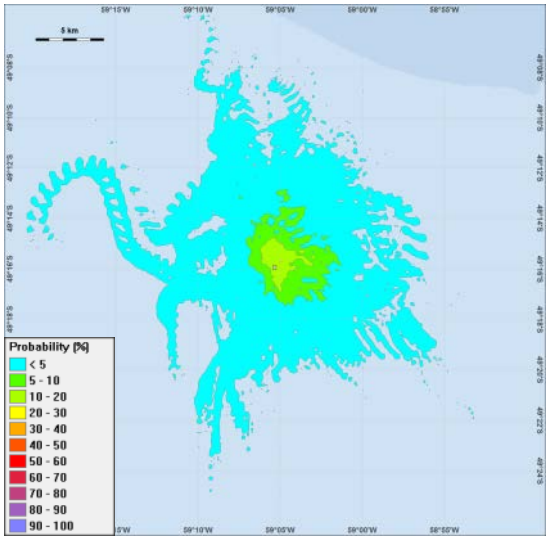
12.1.4.8.2 MGO bunkering spill - Surface results

Figure 12-40a shows the probability of MGO occurring above the threshold of 0.3 µm on the sea surface. Following a bunkering spill, the probability of MGO occurring on the sea surface above the 0.3 µm thickness threshold is between 5 and 10 % at locations a few kilometres from the discharge site, decreasing to less than 5 % further away from the discharge location. These low probabilities are due

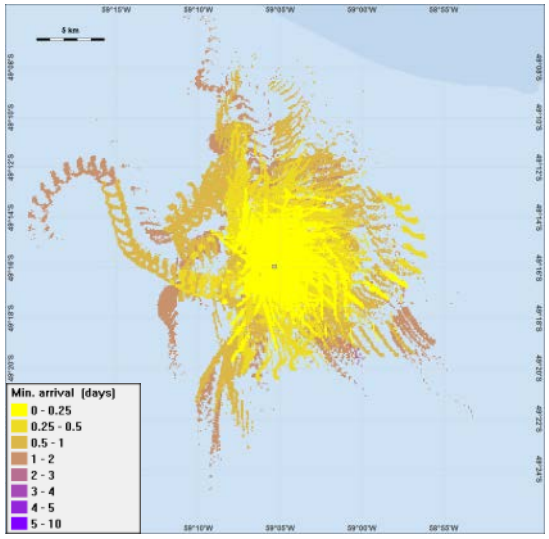
to the small volume of MGO released following a bunkering spill, and the rate at which the MGO evaporates, biodegrades, and becomes dispersed. MGO from a bunkering spill is not predicted to cross the FOCZ as a surface sheen.

Figure 12-40b shows the minimum time taken for MGO above the surface thickness threshold of 0.3 µm to arrive at any location on the sea surface after the bunkering spill. In the most mobile conditions, the MGO can travel up to 20 km within one day, up to 30 km within two days, and up to 55 km within four days. After approximately four days, it is predicted that no MGO will be left on the sea surface, as the majority will have evaporated. No surface location is predicted to be exposed to MGO above the surface thickness threshold of 0.3 µm for more than one day (Figure 12-40c).

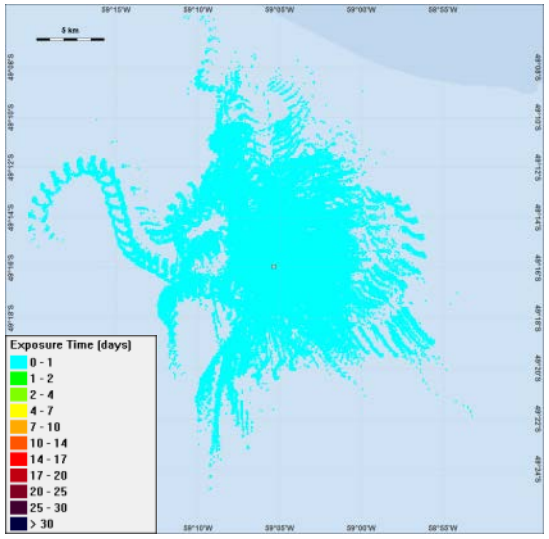
The results in Figure 12-40 are based on an aggregation of results from all the stochastic model runs and therefore do not represent a single spill scenario. To illustrate the impacted surface area for a single, worst-case, spill scenario, a deterministic model run of the MGO bunkering spill was conducted. The total impacted surface area is shown in Figure 12-41. Following a MGO bunkering spill, it is predicted that 'rainbow' sheen could form on the sea surface but would likely only be visible for a short period of time.



a) Probability of surface contamination above threshold of 0.3 µm



b) Minimum arrival times of oil above 0.3 µm on the surface



c) Maximum time surface is exposed to oil above threshold of 0.3 µm

Figure 12-40: Surface results (stochastic) for MGO bunkering spills

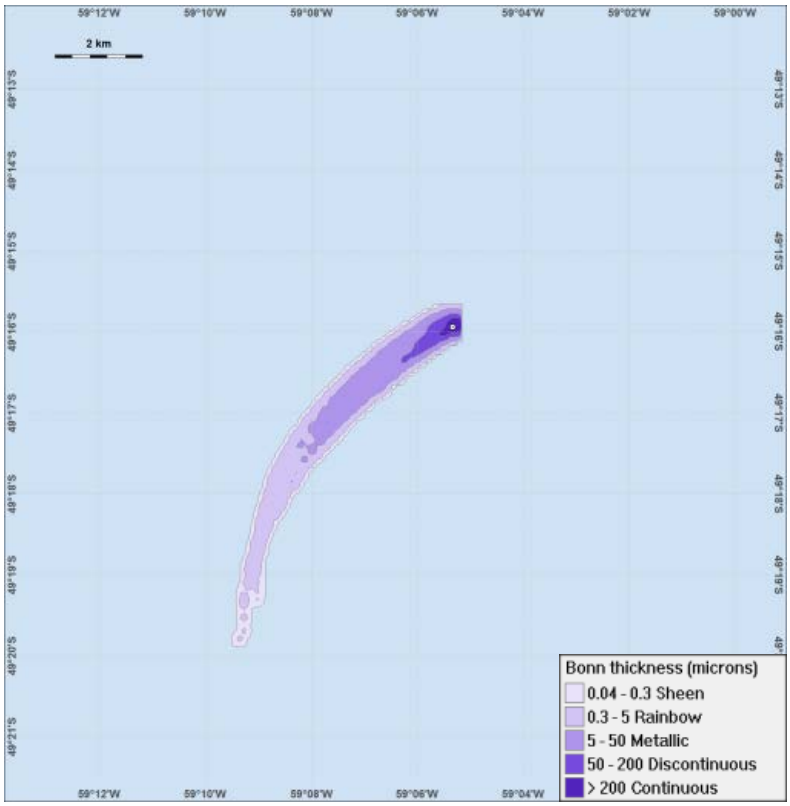


Figure 12-41: Total impacted surface area above threshold of 0.3 µm for the single deterministic model run of the worst-case MGO bunkering spill

12.1.4.8.3 MGO bunkering spill - Water column results

MGO concentrations above the threshold of 25 ppb could occur for up to 5 km downcurrent of the spill in 50 % of cases. The model predictions indicate it is possible for MGO to be found at depths up to 50 metres, but this occurs with low probability. This is primarily related to the rate at which the MGO will evaporate from the sea surface and the depth of the mixing layer caused by surface winds. No water column location is expected to be exposed to MGO above 25 ppb for more than one day. It is expected that for a single spill scenario, the water column threshold of 25 ppb will only be exceeded for short intermittent periods of time, and that the concentration of MGO in the water column will be below this threshold after two days.

12.1.4.8.4 MGO bunkering spill - Shoreline results

No shoreline oiling was predicted in any of the simulations of the MGO bunkering spill scenario. Due to the small volume of MGO involved, and the distance from the discharge location to the Falklands coastline, it is not credible that such a spill would result in any MGO reaching the Falklands shoreline.

12.1.4.8.5 MGO bunkering spill - Effect of oil spill response measures

The rapid dispersion predicted for the MGO inventory release is even more acute in the case of a smaller volume in this case. It is therefore more likely that applying oil spill response measures would be ineffective in altering the environmental impacts of such a scenario.

12.1.4.9 Small scale releases

During the ENVIID workshop (Chapter 9), a number of sources of small spills were identified that, should they occur, could contribute to chronic oil pollution in addition to the low-level contribution made by legally compliant discharges (Section 10.7). Sources of chronic oil pollution from small scale

accidental releases range from small subsea leaks of reservoir hydrocarbon or hydraulic oil to the potential for flare-drop out during emergency blowdowns (Section 5.9.4). These may result from equipment failure or human error and may be very small owing to early detection or discrete volumes of oil, or they may be ongoing e.g., small subsea leaks.

Given that small accidental releases could arise from different sources, it is not possible to estimate the potential volumes of release. However, these will be dealt with appropriately on a case-by-case basis, should they occur. In the event of small spills, the most appropriate response is sometimes for the spill to be monitored and allowed to disperse naturally. All spills, regardless of size, would be reported to FIG *via* the PON 8 (Section 12.1.1.1.5).

As with large accidental spills in the scenarios described above, the behavior, fate and impact of small releases of oil will depend upon the source of leak and the type of the oil. However, it is understood that small spills can result in surface sheens and low-level increases in the background contaminant levels of dispersed and dissolved oils e.g., polyaromatic hydrocarbons (PAHs) etc.

12.1.4.10 Loss of riser contents

If there is a loss of riser contents whilst drilling with NADF, the mud is likely to flow out over the seabed. The volume of drilling fluid lost will be in the region of 60 m^3 as the whole riser volume would always be lost in this situation. The loss of contents would trigger a rapid BOP activation and shutdown of mud pumps to restore the necessary barriers so is unlikely to a be higher volume. It is assumed the drilling fluid would flow out to a thickness of 1 cm, covering an area of approximately 0.006 km^2 around the MODU.

It is not conceivable that a spill from loss of riser contents would reach the shoreline.

12.1.5 Industry-standard mitigation measures

The majority of industry-standard mitigations are built-in to the Phase 1 & 2 Development basis of design and all are factored into the initial risk assessment. These are listed in Table 12.7.

Table 12.7: Industry-standard mitigation measures relevant to each of the oil spill risk scenarios

Scenario	Industry-standard mitigation (and base-case) measures
General	All activities with the potential to result in an oil spill will be carried out by competent personnel in accordance with operational controls, the permit to work system, the requirements of the Navitas OMS (Section 3.2) and Navitas' Drilling Management System, Adherence to the Safety and Environmentally Critical Equipment (SECE) register with appropriate performance standards (Section 3.2.12), Offshore spills, large or small will be reported in compliance with the FIG PON8 using the supplied *pro forma* (Section 12.1.1.1.5), and Offshore spills will be managed in line with the Sea Lion Field OPEP (Section 12.1.1.1.3) which will be submitted to FIG as a separate document for approval prior to the commencement of operations.
1: Subsea well blow-out	The drilling operations will follow established international drilling safety standards to minimise the risk of loss of well control. Well control systems and procedures will be in place as per all Navitas and drilling contractor well control guidelines. Preventative and mitigation controls include: The use of adequately experienced drilling crews, trained in well control techniques and supervised at all times. Training will be continuous with regular emergency drills. Well designs will be reviewed by an independent well examiner. Support contracts will be in place with international well control specialists. Primary well control is achieved by: Development of an appropriate well design for the expected pore pressures with regard to casing etc. (Section 5.4.4.5), Use of appropriately weighted drilling muds to maintain a hydrostatic pressure in the wellbore greater than the pressure of the fluids in the formation being drilled, but less than the formation fracture pressure (Section 5.4.5.3), The use of appropriate mud additives to prevent problems when drilling which can lead to the well becoming underbalanced e.g., lost circulation, fluid loss. The requirement for mud additives e.g., lost circulation material is assessed based on the expected qualities of the reservoir formation. Use of a Blow-Out Preventor (BOP) which will be in place while drilling and will be subject to regular maintenance and testing. BOP equipment / controls and emergency / contingency controls will be tested both prior to and immediately after deployment onto the wellhead. The BOP will be subject to a third-party verification and audit prior to drilling operations commencing. During production a subsea X-mas tree will be in place on each well. Contracts for the supply of a capping device that meets the timescales for deployment described (Table 12.3 above) will be placed to anticipate a sub-sea well blow-out (in the event of failure of both primary and secondary well controls). That is, logistics will be in place to ensure a blow-out can be arrested in an upper estimate of 21 days.
2: FPSO inventory loss	A 1,275 m radius exclusion zone will be established around the FPSO, Cargo and fuel tanks of the FPSO will be double skinned, An ERRV (MRSV) vessel will be on permanent stand-by to intercept any vessel that enters the exclusion zone or assist in the event of emergency situations, and Use of AIS / radar surveillance and radio broadcasts to mariners (advising on the position of the rig and the exclusion zone).
3: Crude transfer spill	Good oilfield practices will be employed to prevent the release of hydrocarbons. Provision of physical barriers, maintenance to minimise leaks and procedures and training to influence human factors will be adopted.

Scenario	Industry-standard mitigation (and base-case) measures
	Navitas working procedures will provide the operational control measures that are designed to minimise the risks. These measures include: Bulk Hose Management in line with procedural control to ensure inspections, and verification of bulk hoses, Use of the 'green line' system to ensure safe crude offload, Hose quick break connectors to prevent spills on disconnection, Reporting of any leaks, or defective equipment, Investigation of any leaks to determine root causes and take action to prevent reoccurrence, and Ensuring that all pipe-work is isolated, drained and purged as required by the permit to work before breaking containment.
4: MGO inventory loss	Working practices will follow industry best practice guidelines designed to prevent the loss of MGO inventory from the drilling rig. Measures such as the use of a 500 m exclusion zone around the MODU, a guard ship, AIS / radar surveillance and radio broadcasts to mariners will further reduce the risk of collisions between vessels and the drilling rig.
5: MGO bunkering spill	Navitas working procedures will provide the operational control measures that are designed to minimise risks associated with MGO bunkering spills. These measures include: Bulk Hose Management in line with procedural control to ensure inspections, and verification of bulk hoses, Hose quick break connectors to prevent spills on disconnection, Reporting of any leaks, or defective equipment, Investigation of any leaks to determine root causes and take action to prevent reoccurrence, and Ensuring that all pipe-work is isolated, drained and purged as required by the permit to work before breaking containment.
Small scale releases	Implementation of the Maintenance Management System (MMS) and inspection protocols, Use of all standard operating procedures and best practice, Following industry bunding guidelines for liquid containing equipment and chemicals, Open deck drains to catch and collect spills to a dedicated slop tank, High level tank filling alarm and emergency shutdown of the process, Reporting of any leaks, or defective equipment, Use of toolbox talks prior to execution of work, and Use of spill kits for deck spills.
Loss of riser contents	Compliance with: ISO 13628-7 - Design and Operation of Subsea Production Systems: Completion / Workover Riser Systems, API 16F - Specification for Marine Drilling Riser Equipment, and DNV RP F204 - Riser Fatigue.

12.1.6 Risk Assessment

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of oil releases should they occur. As any oil release would be an unplanned event, an assessment of the 'Likelihood of Occurrence' is carried out to determine the overall 'Risk' of impacts occurring as a result of oil spills.

A summary of the risk assessment outcomes for this Development is tabulated in Section 12.1.12, which shows the worst-case risk for each activity and receptor, the details of which are provided below.

Owing to the number of receptors which could be impacted by the differing oil spill scenarios, and the number of scenarios, the layout of this chapter is slightly different to the other chapters within this EIS. The *impact* on each receptor is tabulated in each section below, and the *likelihood* of occurrence of the event, which will be consistent within each scenario, is then described as a whole.

The following assessments take account of all industry-standard and base-case mitigations described in Section 12.1.5.

12.1.6.1 Scenario 1: Subsea well blow-out

12.1.6.1.1 Sensitivity of receptor and severity of effect (impact assessment)

A subsea well blow-out is highly unlikely to occur in the lifetime of the proposed Sea Lion Development. The oil dispersion modelling for a subsea blow-out used worst-case conditions to set an upper boundary on potential effects.

In the unlikely event of a well blow-out, prevailing currents and winds in the area will tend to keep oil (wax) at sea where it is subject to dispersion, evaporation and biodegradation. The oil generally travels north as it is transported by dominant currents, or in an arc to the south-south-east, as it is forced by the wind driven surface currents (Section 12.1.4.4.1).

Given its high wax content, extensive surface slicks are not predicted from a Sea Lion crude well blow-out (Section 12.1.4.4.2). Instead, a raft of waxy oil masses is predicted to form and migrate from the area predominantly near the water surface. The oil masses will not coalesce but rather become increasingly dispersed with distance, and their visibility will reduce with increased distance from the release location (Section 12.1.4.4.2). The amount of energy experienced during any release determines the initial size of the oil masses and relatively small droplets are likely to be formed during a blow-out. Some degradation of particle size is expected through prevailing shear forces from waves and turbulence, but very slowly based on laboratory experience. Ultimately, oil may attach to suspended solids and sink (although very little adhesion to suspended solids was observed in the laboratory), or be biodegraded in the water column, involving an element of ingestion, potentially by a range of biota.

Soluble components, which pose a risk to water column ecology, have been shown not to dissolve into the water column in the first seven days after a spill (CEDRE, 2017), and it is assumed that any dissolution will happen slowly. Permeation through the wax is very slow and dissolution relies on new faces being exposed during shearing, and the oil masses appear to be resistant to shearing from typical wave energies in the laboratory. The modelling predicts that toxic water column impacts are not above a widely accepted level of concern, except directly above a blow-out or directly beneath a surface accumulation, and that this occurs for short periods (Section 12.1.4.4.3).

Generally, even in examples where large fractions of the oil transition to sediments, impacts on the benthos show good recovery in the timescale of years and, while effects on lower trophic levels can be observed, little change in higher trophic levels tends to be observed. The area of the western South Atlantic continental shelf is 700,000 km^2. In context, a seabed area of 0.09 % of the continental shelf was shown to contain levels of >10 mg/kg (the most conservative predicted NOEC, Table 12.4 above)

with the maximum predicted concentration of oil in sediment 29.3 mg/kg assuming oil is mixed over a 5 cm layer.

A well-documented example is the Braer incident in 1993 where over 84,000 tonnes of oil was released. Overall, the oil spill caused minimal effect on the ecology of South Shetland (Law and Moffat, 2011). Around 30-35 % of the oil was estimated to have transitioned to sediments, some near the coast and some much further offshore. The nearshore contamination led to a restriction on shellfish fisheries in the area for a period of between 18 months and seven years and the sandeel population, which is a key component in the food chain and a sediment-dweller, exhibited clear increases in hydrocarbon presence but showed only a slight decrease in population level that reversed in one year (Davies and Topping, 1997). In contrast, although the area of sediment contamination further offshore (a better analogue for any Sea Lion impacts) was clearly identified and analysis of fish, including taint testing was undertaken, it did not lead to any closure of fisheries.

Given the above, the potential sediment impacts from a Sea Lion crude release are considered to be low.

The modelling results suggest that there is a possibility that a subsea well blow-out, with the parameters of location and blow-out rate specified, could lead to hydrocarbons reaching the Falklands coastline.

The assessment of the 'Sensitivity of Receptor' and the 'Severity of Effect' for each receptor are provided in Table 12.9 below. The 'Likelihood of Occurrence' of a well blow-out is described below and is also included in Table 12.9 to show how the overall significance ratings of risks associated with a subsea well-blow-out were derived.

12.1.6.1.2 Likelihood of occurrence

Although known in the O&G industry, uncontrolled releases / blow-outs and major losses of containment are extremely rare events. The frequencies of blow-out events in the North Sea are presented in Table 12.8. Here the frequency of blow-out events has been calculated per well drilled, per operation, or per well year in the North Sea (OGP, 2010a). Table 12.8 indicates that the likelihood of a blow-out is generally very low and is higher for High Pressure / High Temperature (HP / HT) gas reservoirs than for normally pressured reservoirs. The Sea Lion reservoir is not an HP / HT reservoir.

Nonetheless, strict regulations governing working practices and lessons learned from previous incidents have helped to further minimise the likelihood of accidental events leading to major losses of containment. Following the Deepwater Horizon incident in the Gulf of Mexico (2010), the Oil Spill Prevention and Response Advisory Group (OSPRAG) was established to review all UK Continental Shelf (UKCS) regulations and pollution response arrangements and to assess the adequacy of financial provisions for that response. This has resulted in significant amendments to the legislation pertaining to oil spill prevention and response.

The International Association of Oil & Gas Producers has issued datasheets (OGP, 2019) on blow-out frequencies for offshore operations of North Sea Standard (NSS). These operations are performed with a Blow-Out Preventer (BOP) installed following the 'two barrier' principle, meaning that there are always two physical barriers preventing the oil from flowing to the seabed, as will be the case with the Sea Lion Development. Taking account of the industry-standard mitigations (Section 12.1.5), the likelihood of occurrence of a subsea blow-out occurring is considered to be '**Unlikely**' (Table 12.9), as it has happened in the industry before, but on extremely rare occasions.

Table 12.8: Blow-out frequencies for offshore operations of North Sea Standard (OGP, 2019)

Operation	Frequency of oil spills	Unit	Proportion Subsea
Development Drilling, Deep (Normal Wells)	3.4×10^{-5} or 0.000034 (1 in every 20,834 wells drilled)	Per well drilled	0.47
Development Drilling (HP/HT)	2.1×10^{-4} or 0.00021 (1 in every 3,333 wells drilled)	Per well drilled	0
Completion	1.4×10^{-4} or 0.00014 (1 in every 18,519 completion operations)	Per operation	0
Producing Wells (Excluding External Causes)	2.1×10^{-5} or 0.000021 (1 in every 384,615 production well year)	Per well year	0.43
Producing Wells (External Causes)	2.7×10^{-5} or 0.000027 (1 in every 25,641 production well year)	Per well year	0

12.1.6.1.3 Overall risk significance

As is shown in Table 12.9 the highest significance of the risk posed by a well blow-out is to the human population (fisheries and tourism), seabirds, marine mammals and coastal areas all of which are considered to be of '**Moderate**' significance and, therefore, project-specific mitigation measures will be required.

Table 12.9: Risk assessment of a subsea well blow-out

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
Water quality and plankton	Plankton show high seasonal and spatial variation in abundance and productivity, and it is expected that any effects will be greatest during summer when the area of the shelf-break to the south of the Sea Lion Field supports higher densities of phyto- and zooplankton (Section 12.1.4.2.1). At other times, the area is less significant for zooplankton but is still considered highly productive. Therefore, the sensitivity of plankton is considered to be '**Moderate**'. Although, oil from a blow-out is likely to rise to the upper water column, due to a combination of short generation times, high reproductive rates, known concentration of oil to effect lethal contamination on representative species (Section 12.1.4.1.1.1) and the potential for immigration from outside contaminated areas, the effects on whole plankton communities are expected to be of a short-term and reversible in nature. Due to the temporary impact on plankton in a localised area around the spill site, the severity of the effect of an uncontrolled release / blow-out of Sea Lion crude on plankton has been assessed as '**Moderate**'. Therefore, the significance of the impact on plankton is assessed as '**Moderate (9)**'.	**Unlikely**	**'Low (6)'**
Sediment quality and benthic communities	In the majority of scenarios where the oil remains at sea, <1 % oil is predicted to transition into sediments (Section 12.1.4.4.1). The oil bench tests (Premier, 2016) and lab testing (CEDRE, 2017) have reinforced the finding that the crude is very buoyant. This keeps it away from sediments, and should tar balls form and cause the oil to sink, the majority of oil becomes enclosed in a crust which tends to avoid acute impacts (Section 12.1.6.2.1). Testing of one benthic species indicated that relatively high concentrations of oil in sediments would impact benthic communities (Section 12.1.4.1.1.1). However, these concentrations are not predicted to occur; the maximum level predicted is 29.3 mg/kg (Section 12.1.6.1.1). The sensitivity of the benthic community is considered to be '**Very Low**' due to uniform nature of the benthic community over much of the NFB. The severity of effect is considered to be '**Serious**' due to the potential widespread impact that could take several years to recover. The significance of impact on the benthic community is therefore assessed as '**Moderate (4)**'	**Unlikely**	**'Low (6)'**
Fish and squid	Known fish and squid spawning sites of commercial species are significant distances from the Sea Lion Field (Section 12.1.4.2.3) and it is unlikely that they will be impacted. Investigations of the effects of Sea Lion oil on fish eggs indicates that a spill is unlikely to have an impact (Section 12.1.4.1.1.1). While the adults of many species use the Northern Slope as a feeding ground (Section 7.4.4.2.2) these are likely to be able to avoid areas of contamination. Nonetheless, it is possible that more than 1 % of the Falklands population of fish and squid species using the Northern Slope could be within the zone of influence of a subsea blow-out either directly while foraging or passing through during migration	**Unlikely**	**'Low (6)'**

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
	(Section 12.1.4.4) and, therefore, the sensitivity of fish and squid receptors to a blow-out is considered to be '**Moderate**'. The impact of a subsea blow-out will have a temporary and reversible impact on the adult fish and squid exposed to crude oil and therefore the severity of the effect on fish is considered to be '**Moderate**'. Therefore, the significance of the impact of a subsea blow-out on fish and squid is assessed as '**Moderate (9)**'.		
Human population (fisheries)	The main commercial fisheries in the NFB target squid and finfish (Section 12.1.4.2.7). While the squid fishing grounds are not usually near the Sea Lion field, in May and June it is believed that a significant proportion of the *Illex* stock passes through the NFB. A blow-out that happened to coincide with this migration could lead to contamination of the spawning stock with unknown implications for reproduction (Section 12.1.4.2.7). The Patagonian toothfish fishing grounds are to the north and east of the Sea Lion Field and the results of modelling indicate that oil is likely to spread over part of the area fished (Section 12.1.4.4). Given the importance of these fisheries to the Falklands' economy and the uncertainty over the extent of any impacts, a precautionary approach should be taken and it is assumed that a blow-out could result in economic impacts for the fishing industry. Given the low capacity for the fishing industry to absorb the losses in revenue, and that such impacts to fisheries would be unacceptable to a majority of stakeholders, the sensitivity of the human population is considered to be '**Very High**'. An uncontrolled release could result in the closure of the fishing grounds due to potential tainting and contamination and therefore, the severity of the effect of an uncontrolled release on fisheries is considered to be '**Serious**'. Therefore, the significance of the impact on the human population *via* fisheries is assessed as '**High (20)**'.	**Unlikely**	**'Moderate (10)'**
Seabirds	Drilling and production will occur throughout the year and seabird vulnerability varies on a monthly / seasonal basis (Section 12.1.4.2.4.3). Given the waxy nature of the Sea Lion crude, seabirds are generally considered to be less susceptible to fouling compared to other crude oils (Section 12.1.4.2.4). However, testing has shown that at concentrations of 1,000 g/m^2 feathers become stained and microparticles of oil are adsorbed by two of the species tested (Section 12.1.4.1.1.1). Also, there is concern that birds will ingest oil, in much the same way that they ingest plastics. The available data, presented as an oil vulnerability atlas, indicate that at times there are areas of relatively high seabird vulnerability in or close to the Sea Lion Field. Further, the presence of the Development vessels will attract groups of scavenging seabirds, many of which are ACAP species and others that are of global conservation concern (Section 12.1.4.2.4). Therefore, given their susceptibility to the ingestion of oil (and other oil impacts), their presence in the wider NFB, their propensity to associate with vessels, and rigs, and the threatened conservation status of many species, the sensitivity of seabirds to the effects of a blow-out, is considered to be '**Very High**'. While the direct impact of Sea Lion crude by fouling is expected to be less than for more fluid crudes (Section 12.1.4.2.4), testing has indicated that there will be impacts to birds contaminated with higher concentrations (1,000 g/m^2) of oil (Section 12.1.4.1.1.1). Crude from a well blow-out is expected to rise to the upper water column and to	**Unlikely**	**'Moderate (10)'**

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
	remain above 1 g/m^2 in the area immediately above the well for up to 30 days (Section 12.1.4.4.2), although it is not predicted to be above levels shown to cause staining and adhesion in laboratory tests. Nonetheless, the behavioural traits of some species increase the likelihood that they will be attracted to the area through their association with vessels, due to the presence of artificial light, discharged wastewater and food, or simply to investigate a novel object in an otherwise uniform environment (Section 12.1.4.2.4.3). This increases the likelihood of contact with and ingestion of oil, potentially resulting in direct mortality or chronic impacts on the survival and reproductive biology of long-lived, late reproducing species (Section 12.1.4.2.4). The severity of the effect of an uncontrolled release on seabirds is therefore considered to be '**Serious**'. Therefore, the significance of the impact on seabirds is assessed as '**High (20)**'.		
Marine mammals	Owing to the presence of the sperm whale (IUCN 'Vulnerable'), the fin whale (IUCN 'Vulnerable') and the sei whale (IUCN 'Endangered') in the NFB (Section 12.1.4.2.5.2), all of which also have priority conservation status under the Falklands biodiversity action plan, the sensitivity of marine mammals is assessed as '**High**'. Away from the immediate release site at which surface oil densities > 1 g/m^2 may persist for up to 30 days, marine mammals may still be at risk from ingestion of the semi-solid waxy crude despite the rapid dispersion of contaminants (Section 12.1.4.1.1 and Section 12.1.4.2.5). While not causing significant immediate impact or mortality, the longer-term effects of sub-lethal exposure or ingestion are not fully understood and may lead to long-term impacts (Section 12.1.4.2.5). Therefore, taking a precautionary approach, the severity of effect of a subsea blow-out on marine mammals has been assessed as '**Moderate**' Therefore, the significance of the impact on marine mammals is assessed as '**Upper Moderate (12)**'.	**Unlikely**	**'Moderate (8)'**
Coastal	There is a slim possibility of oil reaching East Falkland (Section 12.1.4.4.4) which has numerous protected habitats (Section 7.5.2). The likelihood of oil reaching the shore is low (predicted in only approximately 4 % of stochastic model runs and therefore in a very specific and prolonged set of metocean conditions) and the quantity likely to beach is less than 30 tonnes (Section 12.1.4.4.4). However, the areas that are potentially at risk are of national importance. Therefore, the sensitivity of the coastal environment is considered to be '**High**'. Given that there is still some uncertainty regarding the long-term chronic impacts of such a waxy crude on this environment, and the model parameters have a degree of uncertainty, the severity of effect of an uncontrolled blow-out on coastal environment is considered to be '**Moderate**'. Therefore, the significance of the impact of an uncontrolled blow-out is assessed as '**Upper Moderate (12)**'.	**Unlikely**	**'Moderate (8)'**
Human Population (tourism)	The model predicts that some oil could reach the shore following a well blow-out, which will result in a quantity of less than 30 tonnes beaching (Section 12.1.4.4.1). Given the distance offshore and the relatively long travel times of the oil (Section 12.1.4.4.2) it is unlikely that tourists would see oil at-sea arising from a well blow-out. However, media publicity may influence the experience and perceptions of tourists, which may then impact upon their propensity to	**Unlikely**	**'Moderate (10)'**

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
	visit. Given that a well blow-out would be unacceptable to the majority of stakeholders, the sensitivity of tourism is considered to be '**High**'. Due to the long-lasting negative impacts of perceived environmental degradation, the severity of effect of an uncontrolled release on tourism has been assessed as '**Serious**'. Therefore, the significance of the impact on the human population (tourism) is assessed as '**High (16)**'.		

12.1.6.2 Scenario 2: Loss of FPSO crude oil inventory

12.1.6.2.1 Sensitivity of receptor and severity of effect (impact assessment)

The results of the oil dispersion modelling indicate that the behaviour of Sea Lion crude following a complete loss of FPSO crude oil inventory are similar to the worst-case well blow-out scenario. There is a low potential in both cases for oil to reach the north Falklands coastline. In the case of the FPSO inventory loss scenario, the shoreline was reached in 5.8 % of the stochastic model runs in specific metocean conditions (Section 12.1.4.5.4), as opposed to 4 % in the case of the well blow-out scenario. Furthermore, when considering the worst-case scenarios, the maximum mass of beached oil predicted by the models was 36 tonnes for the FPSO inventory loss scenario, compared to 29 tonnes in the case of a well blow-out. However, the potential deposition in offshore sediments is much smaller, largely because oil is assumed to remain in larger, more buoyant masses. Deposition above the LC_{50} level of 392 mg/kg (Table 12.1 above) is not predicted; in fact the maximum predicted deposition concentration in either model run over a 5 cm mixed layer in the model grid is 1-2 mg/kg, well below the OSPAR threshold of 50 mg/kg and the NOEC concentration of 10 mg/kg (Table 12.4 above).

Following an FPSO release, the potential for tar ball formation is higher than for the well blow-out scenario. Tests have reinforced the finding that the Sea Lion crude is very buoyant and formed little attachment to suspended solids, attributes that would generally keep it away from sediments (Section 12.1.4.1.1) Should tar balls form and cause the oil to sink, the majority of oil would likely become enclosed in a crust, which tends to reduce acute impacts.

Containment and recovery operations are overall less effective due to the large volume of oil and the dispersion of oil before significant oil spill response resources arrive, but are predicted to be sufficient to prevent oil from reaching some, but not all, areas of the Falkland Islands coastline.

The ‘Sensitivity of Receptor’ and the ‘Severity of Effect’ for each receptor are provided in Table 12.10. The ‘Likelihood of Occurrence’ of losing the crude from the FPSO is described below and is included in Table 12.10 to show how the overall significance ratings of risks associated with the loss of the FPSO crude oil inventory were derived.

12.1.6.2.2 Likelihood of occurrence

There are no recorded examples that match the worst-case scenario modelled here in over 20 years of global FPSO operations. One possible incident that could result in the complete loss of crude inventory from the FPSO however, is the collision with a large vessel. As detailed in Section 11.1, the likelihood of collisions between vessels operating in the south-west Atlantic and the FPSO on station in the Sea Lion Field was assessed using the COLLRISK model (Anatec, 2024b).

Based on vessel activity, the COLLRISK model was used to estimate the collision risks on an annual basis and distributed the predicted frequency of collision according to the level of impact energy based on the sizes and speeds of vessels involved. Specifically, information on shipping movements in the NFB was used to investigate the risk of vessels colliding with an FPSO stationed in the Sea Lion Field (Anatec, 2024b). On average, 216 vessels pass within 15 nautical miles of the Sea Lion Field per year. The majority of these (176) were commercial fishing vessels, 86 % of which were less than 1,500 DWT (Dead Weight Tonnage). Fourteen vessels were cargo vessels, 14 were tankers and 12 were passenger vessels. Given the size of the tankers, 29 % of which were >40,000 DWT, these vessels pose a greater threat in terms of the force of a collision.

Overall, the annual risk of a collision with a passing vessel was calculated as 9.2 x 10-3 per year and the risk, or probability, of a collision with a larger vessel (collision energy >200 MJ) was assessed as 5.1 x 10^{-8} per year (Section 11.1).

The other credible collision risk for vessels located within the Sea Lion Field is that posed by icebergs. An Iceberg Management Strategy was previously produced in consultation with the British Antarctic Survey (BAS) and the results of their assessment are presented in Premier (2015f). Using the available information (satellite and visual observations), it is predicted that an iceberg will pass within 30 nautical miles of the FPSO with a mean return period of 20 years. The strategy indicates that this is a manageable risk but iceberg management zones and protocols will be instigated. Navitas will prepare an updated Iceberg Management Plan prior to the commencement of operations.

With industry-standard mitigation measures in use (Section 12.1.5), the likelihood of occurrence of a full loss of FPSO crude inventory is considered to be '**Very Unlikely'** (Table 12.10).

12.1.6.2.3 Overall risk significance

As is shown in Table 12.10, the highest significance of the risk posed by the loss of crude from the FPSO is to the human population (tourism and fisheries) seabirds, marine mammals and coastal ecology, all of which were assessed as '**Low**'.

Table 12.10: Risk assessment for loss of FPSO crude oil inventory

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
Water quality and plankton	Justification for this assessment is the same as that for a blow-out and can be found in Table 12.9. The sensitivity of plankton is considered to be '**Moderate**' and the severity of the effect to be '**Moderate**'. Therefore, the overall significance of the impact is assessed as '**Moderate (9)**'.	**Very Unlikely**	**'Very Low (3)'**
Sediment quality and benthic communities	Due to the buoyancy of the wax and the deep water in which it is released, the deterministic model predicts that a small fraction of oil (<0.5 %) could move into sediments (Section 12.1.4.5.1); this is only predicted when / if the oil approaches shallower water and the cloud of suspended droplets makes contact with the seabed, around 40 days after discharge. Testing of one benthic species indicated that relatively high concentrations (> 392 mg/kg) of oil in sediments would impact benthic communities (Section 12.1.4.1.1.1) although other studies indicate lower thresholds of significance (Table 12.4 above). These concentrations are not predicted to occur; the maximum concentration predicted is 1-2 mg/kg (Section 12.1.6.2.1). The sensitivity of the benthic community is considered to be '**Very Low**' due to the uniform nature of the benthic community over much of the NFB. The severity of effect is considered to be '**Serious**' due to the potential widespread impact that could take several years to recover. Therefore, the significance of impact on the benthic community is therefore assessed as '**Moderate (4)**'	**Very Unlikely**	**'Very Low (3)'**
Fish and squid	Justification for this assessment is the same as that for a blow-out and can be found in Table 12.9. The sensitivity of fish and squid is considered to be '**Moderate**' and the severity of the effect to be '**Moderate**'. Therefore, the overall significance of the impact is assessed as '**Moderate (9)**'.	**Very Unlikely**	**'Very Low (3)'**
Human population (fisheries)	Justification for this assessment is the same as that for a blow-out and can be found in Table 12.9. The sensitivity of fisheries is considered to be '**Very High**' and the severity of the effect to be '**Serious**'. Therefore, the overall significance of the impact is assessed as '**High (20)**'.	**Very Unlikely**	**'Low (5)'**
Seabirds	Justification for this assessment is the same as that for the well blow-out scenario and can be found in Table 12.9, except that there are areas of oil above 100 g/m^2 and above 1,000 g/m^2 near to the release where impacts on plumage are more likely. Additionally, the north Falkland coastline includes the IBAs at Seal Bay, Volunteer Point and Cow Bay (Section 12.1.4.2.6). However, by the time oil reaches the coastline it is predicted to be very degraded and dispersed. Penguins breeding at this and other sites are far more likely to come into contact with oil at sea. The sensitivity of seabirds is considered to be '**Very High**' and the severity of the effect to be '**Serious**'. Therefore, the overall significance of the impact is assessed as '**High (20)**'.	**Very Unlikely**	**'Low (5)'**
Marine mammals	Justification for this assessment is the same as that for a blow-out and can be found in Table 12.9. The sensitivity of marine mammals is considered to be '**High**' and the severity of the effect to be '**Moderate**'. Therefore, the overall significance of the impact is assessed as '**Upper Moderate (12)**'.	**Very Unlikely**	**'Low (4)'**

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
Coastal	There is a possibility of oil reaching the coastline of East Falkland (Section 12.1.4.5.4). Parts of this area (Seal Bay; Volunteer Point and Cow Bay) are designated as IBAs (Section 12.1.4.2.6.). Although the likelihood of oil reaching the shore is low (predicted in 5.8 % of stochastic model runs and the quantities involved are barely detectable in the modelled scenario (Section 12.1.4.5.4). However, the areas that are potentially at risk are of national importance. Therefore, the sensitivity of the coastal environment is considered to be '**High**'. Given that there is still some uncertainty regarding the long-term impacts of such a waxy crude on this environment, and the model parameters have a degree of uncertainty, the severity of effect of the FPSO crude inventory loss on coastal environments is considered to be '**Moderate**'. Therefore, the significance of the impact on a complete loss of FPSO inventory is assessed as '**Upper Moderate (12)**'.	**Very Unlikely**	**'Low (4)'**
Human population (tourism)	The potential fouling of iconic tourism destinations would impact greatly on the pristine image of the Falkland Islands and would likely have a negative impact on visitor numbers. While the model predicts that under very specific metocean conditions, oil could reach the shore, the concentrations would be so low (Section 12.1.4.5.4) that it is unlikely that tourists would see oil at sea or along the shore. However, reports, observations and photos of the incident, including affected wildlife that may come ashore will certainly influence the experience and perceptions of tourists. Moreover, international news coverage of the incident (offshore) will potentially influence the perception of the public, whether they see the oil or not. As there is limited capacity to absorb and manage change in visitor numbers in the aftermath of a major incident and given that this will be unacceptable to the majority of stakeholders, the sensitivity of tourism is assessed as '**High**'. Due to the potentially long-lasting negative impacts of perceived environmental degradation the severity of effect of an uncontrolled release on tourism has been assessed as '**Serious**'. Therefore, the significance of the impact on tourism is assessed as '**High (16)**'.	**Very Unlikely**	**'Low (5)'**

12.1.6.3 Scenario 3: Crude oil transfer spill

12.1.6.3.1 Sensitivity of receptor and severity of effect (impact assessment)

The modelling approaches considered a crude oil spill of 70 tonnes that may occur during FPSO crude offload operations. The potential impacts of such a spill on the environmental receptors are similar to that of the larger spill assessed above. The main differences include the volume discharged, the extent of the area affected, the duration of the spill and the number of individuals and proportions of populations of the key environmental receptors exposed to the oil and impacted, which will generally be smaller. Negligible concentrations of oil reached any sediments such that benthic communities are not considered further.

The 'Sensitivity of Receptor' and the 'Severity of Effect' for each receptor are provided in Table 12.11. The 'Likelihood of Occurrence' of a spill during crude oil transfer is described below and is included in Table 12.11 to show how the overall significance ratings of risks associated with crude oil transfer spills were derived.

12.1.6.3.2 Likelihood of occurrence

The likelihood of a crude oil transfer spill associated with the FPSO offload operation can be assessed by investigating the frequency of oil spills associated with such installations in other parts of the world. Figure 12-42 shows the number of all recorded oil spill events associated with offshore O&G installations on the United Kingdom Continental Shelf (UKCS) between 2012 and 2022. This corresponds to 234 installations in 2021 as listed by OSPAR (2023a) with the number declining from 316 in 2012. After accounting for the number of installations, the average number of oil spill events per installation was reasonably consistent over this period although it is important to note that these were not all the result of offloading operations. In 2022, there were 188 unintentional oil releases on the UKCS, involving 33 tonnes of oil released to the marine environment. The average annual reported unintentional oil release size has varied since 2012, between 0.05 and 2.1 tonnes. Infrequent but large releases form a big part of these annual totals, such as was seen in 2020. These data illustrate that spills in the region of 70 tonnes are very infrequent events.

Figure 12-43 illustrates the type of oil involved in unintentional releases from incidents on the UKCS in 2022.

The information presented above suggests that several small spills (from all sources) may occur at an installation each year, although most of these are not necessarily associated with crude oil transfer. The combined impact of these small spills may be more significant than a larger but far less likely spill.

The risk associated with a potential drive-off by a CTT during the offloading operation (i.e., the CTT inadvertently propelling itself off-station during transfer operations) has been mitigated by requiring that the CTT is held by a tug when connecting to the FPSO. The operation will be conducted under a safe system of work such that the CTT is under the control of the tug and is unable to drive-off unintentionally. Taking all the industry-standard mitigation measures into account (Section 12.1.5), the likelihood of occurrence of a 70 tonnes spill is assessed as '**Possible**' (Table 12.11).

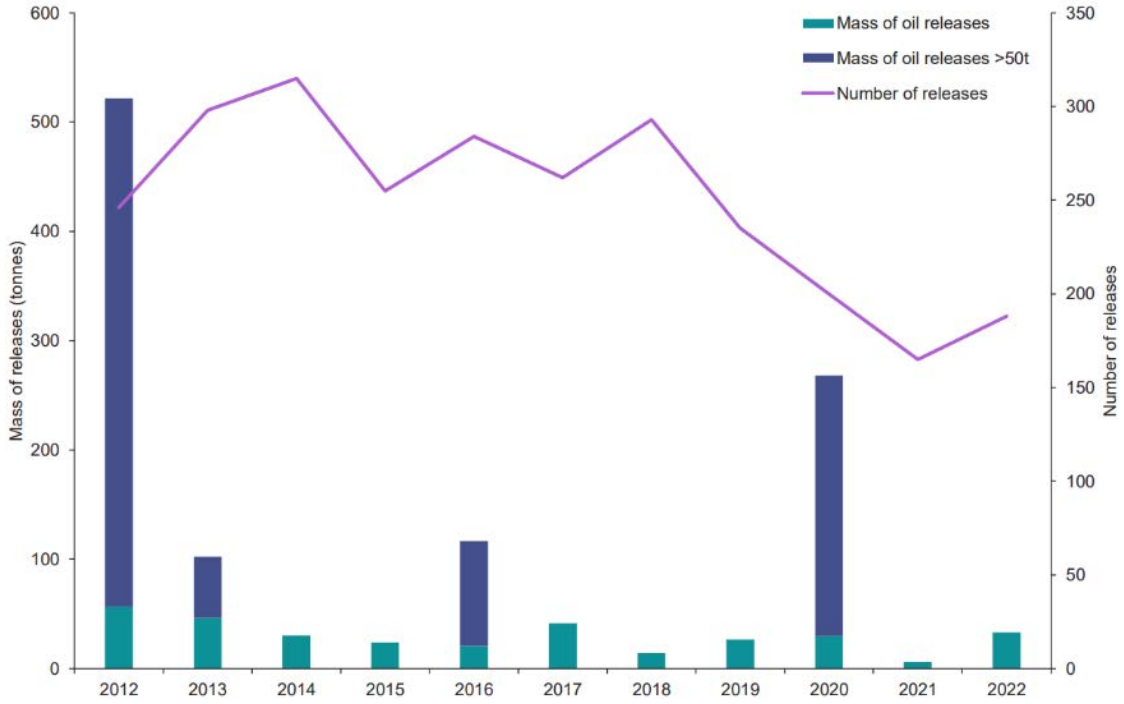


Figure 12-42: Number of oil spills and quantity of oil spilled in UKCS (2012 – 2022) ***(Source: OEUK, 2023)***

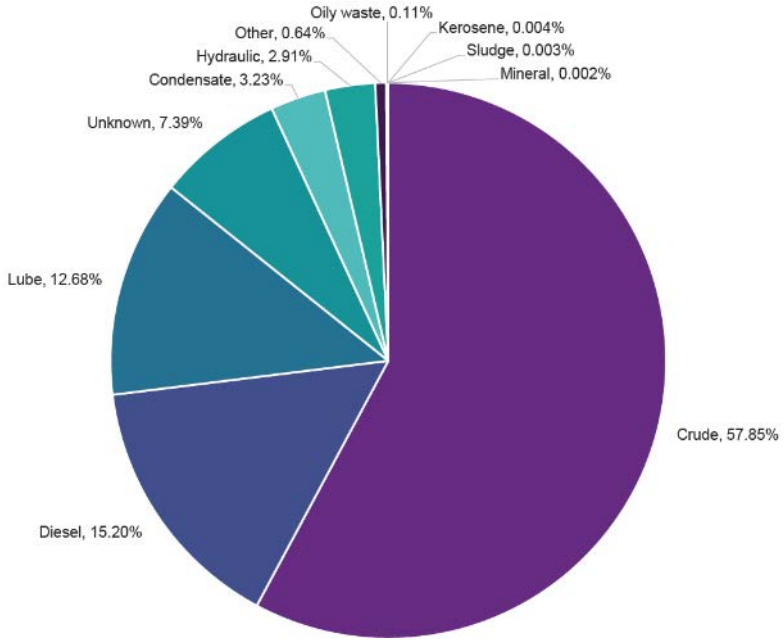


Figure 12-43: UKCS Fraction of releases by oil type, 2022 ***(Source: OEUK, 2023)***

12.1.6.3.3 Overall risk significance

As is shown in Table 12.11, the highest significance of the risk posed by the loss of crude during offloading is to seabirds and the human population (tourism) and is considered to be '**Moderate**' and therefore, project-specific mitigation measures will be required.

Table 12.11: Risk assessment associated with crude oil transfer spills

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
Water quality and plankton	The impact of a crude transfer spill will affect a very small area and therefore a small proportion of the local plankton populations. Consequently the sensitivity of plankton is assessed as '**Low**'. A combination of short generation times, high reproductive rates and immigration from outside the affected area would likely see a quick recovery of the affected communities. The severity of the effect of a crude transfer spill on plankton is therefore considered to be '**Slight**'. Therefore, the significance of the impact is assessed as '**Very Low (2)**'.	**Possible**	**Very Low (3)**
Sediment and benthic communities	n/a	**n/a**	**n/a**
Fish and squid	The zone of influence of a crude transfer spill will be small in space and time and will therefore impact a small proportion of the local fish and squid populations. The sensitivity of fish and squid is considered to be '**Low**'. Any effect will be highly localised and short-term and therefore the severity of the effect is considered to be '**Slight**'. Therefore, the overall significance of the impact is assessed as '**Very Low (2)**'.	**Possible**	**Very Low (3)**
Human population (fisheries)	The sensitivity of fisheries is considered to be '**Low**' and given the low volume of oil that is expected to be rapidly dispersed in the water column, the severity of the effect is therefore considered to be '**Minor**'. The overall significance of the impact is therefore assessed as '**Low (4)**'.	**Possible**	**Low (6)**
Seabirds	Although the volume of oil discharged following a crude oil transfer spill is relatively small, the highest density of seabirds in the area will be closely associated with the Development vessels. It is these birds that are at greatest risk of exposure to oil, regardless of the size of the spill (Section 12.1.4.2.4). The sensitivity of seabirds is considered to be '**Very High**'. The impact of a crude oil transfer spill will be short-lived and restricted to the local area. The severity of the effect of a crude oil transfer spill is considered to be '**Minor**'. The overall significance of the impact is consequently assessed as '**Moderate (10)**'.	**Possible**	**Moderate (9)**
Marine mammals	Given the limited extent and duration of an oil spill associated with crude oil transfer operations, and the tendency for marine mammals to associate less with vessels and structures at sea than seabirds, the sensitivity of marine mammals is considered to be '**Moderate**' and the severity of the impact to be '**Slight**'. Therefore, the overall significance of the impact is assessed as '**Very Low (3)**'.	**Possible**	**Very Low (3)**
Coastal	No shoreline oiling was predicted in any of the stochastic simulations of a crude transfer spill.	**n/a**	**n/a**

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
Human population (tourism)	Given the small volume of oil involved, the distance offshore and the low exposure time (Section 12.1.4.6.2) it is highly unlikely that tourists would see any of the oil discharged following an offshore crude oil transfer spill. While news of an oil spill, even if minor, may influence the perception of the public, whether they see the oil or not, it is very unlikely that smaller spills would come to the attention of tourists. Therefore, the sensitivity of tourism to a crude oil transfer spill, is considered to be '**Moderate**'. Due to the short-term and reversible impacts of a small spill on the perception of tourists regarding environmental degradation, the severity of effect of a crude transfer spill on tourism has been assessed as '**Minor**'. Therefore, the overall significance of the impact is assessed as '**Moderate (6)**'.	**Possible**	**Moderate (9)**

12.1.6.4 Scenario 4: Loss of MODU MGO inventory

12.1.6.4.1 Sensitivity of receptor and severity of effect (impact assessment)

MGO is predicted to remain on the sea surface for a short period of time before it either evaporates or disperses in the water column (Section 12.1.4.7.1). The extent of the sea surface and water column areas likely to be affected by MGO spills is generally more restricted (i.e., close to the release point) than crude oil spills. However, the higher volatility of MGO is such that it is more likely to release toxic substances, such as PAHs into the water column (Section 12.1.4.1.1.2). These chemicals are toxic to marine life and will have localised impacts following exposure. The larger the spill, the greater the area over which the MGO will spread and the longer it will take for the MGO to be reduced to insignificant concentrations.

The 'Sensitivity of Receptor' and the 'Severity of Effect' for each receptor are provided in Table 12.12. The 'Likelihood of Occurrence' of a MGO spill from the MODU is described below and is also included in Table 12.12 to show how the overall significance ratings of risks associated with the loss of MODU's MGO inventory were derived.

12.1.6.4.2 Likelihood of occurrence

One of the most plausible events that could result in a complete loss of the MODUs MGO inventory is a collision with a large vessel. When in the field, during Development Stages 1 and 2, the MODU will be anchored within the vicinity of the FPSO, which will also be anchored. The likelihood of a vessel colliding with the MODU has been assessed by Anatec (2024b) as 1.9×10^{-6} per year, corresponding to a collision return period of approximately 535,000 years, see Section 11.1.

The predicted collision frequency is very low, as for the FPSO, and it is useful to note that only three semi-submersible drilling rigs have ever sunk in the O&G industry. One incident occurred in the Canadian waters of the North Atlantic and was due to a catalogue of errors initiated by a major hurricane (US Coastguard, 1983). The other two incidents occurred in African waters when the MODUs were being towed. No incidents have been recorded on the UKCS, or anywhere since 1995.

With industry-standard mitigation measures in place (12.1.5), the likelihood of occurrence of a vessel colliding with the rig, potentially leading to a loss of containment of the entire MGO inventory, is assessed as '**Unlikely**' (Table 12.12).

12.1.6.4.3 Overall risk significance

As is shown in Table 12.12, the highest significance of the risk posed by the loss of MGO from the MODU is to seabirds and tourism, both of which are considered to be '**Moderate (8)**' and therefore require project-specific mitigation measures.

Table 12.12: Risk assessment of MODU MGO spill

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
Water quality and plankton	Following the loss of the MODU MGO inventory, the models predict that the MGO will remain on or close to the surface of the water initially but is rapidly removed by evaporation, biodegradation and dispersion (Section 12.1.4.7.1). MGO concentrations in the water column are only expected to exceed 1,000 ppb in a small area around the discharge site (Section 12.1.4.7.3), but these levels should decrease rapidly and reach negligible levels after 10 days. While deleterious impacts would generally be greatest during periods of increased plankton productivity, the planktonic organisms will be contaminated over a small area of low productivity for a relatively short period of time. Any impacts will affect a small proportion of the local populations and therefore the sensitivity of plankton is considered to be '**Low**'. A combination of short generation times, high reproductive rates and immigration from outside the affected area would likely see a quick recovery of the affected plankton communities. The severity of the effect of MGO spills on plankton is therefore considered to be '**Minor**'. Therefore, the significance of the impact is assessed as '**Low (4)**'.	**Unlikely**	**Very Low (4)**
Sediment and benthic communities	n/a	**n/a**	**n/a**
Fish and squid	Fish and squid could experience lethal effects if they come into contact with high concentrations of MGO; eggs and larvae are particularly vulnerable as they occupy the surface layers of the sea and are immobile (Section 12.1.4.2.3). In the offshore environment, MGO spills will be dispersed and evaporate rapidly and so fish may be more vulnerable to sub-lethal effects and accumulation of toxins (that can taint the flesh of fish) than direct mortality (Section 12.1.4.2.3). However, because no known spawning sites are in the immediate vicinity of the Development area, and adult fish are likely to move away, any impacts of an MGO spill will affect a small proportion of the local fish and squid populations. Therefore, the sensitivity of fish and squid is considered to be '**Low**'. The impacts of the spills modelled here are very localised and short-term in nature and the severity of the effect is assessed as '**Minor**'. Therefore, the significance of the impact is assessed as '**Low (4)**'.	**Unlikely**	**Very Low (4)**
Human population (fisheries)	Although some tainting of fish and squid is possible following the loss of the MODU MGO inventory, fisheries in the NFB are not located near to the Phase 1 & 2 Development area and the MGO is unlikely to extend to the fishing grounds before it has evaporated (Section 12.1.4.7.1). The sensitivity of fisheries is therefore considered to be '**Low**'.	**Unlikely**	**Low (6)**

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
	Given the rapid rate at which the discharged MGO will evaporate and biodegrade, and thus the limited extent and relatively short duration of a MGO spill associated with the loss of the MODU MGO inventory, the impacts on commercial fisheries are likely to be confined to a relatively small area. The severity of effect of the modelled spill on fisheries is considered to be '**Moderate**', as the effects are expected to be localised and of a short-term nature but could result in localised fisheries closures. The significance of the impact on human population (fisheries) is therefore assessed as '**Moderate (6)**'.		
Seabirds	The MODU will be on location for 44 months in total and seabird vulnerability varies on a monthly / seasonal basis (Section 12.1.4.2.4.3). Further, MGO has greater potential to cause fouling than the Sea Lion crude oil and has greater potential for impacts associated with toxicity (Section 12.1.4.2.4). Following a discharge, MGO rapidly spreads to form a sheen on the surface of the water and the potential impact is proportional to the extent to which seabirds overlap with and encounter the MGO; this is linked to the size of the spill. The presence of the MODU and other vessels associated with the project will attract some seabirds and therefore the density of birds in the immediate vicinity of the vessels, and any spill, will be far higher than the baseline density in surrounding waters (Section 12.1.4.2.4). Due to the potential for the presence of a large number of seabirds, many of which will be ACAP species and / or are of global conservation concern, the sensitivity of seabirds to the effects of a large MGO spill, is considered to be '**Very High**'. Nonetheless, the area affected by the spill is predicted to be relatively small (on the scale of the NFB) and given the relatively rapid rates of evaporation and dispersion, the slick will be short-lived. The severity of effect of a spill resulting from a large MGO spill is therefore considered to be '**Moderate**'. Therefore, the significance of the impact of a loss of MGO inventory from the largest vessel associated with the Development on seabirds is assessed as '**Upper Moderate (15)**'.	**Unlikely**	**Moderate (8)**
Marine mammals	Pinnipeds, and particularly fur seals, that come into contact with a MGO spill may suffer adverse consequences (Section 12.1.4.2.5). However, it is expected that a spill resulting from the loss of the MODU MGO inventory would impact a relatively small area for a short period of time. Cetaceans are more vulnerable to inhaling toxic vapour from MGO spills and are less affected by contact with the skin. They would therefore be most likely to be affected for a short period immediately following a spill before the MGO is dispersed from the release point. Due to seasonal fluctuations in abundance (Section 12.1.4.2.5), the timing of a spill will influence the likely presence, and potential exposure, of different receptor species to a spill of the MODU's MGO inventory. Nonetheless, given that all marine mammals are protected and considered conservation priority species by FIG, the sensitivity of marine mammals to discharged MGO during the Development is assessed as '**High**'.	**Unlikely**	**Low (6)**

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
	Like seabirds, the potential impacts are related, to some extent, to the size of the spill. MGO spills are predicted to be short-lived and localised. The severity of effect of a large MGO spill on marine mammals is therefore considered to be '**Minor**'. Therefore, the significance of the impact of a loss of the MODU MGO inventory on marine mammals is considered to be '**Moderate (8)**'.		
Coastal	No shoreline oiling was predicted in any of the stochastic simulations of the MODU MGO spill scenario.	**n/a**	**n/a**
Human population (tourism)	The modelling predicts that no MGO would reach the shore and given the rapid rate at which MGO will evaporate and disperse, and the distance offshore, it is highly unlikely that tourists would experience or see MGO at sea. However, observations and photos of oiled wildlife that come ashore will certainly influence the experience and perceptions of tourists. Additionally, media publicity may influence the experience and perceptions of tourists, which may then influence their propensity to visit. Given that there would be moderate capacity to absorb change in the aftermath of a large MGO spill, the sensitivity of tourism is considered to be '**Moderate**'. Due to the long lasting negative impacts of perceived environmental degradation, the severity of effect of an uncontrolled release on tourism is considered to be '**Serious**'. Therefore, the significance of the impact of a loss of the MODU MGO inventory on tourism is considered to be '**Upper Moderate (12)**'.	**Unlikely**	**Moderate (8)**

12.1.6.5 Scenario 5: MGO bunkering spill

12.1.6.5.1 Sensitivity of receptor and severity of effect (impact assessment)

The main difference between a MGO bunkering spill and a spill associated with the loss of the MODU's MGO inventory is the volume of MGO discharged: 3,936 tonnes (4,669 m^3) in the case of the MGO inventory loss scenario as opposed to 20 tonnes in a bunkering spill (Section 12.1.5). In both cases, the MGO is expected to evaporate and disperse rapidly. Especially in the case of the MGO bunkering spill, it is expected that the area and duration of impact will be small and short-lived.

The 'Sensitivity of Receptor' and the 'Severity of Effect' for each receptor are provided in Table 12.13. The 'Likelihood of Occurrence' of a MGO spill during bunkering is described below and is included in Table 12.13 to show how the overall significance ratings of risks associated with a MGO bunkering spill were derived.

12.1.6.5.2 Likelihood of occurrence

Section 12.1.6.6 discusses the likelihood of small spills (from all sources). Assuming the use of industry-standard mitigation measures (Section 12.1.5), the likelihood of small-scale MGO spills during fuel transfer has been assessed as '**Possible**' (Table 12.13).

12.1.6.5.3 Overall risk significance

As is shown in Table 12.13, the highest significance of the risk posed by the loss of MGO during bunkering is to Seabirds and is considered to be '**Moderate (9)**' and therefore, project-specific mitigation measures will be required.

Table 12.13: Risk assessment of MGO bunkering spill

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
Water quality and plankton	While any effects will be greater during periods of high plankton productivity, impacts of a MGO bunkering spill will affect a very small proportion of the local populations and therefore the sensitivity of plankton is assessed as '**Low**'. A combination of short generation times, high reproductive rates and immigration from outside the affected area would likely see a quick recovery in the affected communities. The severity of the effect on plankton is therefore considered to be '**Slight**'. Therefore, the significance of the impact associated with a MGO bunkering spill is assessed as '**Very Low (2)**'.	**Possible**	**Very Low (3)**
Sediment and benthic communities	n/a	**n/a**	**n/a**
Fish and squid	The sensitivity assessment is the same as for a MGO inventory spill from the MODU (Table 12.12), and the sensitivity of fish and squid in relation to a MGO bunkering spill is considered to be '**Low**'. Given the small volume of MGO involved the impact of the spills modelled here will be very localised and short-term in nature and so the severity of the effect is considered to be '**Slight**'. Therefore, the significance of the impact associated with a MGO bunkering spill is assessed as '**Very Low (2)**'.	**Possible**	**Very Low (3)**
Human population (fisheries)	The sensitivity assessment is the same as for a MGO spill from the MODU (Table 12.12), and the sensitivity of fisheries in relation to a MGO bunkering spill is considered to be '**Low**'. Given the small volume of MGO involved and the rapid rate at which MGO will evaporate and biodegrade, any impacts on commercially important fish are assessed to be highly localised and short-term in nature. The severity of the effect of a MGO bunkering spill is therefore considered to be '**Slight**'. The significance of the impact on human population (fisheries) is therefore assessed as '**Very Low (2)**'.	**Possible**	**Very Low (3)**
Seabirds	The sensitivity assessment is the same as for a MGO spill from the MODU (Table 12.12), and the sensitivity of seabirds in relation to a MGO bunkering spill is considered to be '**Very High'**. The impact of small MGO spills will be extremely localised and short-term and therefore the severity of the effect of a small transfer MGO spill (20 tonnes) on seabirds is considered to be '**Minor**'. Therefore, the significance of the impact of small MGO bunkering spills on seabirds is assessed as '**Moderate (10)**'.	**Possible**	**'Moderate (9)'**
Marine mammals	The sensitivity assessment is the same as for a MGO spill from the MODU (Table 12.12), and the sensitivity of marine mammals in relation to a MGO bunkering spill is considered to be '**High**'.	**Possible**	**Low (6)**

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
	Marine mammals could be attracted by potential prey species that may shelter near the rig. The severity of the effect of a small short-term release of MGO on marine mammals is therefore considered to be '**Slight**'. Consequently, the significance of the impact of a small MGO bunkering spill on marine mammals is assessed as '**Low (4)**'.		
Coastal	No shoreline oiling was predicted in any of the stochastic simulations of the MGO bunkering spill.	**n/a**	**n/a**
Human population (tourism)	Tourists are highly unlikely to observe, directly or indirectly, any evidence of a MGO bunkering spill of the volume considered here and the sensitivity of tourism is considered to be '**Low**'. Due to the short-term and reversible impacts of a small spill on the perception of tourists regarding environmental degradation, the severity of the effect of a MGO bunkering spill on Tourism considered to be '**Minor**'. Therefore, the significance of the impact of small MGO spills on tourism is assessed as '**Low (4)**'.	**Possible**	**Low (6)**

12.1.6.6 Small scale releases of oil

12.1.6.6.1 Sensitivity of receptor and severity of effect (impact assessment)

As described in Section 12.1.4.9, it is not possible to predict or quantify the volumes that may be released during small accidental spills. Small spills may create surface sheens which have the potential to cause environmental impacts, primarily upon seabirds (Section 12.1.4.2.4).

It is likely that several seabird species present in close proximity to the Development vessels will be classified as 'Vulnerable' or 'Endangered' by the IUCN (which equates to 'High' sensitivity). Some of the species of seabird that associate with vessels in Falkland Islands waters are also listed under ACAP. These are species that are considered to be under wider threat (largely from fisheries related mortality). Moreover, the use of artificial light (Section 10.1) and the discharge of macerated food waste (Section 10.10) may also attract additional species. Various studies have highlighted the risk and impacts to seabird populations associated with small-scale, but chronic, oil pollution from sources such as shipping. Therefore, overall, the sensitivity of the seabird receptors to chronic oil pollution from discharges is considered to be '**Very High**'.

There are no clear guidelines regarding the degree of impact from sheens of a given thickness and the impact may either be reversible or lethal to the individual depending on the amount of fouling (possibly species specific). A sheen of even 0.1 µm could cause an effect that may reduce fitness (Section 12.1.4.2.4.1). However, given the metocean conditions in the region, any sheen resulting from discharges is likely to be temporary. Therefore, the severity of the effect is considered to be '**Minor**'.

The overall significance of the impact on seabirds associated with chronic oil pollution from the Sea Lion activities is therefore considered to be '**Moderate (10)**'.

12.1.6.6.2 Likelihood of occurrence

Given industry figures for small spills, the need for breach of procedural controls to occur, the likelihood of a sheen forming and seabirds becoming oiled is considered to be '**Possible**'.

12.1.6.6.3 Overall risk significance

The overall significance of the risk of a chronic oiling of seabirds is considered to be '**Moderate (9)**'.

12.1.6.7 Loss of riser contents

12.1.6.7.1 Sensitivity of receptor and severity of effect (impact assessment)

It is anticipated that any loss of riser contents would release approximately 60 m^3 of NADF to sea, which would settle to cover an area of around 0.006 km^2 around the MODU. It is likely to impact benthos and sediments in the vicinity *via* both smothering and toxic effects. According to the surveys already carried out in the area (Section 7.2.2), there are no known vulnerable species recorded within the benthos and the community structure is widespread and typical of the area. However, a data gap exists because the Sea Lion Field environmental baseline survey did not sample the site-specific drilling locations. Therefore, although the sensitivity of the receptor is likely to be '**Very Low**', to take a precautionary approach it is assessed here as '**Low**'.

The area predicted to be impacted by a loss of riser contents would be in close proximity to the drill centre and reversible after a number of years. Therefore, the severity of the effect is considered to be '**Moderate**'.

The overall significance of the impact on the benthos and sediments due to the loss of riser contents is therefore considered to be '**Moderate (6)**'.

12.1.6.7.2 Likelihood of occurrence

Given the need for malfunction to occur, and the incidence of loss of riser contents being known within industry but infrequently, the likelihood of a loss of riser contents is considered to be '**Unlikely**'.

12.1.6.7.3 Overall risk significance

The overall significance of the risk associated with a loss of riser contents is considered to be '**Low (6)**'.

12.1.7 Project-specific mitigation measures

The remoteness, poor transport infrastructure and abundant wildlife in the Falklands pose unique and significant challenges in responding to a major oil pollution incident. Therefore, in addition to the industry-standard mitigation measures (Section 12.1.5) and those that are required by legislation, Navitas, and the former operator (POEPL), have spent considerable time and effort determining what additional oil spill response measures may be appropriate. All oil spill response strategies and equipment will be described in the Sea Lion OPEP (Section 12.1.1.1.3).

While Oil Spill Response (OSR) equipment will be carried on the ERRV / MRSV and AHTS / ERRV offshore, and it may be possible to deploy the containment and recovery equipment under the right conditions, in reality it is unlikely to be effective in the prevailing offshore weather conditions of the Sea Lion Field. The modelling shows that oil spill response can recover a certain amount of oil, and it is possible that this can reduce shoreline (and other) consequences. However, for very large releases, the effect is limited and oil spill response is not considered effective in respect of the largest events.

Therefore, in order to ensure a precautionary approach, these mitigations are not considered applicable to this offshore oil spill assessment. It is likely that oil will eventually be dispersed through natural wave and wind action, evaporate and biodegrade. However, it is currently unknown how long Sea Lion crude will remain in the environment beyond seven days, as indicated in Section 12.1.4.1.1.1.

12.1.8 Residual impacts and risks

In the worst-case scenario, weather conditions offshore will be such that effective recovery of oil spills will not be possible and therefore the residual significance of the risk remains the same as in the initial assessment which takes account of all the legal requirements and the industry-standard mitigations. For ease of reading, the initial (and also residual) worst-case risk outcomes are summarised again in Table 12.14.

Table 12.14: Initial and residual (same) worst-case risks for each oil release scenario

Scenario	Impact assessment	Likelihood	Overall residual risk significance
1: Subsea well blow-out	High for Seabirds and Human Population (Fisheries and Tourism)	Unlikely	**Moderate (10)**
2: FPSO inventory loss	High for Seabirds and Human Population (Fisheries and Tourism)	Very Unlikely	**Low (5)**
3: Crude transfer spill	Moderate for Seabirds and Human Population (Tourism)	Possible	**Moderate (9)**
4: MGO inventory loss	Upper Moderate for Seabirds and Human Population (Tourism)	Unlikely	**Moderate (8)**
5: MGO bunkering spill	Moderate for Seabirds	Possible	**Moderate (9)**
Small scale releases	Moderate for Seabirds	Possible	**Moderate (9)**
Loss of riser contents	Moderate for Benthos	Unlikely	**Low (6)**

12.1.9 Cumulative impact

Not applicable.

12.1.10 Confidence

The Sea Lion Field has now been evaluated by a number of test wells. The properties of Sea Lion crude and probable flow rates are relatively well defined. However, the very waxy nature of the crude means that the behaviour of the oil in the marine environment will be quite different to that of a lighter (fluid) crude. Testing of the Sea Lion crude (CEDRE, 2017), expanding on earlier studies of the properties of Sea Lion crude in the event of a spill, confirms our understanding of:

- Physical state in contact with seawater at ambient temperatures (8 °C),
- Evaporation after 3 - 7 days at sea,
- Dispersion (how the oil would break up at sea),
- Biodegradation of the oil after seven days at sea,
- Interaction of spilled oil with suspended solids at various concentrations,
- Adhesion of the oil to feathers,
- Emulsification of the oil,
- Dissolved fractions of the oil after seven days at sea,
- Ecotoxicity to four marine species,
- Adhesion to three types of seaweed, and
- Adhesion to various shoreline types.

The behaviour and nature of the impact of MGO is relatively well known from several decades of research and also from model validation studies.

With regard to the spill modelling, uncertainties have been identified (Table 12.15) and while their potential to materially alter the outcome of the modelling has been considered, it is acknowledged that improvements in the modelling design could increase accuracy of quantification of the impact. The confidence assessments for each scenario are described in Table 12.16.

The seasonal distribution of potential receptors in the NFB is reasonably well understood but further research is required to improve our knowledge of species distributions, and these are acknowledged as data gaps. The Gap Analysis Programme (GAP) conducted research to fill some of these knowledge gaps. Some receptors, especially seabirds (see Wiese, *et al.,* 2001), are known to congregate around vessels (including O&G installations) at-sea, which places artificially higher numbers of receptors in close proximity to sources of oil spills. Surveys are required to assess the influence of project vessels and activities on seabird abundance within the Sea Lion Field (Chapter 15).

Table 12.15: Oil spill uncertainties

Uncertainty	Description
Release volumes	Well blow-outs are extremely rare events that are often controlled within a matter of days using subsea intervention techniques or by the well 'bridging' over and restricting flow. The assumed total duration for the well blow-out in this EIS is 21 days, which is the time required to mobilise and install a capping device and is considered be the worst-case blow-out duration. The inventory loss scenarios that have been considered in this EIS are also extremely rare events. The crude inventory loss scenario was modelled as being the worst possible case of inventory loss whereby all tanks available on the FPSO for crude storage are discharged to sea, as well as two tanks from the offload tanker. In the extremely rare event of this type of spill, it is very unlikely that the complete inventory would be discharged as has been modelled here.
Oil characterisation and behaviour	The properties of the Sea Lion crude, based on the CEDRE testing (CEDRE, 2017), along with input from oil weathering experts, has been used in the modelling predictions and the risk assessment procedures. The OSCAR model is primarily designed to predict physical behaviour for Newtonian fluids which includes the majority of crude oils. As above, choices have been made within the hydrocarbon characterisation and weathering parameters to allow as close a match as possible between the model algorithms and the expected non-Newtonian behaviour of the wax. The outputs appear to be consistent with expectations based on examining intermediate model steps and the overall outputs.
Metocean conditions	The metocean dataset covers three years. This includes a wide range of weather conditions and the modelling results consistently show a tendency for dispersion to the north-west of the site. However, the currents do move in all directions at different times and deposition is locally variable due to the short nature of each release. During operations a real time offshore hydrodynamic model covering 3-day detailed current and wind forecasts will be run and available in the event of a spill.
Model predictions after the oil has been at sea for a long period of time	It is normal to run scenarios for the entire duration of a blow-out, and for some time following an inventory release, to determine the behaviour and location of oil before taking a view on whether this poses a risk to receptors. There is uncertainty around the fate of oil masses in the long term (several months), given its apparent buoyancy and stability in laboratory tests. Overall, the interpretation of results at long timescales should be done with caution and experience. In general, the model results may exaggerate the apparent impact of dispersed oil.
The performance of containment and recovery equipment	*In situ* performance is uncertain and could affect residual impacts post-response (positively or negatively) particularly for larger spills. This can be further investigated by pursuing industry trials and potentially designing site-specific trials.

Table 12.16: Confidence assessments

Scenario	Description	Confidence
1: Subsea well blow-out	There are many uncertainties and assumptions associated with the modelling of oil spills, both in terms of the properties of the oil and the environmental conditions (currents, wind and wave action) that influence its dispersion. The modelling component of the oil spill risk assessment has used the highest resolution metocean data sets available, as well as direct inputs from oil testing to replicate Sea Lion crude parameters, which provide the best possible basis for predicting oil	Due to the uncertainties associated with major accidental events, the confidence in the significance of the
2: FPSO inventory loss		

Scenario	Description	Confidence
3: Crude transfer spill	behaviour at sea. However, there is always an inherent uncertainty when predicting the fate and behaviour of oils using hindcast winds and currents derived from hydrodynamic models. The sensitivities of many of the environmental receptors to a spill vary due to seasonal changes in their distribution, and a spill could potentially happen at any time of the year. Wherever possible, worst-case scenarios have been used to ensure that the potential impacts are not under-estimated.	risk presented in this assessment is '**Uncertain**'.
4: MGO inventory loss	The modelling component of the oil spill risk assessment has used the highest resolution metocean data sets available, which provide the best possible basis for predicting oil behaviour at sea. However, there is always an inherent uncertainty when predicting the fate and behaviour of oils using hindcast winds and currents derived from hydrodynamic models. The volatile nature of MGO fuel means that spills will evaporate, disperse and biodegrade relatively rapidly, and the impact will be localised and short-lived. The exact nature and extent of the impacts will depend on the concentration of environmental receptors in the immediate vicinity of the MODU / FPSO at the time of a spill, which is not possible to predict with precision. The MODU / FPSO itself will influence the distribution of some seabirds and may also influence the distribution of some marine mammals and their prey.	The confidence in the impact assessment of MGO spills on the marine environment is '**Probable**'.
5: MGO bunkering spill		

12.1.10.1.1 Monitoring required

Seabird and Marine Mammal Observers (SMMOs) will be used on support vessels (most likely the FPSO's support vessels) and the possibility of a collaborative survey with Falkland Islands Fisheries Department (FIFD) will be investigated.

The development of a seabird distribution monitoring programme over several years aimed at improving understanding of species-specific distribution patterns will be established, potentially in collaboration with FIFD.

Once production has commenced, the modelled flow rates will be compared with actual flow rates. If the actual flow rates are higher than predicted, the modelling exercises will be re-run with the revised parameters.

The spill modelling and hydrodynamic data will be used to develop a means of forecasting spill trajectories pre-operation to enable rapid and targeted response in the event of a spill.

Detailed monitoring requirements will be confirmed. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the project-specific Phase 1 & 2 Environmental Monitoring and Management Plan (EMMP) (Chapter 15).

12.1.11 Offsetting

Neither of the scenarios considered are likely to occur during the duration of project. Offsetting is therefore not considered appropriate for this type of unplanned event. Should a serious event occur, it is expected that remediation will be part of the final stages of the spill response process and subject to discussion with the authorities and stakeholders.

12.1.12 Findings summary

Table 12.17: Summary of the risk assessment for all oil spill scenarios

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Subsea well blow-out	Scenario 1: Subsea release of oil	Impact to water quality and lethal and sub-lethal toxic effects on Plankton	Accidental	1, 2a, 2b & 3	Moderate	Moderate	Unlikely	**Low (6)**	**n/a**	**Uncertain**	**Industry-standard:** Use of standard operating procedures, Compliance with OMS and Drilling Management System, SECE Register and performance standards, Primary and secondary well control, Development and implementation of the OPEP, and Use of a well capping device. **Project-specific:** None proposed.
		Impact to sediment and lethal and sub-lethal toxic effects on Benthic communities	Accidental	1, 2a, 2b & 3	Very Low	Serious	Unlikely	**Low (6)**	**n/a**	**Uncertain**	
		Lethal and sub-lethal toxic effects on Fish and squid	Accidental	1, 2a, 2b & 3	Moderate	Moderate	Unlikely	**Low (6)**	**n/a**	**Uncertain**	
		Impact on fisheries from tainting of fish and contamination of fishing grounds	Accidental	1, 2a, 2b & 3	Very High	Serious	Unlikely	**Moderate (10)**	**Moderate (10)**	**Uncertain**	
		Plumage contamination and oil ingestion by Seabirds	Accidental	1, 2a, 2b & 3	Very High	Serious	Unlikely	**Moderate (10)**	**Moderate (10)**	**Uncertain**	
		Skin contamination and ingestion of toxins by marine mammals	Accidental	1, 2a, 2b & 3	High	Moderate	Unlikely	**Moderate (8)**	**Moderate (8)**	**Uncertain**	

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
		Impact on coastal ecology	Accidental	1, 2a, 2b & 3	High	Moderate	Unlikely	**Moderate (8)**	**Moderate (8)**	**Uncertain**	
		Negative publicity impacting tourist numbers	Accidental	1, 2a, 2b & 3	High	Serious	Unlikely	**Moderate (10)**	**Moderate (10)**	**Uncertain**	
Catastrophic loss of the FPSO	Scenario 2: Loss of the full FPSO crude oil inventory to surface	Impact to water quality and lethal and sub-lethal toxic effects on Plankton	Accidental	2a, 2b & 3	Moderate	Moderate	Very Unlikely	**Very Low (3)**	**n/a**	**Uncertain**	**Industry-standard:** SECE Register, OMS and performance standards, A 1,275 m radius exclusion zone, An ERRV vessel, AIS and Radar surveillance, Radio broadcasts, and Development and implementation of the OPEP. **Project-specific:** None proposed.
		Impact to sediment and lethal and sub-lethal toxic effects on Benthic communities	Accidental	2a, 2b & 3	Very Low	Serious	Very Unlikely	**Very Low (3)**	**n/a**	**Uncertain**	
		Lethal and sub-lethal toxic effects on Fish and squid	Accidental	2a, 2b & 3	Moderate	Moderate	Very Unlikely	**Very Low (3)**	**n/a**	**Uncertain**	
		Impact of fisheries from tainting of fish and contamination of fishing grounds	Accidental	2a, 2b & 3	Very High	Serious	Very Unlikely	**Low (5)**	**n/a**	**Uncertain**	
		Plumage contamination and oil ingestion by Seabirds	Accidental	2a, 2b & 3	Very High	Serious	Very Unlikely	**Low (5)**	**n/a**	**Uncertain**	

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
		Pelage / skin contamination and ingestion of toxins by marine mammals	Accidental	2a, 2b & 3	High	Moderate	Very Unlikely	**Low (4)**	**n/a**	**Uncertain**	
		Impact on coastal ecology	Accidental	2a, 2b & 3	High	Moderate	Very Unlikely	**Low (4)**	**n/a**	**Uncertain**	
		Negative publicity impacting tourist numbers	Accidental	2a, 2b & 3	High	Serious	Very Unlikely	**Low (5)**	**n/a**	**Uncertain**	
Spill during offshore transfer of crude from the FPSO to the CTT	Scenario 3: Crude oil transfer spill to surface	Impact to water quality and lethal and sub-lethal toxic effects on Plankton	Unplanned	2a, 2b & 3	Low	Slight	Possible	**Very Low (3)**	**n/a**	**Uncertain**	**Industry-standard:** SECE Register, OMS and performance standards, Pipelines will be protected by pressure alarms, A leak detection system will be fitted, Dry break couplings, Development and implementation of the OPEP.
		Impact to sediment and lethal and sub-lethal toxic effects on Benthic communities	Unplanned	2a, 2b & 3	n/a	n/a	n/a	**n/a**	**n/a**	**n/a**	
		Lethal and sub-lethal toxic effects on Fish and squid	Unplanned	2a, 2b & 3	Low	Slight	Possible	**Very Low (3)**	**n/a**	**Uncertain**	

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
		Impact on fisheries from tainting of fish and contamination of fishing grounds	Unplanned	2a, 2b & 3	Low	Minor	Possible	**Low (6)**	**n/a**	**Uncertain**	**Project-specific:** None proposed.
		Plumage contamination and oil ingestion by Seabirds	Unplanned	2a, 2b & 3	Very High	Minor	Possible	**Moderate (9)**	**Moderate (9)**	**Uncertain**	
		Pelage / skin contamination and ingestion of toxins by marine mammals	Unplanned	2a, 2b & 3	Moderate	Slight	Possible	**Very Low (3)**	**n/a**	**Uncertain**	
		Negative publicity impacting tourist numbers (human population Tourism)	Unplanned	2a, 2b & 3	Moderate	Minor	Possible	**Moderate (9)**	**n/a**	**Uncertain**	
Catastrophic event leading to the loss of the MODU or FPSO	Scenario 4: Loss of MODU / FPSO full MGO inventory	Impact to water quality and lethal and sub-lethal toxic effects on Plankton	Accidental	1, 2a, 2b & 3	Low	Minor	Unlikely	**Very Low (4)**	**n/a**	**Probable**	**Industry-standard:** SECE Register, OMS and performance standards, Use of exclusion zones, An ERRV vessel, AIS and Radar surveillance, Radio broadcasts, and
		Impact to sediment and lethal and sub-lethal toxic effects on Benthic communities	Unplanned	2a, 2b & 3	n/a	n/a	n/a	**n/a**	**n/a**	**n/a**	

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
		Lethal and sub-lethal toxic effects on Fish and squid	Accidental	1, 2a, 2b & 3	Low	Minor	Unlikely	**Very Low (4)**	**n/a**	**Probable**	Development and implementation of the OPEP. **Project-specific:** None proposed.
		Impact on fisheries from tainting of fish and contamination of fishing grounds	Accidental	1, 2a, 2b & 3	Low	Moderate	Unlikely	**Low (6)**	**n/a**	**Probable**	
		Plumage contamination and oil ingestion by Seabirds	Accidental	1, 2a, 2b & 3	Very High	Moderate	Unlikely	**Moderate (8)**	**Moderate (8)**	**Probable**	
		Pelage / skin contamination and ingestion of toxins by marine mammals	Accidental	1, 2a, 2b & 3	High	Minor	Unlikely	**Low (6)**	**n/a**	**Probable**	
		Negative publicity impacting tourist numbers (human population Tourism)	Accidental	1, 2a, 2b & 3	Moderate	Serious	Unlikely	**Moderate (8)**	**Moderate (8)**	**Probable**	
Spill during offshore transfer of MGO fuel	Scenario 5: MGO bunkering spill	Impact to water quality and lethal and sub-lethal toxic effects on Plankton	Unplanned	1, 2a, 2b & 3	Low	Slight	Possible	**Very Low (3)**	**n/a**	**Probable**	**Industry-standard:** SECE Register, OMS and performance standards.

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
		Impact to sediment and lethal and sub-lethal toxic effects on Benthic communities	Unplanned	2a, 2b & 3	n/a	n/a	n/a	**n/a**	**n/a**	**n/a**	Pipelines will be protected by pressure alarms, A leak detection system will be fitted, Dry break couplings, and Development and implementation of the OPEP. **Project-specific:** None proposed.
		Lethal and sub-lethal toxic effects on Fish and squid	Unplanned	1, 2a, 2b & 3	Low	Slight	Possible	**Very Low (3)**	**n/a**	**Probable**	
		Impact on fisheries from tainting of fish and contamination of fishing grounds	Unplanned	1, 2a, 2b & 3	Low	Slight	Possible	**Very Low (3)**	**n/a**	**Probable**	
		Plumage contamination and oil ingestion by Seabirds	Unplanned	1, 2a, 2b & 3	Very High	Minor	Possible	**Moderate (9)**	**Moderate (9)**	**Probable**	
		Pelage / skin contamination and ingestion of toxins by marine mammals	Unplanned	1, 2a, 2b & 3	High	Slight	Possible	**Low (6)**	**n/a**	**Probable**	
		Negative publicity impacting tourist numbers (human population Tourism)	Unplanned	1, 2a, 2b & 3	Low	Minor	Possible	**Low (6)**	**n/a**	**Probable**	

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Small scale releases	Development of a sheen on the water	Oiling of seabirds	Unplanned	1, 2a, 2b & 3	Very High	Minor	Possible	**Moderate (9)**	**Moderate (9)**	**Probable**	**Industry-standard:** SECE Register, OMS and performance standards, Maintenance Management System (MMS), Use of spill kits for spills to deck, Development and implementation of the OPEP, Bunding of all liquid containing equipment and chemicals, Open deck drains to catch and collect spills to a dedicated slop tank, and High level tank filling alarm and emergency shutdown of the process. **Project-specific:** None proposed.

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Riser dis-connection	Loss of riser contents to sea	Smothering and toxic effects on benthos and seabed	Unplanned	1, 2a & 2b	Low	Moderate	Unlikely	**Low (6)**	**n/a**	**Probable**	**Industry-standard:** Compliance with Navitas OMS and Drilling Management System **Project-specific:** None proposed.

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

12.2 Inshore fuel oil spill

Table of Contents

12.2.1 Introduction 1236
12.2.1.1 Relevant legislation 1236
12.2.1.1.1 Inshore Oil Spill Strategy 1236
12.2.2 Sources of potential inshore oil spills 1236
12.2.2.1 Accidental event categories 1237
12.2.2.1.1 Fuel bunkering operations 1237
12.2.2.1.2 Vessel collision 1237
12.2.2.2 MGO spill scenarios 1237
12.2.2.2.1 Scenario 1: 10 tonne (12m^3) MGO Bunkering Spill 1238
12.2.2.2.2 Scenario 2: 1,200 tonnes (1,400m^3) release of MGO from LTV 1238
12.2.3 Potential receptors 1238
12.2.4 Characterising and quantifying the risk and impacts of inshore MGO spills 1238
12.2.4.1 Influencing Factors 1239
12.2.4.1.1 Inshore vessel MGO characteristics 1239
12.2.4.1.2 Fuel oil interactions with kelp forests 1239
12.2.4.1.2.1 Kelp as a bioremediation 1240
12.2.4.1.2.2 Kelp as a barrier to oil spread and clean-up 1240
12.2.4.2 The nature of the impact on each of the different receptors 1240
12.2.4.2.1 Marine Flora (Kelp) 1240
12.2.4.2.2 Berkeley Sound benthic communities 1241
12.2.4.2.3 Inshore fisheries receptors 1242
12.2.4.2.4 Intertidal habitats 1242
12.2.4.2.5 Shoreline plants and invertebrates 1244
12.2.4.3 Oil spill modelling methodology 1245
12.2.4.3.1 The OSCAR model 1245
12.2.4.3.2 Release parameters and assumptions 1245
12.2.4.3.3 Understanding the model 1245
12.2.4.4 Modelling results 1246
12.2.4.4.1 Modelling results - Scenario 1: 10 tonne MGO bunkering spill 1246
12.2.4.4.2 Modelling results - Scenario 2: 1,200 tonnes of MGO 1246
12.2.4.5 Oil fate predictions 1250
12.2.5 Industry-standard mitigation 1250
12.2.5.1 Selection of OSR resources (MGO) 1251
12.2.6 Risk assessment 1251
12.2.6.1 Scenario 1: 10 tonne MGO bunkering incident spill 1251
12.2.6.1.1 Likelihood of occurrence 1252
12.2.6.1.2 Overall significance of the risk 1252
12.2.6.2 Scenario 2: 1,200 tonnes of MGO due to vessel collision with LTV 1257
12.2.6.2.1 Likelihood of occurrence 1257
12.2.6.2.2 Overall significance of the risk 1257
12.2.7 Project-specific mitigation measures 1261
12.2.8 Residual impacts and risks 1261

12.2.9 Cumulative impact....1262
12.2.10 Confidence....1262
12.2.10.1 Monitoring required....1262
12.2.11 Offsetting....1262
12.2.12 Findings summary....1263

12.2.1 Introduction

The project activities within Berkeley Sound are limited to the relatively short periods of time when the Sound will be utilised as a sheltered operational area for Large Transport Vessels (LTVs) supporting the offshore installation activities. The main activities during this time will be transit to the location and laying anchor, followed by the transfer (i.e., heavy lift) of subsea structures and materials to installation vessels which will relay them to the Sea Lion location.

As a result, the only credible oil spill scenarios are associated with fuel oil releases.

Note: oil spill waste and the procedure for dealing with oil spill clean-up waste is described in Section 10.10.2.2.3.

12.2.1.1 Relevant legislation

The legislation relevant to inshore oil spills is as described in the offshore oil spill chapter (Section 12.2.1.1), with details provided on the requirements of the project-specific OPEP, the Falklands NOSCP and the PON 8.

12.2.1.1.1 Inshore Oil Spill Strategy

An Inshore Oil Spill Strategy for the Sea Lion Development was developed by the previous operator (Premier, 2017d), which identified the essential components of spill response for the project. Navitas has prepared a preliminary Oil Spill Emergency Plan (OPEP) that will be submitted as a standalone document. The OPEP outlines the organisational responsibilities, actions, reporting requirements and resources available to ensure the effective and timely management of an accidental fuel oil spill and will be compatible with the Falkland Islands' NOSCP. Additional information regarding the NOSCP can be found in Section 12.1.1.1.1. The preliminary OPEP will be updated so that it contains specific operational information such as contact details and detailed action lists for personnel prior to the commencement of operations.

12.2.2 Sources of potential inshore oil spills

During the subsea installation stage of the Sea Lion Development Phase 1 & 2, Berkeley Sound will be utilised as a sheltered operational area for anchored LTVs supporting the offshore installation activities for the storage and transfer (i.e., heavy lift) of subsea structures and materials to installation vessels. Ship to ship diesel bunkering of the installation vessels and LTVs will also be undertaken within Berkeley Sound.

When considering the inshore activities and the sources of spills, it is necessary to consider both:

- Accidental event categories, and
- Differing fuel oil spill scenarios, e.g.:
  - Ship-to-Ship (STS) fuel oil bunkering activities, and
  - Vessel incidents (e.g., collisions, or drift grounding incidents).

A worst-case assumption for LTV fuel inventory was used as the input to inshore oil spill modelling. Table 12.18 gives examples of vessel fuel inventories.

Table 12.18: Potential maximum hydrocarbon inventories

Source	Example Vessel	Inventory	Volume / Type
Large Transport Vessels (LTVs)	Jumbo Jubilee	Marine Gas Oil (MGO)[1]	1, 400 m^3
Offshore Construction Vessels (OCVs)	Severn Arctic	MGO[2]	3,700 m^3
Platform Supply Vessel (PSVs)	Pacific Leader	MGO	820 m^3
Third-party vessels	Jigger	Diesel tanks	600 m^3
	Fuel bunker	Marine Diesel Oil (MDO) / MGO [2]	1,000 m^3
Workboat	n/a	Diesel Tanks	1 m^3

[1] While the LTV may be equipped to carry Intermediate Fuel Oil (IFO) as well as Marine Gas Oil (MGO) (as in this example), Navitas will only store and use MGO fuel on project vessels.
[2] MGO, marine diesel and diesel are available in a number of different forms with similar properties and all represent a light, dispersible and evaporative fuel.

12.2.2.1 Accidental event categories

In this assessment, accidents are defined as unplanned events with the potential to cause a release of MGO.

Spills from the anchored LTVs can result from a number of accidental events, including:

- Fuel bunkering operations, and
- Vessel collision.

12.2.2.1.1 Fuel bunkering operations

While all industry-standard safeguards will be in place (Section 12.2.5), there is the potential for spills of diesel to occur during bunkering operations. Such spills would most likely be small as the bunkering process would cease as soon as any leak or spill was detected.

12.2.2.1.2 Vessel collision

Vessel collisions can occur, for example, between the LTV and installation vessel, or with a third-party vessel (e.g., a jigger). The collision risk is considered to be the same for each type of vessel interaction.

12.2.2.2 MGO spill scenarios

The credible inshore MGO spill scenarios are associated with fuel oil releases from:

- Ship-to-Ship (STS) fuel oil bunkering activities, or
- Vessel incidents (e.g., collisions, or drift grounding incidents).

For vessels going about normal marine activities (including project vessels), spill planning and response are typically matters of Merchant Shipping regulation, and spill planning and response for this situation is addressed in detail in the NOSCP (FIG, 2022b). In choosing the scenarios below for the EIS, consideration was given to situations where spill risk is significantly different to normal harbour operations as a result of the project activities. Inshore, the mooring of LTVs in Berkeley Sound for months at a time presents an unusual risk, and two spill scenarios have been identified to help assess the additional risks presented. The use of other project vessels intermittently tending to the LTVs in Berkeley Sound Harbour or using Stanley Harbour is not significantly different to the normal daily

business of those facilities which are operated for vessel traffic under the Harbour Master[ibid] and which are within the scope of the NOSCP.

The two identified fuel spill scenarios, discussed further below, potentially resulting from Navitas' planned operational activities in Berkeley Sound, include:

- Scenario 1: Loss of fuel during a bunkering incident, and
- Scenario 2: Total inventory loss from an LTV as the result of a collision incident.

12.2.2.2.1 Scenario 1: 10 tonne (12m^3) MGO Bunkering Spill

A review of historic oil spill incidents suggests that the accidental release of MGO during a bunkering operation is the most likely incident to occur as a result of Navitas' planned operations within Berkeley Sound (though still a very unlikely scenario).

A worst-case release of 10 tonnes was selected to determine the consequences of a bunkering incident.

12.2.2.2.2 Scenario 2: 1,200 tonnes (1,400m^3) release of MGO from LTV due to vessel collision

This scenario was identified as the potential worst-case in terms of the volume of hydrocarbon loss into Berkeley Sound. The only credible event that could cause such a release is from a collision with another vessel (e.g., during a period of low visibility). To illustrate the outer envelope, in terms of spill response the modelling assumes that the inventory is lost over a three hour period.

12.2.3 Potential receptors

The ENVironmental Impact IDentification (ENVIID) workshop was used to identify those receptors for which the risks of inshore MGO spills warranted further investigation (Chapter 9). These include:

- Water quality and plankton (Section 7.4.1),
- Marine flora (Section 7.4.2),
- Sediment quality and Berkeley Sound benthic communities (Section 7.4.3.3),
- Fish and squid in Berkeley Sound (Section 7.4.4.3),
- Birds in Berkeley Sound (Section 7.4.5.3),
- Marine mammals in Berkeley Sound (Section 7.4.6.3),
- Coastal communities (Section 7.6),
- Fisheries (Human population) (Section 7.7.3.2.1), and
- Tourism (Human population) (Section 7.7.4.6.1).

These receptors may be impacted upon as they either exist in, or spend time in, the area influenced by fuel oil that might be accidentally released into the marine environment.

12.2.4 Characterising and quantifying the risk and potential impacts of inshore MGO spills

When characterising and quantifying the impacts of MGO spills, it is necessary to consider the following:

- Influencing factors:
  - Summary of MGO properties and its anticipated behaviour at the shoreline, and
  - Interactions with the kelp forests.
- The nature of the impact on each of the receptors,
- The frequency of occurrence of accidents and spills,

- Oil spill modelling methodology:
  - The OSCAR model,
  - The modelling approach inshore,
  - Release parameters,
  - Thresholds of significance, and
  - Understanding the model.
- Spill modelling results for:
  - Scenario 1: 10 tonne MGO bunkering incident, and
  - Scenario 2: 1,200 tonnes of MGO due to LTV collision with non-project vessels.
- Oil fate predictions.

12.2.4.1 Influencing Factors

Over and above the details provided in the offshore oil spill chapter (Section 12.2.4.1), additional factors that may influence the behaviour of MGO spills in *inshore* waters include:

- Inshore vessel MGO properties, and
- The potential for interactions with kelp forests.

12.2.4.1.1 Inshore vessel MGO characteristics

The physical characteristics of MGO are given in Table 12.19. MGO contains relatively light hydrocarbon compounds with a high fraction of aromatics and will readily spread in the marine environment where it will change under the processes of dissolution, evaporation and dispersion (Section 12.1.4.1.1.2). MGO spreads very quickly to a thin film of rainbow and silver sheens and although it disperses quickly, MGO will:

- Adhere to surfaces, fur and feathers,
- Penetrate substrates relatively easily,
- Release an iridescent / silvery sheen on the surface of the water, and
- Will continue to flow readily even at very low temperatures.

Table 12.19: Summary of Typical Fuel Physical and Environmental Properties

Oil type	API (°)	Specific Gravity	Viscosity (cP)	Pour point
MGO (typical)	36.4	0.843-0.86	3.9 cP at 13 ºC	-36 °C
Response	**Surface oil risks**	**Adhesion risk**	**Sediment risks**	**Water column risks**
Limited containment and recovery possible, dispersant ineffective	Significant, short-term sheen	Short-term	More extensive contamination inc. aromatics	Short-term, high

12.2.4.1.2 Fuel oil interactions with kelp forests

It is important to consider the potential for inshore fuel oil spills to interact with kelp for a number of reasons:

- Kelp can promote bio-remediation of certain pollutants, and
- Kelp can impede the spread, and the recovery, of oil.

12.2.4.1.2.1 Kelp as a bioremediation

There is evidence from laboratory studies that kelp may play an important role in the removal of PAHs from the coastal marine environment. Wang and Zhao (2007) found that the brown seaweed *Laminaria japonica* was able to take-up and metabolise two PAHs (phenanthrene and pyrene). This biodegradation appears to be a rapid process and concentration dependent.

At a PAH concentration level of 0.1 mg/l, *Laminaria japonica* tolerated the contamination and survived well with >90 % phenanthrene and pyrene removed, and subsequently degraded, over a two week period. The metabolism of phenanthrene and pyrene in seaweed tissues was carried out mainly by the enzyme-oxidation process converting PAHs to less or non-toxic forms of these compounds. The authors of this study suggest therefore, that, at lower contamination levels, the seaweed could play a role in removing PAHs and possibly other organic pollutants from seawater, thus serving as an 'environmentally-friendly' bioremediation system.

12.2.4.1.2.2 Kelp as a barrier to oil spread and clean-up

Kelp has the potential to impede the spread and the clean-up of fuel oil spills by slowing the progress of fuel oil towards the shoreline, trapping it close to the shoreline, impeding vessels, and dampening swell, thus reducing the break-down and dispersal of oil along the shore through reduced wave-action.

The retention of oil by kelp soon after it is spilled may lead to higher impacts on marine organisms in the immediate vicinity, due to the release of the water-soluble fractions.

12.2.4.2 The nature of the impact on each of the different receptors

The nature of the impact of hydrocarbons (both crude and fuel oils) on the majority of the receptors, which may be affected by an oil spill has already been described in the offshore oil spill chapter (Section 12.1).

However, the potential for inshore fuel oil spills necessitates the additional consideration of:

- Marine flora (kelp),
- Berkeley Sound benthic communities,
- Inshore fisheries,
- Intertidal habitats, and
- Shoreline plants and invertebrates.

12.2.4.2.1 Marine Flora (Kelp)

Notwithstanding the fact that kelp can be a source of bioremediation with regard to the metabolisation of PAH's (Section 12.2.4.1.2.1 above), it should be noted that at higher concentration levels (e.g., >0.2 mg/l), the toxic nature of PAHs to the seaweed was significant, and resulted in serious damage and destruction to the kelp tissue (Wang and Zhao, 2007).

Nonetheless, 'real-life' oil spill incidents of fuel oil spills have not highlighted seaweeds as being particularly sensitive environmental receptors. Worldwide examples of the impact of fuel oils on kelp and other seaweeds are summarised in Table 12.20.

The confidence in the risk assessment for kelp (Section 12.2.6) will be considered 'uncertain' (Section 8.10, Section 12.1.10) as while tests on the impact of sea lion crude were carried out on North Sea analogues, no testing was carried out on Falkland Islands kelp species specifically.

It is recognised that MGO spills will impact upon other marine flora species (e.g., *Ulva pertusa*, Liu, *et al*., 2019), however, Navitas did not assess such other groups as very little is known about the taxonomy and therefore abundance and distribution.

Table 12.20: Case studies on the impact of oil spills on kelp communities

Historical spill	Nature of the impact
World Prodigy Oil Spill 1989 (Peckol, *et al.,* 1990) 922 tonnes of No.2 fuel oil (MGO)	Contamination of subtidal kelps *Laminaria saccharina* and *Laminaria digitata* occurred following this spill. Pre-spill measurements of condition, growth rates and pigment acclimation were compared with post-spill measurements, and there was no evidence that kelps were detrimentally affected by the oiling. Kelp densities were normal and no necrotic or bleached tissue was observed on any kelp in an oiled cove. Background growth rates and other parameters showed wide variation in the absence of oil. Lowest growth rates coincided with an unrelated algal bloom, which also caused high mortality of bivalves. It was concluded that the bay where the spill occurred was spared disaster because little fuel oil mixed into the water column.
Tamano oil spill, Maine, 1975 (USEPA, 1975) 182 tonnes Heavy Fuel Oil (HFO)	Following the spill, 46 miles of varied coastline was contaminated and subsequently cleaned. Of the two seaweed species investigated, *Fucus* sp. accumulated the oil to a much greater extent than *Ascophyllum* sp. Possible reasons put forward were the relative surface area, the lipophylic nature of the mucopolysaccharide substances on the fucoids and simply the degree of exposure related to the location of the seaweed. Oiled seaweed was harvested and was found to be an effective way of removing oil from the intertidal area. When re-surveyed some months following the spill, contaminated *Fucus* was found to have shed much of the oil that had become attached during the oiling incident. Fucoid algae and barnacles were lost from the shoreline and snails, whelks and limpets suffered narcosis.
Evidence from other spills	In Norway, *Laminaria digitata* grown in large concrete basins was continuously exposed to diesel oil for two years. With diesel oil at 130 µg/l, lengthwise growth was reduced by about 50 %. At the lower concentration of 30 µg/l there was no overall inhibition of growth. After two years of continuous exposure, the plants completely recovered during a subsequent oil-free growing season.

12.2.4.2.2 Berkeley Sound benthic communities

Benthic communities consist largely of sessile organisms that are unable to physically move away from areas contaminated by oil or other pollutants and may be affected by MGO releases in inshore waters. Invertebrates such as arthropods and molluscs are known to bioaccumulate hydrocarbons in their tissues (Section 12.1.4.2.3.2). Most of the literature detailing the impacts of hydrocarbon spills on inshore benthic communities refer to inshore crude spills (Glemarec and Hussenot, 1982; Dauvin and Gentil, 1990; Law and Moffat, 1993; Glegg and Rowland, 1996) (Section 12.2.4.2.2). However, the following case-studies illustrate the potential impacts on benthic communities of fuel oils and other pollutants:

- Stark *et al.* (2003) found that experimental contamination of marine sediments with hydrocarbons (diesel and lubrication oils) in Antarctic waters led to changes in recruitment and thus assemblage structure within benthic communities and that hydrocarbon contamination resulted in more severe effects than contamination with metals. This emphasises the potential for ecological switching (changes in community structure) following events that cause significant environmental impact.
- University of California (1971) describes the decimation of a small rocky cove by a 59,000 barrel spill of 'dark diesel oil'. Almost the entire flora and fauna succumbed to the spill, but the elimination of grazers allowed the profusion of giant kelp.

With MGO spills in inshore waters, there is a greater potential for oil to reach the sediments. On a 'balance of evidence' approach, a threshold concentration of 10 mg/kg in sediments for Total Petroleum Hydrocarbons (TPH) is considered a reasonable level below which concentrations would not be considered environmentally significant. For context, North Sea TPH sediment concentrations

have been reported as 10-120 mg/kg (Cefas, 2001) with the PAH component of the TPH concentrations ranging from 0.2 - 2.7 mg/kg.

12.2.4.2.3 Inshore fisheries receptors

The Falkland Islands are important for several commercially harvested fish species including Patagonian toothfish (*Dissostichus eleginoides*) and squid, comprising both Argentine short-finned squid (*Illex argentinus*) and loligo (*Doryteuthis gahi*) (Section 7.7.3.1.1). Loligo is the target species of the largest domestic fishery in the Falklands. Although fishing is not permitted within three nautical miles of the coast, the stock migrate into inshore waters. Loligo have a short lifespan (growing rapidly for one year before breeding and dying) and normally survive in only two cohorts, potentially making populations more vulnerable to short-term impacts e.g., during spawning. For many years their spawning grounds were thought to be associated with kelp beds. However, it is now recognised that there does not appear to be sufficient habitat to support the observed populations. Therefore, it is likely that squid also spawn in other habitat types but the location of their principle spawning grounds currently remain unknown. Squid and other molluscs are known to bioaccumulate hydrocarbons (such as PAH) in their tissues, which has potential human health implications. Section 12.1.4.2.3.2 provides further details regarding the impact of oil on squid.

Although the oil was crude oil rather than MGO, the oil spilled by the Braer in 1993 (Gulfaks) was a heavily biodegraded oil with high PAH levels and this resulted in elevated levels of PAH in both wild fish and farmed fish. However, this spill was considerably larger (84,000 tonnes) than the credible scenarios described here. In the Braer example, concentrations of PAH in wild fish fell rapidly from a maximum of 2,650 mg/kg wet weight to reference concentrations of less than 40 mg/kg over several months, by which time there was also an absence of tainting.

12.2.4.2.4 Intertidal habitats

This section is informed by a review of the impacts of oil spills on shorelines by IPIECA (1995).

The fate of oil that reaches the shoreline is not only determined by the properties of the oil but also the topography of the shore and exposure of the oil to wave and tidal energy. For example, stranded oil that is exposed to heavy wave action is unlikely to remain on the shore for long. However, where oil strands on sheltered coasts with limited water movement it could persist for several years. Penetration of oil in sediments depends on a number of factors such as porosity (sediment type and grain size), the depth of the water table, the viscosity of the oil and the presence of burrowing animals. Once contaminated, oil in the subsurface layer can be persistent.

The characteristics of the shoreline around the Falkland Islands, and the behaviour of oil were used to generate an Environmental Sensitivity Index (ESI) that classifies shores according to the likely persistence of oil. The ESI for Berkeley Sound is presented in Section 7.6.3. (Table 12.21) and summarises the general features of shorelines in relation to the potential impact from oil spills. The greater the ESI number, the greater the potential for oil persistence.

During the 2018 coastal bird surveys carried out in Berkeley Sound, observations of typical Falkland Islands shoreline types were recorded and given a classification index for the purposes of oil spill planning that parallels the IPIECA (2011) system of Environmental Sensitivity Indexing. The ESI data is used in the oil spill modelling and improves understanding of the mitigation measures for oil spill response and will inform the more detailed Oil Pollution Emergency Plan (OPEP) that will follow approval of the project. An example of shoreline type 1A, the most common type in outer Berkeley Sound, is shown in Figure 12-44.

Table 12.21: General features of shorelines that influence their potential susceptibility to oil spill impacts, as classified on the ESI scale

ESI	Shoreline description
1	Exposed rocky shores, steeply sloping. Oil is typically held offshore by reflecting waves. Any oil deposited is rapidly removed by wave action. Impacts on intertidal communities are typically short-term, unless acute exposure of a fresh light oil product causes high mortality.
2	Exposed wave-cut platforms in bedrock. Shelf or platform of variable width and gentle slope. Often backed by steep scarp, sometimes with sediment at base. Pools and crevices are common, possibly with some loose gravel. Oil will not adhere to the platform, but may accumulate among gravel at the high tide line. Persistence is usually short-term.
3	Fine- to medium-grained sand beaches. Flat to moderately sloping and hard packed. Wrack may accumulate along the strandline. Oil may cover large areas but will lift off the lower beach and become concentrated along the upper intertidal zone. Oil may penetrate sand or become buried and there may be a decline in sediment fauna. These beaches are among the easiest to clean.
4	Course-grained sand beaches. Moderate slope of soft sediment. Sediment fauna is limited. Sediment is too soft for vehicles. Oil may cover large areas, but will lift off the lower beach and become concentrated along the upper intertidal zone. Oil may penetrate sand or become buried to depths greater than 1 m and there may be a decline in sediment fauna.
5	Mixed sand and gravel beaches. There may be zones of mobile sand, pebbles or cobbles, and distribution may change. Fauna and flora is generally limited, except on the more stable substrata. Oil may cover the whole beach, but will lift off the lower beach and become concentrated along the upper intertidal zone. Oil may penetrate sediment or become buried. Asphalt pavement may form in sheltered locations.
6	Gravel beaches, ranging from pebbles to boulders. Can be steep with wave-built berms. Fauna and flora is generally limited except on the more stable sub-strata on the lower beach. Stranded oil is likely to penetrate deeply, can be pushed over the high tide line and can be very persistent. Asphalt pavement may form in sheltered locations. Potential for chronic oiling.
7	Exposed tidal flats. Broad, flat areas of sand with some mixed shell or mud. Usually in tidal inlets. Water-saturated except on higher ridges. Can have dense sediment life and be important for wetland birds. Oil does not adhere to wet sediment, but accumulates at the high tide line and may penetrate at the tops of ridges. There may be a severe decline in sediment fauna.
8	Sheltered rocky shores. Variable permeability depending on substrata. Can have high densities of attached fauna and flora. Oil will adhere to rough surfaces along the high tide line, but not on wet lower shore surfaces. Oil will penetrate loosely packed angular rubble with potential for long-term persistence.
9	Sheltered tidal flats. Soft mud, with some sand and shell. Frequently backed by marshes. Can have dense sediment life and be important for wetland birds. Oil does not adhere to wet sediment, but accumulates at the high tide line and may penetrate burrows. Potential for deposition of contaminated sediments. There may be a severe decline in sediment fauna.

ESI	Shoreline description
10	Saltwater and brackish-water marshes. Temperate and subtropical wetlands dominated by marsh plants. Sediments are organic-rich muds, except on the edge of tidal channels where they may be sandy. Abundant flora and fauna. Oil adheres to emergent vegetation. Heavy oil coating restricted to outer fringe of marsh, but lighter oils may penetrate more deeply. Medium and heavy oils do not penetrate wet sediments, but can pool in depressions. Light oils can penetrate the upper few centimetres. There may be a severe decline in flora and fauna.



Figure 12-44: Proposed local shoreline classification 1A, reference location as the north coast of Kidney Island

12.2.4.2.5 Shoreline plants and invertebrates

All intertidal species can potentially be affected directly or indirectly by oil contamination, but some are more susceptible and vulnerable than others. Organisms can interact with shoreline oiling in a number of ways. Direct physical oiling can smother plants and animals, which may interfere with filter feeding appendages. Prolonged exposure to oil may result in direct toxicity. However, tolerance to the toxic effects of oil varies considerably between organisms. For example, filter feeding bivalves can accumulate hydrocarbons in their tissues, which may take weeks or months to purge (e.g., USEPA, 1981). Although bivalves are able to tolerate high concentrations of hydrocarbons, there may be sub-lethal effects, such as reduced growth and reproductive capacity.

Limpets and other marine snails graze on algae and are regarded as one of the most sensitive groups of intertidal invertebrates to the acute toxic effects of oil (e.g., IPIECA, 1995). A small amount of fresh oil on a limpet's foot has a narcotic effect leading to the limpet falling from the rock, where it is then unlikely to survive. Impacts on the populations of these taxa, and the consequent effects on the

abundance of the plants and algae they feed on, have been described following many oil spill incidents. For these reasons, limpets are widely used as the focus of rocky shore monitoring programmes near oil facilities (e.g., SOTEAG).

Oil and diesel spills are known to modify macrobenthic assemblages at the intertidal zone (Zhou, *et. al*., 2019).

12.2.4.3 Oil spill modelling methodology

In order to assess the potential impacts of inshore oil spills on environmental receptors, the two MGO scenarios were modelled by Navitas using the OSCAR model. While there will be an OPEP in place, as is industry standard (Section 12.2.5), it is understood that Oil Spill Response (OSR) efforts are only modestly effective in the event of MGO spills. Therefore the modelling was carried out assuming no OSR effort in order to better understand the behaviour of any such spill and thus to inform the selection of optimal OSR equipment and strategy.

The main aims of the modelling were to understand the:

- Fate of the hydrocarbons in terms of the relative amounts dispersed, evaporated, beached, biodegraded and deposited in sediments,
- Probability of hydrocarbons on the sea surface or reaching the shore,
- Characteristics of hydrocarbons dissolved in the water column, and
- Overall likely transport of MGO at sea in terms of density, direction and time.

The following section summarises the key information to facilitate an appreciation and understanding of the inshore modelling results.

12.2.4.3.1 The OSCAR model

The OSCAR model used for the inshore MGO spill modelling is the same as that carried out for the offshore spill modelling (Section 12.1.4.3). The same approach to modelling using stochastic and deterministic modelling methods was used.

12.2.4.3.2 Release parameters and assumptions

As described in Section 12.2.2.2, two worst-case inshore MGO spill scenarios were modelled using the release parameters summarised in Table 12.22.

Table 12.22: Summary of the release parameters and assumptions used in the model run for each scenario

Scenario	Fluids discharged	Release volume (m^3)	Release duration	Release location	Release temp. (°C)	Release type	Model run duration	Worst-case assumptions
MGO release during bunkering	MGO	12	10 mins[1]	LTV anchorage	10	Bulk release	5 days	Worst-case shoreline oiling illustrated
Total MGO inventory loss - collision	MGO	1,400	3 hours[2]	LTV anchorage	10	Bulk release	5 days	Worst-case shoreline oiling illustrated

[1] A short duration representing a range of possible leak/pumping scenarios during bunkering.
[2] Estimated time for large volume to be displaced from tanks by seawater.

12.2.4.3.3 Understanding the model

The oil spill modelling utilised the two types of modelling approach previously described in Section 12.1.4.3, namely: stochastic modelling - carried out by running individual discharge scenarios multiple

times over different time periods (thereby utilising different wind and current conditions); and deterministic modelling - conducted over a particular time frame which was selected based on the results of the stochastic model results.

12.2.4.4 Modelling results

12.2.4.4.1 Modelling results - Scenario 1: 10 tonne MGO bunkering spill

Figure 12-45 shows the stochastic model for the probability of MGO on the sea surface above the threshold of 0.3 µm (a surface thickness threshold of 0.3 µm thickness corresponds to a rainbow sheen and at thicknesses below this value any sheen is unlikely to be visible) over a five day period. After 12 hours the MGO is typically no longer visible and therefore no longer amenable to response techniques such as enhanced natural dispersion (i.e., where the bow wave, propeller, or firefighting systems of a response vessel are utilised to break up the MGO into smaller fragments which are more susceptible to the effects of natural weathering).

As can be seen in Figure 12-45a generally the oil moves in an eastward direction towards the mouth of Berkeley Sound with a 40 – 70 % probability of impacting the sensitive areas of Cochon and Kidney Islands. Overall, the results show a relatively low probability (10 -20 %) that the oil will migrate in a south-easterly direction impacting the southern coastline of Berkeley Sound. This corresponds with the probable shoreline oiling results shown in Figure 12-45b as it shows the highest probable location of shoreline oiling is the southern coastline of Berkeley Sound, including Cochon and Kidney Islands. Coastline sensitivity mapping of the shoreline shows that the area of shoreline most likely to be impacted is characterised by rocky outcrops (of the kind shown in Figure 12-44 above). Rocky outcrops are recognised as high energy areas where weathering of spilt MGO is increased due to the abrasive action of seawater against the rock face breaking up the oil and increasing the surface area susceptible to natural weathering process. There is a low probability of oil reaching finer-grained sediments associated with the Volunteer Point beaches and with the beaches of inner Berkeley Sound, but the oil will be very dispersed by this point and is predicted to be below surface sheen thresholds.

The modelling suggests that MGO will reach the shoreline within 11 hours on average. In terms of seasonality, the analysis shows that in the months July - December there is a greater likelihood that the relatively small slick will pass straight out of Berkeley Sound without contacting the shore, although if it does reach the shore, the masses beached are consistently around seven tonnes.

It is predicted that 5 % (0.5 tonnes) of the MGO will reach the sediments, mainly near the point at which it first reaches the shoreline. Around 5 % (0.5 tonnes) of MGO will dissolve and present very transient high concentrations of MGO.

12.2.4.4.2 Modelling results - Scenario 2: 1,200 tonnes of MGO due to vessel collision with LTV

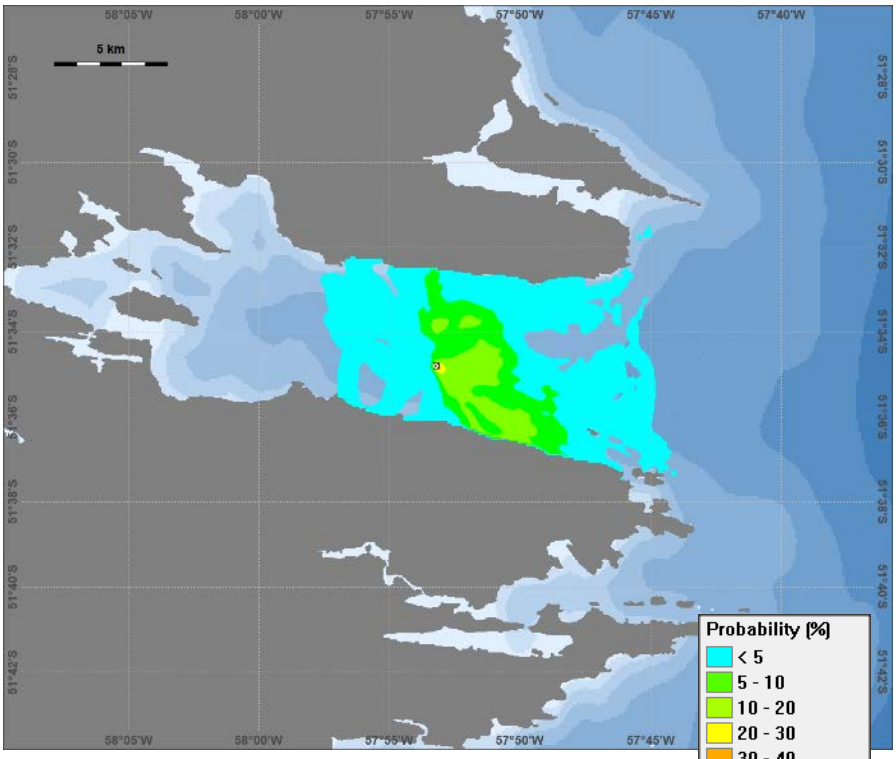
Figure 12-46 shows the stochastic model for the probability of oil on the sea surface above the threshold of 0.3 µm over a five day period.

As can been in Figure 12-46a the movement of the MGO is similar to that in Scenario 1 although, with the higher volumes in the Scenario 2 release, there is a moderate to high (50 – 70 %) probability of impacting the highly sensitive areas of Cochon and Kidney Islands which are known habitats for species of penguins and other vulnerable birds. Although the main shorelines affected there are not amongst the most sensitive types, they still include some areas of gently sloping finer sands that are more sensitive to oil pollution and will tend to retain oil. Similarly, a small amount of MGO could reach Volunteer Point (Section 7.5.2) although the sheen has dissipated after that much time.

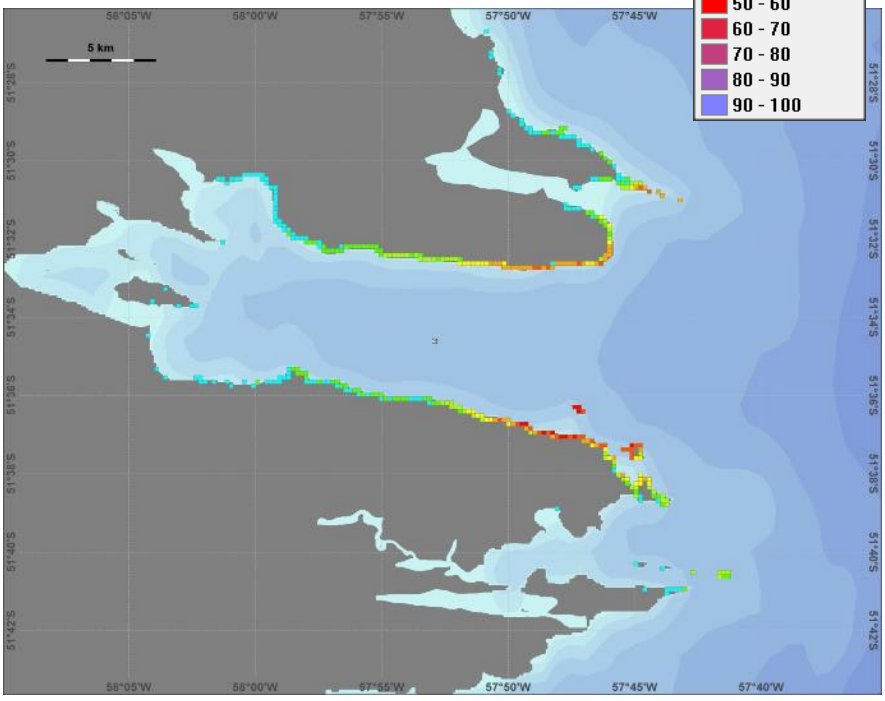
As with Scenario 1, the results also show a relatively high probability that the MGO will migrate in a south-easterly direction thus potentially impacting the southern coastline of the Berkeley Sound, including Cochon and Kidney Islands. This corresponds with the probable shoreline oiling results shown

in Figure 12-46b which shows the highest probable location of shoreline oiling along the southern coastline of Berkeley Sound. There is up to approximately a 40 % probability of oil reaching the finer-grained sediment beaches of Volunteer Point, and up to a 60 % probability of reaching beaches opposite Kidney Island. Should oil reach these beaches, typically after around 24 hours, it will be considerably dispersed although still in the form of a surface sheen and the shoreline and nearshore sediments would be contaminated. It is predicted that 5 % (60 tonnes) of the MGO will reach the sediments. Concentrations are predicted to peak locally in the sediments opposite Kidney Island (0.2 mg/kg), Cochon Island (350 mg/kg), and at Volunteer Point (2 mg/kg). The probability of reaching the beaches of inner Berkeley Sound to the west remains very low. There is a lower probability (20 – 40 %) of the MGO reaching areas on Cape Pembroke.

It is predicted that MGO will impact the shoreline within 11 hours on average, taking at least 6 hours to reach Cochon Island and 12 hours to reach Volunteer Point. An average of nine tonnes of oil is predicted to deposit on the shoreline, with a worst-case of 51 tonnes. In terms of seasonality, seasonal variations have very little effect on the fate of the MGO.

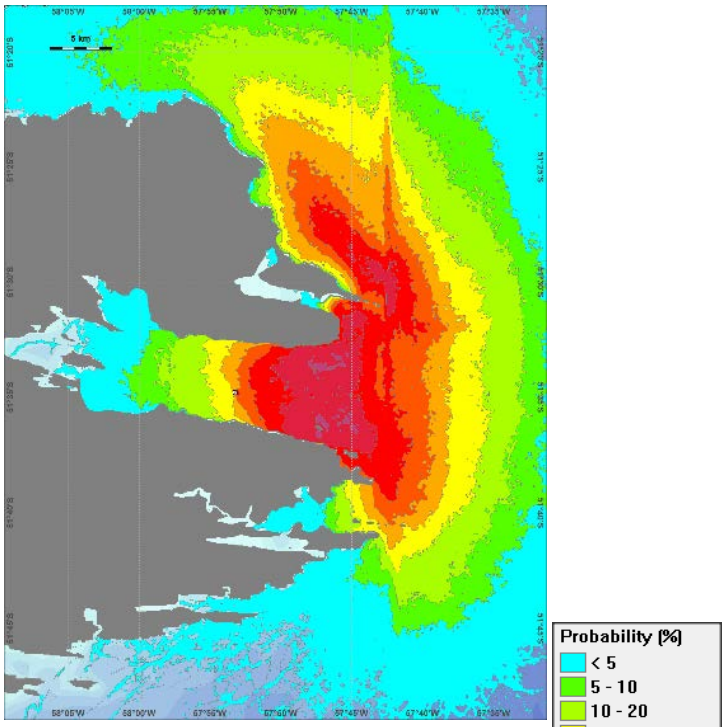


a) Probability of surface oil

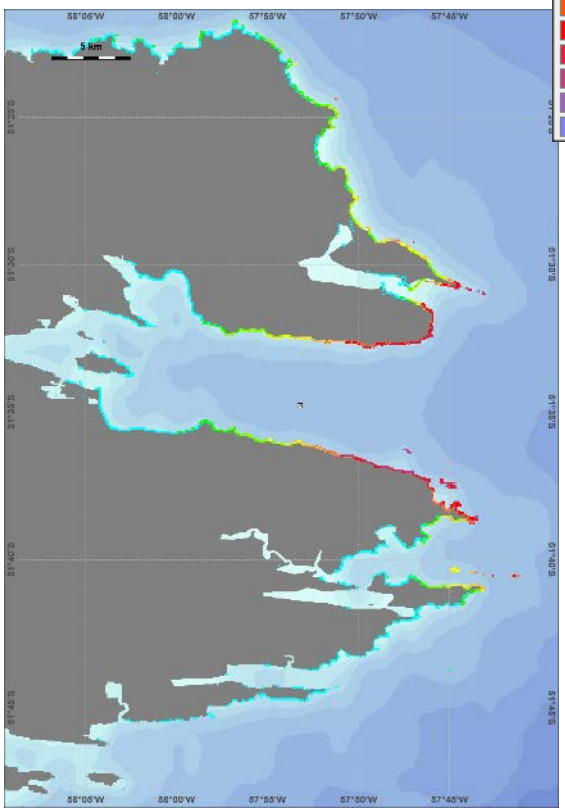


b) Probability of MGO on shoreline

Figure 12-45: Probability of surface contamination and shoreline oiling – Scenario 1



a) Probability of surface oil



(a) Probability of MGO on shoreline

Figure 12-46: Probability of surface contamination and shoreline oiling – Scenario 2

12.2.4.5 Oil fate predictions

The MGO spill modelling predicts that:

- Surface oil remains closely grouped until it is acted on by stronger, more complex currents exiting Berkeley Sound,
- There is up to a 70 % probability of a light sheen reaching Cochon and Kidney Islands (in Scenario 2), and
- MGO leaving Berkeley Sound will tend to continue north-east and out to sea. There is a small likelihood of some MGO returning to the north coast of East Falkland, and very little likelihood of oil reaching the shore south of Cape Pembroke.

With reference to the distribution of kelp beds (Figure 7-37), there is limited risk to kelp beds from the 10 tonnes diesel bunkering scenario. While the main channel of Berkeley Sound contains some kelp beds along the shorelines, these are not the highest density areas, and the 10 tonnes scenario is mainly confined to the main channel and is dispersed before it reaches the mouth of Berkeley Sound. In contrast, the full inventory loss of 1,200 tonnes is likely to lead to exposure of the high densities of kelp beds around Volunteer Point and also Cochon and Kidney Islands (Figure 7-37) to MGO. Much more of the sensitive shoreline types near Cochon Island and Volunteer Point are at risk in this scenario. As noted above in Section 12.2.4.1.2.1, one species of kelp (*Laminaria japonica*) has been shown to have bioremediation properties. It is, as yet, unknown whether Falklands kelp (*Macrocystis pyrifera*) has similar properties but it is possible kelp may play a role in bioremediation in spill events, particularly where contamination levels are lower. However, it should be noted that kelp also has the potential to impede the spread of oil and hamper clean-up operations (Section 12.2.4.1.2.2). This highlights the importance of collision prevention for the LTVs moored in Berkeley Sound and the provision of response equipment that can be mobilised quickly – MGO is predicted to take at least 6 hours to reach Cochon Island and 12 hours to reach Volunteer Point.

12.2.5 Industry-standard mitigation

In addition to the legislative requirements described in Section 12.2.1.1, a number of industry-standard measures exist in order to reduce the likelihood of accidental events occurring during inshore operations. These requirements are factored into the Phase 1 & 2 base-case as follows:

- AIS beacons and other navigation aids and charting / notifications maintained,
- Safety lighting as required,
- Operational limits defined and implemented,
- Development and implementation of bunkering procedures with fuel supplier to ensure corporate standards of operational safety are maintained, and
- Bunkering conducted within the 500 m LTV exclusion zone, or other defined area.

The equipment and strategies for Oil Spill Response (OSR) will be described within the project-specific OPEP (Section 12.2.1.1.1) and will be compatible with the Falkland Islands' NOSCP. However, the majority of the industry-standard mitigation measures defined within OPEPs are aimed at the prevention (avoidance) of spills in line with the hierarchy of risk reduction. As described above, the modelling was carried out assuming no OSR was in place in order to determine the most probable behaviour of any such spill, to inform the project-specific OSR and OPEP strategies that may serve to also lessen the severity of effects, and to take a precautionary approach.

Based upon the modelling outcomes in Section 12.2.4.4, the following section provides detail on the selection of OSR resources.

12.2.5.1 Selection of OSR resources (MGO)

Typically, spills of MGO spread quickly to form a very thin layer that is difficult to recover. For an incident of a small scale such as less than one tonne, recovery attempts are unlikely to be successful. As the volume of a release increases, the size and persistence of a thick oil layer increases and becomes more amenable to containment and recovery in the short-term. Further, in Berkeley Sound, the modelling shows that oil may well move to one or other shoreline and then move slowly along the coast giving some opportunity for a boom to be deployed off the shore to arrest the oil. However, the opportunities for deploying such a boom in Berkeley Sound are limited given the steep rocky sides along much of its length, as shown in Figure 12-44 above.

Navitas will maintain a set of OSR equipment at the supply base / TDF sufficient to respond to Tier 1 and 2 inshore oil spill events (Section 12.2.5.1) such as those described in this chapter. The equipment will be containerised and it will be able to be moved and deployed by a suitable fast response vessel to Berkeley Sound as necessary. This will contain a standard equipment set for dealing with MGO spills such as shore sealing booms, inflation booms and air pumps, mooring lines, water pumps and hoses, two skimmers on each offshore vessel, and an oil pump.

Dispersants are not proposed as marine receptors such as kelp are likely to be more affected by the chemicals and dispersed oil than by the oil remaining on the surface. If seabirds are at risk, then sheen can be minimised by using prop washing techniques to break up and disperse the surface layer, and this can be done more quickly and reliably than the application of dispersants. However, it should be noted that prop washing techniques can be hindered by kelp beds (Section 12.2.4.1.2.2) as found in some of the areas which may be affected e.g., Volunteer Point and Kidney and Cochon Islands (Section 12.2.4.5).

The OPEP will further detail how spill response will be managed within the framework of the NOSCP, as described in Section 12.1.1.1.1 of the offshore oil spill chapter.

12.2.6 Risk assessment

The following section draws on all the data described above to assess the risk of inshore oil spills. As with all risk assessments, it is necessary to consider first the potential impact of the event (i.e., 'Sensitivity of Receptor' x 'Severity of Effect') and then to consider the Likelihood of Occurrence of that event to establish the overall risk. The impact on each receptor is tabulated in each section below, and the likelihood of occurrence, which will be consistent within each scenario, is described as a whole.

The following assessments take account of all legislation and industry-standard and base-case mitigations described in Section 12.2.1.1 and Section 12.2.5 respectively. A summary of all the risk assessment outcomes is tabulated in Section 12.2.12, which shows the worst-case impact / risk for each activity and receptor.

12.2.6.1 Scenario 1: 10 tonne MGO bunkering incident spill

Diesel fuel is most often a light, refined petroleum product. Small diesel spills will usually evaporate and disperse naturally within a day or less, and OSR equipment would not be deployed. This is true for most spills even in cold water. However, 'marine diesel' (MGO) is a slightly heavier fuel oil that will persist longer when spilled. When spilled on water, MGO may form a thicker film of dull or dark colours (Section 12.2.4.1).

MGO spreads rapidly and also evaporates and dissolves or mixes with water, which means that containment and recovery is rarely very successful. MGO forms a significant short-term surface sheen. Birds and other animals may be initially affected *via* contact although the window is confined to a few days and diminishes rapidly. MGO has a relatively high proportion (5 %) of oil that dissolves in the

water column, resulting in a high but short-lived risk (Section 12.2.4.1.1). In the longer-term, sediment toxicity is more likely than with the other oil types modelled in this assessment.

12.2.6.1.1 Likelihood of occurrence

A review of historic oil spill incidents suggests that the accidental release of MGO during a bunkering operation is the most likely incident to occur as a result of Navitas' planned operations within Berkeley Sound. While there is little inshore data on spill size and frequency published to make a direct comparison, it is noted that for UK offshore waters in 2022 there were 188 oil spills reported in total from around 234 installations (OEUK, 2023b), which would each typically receive MGO more than once a month, in much more challenging conditions than Berkeley Sound. MGO formed a minority of the oil spilled and incidents involving more than 1 tonne of MGO are extremely rare.

Bunkering spills have occurred previously in the industry, and while failure of numerous operational controls would be required (e.g., procedural and engineering controls) on balance, the likelihood of occurrence is considered to be '**Unlikely**'.

12.2.6.1.2 Overall significance of the risk

A summary of the risk assessment for a 10 tonne spill of MGO in Berkeley Sound is presented in Table 12.23. While the *impact* of such an event to some of the receptors would be 'High', owing to the likelihood of such an event occurring, the worst-case significance of the *risk* posed by a 10 tonne MGO spill, with the base-case measures in place, is '**Moderate**' for fish and squid, human population (fisheries) ('**Moderate (8)**'), seabirds and marine mammals '**Moderate (10)**'.

Table 12.23: Summary of the impact assessment for a 10 tonne MGO spill at the LTV Mooring location, with base-case mitigation in place

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
Water quality and plankton	Plankton show high seasonal and spatial variation in abundance and productivity, and it is expected that any effects will be greatest during summer when productivity is highest (Section 7.4.1.2.2). The planktonic lobster krill is known to be abundant within Berkeley Sound, and elsewhere in the Falklands, which attracts higher predators to feed on this resource. At other times, the area is less significant for zooplankton but is still considered highly productive. Therefore, the sensitivity of plankton is considered to be '**Moderate**'. An MGO spill would rapidly spread to cover a wide area. Although the volatile nature of MGO limits exposure time to receptors, MGO is highly toxic to marine organisms. As the impact would be local, temporary and reversible (due to immigration of planktonic organisms from unaffected areas), the severity of the effect of a 10 tonne spill of MGO on plankton has been assessed as '**Moderate**' Therefore, the significance of the impact on plankton is assessed as '**Moderate (9)**'.	**Unlikely**	**'Low (6)'**
Marine flora	Kelp forest is a widespread habitat around the entire coast of the Falklands archipelago but is relatively sparse within Berkeley Sound (Section 7.4.2). Kelp is a habitat forming species, and although undesignated this habitat is considered to be of national importance and therefore the sensitivity of the receptor is considered to be '**Moderate**'. Kelp is apparently reasonably tolerant of hydrocarbon pollution (Section 12.2.4.1.2). Modelling indicates that there is a low probability of oil reaching large areas of kelp forest. Any impact will be localised, short-term and rapidly reversible leading to a barely detectable impact on kelp taxa such that the severity of effect is considered to be '**Minor**'. Therefore, the significance of the impact is assessed as '**Moderate (6)**'.	**Unlikely**	**'Low (6)'**
Sediment quality and benthic communities	Berkeley Sound supports a diverse benthic fauna (Section 12.2.4.2.2) and includes habitats that could be considered to be biogenic and geogenic reefs congruent with habitats listed in UK Habitats Regulations (Section 12.2.4.2.4). It also forms part of the inshore pMMA. By nature, reef forming organisms are sessile and often filter feeders, and are therefore vulnerable to water borne pollutants. Additionally, recent testing of one benthic species indicated that relatively high concentrations of oil in sediments would impact benthic communities (Section 12.2.4.2.2) Although benthic habitats are undesignated within the Falklands, those found within Berkeley Sound are considered to be of national or local importance. The sensitivity of the benthic community is therefore considered to be '**Moderate**'. Most of the oil reaching the sediment does so in coastal waters. Although buoyant, MGO is more dispersible in water than other oil types. In addition, as it spreads into shallower waters the likelihood of adhering to fine grain particulate matter increases resulting in diesel deposits in the sediment. It is predicted that 5 % (0.5 tonnes) of the MGO will reach the sediments (Section 12.2.4.4.1), a higher proportion than for other oil types. Once in the sediment, MGO will persist as a source of toxic aromatics, such as PAHs. Additionally, about 5 % (0.5 tonnes) of MGO will dissolve, which will pose a	**Unlikely**	**'Low (6)'**

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
	locally high risk over the short-term, until the oil disperses. Contamination will be restricted to a local area and is temporary in nature. The severity of effect is considered to be '**Moderate**' due to the potential for localised reversible nature of the impact. The significance of impact on the benthic community is therefore assessed as '**Moderate (9)**'.		
Fish and squid	Loligo squid are known to spawn within Berkeley Sound although large aggregations of squid eggs have not been found to date. Overall, there is a great deal of uncertainty regarding where squid spawn and what areas should be considered as important spawning sites (Section 12.2.4.2.3). However, it is known that eggs and larvae of fish and squid are regarded to be more susceptible to pollution events than adults due to their immobility (Section 12.2.4.2.3). Given the uncertainty regarding the distribution of loligo spawning grounds, it is possible that a regionally important proportion of the population (1 % of biogeographic population) could fall within the zone of influence of the Phase 1 & 2 Development activity. Therefore, the sensitivity of fish and squid receptors to a 10 tonne MGO spill is considered to be '**High**'. Due to the properties of MGO (Section 12.2.4.1.1), the impact of a 10 tonne MGO spill on the water column will be high but very short-lived. Contamination associated with sediments will be more persistent. It is unlikely that adult fish and squid will be impacted directly but they could consume toxins *via* food. Direct toxic effects on fish and squid eggs and larvae could occur but the impact will be locally high, but short-term, and therefore the severity of the effect on fish is considered to be '**Moderate**'. The significance of the impact of a 10 tonne MGO spill on fish and squid is assessed as '**Upper Moderate (12)**'.	**Unlikely**	**'Moderate (8)'**
Human population (fisheries)	The loligo trawl fishery is the second largest (in terms of catch) in the Falklands and is therefore an important part of the Islands economy. The squid are caught off the coast of East Falkland, including waters adjacent to Berkeley Sound and they are known to spawn inshore (Section 12.2.4.2.3). Given the importance of these fisheries to the Falklands' economy, and the uncertainty over the extent of any impacts, a precautionary approach should be taken. Consequently, it is assumed that a 10 tonne spill would result in economic impacts for the fishing industry. Given that there have been spills of hydrocarbons within Berkeley Sound in the past and background levels of contamination are detectable (Section 12.2.4.2.3), the fishery is believed to have a moderate capacity to absorb change on this scale. However, a spill of this size would be unacceptable to a majority of stakeholders and therefore the sensitivity of the human population is considered to be '**High**'. Berkeley Sound has experienced similar sized spills of MGO in the past with no impact on local fishing grounds. Nevertheless, taking the precautionary approach, there is a chance that a 10 tonne MGO spill could result in the localised temporary closure of the fishing grounds due to potential tainting and contamination and therefore, the severity of the effect of an uncontrolled release on fisheries is considered to be '**Moderate**' Therefore, the significance of the impact on the human population *via* fisheries is assessed as '**Upper Moderate (12)**'.	**Unlikely**	**'Moderate (8)'**

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
Seabirds	At times, during the summer breeding seasons, more than 1 % of the biogeographic populations of several species (e.g., gentoo penguin and sooty shearwater) and species of IUCN 'Vulnerable' status (e.g., rockhopper penguin, white-chinned petrel) may be present. Species of local conservation concern (Falkland steamer duck) will be present year-round (Section 12.1.4.2.4.3). Therefore, the sensitivity of seabirds to the effects of a 10 tonne MGO spill, is considered to be '**High**'. A spill of 10 tonnes of MGO would rapidly spread to form a sheen throughout Berkeley Sound. Although the sheen will be short-lived due to natural break-down and evaporation, MGO has the potential to contaminate the feathers of any seabirds that come into contact with it. Further, diesel has greater potential than Sea Lion crude for impacts associated with toxicity (Section 12.1.4.2.4). The highest probability is for the MGO to move south-eastwards towards the breeding sites of the species mentioned above. A large proportion of the Falklands populations of sooty shearwaters and white-chinned petrels breed on Kidney Island. During the breeding season, these birds form huge rafts close inshore before returning to nest burrows at dusk. A 10 tonne MGO spill during the breeding season could impact a significant proportion of the regional population, which may have long-term implications for the populations of these species. The severity of the effect of a 10 tonne MGO spill on seabirds is therefore considered to be '**Serious**'. Therefore, the significance of the impact on seabirds is assessed as '**High (16)**'.	**Unlikely**	**'Moderate (10)'**
Marine mammals	Berkeley Sound experiences a seasonal presence of fin and sei whales (classified as IUCN 'Vulnerable' and 'Endangered') (Section 12.1.4.2.5) and the presence of several other species of local conservation concern (Peale's and Commerson's dolphins, South American sea lions and fur seals), as prescribed in the Falklands biodiversity action plan (Section 12.1.4.2.5). Although it is possible that MGO from a spill of this size will not come into direct contact with any marine mammals, this is not certain. Therefore, the sensitivity of marine mammals is assessed as '**High**'. Given the modest volatility of MGO, marine mammals could be susceptible to inhaling hydrocarbons upon surfacing to breath. Further, the coats of fur seals and sea lions that come into contact with oily sheens will become contaminated. This will result in a loss of insulation and direct ingestion while grooming. The potential for exposure is short lived (measured in days). However, as a worst-case the ingestion of MGO could have long-lasting implications for the individuals concerned and potentially the local populations. Therefore, taking a precautionary approach, the severity of effect of a 10 tonne MGO spill within Berkeley Sound on marine mammals is assessed as '**Serious**'. Therefore, the significance of the impact on marine mammals is assessed as '**High (16)**'.	**Unlikely**	**'Moderate (10)'**
Coastal habitats (terrestrial)	The coast of Berkeley Sound contains a wide variety of coastal habitats. The probability plots indicate that the north and south coasts of the outer Sound are more likely to be impacted than elsewhere. These shorelines are steep, rocky and subject to moderate wave action. Of greater concern are the coasts of the inner Sound and Volunteer Lagoon, which have high Environmental Sensitivity Scores due to the fine-grained sediments (Section 7.6), where oil is more likely to	**Unlikely**	**'Low (6)'**

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
	persist longest. Probability plots indicate that it is likely that the MGO will drift towards the National Nature Reserve of Cochon and Kidney Island (Section 12.2.4.5). The coastal habitat of these islands is important for all three of the Falklands endemic bird species (Cobb's wren, Tussac bird and Falkland steamer ducks). These are nationally designated sites and therefore the sensitivity of the receptor is considered to be '**High**'. Modelling predicts that under the prevailing environmental conditions MGO will travel towards the coast where it becomes trapped and sedimentation takes place. While a large proportion of the Berkeley Sound coast could be impacted, the nature of the MGO is such that this will be short-term and the severity of effect is therefore assessed as '**Minor**'. Therefore, the significance of the impact is assessed as '**Moderate (8)**'.		
Human Population (tourism)	There are unlikely to be significant impacts on local tourism from an incident at the scale of a 10 tonne MGO spill (see assessments above). However, media publicity may influence the experience and perceptions of tourists, which may then impact upon their propensity to visit. Given that there would be moderate capacity to absorb change in the aftermath of a small inshore MGO spill, the sensitivity of tourism is considered to be '**Moderate**'. Any negative impact from adverse publicity associated with an incident of this size would be short lived but may have a small short-term impact on the number of visitors. The severity of effect of a 10 tonne MGO spill in Berkeley Sound on tourism has been assessed as '**Minor**'. Therefore, the significance of the impact on tourism is assessed as '**Moderate (6)**'.	**Unlikely**	**'Low (6)'**

12.2.6.2 Scenario 2: 1,200 tonnes of MGO due to vessel collision with LTV

This scenario was identified as the potential worst-case in terms of the quantity of hydrocarbon spilled into Berkeley Sound. The only credible event that could cause such a release is from a collision with a vessel during a period of low visibility. To illustrate the outer envelope in terms of spill response, the modelling assumes that the inventory is lost over a three hour period. This is presented as a worst-case scenario.

12.2.6.2.1 Likelihood of occurrence

Of the measures described in Section 12.2.7, the following preventative measures are intended to make such an incident extremely unlikely:

- Clear manoeuvering and approach channel,
- Use of exclusion zones around LTVs, and
- Operational limits defined and implemented.

As a result, on balance, the likelihood of occurrence is considered to be '**Unlikely**'.

12.2.6.2.2 Overall significance of the risk

A summary of the risk assessment for a 1,200 tonne spill of MGO in Berkeley Sound is presented in Table 12.24. While the *impact* of such an event to some of the receptors would be 'High', owing to the likelihood of such an event occurring, the worst-case significance of the *risk* posed by a 1,200 tonne MGO spill, with the base-case measures in place, is '**Moderate**' for fish and squid, human population (fisheries) ('**Moderate (8)**'), seabirds and marine mammals '**Moderate (10)**'.

Table 12.24: Summary of the impact assessment for a 1,200 tonne MGO spill at the LTV Mooring location, with base-case mitigation in place

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
Water quality and plankton	The sensitivity of plankton is as described in Table 12.23 above and is considered to be '**Moderate**'. An MGO spill would rapidly spread to cover a wide area. Although the volatile nature of MGO limits exposure time to receptors, MGO is highly toxic to marine organisms. As the impact would be local, temporary and reversible (due to immigration of planktonic organisms from unaffected areas), the severity of the effect of a 1,200 tonne spill of MGO on plankton has been assessed as '**Moderate**' Therefore, the significance of the impact on plankton is assessed as '**Moderate (9)**'.	**Unlikely**	**'Low (6)'**
Marine flora	The sensitivity of kelp is as described in Table 12.23 above and is considered to be '**Moderate**'. Kelp is apparently reasonably tolerant of hydrocarbon pollution and the exposure timescales are far shorter here than described in Section 12.2.4.2.1. Modelling indicates that there is a moderate probability of oil reaching denser areas of kelp forest. Any impact will be localised, short-term and rapidly reversible leading to a barely detectable impact on kelp taxa. The severity of effect is therefore '**Minor**'. Therefore the significance of the impact is assessed as '**Moderate (6)**'.	**Unlikely**	**'Low (6)'**
Sediment quality and benthic communities	The sensitivity of the benthic community is as described in Table 12.23 and is considered to be '**Moderate**'. Modelling predicts that a relatively high proportion of MGO will reach the sediments (Section 12.2.4.4.2). Most of the MGO reaching the sediment does so in coastal waters. Although buoyant, MGO is more dispersible in water than other oil types. In addition, as it spreads into shallower waters the likelihood of adhering to fine grain particulate matter increases resulting in diesel deposits in the sediment. Without any OSR, it is predicted that 5 % (60 tonnes) of the MGO will reach the sediments, a higher proportion than for other oil types. Concentrations are predicted to peak locally in the sediments opposite Kidney Island (0.2 mg/kg), Cochon Island (350 mg/kg), and at Volunteer Point (2 mg/kg), compared with a potential effects level of 10 mg/kg. Once in the sediment, MGO will persist as a source of toxic aromatics, such as PAHs. Additionally, a significant fraction of MGO will dissolve, which will pose a locally high risk over the short-term, until the oil disperses. Contamination will be restricted to a local area and is temporary in nature. While OSR may reduce the volume of MGO in the water, the severity of effect is considered to be '**Moderate**' due to the potential for localised reversible nature of the impact. The significance of impact on the benthic community is therefore assessed as '**Moderate (9)**'.	**Unlikely**	**'Low (6)'**
Fish and squid	The sensitivity of fish and squid is as described in Table 12.23 above and is considered to be '**High**'. Due to the properties of MGO, the impact of a 1,200 tonne MGO spill on the water column will be high but short-lived. Contamination associated with sediments will be more persistent. It is unlikely that adult fish and squid will be impacted directly but they could consume toxins *via* food. Direct toxic effects on fish and squid eggs and larvae could	**Unlikely**	**'Moderate (8)'**

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
	occur but the impact will be locally high, but short-term, and therefore the severity of the effect on fish is considered to be '**Moderate**'. The significance of the impact of a 1,200 tonnes MGO spill on fish and squid is assessed as '**Upper Moderate (12)**'.		
Human population (fisheries)	The sensitivity of the human population is as described in Table 12.23 above and is considered to be considered to be '**High**'. Berkeley Sound has experienced spills of MGO in the past, although not at this scale, with no known impact on local fishing grounds. Therefore, taking the precautionary approach, there is a chance that a 1,200 tonne MGO spill could result in the localised temporary closure of the fishing grounds due to potential tainting and contamination and therefore, the severity of the effect of an uncontrolled release on fisheries is considered to be '**Moderate**' Therefore, the significance of the impact on the human population *via* fisheries is assessed as '**Upper Moderate (12)**'.	**Unlikely**	**'Moderate (8)'**
Seabirds	The sensitivity of the seabird populations is as described in Table 12.23 above and their sensitivity to the effects of a 1,200 tonne MGO spill, is considered to be '**High**'. A spill of 1,200 tonnes of MGO would rapidly spread to form a sheen throughout Berkeley Sound. Although the sheen will be short-lived due to natural break-down, and OSR equipment may reduce the overall volume of MGO in the water, MGO has the potential to contaminate the feathers of any seabirds that come into contact with it. The highest probability is for the MGO to move south-eastwards towards the breeding sites of, for example, sooty shearwaters and white-chinned petrels. A large proportion of the Falklands populations of sooty shearwaters and white-chinned petrels breed on Kidney Island. During the breeding season, these birds form huge rafts close inshore before returning to nest burrows at dusk. Even if strategic booms are deployed as part of the OSR, a 1,200 tonne MGO spill during the breeding season could impact a significant proportion of the regional population, which may have long-term implications for the populations of these species. Similarly, sensitive areas around Volunteer Point could be affected by the spill, although the effects of distance and dispersion will be higher. The severity of the effect of a 1,200 tonne MGO spill on seabirds is therefore considered to be '**Serious**'. Therefore, the significance of the impact on seabirds is assessed as '**High (16)**'.	**Unlikely**	**'Moderate (10)'**
Marine mammals	The sensitivity of marine mammals is as described in Table 12.23 above and is considered to be '**High**'. In addition to the effects of crude oil on marine mammals described in Section 12.1.4.2.5, the volatile nature of MGO is such that marine mammals are susceptible to inhaling hydrocarbons upon surfacing to breath. Further, the coats of fur seals and sea lions that come into contact with oily sheens will become contaminated. This will result in a loss of insulation and direct ingestion while grooming. The potential for exposure is short lived (measured in days). However, as a worst-case the ingestion of MGO could have long-lasting implications for the individuals concerned and potentially the local populations. Therefore, taking a precautionary approach, the severity of effect of a 1,200 tonne MGO spill within Berkeley Sound on marine mammals is assessed as '**Serious**'.	**Unlikely**	**'Moderate (10)'**

Receptor	Sensitivity of Receptor and Severity of Effect (Impact)	Likelihood of occurrence	Overall risk significance
	Therefore the significance of the impact on marine mammals is assessed as '**High (16)**'.		
Coastal habitats (terrestrial)	The sensitivity of the receptor is as described in Table 12.23 and is considered to be '**High**'. Modelling predicts that under the prevailing environmental conditions MGO will travel towards the coast where it becomes trapped and sedimentation takes place. While strategically placed OSR booms may reduce the volume of MGO reaching the coast, modelling (which does not consider OSR) predicts that an average of 9 tonnes of oil is predicted to deposit on the shoreline, with a worst-case of 51 tonnes (Section 12.2.4.4.2). While a large proportion of the Berkeley Sound coast could be impacted, the nature of the MGO is such that this will be short-term and the severity of effect is therefore assessed as '**Minor**'. Therefore, the significance of the impact is assessed as '**Moderate (8)**'.	**Unlikely**	**'Low (6)'**
Human Population (tourism)	Although there would be OSR activity to respond to the spill in areas frequented by tourists, and any tourists in the affected areas would be aware of the issue, there are unlikely to be significant impacts on local tourism from an incident at the scale of a 1,200 tonne MGO spill (see assessments above). However, media publicity may influence the experience and perceptions of tourists, which may then impact upon their propensity to visit. Given that there would be moderate capacity to absorb change in the aftermath of such a spill, the sensitivity of tourism is considered to be '**Moderate**'. Any negative impact from adverse publicity associated with an incident of this size would be short lived but may have a small short-term impact on the number of visitors. The severity of effect of a 1,200 tonne MGO spill in Berkeley Sound on tourism has been assessed as '**Minor**'. Therefore, the significance of the impact on tourism is assessed as '**Moderate (6)**'.	**Unlikely**	**'Low (6)'**

12.2.7 Project-specific mitigation measures

In addition to the industry-standard measures listed in Section 12.2.5, a number of project-specific measures will be implemented to reduce the likelihood of accidental events occurring during inshore operations and to mitigate against any impacts should releases occur. To eliminate the risk of potential collisions due to human error or dynamic positioning control system faults (which could result in a powered collision), both the LTV and installation vessel will be at anchor prior to heavy lifts commencing. Further mitigations to be used include:

- Dialogue with FIG on operating within the Harbour Management Plan, with operational limits defined,
- Speed limitations to minimise collision energies (Sea Lion Development vessels entering Berkeley Sound will be limited to eight knots),
- Watch keeping for errant vessels (in good weather) or radar monitoring (in bad visibility conditions),
- For bunkering operations, good practices as detailed in the Guidelines for Offshore Marine Operations (GOMO, 2013) will be followed to prevent accidental release of bunker fuel at source,
- LTVs vetted for double skinned fuel tanks, and
- Enhanced crew bunkering competency, including but not limited to:
  - Identified by Navitas' Offshore Bunkering Procedure and the Area Specific Operational Guidelines (ASOGs),
  - Achieved by a Hazard Identification and Risk Assessment (HIRA) once the marine contractor for the OSVs has been selected,
  - Verified by Job Safety Assessments and Tool Box Talks prior to each operation, and
  - Regular drills and Navitas' Audit and Assurance Procedure will assure crews achieve and retain the required level of competency.

12.2.8 Residual impacts and risks

While the initial risk assessment for the different oil spill scenarios indicates that the risks to many of the receptors are '**Low**' or '**Very Low**' (Section 12.2.6), this was primarily because the likelihood of the incidents occurring in the first place is '**Unlikely**'. However, as shown in the initial risk assessment sections above, the impacts of the spill, should they actually occur, ranged from '**Moderate**' to '**High**'. Nonetheless, neither the impact nor the likelihood of occurrence are likely to be changed by the project-specific mitigations such the overall risks remain the same as in the initial assessment. For ease of reading, the initial (and also residual) worst-case risk outcomes are summarised again in Table 12.25.

Table 12.25: Summary of the worst-case initial and residual (same) risk assessments for both MGO release scenarios

Scenario	Impact assessment	Likelihood	Overall residual risk significance
1: 10 tonne MGO bunkering spill	High for Seabirds and marine mammals	**Unlikely**	**Moderate (10)**
2: 1,200 tonne MGO spill	High for Seabirds and marine mammals	**Unlikely**	**Moderate (10)**

12.2.9 Cumulative impact

Fuel bunkers are undertaken within Berkeley Sound on a regular basis and all of these operations carry a risk of fuel oil spill. Therefore, there is the potential for cumulative impacts through 'increased concentration' of fuel from oil spills (Section 8.9.1). There are several known spills of MGO in Berkeley Sound, the largest of these are associated with ships that sank or ran aground (Table 12.26), although many of these incidents have not been formally recorded.

Baseline Total Hydrocarbon Concentrations (THC) and PAH in Berkeley Sound sediments have been sampled and reported by Benthic Solutions (BSL, 2015c).

Background levels are interpreted as being a mixture of naturally occurring hydrocarbons and weathered diesel. With regard to THCs, background levels range from 1.03 - 159.89 mg/kg, with typical levels of 10 mg/kg (Section 7.3.7.2.2). It is noted that these baseline levels are already at or above potential levels of concern, starting at 10 mg/kg (Section 12.2.4.2.2).

With regard to PAHs, the baseline levels are reported as <1 µg/kg up to 0.938 mg/kg (Section 7.3.7.2.2.2). Again, these pre-existing levels are already within the range of common levels of concern.

The fuel bunkering operations within Berkeley Sound carry an environmental risk. However, with industry-standard, base-case and project-specific prevention and mitigation measures in place, the risk is reduced to ALARP. Tighter regulation of all activities within Berkeley Sound will help to reduce the risks of accidental events occurring with third-party vessels. Additionally, the availability of vessels with OSR capability and additional OSR equipment should reduce the potential for environmental impacts from any oil spill events that might occur.

Table 12.26: Anecdotal data on incidents that could lead to oil leaks involving vessels in Berkeley Sound[1]

Date	Vessel type	Type of incident	Outcome	Environmental impact
April 2005	Reefer	Grounding in Berkeley Sound (Cochon Island)	Refloated with damage to hull	Fuel oil leak
May 2008	Trawler	Fire in Berkeley Sound	Vessel eventually sank	Fuel oil leaks (*c.*137 Tonnes)
Unknown	Jigger	Struck a rock and sank	Vessel sank	Fuel oil leaks

[1] M. Jamieson, *pers. comm.* and A. Black, *pers. obs*.

12.2.10 Confidence

There are a number of uncertainties regarding:

- The models used to predict the likelihood of oil spill events (Section 12.2.4.3),
- The effectiveness of response measures, and
- The range of environmental effects that could result from a spill.

Overall, confidence in the assessment of the impacts and risks due to oil spills associated with Inshore operations is therefore considered to be '**Uncertain**'.

12.2.10.1 Monitoring required

During operations a real time inshore hydrodynamic model covering 3-day detailed current and wind forecasts will be run and available in the event of a spill.

12.2.11 Offsetting

Neither of the scenarios considered are likely to occur during the duration of project activities in Berkeley Sound which will occur over a maximum period of 13 months. Offsetting is therefore not considered appropriate for this type of unplanned event. Should a serious event occur, it is expected

that remediation will be part of the final stages of the spill response process and subject to discussion with the authorities and stakeholders.

12.2.12 Findings summary

Table 12.27: Summary of the risk assessment for all oil spill scenarios

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
MGO Spill during bunkering of fuel oil	Scenario 1: 10 tonne MGO spill	Water quality and toxic effects on Plankton	Accidental	1 & 2	Moderate	Moderate	Unlikely	**Low (6)**	n/a	**Uncertain**	**Industry-standard and base-case:** AIS beacons and other navigation aids, Safety lighting, Operational limits defined and implemented, Development and implementation of bunkering procedures, Bunkering conducted within the 500 m LTV
		Toxic effects on Marine flora (kelp)	Accidental	1 & 2	Moderate	Minor	Unlikely	**Low (6)**	n/a	**Uncertain**	
		Sediment quality and toxic effects on Benthic communities	Accidental	1 & 2	Moderate	Moderate	Unlikely	**Low (6)**	n/a	**Uncertain**	
		Toxic effects on Fish and squid	Accidental	1 & 2	High	Moderate	Unlikely	**Moderate (8)**	**Moderate (8)**	**Uncertain**	
		Impact on fisheries from tainting of fish and contamination of fishing grounds	Accidental	1 & 2	High	Moderate	Unlikely	**Moderate (8)**	**Moderate (8)**	**Uncertain**	
		Plumage contamination and oil ingestion by Seabirds	Accidental	1 & 2	High	Serious	Unlikely	**Moderate (10)**	**Moderate (10)**	**Uncertain**	
		Skin contamination and ingestion of toxins by marine mammals	Accidental	1 & 2	High	Serious	Unlikely	**Moderate (10)**	**Moderate (10)**	**Uncertain**	
		Coastal communities	Accidental	1 & 2	High	Minor	Unlikely	**Low (6)**	n/a	**Uncertain**	
		Negative publicity impacting tourist numbers	Accidental	1 & 2	Moderate	Minor	Unlikely	**Low (6)**	n/a	**Uncertain**	

Activity	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity [1]	Severity [1]	Likelihood [1]	Impact / Risk Significance [1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
Vessel collision / grounding leading to MGO Spill in Berkeley Sound	Scenario 2: 1,200 tonne MGO spill	Water quality and toxic effects on Plankton	Accidental	1 & 2	Moderate	Moderate	Unlikely	**Low (6)**	n/a	**Uncertain**	exclusion zone, or other defined area, and Development and implementation of the OPEP. Site-optimised OSR capability. **Project-specific:** Speed limitations (eight knots), Watch-keeping, Adherence to GOMO Guidelines (2013), LTVs vetted for double-skinned fuel tanks, Enhanced crew competency,
		Toxic effects on Marine flora (kelp)	Accidental	1 & 2	Moderate	Minor	Unlikely	**Low (6)**	n/a	**Uncertain**	
		Sediment quality and toxic effects on Benthic communities	Accidental	1 & 2	Moderate	Moderate	Unlikely	**Low (6)**	n/a	**Uncertain**	
		Toxic effects on Fish and squid	Accidental	1 & 2	High	Moderate	Unlikely	**Moderate (8)**	**Moderate (8)**	**Uncertain**	
		Impact on fisheries from tainting of fish and contamination of fishing grounds	Accidental	1 & 2	High	Moderate	Unlikely	**Moderate (8)**	**Moderate (8)**	**Uncertain**	
		Plumage contamination and oil ingestion by Seabirds	Accidental	1 & 2	High	Serious	Unlikely	**Moderate (10)**	**Moderate (10)**	**Uncertain**	
		Pelage / skin contamination and ingestion of toxins by marine mammals	Accidental	1 & 2	High	Serious	Unlikely	**Moderate (10)**	**Moderate (10)**	**Uncertain**	
		Coastal ecology	Accidental	1 & 2	High	Minor	Unlikely	**Low (6)**	n/a	**Uncertain**	
		Negative publicity impacting tourist numbers (human population Tourism)	Accidental	1 & 2	Moderate	Minor	Unlikely	**Low (6)**	n/a	**Uncertain**	

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

12.3 At-shore and onshore fuel oil and chemical spills

Table of Contents

12.3.1 Introduction 1267
12.3.1.1 Relevant legislation 1267
12.3.1.1.1 Compliance with chemical selection legislation 1268
12.3.1.1.1.1 Compliance with chemical use and discharge legislation 1268
12.3.1.1.1.2 COMAH regulations compliance 1268
12.3.1.1.2 MARPOL Annex III 1268
12.3.2 Sources of at-shore oil and chemical spills 1269
12.3.3 Potential receptors 1269
12.3.4 Characterising and quantifying the risk of at-shore and onshore spills 1269
12.3.4.1 Port facility and onshore supply base use 1270
12.3.4.1.1 Day-to-day operations 1270
12.3.4.1.2 Bulk transfer of substances 1271
12.3.4.1.2.1 MGO bunkering at the TDF and / or FIPASS 1271
12.3.4.1.2.2 Chemical transfer operations 1271
12.3.4.1.3 Vessel approaches 1273
12.3.4.1.3.1 History of collisions in Stanley Harbour 1273
12.3.4.1.4 Fate of chemicals in the marine environment 1274
12.3.4.2 Onshore chemical storage 1274
12.3.4.2.1 History of onshore chemical spills during exploration campaigns 1274
12.3.4.3 Major accidents at the supply base 1275
12.3.5 Industry standard mitigation 1275
12.3.5.1 Day-to-day operations and bulk transfers at the TDF 1275
12.3.5.2 Vessel approaches 1276
12.3.5.3 Chemical storage at onshore supply base - major accident prevention 1276
12.3.5.4 Oil Pollution Emergency Plan (OPEP) 1277
12.3.5.4.1 Response options available for all at-shore oil and chemical spills 1277
12.3.5.4.1.1 Equipment List 1277
12.3.6 Risk assessment for at-shore oil and chemical spills 1278
12.3.6.1 Day-to-day operations 1278
12.3.6.2 Bulk transfer of substances 1279
12.3.6.2.1 MGO fuel transfer spills at TDF and / or FIPASS 1279
12.3.6.2.2 Chemical transfer spills at the TDF 1279
12.3.6.3 Vessel approaches 1279
12.3.6.4 Chemical storage spills at onshore supply base 1280
12.3.6.5 Spills associated with major accidents at the supply base 1280
12.3.7 Project-specific mitigation measures 1280
12.3.8 Residual impacts and risks 1280
12.3.9 Cumulative impact 1281
12.3.10 Confidence 1281
12.3.10.1 Monitoring required 1281
12.3.11 Offsetting 1281
12.3.12 Findings summary 1281

12.3.1 Introduction

The interface between the land-based storage of fuel and chemicals and their offshore use presents a risk in terms of the onshore storage and the 'at-shore' transfer of potentially hazardous liquid products, for example fuel oil and chemicals.

This chapter assesses the impacts and risks associated with:

- The transfer of fuel oil at the Temporary Dock Facility (TDF) and / or Falklands Interim Port And Storage System (FIPASS),
- The movement of chemicals at the TDF, and
- The storage of chemicals at the onshore supply base.

Under the Planning Ordinance 1991, an Environmental Impact Assessment (EIA) was conducted as part of the original planning application for the TDF to cover the construction and operational use of the facility (NEFL, 2013). In addition to the EIA, a TDF Oil Pollution Emergency Plan (OPEP) to cover activities within Stanley Harbour was produced (Premier, 2014b), which is compatible with the Falklands National Oil Spill Contingency Plan (NOSCP). The assessment below draws on the conclusions of the EIA and contents of the project-specific OPEPs.

Note: the other impacts and risks associated with potential oil spills during offshore and inshore operations are described elsewhere in this document (Sections 12.1 and 12.2 respectively).

Note: oil spill waste and the procedure for dealing with oil spill clean-up waste is described in Section 10.10.2.2.3.

12.3.1.1 Relevant legislation

The legislation relevant to all oil spills is described in Section 12.1.1.1.

Additional legislation relevant to at-shore activities or to the selection, use and discharge of chemicals, and / or that which is directly relevant to chemical spills at the TDF and onshore supply base specifically include:

- International legislation:
  - International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78:
    - Annex III- Regulations for the Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form.
  - OSPAR Decision 2000/2 on a Harmonised Mandatory Control System (HMCS) for the Use and Reduction of the Discharge of Offshore Chemicals.
  - OSPAR Recommendation 2010/3 on a Harmonised Offshore Chemical Notification Format (HOCNF).
  - OSPAR Recommendation 2010/4 on a Harmonised Pre-Screening Scheme for Offshore Chemicals.
  - OSPAR Recommendation 2006/3 on Environmental Goals for the Discharge by the Offshore Industry of Chemicals that are, or which contain Substances Identified as Candidates for Substitution.
  - EC Directive 2012/18/EU on control of major-accident hazards involving dangerous substances.
- UK legislation:
  - Offshore Chemical Regulations (OCR) 2002 (and all amendments).
  - The Control of Major Accident Hazards (COMAH) Regulations 2015.

12.3.1.1.1 Compliance with chemical selection legislation

Details on the compliance requirements relevant to chemical selection are provided in Section 10.7.1.1.2 so are not repeated here.

12.3.1.1.1.1 Compliance with chemical use and discharge legislation

The offshore chemical regulations require that the use and discharge of all chemicals be permitted and reported and that all chemical releases be reported *via* the PON system to FIG.

12.3.1.1.1.2 COMAH regulations compliance

The aim of the COMAH Regulations is to prevent and mitigate the effects on people and the environment of major accidents involving dangerous substances. They are applicable to any establishment storing, or otherwise handling, large quantities of industrial chemicals of a hazardous nature. Types of establishments include chemical warehousing, chemical production facilities and some distributors. Whether or not a site qualifies as a COMAH site will depend upon the type and quantity of chemicals stored:

- Lower tier establishments are required to document a Corporate Major Accident Prevention Policy (CMAPP) which should be signed off by the managing director, and
- Top tier COMAH establishments are required to produce a full safety report which demonstrates that all necessary measures have been taken to minimise risks posed by the site with regard to the environment and local populations.

The proposed storage of up to 400 m^3 of methanol does not qualify the proposed operations base as the equivalent of a lower tier UK COMAH site however, Navitas' internal process will apply a COMAH methodology and require the following activities to be undertaken:

- Reduce risks to ALARP,
- Notify the Competent Authority,
- Prepare a Major Accident Prevention Policy (MAPP),
- Provide information for the public, and
- Consider the possible domino risks.

In addition to the above, Navitas intend to produce a Safety Report covering the transportation and storage of chemicals at the proposed base. Further details are provided in the Major Accident Hazard Assessment completed for POEPL by Risktec (Premier, 2017a).

Full guidance on the COMAH qualification and assessment process is provided by the Health and Safety Executive.

12.3.1.1.2 MARPOL Annex III

In 1973, IMO adopted the International Convention for the Prevention of Pollution from Ships, now known universally as MARPOL. The convention has been repeatedly amended and updated by the Marine Environmental Protection Committee (MEPC).

Annex III sets out regulations for the prevention of pollution by harmful substances in packaged form and includes general requirements for the issuing of detailed standards on packing, marking, labeling, documentation, stowage, quantity limitations, exceptions and notifications for preventing pollution by harmful substances. For the purpose of Annex III, 'harmful substances' are those identified as 'marine pollutants' in the International Maritime Dangerous Goods (IMDG) Code and compliance with Annex III will form part of Navitas' contractor management and audit processes (Section 3.2.15).

12.3.2 Sources of at-shore oil and chemical spills

It is the intention of Navitas to apply to FIG to extend the operational life of the TDF. Further, Navitas shall propose future modifications to improve the Dock's functionality. As described in Section 5.11.1.1.1, proposals to extend the life of the TDF and / or upgrade the facilities will have to go through the process of planning, which may be accompanied by a full separate EIA.

For the purposes of this EIA, it is assumed that proposed upgrades to the TDF will be approved.

Sources of at-shore oil and chemical spills / leaks during the project include:

- The presence and use of pieces of equipment that involve fluid products. Such equipment includes (but may not be limited to):
  - Crane/s,
  - Forklifts,
  - Ballast pumps,
  - Diesel generator,
  - Oil storage tanks and fixed, hard-piped lines, and
  - Heavy goods vehicles and cars.
- Chemical transfer at the TDF (Section 5.11.1.1.1),
- Diesel (Marine Gas Oil, MGO) bunkering at the TDF and / or at FIPASS (Section 5.11.1.1.2),
- Mud and chemical storage at the onshore supply base,
- Major accidents at the supply base, and
- Vessel collisions and groundings on approach to the port facilities

12.3.3 Potential receptors

The ENVironmental Impact and risk IDentification (ENVIID) workshop was used to identify those receptors upon which the impacts and / or risks of oil spills warranted further investigation (Chapter 9). These include:

- Sediment quality and marine benthic flora and fauna in Stanley Harbour and surrounding areas (Section 7.4.3.4),
- Water quality and plankton (Section 7.4.1),
- Fish and squid in Stanley Harbour and surrounding areas (Section 7.4.4.4),
- Seabirds in Stanley Harbour and surrounding areas (Section 7.4.5.4),
- Marine mammals in Stanley Harbour and surrounding areas (Section 7.4.6.4),
- Coastal communities and habitats (Section 7.5.1), and
- Tourism (Human population) (Section 7.7.4.6.1).

These receptors may be impacted upon as they either exist in, or spend time in, the area that might be influenced by fuel oils or chemicals accidentally discharged into the environment.

12.3.4 Characterising and quantifying the risk of at-shore and onshore oil and chemical spills

The influencing factors with regard to oil type and behaviour, and the nature of the impacts of oil spills on receptors have already been described in Section 12.1 above. However, when characterising and quantifying the impacts of at-shore oil and chemical spills specifically, it is also necessary to consider the following:

- Port facility and onshore supply base use and the scenarios which could lead to spills:
  - Day-to-day operations,
  - Bulk transfer of substances,
  - Vessel approaches, and
  - The fate of chemicals in the marine environment.
- Onshore chemical storage, and
- Major accidents at the supply base.

12.3.4.1 Port facility and onshore supply base use

Given the known activities occurring at the TDF, FIPASS and the onshore supply base, a spill scenario identification exercise was conducted in 2014 by POEPL (now Navitas) to identify the credible emergency scenarios that could result in a spill of hydrocarbon and / or chemicals (Premier, 2014b). These scenarios are identified below and will be included within the scope of Navitas' Phase 1 & 2 Development At-shore OPEP.

12.3.4.1.1 Day-to-day operations

Small scale spills and leaks may occur through the presence and / or the day-to-day use of equipment (as listed in Section 12.3.2 above). Specifically, spills and leaks that may result from the presence and / or use of equipment include losses of:

- Fuel oils,
- Hydraulic oils,
- Oily bilges from machinery spaces,
- Oil fouled water from ballast tanks,
- Leaks from propeller shaft or drive-shaft oil seals, and
- Leakage of hydraulic or lubricating oils from various moving parts such as hydraulic ramp and deck moving / lifting mechanisms.

Leaks most commonly occur due to incorrect maintenance or neglect of maintenance schedules and most can be avoided in the first instance through procedural control. However, where leaks do occur, they can be a significant source of discharged fluids, particularly if they go undetected for significant periods of time.

At the TDF, very small leaks or spills of diesel from vehicles or machinery are likely to be contained on the superstructure of the dock where they will rapidly evaporate and are amenable to clean-up. However, larger spills may reach the water which could occur through drains or direct runoff from quayside surfaces.

In water, MGO readily spreads to form a sheen, which evaporates rapidly (Section 12.1.4.1.1.2). Heavier oils, such as hydraulic oil, behave differently and some fractions of these oils will transfer to the bottom and stay there. Eventually, the ingredients of hydraulic fluids are degraded in the environment, but complete degradation may take more than a year (ATSDR, 1997). Little is known about how some of the ingredients in hydraulic fluids break down in the environment, but almost nothing is known about how toxic these breakdown products are. However, there are biodegradable hydraulic oils on the market, the use of which would greatly reduce the risk of environmental impact. Over recent years, the O&G industry has progressively replaced many more harmful fluids that were once oil-based and has transitioned to less harmful oils or non-oil systems. For example, hydraulic fluids planned for the subsea control system on the FPSO, for the operation of the BOP on the MODU

and for the operation of tensioning systems on the MODU are biodegradable products based on the PLONOR chemical Monoethylene Glycol (MEG).

Any unintentional at-shore release which reaches the water, however small, will contribute to chronic pollution of the marine environment.

12.3.4.1.2 Bulk transfer of substances

Bulk transfers involve the use of unbunded flexible bulk hoses which can be considered a weak link in terms of the potential for accidental spills and leaks.

12.3.4.1.2.1 MGO bunkering at the TDF and / or FIPASS

There is a potential risk that during bunkering operations, MGO could be spilled to sea, due to:

- Equipment failure / malfunction e.g., dry-break valve failure, perishing of hoses, failure of level gauge, level alarms, tank failure and / or
- Operator error e.g., poor bulk hose storage, neglect of hose inspections / change-out schedules, neglect of watchman during operations.

In the past ten years there have been several small MGO spills in Stanley Harbour, with the largest amounting to about 100 litres (ITOPF, 2018). However, there have been larger spills recorded within the Islands' territorial waters in the last 20 years, resulting from groundings (see Section 12.2).

The likelihood of unintentional releases of MGO is greatest during transfer operations, when diesel is moved from one secure holding tank to another *via* bulk hoses. Detailed spill statistics are not available for the Falkland Islands, but as dry-break couplings will be used on the bulk hoses alongside shut-down valves and observations, it is assumed that the worst-case maximum volume of any spill would comprise only the volume of diesel contained in the mains pipe before the valve is manually shut down. This is estimated to be approximately one tonne (Table 12.28). This scenario could only occur if the automated emergency shut down valves failed and the quayside watchman was unaware of the incident and pumps remain on for a time before being shut-off.

As detailed in Section 12.1.4.1.1.2, MGO contains a high percentage of low molecular weight hydrocarbon compounds, known as 'light ends' and hence tends to disperse very rapidly upon release to the marine environment (mainly *via* evaporation), usually within a matter of hours on the surface. Further, MGO is biodegraded by naturally occurring microbes in the sediment, under a time frame of months. However, if a large volume of the fuel were to be released in the vicinity of the TDF, it could spread and pose a significant risk of possible impact to wildlife throughout Stanley Harbour, even if only for a brief period of time. Small diesel spills can affect marine birds due to ingestion during preening as well as by hypothermia from matted feathers, though the number of birds affected is usually small because of the short time the diesel is on the water's surface (Section 12.1.4.1.1.2).

When small fuel oil spills do strand on the shoreline, the fuel oil tends to penetrate porous sediments rapidly but also tends to be washed off quickly by waves and tidal flushing. Thus, shoreline clean-up following diesel spills is usually not needed.

12.3.4.1.2.2 Chemical transfer operations

For the purpose of this assessment, it is assumed that all chemical cargo (and other supplies needed to support offshore operations) will be delivered to the TDF and stored at the onshore supply base (Section 5.11.1).

Throughout the project all chemicals will be selected to minimise environmental impacts as much as possible, in compliance with legislation. However, although chemicals may be rated as Posing Little Or NO Risk (PLONOR) when used in-field due to the concentrations and application type, they are transported as undiluted chemicals and in this state, pose a greater environmental risk.

Well chemicals

Details on the specific chemicals that will be used during the drilling operations are not yet known. However, the well chemical function groups required are as described in Section 5.9.1.

Vessels will be loading and offloading a number of chemicals that will be used in the drilling operation. The majority of chemicals required are dry 'bulk' chemicals used in the make-up of drilling fluids. However, Non-Aqueous Drilling Fluid (NADF) may be pumped across the TDF and onto the supply vessels (subject to approval of proposed upgrades to the TDF). Other chemicals that will be transferred at the TDF might include: cementing chemicals, rig cleaning chemicals, and pipe dope (drill pipe connector thread lubricants and sealing compounds). During transfer of chemicals to and from the TDF, there is a potential risk that the chemicals could be spilled to sea. Liquid chemicals will be transported in various sizes of drum, Intermediate Bulk Containers (IBCs) and tote tanks that are sealed for transit, and as such a loss of a load during transfer would not immediately result in a loss of chemical to sea; the container would have to be breached in some way during the incident for this to occur. The most credible spill scenario would be damage to one of the bunkering lines for NADF. These have dry-break couplings and so a release would be limited to the length of one hose section with a likely volume of up to 1 m^3.

Production chemicals

Details on the specific chemicals which will be used during production operations are not yet known. However, the production chemical function groups required are as described in Section 5.9.1.

Of the chemical function groups required, two chemicals which are required to ensure flow assurance (namely wax inhibitor and methanol) are required in significant volumes, while the other chemicals are required in lesser quantities (Section 5.9.1.1). While the quantities of the different production chemicals will change as oil production rates decline, the wax inhibitor and methanol make up 70 % of the total first year production chemical volume requirements. These bulk chemicals will be transported from their place of manufacture (which is likely to be the UK) to the Falklands in 24,000 litre (20') ISO frame tanks.

Once the bulk chemicals are delivered to the Falkland Islands, the tanks will be unloaded at the TDF and moved onshore to be stored in the production chemical laydown yard until they are ready to be taken offshore. When required offshore, the bulk chemicals will be shipped to the field, by transporting the 20' ISO frame containers to the TDF and pumping the contents into the hull tanks of the FPSO's supply vessels. These hull tanks will be used only for these chemicals such that there will be no cross-contamination. The maximum possible spillage that could occur is the full volume of a single tank (Table 12.28). The empty containers will then be returned to the production chemical laydown yard for storage and subsequent back loading (Section 10.10). The FPSO's supply vessel will then transport the chemicals to Sea Lion where they will be offloaded *via* bulk hoses into the storage tanks in the FPSO.

The worst-case scenarios which could lead to the loss of the content of an ISO frame tank to sea during transfer include:

- Offload of the frame tanks from a vessel to a vehicle on the TDF *via* crane-lift, and
- Pumping of the tank content into the FPSO's supply vessel from the TDF.

The smaller volume chemicals will be decanted into tote tanks in the production chemical laydown yard. These will then be transported to the TDF on trucks and lifted by crane onto the back deck space of a supply vessel. They will then be transported out to Sea Lion, where they will be lifted by crane into metal framed bins on the deck of the FPSO.

12.3.4.1.3 Vessel approaches

The increase in the number of vessels utilising Stanley Harbour during the project increases the potential risk of vessel collision, particularly if vessels working on behalf of Navitas are not familiar with the location.

However, by international standards, the Harbour is not regarded as a busy port. Instead it can be described as a relatively quiet port with notable busy periods during cruise ship and fishing seasons such that collisions and groundings should be readily avoidable by following standard navigational procedures (e.g., ColRegs).

Assuming a worst-case-scenario, a fully laden offshore support vessel would contain approximately 800 m^3 of MGO fuel. This would be spread between numerous different tanks and therefore it is extremely unlikely that all of this could be lost in a single event. A more credible worst-case scenario is the loss of fuel from two fuel tanks, which is predicted to be around 320 m^3, based on a typical MRSV. Nevertheless, a breach of a fuel tank could result in a sizable spill in sheltered inshore waters, where dispersal by wind and waves would be limited.

Table 12.28: Summary of the credible worst-case spill quantities for each at-shore scenario

Scenario	Cause	Spill type	Credible worst-case volume (m^3)
Day to Day operations	Leaks, seeps and weeps	Fuel and hydraulic oils to sea	<1 m^3
Diesel bunkering	Equipment failure (e.g., hose rupture) / human error	Diesel to sea	1 m^3
Chemical bunkering	Equipment failure (e.g., hose rupture) / human error	Drilling mud	1 m^3
	Equipment failure (e.g., crane failure) / human error	Wax inhibitor or methanol to sea	24 m^3
Chemical storage	Equipment failure (e.g., failure of forklift truck) / human error	Drilling / production chemical to land	1 m^3
	Major accident with associated spill	Chemical / oil to sea or land	0[1] m^3
Vessel approach	Collision or grounding due to equipment failure / human error	Fuel to sea	320 m^3
		Chemical to sea	10 m^3

[1] No spill is theoretically credible as the bund capacity is 110 % of the total volume of chemicals stored, so any spill on the base will be contained within the bund and double drainage system.

12.3.4.1.3.1 History of collisions in Stanley Harbour

Fishing vessel *Pesca Vaqueiro* ran into the FIPASS dock whilst on approach on 5th September 2019. Otherwise, there are no formal records of collisions in Stanley Harbour although there have been a number of collisions between local vessels, or vessels running aground, in Stanley Harbour and Port William in recent years (A. Black, *pers. obs.*). None of these events involved vessels associated with the Oil and Gas (O&G) industry and none resulted in a major pollution incident.

12.3.4.1.4 Fate of chemicals in the marine environment

The fate of chemicals in the environment will vary enormously depending upon the substances concerned; however, the following properties of each chemical used will be considered:

- Relative biodegradation,
- Persistence and toxicity, and
- Potential to bioaccumulate.

The varying combinations of the above will affect the impact each chemical may have in the event that it is spilled.

For example, the behaviour of a methanol spill would be similar to that of an MGO spill (i.e., relatively rapid evaporation); however, as methanol is soluble in water it would disperse more rapidly to non-toxic levels (<1 %) (dependent on water mixing due to tide or wind) and would biodegrade. Although biodegradation of a large spill in enclosed waters could lead to localised deoxygenation of surface waters, this is unlikely where water is well mixed.

12.3.4.2 Onshore chemical storage

Once offloaded onto the TDF and transported to the yard:

- Drilling chemicals will be stored in a dedicated NADF and bulks facility, and
- Production chemicals will be stored in a dedicated production chemical laydown yard (Section 5.11.1.2).

The worst-case scenarios which could lead to the loss of containment of chemical to ground during transfer include:

- Offload of the frame tanks from the vehicle to the chemical laydown yard, and
- Loading of the frame tanks onto a vehicle at the laydown yard for transportation to the TDF.

12.3.4.2.1 History of onshore chemical spills during exploration campaigns

There were two incidents of chemical spills at the onshore supply base during the 2015 exploration wells campaign. Neither incident resulted in significant release of chemicals or in environmental damage.

The first incident occurred as IBCs, containing approximately 1,000 litres each, were being moved from one laydown yard to another. As the forks of the forklift truck were entered into the lifting pockets of the IBC, the metal plate at the base was caught and scraped by the right-hand fork, resulting in the plate being dented and pushed upwards, thereby puncturing the IBC. When reversing, the forklift operator noticed a puddle of liquid on the ground. The chemical spilled was Halliburton CFS - 476 (Oxygen Scavenger) which is a Cefas Gold chemical (see Section 12.3.1.1.1). The spill was estimated to be in the region of 400 litres. Action was taken to prevent further spillage and the incident was reported to FIG.

The second incident concerned small leaks from several IBCs that had been stored at the laydown yard for over a year. The IBCs had been placed on chipboard boards, which, when lifted, were discovered to be damp, with the screed floor underneath also damp. There was no other obvious source of the dampness other than from the IBCs. The IBCs contain MEG which is an OCNS E rated chemical (see Section 12.3.1.1.1).

It was noticed that some of the caps at the bottom of the IBCs were not fully finger tight, so the decision was made to re-locate all IBCs containing MEG and manually tighten their caps. All IBCs were accessible in the hold of the vessel and in the warehouse, and three were found to have minor leaks from the

cap. They were tightened and spill pads were secured around the cap to prevent any further leakage. It is estimated that 1 litre had leaked over a 12 month period.

12.3.4.3 Major accidents at the supply base

In the event of a major incident at the supply base, such as an explosion, whilst safety of personnel is of greatest concern, there can be the risk of an associated spill to ground or sea. The UK COMAH regulations (Section 12.3.1.1.1.2), which Navitas will adhere to, are designed to prevent any impacts of major accidents, to both the human population through separation distances, and to the surrounding environment *via* the implementation of appropriately designed site bunding and drainage, see Section 12.3.5.2.

The inventories identified as having the potential to cause a major accident are the methanol and explosives, which may be used in drilling to release the drillstring in the event of stuck pipe[99]. The explosives will be stored at a dedicated separate location, such that any explosions instigated by them will not cause an associated spill.

Any fire / explosion in the methanol storage area, which has the potential to cause an associated spill, will be firstly contained within the bund (see Section 12.3.5.2 below), and, due to the highly flammable nature of methanol, is likely to be burnt up in the explosion.

Navitas will apply mitigations to the methanol storage to ensure other flammable material or oils are not stored in proximity to the methanol to prevent event escalation.

12.3.5 Industry standard mitigation

The following sections described the industry standard mitigations relevant to each potential source of spills / leaks and conclude with an overview of the Oil Spill Response (OSR) equipment that will be utilised in accordance with the project-specific OPEP.

12.3.5.1 Day-to-day operations and bulk transfers at the TDF

The industry-standard mitigation measures used by Navitas to prevent and mitigate against leaks and spills at the quayside are as follows:

- Use of Maintenance Management System (MMS) to ensure all equipment remains in good working order and fit for the purpose intended:
  - The MMS will provide alerts for regular Preventative Maintenance Routines (PMR), with priority given to equipment listed in the Safety and Environmentally Critical Elements (SECE) Register (Section 3.2.7),
  - A Locked Open / Locked Closed (LO / LC) Register will be used at the TDF to ensure that all safety and environmentally critical valves will be left in the appropriate position,
  - Critical spares will be identified and in place, and
  - Hose management processes in line with NWEA good practice guidelines (Chamber of Shipping, 2009). Bulk hose and flexible hose management procedures which will ensure that all hoses are stored correctly, inspected and changed-out regularly, colour coded appropriately, listed in hose registers and utilise swivel joints to minimise kinking etc.
- Use of standard operating procedures, for example:
  - Diesel bunkering procedures which will ensure that:
    - Bunkering operations will be monitored throughout by trained personnel under Navitas supervision, and

[99] No explosives will be used to perforate the casing in the proposed basis of design as the wells will be completed using Open Hole Gravel Packs (OHGP) (Section 5.4.5.5).

        - A team utilised to hook up, and following commencement of pumping, to monitor from the quayside.
    - Chemical handling and loading procedures.
- Use of task-specific planning, toolbox talks, risk assessments, job safety analysis and pre-use checks,
- Use of emergency response plans e.g.:
    - Facility Emergency Response Plan (ERP) and OPEP for the TDF will align with the existing OSCP in place for FIPASS,
    - Use of a Hazardous Chemical Management Plan (HCMP) to manage the handling of chemicals, and
    - Sea Lion Field At-shore Development OPEP.
- Use of engineering controls e.g., dry-break coupling on bulk hoses, emergency shut-down valves,
- Training of all personnel in spill prevention and response, and
- Use of spill kits which will be located on the TDF and at FIPASS.

12.3.5.2 Vessel approaches

It is anticipated that Navitas will co-operate in a Harbour Management Plan (HMP), designed and implemented in close collaboration with the Harbour Master[ibid] to include the following:

- Pre-notification protocols associated with the entry of vessels into Stanley Harbour during operation,
- Procedures associated with vessel collision and emergency response,
- Marine night-time lighting requirements, and
- VHF Radio communication protocols.

The system of reporting within the Harbour and Port William will inform all users of vessel movements. The crews of O&G related vessels are highly trained and the vessels (e.g., AHTS/MRSVs) are extremely manoeuverable. All users of Stanley Harbour will continue to be made aware of the position of the TDF and the structure will be lit at night.

Pre-mobilisation audits will be undertaken on all vessels. Vessels will be selected which comply with all IMO codes for the prevention of pollution from both oil and chemicals.

All vessels will have a Shipboard Oil Pollution Emergency plan (SOPEP) in place to enable fast and effective response to any potential pollution incident.

12.3.5.3 Chemical storage at the onshore supply base and major accident prevention

The industry-standard mitigation measures used by Navitas to prevent and mitigate against leaks and spills at the supply base are as follows:

- All onshore storage operations involving the production chemicals will take place in a bunded facility to ensure that any spills can be contained:
    - In line with COMAH (2015), the normal design specifications for bunding require a holding capacity of 110 % of the largest tank contained within the bunding and 25 % of the total capacity of all the tanks within the bund (whichever is the greatest volume).
- A ‘double drainage’ system will be required for surface water in hazardous areas, which will allow the recovery and appropriate disposal of surface water that has become contaminated by any spilt production chemicals,

- Tote tanks will be inspected and maintained within the production chemical laydown yard in compliance with the inspection and certification regime,
- Tote tanks will be returned to the UK for in depth inspections and certification, if it is not possible to complete this within the Islands, and
- All personnel will be adequately trained in spill prevention and response and in the use of spill kits which will be located around the supply base.

Based on the maximum volume of methanol that will be stored at the onshore facility (i.e., up to 400 m^3 at any one time) it is anticipated the location will fall below the definition of a lower tier COMAH site. Nevertheless, Navitas will adopt chemical management standards in line with the COMAH regime in the UK. This will include, amongst other safety precautions, adherence to safe separation distances of flammable chemicals to local houses and roads, which has been calculated to be between 80 - 136 m (Premier, 2017a).

12.3.5.4 Oil Pollution Emergency Plan (OPEP)

Numerous spill response measures will be defined within the OPEP and will therefore be in place to minimise the consequence of a spill should it occur. This equipment will be stored in Stanley and will be available for use, where appropriate, in the event of at-shore incidents.

12.3.5.4.1 Response options available for all at-shore oil and chemical spills

In the unlikely event of a spill in Stanley Harbour, the main response to spilled MGO or chemicals would be to use absorbent materials to contain and collect the spill.

In the event of a larger spill, booms will be deployed to contain the spill to allow recovery and prevent contamination of the shore. Once corralled, sorbents will be used to soak up the hydrocarbons. It may also be possible to use an oil skimmer to recover the spill from the sea's surface. Dispersants are not included here as they would not be considered an appropriate response for chemical or diesel spills in shallow water, such as around Stanley Harbour.

Shorelines may also be boomed, but if the spill impacts the shoreline, personnel may be required to physically remove diesel / chemical deposits from the shoreline using hand tools. However, it should be noted that this is only a viable response option if the safety of personnel is assured and the response will be more effective than allowing the spill to breakdown naturally.

It will always be necessary to monitor the extent of the spill as far as possible from the shore and using boats in the area, and to inform the local authorities of the spill (PON 8) and the planned response.

12.3.5.4.1.1 Equipment List

The following spill response equipment, or similar, will be available in Stanley (see also Section 5.11.1.2.3):

- Oil skimmer[100] with diesel pump and hoses,
- Inshore boom,
- Oil water storage tank with groundsheet and cover,
- Fish totes containing pads and heavy-duty waste bags,
- Chemical sorbent spill kits (stored in wheeled totes),
- Sealed plastic fish tote with spare hand tools, basic Personal Protective Equipment (PPE) and signage,
- Flexible IBCs,

[100] **Note:** oleophilic weir skimmers will only be deployed for response to MGO spills.

- Pressure washer,
- Oil snare and oil snare on rope,
- Steam generator,
- Two trailers,
- A fast response Rigid Inflatable Boat (RIB) which will have oil recovery equipment on board for boom deployment and support will be based in Stanley, and
- FIPASS spill response equipment (mobilised and managed by FIG).

12.3.6 Risk assessment for at-shore oil and chemical spills

The following section draws upon all the information provided above to assess the 'Sensitivity of the Receptor' and the 'Severity of Effect' in order to determine the overall 'Impact' of any spills, followed by an assessment of the 'Likelihood of Occurrence' to determine the overall 'Risk'.

A summary of the risk assessment outcomes for this Development is tabulated in Section 12.3.12, which shows the worst-case risk for each activity and receptor and details are provided below.

12.3.6.1 Day-to-day operations

The nature of the impact of MGO, or chemical spills, on birds and marine mammals is different (see Section 12.2.4.2) and is likely to be greater on birds due to feather fouling and loss of insulation than on marine mammals, which are generally more impacted by ingestion. Therefore, birds are considered to be the more sensitive receptor. As described in Sections 7.4.5.4 and 7.4.6.4, Stanley Harbour supports a population of flightless Falkland steamer ducks, and is utilised by Commerson's and Peale's dolphins and South American sea lions. Although the number of animals present is not significant in terms of the Falklands populations, all of these are included in the list of priority conservation species (Section 7.5.3) and therefore the sensitivity of receptors is considered to be '**High**'.

Although there is some uncertainty regarding the potential impacts of some of the fluids used during operations on the TDF (Section 12.3.4.1.4), the environmental impact of any small leak or spill will be localised, short-term and fully reversible once activity ceases. Considering the range of other activity that could result in leaks or small spills of hydrocarbons that is currently undertaken around the Harbour, the impact from project activity is considered to pose a barely detectable impact on species, habitats or the ecosystem. Small spills or leaks would not warrant the deployment of full OSR equipment although the swift use of localised spill kits may serve to lessen the severity of effect. Nonetheless, this cannot necessarily be relied upon and therefore, on balance, the severity of effect is considered to be '**Minor**'.

Therefore, the overall significance of impact is '**Moderate (8)**'.

Accidental release of small volumes of fluids associated with day-to-day operation of the TDF represents the most likely source of unintentional releases. During the 2015 exploration wells campaign, there were two incidents of small chemical spills and leaks in the laydown yard. There was no risk of the chemicals escaping into the marine environment but it highlights the potential for accidental events and undetected leaks. These events may occur less than once per year but could occur more than once over 10 years in the event that operational controls failed; therefore, the likelihood of small-scale spills or leaks occurring and contaminating the environment is '**Possible**'.

Therefore, the overall risk associated with day-to-day small spills is assessed as '**Moderate (9)**'.

12.3.6.2 Bulk transfer of substances

12.3.6.2.1 MGO fuel transfer spills at TDF and / or FIPASS

The most sensitive potential receptors are the same as those described in Section 12.3.6.1. Therefore, the sensitivity of receptors is considered to be '**High**'.

The environmental effect of small MGO spills (i.e., <1 tonne) would be localised short-term, and fully reversible. The impact would be barely detectable on species, habitats or the ecosystem as a whole and therefore, the severity of effect is considered to be '**Minor**'.

Therefore, the overall significance of impact is '**Moderate (8)**'.

The zone affected by any spill will vary according to weather conditions. In severe weather, for example, any pollution will be moved a greater distance but will be diluted more quickly at the same time by increased turbulence. Although small spills have occurred infrequently during fuel transfer operations at FIPASS in the past, no spills occurred during the 2015 POEPL exploration drilling campaign. The base-case mitigations applied by Navitas vessels represents a higher standard than that applied generally within the shipping industry, such that the likelihood of diesel spills during bunkering operations is considered to be '**Unlikely**'.

Therefore, the overall risk associated with MGO spills during bunkering is '**Low (6)**'.

12.3.6.2.2 Chemical transfer spills at the TDF

The most sensitive potential receptors are the same as those described in Section 12.3.6.1. Therefore, the sensitivity of receptors is considered to be '**High**'.

The nature and severity of the impact of a chemical spill will depend on the chemicals involved. For instance, in terms of volume transferred, methanol will be one of the most significant chemicals used during the project but will rapidly disperse causing only localised deoxygenation (Section 12.3.4.1.4). In contrast, another chemical may be spilled in lower volumes but may, for example, be more toxic. On balance, however, and given that the bulk chemicals intended for use are expected to be Cefas Gold or OCNS E (see Section 12.3.1.1.1), the overall severity of the impact of a chemical spill is considered to be '**Minor**'.

Therefore, the overall significance of the impact is '**Moderate (8)**'.

As above, the zone affected by any spill will vary according to weather conditions. Small chemical spills have occurred previously in the global O&G industry, however, no spills occurred during the POEPL 2015 exploration drilling campaign and failure of numerous operational controls would be required. The likelihood of all mitigation measures described above failing is such that the likelihood of chemical spills is considered to be '**Unlikely**'.

Therefore, the overall risk associated with the transfer of liquid chemicals is '**Low (6)**'.

12.3.6.3 Vessel approaches

The most sensitive potential receptors are the same as those described in Section 12.3.6.1. Therefore, the sensitivity of receptors is considered to be '**High**'.

Small spills such as those that may result from collisions of vessels using Stanley Harbour are likely to have a short-term, rapidly reversible impact on the local ecosystem and species. Nonetheless, the loss of up to 320 m^3 of fuel would warrant an immediate local OSR and therefore the severity of a collision between vessels that resulted in a significant oil spill is considered to be '**Serious**'.

Therefore, the overall significance of impact is '**High (16)**'.

As described in Section 12.3.5, numerous barriers will be in place to prevent collisions between vessels within Stanley Harbour such that the likelihood of collisions involving vessels supporting the project will be minimised as far as reasonably practicable. Failure of nearly all these operational controls would be required for a collision to occur and therefore the likelihood of a collision involving vessels associated with the Phase 1 & 2 Development that resulted in a significant oil spill is considered to be '**Very Unlikely**'.

Therefore, the overall risk associated with the major diesel spills resulting from a collision involving one or more vessels associated with Navitas' operations is '**Low (5)**'.

12.3.6.4 Chemical storage spills at onshore supply base

Given the use of the mitigation measures described in Section 12.3.5.2, it is not considered possible for spills at the supply base to reach any potential receptors. Therefore, as there is 'no potential to transmit contaminants to nearby sensitive receptors' the sensitivity of soil as a receptor is considered to be '**Very Low**'.

With no receptors impacted by any spill which will be contained within the bunds and double drainage system, the severity of effect is considered to be '**Slight**'.

Therefore, the overall significance of impact is '**Very Low (1)**'.

Spills and leaks at onshore supply bases have been known to occur within the industry and the majority of operational controls require implementation by humans e.g., correct storage / segregation / local bunding checks etc. rather than reliance on, and maintenance of, engineering controls. Therefore, the likelihood of chemical spills at the onshore is considered to be '**Possible**'.

Therefore, the overall risk associated with storage spills at the supply base is '**Very Low (3)**'.

12.3.6.5 Spills associated with major accidents at the supply base

Given the use of the mitigation measures described in Section 12.3.5.2, it is not considered possible for spills associated with major accidents at the supply base to reach any potential receptors. Therefore, as there is 'no potential to transmit contaminants to nearby sensitive receptors', the sensitivity of soil and sea as receptors is considered to be '**Very Low**'.

With no receptors impacted by any spill, which will be contained within the bunds and double drainage system, the severity of effect is considered to be '**Slight**'.

Therefore, the overall significance of impact is '**Very Low (1)**'.

Major spills at onshore supply bases breaching bunding limits have been known to occur within the industry but are rare. The majority of controls to prevent this happening are appropriate design of the bunding and drainage system, maintenance of bunds and linings and engineering controls. Therefore, the likelihood of chemical spills at the onshore is considered to be '**Unlikely**'.

Therefore, the overall risk of spills associated with major accidents is '**Very Low (2)**'.

12.3.7 Project-specific mitigation measures

With the exception of the presence and use of localised spill kits and the OSR equipment which will be described within the OPEP (Section 12.3.5.4), the majority of industry-standard mitigation measures are based around the prevention of spills occurring. There is not a great deal more which could be put in place to prevent the occurrence of incidents or to reduce the severity of effect.

12.3.8 Residual impacts and risks

With industry-standard mitigations in place, the significance of the risk associated with at-shore and onshore oil and chemical spills is generally '**Low**' or '**Very Low**'. The exception is the risk of small spills

and leaks during day-to-day operations which is considered to be '**Moderate**' as this is the most likely source of oil or chemicals escaping into the environment.

In the absence of additional means of reducing the likelihood of occurrence, or the severity of effect, the overall risk assessment for day-to-day spills and leaks remains '**Moderate (9)**'.

12.3.9 Cumulative impact

Although the TDF is reserved for O&G activities, throughout the lifecycle of the project many other users of the sea will be operating within Stanley Harbour. Many of these vessels will also be taking on fuel at FIPASS and will be required to safely navigate through inshore waters.

The presence of O&G vessels and activity will increase the number of fuel transfers within the Harbour ('increased concentration', Section 8.9.1). Navitas' activity will add to the potential sources of fuel and chemical spills occupying the same 'space' consecutively or soon after each other. This may increase the 'duration' of exposure for the same receptors and / or the 'extent and proportion' (Section 8.9.1) of the local or regional population at risk. However, the O&G industry will also bring many benefits in terms of harbour management and response capability and therefore the cumulative impact of Navitas' activities within Stanley Harbour is likely to be beneficial.

12.3.10 Confidence

Stanley Harbour has been the focus of vessel activity for many years. Records from FIMA (Section 7.6.4) show that from 2000 -2023 there have been 17 spills recorded in Stanley Harbour, indicating these are relatively rare events considering the volume of vessel traffic, and none of these spills have resulted in significant environmental impact. Additionally, the use of the TDF during the 2015 exploration campaign means that procedures have been developed and implemented and will be refined to meet the requirements of the Phase 1 & 2 Development. The history of O&G activity within the Harbour is such that confidence in the assessment of at-shore oil spills is considered to be '**Certain**'.

In contrast, while there have been no chemical spills to sea to date during the O&G activities (as is reflected in the likelihood of chemical spills (Section 12.3.6.2.2)), the current uncertainty over the specific chemicals which will be used is such that the severity of effect of chemical spills is based on assumptions. Therefore, the confidence in the assessment of at-shore chemical spills is considered to be '**Probable**'.

12.3.10.1 Monitoring required

Monitoring will be carried out in the event of any oil or chemical spill. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the project-specific Environmental Monitoring and Management Plan (EMMP) (Chapter 15).

12.3.11 Offsetting

Neither of the scenarios considered are likely to occur during the duration of project. Offsetting is therefore not considered appropriate for this type of unplanned event. Should a serious event occur, it is expected that remediation will be part of the final stages of the spill response process and subject to discussion with the authorities and stakeholders.

12.3.12 Findings summary

Table 12.29: Summary of the risk assessment of leaks and spills at the TDF, FIPASS and the onshore supply base

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity[1]	Severity[1]	Likelihood[1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
At-shore spills of liquid fuel and chemicals	Small leak / spill: day-to-day operations	Pollution of Stanley Harbour through spills and leaks with the potential to impact several species of local conservation concern and human population	Unplanned	1, 2a, 2b & 3	High	Minor	Possible	**Moderate (9)**	**Moderate (9)**	**Certain**	**Industry-standard:** Use of MMS, Use of standard operating procedures, Task specific planning, risk assessments etc., Use of emergency response plans e.g., ERP, OPEP and OSR equipment, NOSCP, HCMP, Use of engineering controls e.g., dry-break couplings, Training and spill kits, Use of HMP, Pre-mobilisation vessel audits, and Use of SOPEPs. **Project-specific:** None proposed
	Spill of diesel fuel during bulk transfer at the TDF and / or FIPASS		Accidental		High	Minor	Unlikely	**Low (6)**	**n/a**	**Certain**	
	Spill of chemical during bulk transfer at the TDF				High	Minor	Unlikely	**Low (6)**	**n/a**	**Probable**	
	Spill of diesel fuel due to collision or grounding during vessel approach				High	Serious	Very unlikely	**Low (5)**	**n/a**	**Certain**	
Spill of chemical at onshore supply base	Spill of chemicals to soil	Potential for impact to soil quality	Accidental		Very Low	Slight	Possible	**Very Low (3)**	**n/a**	**Certain**	**Industry-standard:** Adherence to COMAH (2015), Bunded storage sites,

Activity / Event	Aspect	Potential Impact	Type of Activity	Stage of operation	Sensitivity[1]	Severity[1]	Likelihood[1]	Impact / Risk Significance[1]		Confidence	Mitigation / Prevention / Control
								Initial	Residual		
											Double drainage in hazardous areas, Tank inspection, and Training and use of spill kits. **Project-specific:** None proposed.
Major Accident	Spill of chemical to soil or sea	Potential for impact to soil quality and / or pollution of Stanley Harbour	Accidental		Very Low	Slight	Unlikely	**Very Low (2)**	**n/a**	**Certain**	As above

[1] See Chapter 8 for definitions of sensitivity, severity, likelihood and significance.

13 CUMULATIVE IMPACTS AND IMPACT INTERACTIONS

Table of Contents

13.1 Introduction 1285
13.2 Cumulative impacts 1285
13.3 Indication of impact interactions 1286

13.1 Introduction

The following chapter describes the way that cumulative impacts and impact interactions have been considered within this EIS.

13.2 Cumulative impacts

Within each impact and risk assessment chapter, consideration was given to the potential for the cumulative effects of each aspect of the Phase 1 & 2 Development. Where possible, these qualitative assessments explored the cumulative impacts that may result if a similar activity was to occur at the same time in the same place, nearby, or just before or after the Navitas Development activities, as described in Section 8.9.1. For example, the assessment of the cumulative impact of underwater noise on inshore marine mammals takes account of the noise generated by Navitas vessels along with that generated by other vessels.

The approach taken with regard to assessing cumulative impacts in this EIS was discussed and agreed with FIG on the 25th November 2015. Since this time a review of EIA methodology was carried out as part of the GAP II project with a view to providing a best practice guideline for FIG. This resulted in the following reports:

- GAP II Project: Review of impact and risk assessment methodologies (July 2018) (Spencer, 2019a), and
- Best Practice Guideline for EIA methodology (March 2019) (Spencer, 2019b).

In addition to the cumulative impact of each activity which may overlap with other industries and recognising the potential for impact interactions as shown above, Navitas acknowledge that there is potential for a broader cumulative impact from the project as a whole, in combination with other industries.

The Best Practice Guideline provides extensive guidance on conducting Cumulative Impact Assessments (CIA) and while it lists the best practice approach, the report also states that:

> *'… while the above [best practice] approach is proposed, it is also recognised that it cannot be considered reasonable to expect the proponent of a single project to take responsibility for the full extent of data gathering etc. that is required to achieve the above [a full CIA]. Therefore, the project-level EIA may not be the most appropriate vehicle for conducting the full CIA and arguably, a CIA can only be of real value when connected with the breadth of a Regional Environmental Assessment (REA) and a Strategic Environmental Assessment (SEA) (Sinclair, et al., 2017) which are the responsibility of government rather than individual project proponents.'*

With regard to project-level CIA, the EIS follows the guidance provided in the Best Practice Guideline as follows:

- Narrative on the cumulative impacts associated with each activity is provided in the impact / risk assessment sections in Chapters 10, 11 and 12, consistently using the language described in Section 8.9.1.
- Where possible, and as described in Section 8.9.1, these take account of other operations that immediately precede the proposed operation and / or will occur simultaneously, and other sources of impact e.g., shipping, fisheries etc., and
- Where possible, outputs from the other impact sources are quantified although the majority of the assessments are qualitative.

13.3 Indication of impact interactions

As is detailed in Section 8.9.2 impact interactions can also occur. Impact interactions refer to the potential for one impact upon a given receptor to be 'additive or synergistic' or 'cancelling or ameliorative' to the impact from another activity on the same receptor.

For example, interactions which may exacerbate the impact of separate activities could include the following:

- Where artificial lights on the FPSO / MODU attract plankton, and therefore fish and cephalopods (Section 10.1.6.1.1), these may in turn attract marine mammals to feed. Increased proximity to the FPSO / MODU may then make the marine mammal more vulnerable to the impact of underwater noise (Section 10.4), or
- Where macerated food waste (Section 10.7) and / or artificial light (Section 10.1) attract birds to the MODU / FPSO / vessels, the birds may be more susceptible to collision with the vessel / or to oiling should this coincide with a time when an unplanned process upset means that the Produced Water Re-Injection (PWRI) system is down and produced water is being discharged (Section 10.7) or a small spill has occurred (Section 12.1).

Impact interactions of any kind are very difficult to quantify and assess, particularly when factoring in the potential for unplanned or accidental events. The number of variables, the extent of the unknowns and the inevitable 'what if' element, ultimately make it difficult to carry out a meaningful and representative assessment.

Therefore, this chapter aims only to provide an indication of the potential for impact interactions with a view to informing the Environmental Monitoring and Management Plan (EMMP) (Chapter 15).

Table 13.2 provides a basic indication of the number of impact interactions that may occur throughout the Sea Lion Development, including both planned, and unplanned events. Each receptor to an impact is identified with a 'Y' and is colour-coded, based on the outcome of the impact assessments in Chapters 10, 11 and 12. This aims to give an indication of both the range of receptors affected and the overall worst-case significance of the impact. As per Table 8.4 (Chapter 8), the colours are used to indicate the impact significance level, see Table 13.1 below.

For example, seabirds may be impacted in various ways by six aspects associated with planned activities, and by five aspects associated with unplanned activities, giving a total of eleven ways this receptor could be impacted. This highlights both the number of ways in which the receptor, e.g., seabirds, could be impacted and gives an indication of where impact interactions may occur i.e., by a combination of any of these factors. Table 13.2 illustrates that there is the greatest potential for planned and unplanned impact interactions to fish / cephalopods, seabirds, marine mammals and the seabed.

Table 13.1. Impact significance level colours (after Table 8.4)

High	Upper Moderate	Moderate	Low	Very Low	Beneficial
Unacceptable	ALARP			Broadly acceptable	Beneficial

Table 13.2: The number of ways receptors[1] could be impacted, indicating the worst-case significance[2] of the impact[3]

Receptor	Aspects associated with planned activities													Aspects associated with unplanned and accidental events								Total number of ways receptor could be impacted
	Environmental									Social				Environmental and social								
	Use of artificial light	Onshore disturbance from helicopters	Disturbance to seabed / placement of objects	Underwater noise	Drilling mud and cuttings	Operational discharges to sea	Thermal discharges to sea	Atmospheric emissions (climatic factors)	Management of waste	Increased vessel presence, subsea presence, exclusion	Competition for onshore resources	Nuisance factors to humans	Number of ways receptor could be impacted	Bird-strike	Loss of containment of solid waste	Unplanned emissions	Collision with marine mammals	Non-natives - marine	Non-natives - terrestrial	Loss of containment of crude, fuel oil, chemicals	Number of ways receptor could be impacted	
Human population									Y	Y	Y	Y	4		Y			Y	Y	Y	4	8
Other users of the sea										Y			1							Y	1	2
Commercial fisheries								Y		Y			2		Y			Y		Y	3	5
Plankton	Y		Y		Y	Y	Y	Y					6			Y		Y		Y	3	9
Benthos			Y	Y	Y	Y	Y	Y					6		Y	Y		Y		Y	4	10
Fish / cephalopods	Y		Y	Y	Y	Y	Y	Y					7		Y	Y		Y		Y	4	11
Seabirds	Y	Y		Y		Y	Y	Y					6	Y	Y	Y		Y		Y	5	11
Marine mammals		Y		Y		Y	Y	Y					6		Y	Y	Y	Y		Y	5	11
Terrestrial flora and fauna		Y						Y					2		Y	Y			Y		3	5
Designated sites		Y						Y					2		Y	Y			Y	Y	4	6
Biosecurity													0					Y	Y		2	2

Receptor	Aspects associated with planned activities													Aspects associated with unplanned and accidental events									
	Environmental									Social				Environmental and social									
	Use of artificial light	Onshore disturbance from helicopters	Disturbance to seabed / placement of objects	Underwater noise	Drilling mud and cuttings	Operational discharges to sea	Thermal discharges to sea	Atmospheric emissions (climatic factors)	Management of waste	Increased vessel presence, subsea presence, exclusion	Competition for onshore resources	Nuisance factors to humans	Number of ways receptor could be impacted	Bird-strike	Loss of containment of solid waste	Unplanned emissions	Collision with marine mammals	Non-natives - marine	Non-natives - terrestrial	Loss of containment of crude, fuel oil, chemicals	Number of ways receptor could be impacted	Total number of ways receptor could be impacted
Seabed (including soil)			Y		Y	Y	Y	Y	Y				6		Y	Y		Y	Y	Y	5	11
Water quality			Y		Y	Y	Y	Y	Y				6			Y				Y	2	8
Regional air quality											Y		1								0	1
Global atmosphere								Y	Y				2			Y					1	3
Landscape / seascape													0		Y				Y	Y	3	3
Tangible property, including livestock, landfill		Y							Y		Y	Y	4		Y				Y	Y	3	7

[1] Note: in some chapters, flora and fauna receptors may be grouped and assessed as, for example, 'marine organisms' or may be grouped into 'biodiversity' as a whole. Here these groupings have been separated out to better indicate the interactions e.g., the marine invasive risk assessment chapter assesses the impact to biodiversity as a whole but here each flora / fauna group is itemised.

[2] Where there are multiple impact assessments for a receptor, the higher impact is reflected here. For example, Artificial light impacts to seabirds offshore is assessed as 'Very Low' (green) but inshore the impact is assessed as Low (yellow), so only the higher impact (Low, yellow) is included in the above table.

[3] Please note that this table summarises the worst-case impact / risk assessment outcomes. While some impacts may have been identified as requiring further assessment ('F') in the ENVIID outcome tables (Chapter 9), the further assessment carried out may have concluded that there would be no impact. This is indicated where necessary in the individual assessment chapters (Chapters 10, 11 & 12). Further, while individual receptors may be highlighted within Figure 1-3 above, for some activities the actual impact assessment may refer to biodiversity as a whole to assess the broad and primary impact rather than to itemise each individual receptor, thereby avoiding excessive repetition.

14 SUMMARY OF EIS FINDINGS

14.1 Introduction

Table 14.1 presents a summary of all the impact and risk assessments above. Note that, for summary purposes, the 'residual assessment' column indicates the final outcome for all impacts and risks, whether project-specific mitigations and a residual assessment were required or not.

Table 14.1: Overall summary of EIA findings

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
Chapter 10.1: Artificial light									
Presence of all vessels / MODU / FPSO offshore	Deck and accommodation lights, flare pilot light, and flaring during shutdowns.	Planned	The use of blackout blinds in accommodation block.	Attraction of plankton, invertebrates and fish			Reduce light pollution by: Design (where possible and limited by safety) and auditing. Dousing of unrequired lights.	**Very Low (1)**	**Probable**
				Sensitivity	Severity	Significance			
				Very Low	Slight	Very Low (1)			
		Planned		Attraction and disorientation of seabirds				**Very Low (2)**	**Probable**
				Sensitivity	Severity	Significance			
				Low	Slight	Very Low (2)			
		Planned		Attraction of marine mammals				**n/a**	**n/a**
				Sensitivity	Severity	Significance			
				n/a	n/a	n/a			
Presence of all vessels inshore		Planned		Attraction and disorientation of seabirds				**Low (4)**	**Probable**
				Sensitivity	Severity	Significance			
				High	Slight	Low (4)			
		Planned		Attraction of marine mammals				**n/a**	**n/a**
				Sensitivity	Severity	Significance			
				n/a	n/a	n/a			
Small scale bird-strike offshore		Unplanned		Injury or fatality to single / handful of birds				**Low (4)**	**Probable**
				Impact	Likelihood	Significance			
				Very low (2)	Likely	Low (4)			
Large scale bird-strike offshore		Unplanned		Injury or fatality to multiple (dozens) birds				**Moderate (9)**	**Probable**
				Impact	Likelihood	Significance			
				Moderate (6)	Possible	Moderate (9)			
Small scale bird-strike inshore		Unplanned		Injury or fatality to single / handful of birds				**Moderate (8)**	**Probable**
				Impact	Likelihood	Significance			
				Low (4)	Likely	Moderate (8)			
Large scale bird-strike inshore		Unplanned		Injury or fatality to multiple (dozens) birds				**Moderate (9)**	**Probable**
				Impact	Likelihood	Significance			
				Moderate (8)	Possible	Moderate (9)			

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
Chapter 10.2: Onshore disturbance to wildlife from helicopter operations									
Helicopter use	Noise disturbance to wildlife.	Planned	FILFH	Impacts to breeding and moulting seabirds and marine mammals			None proposed.	**Low (4)**	**Certain**
				Sensitivity	Severity	Significance			
				Low	Minor	Low (4)			
Chapter 10.3: Disturbance to the seabed / placement of objects									
Placement of objects on the seabed	Installation of mooring systems, SPS and SURF at Sea Lion Field.	Planned	Good operational practise to minimise anchor scarring, Marine growth removal, Inspection of marine growth during seabed surveys / inspections, and Reporting and retrieval of dropped objects.	Disturbance to the benthos and habitats			None proposed.	**Very Low (1)**	**Probable**
				Sensitivity	Severity	Significance			
				Very Low	Slight	Very Low (1)			
		Planned		Habitat modification and marine growth on artificial substrate				**Low (3)**	**Probable**
				Sensitivity	Severity	Significance			
				Very Low	Moderate	Low (3)			
	Installation of OSR equipment and floating logistics vessel anchors in Berkeley Sound.	Planned		Disturbance to the benthos and habitats				**Very Low (3)**	**Probable**
				Sensitivity	Severity	Significance			
				Moderate	Slight	Very Low (3)			
Dropped objects	Loss of equipment or infrastructure.	Unplanned		Disturbance to the seabed and benthos				**Very Low (2)**	**Probable**
				Impact	Likelihood	Significance			
				Very Low (1)	Unlikely	Very Low (2)			

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance	Project-specific mitigation	Residual impact / risk	Confidence
Chapter 10.4: Underwater noise offshore							
Underwater vessel noise	Continuous moderate intensity noise.	Planned	No	Injury to invertebrates and fish Sensitivity: Low; Severity: Slight; Significance: Very Low (2)	None proposed.	**Very Low (2)**	**Uncertain**
		Planned		Injury to seabirds Sensitivity: High; Severity: Slight; Significance: Low (4)		**Low (4)**	**Uncertain**
		Planned		Injury to marine mammals Sensitivity: n/a; Severity: n/a; Significance: n/a		**n/a**	**n/a**
		Planned		Behavioural disturbance to marine mammals Sensitivity: High; Severity: Minor; Significance: Moderate (8)		**Moderate (8)**	**Uncertain**
Chapter 10.5: Underwater noise inshore							
Vessel operations within Berkeley Sound	Intermittent moderate intensity noise during LTV operations.	Planned	None	Behavioural disturbance to invertebrates and fish Sensitivity: Low; Severity: Slight; Significance: Very Low (2)	None proposed.	**Very Low (2)**	**Uncertain**
		Planned		Behavioural disturbance to seabirds Sensitivity: High; Severity: Slight; Significance: Low (4)		**Low (4)**	**Uncertain**
		Planned		Behavioural disturbance to marine mammals Sensitivity: High; Severity: Slight; Significance: Low (4)		**Low (4)**	**Uncertain**

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance	Project-specific mitigation	Residual impact / risk	Confidence
Chapter 10.6: Discharge of drilling mud and cuttings							
Drilling operations	Discharge of seawater and bentonite sweeps, tophole drill cuttings and thermally treated NADF drill cuttings.	Planned	Compliance with Drilling discharges to be minimised as far as possible in line with BAT, Selection of benign chemicals where possible, NADF cuttings returned to the rig and thermally treated to minimise oil on cuttings (aiming to exceed compliance requirements), and Post-drilling monitoring of seabed recovery.	Water quality: Suspension of particles leading to increased turbidity Sensitivity: Very Low; Severity: Slight; Significance: Very Low (1)	None proposed.	**Very Low (1)**	**Probable**
		Planned		Plankton: Reduction in the ambient light, barite particles may affect zooplankton Sensitivity: Very Low; Severity: Slight; Significance: Very Low (1)		**Very Low (1)**	**Probable**
		Planned		Seabed sediment: Deposition of drill cuttings modifying sediment particle size Sensitivity: Very Low; Severity: Moderate; Significance: Low (3)		**Low (3)**	**Probable**
		Planned		Benthic fauna: Burial of benthic fauna, modification of habitat, toxicity and oxygen depletion Sensitivity: Low; Severity: Moderate; Significance: Moderate (6)	Continual improvement so that oil on cuttings will be minimised, as far as is possible, during drilling campaign to below a 0.5 % average.	**Moderate (6)**	**Probable**
		Planned		Fish and shellfish: Suspended barite particle may affect gill structures Sensitivity: Low; Severity: Minor; Significance: Low (4)	None proposed.	**Low (4)**	**Probable**

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance	Project-specific mitigation	Residual impact / risk	Confidence
Chapter 10.7: Operational discharges							
Chemical discharges	Discharge general operational fluids e.g., hydrotest water	Planned	Selection of benign chemicals where possible, OiW target of 10-15 mg/l, RBA of PW, EI (2016) Guidance, Maintenance Management System, OMS, Off spec tank, and OEUK Well Clean-up Guidelines.	Impacts on water quality and marine organisms Sensitivity: Very Low; Severity: Slight; Significance: Very Low (1)	None proposed.	**Very Low (1)**	**Probable**
	PW discharge-commissioning of PWRI units	Planned		Toxic impacts on marine organisms Sensitivity: Very Low; Severity: Moderate; Significance: Low (3)		**Low (3)**	**Probable**
PWRI malfunction / unavailability	Discharge of PW	Unplanned		Acute and chronic impacts on marine fauna Impact: Very Low (2); Likelihood: Unlikely; Significance: Very Low (2)		**Very Low (2)**	**Uncertain**
All MODU, FPSO and vessel activity	Discharge of wastewater / food	Planned		Impacts to water quality and plankton Sensitivity: Very Low; Severity: Slight; Significance: Very Low (1)		**Very Low (1)**	**Certain**
	Discharge of drainage / bilge water	Planned		Impacts to water quality Sensitivity: Very Low; Severity: Slight; Significance: Very Low (1)		**Very Low (1)**	**Certain**
	Discharge of hypersaline water	Planned		Impact to benthos, flora and fauna Sensitivity: Very Low; Severity: Slight; Significance: Very Low (1)		**Very Low (1)**	**Certain**
Off-spec discharges of bilge and drainage	Formation of a sheen	Unplanned		Contamination of seabirds Impact: Upper Moderate (15); Likelihood: Very Unlikely; Significance: Low (4)		**Low (4)**	**Probable**

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
Chapter 10.8: Thermal discharges									
Heated subsea infrastructure	Radiation of heat	Planned	None.	Potential impact of heat on benthic fauna			None proposed.	**Very Low (1)**	**Probable**
				Sensitivity	Severity	Significance			
				Very Low	Slight	Very Low (1)			
Topside cooling process	Discharge of heated water	Planned		Potential for impacts on flora and fauna				**Very Low (1)**	**Probable**
				Sensitivity	Severity	Significance			
				Very Low	Slight	Very Low (1)			
Production from the FPSO	PW discharge (90°C) - PWRI commissioning	Planned		Potential for impacts on flora and fauna				**Very Low (1)**	**Probable**
				Sensitivity	Severity	Significance			
				Very Low	Slight	Very Low (1)			
PWRI unavailability	Discharge of PW overboard	Unplanned		Potential for impacts on flora and fauna				**Very Low (3)**	**Certain**
				Impact	Likelihood	Significance			
				Very Low (1)	Possible	Very Low (3)			
Chapter 10.9: Atmospheric emissions (climatic factors)									
Fuel combustion throughout Development	Generation of atmospheric emissions (CO_2, CH_4, N_2O, indirect NOx, SO2, CO, VOCs)	Planned	Use of BAT in project design, Monitoring and measuring, Selection and pre-mobilisation audits, Optimisation of operations, Management Maintenance System, SMART objectives and targets, and Ongoing ALARP reviews.	Contribution to global warming			Use of EEOI in developing tanker KPIs, and Investigation of pilot-free flare design using automatic ignition systems.	**Moderate (10)**	**Certain**
				Sensitivity	Severity	Significance			
				Very High	Minor	Moderate (10)			
		Planned		Contribution to ocean acidification				**Moderate (8)**	**Certain**
				Sensitivity	Severity	Significance			
				High	Minor	Moderate (8)			
Emergency blowdown / Venting of full HC gas blanket	Emissions of CO_2, NOx, SO_2, CO, VOCs and/or CH_4	Unplanned		Incremental increase in emissions				**Low (6)**	**Certain**
				Impact	Likelihood	Significance			
				Low (5)	Possible	Low (6)			
		Unplanned		Incremental increase in emissions				**Low (6)**	**Certain**

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
Malfunction of HVAC and fire-fighting equipment	Venting, flaring, release of F-Gas			Impact	Likelihood	Significance			
				Low (5)	Possible	Low (6)			
Use of sold product	Combustion of product	Planned	Impact is outwith Navitas' ability to influence.	Incremental increase in emissions			Impact is outwith Navitas' ability to influence.	**Upper Moderate (15)**	**Uncertain**
				Sensitivity	Severity	Significance			
				Very High	Moderate	Upper Moderate (15)			
Chapter 10.10: Waste generation and management									
Waste from drilling, installation / production	Use of landfill	Planned	Compliance with the Navitas OMS with regard to contractor management, auditing, performance monitoring and the setting of waste objectives and targets, E-Reps scheme, waste awareness training, segregated bins, signage, netting, dedicated waste laydown areas.	Use of landfill resource			Collaboration with FIG.	**Moderate (8)**	**Probable**
				Sensitivity	Severity	Significance			
				High	Minor	Moderate (8)			
Improper waste containment	Loss of containment of solid and liquid waste	Unplanned		Potential impact to landscape / seascape and human population				**Low (6)**	**Certain**
				Impact	Likelihood	Significance			
				Moderate (8)	Unlikely	Low (6)			
		Unplanned		Potential impact to wildlife				**Low (6)**	**Certain**
				Impact	Likelihood	Significance			
				Moderate (10)	Unlikely	Low (6)			
Improper waste segregation	Cross-contamination of waste	Unplanned		Increased use of landfill			None proposed.	**Low (6)**	**Certain**
				Impact	Likelihood	Significance			
				Low (5)	Possible	Low (6)			
Chapter 10.11: Collisions between vessels and marine mammals									
Presence of project vessels	Collisions during drilling,	Unplanned		Potential for fatal injury			Awareness training for vessel crews,	**Moderate (8)**	**Uncertain**
				Impact	Likelihood	Significance			

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
	installation and production		Premise of NOAA (2009) guidelines will be followed. Increased vigilance by officer of the watch in high risk areas, Reduced vessel speed to 10 knots at the MMA boundary.	Upper Moderate (12)	Unlikely	Moderate (8)	Reduced vessel speed to max eight knots in Berkeley Sound Seabird and Marine Mammal Observers on vessels Reporting of collisions.		
	Collisions inshore Berkeley Sound	Unplanned		Potential for fatal injury				**Moderate (8)**	**Uncertain**
				Impact	Likelihood	Significance			
				Upper Moderate (12)	Possible	Upper Moderate (12)			
	Collision with small cetaceans	Unplanned		Potential for fatal injury				n/a	**Certain**
				Impact	Likelihood	Significance			
				n/a	n/a	n/a			
	Entanglement with chains	Unplanned		Potential for fatal injury				n/a	**Certain**
				Impact	Likelihood	Significance			
				n/a	n/a	n/a			
Chapter 10.12: Introduction of marine non-native species									
Navitas in-field vessels	Introduction of non-native species by project vessels, *via* ballast water and biofouling Potential to have irreversible impact on biodiversity and designated sites	Unplanned	Pre-selection and pre-mobilisation audits. Compliance with BWMC requirements - Exchange of ballast water *en route* or D2 treatment process. Vessel specific BMP and audit prior to leaving shipyard for to Falkland Islands. Oil Companies International Marine Forum (OCIMF) Ship Inspection Report	Potential impact			LTVs used as floating logistics vessels will have their hulls inspected prior to departure for the Falklands, Non-natives species monitoring programme and ballast sampling.	**Moderate (10)**	**Uncertain**
				Impact	Likelihood	Significance			
				High (20)	Unlikely	Moderate (10)			
Navitas *ad hoc* freight vessels		Unplanned		Potential impact				**Moderate (10)**	**Uncertain**
				Impact	Likelihood	Significance			
				High (20)	Unlikely	Moderate (10)			

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
			Programme (SIRE) will be applied to audit BWMP and the BFMP and all records.						
Presence of Large Transport Vessels (LTV)		Unplanned		Potential impact				**Moderate (10)**	**Uncertain**
				Impact	Likelihood	Significance			
				High (20)	Possible	Upper Moderate (15)			
Presence of third-party Conventional Trading Tanker (CTT)		Unplanned		Potential impact				**Moderate (10)**	**Uncertain**
				Impact	Likelihood	Significance			
				High (20)	Unlikely	Moderate (10)			
Chapter 10.13: Introduction of terrestrial non-native species with cargo imports									
Freight arriving in the Falklands	Introduction of terrestrial non-native species. Potential to have irreversible impact on biodiversity and designated sites	Unplanned	None	Potential impact			Implementation of Project-specific Biosecurity Plan.	**Upper Moderate (12)**	**Probable**
				Impact	Likelihood	Significance			
				Upper moderate (12)	Upper moderate (12)	Upper moderate (12)			
Food products arriving in the Falklands	Introduction of pathogens in Food of Animal Origin (FOAO)	Unplanned		Potential impact			Source food of animal origin from UK / EU certified sources and from within the UK / EU.	**Low (4)**	
				Impact	Likelihood	Significance			
				Upper moderate (15)	Very Unlikely	Low (4)			

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance	Project-specific mitigation	Residual impact / risk	Confidence
Chapter 11.1: Disturbance to other users of the sea offshore							
Presence of offshore development	Offshore 1,275 m radius exclusion zone	Planned	Exclusion zones added to charts and status issued in 'Notes to Mariners' / on radio.	Exclusion of fishing vessels and loss of catch Sensitivity: Very Low; Severity: Slight; Significance: Very Low (1)	None proposed.	**Very Low (1)**	**Certain**
Interference - fishing gear and subsea infrastructure	Snagging of fishing gear	Unplanned	500 m exclusion zone, Permanent presence of ERRV, Amended Admiralty charts, AIS and radio broadcasts, and Collision risk management procedures.	Loss of fishing gear / subsea damage Impact: Moderate (9); Likelihood: Unlikely; Significance: Low (6)	None proposed.	**Low (6)**	**Probable**
Offshore vessel collision	Third-party vessel collision	Unplanned		Damage to vessel and FPSO / MODU Impact: High (20); Likelihood: Very Unlikely; Significance: Low (5)		**Low (5)**	**Probable**
Chapter 11.2: Disturbance to other users of the sea inshore							
Presence of vessels in Stanley	Use of amenities in Stanley Harbour	Planned	Adherence to the Stanley Harbour Management Plan.	Disruption to other users of Stanley Harbour Sensitivity: Low; Severity: Minor; Significance: Low (4)	None proposed	**Low (4)**	**Certain**
Berkeley Sound exclusion zones	Reduction in the area available to navigating and anchoring vessels	Planned	Use of local pilots for Navitas managed vessels in Berkeley Sound, and Status issued in 'Notes to Mariners' and on radio.	Loss of potential anchorage Sensitivity: Low; Severity: Minor; Significance: Low (4)	Briefing documents issued in the language of the Captain.	**Low (4)**	**Probable**

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
Collisions due to reduction in sea room in Berkeley Sound	Temporary exclusion zone	Unplanned	Exclusion zones added to charts and status issued in 'Notes to Mariners' / on radio. FI Berthing Master / Pilot will accompany LTVs prior to entering Berkeley Sound. FI information sheets available for Berkeley Sound, Port William and Stanley Harbour	Damage to vessels			In order to help communicate the positions and restrictions associated with the exclusion zones, briefing notes will be issued in the first languages of the vessel Captains.	**Low (4)**	**Probable**
				Impact	Likelihood	Significance			
				Upper Moderate (12)	Very Unlikely	Low (4)			
Collision due to addition of Phase 1 & 2 vessels	Collision in Stanley Harbour	Unplanned		Damage to vessels				**Low (6)**	**Probable**
				Impact	Likelihood	Significance			
				Moderate (6)	Unlikely	Low (6)			
Chapter 11.3: Resource competition - Accommodation									
Need to accommodate transitory personnel	Competition with domestic housing needs	Planned	None.	Reduction of available accommodation			None proposed.	**Very Low (2)**	**Probable**
				Sensitivity	Severity	Significance			
				Low	Slight	Very Low (2)			
Need to accommodate permanent personnel	Competition with domestic housing needs	Planned	None.	Reduction of available accommodation			None proposed.	**Low (4)**	**Probable**
				Sensitivity	Severity	Significance			
				Low	Minor	Low (4)			

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
Chapter 11.4: Resource competition - Fresh potable water									
Water use for MODU drilling and vessel top-up and for onshore yards and accomm.	Competition for water resources	Planned	End user prioritisation, Buffer tank capacity and voluntary restrictions, Offshore desalination.	Restriction of water supply and / or quality			Sustainable design, and Offshore planning.	**Upper Moderate (15)**	**Uncertain**
				Sensitivity	Severity	Significance			
				Very High	Serious	High (20)			
Water use for offshore vessel top-up and onshore yards and accomm.		Planned		Restriction of water supply and / or quality				**Upper Moderate (15)**	**Uncertain**
				Sensitivity	Severity	Significance			
				Very High	Moderate	Upper Moderate (15)			
Chapter 11.5: Resource competition - Electricity									
Electricity use by TDF, yards, accomm. and heli ops	Competition with domestic energy needs	Planned	None.	Overloading of current capacity and need for use of stand-by generators			Sustainable design, and Off-peak power utilisation.	**Upper Moderate (12)**	**Uncertain**
				Sensitivity	Severity	Significance			
				High	Serious	High (16)			
Chapter 11.6: Resource competition - Air links									
International movement of personnel to and from the Falkland Islands	Air-link resource competition for seat availability	Planned	None.	Lack of seat availability of seats			The base-case dedicated regular charter flight will be sufficient to meet all personnel travel requirements.	**Low (4)**	**Certain**
				Sensitivity	Severity	Significance			
				High	Slight	Low (4)			
	Additional air-links	Planned		Potential for extra seat availability				**Beneficial**	**Uncertain**
				Sensitivity	Severity	Significance			
				Beneficial					

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
Chapter 11.7 Resource competition - Road Network									
Use of existing road network	Increased number of vehicles and use of infrastructure	Planned	Adherence to vehicle and road statutory requirements. Specific applications for abnormal road movements including signage and warning devices. Strict HSE driving policy, risk assessment and local training. All non-critical activities coordinated to avoid peak periods.	Potential for nuisance to human population			Traffic Management Plan. Accommodation with off-street parking will be a preference.	**Moderate (6)**	**Probable**
				Sensitivity	Severity	Significance			
				Moderate	Minor	Moderate (6)			
		Planned		Degradation of road surfaces				**Low (4)**	**Probable**
				Sensitivity	Severity	Significance			
				Low	Minor	Low (4)			
		Planned		Degradation in air quality				**Low (3)**	**Probable**
				Sensitivity	Severity	Significance			
				Moderate	Slight	Low (3)			
Chapter 11.8: Disturbance to the human population - Light									
Operations at the TDF and supply base	Vessel, TDF and yard lighting	Planned	Good working practice and design, and Black-out blinds for the vessel accommodation sections.	Annoyance, sleep disturbance			Deck lights and yard lights will face inwards, Vessel lights to be turned off when not required, particularly deck lighting, TDF offices and yard offices.	**Moderate (6)**	**Probable**
				Sensitivity	Severity	Significance			
				Moderate	Minor	Moderate (6)			
Inshore operations in Berkeley Sound	Deck and accommodation lights	Planned		Annoyance, sleep disturbance, impairment of dark skies				**Moderate (6)**	**Probable**
				Sensitivity	Severity	Significance			
				Moderate	Minor	Moderate (6)			

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
Chapter 11.9: Disturbance to the human population - Noise									
Helicopter use for crew changes and SAR test flights	Disturbance to human population	Planned	Use of specific flight plan in line with the flight avoidance map as the basis for flight planning, following the Falkland Islands Low Flying Handbook Guidance (FILFH, 2024).	Annoyance, sleep disturbance			Optimising design and management to minimise noise, Equipment specific noise mitigations, Activity restrictions.	**Low (4)**	**Probable**
				Sensitivity	Severity	Significance			
				Low	Minor	Low (4)			
	Noise disturbance to livestock	Planned		Stress, reduced lambing success				**Low (4)**	**Certain**
				Sensitivity	Severity	Significance			
				Low	Minor	Low (4)			
Operations at the TDF and supply base	Noise at the TDF, reversing alarms and yard activities	Planned	Compliance with noise guidelines.	Annoyance, sleep disturbance in Stanley				**Very Low (3)**	**Probable**
				Sensitivity	Severity	Significance			
				Moderate	Minor	Moderate (6)			
Inshore operations in Berkeley Sound	Noise from pumps, vessel engines and vessel loading	Planned		Annoyance, sleep disturbance				**Very Low (3)**	**Probable**
				Sensitivity	Severity	Significance			
				Moderate	Minor	Moderate (6)			

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
Chapter 12.1: Offshore accidental and chronic discharges of crude oil and diesel									
Well drilling and production	Scenario 1: Subsea well blow-out	Accidental	Use of standard operating procedures, Compliance with OMS and Drilling Management System, SECE Register and performance standards, Primary and secondary well control, Development and implementation of the OPEP, Use of a well capping device.	Toxic effects on Plankton			Additional oil spill recovery equipment on support vessels.	**Low (6)**	**Uncertain**
				Impact	Likelihood	Significance			
				Moderate (9)	Unlikely	Low (6)			
		Accidental		Toxic effects on Benthos				**Low (6)**	**Uncertain**
				Impact	Likelihood	Significance			
				Moderate (4)	Unlikely	Low (6)			
		Accidental		Toxic effects on Fish and squid				**Low (6)**	**Uncertain**
				Impact	Likelihood	Significance			
				Moderate (9)	Unlikely	Low (6)			
		Accidental		Taint of fish / contamination of grounds				**Moderate (10)**	**Uncertain**
				Impact	Likelihood	Significance			
				High (20)	Unlikely	Moderate (10)			
		Accidental		Contamination / ingestion by seabirds				**Moderate (10)**	**Uncertain**
				Impact	Likelihood	Moderate (10)			
				High (20)	Unlikely	Moderate (10)			
		Accidental		Contamination / ingestion by mammals				**Moderate (8)**	**Uncertain**
				Impact	Likelihood	Significance			
				Upper Moderate (12)	Unlikely	Moderate (8)			
		Accidental		Impact on coastal ecology				**Moderate (8)**	**Uncertain**
				Impact	Likelihood	Significance			
				Upper Moderate (12)	Unlikely	Moderate (8)			
		Accidental		Negative publicity impacting on tourism				**Moderate (10)**	**Uncertain**
				Impact	Likelihood	Significance			
				High (16)	Unlikely	Moderate (10)			

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
Catastrophic loss of the FPSO	Scenario 2: loss of the full FPSO crude oil inventory	Accidental	SECE Register, OMS and performance standards, A 500 m radius exclusion zone, A ERRV vessel, AIS and Radar surveillance, Radio broadcasts, and Development and implementation of the OPEP.	Toxic effects on Plankton			Additional oil spill recovery equipment on support vessels.	**Very Low (3)**	**Uncertain**
				Impact	Likelihood	Significance			
				Moderate (9)	Very Unlikely	Very Low (3)			
		Accidental		Toxic effects on Benthos				**Very Low (3)**	**Uncertain**
				Impact	Likelihood	Significance			
				Moderate (4)	Very Unlikely	Very Low (3)			
		Accidental		Toxic effects on Fish and squid				**Very Low (3)**	**Uncertain**
				Impact	Likelihood	Significance			
				Moderate (9)	Very Unlikely	Very Low (3)			
		Accidental		Taint of fish / contamination of grounds				**Low (5)**	**Uncertain**
				Impact	Likelihood	Significance			
				High (20)	Very Unlikely	Low (5)			
		Accidental		Contamination / ingestion by seabirds				**Low (5)**	**Uncertain**
				Impact	Likelihood	Significance			
				High (20)	Very Unlikely	Low (5)			
		Accidental		Contamination / ingestion by mammals				**Low (4)**	**Uncertain**
				Impact	Likelihood	Significance			
				Upper Moderate (12)	Very Unlikely	Low (4)			
		Accidental		Impact on coastal ecology				**Low (4)**	**Uncertain**
				Impact	Likelihood	Significance			
				Upper Moderate (12)	Very Unlikely	Low (4)			
		Accidental		Negative publicity impacting on tourism				**Low (5)**	**Uncertain**
				Impact	Likelihood	Significance			
				High (16)	Very Unlikely	Low (5)			
Offshore transfer of	Scenario 3: Crude oil transfer spill	Accidental	SECE Register, OMS and performance standards,	Toxic effects on Plankton			Additional oil spill recovery equipment on support vessels.	**Very Low (3)**	**Uncertain**
				Impact	Likelihood	Significance			
				Very Low (2)	Possible	Very Low (3)			

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance	Project-specific mitigation	Residual impact / risk	Confidence
crude from the FPSO to the CTT		Accidental	Pipelines will be protected by pressure alarms, A leak detection system will be fitted, Dry break couplings, Development and implementation of the OPEP.	Toxic effects on Benthos Impact / Likelihood / Significance n/a / n/a / n/a		n/a	n/a
		Accidental		Toxic effects on Fish and squid Impact / Likelihood / Significance Very Low (2) / Possible / Very Low (3)		**Very Low (3)**	**Uncertain**
		Accidental		Taint of fish / contamination of grounds Impact / Likelihood / Significance Low (4) / Possible / Low (6)		**Low (6)**	**Uncertain**
		Accidental		Contamination / ingestion by seabirds Impact / Likelihood / Significance Moderate (10) / Possible / Moderate (9)		**Moderate (9)**	**Uncertain**
		Accidental		Contamination / ingestion by mammals Impact / Likelihood / Significance Very Low (3) / Possible / Very Low (3)		**Very Low (3)**	**Uncertain**
		Accidental		Negative publicity impacting on tourist numbers Impact / Likelihood / Significance Moderate (6) / Possible / Moderate (9)		**Moderate (9)**	**Uncertain**
Catastrophic event leading to the loss of the MODU or FPSO	Scenario 4: Loss of MODU / FPSO full diesel inventory	Accidental	SECE Register, OMS and performance standards, A 500 m radius exclusion zone, A ERRV vessel, AIS and Radar surveillance, Radio broadcasts, and	Toxic effects on Plankton Impact / Likelihood / Significance Low (4) / Unlikely / Very Low (4)	Additional oil spill response equipment on support vessels.	**Very Low (4)**	**Probable**
		Accidental		Toxic effects on Benthos Impact / Likelihood / Significance n/a / n/a / n/a		n/a	n/a
		Accidental		Toxic effects on Fish and squid Impact / Likelihood / Significance		**Very Low (4)**	**Probable**

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
			Development and implementation of the OPEP.	Low (4)	Unlikely	Very Low (4)			
		Accidental		Tainting of fish / contamination of fishing grounds				**Low (6)**	**Probable**
				Impact	Likelihood	Significance			
				Moderate (6)	Unlikely	Low (6)			
		Accidental		Contamination / oil ingestion by seabirds				**Moderate (8)**	**Probable**
				Impact	Likelihood	Significance			
				Upper Moderate (15)	Unlikely	Moderate (8)			
		Accidental		Contamination / oil ingestion by marine mammals				**Low (6)**	**Probable**
				Impact	Likelihood	Significance			
				Moderate (8)	Unlikely	Low (6)			
		Accidental		Negative publicity impacting on tourism				**Moderate (8)**	**Probable**
				Impact	Likelihood	Significance			
				Upper Moderate (12)	Unlikely	Moderate (8)			
Offshore transfer of diesel fuel	Scenario 5: Diesel bunkering spill	Accidental	SECE Register, OMS and performance standards, Maintenance Management System (MMS), Use of spill kits for spills to deck, Development and implementation of the OPEP.	Toxic effects on Plankton			Additional oil spill response equipment on support vessels.	**Very Low (3)**	**Probable**
				Impact	Likelihood	Significance			
				Very Low (2)	Possible	Very Low (3)			
		Accidental		Toxic effects on Benthos				n/a	n/a
				Impact	Likelihood	Significance			
				n/a	n/a	n/a			
		Accidental		Toxic effects on Fish and squid				**Very Low (3)**	**Probable**
				Impact	Likelihood	Significance			
				Very Low (2)	Possible	Very Low (3)			
		Accidental		Tainting of fish / contamination of fishing grounds				**Very Low (3)**	**Probable**

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance	Project-specific mitigation	Residual impact / risk	Confidence
			Bunding of all liquid containing equipment and chemicals, Open deck drains to catch and collect spills to a dedicated slop tank, and High level tank filling alarm and emergency shutdown of the process.	Impact: Very Low (2) / Likelihood: Possible / Significance: Very Low (3)			
		Accidental		Contamination / oil ingestion by seabirds Impact: Moderate (10) / Likelihood: Possible / Significance: Moderate (9)		**Moderate (9)**	**Probable**
		Accidental		Contamination /oil ingestion by marine mammals Impact: Low (4) / Likelihood: Possible / Significance: Low (6)		**Low (6)**	**Probable**
		Accidental		Negative publicity impacting on tourist numbers Impact: Low (4) / Likelihood: Possible / Significance: Low (6)		**Low (6)**	**Probable**
Small scale spills and releases	Development of an oily sheen on the water	Unplanned		Potential for the formation of oily sheens, which can lead to the oiling of seabirds Impact: Moderate (10) / Likelihood: Possible / Significance: Moderate (9)		**Moderate (9)**	**Probable**
Riser disconnect	Loss of riser contents (NADF) to sea	Unplanned	Compliance with OMS and Navitas Drilling Management System.	Smothering and toxic effects on benthos and seabed Impact: Moderate (6) / Likelihood: Unlikely / Significance: Low (6)	Additional oil spill response equipment on support vessels.	**Low (6)**	**Probable**
Chapter 12.2: Inshore oil spill							
MGO Spill during fuel bunkering	Scenario 1: 10 tonne MGO spill	Accidental	Limiting operational criteria, Standard operational procedures,	Toxic effects on Plankton Impact: Moderate (9) / Likelihood: Unlikely / Significance: Low (6)	Clear manoeuvring and approach channel, Operational limits defined and implemented,	**Low (6)**	**Uncertain**
		Accidental		Toxic effects on Marine flora (kelp) Impact: Moderate (6) / Likelihood: Unlikely / Significance: Low (6)		**Low (6)**	**Uncertain**

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
		Accidental	Development and implementation of the OPEP. Tug assist during manoeuvering.	Toxic effects on Benthic communities			Development and implementation of bunkering procedures with fuel supplier to ensure corporate standards of operational safety are maintained, Bunkering conducted within the 500 m LTV exclusion zone, or other defined area, Development and implementation of the OPEP, and On-site OSR capability.	**Low (6)**	**Uncertain**
				Impact	Likelihood	Significance			
				Moderate (9)	Unlikely	Low (6)			
		Accidental		Toxic effects on Fish and squid				**Moderate (8)**	**Uncertain**
				Impact	Likelihood	Significance			
				Upper Moderate (12)	Unlikely	Moderate (8)			
		Accidental		Tainting of fish / contamination of fishing grounds				**Moderate (8)**	**Uncertain**
				Impact	Likelihood	Significance			
				Upper Moderate (12)	Unlikely	Moderate (8)			
		Accidental		Contamination / oil ingestion by seabirds				**Moderate (10)**	**Uncertain**
				Impact	Likelihood	Significance			
				High (16)	Unlikely	Moderate (10)			
		Accidental		Contamination / oil ingestion by marine mammals				**Moderate (10)**	**Uncertain**
				Impact	Likelihood	Significance			
				High (16)	Unlikely	Moderate (10)			
		Accidental		Coastal communities				**Low (6)**	**Uncertain**
				Impact	Likelihood	Significance			
				Moderate (8)	Unlikely	Low (6)			
		Accidental		Negative publicity impacting tourist numbers				**Low (6)**	**Uncertain**
				Impact	Likelihood	Significance			
				Moderate (6)	Unlikely	Low (6)			
Vessel collision / grounding leading to MGO	Scenario 2: 1,200 tonne MGO spill	Accidental	Limiting operational criteria, Standard operational procedures,	Toxic effects on Plankton			Clear manoeuvring and approach channel,	**Low (6)**	**Uncertain**
				Impact	Likelihood	Significance			
				Moderate (9)	Unlikely	Low (6)			
		Accidental		Toxic effects on Marine flora (kelp)				**Low (6)**	**Uncertain**

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance			Project-specific mitigation	Residual impact / risk	Confidence
Spill in Berkeley Sound			Development and implementation of the OPEP.	Impact	Likelihood	Significance	Operational limits defined and implemented, Development and implementation of bunkering procedures with fuel supplier to ensure corporate standards of operational safety are maintained, Bunkering conducted within the 500 m LTV exclusion zone, or other defined area, Development and implementation of the OPEP, and On-site OSR capability.		
				Moderate (6)	Unlikely	Low (6)			
		Accidental		Toxic effects on Benthic communities				**Low (6)**	**Uncertain**
				Impact	Likelihood	Significance			
				Moderate (9)	Unlikely	Low (6)			
		Accidental		Toxic effects on Fish and squid				**Moderate (8)**	**Uncertain**
				Impact	Likelihood	Significance			
				Upper Moderate (12)	Unlikely	Moderate (8)			
		Accidental		Tainting of fish / contamination of fishing grounds				**Moderate (8)**	**Uncertain**
				Impact	Likelihood	Significance			
				Upper Moderate (12)	Unlikely	Moderate (8)			
		Accidental		Contamination / oil ingestion by seabirds				**Moderate (10)**	**Uncertain**
				Impact	Likelihood	Significance			
				High (16)	Unlikely	Moderate (10)			
		Accidental		Contamination / oil ingestion by marine mammals				**Moderate (10)**	**Uncertain**
				Impact	Likelihood	Significance			
				High (16)	Unlikely	Moderate (10)			
		Accidental		Coastal communities				**Low (6)**	**Uncertain**
				Impact	Likelihood	Significance			
				Moderate (8)	Unlikely	Low (6)			
		Accidental		Negative publicity impacting tourist numbers				**Low (6)**	**Uncertain**
				Impact	Likelihood	Significance			
				Moderate (6)	Unlikely	Low (6)			

Activity / Event	Aspect	Type of activity	Industry-standard mitigation	Initial impact / risk and significance	Project-specific mitigation	Residual impact / risk	Confidence
Chapter 12.3: At-shore and onshore fuel oil and chemical spills							
At-shore spills of liquid fuel and chemicals	Small leak / spill during day-to-day operations	Unplanned	Compliance with legislation and Navitas OMS, Compliance with MMS, Use of standard operating procedures, Task specific planning, risk assessments etc, Use of all emergency response plans e.g., OPEP, NOSCP, HCMP, On site OSR equipment, Use of engineering controls e.g., dry-break couplings, and Use of OSR training and spill kits manage vessel movements in Stanley Harbour.	Pollution of Stanley Harbour Impact: Moderate (8) / Likelihood: Possible / Significance: Moderate (9)	None proposed.	**Moderate (9)**	**Certain**
	Spill of diesel fuel transfer at TDF or FIPASS	Accidental		Pollution of Stanley Harbour Impact: Moderate (8) / Likelihood: Unlikely / Significance: Low (6)		**Low (6)**	**Certain**
	Spill of chemical transfer at the TDF	Accidental		Pollution of Stanley Harbour Impact: Moderate (8) / Likelihood: Unlikely / Significance: Low (6)		**Low (6)**	**Probable**
	Spill of diesel fuel due to vessel collision or grounding during approach	Accidental		Pollution of Stanley Harbour Impact: High (16) / Likelihood: Very Unlikely / Significance: Low (5)		**Low (5)**	**Certain**
Spill of chemical at onshore supply base	Spill of chemicals to soil	Accidental	Bunded storage sites, Double drainage, Tank inspection, and Training and use of spill kits.	Potential for impact to soil quality Impact: Very Low (1) / Likelihood: Possible / Significance: Very Low (3)	None proposed.	**Very Low (3)**	**Certain**
	Spill of chemical to soil or sea associated with a major accident	Accidental		Potential for impact to soil quality and / or pollution of Stanley Harbour Impact: Very Low (1) / Likelihood: Unlikely / Significance: Very Low (2)		**Very Low (2)**	**Certain**

15 OUTLINE ENVIRONMENTAL MONITORING AND MANAGEMENT PLAN

Table of Contents

15.1 Introduction 1313
15.2 EMMP Workshop 1313
15.3 EMMP Scope 1314
15.3.1 Screening 1314
15.3.2 Periodic review of scope 1318
15.4 Legislative and corporate monitoring 1318
15.5 Governance 1327
15.6 Baseline data and survey work 1327
15.6.1 Project timeline 1327
15.6.2 Proposed survey activities 1327
15.6.2.1 Environmental 1330
15.6.2.1.1 Benthic sediments 1330
15.6.2.1.2 Seabirds offshore 1331
15.6.2.1.3 Marine mammals – underwater noise 1332
15.6.2.1.4 Marine mammals - Collision 1333
15.6.2.1.5 Oil Spill 1334
15.6.2.1.6 Marine Invasive species 1335
15.6.2.2 Social 1336
15.6.2.2.1 Disturbance to humans 1336
15.7 Research and studies 1337
15.7.1 Offshore seabirds 1337
15.7.2 Marine Invasives 1338
15.7.3 Underwater vessel noise 1338
15.7.4 Seawater quality 1339
15.7.5 Vessel collisions (disturbance to human population) 1339
15.7.6 Oil spills 1340

15.1 Introduction

The Environmental Management and Monitoring Plan (EMMP), details the actions / plans required to:

- Measure and monitor the predicted and potential impacts of the Development,
- Check the efficacy of the project-specific mitigations in place, and
- Address uncertainties, such as spatial / temporal data gaps, to increase the level of confidence in the impact / risk assessment.

Should the monitoring of impacts indicate that the significance of the impacts and risks predicted in the EIS are not appropriate, and / or that mitigation is not effective, a revised mitigation measure and / or monitoring regime will be required.

The EMMP will identify specific monitoring and management plans for those issues where:

- The impact was assessed as '**Significant**' and / or the confidence in the assessment was assessed as either '**Probable**' or '**Uncertain**', or when
- The sensitivity of a receptor was assessed as '**High**' or '**Very High**' and / or the confidence in the assessment was assessed as either '**Probable**' or '**Uncertain**'.

These monitoring, mitigation, survey and research actions are noted in each assessment chapter (Chapters 10, 11 and 12) and are collated below.

Navitas has developed an EMMP strategy and will collaboratively work with FIG to identify how the EMMP may be jointly best managed. An integral part of the EMMP development process was an EMMP workshop (see below), which was conducted by POEPL in 2019.

Once the FDP has been approved and the project has been sanctioned, the EMMP will become a live document which will provide detail on:

- Specific roles and responsibilities,
- Timelines, deadlines and 'frequency of execution' for actions identified, and
- Progress and completion for use throughout the life of the field.

15.2 EMMP Workshop

A workshop to consider the content of an EMMP to accompany the Phase 1 & 2 Development Environmental Impact Statement (EIS) was held in Stanley, Falkland Islands on 23-25 April 2019. It was attended by 25 interested stakeholders, comprising FIG, POEPL, industry bodies and NGOs. Consideration was given to 11 of the environmental impacts and risks identified in the Environmental Impact Assessment (EIA) where there was potentially a need for further certainty as to the actual impact. Summary EMMP tables were prepared, and reproduced herein, for seven (reduced from 11 as inshore transfer was removed from the project (Section 2.1.1)) of these impacts, namely:

- Seabird attraction to light,
- Effects of underwater noise on marine mammals,
- Effects on offshore benthos,
- Risk of ship collision with cetaceans,
- Invasive species,
- Seabird risk from offshore oil spills, and
- Nuisance effects on humans.

15.3 EMMP Scope

The EMMP covers the activities to be undertaken as part of the construction, drilling and operational phases of the Sea Lion Development and aims to ensure the performance of the mitigations proposed within the EIS on the key project activities are monitored and managed.

Where execution of the proposed actions in the EMMP programme indicates that the mitigations / management actions proposed have not been appropriate, do not deliver the level or value expected, or indeed are considered unnecessary, the EMMP Steering Group may reassess the mitigations in place.

The Monitoring and Management Programme can be split into three types of work:

- Legislative and corporate monitoring activities (Section 15.4),
- Baseline data and survey work (Section 15.6), and /or
- Research and studies (Section 15.7).

The EMMP will also, where possible, identify the thresholds and the associated adaptive management actions.

Legislative and corporate monitoring requirements are determined by FIG or UK legislation and Navitas' corporate requirements, which are themselves driven by:

- Navitas' OMS being certified to ISO14001 or equivalent, and
- Navitas' environmental reporting commitments both to the GRI (Global Reporting Initiative) and in accordance with IOGP (International Association of O&G Producers) guidelines.

15.3.1 Screening

To determine whether actions over and above those stipulated by legislation or corporate governance were required, the EIS assessment results were screened for impacts and risks where:

- The impact was assessed as '**Moderate**' or above and the confidence in the assessment was assessed as either '**Probable**' or '**Uncertain**', and / or
- The sensitivity of a receptor was assessed as '**High**' or above and the confidence in the assessment was assessed as either '**Probable**' or '**Uncertain**'.

A worked example of the screening process is provided below in Table 15.1.

If an action is required it could lead to either further gathering of baseline data and survey effort, a requirement for further research or studies, or a management action.

All 'scoped in' impacts and risks are presented below in Table 15.2 and their corresponding EMMP action referenced.

It should be noted that for some impacts / risks that were scoped out, monitoring will still be required. This is either to comply with Navitas' corporate reporting standards, for example, in the case of the monitoring of day-to-day energy and water usage. There are also some aspects that will be monitored to ensure Navitas is following its social commitments as a responsible operator, such as monitoring for noise nuisance and tracking usage of local accommodation and use of seats on the Airbridge. These monitoring requirements are described in Section 15.4.

Table 15.1: Example: collisions between cetaceans and an inshore vessels

Impact assessment results					
Sensitivity	**Severity**	**Likelihood**	**Impact assessment**	**Residual impact assessment**	**Confidence**
High	Moderate	Unlikely	Moderate (8)	Moderate (8)	Uncertain
Screening					
Is an EMMP action required for this impact /risk?					
Is impact / risk '**Moderate**', '**Upper Moderate**' or '**High**' and is confidence '**Probable**' or '**Uncertain**'?				Yes, therefore EMMP action is required.	
Is sensitivity of receptor '**High**' or '**Very High**' and is confidence '**Probable**' or '**Uncertain**'?				Yes, therefore EMMP action is required.	

Table 15.2: Screened impacts and risks from the assessment that require EMMP action

EIS chapter	Impact / risk	Screening rationale based on impact / risk assessment	EMMP action
10.1 Artificial light	Risk of bird strikes offshore and inshore	Large and small scale bird collisions offshore Impact '**Moderate'**, Confidence '**Probable**' Large and small scale bird collisions inshore: Impact '**Moderate**', Confidence '**Probable**'	See Sections 15.6.2.1.2 and Section 15.7.1
10.4 Underwater noise offshore	Impact of vessel noise on receptors offshore	Injury to seabirds from underwater vessel noise Sensitivity '**High**', Confidence '**Uncertain**' Behavioural disturbance to marine mammals from vessel noise Impact '**Moderate**', Confidence '**Uncertain**'	See Section 15.6.2.1.3 and Section 15.7.3
10.6 Drill muds and cuttings	Impact to benthic fauna	Impact to benthic fauna Impact '**Moderate**', Confidence '**Probable**'	See Table 15.4 and Section 15.6.2.1.1
10.7 Operational discharges	Risk of sheens impacting seabirds offshore	Impact of oil sheens on seabirds Sensitivity '**Very High**', Confidence '**Probable**'	See Table 15.3, Table 15.4, Section 15.6.2.1.2 and Section 15.7.4
10.9 Atmospheric emissions	Combustion of sold product	Emissions from combustion of sold product Sensitivity '**Very High**', Confidence '**Uncertain**'	No action proposed as it is considered beyond the operator's ability to monitor the destination and/or end use of sold product
10.10 Waste	Use of a finite resource	Waste generation for disposal in the UK Impact '**Moderate**', Confidence '**Probable**'	See Table 15.3 and Table 15.4[1]
10.11 Cetacean collisions	Risk of Navitas vessels colliding with marine mammals offshore and inshore	Risk of vessels colliding with marine mammals Sensitivity '**High**', Confidence '**Uncertain**'	See Section 15.6.2.1.4
10.12 Marine invasives	Risk of introducing invasives by vessels associated with the Development	Introduction of invasives by Sea Lion in-field vessels, *ad hoc* freighter and CTT vessels Impact '**Moderate**', Confidence '**Uncertain**' Introduction of invasives by LTVs, in Berkeley Sound Impact '**Upper Moderate**', Confidence '**Uncertain**'	See Table 15.4, Section 15.6.2.1.6 and Section 15.7.2

EIS chapter	Impact / risk	Screening rationale based on impact / risk assessment	EMMP action
10.13 Terrestrial non-natives	Risk of introducing invasives by marine and air freight associated with the Development	Introduction of invasives by air freight Impact '**Upper Moderate**', confidence '**Probable**' Introduction of pathogen species in FOAO (Food of Animal Origin) Sensitivity '**Very High**', confidence '**Probable**'	See Table 15.4[1]
11.1 Other Users of the Sea Offshore	Third-party vessel collision	Damage to FPSO or MODU Sensitivity '**Very High**', Confidence '**Probable**'	See Table 15.5 and 15.7.5 15.6.2.2.1 and Section 15.7.5
11.4 Competition for water resources	Restriction of water supply and / or quality	Risk of restriction of water supply to the community and/or Project Impact '**High**' / '**Upper Moderate**', Confidence '**Uncertain**'	See Table 15.5
11.5 Competition for energy resources	Competition with domestic energy needs	Risk of overloading of current capacity Impact '**High**', Confidence '**Uncertain**'	See Table 15.5
11.7 Competition for roads network	Increased number of vehicles and use of infrastructure	Potential for nuisance to human population, e.g., congestion Impact '**Moderate**', Confidence '**Probable**'	See Table 15.5
11.8 Disturbance to the human population from light	Annoyance, sleep disturbance	Annoyance, sleep disturbance to Stanley residents Impact '**Moderate**', confidence '**Probable**' Annoyance, sleep disturbance and impairment of dark skies Impact '**Moderate**', confidence '**Probable**'	See Table 15.5 and Section 15.6.2.2.1
11.9 Disturbance to the human population from noise	Noise disturbance to residents	Annoyance, sleep disturbance to residents in Stanley and Berkeley Sound Impact '**Moderate**', confidence '**Probable**'	See Table 15.5 and Section 15.6.2.2.1
12.1, 12.2 and 12.3 Oil spills	Risk of oil spills offshore, inshore or at-shore	See Sections 12.1.12, 12.2.12 and 12.3.12	See Table 15.5 and Section 15.6.2.1.5, and Section 15.7.6

[1] Currently there are no additional monitoring measures proposed over and above that already required by legislation and / or Navitas' corporate requirements as there are no other feasible measures expected to be effective in monitoring these impacts / risks.

15.3.2 Periodic review of scope

At least every five years, the scope of the EMMP will be formally reviewed.

If, through acquisition of data outwith the EMMP or through third-party sources or observations, an impact that is initially scoped out appears to have unexpected significance, this will be raised at the Steering Group and a course of action agreed.

Equally, if sufficient evidence is present to demonstrate that the issue no longer reasonably meets the screening criteria, the issue will be removed from scope.

Changes to the EMMP scope may occur within the five-year period if agreed at the EMMP Governance Board.

15.4 Legislative and corporate monitoring

Legislative monitoring requirements cover those that are defined by FIG or, where no local legislation currently exists, the equivalent UK requirement. The EMMP must also cover Navitas' corporate environmental reporting requirements which are defined to meet the company's environmental reporting commitments both as a member of the IOGP and to report to the standards of the GRI.

All Navitas' environmental data systems are included in independent audits as part of Navitas' ISO 14001 certification or its equivalent, and as part of Navitas' annual reporting (Table 15.3) to the standards of the GRI.

Currently understood activities related to legislative and corporate environmental and social monitoring are shown in Table 15.4 and Table 15.5 respectively.

Any additional legislative requirements that may develop as FIG legislation is enacted will be updated in the EMMP as required.

Table 15.3: Navitas' environmental performance data reporting

Area	Sub Area	Data Requirements	Frequency	Units	Comment / Basis
GHG Emissions	Direct Emissions (Scope 1)	Gross Production	Monthly	Tonnes	Collected in Navitas database for HSE statistics
		Flared Gas	Monthly	Tonnes	Collected in Navitas database for HSE statistics
		Fuel Gas Use[1]	Monthly	Tonnes	Collected in Navitas database for HSE statistics
		Diesel Consumption	Monthly	Tonnes	To include diesel used on platforms and in vessels (standby and supply vessels), and to be reported by Business Units (BUs)
		Helicopter Fuel Use	Monthly	Tonnes	Reported to Navitas by helicopter provider
		Vented Gas[1]	Monthly	Tonnes	Estimated from information on point source vents and quantity vented, provided by the BUs.
		Fugitive Emissions	Monthly	Tonnes	Calculated using production figures and information on each facility from BUs
	Indirect Emissions (Scope 2)	Office Energy Consumption	Annually	kW-h	Reported by BUs. Also include the percentage of electricity consumption (if any) from renewable energy
	Indirect Emissions (Scope 3)	Global Business Travel	Annually	Tonnes CO_2e	Collected from corporate travel provider
Pollution Prevention	Planned Discharges	Produced Water	Quarterly	Tonnes	Reported by BUs
		Oil in Produced Water	Quarterly	Tonnes	Reported by BUs
		Drainage Water	Quarterly	Tonnes	Reported by BUs (if available)
		Oil in Drainage Water	Quarterly	Tonnes	Reported by BUs (if available)
		Black Water	Quarterly	Tonnes	Reported by BUs
		Grey Water	Quarterly	Tonnes	Reported by BUs
		Discharges to Air	Annually	Tonnes	Estimated by Navitas, to include NOx, SOx, VOC and CO emissions
	Unplanned releases	Hydrocarbon Spills	Monthly	Tonnes	BU to register cases in Navitas' incident reporting system cases and update as new information becomes available. Corporate to collect number of spills and quantity spilled from Navitas database for HSE statistics
		Chemical Spills	Monthly	Tonnes	BU to register cases in Navitas' incident reporting system and update as new information becomes available. Corporate to collect number of spills and quantity spilled from Navitas database for HSE statistics
	Waste	Hazardous Waste	Quarterly	Tonnes	Reported by BUs, to include quantity of waste recycled

Area	Sub Area	Data Requirements	Frequency	Units	Comment / Basis
		Non Hazardous Waste	Quarterly	Tonnes	Reported by BUs, to include quantity of waste recycled
Natural resources	Energy Use	Fuel Gas and Diesel	Annual	GJ	Calculated by Corporate based on fuel use figures provided by BUs
	Water Use	Drilling water, potable water offshore	Quarterly	Tonnes	Reported by BUs
	Biodiversity impacts	As identified in this EIS	Annual	-	To be covered in annual meeting/phone call for qualitative data collection

[1] Note there is zero planned flaring once into steady state production and zero routine venting.

Table 15.4: Legislative and corporate environmental monitoring requirements

Relevant Chapter	Impact	Relevant legislation	Legal Monitoring & Measurement requirements	Project-specific commitments	Navitas KPI	When monitored	Regularity of monitoring
10.6 Drill muds and cuttings	Discharge of treated NADF cuttings	FIG PON 10: <1 % oil on discharged cuttings	Monitor % oil on discharged cuttings	Navitas targeting 0.5 % oil on cuttings	No	Drilling	Representative (multiple) samples per well section
10.6 Drill muds and cuttings	Discharge of drill muds	UK Offshore Chemical Regulations (OCR) 2002: only approved chemicals may be discharged (application *via* Chemical Permit)	Select OCNS approved chemicals and monitor use and discharge	-	No	Drilling	Daily
10.7 Operational discharges	Discharge of chemicals during commissioning (hydrotest water)	UK OCR 2002: only approved chemicals may be discharged (application *via* Chemical Permit)	Select OCNS approved chemicals and monitor use and discharge	-	No	Commissioning and hook up	Weekly
10.7 Operational discharges	Discharge of chemicals during operations (cooling water, prod water)	UK OCR 2002: only approved chemicals may be discharged (application *via* Chemical Permit)	Select OCNS approved chemicals and monitor use and discharge	-	No	Operations	Monthly
10.7 Operational discharges	Discharge of NADF % in completion fluids	UK Well Cleanup Guidelines: must be visibly clean	Monitor NADF % in completion discharges, only visibly oil-free water discharged	Oily water treatment system installed on MODU, target <30 mg/l	No	Drilling	Representative (multiple) samples during each wellbore clean-up
10.7 Operational discharges	Discharge of drainage water from MODU,	MARPOL (Annex 1): No discharges >15 ppm in transit	Monitor drainage discharges	No discharges > 15 ppm in transit and on station	No	Throughout Field Life	Daily

Relevant Chapter	Impact	Relevant legislation	Legal Monitoring & Measurement requirements	Project-specific commitments	Navitas KPI	When monitored	Regularity of monitoring
	FPSO and vessels						
10.7 Operational discharges	Discharge of produced water (not normal operation)	FIG PON8: 40 mg/l averaged over the month, and that no single discharge exceed 100 mg/l. 30 mg/l monthly average during periods of discharge has been advised by DMR verbally.	Monitor any produced water discharge for oil in water content, Volume injected, Volume discharged, Monitoring of dissolved components	Averaged monthly discharge target 10-15 mg/l. Target 93 % produced water reinjection uptime	Yes (OIW content and PWRI uptime)	Production (if PWRI offline)	Twice daily samples if over-boarding, Volumes taken daily, Dissolved components twice a year
10.9 Atmospheric emissions	Combustion equipment and fuel use	The Climate Change Act 2008 and The Climate Change Act 2008 (2050 Target Amendment) Order 2019.	Meter fuel gas, Monitor all diesel, helifuel and MGO use, Calculate and reports all emissions from MODU and FPSO, Monitor fuel gas composition Monitor NOx and SOx emissions	Injection of surplus gas, Efficient design including turbine selection and waste heat recovery, Use of MGO instead of IFO inshore, Auditing of third-party vessels during pre-mobilisation process	Yes (energy use, GHG intensity and Gas Production / Injection (GPI) uptime)	Throughout Field Life	Monthly. For fuel gas composition, quarterly. For NOx emissions, occasionally during Field Life Annually: Other releases e.g., fugitive emissions, MODU emissions
10.9 Atmospheric emissions	Flaring	UK Petroleum Act 1998 UK Petroleum Licensing (Production) (Seaward Areas) Regulations 2008 World Bank Zero Routine Flaring initiative	Meter all flaring, Monitor flare gas composition	No routine flaring except HP pilot, Flare recovery system on FPSO and gas reinjection, see also studies in Section 15.7.1	Yes (energy use)	Throughout Field Life	Daily. For flare gas composition, quarterly.

Relevant Chapter	Impact	Relevant legislation	Legal Monitoring & Measurement requirements	Project-specific commitments	Navitas KPI	When monitored	Regularity of monitoring
10.9 Atmospheric emissions	Venting	UK Energy Act 1976 UK Petroleum Act 1998 Global Methane Pledge	Monitor all unplanned venting	Vapour recovery package on cargo tanks, Leak detection programme, no routine flaring	Yes	Production	As required
10.9 Atmospheric emissions	F-Gases	The Fluorinated Greenhouse Gases Regulations 2015	Monitor all unplanned F-gas releases	Log all F gas inventories on the facility, maintain *via* specialist contractors	No	Drilling and Production	As required
10.9 Atmospheric emissions	Fugitive emissions	n/a	Minimise all fugitive emissions	Minimisation of releases *via* good practices including STEP Change Hydrocarbon Release Reduction Toolkit	No	Drilling and Production	Ongoing leak detection and repair programme including use of FLIR (Forward looking Infra-Red) Camera
10.10 Waste	Waste production	UK Waste Regulations (various), Falkland Islands Pollution Prevention and Waste Management Policy	Monitor all waste generated on the MODU, FPSO, vessels, TDF and onshore bases	Education of offshore and onshore personnel on waste management and consequences of mis-management. To be included in all personnel inductions, E-Reps[1] programme, Biosecurity Management Plan implemented.	Yes	Throughout Field Life	Monthly

Relevant Chapter	Impact	Relevant legislation	Legal Monitoring & Measurement requirements	Project-specific commitments	Navitas KPI	When monitored	Regularity of monitoring
10.12 Marine non-natives	Introduction of marine non-native species	n/a	Adhere to IMO BWMC[2] (no monitoring actions required)	Adherence to ballast water and biofouling requirements included in pre-selection and pre-mob audits, Sampling of ballast water discharges from LTVs and OCVs in Berkeley Sound. LTVs hull inspection requirement included in vetting, Sampling of shoreline, benthos, settlement plates and structures for presence of non-native species	No	LTVs, OSV and PSV	As required for vessels. Seasonally or less frequently for presence of non-native species in the environment.
10.13 Terrestrial invasives	Introduction of terrestrial non-native species	n/a	Adhere to FIG Biosecurity Guidelines – FIG monitor of incoming cargoes	Biosecurity Management Plan implemented Training and awareness for yard/TDF personnel accepting cargoes, E-Reps[1] programme, Visual inspection of all cargoes on arrival	No	Throughout Field Life	As required
12.1, 12.2 & 12.3 Oil spill offshore, inshore and at-shore	Impact to various flora and fauna	FIG PON8: Reporting spills and sheens FIG OPEP requirements: An OPEP must be submitted to FIG	Monitor all spills and sheens and report to FIG	Regular oil spill response exercises to be conducted. Tests with oil on fur to be completed prior to	Yes	Throughout Field Life	As required

Relevant Chapter	Impact	Relevant legislation	Legal Monitoring & Measurement requirements	Project-specific commitments	Navitas KPI	When monitored	Regularity of monitoring
				drilling commencing and in sufficient time to inform key operational documents including ERPs and OPEPs, subject to import permits (for France).			
Other	n/a	n/a	n/a	Development of an E-Rep[1] role	No	Throughout Field Life	n/a

[1] A voluntary Environmental representative (E-Rep) role on the MODU / FPSO to promote environmental awareness, similar to a Safety Rep.
[2] Ballast Water Management Convention.

Table 15.5: Legislative and corporate social monitoring requirements

Relevant Chapter	Impact	Relevant legislation	Legal Monitoring & Measurement requirements	Project-specific commitments	Navitas KPI	When monitored	Regularity of monitoring
11.3 – 11.7 Competition for Resources	Impact to local residents from competition for accommodation, water, power, air links	n/a	n/a	All complaints will be monitored. All use of local accommodation and Airbridge monitored, Water and power use monitored.	Water use and power use	Throughout Field Life	As required
11.8-11.9 Nuisance to the human population	Impact to local residents from light and noise	n/a	n/a	All complaints will be monitored. Confirm background noise levels.	No	Throughout Field Life	As required
11.1 and 11.2 Disturbance to other users of the sea	Impact to other users of the sea due to additional vessels present and exclusion zones offshore and inshore	n/a	n/a	All complaints will be monitored, reviewed and responded to.	No	Throughout Field Life	Reporting of all vessel incursions into the exclusion zones

15.5 Governance

The following governance framework for the EMMP was discussed at the EMMP Workshop in 2019. A governance board consisting of representatives of FIG and of Navitas was suggested. This would be supported by an advisory forum including both non-technical stakeholders and relevant individuals with expertise in the subjects being monitored and managed (e.g., offshore benthos, seabirds, marine mammals, invasive species). The advisory forum would help draw up the specifications in any scope of work used in contracting particular monitoring work, and would also be able to comment upon the results of the monitoring or performance / success of management actions. This commentary may include giving advice as to whether any threshold has been passed, any further management that might be needed and reviewing whether monitoring efforts should be increased or could be reduced. Decision-taking on the whole EMMP lies ultimately at FIG level, but the above suggestions would provide support to such decisions, while also ensuring that stakeholders would be able to be involved at all relevant stages.

Throughout Field Life, information arising from the EMMP process will be reported to the EMMP Governance Board on a regular basis, likely biannually. The relevant actions will be discussed and the programme of work updated as necessary. Meetings of the Governance Group will include FIG, technical advisors, and invited or statutory stakeholders, with outputs reported publicly.

15.6 Baseline data and survey work

15.6.1 Project timeline

Where uncertainties in the EIS arise from lack of baseline data (Section 7.2.4), Navitas propose to develop a number of key surveys and data collection programmes related to the key phases of the project:

- Pre-sanction,
- Post-sanction and pre-First-Oil, and
- Post-First-Oil and throughout production.

Table 15.6 shows the three main phases of the project timeline. This is included for each EMMP activity to show when it will occur and for how long the programme will continue.

Table 15.6: Project timeline

Pre-sanction			Post-sanction and pre-First-Oil				Post-First-Oil and throughout production		
Now	EIS submission	Public consultation	Sanction / FIG approval	Construction of FPSO etc.	Development drilling	Offshore construction and Commissioning	First-Oil	Production	End of Field Life

15.6.2 Proposed survey activities

Based on the uncertainties noted in the EIS, the proposed surveys include:

- Offshore seabird monitoring using SMMOs which will be deployed for the first three years of operations initially, followed by a review of the data collected and evaluation of the need for ongoing monitoring,
- Measurements of underwater noise during construction operations at Sea Lion,
- Marine mammal observations prior to and during operations at the Sea Lion location and on transits,

- Pre-drilling seabed surveys of benthos and sediment chemistry at Sea Lion, and ongoing throughout Field Life,
- Invasive species monitoring of shorelines, benthos, settlement plates and structures, and
- Operational monitoring and measurements of potential disturbance to humans ongoing throughout Field Life.

The EMMP activities presented below are an outline only and the final scope of environmental baseline data collection, surveys, monitoring, thresholds and potential management actions will be discussed and agreed with input from technical advisors and the Governance Board.

Table 15.7 below presents an overview of the EMMP survey activities throughout Field Life. They are followed by individual workscope activities (see Section 15.7 below) which provide further details, as guided by the EIS assessment. These proposed activities are set out in each chapter of the EIS but these workscopes describe the proposed scope of the task and any concurrent surveys or monitoring (outwith Navitas activities), which may feed into the Navitas scope of work. Indications of timing and regularity are provided as well as any reporting requirements.

Table 15.7: Overview of proposed EMMP survey activities throughout Sea Lion Field life

Year					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	...	30	See Section
Receptor	Post-sanction and pre-First-Oil				Post-First-Oil and throughout production																				
	Sanction / FIG approval	Construction of FPSO etc.	Development drilling	Offshore construction	1st Oil	Production																			
Offshore																									
Benthic sediments																									Section 15.6.2.1.1
Seabirds offshore																									Section 15.6.2.1.2
Offshore and Inshore																									
Marine mammals - noise																									Section 15.6.2.1.3
Marine mammals - collision																									Section 15.6.2.1.4
Oil spill	n/a	n/a	n/a	n/a	In the event of a spill																				Section 15.6.2.1.5
Inshore																									
Invasives																									Section 15.6.2.1.6
Onshore																									
Disturbance to humans																									Section 15.6.2.2.1
Baseline data collection			**Ongoing Monitoring**									**Ongoing Monitoring, frequency to be reviewed**													

[1] Decommissioning (including any associated monitoring) will be subject to a separate EIA.

15.6.2.1 Environmental

15.6.2.1.1 Benthic sediments

Impact Chapter Ref: 10.6 Drill Cuttings										
Reason for inclusion: Pre-drilling environmental surveys to confirm no habitats or species of conservation significance are present within the zone of influence and ongoing surveys every five years thereafter.										
Management Objective: Confirm no habitats or species of conservation significance are present withing the zone of influence of each drill centre										
Scope of work: Seabed grabs for sediment characterisation, benthos, chemistry and heavy metal analysis (e.g., TOM and TOC levels, PAH, metal toxicity etc.) Visual survey with ROV at each monitoring station. Cuttings pile sampling. Analysis of PAH content of treated cuttings.										
Inputs to task	Agree habitats and species of concern prior to ROV survey and ensure competent person on board (or available remotely) during ROV survey who is familiar with these habitats / species									
Timing	**Pre-sanction**			**Post-sanction and pre-First-Oil**				**Post-First-Oil and throughout production**		
	Now	EIS submission	Public consultation	Sanction / FIG approval	Construction of FPSO etc.	Development drilling	Offshore construction	First-Oil	Production	End of Field Life
Notes	Survey repeated every five years.									
Reporting	Results shared with FIG									
Adaptive Management Thresholds	Resample - If habitats of species of significance are found, position will be moved slightly away from habitat or species of conservation significance Review – During production drilling and once drilling complete Investigate - Analysis shows a new or significantly changed species or habitat not previously noted in benthic surveys in the area React – Significant change to species and / or habitats noted during previous benthic surveys at multiple locations Adapt - Presence of habitats or species of conservation significance throughout the area									
Potential Management Actions	Reaction – Move location of penetration to avoid species or habitat of conservation significance									

15.6.2.1.2 Seabirds

<table>
<tr><td colspan="11">Impact Chapter Ref: 10.1 Artificial light, 10.7 Operational discharges and Sections 12.1 and 12.2 on oil spill</td></tr>
<tr><td colspan="11">Reason for inclusion: To support historical seabird at sea Team (SAST) surveys[1]</td></tr>
<tr><td colspan="11">Management Objective: To collect further seabird data from vessels associated with the Sea Lion development.</td></tr>
<tr><td colspan="11">Scope of work: Use of SMMOs for the first three years on vessels in transit between the Falkland Islands and the Field[2]. Seabird observers will be also deployed offshore during any initial well test and commissioning flaring to quantify any impacts. Monitoring of bird-strike occurrence and severity.</td></tr>
<tr><td>Inputs to task</td><td colspan="10">Use of SMMOs on Development vessels offshore</td></tr>
<tr><td rowspan="2">Timing</td><td colspan="3">Pre-sanction</td><td colspan="4">Post-sanction and pre-First-Oil</td><td colspan="3">Post-First-Oil and throughout production</td></tr>
<tr><td>Now</td><td>EIS submission</td><td>Public consultation</td><td>Sanction / FIG approval</td><td>Construction of FPSO etc.</td><td>Development drilling</td><td>Offshore construction</td><td>First-Oil</td><td>Production</td><td>End of Field Life</td></tr>
<tr><td>Frequency</td><td colspan="10">Use of SMMOs will occur for the first three years of the project and the need for further monitoring will be reviewed after year three.</td></tr>
<tr><td>Notes</td><td colspan="10">SMMOs will make observations at site as well as during transits between the Falkland Islands and Sea Lion.</td></tr>
<tr><td>Reporting</td><td colspan="10">Results shared with FIG
Monthly bird strike reporting to FIG</td></tr>
<tr><td>Adaptive Management Thresholds</td><td colspan="10">Resample – n/a
Review – Inshore SMMO observations will be collated and reviewed once operations in Berkeley Sound cease – these data will be used to validate the EIA. Offshore SMMO observations will be collated and reviewed every six months and again after the first three years to validate the EIA and determine whether or not ongoing monitoring is required
Investigate – Any multiple bird strikes on single vessel
React – Multiple bird strikes on more than one vessel
Adapt – Occasional but repeated bird strikes</td></tr>
<tr><td>Potential Management Actions</td><td colspan="10">Reaction – Investigate alternative lighting methods (e.g., as new technology emerges)</td></tr>
</table>

[1] The SAST data was a collaboration between FIG and industry in terms of funding and was delivered by the Joint Nature Conservation Council (JNCC) in conjunction with Falklands Conservation (FC). The EMMP workshop agreed that it would be useful to collect further seabird data opportunistically from vessels associated with the Sea Lion Development, but that an area wide data collection effort was considered beyond the scope of an individual operator. It was agreed that this will require a FIG-Pan industry collaboration; an initiative which is considered needs to be coordinated by FIG.

[2] **Post-consultation note (July 2025):** Potential for guidance in the vessel specific ASOGs (Section 5.5.1) regarding northerly passage into Berkeley Sound and adherence to allocated time windows for entry.

15.6.2.1.3 Marine mammals – underwater noise

<table>
<tr><td colspan="11">EIA Chapter Ref: 10.4 Offshore underwater noise</td></tr>
<tr><td colspan="11">Reason for inclusion: Sensitive receptor with uncertain impacts</td></tr>
<tr><td colspan="11">Management Objective: Confirm that impacts are within the envelope of predictions in the EIS, and feedback data to review the significance of impacts and the measures to mitigate any significant impacts</td></tr>
<tr><td colspan="11">Scope of work: Post-sanction, pre-First-Oil: Baseline data collection and ongoing monitoring - Measurement of underwater noise levels will be undertaken via hydrophone (i.e. Passive Acoustic Monitoring (PAM)) as a monitoring exercise and use of independent SMMOs for ongoing monitoring</td></tr>
<tr><td colspan="11">Scope of work: Post-First-Oil: Ongoing monitoring. Monitoring of day-to-day operational noise including during activation of thrusters as well as various vessel scenarios to understand baseline noise levels during operations. Independent SMMOs for ongoing monitoring</td></tr>
<tr><td>Inputs to task</td><td colspan="10">Observation protocols to be developed.
Details on monitoring will be worked out with the advisory committee and in adherence to the Cetacean Code of Conduct for the Falkland Islands.
See Martin et al., 2023 for example array design.
Updated noise modelling report (Genesis, 2024a & b).</td></tr>
<tr><td rowspan="2">Timing</td><td colspan="3">Pre-sanction</td><td colspan="4">Post-sanction and pre-First-Oil</td><td colspan="3">Post-First-Oil and throughout production</td></tr>
<tr><td>Now</td><td>EIS submission</td><td>Public consultation</td><td>Sanction / FIG approval</td><td>Construction of FPSO etc.</td><td>Development drilling</td><td>Offshore construction</td><td>First-Oil</td><td>Production</td><td>End of Field Life</td></tr>
<tr><td>Frequency</td><td colspan="10">Use of SMMOs for first three years of the project then review and revise strategy as required (depending on other ongoing work)</td></tr>
<tr><td>Notes</td><td colspan="10">SMMOs will make observations at site as well as during transits between the Falkland Islands and Sea Lion
Align with any concurrent marine mammal monitoring programmes
Seabird observers will also contribute to marine mammal survey as well as collecting seabird data
Two SMMOs on vessels transiting between field and Stanley
Systematic programme and protocols to be developed</td></tr>
<tr><td>Reporting</td><td colspan="10">SMMO and noise reports to FIG</td></tr>
<tr><td>Adaptive Management Thresholds</td><td colspan="10">Resample - n/a
Review - SMMO observations will be collated and reviewed every six months and again after the first three years to validate the EIA and determine whether or not ongoing monitoring is required
Investigate - Any adverse noise-related behaviour of marine mammals
React - Any mass noise-related behaviour
Adapt - Chronic noise-related behaviour change</td></tr>
</table>

EIA Chapter Ref: 10.4 Offshore underwater noise	
Potential Management Actions	Reaction - Scale back noisy activity. Adaptation - Adjust timing of operations.

15.6.2.1.4 Marine mammals - Collision

EIA Chapter Ref: 10.11 Cetacean collisions										
Reason for inclusion: Sensitive receptor with potentially significant impact										
Management Objective: Confirm that impacts are within the envelope of predictions in the EIS, and feedback data to review the significance of impacts and the measures to mitigate any significant impacts										
Scope of work: Post-sanction, pre-First-Oil, post-First-Oil: Baseline data collection and ongoing monitoring - Independent SMMOs on OSVs for ongoing monitoring and mitigation										
Inputs to task	Observation protocols to be developed Cetacean Code of Conduct for the Falkland Islands									
Timing	**Pre-sanction**			**Post-sanction and pre-First-Oil**				**Post-First-Oil and throughout production**		
	Now	EIS submission	Public consultation	Sanction / FIG approval	Construction of FPSO etc.	Development drilling	Offshore construction	First-Oil	Production	End of Field Life
Frequency	SMMOs on board vessels periodically covering all seasons over the first three years with particular focus at the time of year when animals are concentrated in the area of ship movements Complete for first three years of the project then review and revise strategy as required (depending on other ongoing work)									
Notes	SMMOs will make observations at site as well as during transits between Sea Lion and the Falkland Islands Align with any concurrent marine mammal monitoring programmes Seabird observers will also contribute to marine mammal survey as well as collecting seabird data Two SMMOs on OSVs transiting between field and Stanley Systematic programme and protocols to be developed									
Reporting	SMMO reports to FIG, real time reports between vessels if aggregations of marine mammals observed.									
Adaptive Management Thresholds	Resample - n/a									

	Review - Inshore SMMO observations will be collated and reviewed once operations in Berkeley Sound cease – these data will be used to validate the EIA. Offshore SMMO observations will be collated and reviewed every six months and again after the first three years to validate the EIA and determine whether or not ongoing monitoring is required Investigate - Any near miss situations with marine mammals React - Any collision or suspected collision Adapt - Occasional but repeated interactions at risk of collision
Potential Management Actions	Reaction - Reduce vessel speed near marine mammals not attracted to the vessel Adaptation - Add marine mammal detection systems (e.g., infra-red camera systems); adjust timing of operations; consider use of deterrents

15.6.2.1.5 Oil Spill

EIA Chapter Ref: 12.1 Offshore oil spill, 12.2 Inshore oil spill and 12.3 At-shore oil spill										
Reason for inclusion: To survey potentially significant impacts resulting from any unplanned oil releases										
Management Objective: Confirm that impacts are within the envelope of predictions in the EIS, and feedback data to review the significance of impacts and the measures to mitigate any significant impacts										
Scope of work: Post-sanction, pre- and post First-Oil: Baseline data collection - Use of Independent SMMOs on Navitas vessels infield and on transit to and from the field and potentially the helicopters to detect oiled birds (and help in wider data collection) Sampling of oil from plumage of oiled birds to determine if it is Sea Lion crude										
Inputs to task	Review GAP modelling work, which may augment the Seabirds At Sea Team data Methods to be agreed Application of project-specific OPEPs									
Timing	**Pre-sanction**			**Post-sanction and pre-First-Oil**				**Post-First-Oil and throughout production**		
	Now	EIS submission	Public consultation	Sanction / FIG approval	Construction of FPSO etc.	Development drilling	Offshore construction	First-Oil	Production	End of Field Life
Frequency	In the event of a spill									
Notes	University of Highlands and Islands are conducting a review of the Oil Vulnerability Indices for oil and gas activities in the sub-Arctic. An Oil Vulnerability Index has been updated to Seabird Oil Sensitivity Index in the UK Continental Shelf The Sea Lion oil spill strategies and statutory reporting of all oil spills are relevant									
Reporting	Data to be reported to FIG									

15.6.2.1.6 Marine Invasive species

Impact Chapter Ref: 10.12 Marine non-natives										
Reason for inclusion: Potentially significant impact resulting from introduction of invasive species										
Management Objective: Confirm that presence of non-native species is not increased beyond levels of background change. Feedback observations into management of the issue.										
Scope of work: Settlement plates will be positioned in Berkeley Sound prior to and during the construction phase of the project. Settlement plates will be positioned at the Temporary Dock Facility / Stanley Harbour for sampling throughout the duration of the project. In the event that a new marine invasive species is discovered, a pathway analysis will be conducted to attempt to determine where / how the species had been brought to the Islands. If appropriate, safe and feasible, efforts will be made to eradicate the invasive species.										
Inputs to task	Discussion with FIG Biosecurity Officer									
Timing	**Pre-sanction**			**Post-sanction and pre-First-Oil**				**Post-First-Oil and throughout production**		
	Now	EIS submission	Public consultation	Sanction / FIG approval	Construction of FPSO etc.	Development drilling	Offshore construction	First-Oil	Production	End of Field Life
Notes	Ballast water management in line with IMO standards will be undertaken regardless of any further actions. Pre-charter inspection of hulls for fouling will also be undertaken									
Reporting	Results shared with FIG									
Adaptive Management Thresholds	Resample - If obvious failure or contamination of a monitoring site or inconclusive tests of settlement plates Review - Annual review of results Investigate - Analysis shows a new or significantly changed species within a list of high-risk species; employ pathway analysis to determine most likely causes React - Obvious infestation or release or gross contamination of equipment / cargo. Adapt - Presence of high risk species or adverse change in species composition outwith background variation									
Potential Management Actions	Reaction - Minimise ballast water discharge inshore, refuse mooring to contaminated vessels, backload contaminated cargo Adaptation - Change vessel logistics, additional treatment or exchange of ballast water									

15.6.2.2 Social

15.6.2.2.1 Disturbance to humans

Impact Chapter Ref: 11.8 and 11.9 Disturbance to the human population from light and noise										
Reason for inclusion: Potentially significant impact from light and noise emissions										
Management Objective: Confirm that impacts are within the envelope of predictions in the EIS and feedback observations into management of the issue										
Scope of work: Post-sanction, pre-First-Oil: Baseline data collection and ongoing monitoring - Light and noise monitoring in Stanley Light and noise monitoring and photographs taken from relevant receptors to establish baseline. Further monitoring and photographs during operations to verify EIS predictions and monitor any changes. Ongoing monitoring and recording of all complaints received										
Inputs to task	Helicopter, FIGAS and onshore baseline noise recordings Any synergistic outcomes from the joint Navitas/FIG Social Effects Monitoring Programme. BS EN 12464-2:2007 for lighting intrusion BS 4142 for industry noise BS 8233 for community noise									
Timing	**Pre-sanction**			**Post-sanction and pre-First-Oil**				**Post-First-Oil and throughout production**		
	Now	EIS submission	Public consultation	Sanction / FIG approval	Construction of FPSO etc.	Development drilling	Offshore construction	First-Oil	Production	End of Field Life
Frequency	Frequency and continued monitoring dependent on impacts recorded and complaints received									
Notes	-									
Reporting	Reports to FIG									
Adaptive Management Thresholds	Resample - If surveys are compromised by weather Review - Review survey findings within 6 months Investigate - If noise levels are >5 dBA above those predicted and there are reasonable grounds to link this to the project activities; any incident of complaint. React - If noise levels are >10 dBA above those predicted and there are reasonable grounds to link this to the project activities; multiple related complaints. Adapt - Continued regular complaints over period of 1 year									
Potential Management Actions	React - Change operational practices e.g., timing of activities; switch off idle equipment Adapt - Replace, muffle or shield equipment; provide additional physical barriers; look at alternative logistics arrangements or equipment									

15.7 Research and studies

15.7.1Seabirds

Impact Chapter Ref: 10.1 Artificial light										
Scope of work: The use of different light spectra (green lighting) and the use of a ballistic flare ignition system to negate the need for a pilot light) will be explored in the FEED process with Reliability, Availability and Maintenance (RAM) studies conducted for viable options, and ongoing monitoring of bird-strikes during the operation will serve to validate the impact assessment and adjust the use of mitigation measures as necessary[1]. Reporting of bird strikes Investigation into the possibility of a collaborative survey with FIFD, potentially using the fisheries patrol vessel as a platform. Investigation of a seabird distribution monitoring programme to be developed over several years with an understanding of ongoing work and in collaboration with FIFD.										
Inputs to task	FEED / Detailed Design contractor studies Bird strike protocol Training for downed seabirds for crew Explore collaboration with FIFD									
Timing	**Pre-sanction**			**Post-sanction and pre-First-Oil**				**Post-First-Oil and throughout production**		
	Now	EIS submission	Public consultation	Sanction / FIG approval	Construction of FPSO etc.	Development drilling	Offshore construction	First-Oil	Production	End of Field Life
Notes	Once activities start in the Falklands, bird strike reporting will commence both offshore and onshore at the base									
Reporting	Results shared with FIG Monthly reporting of bird strikes to FIG									

[1]**Post-consultation note (July 2025):** Potential for guidance in the vessel specific ASOGs (Section 5.5.1) regarding northerly passage into Berkeley Sound and adherence to allocated time windows for entry.

15.7.2 Marine Invasives

Impact Chapter Ref: 10.12 Marine non-natives										
Scope of work: In the event marine invasives are discovered in the course of normal monitoring, pathways analysis will be conducted to determine where / how invasives are being brought into the Islands This will be done in conjunction with genomics whereby water samples are taken at various points and analysed to identify the individual DNA										
Inputs to task	Discussion with FIG Biosecurity Officer (DNR) Investigation into antifouling slick paints Biosecurity Management Plan									
Timing	**Pre-sanction**			**Post-sanction and pre-First-Oil**				**Post-First-Oil and throughout production**		
	Now	EIS submission	Public consultation	Sanction / FIG approval	Construction of FPSO etc.	Development drilling	Offshore construction	First-Oil	Production	End of Field Life
Notes										
Reporting	Results shared with FIG									

15.7.3 Underwater vessel noise

Impact Chapter Ref: 10.4 Underwater noise offshore										
Scope of work: Investigate low noise thrusters and propellers on any Navitas operated and newly constructed / re-fitted vessels, i.e., MRSVs and inshore support vessels, ERRV and AHTS										
Inputs to task	Vessel specifications									
Timing	**Pre-sanction**			**Post-sanction and pre-First-Oil**				**Post-First-Oil and throughout production**		
	Now	EIS submission	Public consultation	Sanction / FIG approval	Construction of FPSO etc.	Development drilling	Offshore construction	First-Oil	Production	End of Field Life
Notes	Navitas is aware this technology is used by local fishing companies Vessels will be dry docked in accordance with their classification requirements. Hulls and propellers will be cleaned accordingly. Engines shall be maintained similarly and Dynamic Positioning will be used only when necessary									
Reporting	Results shared with FIG and informs EIS impact assessment chapter reviews									

15.7.4 Seawater quality

Impact Chapter Ref: 10.7 Operational discharges											
Scope of work: Risk Based Approach (RBA) to ascertain composition of produced water, and modelling (using a suitable model) of produced water once samples taken and composition known to confirm impact zone, impact assessment in EIS and test the model											
Inputs to task	Produced water samples: Whole Effluent Testing in line with the laboratory analysis requirements of the UK RBA Implementation Programme										
Timing	**Pre-sanction**			**Post-sanction and pre-First-Oil**				**Post-First-Oil and throughout production**			
	Now	EIS submission	Public consultation	Sanction / FIG approval	Construction of FPSO etc.	Development drilling	Offshore construction	First-Oil	Production	End of Field Life	
Notes	After produced water breakthrough in Sea Lion reservoir										
Reporting	Results shared with FIG										

15.7.5 Vessel collisions (disturbance to human population)

Impact Chapter Ref: 11.1 Disturbance to other users of the sea											
Scope of work: An AIS based study will be carried out at the location of the Sea Lion Development to confirm the shipping traffic pattern in the area once the FPSO exclusion zone is in place											
Inputs to task	AIS data										
Timing	**Pre-sanction**			**Post-sanction and pre-First-Oil**				**Post-First-Oil and throughout production**			
	Now	EIS submission	Public consultation	Sanction / FIG approval	Construction of FPSO etc.	Development drilling	Offshore construction	First-Oil	Production	End of Field Life	
Notes	Once FPSO exclusion zone is established										
Reporting	Results shared with FIG										

15.7.6 Oil spills

Impact Chapter Ref: 12.1, 12.2 & 12.3 Oil spills											
Scope of work: Maintain continuous and live hydrodynamic model for use in the event of any spills. Once into production actual flow rates will be compared with modelled flow rates. If actual flow rates are higher than predicted, modelling will be re-run. Use of the spill modelling and hydrodynamic data to develop a means of forecasting spill trajectories to enable rapid and targeted response in the event of a spill. Complete testing of oil adhesion to seal fur prior to drilling commencing, subject to import permits (for France).											
Inputs to task	Well flowrates. Weather data.										
Timing	**Pre-sanction**			**Post-sanction and pre-First-Oil**				**Post-First-Oil and throughout production**			
	Now		Public consultation	Sanction / FIG approval	Construction of FPSO etc.	Development drilling	Offshore construction	First-Oil	Production	End of Field Life	
Notes	Hydrodynamic data will be collected to develop and improve the model										
Reporting	Results shared with FIG										

16 FINAL REVIEW AND CONCLUSION

Table of Contents

16.1 Introduction 1342
16.2 Significant impacts and risks of planned activities and unplanned events 1342
16.3 Significant risks associated with accidental events 1343
16.4 Overall conclusion 1344

16.1 Introduction

Sea Lion Field Phase 1 & 2 Development is the first proposed oil and gas (O&G) production development in the waters of the Falkland Islands. Therefore, a precautionary approach was taken with respect to all assessments carried out within this EIS. Nonetheless, the majority of the residual impacts and risks associated with the Phase 1 & 2 Development were considered to be of 'Low' or 'Very Low' significance and are not considered to warrant further reduction to meet Navitas' Policy of doing all that is 'reasonably practicable' to minimise environmental impacts. These will, however, be periodically reviewed to ensure that the controls remain in place.

No residual impacts or risks were considered to be '**High**'.

However, while all residual impacts and risks have been reduced to ALARP, some were still considered to be of potentially '**Moderate**' or '**Upper Moderate**' significance and shall be subject to continuous improvement where opportunities exist.

16.2 Significant impacts and risks of planned activities and unplanned events

Significant residual impacts from planned activities and unplanned events associated with planned activities are:

- Artificial light - risk of bird-strikes - **Moderate** (Section 10.1),
- Vessel noise offshore – potential for behavioural disturbance impacts to marine mammals - **Moderate**' (Section 10.4),
- Discharge of drill cuttings – Impacts on benthos including burial of benthic fauna, modification of habitat, toxicity and oxygen depletion – **Moderate** (Section 10.6),
- Emissions - greenhouse gas contribution to global warming and ocean acidification - **Moderate** (Section 10.9),
- Atmospheric emissions associated with the combustion of sold product - **Upper Moderate** (Section 10.9).
- Waste - impact of waste upon unsustainable resources with regards to export and the use of UK landfill – **Moderate** (Section 10.10),
- Collisions between vessels and marine mammals inshore and offshore – **Moderate** (Section 10.11),
- Marine invasive species - risk of introducing marine non-native species from Navitas in field vessels, *ad hoc* freighter vessels, LTVs and the purchaser's CTT- **Moderate** (Section 10.12).
- Terrestrial invasive species - non-native species arriving on marine and air freight – **Upper Moderate** (Section 10.13),
- Competition for freshwater – water use during Development Stages 1 and 2 - **Upper Moderate** (Section 11.4):
- Competition for electrical energy use – **Upper Moderate** (Section 11.5),
- Nuisance to human population from the use of roads – **Moderate** (Section 11.7), and
- Disturbance to the human population from light - Operations at TDF, supply base and LTV operations – **Moderate** (Section 11.8).

These remain significant, despite all mitigations, primarily because:

- A precautionary approach was taken owing to data gaps with regard to the above e.g., data gaps in whale species distribution and the long-term impact of vessel noise on hearing,
- Of the potential consequences with regard to:

- The sensitivity of the receptors e.g., the protected status of whale / bird species or the unsustainability of the resource such as regulated landfill, and / or
- The irreversible nature of some of the impacts e.g., the longevity of GHGs in the atmosphere or the difficulty in detecting whether a species has become invasive and in reversing the potential impacts to biodiversity.

As described in this EIS, technologies to reduce the impacts and risks have been built-in to the Phase 1 & 2 basis of design, where possible, and into the Navitas OMS. These, and the relevant project-specific mitigation measures, include:

- Use of Best Available Technologies,
- Application of all industry-standard safeguards,
- Implementation of the:
  - Bird-strike Management Plan, and
  - Waste Management Plan.
- Awareness of the Navitas Carbon Strategy,
- Application of emissions, discharge and waste ALARP studies carried out during the Execution Phase of the project, and
- The use of SMART environmental targets and Key Performance Indicators (KPIs) throughout the Field Life to ensure continual optimisation of emissions, discharges and waste.

Moreover, monitoring and reporting will be carried out over the lifetime of the Development to ensure verification and comparison with the predictions made in this EIS.

16.3 Significant risks associated with accidental events

Significant residual risks associated with accidental events are:

- The risk of minor or major unplanned releases of hydrocarbon or Marine Gas Oil (MGO) offshore - **Moderate** (Section 12.1),
- The risk of minor or major unplanned releases of hydrocarbon or MGO inshore - **Moderate** (Section 12.2), and
- The risk of day-to-day releases during operations and the TDF – **Moderate** (Section 12.3).

These remain significant, despite all reasonably practicable preventative measures designed to minimise the likelihood of accidental events occurring, primarily because:

- A precautionary approach was used in the assessments, and / or
- Of the potential consequences with regard to:
  - The sensitivity of the receptors to impacts e.g., the fragility of the Falkland Islands ecosystems and tourism industries and the globally important number of protected species (particularly seabirds), and / or
  - The severity of effect e.g., the potentially long-term impacts upon bird populations or public perception and therefore, potentially tourism.

All reasonably practicable efforts will be made to eliminate and prevent accidental events occurring and to Detect, Control, Mitigate, Respond and Remediate any consequences in the event that they do so, such that risks are reduced to ALARP. These measures include:

- Application of all industry-standard safeguards,
- Implementation of the:
  - Oil Pollution Emergency Plans, and

- Wildlife Response Plan.

- ALARP reviews, and
- Preparation of robust operations procedures during the Execution Phase of the project .

16.4 Overall conclusion

In summary thirteen aspects remain of significance:

- Impacts - Planned activities:
  - Artificial light offshore and inshore - **Moderate**,
  - Underwater vessel noise offshore - **Moderate**,
  - Drill cuttings discharges – **Moderate**,
  - Atmospheric emissions directly associated with the Phase 1 & 2 Development (climatic factors) - **Moderate**,
  - Waste management (contingent export to UK with unrecoverable waste going to UK landfill) – **Moderate**,
  - Collisions with marine mammals inshore – **Moderate**,
  - Introduction of marine invasive species - **Moderate**,
  - Introduction of terrestrial invasive species – **Upper Moderate**,
  - Competition for freshwater resources – **Upper Moderate**,
  - Competition for energy resources – **Upper Moderate**,
  - Competition for use of roads – **Moderate**, and
  - Disturbance to the human population from light – **Moderate**.
- Indirect impacts outwith Navitas' control:
  - Atmospheric emissions associated with the combustion of sold product – **Upper Moderate**.
- Risks - Unplanned / accidental events:
  - Oil spill offshore, inshore and at-shore - **Moderate**.

The use of vessels and fossil fuels is necessary to carry out any operation and the generation of some waste which cannot be re-used or recycled is unavoidable. Similarly, the use of third-party vessels from elsewhere in the world will always carry some risk of non-native species introduction and all oil production can carry the risk of oil spill.

Navitas believes that all impacts and risks have been identified, that those of low significance are sufficiently controlled and those that remain significant have been reduced to ALARP. Therefore, Navitas is satisfied that its Policy of doing all that is reasonably practicable to minimise environmental impacts has been met. Navitas will ensure that all impacts and risks are periodically reviewed to ensure that the controls remain in place and that potentially '**Moderate**' and '**Upper Moderate**' impacts and risks are subject to continual improvement where opportunities exist.

17 POST-SUBMISSION CONSULTATION OUTCOMES

Detail on the representations made during the 42-day statutory and public consultation process required under the FIG Offshore Minerals Ordinance (OMO, Section 3.1.7.3.1) are presented below.

Table 17.1 shows the representations made during the public consultation and Table 17.2 shows the requests for information made under section 66 of the OMO. Figure 17-1 below presents the written response from Byron Holdings Ltd. to the Falklands Conservation representation.

Note that some figures, tables and sections have been added to the post-consultation document (Rev 02) in response to the representations made. Therefore, some page numbers and figure / table / section numbers have changed since the statutory consultation version. The references made in the 'Representation' and 'Navitas Response' columns refer to the figure / section numbers (etc.) from the original consultation document and the final column ('Change in Rev 04') refers to the relevant section / figure / table in this current revision (Rev 04).

Also, please note that while not itemised within each response, all additional references have been added to Chapter 20.

Table 17.1: Representations made during the public consultation

Ref.	Representation	Navitas response	Changes in Rev 4
Byron Holdings Limited			
BYR 1	We welcome the recently released Environmental Impact Statement by Navitas Petroleum, and we wish to submit the following statements. We all use oil in our everyday life. It is widely stated that oil will be part of the energy mix during the Energy Transition for at least the next 30 years, or longer. Therefore, oil needs to be produced. It should be produced to high environmental standards. It is hypocritical to use oil but rule out the production of it in the Falklands on environmental grounds, whilst believing it should be produced by other countries, often to lower environmental and other standards. The EIS is a substantial, thorough and very detailed assessment of the impact of the Sea Lion development, impacts and mitigation measures.	Thank you for the comments.	N/A
BYR 2	FIG Policy. The EIS of the Sea Lion development is in accordance with the Islands Plan 2022–2026, that states “This Assembly will… progress extractive industries in an environmentally conscious way.” The EIA recognises other relevant FIG policies including those to protect the environment and biodiversity, and climate change.	Noted and agreed.	N/A
BYR 3	Further work. The EIS recognises further work to be done in legislation & offsetting. This is understandable given that O&G is a new industry to the Falklands. These additional provisions can be pragmatically put in place as the project develops.	Navitas continues to work with FIG and its key contractors to ensure that its arrangements are aligned with industry best practice and FIG's planned changes to legislation. Navitas' offsetting approach is being confirmed with FIG and will be consistent with FIG legislation, policy and guidance. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		a Sea Lion specific carbon and biodiversity offsetting fund.	
BYR 4	The EIS appears to cover all environmental risk areas. The Sea Lion development has Environmental Risks. The EIS does not indicate there are specific, significant, negative environmental impacts. It appears there are environmental risks, if accidental events take place but not definite impacts. Measures to reduce significant adverse effects on the environment. The O&G sector is treated differently to other Falklands business sectors. The Falklands O&G industry has had to undertake an EIA. No other Falklands industry has had to do so. Neither fishing nor tourism (flights) is being asked to do this i.e., the EIS (Chapter 10) assesses the risks of birds landing on ships. The Sea Lion development will only have a handful of modern ships in the EEZ, but including an attending offshore emergency response vessel, and other vessels maintaining modern state of the art features. The fishing industry often has a substantial number >100 vessels, some of which, jiggers and reefer vessels that intentionally utilise a lot of light to conduct fishing operations. There is a real danger of inconsistent standards being applied to the Falklands O&G sector, not applied to other sectors.	Thank you for your comments. In response to the second bullet, Navitas agree that the majority of the impacts and risks identified and assessed throughout the document are not considered significant (i.e., are not Moderate or above). However, the EIS does highlight a number of impacts and risks as potentially significant, e.g., the impact of direct emissions (assessed as Moderate), the risk of impacts from the introduction of terrestrial invasives (assessed as Upper Moderate). Mitigation measures are identified where possible to reduce these significant impacts and risks to ALARP but some remain significant due to the precautionary approach taken in the assessment.	N/A
BYR 5	Oil Pollution Emergency Plans. - Oil Pollution Emergency Plans are based on credible worst-case scenarios (EIS chapters 12.1, 12.2, 12.3). This approach seems appropriate. The likely location of spill, weather, environmental receptors and type of oil are all factors considered. The likelihood of oil beaching in the Falklands is low. - This level of risk is acceptable and compares with existing tanker operations both in Falklands harbours and offshore. Current offshore tanker and bunker operations appear to have fewer mitigating measures being taken and the risk of these appear to be unevaluated by FIG and conservation groups.	Thank you. These comments are noted and are a welcome observation.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
BYR 6	Waste. The use of the planned FIG incinerator to treat and dispose of the majority of project wastes, with non-combustible wastes being returned to the UK for disposal, should mean there is little environmental risk from O&G waste in the Falklands; this compares favourably with the current arrangements for other waste in the Falklands.	Thank you for your comment.	N/A
BYR 7	Offsetting /GHG. - All Green House Gases (GHG) generated from undertaking the development and production should be offset, ideally by offsetting measures within the Falklands. It is recognised that these measures have yet to be fully identified. This is understandable given that O&G is a new industry and little is known about the science and offsetting potential in the Falklands. - The emissions produced by actually using the oil, should be offset by the actual users of the oil that produce the emissions, not the producer i.e.. Navitas. This is consistent with FIG's User Pays Policy. - The EIS proposes that Navitas provides an environmental fund. This is a welcome and positive development and if properly managed will provide an opportunity to address a number of Falkland environmental issues including: biodiversity, habitat reinstatement, land restoration and endangered species protection,	Thank you for the comment. Navitas' Carbon and Biodiversity offsetting fund will be established and intends to pursue the Falkland islands environmental opportunities the comment mentions. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund.	N/A
BYR 8	No residual impacts or risks in the EIS were considered to be 'High' (Chapter 16). This is highly reassuring for the Falklands and contrasts with the production and developments in other countries. The majority of the residual impacts and risks associated (Chapter 16) with Phases 1 & 2 of the Sea Lion Development were considered to be of 'Low' or 'Very Low' significance. This is acceptable. It is important that these will be periodically reviewed to ensure that proper controls remain in place. Significant impacts & risks of planned activities & unplanned events. There are just thirteen aspects of significance, rated as 'Moderate'. A number of the 'Moderate' risks relate to marine activities: - Artificial light - risk of bird-strikes (Section 10.1); - Vessel noise offshore - impacts to marine mammals (Section 10.4);	See BYR 4 above. There are some impacts and risks that remain significant i.e., (Moderate or above) but no residual impacts and risks remain high owing to the implementation of project specific mitigation measures. Navitas welcome these comments and the context they provide.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	- Emissions – GHG (Section 10.9); - Collisions between vessels and marine mammals inshore and offshore (Section 10.11), - Marine invasive species - risk of introducing marine non-native species (Section 10.12). There is a far greater risk of these impacts and risks from planned and unplanned events in the fishing industry, (or from transiting ocean traffic), which has far more vessels entering and operating within the Falklands EEZ.		
BYR 9	Mitigation. Whilst it is noted that Navitas are planning on using industry standard mitigation measures, it is important that these are effectively monitored by FIG, including using KPIs.	There are extensive statutory monitoring and reporting requirements associated with industry standard mitigation measures. In addition the operations EMMP will detail monitoring and reporting requirements. EMMP outcomes will be reported to the EMMP governance and advisory committee and published. In alignment with Navitas' contracts and procurement procedure, contractors will also be expected to report performance against KPIs.	N/A
BYR 10	The 'Moderate' rating for the onshore activities seems too high: - Waste management (contingent export to UK with unrecoverable waste going to UK landfill) – if the materials come from the UK and can be returned to the UK for disposal in accordance with UK standards, surely this is a high enough environmental standard. The Falklands, with its limited resources and capability cannot expect higher standards than the UK. - Competition for freshwater resources – the freshwater requirement is mainly during the drilling phase. This requirement is not huge in comparison with the overall requirement. FIG should ensure it has the water capacity to be able to deal with this. - Competition for energy resources – the onshore energy use is not that significant to overall grid requirement and FIG already has plans to increase capacity with the increased wind farm and new power station	Thank you for the comment. The EIS deliberately takes a precautionary approach to ensure all impacts and risks are assessed appropriately and with consideration for the human population as receptors. This is particularly true when it comes to onshore activities. Navitas does not propose to make any change to the document in light of the comment.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	- Competition for use of roads – O&G activity will mainly focus on the Gordon Lines area. The increase in traffic is not huge on lightly used roads with lots of capacity. - Disturbance to the human population from light – residents in Stanley already have light pollution from FIPASS and Port William, and Berkeley Sound activities; Oriental jiggers in close proximity to Stanley are the worst light pollution offenders. The development phase is relatively short period and there will not be a major increase in the number of vessels, following First-Oil. We thank you for the opportunity to comment, and wish the project a successful delivery		
BYR2 1	A response to the 57-page Falklands Conservation submission to the Navitas Petroleum EIS.	This is a response from one consultee to another and is included below in Figure 17-1.	N/A
Chamber of Commerce			
CoC 1	The Falkland Islands Chamber of Commerce welcomes the first steps towards potential oil production in the Sea Lion field by Navitas Petroleum Development and Production Limited; and their presentation of the recently released Environmental Impact Statement (EIS) It is encouraging to note that Navitas has considered critical issues of (a) waste management, (b) freshwater supply, (c) energy supply, (d) affected Stanley road networks, (e) air travel and support, and (f) accommodation within the EIS submission. These areas also have an impact on existing businesses, and non-oil and gas vessel berthing operations. Oil exploration has been progressing for about 30 years with the Falkland Islands Government (FIG) having a strategic vision of oil production to secure the economy of the Falkland Islands. Within the next few years there is a strong possibility that this vision will be realised; and oil will start to be produced offshore in the Falkland Islands, reducing the current heavy reliance of revenue from the fishing industry, and enabling the creation of a Patrimony Fund which will secure the Falklands economy for the long term. FIG have set out an agenda to reduce carbon emissions and introduce more	Noted, Navitas welcome the comments and looks forward to continuing to work with the Chamber of Commerce, and in relation to the Socio-Economic Impact Assessment in particular.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	green energy, such as phase 3 of the Sand Bay wind farm. However, as the world transitions to green energy there will still be a reliance on oil for the next few decades. Navitas, during their presentation of the EIS, stated that new methods of oil extraction will be utilised therefore reducing the level of emissions to the atmosphere. It was explained that these emissions, at the worst-case scenario, would be lower than the pro-rata emissions from oil production within the UK. This is an encouraging statement as the Falkland Islands enjoys a unique environment and continues to work towards reducing carbon emissions further. FIG requires Navitas to operate a fund to 'offset' carbon emissions from the Sea Lion development. This fund will be open to all applicants who have investment proposals that they can demonstrate reduce greenhouse gases, contribute to carbon storage, or are otherwise environmentally friendly, including land restoration and bio-diversity protection. FIG and Navitas are seeking to ensure the safest operations, as far as is reasonably practicable, for offshore oil production. These endeavours will ensure the lowest possible risks and impacts, as set out in the EIS, for all areas of our community and the environment. In the view of the Chamber of Commerce, the list of impacts appears comprehensive and the mitigations appropriate to the risk. FIG has an opportunity to shape the future of the Falkland Islands by introducing an industry that will bolster the economy and help deliver sustainable national development. Falkland Islands businesses will have the opportunity to grow to meet the requirements of Navitas and future FIG capital projects. This growth in local businesses will provide further economic stability to the Falkland Islands through more viable business units and sectors, improved opportunities for diversification and generation of corporate taxes to fund social programmes. The Falkland Islands Chamber of Commerce eagerly awaits the Navitas Socio-Economic Impact Statement and looks forward to engaging with aspects of the Field Development Plan. These documents will help to determine how to deliver best possible private sector		

Ref.	Representation	Navitas response	Changes in Rev 4
	support for the project whilst recognising wider national development opportunities and benefits.		
Dragon Fishing and Trading			
DGN 1	We understand that the plan is to anchor LTVs in Berkeley Sound during the construction phase and that there will be a 500m exclusion zone around these. While we haven't had a season comparable to that in 2015 we would seek assurance from Navitas that there won't be any impact on transhipping operations in Berkeley Sound, if we were to have a season with huge catches.	Navitas shall work closely with FIMA throughout the planning and execution stages of the development to ensure that: - final positions for the LTV anchorage sites are agreed and well communicated to mariners and other users of the sea - Activity Specific Operating Guidelines (ASOGs) are developed for the vessels operating in the area - FIMA is advised of all vessels planning to operate in the area - FIMA is advised of the activities and equipment / product transferred between vessels. The LTVs (and 500m radius exclusion zones around both vessels) will take up 1.349% of the area of Berkeley Sound so are not considered to pose a significant impact to other users of the area. This will be referenced in the post-consultation EIS in Section 5.5.1 & Section 11.2	Section 5.5.1 Section 11.2
DGN 2	The *Illex* fishery has changed substantially over the last few years and local companies are more invested in the fishery having built strong relationships with overseas partners. It's no longer a fishery where the financial arrangement is a 'brokers' fee or 'fishing licences are sold' to overseas partners. The potential loss to the local economy if negatively impacted by the oil industry is significant.	FIG requires Navitas to submit a separate 'Financial Liability for Oil Spill Assessment' for review and approval. This assesses the worst-case financial impact arising from an oil spill event and includes an assessment of the financial impact of such a spill on the Falkland Islands fishing industry. Navitas is required to demonstrate that it has insurance arrangements in place to compensate for such impacts in the unlikely event of an oil spill.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
DGN 3	While we appreciate that historically there may not have been a great deal of fishing in the area there is nothing to say that this may not change in the future. Therefore we suggest a stronger commitment to decommissioning and leaving the seabed clear is important.	As stated in the EIS, 'Decommissioning will be carried out in accordance with the legislation in place at the time'. At the time of writing, the project defers to the current UK legislation and its sources. OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations prohibits dumping, and leaving wholly or partly in place, of disused offshore installations within the OSPAR maritime area. While derogation from this prohibition may be sought for qualifying installations, e.g., large steel or concrete footings of fixed platforms, this will not apply to the proposed project which will utilise an FPSO with subsea wellheads and infrastructure. Under OSPAR, all subsea structures must be removed with any associated piles, well conductors etc. cut to a level below the natural seabed which ensures they remain below the seabed in the face of prevailing conditions. Of importance, pipelines and other structures which are listed in a UK Pipeline Works Authorisation are excluded from OSPAR Decision 98/3 and in the UK, decommissioning of these is managed in line with the Petroleum Act 1998 (Part IV) and the Pipeline Safety Regulations 1996. These require a similar assumption of complete removal where reuse of the pipeline and associated structures for further hydrocarbon development is not possible. However, under the UK regulations, there are certain pipelines and/or circumstances in which a pipeline may be wholly or partially left *in situ* e.g., pipelines that are adequately buried or trenched and are not subject to development of spans, and are expected to remain so. However, the decision to do	Section 5.12

Ref.	Representation	Navitas response	Changes in Rev 4
		so would need to be informed by an EIS which is supported by a formal Comparative Assessment of the options which must include a robust assessment of the environmental impact of removal *vs.* that of leaving wholly or partially in situ. Part V of the Offshore Minerals Ordinance 1994 confers obligations for decommissioning. A decommissioning programme has to be approved by FIG in advance. FIG has powers under the Ordinance to develop additional regulations in relation to field decommissioning. As stated in Section 5.12 of the EIS: '…in line with the current legislation, the Phase 1 & 2 Development infrastructure has been designed to enable complete removal of all structures. Equally, the flowlines will be surface laid and will not be trenched or buried thus facilitating complete removal (noting that the seabed is very soft, so flowlines may self-bury which could change the methods required for complete removal).' Also in line with legislation, all relevant 'As Left' surveys will be carried out to ensure that the seabed is left clear. The Sea Lion Phase 1 & 2 offshore installation and subsea infrastructure has been designed so that it can be removed completely and the seabed left clear. Therefore the project has been designed with compliance to current regulation in mind and Navitas will comply with the prevailing legislation at the time of decommissioning.	
DGN 4	The table on Page 1154 does capture the potential severity of blow-out/loss of FPSO to some degree. The EIS goes to some length to show that oil reaching coast of FI is very unlikely however, we believe that the likely	Navitas has submitted a separate 'Financial Liability for Oil Spill Assessment' for review and approval by FIG. This assesses the worst-case financial impact	Section 12.1

Ref.	Representation	Navitas response	Changes in Rev 4
	overlap between a major oil spill and the *Illex* fishery/*Illex* distribution is much greater and that more could be done to model that and define impacts.	arising from an oil spill event and includes an assessment of the financial impact of such a spill on the FI fishing industry. Navitas is required to demonstrate that it has insurance arrangements in place to compensate for such impacts in the unlikely event of an oil spill. Navitas has also analysed AIS data and it is clear that the *Illex* fleet fish on the shelf break and sometimes report either their midday or midnight positions in the relevant grid square XFAK but do not fish in there. The AIS data corroborates the VMS data. The general direction of the oil in a modelled blow out scenario will generally head in a N / NW direction. The oil is also buoyant and will float on the surface away from Ilex biomass generally. Navitas's financial liability assessment recognises that even if there were no, or very a limited or short-lived biological impact on FI fish species, reputational impacts would extend to depress demand and/or prices, even in unaffected areas. These marketing impacts are considered when determining the potential liability and associated insurance arrangement required in order to provide compensation.	
Environmental Department			
ED 1	Page 37: Previous surveys - would be good to state how many previous surveys have been undertaken	A list of surveys will be developed and included as an appendix.	Appendix 4
ED 2	Page 40: Have there been any more unusual influxes of marine mammals reported, or a general change in behaviour since 2017?	2017 was unprecedented compared to previous years and abundances have been similar since. Note that 2017 was also the year that FC and SAERI started	Section 7.4.6.3.1.1

Ref.	Representation	Navitas response	Changes in Rev 4
		surveys and a point in time when empirical data collection started. It is acknowledged that whale populations have increased over time since the cessation of whaling. However, it is not possible to determine whether abundances were similar prior to the commencement of the BEST Sei whale project that commenced in 2017. The post-consultation EIS will be updated for clarity.	
ED 3	Page 45: Titles not complete on table	Noted. This will be amended.	Figure 1-3
ED 4	Page 48: regular monitoring and reporting on performance of offsetting initiatives - what are the timescales?	The governance and timescales for reporting against offsetting initiatives will be agreed with FIG. The establishment, implementation and continued development of the Carbon and Biodiversity Offsetting Fund shall be aligned to key milestones within the Sea Lion development Phase 1 and 2 schedule. Once operations are underway, it is proposed that monitoring will be at 6 month intervals and that performance will be reviewed twice a year with an annual report to be provided to the public. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund.	N/A
ED 5	Page 52-53: Would discharge of drilling muds at seabed impact on levels of microplastics in the water surrounding the site? No mention of micro-plastics in EIS, drilling chemicals have been found to contain micro-plastics and a be contributor to ocean micro-plastic pollution. This may have cumulative impact on receptors such marine species also. Can this pollution be avoided? Possible to monitor in e.g., discharges?	Drilling muds do not contain plastics/microplastics. There are no plastics in the circulation fluids for gravel packing. The circulation fluid is water-based, which has a gelling agent to increase its viscosity, to improve the ability to transport the proppant into the wellbore. The gelling agent is normally a polysaccharide, such as xanthan, which is a common food additive.	Section 5.4.5.3 Section 5.4.5.5 Section 5.4.6

Ref.	Representation	Navitas response	Changes in Rev 4
		The proppant is not used during the drilling phase of the well. The proppant is placed in the well during the completion phase of the well, which acts as a filter medium during the production of the well. The proppant is inert ceramic with no plastics.	
ED 6	Page 53: Is Marine Flora not disturbed by discharge of drilling mud and cuttings? Table 1.7 mentions Marine Flora is affected by thermal discharge	This section refers to phytoplankton, Navitas are unclear what the query refers to as there is no marine flora (e.g., seaweeds) at the location bar marine growth which will grow on the installation. A footnote will be added to the post-consultation EIS for clarity.	Table 1.8
ED 7	Page 65: At least 9 extra supporting plans area needed, a long list of them appears (incl. oil pollution management plan, bird strike management plan, EMMP). When will all of these be ready?	Navitas are following the regulations and guidance provided by FIG in relation to the timing for submission of supporting plans. Alongside this, Permits, Licences, Notifications and Consents (PLANC) registers are being developed in consultation with FIG DMR, to track the submissions (including the supporting plans mentioned) and the timeframe for their submission in step with the project execution timeline.	N/A
ED 8	Page 118: Are 3m significant wave heights typical for all seasons of weather at Sea Lion? Other studies of the South Atlantic would suggest 3m is average wave height in the South Atlantic with significant waves as 5m.	There will be clear operating limits for connection and offtake. The wave study information gathered for the Sea Lion Project was location specific, the data came from several Metocean data collection exercises conducted to assist in the selection for design and operation of the FPSO. The studies supported the decision that direct offloading to conventional trading tankers was both a viable option and one that could be done safely. Note that connection, offloading and disconnection	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		for direct offloading will only commence, and continue, if the sea state and wind conditions are within the allowable operating parameters, if not then connection will not commence and during operations if conditions reach the operating limits offloading it will be stopped and the operation made safe.	
ED 9	Page 123: How were the financial and environmental costs/considerations for e.g., marine life, seabed, water etc of a drilled disposal well versus processing using thermo-mechanical cuttings (TCC) unit and disposal at site considered against each other?	Without a Thermomechanical Cuttings Cleaner (TCC) the proposed batch drilling strategy would require a disposal well at each drill centre location. The TCC minimises environmental impact and represents the Best Practical Environmental Option and is used internationally.	N/A
ED 10	Page 123: Water injected into wells is seawater- will this be tested prior to injection for e.g., small organisms? What volume of water is considered too much of an unknown impact on the organism?	Seawater is treated with chlorine and also filtered once brought onboard the FPSO. This water then passes into the injection system where it has further filtration and also the oxygen is removed. Water specification is maintained and is monitored automatically and also through laboratory testing. Additionally periodic culture tests will be carried out to check for bacterial / organism growth. The injected water goes into the reservoir not the surrounding environment.	N/A
ED 11	Page 146: Do drilling muds and cuttings contain plastics? Can these be cleaned?	See ED 5.	N/A
ED 12	Page 147: Use of TCU in the table but is not used anywhere else, consistency in abbreviations needs to be used	Noted. This will be amended.	Table 5.8
ED 13	Page 150: Good to see that “chemicals will be selected to minimise environmental impacts as much as possible, in compliance with legislation”. Is this UK legislation? Will the environmental considerations go beyond legislation when choosing chemicals?	Yes. Chemicals will be selected in compliance with all UK legislation and every effort will be made to ensure the selection of those with minimal environmental impact. Text will be added to Section 5.4.6 to refer to Sections 10.6 and 10.7 which provide more detail on	Section 5.4.6

Ref.	Representation	Navitas response	Changes in Rev 4
		the legislation with which the project will comply. All chemicals selected will be listed on the Offshore Chemical Notification Scheme (OCNS) List of Notified and Ranked Product generated by CEFAS (Link).	
ED 14	Page 150: Drilling chemicals being discharged at sea - what are the volumes/frequency?	As stated in Section 5.9.1.1 details on the specific operational chemicals which will be used during the Phase 1 & 2 Development are not yet known, and neither are the actual volumes of individual chemicals over and above the anticipated mud volumes indicated in Section 10.6. Nonetheless, all operational chemicals used during the Development will be selected to minimise environmental impacts as much as possible. Further detail on the UK legislation which will be adhered to is provided in Sections 10.6.1.1 and 10.7.1.1. All chemicals selected will be listed on the Offshore Chemical Notification Scheme (OCNS) List of Notified and Ranked Product generated by CEFAS (Link).	N/A
ED 15	Page 167: Open drains will be routed to marine systems - will meet MARPOL 73/78 annex requirements prior to discharge to sea- how will this be regulated and checked?	The open drains system is not pressurised. It can receive hydrocarbons and it separates out oil from water. However, the open drains system cannot go overboard; t is still contained. What goes in is open, what goes out is enclosed and will either go to the closed drains system or slops tank for further treatment. Any discharges overboard must meet MARPOL requirements.	N/A
ED 16	Page 186: Although well workovers are not planned, and if one is considered an EIA will be carried out and discussion with FIG, this still holds a potential increase for environmental impacts?	If well workovers are required, the requirement for an additional EIA will be discussed with FIG at that time.	N/A
ED 17	Page 195: Number of vessels travelling back and forth is not fully known yet- this will have an effect on emissions data and should be logged and monitored.	The projections included in the emissions chapter are very precautionary - as such it is currently anticipated that the emissions arising for the actual number of	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		vessel movements during operations will be within the emissions envelope that has been estimated. Emissions will be recorded and reported as a matter of course.	
ED 18	Page 201: How will the desalination plant at the FPSO be powered?	All power on the FPSO comes from the electrical distribution system which in turn comes from the main power generated by the Gas Turbine Generators. The desalination system is powered from here. Back up periodic power is supplied by the Essential Diesel Power Generators for the occasions when main power is offline. Power feeds the main electrical board and is distributed accordingly to all electrical users onboard the FPSO.	N/A
ED 19	Page 203: Temporary modular accommodation units initially provided by Navitas, supplemented by local hotels. Transferring to in- transit accommodation as soon as available. Where will this be? Is land for this already designated?	An EOI was issued in the Penguin News in February 2024 for the development's accommodation requirements. Once the project is sanctioned an RFQ can be issued to the respondees which will provide further information on the development's short-, medium- and long-term accommodation needs. This will include a 'hotel'. A number of companies and individuals responded to the February EOI. Navitas has not designated any land for the accommodation requirements this is expected to be covered during the responses to the accommodation RFQ.	N/A
ED 20	Page 209: Will decommissioning involve any species studies prior to removal of all subsea infrastructure to check if there are any potential disturbances to ecosystems that should be carefully managed?	Decommissioning will be covered under a separate and dedicated decommissioning EIS which will be supported by baseline surveys prior to work commencing to ensure that any sensitivities are appropriately managed. 'As left' surveys will be	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		undertaken upon completion of decommissioning activities to ensure the site is left as it is found. Decommissioning activities will be compliant with legislative requirements in place at the time of decommissioning. See also DGN 3.	
ED 21	Page 209: Could be important to know general environmental risks associated with decommissioning - i.e., high risk to decommissioning may influence whether structures should be put in in the first place.	Navitas is required to ensure that all structures are designed to be fully decommissioned in a safe and environmentally responsible manner. The seabed has been extensively surveyed to explore environmental sensitivities. These have not indicated that the structures will cause adverse environmental impact. Location specific site surveys will be undertaken immediately prior to installation to ensure there are no localised environmental sensitivities that suggest installation is inadvisable at that location. Navitas will add this additional commentary to Section 5.12 of the post-consultation EIS. See also DGN 3.	Section 5.12
ED 22	Page 218: Stakeholders: There is reference to the FIG Policy Unit. Please update the names: Directorate of Policy, Economy and Corporate Services, with Environment Department, and Policy Department, as required.	These names were correct at the time of the original scoping exercises. They will be updated to the current names with footnotes to explain.	Section 6.1.3 Table 6.2
ED 23	Page 246: Area wide environmental baseline survey of Sea Lion field in 2012- is there a more recent study?	Rockhopper conducted the area wide survey in 2012. Shortly after, Premier conducted a survey south at Isobel Deep in 2014. In 2015, Premier also carried out investigations at 2 gas well sites adjacent to the Main Drill Centre. These studies examined benthic habitats and sediment and water quality, among other things and will not likely have changed since that time. See Table 7.1, and Figures 7-4 and 7-5.	N/A
ED 24	Page 251: The environmental baseline survey of Berkeley Sound occurred between June and August 2015 - does this survey need to be repeated to	This is not considered necessary due to the small time frame and level of activities taking place in Berkeley	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	capture all the different life cycles, seasons and organisms that may be impacted within that habitat?	Sound (two vessels moored for non-consecutive 13 month period).	
ED 25	Page 252: Four seasonal coastal bird surveys in and around Berkeley Sound were carried out between 2016 to 2019. Do you consider this to be adequate information to form a baseline for birds at that site?	Yes, Navitas does consider this adequate information to form a baseline, not least because of the small time frame and level of activities taking place in Berkeley Sound (two vessels moored for a non-consecutive 13 month period).	N/A
ED 26	Page 253: Were the data gaps of offshore benthic ecosystems, oceanography in relation to oil spill modelling, seabirds with regard to priority species and movements, marine mammals, populations and breeding activities identified before or after the GAP Project?	These gaps were identified after the GAP project.	Section 7.2.4.1
ED 27	Page 253: In regards to the Key Gaps of relevance to the Sea Lion EIA, it is not stated if these have been addressed or are still key gaps; if these are still gaps remaining requiring information, how will this information be obtained, and by whom?	It is important to note that under FIG's guidance the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they are addressed in risk assessment. The presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained. The key data gaps will be covered in the EMMP. At the time of project sanction, this will be discussed further with FIG. The EMMP chapter will be updated in the post-consultation EIS to ensure that all of the EMMP workshop conclusions and outline tables are included. Navitas will also update Section 7.2.4 to make it clear which data gaps remain and to more specifically state those which have been filled since the inception of the Sea Lion.	Section 7.2.4

Ref.	Representation	Navitas response	Changes in Rev 4
ED 28	Page general: General concern about lack of references to the data sources, references would allow the data and conclusions derived from data to be checked and assessed by us/ by other stakeholders.	Navitas request further detail on which sections contain unreferenced data. Navitas has committed to preparing a table of primary data sources. This will be added as an appendix to the post-consultation EIS, and reports will be provided on request. Note that during the public consultation Navitas provided any reports and data that were requested.	Appendix 4
ED 29	Page general: Would be good to have a table as an annex with all studies used/ surveys conducted including the dates. As well as an annex of all data gaps identified and if they are going to be further looked into.	Noted. A table will be compiled and appended to the EIS.	Appendix 4
ED 30	Page 262: Water column characteristics were measured for 1 month in March and April 2012. Do you consider that a one-month survey over 10 years ago that doesn't take into consideration seasonality or the changes that may have occurred since then, is acceptable for forming a baseline?	This section is referring to the portion of the survey aimed at characterising the general water column structure e.g., characterisation of layers, presence of thermoclines, and vertical mixing. The respondent is correct that such characteristics may vary seasonally, but seasonal variability will not be so great that it requires special consideration with respect to the potential impacts or mitigations described in relation to the drilling programme. In other words, the water column characterised at the time will be indicative of the present situation, and seasonal variability is not likely to have a strong modifying effect relative to impacts. The measurement is therefore believed to be acceptable for a baseline; however, the text within the EIS will be updated for clarity.	Section 7.3.3.3
ED 31	Page 263: Reference to 1982 study, then references that dynamics of water masses in an area can change over time- is this study still most relevant considering the time elapsed since the study and potential changes in water mass dynamics?	Please see ED 30 above. The text will be modified to say Navitas is referring to variability and not infer that there is a one-way change over time. Although, it is true that there will be long-temporal trends in water mass dynamics, these would be over geologic times scales, although recent climate change is thought to have a modifying effect. Unfortunately there are no	Section 7.3.3.3

Ref.	Representation	Navitas response	Changes in Rev 4
		recent studies aimed at describing water structure and dynamics in the area; recent work focuses primarily on biology and tend to cite the original papers of Bianchi *et al.,* 1982; Peterson and Whitworth, 1989. The text will be updated for clarity.	
ED 32	Page 263: 8 water quality profiles completed within Berkeley Sound survey area over 1-month time period- very short time interval for collecting data or is data still being recorded? Mention of surface temperatures as recent as 2016 and 2017. Where is information kept such as report or data portal?	There is now limited activity planned in Berkeley Sound (13 months [total] of two vessels in non-consecutive activity). Results of profiles indicated relatively well mixed, oxygenated water, which makes sense given the relatively shallow depths, tide, and the persistent wind causing vertical mixing. There is no indication that the water column structure will vary widely from this, but will indeed have some daily and seasonal variation with strengthening and weakening of a shallow thermocline that is reflective of seasonal air temperatures affecting surface water. The water quality profiles (CTD data) is detailed in the Gardline/Benthic Solutions report that is available through the Data Centre or on request. Note that continued Berkeley Sound baseline data collection effort was not considered necessary once inshore transfer in Berkeley Sound was discounted.	N/A
ED 33	Page 277: Organic matter in sediment can influence chemical and biological processes- Survey carried out by Gardline post drilling campaign is in 2013 report but not readily accessible, unable to be found.	All commissioned surveys can be made available upon request.	N/A
ED 34	Page 277: TOM and TOC levels were found to be 5.6% and 0.9% respectively- similar values to pre-drilling survey nearby in 1998, but unable to corroborate data.	All commissioned surveys can be made available upon request.	N/A
ED 35	Page 278: Polycyclic aromatic hydrocarbons from pyrogenic sources due to flare stacks among other reasons- is this going to be monitored as the oil production commences?	Navitas will monitor and report all air emissions in accordance with regulations.	Table 15.4

Ref.	Representation	Navitas response	Changes in Rev 4
ED 36	Page 284: How many recorded oil spills have occurred since this survey was completed in 2012/2013? Is it worth repeating this survey to get a true baseline to be able to determine any impact of production of oil and provide more up-to-date data for point of comparison for the future?	A list of recorded spills in Stanley Harbour, Port William and Berkeley Sound has been provided by FIMA and will be included in the updated, finalised EIS. The baseline environmental survey of Berkeley Sound was completed by Benthic Solutions Limited for Premier Oil in 2015. An SMSG report (2012) noted that there have been numerous fuel oil diesel spills in Berkeley Sound, and section 7.3.7.2.2 references this SMSG report as background context when reporting on the outcomes of the 2015 baseline survey, which indicate that the baseline situation in Berkeley Sound is not a pristine location in terms of hydrocarbons even prior to any oil industry activity in the area. Regarding the suggestion of repeating the survey to get a true baseline for comparison in future, impact from oil production is not considered relevant regarding Berkeley Sound. There is no plan for inventories of crude oil produced at Sea Lion to enter Berkeley Sound. Berkeley Sound is anticipated to be utilised by the Large Transport Vessels (LTVs) for a maximum period of 13 non-consecutive months. There will be bunkering of MGO to these vessels in the Sound, with strict operating guidelines in place. Bunkering in Berkeley Sound is already a common occurrence for numerous (non oil industry vessels). Navitas does not consider that there is any merit in re-examining Berkeley Sound environmental baseline given the limited nature and scale of Sea Lion activity in Berkeley Sound, which is far less than that anticipated by Premier Oil when the 2015 baseline environmental survey was commissioned.	Section 7.6.4 Section 12.3.10

Ref.	Representation	Navitas response	Changes in Rev 4
ED 37	Page 284: Polycyclic aromatic hydrocarbon levels are discussed but it is not mentioned what this means i.e., if these are within acceptable limits? PAH, particularly 2 and 3 ringed aromatics are carcinogens and we should ensure that this is firstly in a suitable level, and secondly is then monitored.	Extensive baseline surveys were conducted in Berkeley Sound ahead of inshore transfer which was subsequently discounted and is no longer part of the project. However, while these data serve as a great legacy for future work, monitoring is not considered necessary due to the small time frame and level of activity taking place in Berkeley Sound (two vessels moored for a non-consecutive 13 month period). PAH levels in Berkeley Sound sediments are mentioned in this section of the EIS which describes the environmental baseline and measured characteristics in Berkeley Sound. The baseline PAH levels encountered have not been caused by oil industry activity, as they were measured prior to any industry use of the Sound. As such whether the PAH levels encountered are within acceptable levels is a matter for FIGs consideration. Furthermore, given the scope and scale of Sea Lion development activity anticipated in Berkeley Sound (up to 13 months' vessel logistics operation and MGO bunkering), ongoing monitoring of PAH levels would not seem a Navitas responsibility.	N/A
ED 38	Page 287: Cd and Ni are above the ERL levels	**Initial Consultation Response:** Noted, see also ED 37. **Post-Consultation Comment:** A footnote will be added to the appropriate sections.	Section 7.3.7.2.2.2 Table 7.2
ED 39	Page 288: V is in low concentrations - a good monitor for the effects of oil production as it is present in most crude oils.	This section of the EIS refers to the environmental baseline survey of Berkeley Sound in 2015. At that time Vanadium was found to be in low concentrations. As oil production activity will not be undertaken in Berkeley Sound, and no crude oil	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		produced will be present in Berkeley Sound at any point Navitas disagrees with the suggestion that Berkeley Sound V levels will be good a monitor for the effects of oil production.	
ED 40	Page 289: Oceanography in summary table - mentions priority to GAP project- It is unclear if this has been addressed by the GAP project or is outstanding to complete	Oceanography was recognised as a gap in the scoping stage, but was not adopted as part of the scope for the GAP project. For the purposes of the EIA, the oceanographic data available is sufficient and valid for the purposes of the modelling. We will clarify the text in the post-consultation EIS.	Table 7.3
ED 41	Page 292: When was the last time data for the NFB and Sealion Field was gathered on the phyto and zooplankton communities?	A small area of like Sea Lion field is highly dynamic and indeed phyto/zooplankton were not identified as a gap.	N/A
ED 42	Page 298: Why was kelp coverage only surveyed in winter? Many species of seaweed have their maximum growth and extent in summer, just showing winter coverage of Berkeley Sound can be misleading and bias the information. Information for other kelp species extent is available however the EIS only includes Giant kelp extent	The commenter is referring to Land-Sat imagery used. This was likely restricted by availability of good quality images. However, a number of sources and analyses were used to fully assess kelp coverage. Kelp was mapped using a variety of sources including analysis by EnvSys (2016) further investigating kelp beds as detected below the water surface, and increased resolution. Sentinel satellite images (10m resolution) under the DPLUS 065 'Mapping the Falklands & South Georgia coastal margins for spatial planning' project. See the same section for further info.	N/A
ED 43	Page 301: While they can be certain none were found in their survey, the EIS says that there is at least a 50% probability of VMEs being present in the production area therefore habitats of high conservation importance cannot be ruled out.	This statement has been revised. Interpretation of both the SAERI (2023) VME study and the Gardline (2013a) survey suggests that even though some VME indicator taxa have at least a 50% probability of being present, the lack of their observation in the Gardline study suggest that they are likely to be sparsely occurring in the focal area. This makes sense, given	Section 7.4.3.2.3

Ref.	Representation	Navitas response	Changes in Rev 4
		that many VME indicator taxa are related to drop-stones (hard substrate) amidst vast areas of silty mud. Additionally, VME indicator taxa are predicted to be widely distributed around the FOCZ, suggesting that VME's potentially impacted within the drilling area will have a high likelihood of recovery.	
ED 44	Page 305: EIS mentions that station 31 is close to the LTV anchorage sites but not what was found in this area. Is that not of more significance than the stations mentioned that may not be close to the LTV anchorage sites?	Thank you for the comment. Navitas will add the findings of Station 31 to the text.	Section 7.4.3.3.1.2
ED 45	Page 323: There is some uncertainty in the data and if habitats appear widespread does not mean that they are not environmentally sensitive or important areas. Could be important source populations for other locations	The commenter is correct. However, please refer to the definition of 'Sensitive' in section '8.5.2.1 Assessment of sensitivity of receptors'. In summary, commonness of the habitat suggests that the probability of recovery after an impact is high, and therefore less sensitive that for example, a habitat that is only found at one particular location. This text will be updated to make this clearer.	Section 7.4.3.3.4
ED 46	Page 328: There is meant to be a summary of the NFB however it is the exact same text that is used in the information for Berkeley sound. This is an error and needs correcting	Noted. This will be amended.	Table 7.8
ED 47	Page 330: What is the significance of skate species spawning in the area? Which species and are these on the IUCN Red List? Is there a data gap that needs to be further surveyed to fully understand potential impacts?	There are data gaps in this area as the commenter points out, due to lack of commercial fishing in this area. Available studies show that the main species is the yellownose skate (*Dipturus chilensis*) and is typically feeding when in the area of interest. IUCN status is given in the text.	N/A
ED 48	Page 330: Coral is mentioned in the Northern Slope area, there is no previous mention of this in previous sections. With the proximity of the site to the NFB there is the potential corals could be present at the site.	It is not quite clear what the commenter is referring to here. However, coral species and distribution is described extensively in Section 7.4.3.	N/A
ED 49	Page 344: EIS should be using up to date IUCN red listings. April 2020 is not considered current. Please update.	This will be reviewed and updated as appropriate.	Section 7.4.5

Ref.	Representation	Navitas response	Changes in Rev 4
ED 50	Page 344: The use of the JNCC SAST data is of concern as it is over 20 years old. Is it still believed to be representative of present-day populations?	Baylis *et al.* (2019) highlights that for nine-species tracked, the probability of occurrence is highest on the Patagonian Shelf, shelf slope and the Burdwood Bank (Fig 7-53, pg. 360). These findings are similar to the at-sea distribution presented for the same species (White *et al.,* 2002). This is likely to reflect productivity on the Patagonian Shelf, being linked to the Patagonian Shelf, slope and Burdwood Bank (static features, associated with predictable areas of enhanced productivity) (e.g., Fig 7-35, pg. 293). Based on the predictive models, and knowledge of local oceanography, the importance of the Patagonian Shelf around the Falkland Islands is unlikely to have changed over the past 24 years, hence animal distribution is still likely to be associated with the Patagonian Shelf. This will be made more explicit in the post-consultation EIS. The EMMP aims to collect further data in the field, specifically using Seabird and Marine Mammal Observers on two vessels for the initial years of the project (post sanction, pre-First-Oil and post-First-Oil).	Section 7.4.5.2.1 Section 15.6.2.1.2
ED 51	Page 382: Species have been given acronyms or codes without any explanation to what those codes mean or reference of where to find them. Please update table caption to explain what the codes mean.	Noted. This will be amended.	Table 7.19
ED 52	Page 481: EIS states that Navitas is currently working on an update to the Sea Lion socio-economic environment of the Falklands - when will this be ready?	The updated socioeconomic impact assessment is currently expected in Q1 2025.	N/A
ED 53	Page 482: Census data is not up to date. Full census now available: The 2021 Census asked people to state their national identity: 42 % of residents considered themselves Falkland Islanders, 18 % British, 7 % St. Helenian, 4 % Filipino and 3 % Chilean (FIG, 2023). However, census data stats 54% identify as FI, 22% British, St Helenian 8%, Filipino 5%, Chilean - 4%	This reflects the census data tables provided prior to the census being published by FIG Policy Dept to calculate these numbers, this reflects the % of ppl present on census night (following Table 1e in the census tables provided). See below but it is	Section 7.7.2.1

Ref.	Representation	Navitas response	Changes in Rev 4
		understood the final census report was adjusted to include those not present on census night where possible. These numbers will be updated to reflect the published census numbers.	
ED 54	Page 482: 433 work permit holders were recorded in Stanley (FIG, 2023 - 456 in census). 663 employed by FIG - 33% as per 2021 census not 487 as per EIS.	Table 8a in the census report notes 433 work permit holders (total), which correlates with the data provided by FIG in the detailed census tables. Although it is noted that in Table 11 in the census report there are 456 WPHs in Stanley. It is understood that while the census data records only the people present on census night a lot of work was done to consider those not present, could this account for the difference in values? We'd be grateful if FIG could confirm. However, the EIS will be amended. to reflect the published census report. Data provided in the census tables notes 487 as FIG employees within Stanley, It is understood the figure in the census report (633) includes UK government and GSGSSI employees as well.	Section 7.7.2.2
ED 55	Page 483: The land surrounding Berkeley Sound is divided between six landowners / farms (Figure 7 115 below) and is primarily used for grazing sheep. However, several farms also run tourism-based businesses, which are described in Section 7.7.4.6.1. What about FIG owned Kidney Island? It is a National Nature reserve	Noted, this will be added.	Section 7.7.2.3
ED 56	Page 484: 'Summary Report of Fishing Activity over the Sea Lion Development Area', conducted by Pale Maiden Consulting (April 2013), and the FIG Fisheries Department Catch Report Database from 2013 to 2022 (FIG, 2023). Some information is also taken from the Fishing and Trawling Risk Study conducted by Jee (2013) on behalf of POEPL. Are there more up to date studies?	2022 data (available in 2023) was the latest available from FIG at the time of writing. Anatec Ltd (2024a and 2024b) were based on 2023 FIG data and will be added to the text.	Section 11.1 Section 12.1
ED 57	Page 485: Argentinian shortfin squid - annual variations but has largest catch 2013-2022 - grid where drill centres taking place are open to fishing vessels	This can be added. Thank you for the comment.	Section 7.7.3.1 Table 7.41

Ref.	Representation	Navitas response	Changes in Rev 4
	to fish for these but have been rarely fished - This grid square has been rarely fished by any licensed vessels in recent years. Total annual fish catch for each year would be good to see in table		
ED 58	Page 485: Catches and fishing effort in the grid square occupied by the Sea Lion Field (XFAK) are relatively low (FIG, 2023). This said, exceptionally high catches of Ilex squid were made in 2014, 2017, and 2022 reflecting high catches throughout the zone during these seasons. Overall however, these data indicate that generally the area of the Sea Lion Field is rarely fished. - but it has been fished and a lot of fish caught very recently too - should not be discounted.	In relative terms, there is a very small fraction of fishing done in this area. The commenter correctly points out years where catch has been reported in XFAK and Navitas has looked into this more closely. Results of this analysis shows that although catch by a few vessels has been attributed to XFAK with either their mid-day or midnight position, in actual fact the vessel did not enter this grid square at all, as evidenced from Marine Satellite -based AIS. These are likely to be rare, accidental mis-reporting's. Navitas will point these out to FIFD for further investigation.	N/A
ED 59	Page 487: Fishery Patrol vessel - inconsistencies in data: • 2014 - 37 visits.; - table says = 37 visits • 2018 - 48 visits. and table says 34 visits • 2022 - 27 visits (Table 7.45). table says 28 visits	Noted, this will be updated.	Section 7.7.4.1.4.2 Table 7.45
ED 60	Page 494: Cargo vessels - Cargo vessels visit Stanley on a regular basis and require a berth at FIPASS to transfer cargo onshore. In 2014, 38 cargo vessels visited FIPASS. In 2018 cargo vessel visits to FIPASS were slightly less at only 32, and less again in 2022, visiting on 27 occasions (Table 7.45). Table clearly says 2014 - 37, 2018 - 32 and 2022 - 25	Noted, this is a typo (table correct, bullets to be updated).	Section 7.7.4.1.4.2 Table 7.44 Table 7.45
ED 61	Page 496: In 2014, 61 yachts came into Stanley Harbour with 71 yachts in 2018. This number had reduced greatly by 2022 with only seven yachts entering the harbour. These vessels usually moor at the Public Jetty, the East Jetty or anchor in the Harbour. - where did this data come from because it only mentions yacht in the table and not pleasure craft?	This section references the Table above as most yachts do not go alongside FIPASS but do enter Stanley harbour, will add ref to Table. Will remove 'pleasure craft' from title.	Section 7.7.4.1.4.7
ED 62	Page 497: The only asphalted roads are those within Stanley, those within the Mount Pleasant Complex (MPC) and most of the main road between Stanley and MPC. - needs updating- all tarmacked now	Will be updated.	Section 7.7.4.2

Ref.	Representation	Navitas response	Changes in Rev 4
ED 63	Page 498: In April 2010, over a 19 day period, 5,484 vehicles (of which 2 % were Heavy Goods Vehicles (HGVs)) used the road between Stanley and Mount Pleasant. This represents a 170 % increase over the previous 10 years for all vehicles (FIG, 2012b) - Use more up to date figures?	Navitas checked with PWD for any updates but there has not been a survey since then.	N/A
ED 64	Page 498: MPC Road usage has generally increased significantly year on year, however exact recent trends are not certain and road usage may have stabilised. - Are these assumptions without up to date data - may have stabilised - may not?	As above there has not been a more recent survey but with the increase in population, SAERI suggest it is a reasonable assumption to make that traffic increases as population increases, particularly with the high vehicle to person ownership in the Falklands.	N/A
ED 65	Page 501: The 2021 Census recorded a total of 1,523 resident households, of which, 1,147 (75 %) are located in Stanley (Table 7.48). - census states 1,600 total and Stanley = 1,148	The census data tables provided by FIG prior to publication of the census report noted 1,523 resident households (1,147 in Stanley), this will be updated to reflect the final census report numbers.	Section 7.7.4.5.1.1 Table 7.48
ED 66	Page 501: In 2021, the majority of houses in Stanley were mortgaged or owned outright (54%) (Table 7.48). Approximately 40 % of Stanley households were held under rental, while a further 5 % were provided rent free as part of an employment package (Table 7.48 - where did this info come from as can't find it in census?)	Noted. This will be amended.	Section 7.7.4.5.1.1
ED 66	Page 509: Household batteries are collected within Stanley and recycled in the UK. Currently they are only collected, but recycling is expected in the future.	Noted, this will be updated.	Section 7.7.4.5.6
ED 68	Page 520: Identified 2 wrecks in close proximity: 1 x 100m away and 1 x 1km away - EIS states they are there but has not said anymore. Has the risk to these wrecks been assessed?	The 100m and 1km distances referred to in this section are the distances that the wrecks have 'moved' from their charted position to the position actually recorded during the survey. Both wrecks are not considered to be close enough to the LTV anchoring locations to be disturbed by the activities proposed.	N/A
ED 69	Page general: If the receptor is deemed low due to IUCN status - will this be an iterative process in that should the IUCN status change during the lifetime of the project would this new status be reflected in the risk assessment?	As the EIS is reviewed every 5 years, changes to IUCN status will be captured then. This will then feed into the EMMP process if there are changes which impact on monitoring and management actions.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
ED 70	Page 550: It is not clear how the fund will be allocated and whether this is for a biodiversity fund being set up by Navitas or using the already set up Environmental Fund. How have offsetting measures have been considered by the operator - where will this be reported?	Navitas has committed to a dedicated carbon and biodiversity offsetting fund that will be financed by contributions from Navitas and governed by a steering group comprising Navitas, FIG, NGO stakeholders and technical advisors. It shall be aligned with FIG's offsetting guidance and policy. Initially the fund will invest in the feasibility of potential local offsetting projects. Navitas will then finance the viable projects that are identified. The Fund will also invite proposals for funding of projects to achieve offsetting objectives which will be considered for approval by the multi-agency steering group. The adopted offsetting projects will be overseen by the governance committee and their performance will be reported upon publicly. In the event that local offsetting cannot be achieved successfully, Navitas will look to invest in international offsetting schemes. The performance of Navitas' offsetting endeavours will be reported. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund.	N/A
ED 71	Page 561: Has disturbance to the human population through onshore light in Berkeley Sound been considered? Receptors include settlements on the Sound.	Yes, see Section 11.8.	N/A
ED 72	Page 561: Would discharge of chemicals during drilling, or use and discharge of chemicals in produced water, or discharge of hot water from cooling systems, not affect plankton & water quality & marine mammals?	The table will be reviewed against the relevant chapters and both will be updated if considered necessary.	Table 9.1

Ref.	Representation	Navitas response	Changes in Rev 4
ED 73	Page 590: A maximum of two LTVs will be present in Berkeley Sound for only eight months (*c.* August-2022 to end March-2023), should this be 13 months as stated on page 580?	Noted. This will be amended.	Section 10.1.2
ED 74	Page 592: Potential receptors - in bullet points missed off Human populations - identified as needing further investigation in table 9.1	Section 10.1.1 states in a note that impacts to humans are assessed elsewhere (Section 11.8).	N/A
ED 75	Page 619: Helicopters may have a significant impact on penguin behaviour, although degree of habituation to aircraft is believed from South Georgia study- Have any studies been done on the tourist helicopter flights?	Navitas are not aware of any studies on local tourist helicopter flights (which no longer operate), and the South Georgia study is considered the best comparison. It should be noted that tourist flights operated differently to the proposed Sea Lion helicopter flights as, when operating, they landed in close proximity to penguin colonies, while the O&G helicopter flights will be flying overhead, in accordance with the Falkland Islands Low Flying Handbook.	N/A
ED 76	Page 624: Fur seals and sea lions most vulnerable to noise during pupping - between October and January combined	Yes, this is noted in the 5th bullet point.	N/A
ED 77	Page 626: With reference to the Falkland Islands Low Flying Handbook that shows where not to fly - IBA, NNR etc, are these locations up to date and correctly identified in the EIS?	These are replicated as provided by the FILFH, Navitas understand this is a FIG document.	N/A
ED 78	Page 628: There is no monitoring mentioned in terms of the number of flights, or the impact of flights on identified species, this does not appear in Chapter 15 (EMMP) either.	The residual impact from helicopter flights does not trigger an EMMP action as it is neither significant nor has a receptor that is considered 'High' or 'Very High' sensitivity, and confidence is 'Certain'. Although number of helicopter flights will be logged by Navitas.	N/A
ED 79	Page 628: Most vulnerable is King Penguin at Volunteers Point - almost all the population of Falklands' King Penguins are there, and they occupy location year round	Agreed, Navitas feel this is reflected in the text in section 10.2.6.1.	N/A
ED 80	Page 629: Is monitoring the impacts on the IBA and NNR considered as part of the EMMP or offsetting?	See response to comment ED78. As the impact of helicopter use is assessed as 'Low' no offsetting or monitoring measures are proposed.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
ED 81	Page 635: Use of a 1971 study - are there more recent studies which could be used?	The reference is intended to indicate that the way seabed reacts when something lands on it has been verified. It is not expected that this will have changed since 1971.	N/A
ED 82	Page 648: With the data gaps, the numbers of geographical important species are not well know. Given that in section 7.4.3.2.3 there is a 50% probability of VME species present, it cannot be ruled out that habitats of conservation importance are present. This statement should be reviewed.	The text in 7.4.3.2.3 has been revised to indicate that interpretation of the studies in this area suggest that although VME indicator taxa may be present, they are likely to be sparsely occurring in the focal area. Additionally, VME indicator taxa are predicted to be widely distributed around the FOCZ, suggesting that VME's potentially impacted within the drilling area will have a high likelihood of recovery. Therefore, sensitivity is likely to be low. Please refer to '8.5.2.1 Assessment of sensitivity of receptors' for definitions.	Section 7.4.3.2.3
ED 83	Page 657: There is hardly any baseline data on seabird injury thresholds to underwater noise, despite acknowledgment that penguins and diving birds do spend significant time underwater. Info is all about fish and marine mammals. For birds it seems to be entirely based on 'marbled murrelet' - Is this sufficient?	Additional research has been found to support an assessment of underwater noise impacts on seabirds, and the chapter is being revised accordingly. See also FIFD 54.	Section 10.4.4.4.4
ED 84	Page 666: This section presents a risk assessment for offshore underwater noise on seabirds. Given that there is hardly any baseline info going into this assessment, and it focusses only on penguins and ignores other diving seabirds, much of this assessment is based on assumptions rather than facts. There is no info given about the confidence of this assessment (unlike for marine mammals). Whilst we realise this kind of information may be very hard to measure, we do not feel like it has adequately assessed this risk to seabirds.	See comment ED 83 and note that a confidence assessment will be added to the risk assessment for seabirds in the revised chapter.	Section 10.4.10
ED 85	Page 686: Sea bird and Marine mammal observers will be on board vessels to provide ongoing monitoring of birds present. As well as ongoing noise monitoring to understand better the baseline noise levels. Will this will be in the EMMP?	Yes, see Section 15 of the EIS.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
ED 86	Page 690: The EIS notes that the actual locations of the anchoring points for ships in Berkeley Sound are yet to be decided, and will be chosen in conjunction with FIG to be least bother to other vessels that use the area. We would want to make sure that the locations are not too close to Kidney and Cochon NNR so that underwater noise does not disturb wildlife.	The anchorage locations will be chosen in consultation with FIG - criteria for site selection will cover both environmental considerations and disturbance to other users of Berkeley Sound. Anchorages close to the Kidney and Cochon NNRs would not be considered appropriate.	Section 5.5.1 Section 11.2.4.4.1
ED 87	Page 719: It is clear that a baseline is still required for toothfish and other species in this environment. Who will be checking that this baseline is done?	Fisheries in the areas were assessed, and the baseline data comes from the Falkland Islands Fisheries Department. There are gaps however, and these are acknowledged, noting that the assessment has taken a precautionary approach.	N/A
ED 88	Page 744: Sampling and analysis two times per day when discharging and once per month when reinjecting - Who would do the analysis? Where would the analysis take place?	There will be some automatic detection devices on the FPSO that measure oil in water and other discharges and a laboratory technician will be onboard the FPSO to undertake analysis.	N/A
ED 89	Page 746: Discharge giving rise to a visible oil sheen- will others be notified as well as DESNZ?	Thank you for your comment, and yes, Navitas will follow the PON8 requirements as described in Section 10.7.1.1.5. The narrative in 10.7.1.1.3 will be amended for clarity.	Section 10.7.1.1.3
ED 90	Page 746: Will there be an independent representative offshore to ensure compliance with reporting measures for oil sheens?	A PON 8 is required in the unlikely event an oil spill event. Further reporting would then be in accordance with direction from FIMA and DMR. FIG may choose to deploy an independent observer in the event that an oil sheen is reported. Please note that testing of Sea Lion crude by CEDRE has demonstrated that it is unlikely that Sea Lion crude will produce a visible sheen in water.	N/A
ED 91	Page 747: Will macerated food after discharge affect algae levels and attract bird life etc?	As the impact to the water quality and plankton is Very Low, there are unlikely to be impacts up the food chain.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
ED 92	Page 748: How much monoethylene glycol will be used in hydrotesting of the umbilicals? This is a PLONAR chemical; toxic if ingested in large amounts; takes weeks to break down.	MEG is transported in closed containers and is only used in a closed loop processing circuit - i.e., to prevent hydrate formation. Therefore, unless you had a major containment issue there is no risk of MEG ingestion. MEG naturally depletes in a closed system.	N/A
ED 93	Page 748: Discharge of warm seawater discussed in section 10.8- What are the impacts to the local marine environment?	Please refer to section 10.8 for further discussion on the impacts of the discharge of seawater to the local marine environment.	N/A
ED 94	Page 748: PW from oil wells first starts to arrive before the PWRI are commissioned. Volumes of PW that may be discharged are as yet unknown. When will they be confirmed?	There will always be some PW discharge while the PWRI units are commissioned. It is not possible to determine at this point how much PW will need to be discharged prior to the commissioning of the PWRi, as it uncertain how long commissioning of the PWRi will take. However every effort will be made to ensure that discharges will be low-volume and short-lived. In EIS Section 10.7 Navitas states: 'It is anticipated however that there may be discharge of PW when it first starts to appear and the PWRI units are being commissioned. At the time of writing it was not possible to estimate when PW may start to arrive, nor how much may be discharged during the commissioning phase. However, water will start to cut from the production wells at different times and the PWRI commissioning process will commence upon first arrival of water from any one of the production wells. Therefore, all efforts will be made to minimise discharges that follow between the first 'water cut' and full implementation of the PWRI system. Therefore, it is anticipated that PW discharges during the commissioning stage will be low volume and short-lived.'	Section 10.7.2.5 Section 10.7.4.4.2

Ref.	Representation	Navitas response	Changes in Rev 4
ED 95	Page 750: Are there any values that have to be complied with for grey and black water after treatment for discharge? Or any testing that is required before discharge?	As described in Section 10.7.1.1.6: In compliance with MARPOL Annex IV, which applies to vessels > 400 GT or certified to carry > 15 persons on board, untreated black water (sewage) may only be discharged beyond 12 nm from shore whilst the vessel is moving. Between 3-12 nm, sewage must be treated prior to disposal at sea and only if vessels are moving at a speed of greater than or equal to four knots. Depending on the vessel's sewage treatment equipment, some sewage may be discharged within three nm, and again only if it is travelling at a minimum of four knots. For stationary offshore 'vessels' such as the FPSO and MODU, although they are >12 nm from shore, sewage must be treated before discharge to sea. Food waste must be macerated to ensure a maximum solid particle size of 25 mm prior to discharge as required under MARPOL Annex V, to aid its dispersal and decomposition in the water column.	N/A
ED 96	Page 750: Oil separated from drainage water on MODU will be shipped to Stanley prior to incineration- What is the plan if the incinerator in Stanley is not operational by this time? Or is out of action? Has this been included and referenced in emissions data?	See section 10.10.2.2.1 which states that 'occasionally the recovered oil may be sufficiently 'off spec' that it will not be suitable for processing offshore and in these instances it will be collected and stored in drums / transit tanks and will be shipped back to the onshore supply base.' From there it will be transferred into a sludge truck for disposal at the FIG Stanley incinerator. It is understood that the FIG Stanley Incinerator will be operational by end of 2026. This aligns with Navitas' operational schedule. Should the FIG Stanley Incinerator not be available Navitas would: 1. Store the waste in suitable containers onshore until	Section 10.7.2.8 Table 10.72

Ref.	Representation	Navitas response	Changes in Rev 4
		the FIG incinerator is once again available 2. Store the waste in suitable containers onshore until offshore treatment on board either the MODU or FPSO is available 3. Store the waste in suitable containers onshore until a suitable volume is ready for export under the Basel Convention to the UK. Waste oils from this process shall always ben candidates for re-use and incineration is a secondary solution. Section 10.10.2.2.1 will be updated for clarity. Emissions for the FIG incinerator are not included in the assessment but those associated with returning vessels, which would take waste back to the UK, are included, and the incineration emissions volumes are provided in a footnote to Table 10.72. Please refer to comment ED 131	
ED 97	Page 750: Hypersaline water produced from desalination will be discharged to sea- At what concentrations will they be? What are requirements for concentrations? What is the frequency of the discharge?	The minimal amounts of hypersaline water produced will be diluted prior to discharge. As such it is not anticipated that discharge will have any environmental impact. The selected FPSO is currently operating in the UK North Sea and meets all legislative requirements under this regime. The hypersaline concentration is expected to be *c.* three times that of seawater and will be discharged on a continuous basis as the desalinators operate to produce the freshwater. See also ED 104.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
ED 98	Page 750: CW will be dosed with a biocide to prevent marine growth, discharge will contain biocides, CW plume will be buoyant and remain in top 200m of water column, and chemicals selected will minimise potential environmental impact. Detail is lacking on these chemicals - what are these chemicals?	As stated in Section 5.9.1.1 details on the specific operational chemicals which will be used during the Phase 1 & 2 Development are not yet known. Nonetheless, all operational chemicals used during the Development will be selected to minimise environmental impacts as much as possible. Further detail on the UK legislation which will be adhered to is provided in Sections 10.6.1.1 and 10.7.1.1. All chemicals selected will be listed on the Offshore Chemical Notification Scheme (OCNS) List of Notified and Ranked Product generated by CEFAS (Link).	N/A
ED 99	Page 751: Details of biocides discharge to prevent marine growth are not given, what is likely to be used?	See ED 110.	N/A
ED 100	Page 751: Who tests discharge samples?	There will be some automatic detection devices on the FPSO that measure oil in water, and other discharges. A Laboratory technician will also be onboard the FPSO can also undertake analysis. Please also see ED 88.	Section 10.7.5
ED 101	Page 752: If specific composition of Sea Lion PW is not yet known, but estimated, should this be followed up when PW is obtained?	Yes, this is captured in the EMMP. Once PW is produced analysis will be done and the PW sampling confirmed. The EMMP text will be checked and amended. to reflect this as necessary.	Section 10.7.4.1.2
ED 102	Page 752: Although it is clear that the PW concentration of chemicals referenced in this section are small concentrations (Naphthalene, Dibenzothiophene, Dibenzanthracene, Chrysene, Benzofluroanthene, Benzopweylene, Benzofluoranthene, Benzopyrene, Benzanthracene), what is the potential impact of long-term discharge of these chemicals? Concentration of MAH and some Alkyl phenols are also higher than PNEC.	Section 10.7.4.1.2 will be subject to an updated lit review to provide more data where possible.	Section 10.7.4.1.2 Section 10.7.4.2.2
ED 103	Page 756: Will the toxicity of the PW be monitored on a regular basis to check for accumulation of these contaminants in the surrounding area?	Yes. Regular PW testing and 5 yearly seabed surveys. Navitas will include this detail in Section 10.7.5 of the post-consultation EIS.	Section 10.7.5

Ref.	Representation	Navitas response	Changes in Rev 4
ED 104	Page 757: Not much information offered on hypersaline water: Doesn't discuss the impacts of the hypersaline water on the surrounding environment. It mentions the study measured instances of no more than 2mg/l above background salinity - what is the threshold of organisms in the ecosystem?	Noted. The subject matter will be reviewed and the narrative updated where necessary. In a study of the impact potential of hypersaline brines released into the marine environment, Dewar *et al.* (2022) found that dispersion in a hydrodynamically active region like the North Sea acts to dilute disposed brine rapidly such that the potential impact footprint is small, measured in tens of meters. This was found to depend on the release scenario and site specific data, for example the in-situ conditions such as currents and mixing. The method of brine disposal has a significant influence on dispersal, and brines released nearer the sea surface disperse more rapidly, compared with those released at the seabed. All hypersaline discharges at the Sea Lion field will be to the surface. And into such a dynamic environment. Marius Dewar, Jerry Blackford, Tony Espie, Sarah Wilford, Nicolas Bouffin. 2022. Impact potential of hypersaline brines released into the marine environment for CCS reservoir pressure management, International Journal of Greenhouse Gas Control, Volume 114, 103559, ISSN 1750-5836.	Section 10.7.4.1
ED 105	Page 757: Will the effect on marine life due to the low concentrations of produced water be monitored as mesocosm studies show low concentrations of produced water may have subtle effects on marine planktonic communities?	The base case is to re-inject, so discharges are being minimised as far as possible. This is a localised discharge and will be mixed and dilute rapidly. The needs for in situ sampling may be considered should it be justified based upon the results of the RBA modelling. The post-consultation EIS will be updated to reflect this.	Section 10.7.5

Ref.	Representation	Navitas response	Changes in Rev 4
ED 106	Page 758: Increased seabirds at site due to discharged food - will they be exposed to discharges of PW and contaminants within it?	Discussion on indirect impacts such as these are included within the EIS and are more specifically itemised within Chapter 13. Navitas will update Chapter 13 with worst-case impact colours in the post-consultation EIS. See also ED 191	Chapter 13
ED 107	Page 759: Can bilge oil and other discharges that produce oil sheens be minimally discharged on calmer days as dispersal through water less effective in calmer weather?	All discharges will be legally compliant and discharged under permit. Where possible Navitas will endeavour to minimise discharges on calm days.	N/A
ED 108	Page 761: Test on bulk crude oil at 55 degrees released into 18 degree seawater- test not representative or a replication of Falkland Islands waters. Can this be replicated with water conditions mimicking the Falkland Islands?	CEDRE leading facility for this type of testing. The CEDRE test work represents the worst-case (hot oil into warm water). It is not considered necessary or practical to repeat the tests with lower water temperatures. while the outdoor test basin was warmer than NFB, CEDRE drew a firm conclusion from the experiment that sheens were very limited, and the longer-term behaviour in the form of waxy masses was shown in the 9-day flume test at 8 Celsius. Navitas will add this clarification to the post-consultation EIS.	Table 12.1
ED 109	Page 761: Interactions of the birds with oil may affect reproductive success and thermoregulation. Unlikely to occur from a sheen alone. However sheens of thickness of 0.1 micro metres thick could result in measurable oil transfer to feathers. Have interactions of birds with oil contamination been fully investigated or explored here?	There is a good amount in the literature on this. Sea lion crude is waxy and produces a very small sheen when released into water at 18 degrees. However given the metocean conditions, any sheen that might form would be temporary. A precautionary approach has been taken in the assessment to show worst-case impact of sheens on birds from Sea Lion crude.	N/A
ED 110	Page 762: What biocide is likely to be present in discharge water? What impacts are likely?	Biocide is added to the seawater/produced water system for treatment prior to injection into the reservoir to inhibit biological growth in the reservoir and to prevent reservoir souring. Biocide will not be added to discharge water.	Section 5.9.1.1 Table 5.21

Ref.	Representation	Navitas response	Changes in Rev 4
		As stated in Section 5.9.1.1 details on the specific operational chemicals which will be used during the Phase 1 & 2 Development are not yet known. Nonetheless, all operational chemicals used during the Phase 1 & 2 Development will be selected to minimise environmental impacts as much as possible. By nature, biocides are intended to harm marine life, but efforts will be made to ensure selection of a Cefas Gold product with no Sub warnings (there are currently > 40 products on the Ranked listings for production and *c.* 15 for drilling ops).	
ED 111	Page 762: PW that has OIW above limits will be diverted to off-spec tanks - what happens to this?	Off-spec water will be routed back into the separation process and Sections 5.8.5.4.1 and 10.7.2.5 will be amended. for clarity.	Section 10.7.4.4.2 Section 5.8.5.4.1
ED 112	Page 762: Volumes of grey and black water per day per person- how many people will there be? Or likely to be? Actual amounts of grey/black water not currently calculable without this.	The personnel numbers are more explicitly provided in Chapter 10.10 on Waste. However, the estimated personnel numbers will be added as a footnote to Table 10.45.	Section 10.7.4.4.3 Table 10.49
ED 113	Page 763: Volume of water in table 10.46 average is calculated incorrectly	This has been checked and Navitas note the numbers are correct but cannot be exactly replicated in the word document due to rounding in the excel spreadsheet. A note will be added to this effect.	Table 10.49
ED 114	Page 763: Will record be kept of bilge water and drainage water from MODU/FPSO, whether above or below 15mg/l?	Yes. All operational discharge records will be kept in line with the current legislation (Section 10.7.1.1). Reference to reporting requirements will be added to Section 10.7.4.4.4.	Section 10.7.4.4.4 Section 10.7.4.4.5
ED 115	Page 763: W discharges will occur 7% of the time - 25 days per year amounting to 428,294 m3- Is there likely to be more than this, and if so, what will happen?	At all times the outputs to the environment, produced water modelling is based on the realistic worst-case. If this is found to be an underestimate of PWRI down time the impact assessment would need to be revisited. As described in 10.7.4.5.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
ED 116	Page 765: Discharge temperature of the PW is predicted to be around 75 degrees? Salinity is anticipated to be around 6.4mg/l - What impact will this have on the surrounding area?	Section 10.8 describes and assess the impacts of thermal discharges and 10.7 assesses the of PW with the support of modelling.	N/A
ED 117	Page 767: Modelling seems to suggest benthic community will not be affected by PW as it will sit in the top 80-120m of water due to temp and salinity. What about the rest of the water column?	Section 10.7.6.1.2 assesses the impact of PW on water quality and marine fauna that may be exposed but the point of the modelling is to understand and predict the likely dispersion of the plume. As shown in Section 10.7.4.5.2.3 the discharged water does not descend significantly into the water column due to the temperature and salinity of the plume. The PW plume is confined to the top 80 m of the water column in early Field Life, and 120 m in late Field Life such that the deeper water and benthos are unlikely to be exposed.	N/A
ED 118	Page 772: No species or habitats of conservation importance will be affected? Good that chemicals will be chosen to minimise environmental impact, but what are these chemicals?	As stated in Section 5.9.1.1 details on the specific operational chemicals which will be used during the Phase 1 & 2 Development are not yet known. Nonetheless, all operational chemicals used during the Development will be selected to minimise environmental impacts as much as possible. Further detail on the UK legislation which will be adhered to is provided in Sections 10.6.1.1 and 10.7.1.1. All chemicals selected will be listed on the Offshore Chemical Notification Scheme (OCNS) List of Notified and Ranked Product generated by CEFAS (Link).	N/A
ED 119	Page 772: Grey water, black water and food waste causing slight eutrophication. Direct impacts are low- what about for seabirds and marine life?	As the impact to the water quality and plankton is Very Low, there are unlikely to be impacts up the food chain.	N/A
ED 120	Page 774: Will hypersaline water mix in 450m depth water - or will it remain localised and so therefore a problem for local marine life?	Hypersaline water is denser than seawater such that in a static environment it would slowly sink deeper and could affect the deeper water column. However, when discharged into the turbulent waters at the Sea	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		Lion field location it is anticipated that dispersal will be rapid and equilibrium will be reached before any descent to the full water column could occur. See also ED 104.	
ED 121	Page 774: Even though it is unlikely that both PWRI units would malfunction before PW is discharged, the significance of the impact is 'upper moderate ', and given the status of seabirds potentially affected, and potential effects of oiling, is there a contingency in place or considered for this, and for oiling of seabirds?	Navitas assumes the question relates to 10.7.6.2.2 as the assessment in 10.7.6.2.1 is considered to be Very Low. With regard to the potential for oil sheens, this assessment is very precautionary and any off-spec waters would not be discharged such that only water within the compliance limits would be discharged, As yet it is not clear if the Sea Lion oil is able to form significant sheens when discharged in small quantities. The focus here is on preventative mitigation measures such that the likelihood of the series events that could lead to a sheen is very low. Nonetheless, should a sheen occur and should it affect seabirds, the Wildlife Management Plan would be activated. In compliance with the PON8, any sheens will be reported to FIG.	N/A
ED 122	Page 775: No offsetting is determined necessary to reduce impact, e.g., seabirds attracted by discharged food waste?	Offsetting is not designed to reduce an impact. Further, the impact of the discharge of macerated food on seabirds is not significant (moderate or above) so it does not qualify for offsetting. See OMO 1994 as amended (significant impacts to be offset).	N/A
ED 123	Page 784: With little known about the oceanic response to thermal discharge, is the assumption that discharges wouldn't alter temperature in a sustained way valid?	As the discharge is to the open ocean it is not expected that any localised temperature change at the point of discharge will lead to sustained change in the temperature of the ocean.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
ED 124	Page 785: Produced water has a salinity of 6.4 (fresh water). Are the effects of discharging this fresh water accounted for anywhere in the EIS? Will hot fresh water act differently to hot saline water?	Discharge of freshwater is not itemised in the assessment of PW over and above the impacts of the potential content of PW. The impact of freshwater which will disperse quickly is considered as negligible and will be added to Table 9.1 to indicated this impact has been scoped out.	Table 9.1
ED 125	Page 786: With different trajectories of the different thermal discharges and small periods of alignment, do these discharges have a cumulative effect on the area?	The rate of dispersion and the footprint of areas affected are such that the cumulative impact of overlapping trajectories is not considered further in the EIS.	N/A
ED 126	Page 788: Regarding the data gaps, should it not be said that there are indeed populations that are of geographical importance?	No, this concerns the benthos and heated infrastructure. The area is very localised.	N/A
ED 127	Page 788: What are the effects of thermal discharge on algal blooms? The EIS states that there is uncertainty around what continuous discharge will do in regards to algal blooms yet there is no specific monitoring identified for this.	Algal blooms tend to form seasonally when the combination of photoperiod and nutrient mixing is optimal. While sustainable temperature changes may impact upon the proliferation of algal blooms, the thermal discharges associated with the Sea Lion field will disperse rapidly and will not be sustained. Nonetheless, should such impacts occur, these will be recorded and monitored, not least as blooms could impact the seawater intakes. Navitas will review the text in the post-consultation EIS to ensure that this is clear.	Section 10.8.4.2
ED 128	Page 791: We question whether the sensitivity rating of 'very low' is accurate because we do not currently have an adequate baseline for what species are present. Cold water corals, if present, would have a much higher sensitivity to heat radiation and once gone may not be able to recover	Cold water corals are only associated with glacial drop stones in the area; these are patchy. Also note, the area will be surveyed prior to installation of subsea infrastructure or drilling.	N/A
ED 129	Page 798: What energy efficiency measures are being adopted in the vessels being used by Navitas?	Navitas will continue to explore emissions reduction initiatives prior to commencement of operations and throughout the lifecycle of the Sea Lion Field.	Section 10.9.7.1

Ref.	Representation	Navitas response	Changes in Rev 4
		Energy and emissions efficiency will form one of the evaluation criteria within the forthcoming tenders.	
ED 130	Page 799: How will we know f-gases have been accidentally released?	F-gas releases are not identifiable at the time of the release. When the equipment is serviced, releases/leaks are identified by the amount of top-up required. For this reason, all equipment will be serviced in line with legislation. The servicing period is dictated by the GWP of the F-gas and the tonnage of CO_2e that would be released in the event of an F-Gas release. Navitas commit to using low GWP F-gases.	Section 10.9.5.2
ED 131	Page 800: Treatment of waste has not been referenced in emissions activity. Please amend	Navitas does not account for incineration emissions as, in discussion with FIG, it is assumed that the FIG incinerator will have been commissioned and fit for use. Emissions from shipping the waste to the UK are considered the worst-case option and are accounted for in Section 10.9. To include emissions from incineration of waste locally and emissions from shipping the waste for disposal would constitute double counting. Nonetheless, the amount of emissions that would result from incineration of all waste (irrespective of which incinerator) is now itemised in a footnote to Table 10.72.	Section 10.9.2 Table 10.72
ED 132	Page 801: Has the power demand of consumers been cross referenced with PWD?	Navitas assume from the page number (801) that the comment refers to Table 10.55. This table provides detail on the key consumers of electricity generated by the DLE turbines on the FPSO so no consultation with PWD was relevant.	N/A
ED 133	Page 801: What effect will a flare recovery package have on the emissions?	It is not possible to quantify the % reduction that could potentially be achieved at this stage, but it will be evaluated and assessed in FEED and later phases of the project.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
ED 134	Page 802: If CCC have proposed that F gases are replaced by low carbon alternatives by 2030 - should this not be the case here?	Navitas will comply with all relevant FIG/UK legislation regarding the phase out of F-Gases. This will be reiterated in Section 10.9 and specifically in Section 10.9.1.1.4.	Section 10.9.1.1.4
ED 135	Page 810: The values are under the wrong headings. Please amend	The source data will be checked and amended accordingly.	Table 10.62
ED 136	Page 816: No inclusion of car use in the personnel transportation - only refers to air transfer. Please amend this	Fuel consumption data associated with onshore personnel transportation and other vehicle use is included within Table 10.64. The use of cars is included within the category 'supply base' in Table 10.66, so the emissions are included in the calculations. A footnote will be added to Table 10.66 to ensure this is transparent.	Table 10.72
ED 137	Page 820: Table 10.64 Includes car transportation however in table 10.66 it is unclear which category it is included if at all.	Please see response to ED 136.	Table 10.72
ED 138	Page 823: What renewable energy options have been put in place throughout the stage 1 and 2 development to reduce emissions?	Navitas has considered renewable energy options for its onshore infrastructure. Navitas was advised by the PWD Power Station that it is preferred that Navitas does not incorporate individual solar/wind power at its onshore infrastructure facilities as it is difficult for the Stanley grid to absorb any over-production or to accommodate spikes in demand that would arise in incidences in which the renewable energy sources could not supply onshore infrastructure demand (e.g., calm weather, low sunshine). As such, Navitas is exploring how it can support investment in municipal renewable energy generation and battery storage to secure both emissions reduction and offsetting objectives.	N/A
ED 139	Page 824: It would be helpful to separate out the contribution of different vessels to this total for each stage as the data to reach this extends over multiple tables in different sections of the document.	It would be possible to separate out the contribution of different vessels in each Stage of the Development. However, Navitas does not believe this would	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		materially add to the estimation of emissions or to the assessment. In an already complicated Chapter, Navitas opt not to add more tables that do not effectively add to the chapter.	
ED 140	Page 824: What about emissions due to construction of onshore and offshore?	Emissions from offshore construction are related to the vessels used and are included with the 'All vessels' line item in the relevant project Stages. Table 10.66 will be footnoted to indicate this. With regard to onshore construction, these are out of scope of this EIS and will be covered in a dedicated EIS and planning applications as necessary. This is described in Section 2.4 on the 'Scope of the EIS'.	Table 10.72
ED 141	Page 824: Calculation for CO_2e in each stage show possible rounding errors considering GWPs w/o cc feedback. Calculation for CH4 and N2O total project CO_2e incorrect using GWPs w/o cc feedback	An extensive spreadsheet sits behind all the tables presented in the EIS. These spreadsheets calculate the data to many decimal places. Once these are rounded up/down to enable cleaner presentation in the EIS, the totals no longer exactly match the totalled figures. The spreadsheet has been extensively checked as part of the internal QC process. They have been checked again in response to this comment and Navitas are confident that the totals are accurate. A footnote will be added as appropriate to indicate that the data have been rounded up/down from many decimal places.	Table 10.72 Table 10.73
ED 142	Page 826: Calculations of CO_2e for CH4 and N2O are incorrect, also unclear how the average emissions per year (CO_2e) was calculated	See ED 141.	Table 10.72 Table 10.73
ED 143	Page 827: Calculations of CO_2e for direct GHG are incorrect and consequently the total CO_2e is incorrect	See ED 141.	Table 10.72 Table 10.73
ED 144	Page 828: How has the figure of 77.68 tonnes of HC gas that could be released been estimated?	The quantity of HC gas blanket that could be vented is based on the volume of the cargo tanks and works on the worst-case assumption that the VRP malfunctions	Section 10.9.4.4.5

Ref.	Representation	Navitas response	Changes in Rev 4
		when the cargo tanks are empty and remains out of commission for the duration it takes for the tanks to fill. In such a circumstance (albeit unlikely) the full cargo volume of HC gas would be displaced by the crude and vented to the atmosphere. It is very unlikely that this set of circumstances would occur such that this is considered to be a worst-case. The actual figure of 77.68 tonnes was based on the cargo tanks of a larger FPSO than is proposed for use, such that again, this estimates a worst-case. As the development becomes more mature, it can now be confirmed that the cargo tanks will be smaller and the text, and Table 10.69, will be amended. to reflect tanks half the size, such that the quantity of HC released would be 38.84 tonnes.	
ED 145	Page 828: Regarding the emissions resulting from use of municipal electricity generation, has PWD confirmed if this estimate is realistic?	An Emissions Factor was requested from FIG but wasn't available at the time of writing. Navitas judge the EF used to be reasonable and on the conservative side and have referenced the source. Given the amount of emissions for this item is so small in comparison to the overall project, changing this EF will have negligible impact on the overall.	N/A
ED 146	Page 838: Continuation of incorrect values from previous table	**Initial Consultation Response:** Noted. This will be amended. **Post-Consultation Comment:** Relevant tables have been updated with a footnote explaining the potential for differential totals owing to rounding errors. However, Table 10.49 in Section 10.7 has been updated, as has Table 10.85 in Section 10.10.	Table 10.49 Table 10.85

Ref.	Representation	Navitas response	Changes in Rev 4
ED 147	Page 838: Most project specific mitigations have been included - however there could be more opportunities missed to reduce emissions - car transportation could be completed with EV, powered by renewable energy if a suitable wind turbine / battery storage was installed at the Navitas onshore site.	Navitas continues to explore emissions reduction opportunities and will do so throughout field life. Navitas will tender the provision of onshore vehicle transportation in due course. It is anticipated that prospective tenderers will be asked to consider electric transportation opportunities. However, close dialogue will be required with FIG to ensure that the municipal power generation can accommodate an increase in the number of electric vehicles. The situation will also be monitored as technologies advance and capacity increases through the life of field. In the meantime the EIA has assessed the worst-case emissions anticipated, and therefore assumes that vehicles will be powered by traditional combustion engines. In the post-consultation EIS Navitas will add a section under 10.9.7 or 10.9.10.1 on additional measures that may be investigated.	Section 10.9.7.1
ED 148	Page 844: Why have other annexes not been included under 'relevant legislation'? Annex II - control of pollution by noxious liquid, Prevention of pollution by harmful substances carried by sea in packaged form, Annex IV - prevention of pollution by sewage from ships	These will be included.	Section 10.10.1.1
ED 149	Page 844: The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, the protocols of which apply to the onward processing of waste from the Falkland Islands to the UK. - The FI is not party to the Basel Convention - but has a bilateral agreement in place	Noted, this will be amended.	Section 10.10.1.1 Section 3.1.7.1
ED 150	Page 848: Ash generated from waste incineration (if the FIG incinerator is not operational and a temporary incinerator is required at the onshore base). - Ash will be generated whether from FIG incinerator or Navitas. If generated by Navitas incinerator what will happen to this ash?	As described in 10.10.2.2.2.1 'In the event that the new [FIG] facility is not completed in time, the project will provide a temporary portable incinerator and waste ash will be temporarily securely stored at the supply base and periodically sent back to the UK along with other waste returns.'	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
ED 151	Page 848: However, occasionally the recovered oil may be sufficiently 'off spec' that it will not be suitable for processing offshore and in these instances it will be collected and stored in drums / transit tanks and will be shipped back to the onshore supply base. What happens in this case, will they be taken back to the UK or left in the Falklands?	As described in paragraphs 3 and 4 of section 10.10.2.2.1, this waste stream may be a candidate for re-use, with incineration being another option. Alternatively, if 'off spec' oil is returned to shore due to malfunction on the MODU/FPSO, the waste would be stored onshore and then returned offshore for processing once equipment is fixed.	N/A
ED 152	Page 847: The EIS states that oily water will be treated as sewerage - will this actually go straight to sea as there is no sewerage treatment in the Falklands?	Onshore oily waste water will not go into the Stanley sewerage system unless under consent from FIG. Onshore operations which may result in oily water discharge will be completed in a bunded area which will contain the oily water, this will then be treated, incinerated or dealt with away from the sewerage network and shall align with Navitas' Waste Management Procedure. It is understood that the FIG Stanley Incinerator will be operational by end 2026. This aligns with Navitas' operational schedule. Should the FIG Stanley Incinerator not be available Navitas would: 1. Store the waste in suitable containers onshore until the FIG incinerator is once again available; or 2. Store the waste in suitable containers onshore until offshore treatment on board either the MODU or FPSO is available 3. Store the waste in suitable containers onshore until a suitable volume is ready for export under the Basel Convention to the UK. Waste oils from this process shall always be candidates for re-use, incineration is a secondary solution.	Section 10.10.2.2.1 Table 10.86

Ref.	Representation	Navitas response	Changes in Rev 4
ED 153	Page 848: The EIS states that more details on the oil spill waste clean-up and management will be detailed in Navitas' Waste Management Strategy. When will this strategy be completed?	Navitas has submitted a waste management procedure to FIG for review. The Preliminary OPEPs provide more detail on proposals for oil spill waste management.	N/A
ED 154	Page 858: The Environmental and Emissions Monitoring System (EEMS) is the environmental database of the UK oil and gas industry. The EEMS was updated in Feb 2024. Have the waste figures from 2013 been updated?	The EEMS data is no longer referenced in this chapter - this bullet will be removed.	Section 10.10.4.4.1
ED 155	Page 860: Can the incinerator incinerate hazardous waste, aerosols, pipe dope, oily rags?	Following discussions with FIG it is Navitas' expectation that the incinerator will be able to handle this type of waste. If FIG is no longer able to handle this type of waste Navitas would send these streams back to the UK under the Basel Convention regulations, in accordance with its Waste Management Procedure.	N/A
ED 156	Page 872: Marine Mammals are also protected under the Conservation of Wildlife and Nature Ordinance 1999 - this should be included	This will be added.	Section 10.11.1.1
ED 157	Page 873: There have been collisions reported in the past - Caroline Weir (Falklands Conservation) has the information, and we suggest it should be included in the EIS	This will be added.	Section 10.11.4.1
ED 158	Page 876: Inshore is a ratified KBA for sei whales and 9 seabird species	The KBA is covered in the baseline section (7.5.2.3.4), which is referenced in this section.	N/A
ED 159	Page 880: Falklands guidelines also exist - the cetacean code of conduct - should be included in EIS	This will be added.	Section 10.4.4.1 Section 15.6.2.1.3 Section 15.6.2.1.4
ED 160	Page 881: Says highest number of vessels is during stage 2a/b, however the table shows 13 during this stage but 16 for stage 1. Statement does not add up	Noted, this will be amended.	Section 10.11.4.5 Table 10.83
ED 161	Page 881: There is no definitive data that populations of whales are increasing in the area therefore should be very careful in concluding that the loss of an individual animal would not have a long-term impact on the local population	This sentence will be removed.	Section 10.11.6.1

Ref.	Representation	Navitas response	Changes in Rev 4
ED 162	Page 883: Review of SMMO reports after 5 years. Why such a long wait for the review with the uncertainties over cetaceans interaction? Would a review after 2 years not be more appropriate in the first instance?	This will be revised to regular reviews with an in depth review every 5 years.	Section 10.4.10.1 Section 10.5.10.1 Section 15.6.2.1.2 Section 15.6.2.1.3
ED 163	Page 891: Mentions CBD - but references the old CBD Aichi targets, not the newer Kunming-Montreal targets that superseded them. Please update	This will be updated.	Section 10.12.1.1.2
ED 164	Page 908: This section about biofouling says: In order to specifically mitigate the 'Upper Moderate' risk of species introduction *via* bio-fouling which is posed by the LTVs used as floating logistics barges, these vessels will be required to have a hull inspection prior to transport to Berkeley Sound and consideration will be given to hull cleaning, depending on the results of the survey. If hull cleaning is required, this would not be done in Falklands waters. Questions: will all hulls be cleaned before arriving in the Falklands? There is no information given about whether this will actually happen, who decides when to clean a hull and when not to clean a hull? How will this be decided, managed, monitored and recorded? Given the impacts that bringing invasive species could cause, would not ALL hulls need to be cleaned? These questions are important because the entire mitigation for this risk appears to be at the discretion of someone without any protocols around it.	The standard used will be appropriate and agreed in collaboration with FIG. Navitas will reference the IMO 2023 Biofouling Guidelines and Table 1 - Rating Scale for proposed actions in the post-consultation EIS. Link	Section 10.12.1.1 Section 10.12.7.2
ED 165	Page 918: Mitigations for terrestrial invasive species rely heavily on the biosecurity management plan that exists but needs to be revised (and the EIS says it will be revised for this project). Therefore the EIS is scant on exact information about what mitigations will actually be done to address the risks. Whilst we appreciate that this is a work in progress and has been added to the 'to do list' for Navitas, nonetheless it means that the level of confidence for the risk assessment is not as good as it could have been if those actual mitigations were documented in the EIS. It could also include using the rat detector dogs that operate in the Falklands. Would be good to see this included as part of the mitigations.	The Sea Lion Phase 1 and 2 Biosecurity Management Plan will be developed after project sanction and prior to the commencement of operations. This will build upon the 2015 exploration Biosecurity Management Plan. The EMMP advisory group will be invited to review and input in to the draft Biosecurity Management Plan prior to its finalisation and issue. The intention is to bio-secure cargo at its port of origin. It will be inspected on arrival and any cargo considered deficient will be treated in a dedicated biosecurity area in the supply yard prior to release. Methods of inspection and remediation will be	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		discussed and agreed with the EMMP advisory group and FIG Biosecurity prior to finalisation of the Biosecurity Management Plan.	
ED 166	Page 966: Has there been consideration of impacts if Navitas cannot contract for the building of the transit style accommodation or for new builds that may need to occur for the permanent onshore staff? What would be the impacts if Navitas has to use the limited rental accommodation that exists?	If the local supply chain is unable to respond to the onshore accommodation contract opportunity, then Navitas can seek international contractors to fulfil the construction requirement. Socioeconomic impacts, monitoring and management will be discussed in more detail in the updated Sea Lion Socio-economic Impact Assessment.	N/A
ED 167	Page 974: There has been ongoing policy work surrounding housing. Is there more up to date information available than 2021?	FIG Policy department (FIG Policy, Economy and Corporate Services) was asked and no update was available at the time (Q2 2024).	N/A
ED 168	Page 974: Severity has been categorised as minor; however, more than likely under the current housing climate it will increase to at least moderate.	The EIS can only assess the current situation but it is understood housing is a challenging issue and Navitas will do what they can to minimise impact. As the addition of accommodation required by Navitas is only 2 % change, the assessment looks at the worst-case and is precautionary, Navitas feel the assessment is appropriate. Currently the assessment is sensitivity Low 'The receptor is tolerant of change without detriment to its character, or unacceptable to a handful of stakeholders' and Severity Minor: 'Short-term minor impact on livelihood and/or health, inconvenience of resource use, minor levels of disturbance to local pop, concern to a handful of stakeholders'. Wider aspects of the impact of the development on accommodation are considered in the SIA.	N/A
ED 169	Page 979: Most vessels will have water makers on board however any net deficit will be supplied at the TDF for domestic use- Will the ad hoc nature of demand of water requirements make planning for water difficult?	The trickle-feed buffer tank at TDF will help with this issue as there will be no large drawdowns of water from the FIG system but rather a gradual trickle which	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		will be more manageable. There is also a need for appropriate planning by Navitas in terms of vessels' water requirements e.g., top up times/quantities, which will be managed by the onshore teams.	
ED 170	Page 981: Two receptors by use of Stanley freshwater are human population and tangible property - what about the ecosystem catchment? If more water than is necessary is abstracted, this may impact the health of the catchment, however this is not included in the EIS	This section of the EIS focuses on the competition of a resource (water) for the human population. As such, the natural environment would not be considered a receptor in this case. The volume of water to be extracted from the natural supply is managed by FIG and Navitas will be one of many end users. Navitas are going to be taking water *via* a trickle-feed to minimise significant drawdowns on the system.	N/A
ED 171	Page 981: Impacts to local users may arise from increase in volume and rate of demand- also any significant reduction in rainfall patterns will have impact.	Noted, this will be included.	Section 11.4.4.1.1
ED 172	Page 981: EIS stated that PWD are required to hold two days water supply in storage tanks - is this correct as we believe it is three days water supply?	This has been checked again with PWD who confirm 'there is theoretically enough to supply the town with 2.2 days, and including the water already in the network this could stretch to 2.5 days'. Suggest text is amended. to '2-3 days'	Section 11.4.4.1
ED 173	Page 985: Pumping water to vessels - Has electricity to pump the water been factored into the emissions?	The onshore electricity generation usage has been included in the project's emissions calculations. This includes electricity required to pump water to vessels. Navitas will add a footnote to table 10.66 in the post-consultation EIS to ensure that this is clear.	Table 10.72
ED 174	Page 986: Sustainable design - Will the supply base and accommodation units include rainwater harvesting for grey water use?	Tenderers will be asked to provide detail of their proposed incorporation of sustainable design features in their tender submissions. Environmental considerations and sustainable design will form part of the contract evaluation criteria. This detail will be included in the post-consultation EIS.	Section 5.11.2

Ref.	Representation	Navitas response	Changes in Rev 4
ED 175	Page 986: Alterative to reduce demand of fresh water/ pumping raw water from catchment source rather than the water treatment plant - this needs to be carefully managed with the health of the surrounding ecosystem in mind, especially if average water demand from onshore centres and offshore assets ranges from 99.5-112.5m3 per day, and excess Stanley capacity is 82m3 per day.	FIG Public Works Department has indicated to Navitas that it intends to increase both water catchment and treatment such that the prognosed demand from Sea Lion will easily be accommodated within the prognosed increased capacity. Water demand and pressure on supply will be a matter for continuous monitoring between FIG and Navitas so that if issues are encountered measures to increase capacity/reduce constraints can be implemented.	N/A
ED 176	Page 995: Annual increase in water demand of between 2 to 3 % per annum - we have calculated that there will actually be a 3.5% increase.	Noted, this will be amended. and referenced as (FIG Environment Department, *pers. comm.*)	Section 11.4.9
ED 177	Page 995: Monitoring of onshore water use - Will this be metered?	Yes, water usage will be metered as it was for previous drilling campaigns.	N/A
ED 178	Page 1006: Risk is remaining at 'upper moderate' - Concern that if the energy supply and new power station in Stanley is not significantly upgraded in time that increased demand will not be able to be met for phase 1 & 2.	Risk is assessed as 'Upper Moderate' as it is based on existing capacity - FIGs planned investment in the new power station has not been factored in to the assessment. The Public Works Department has advised that with its planned investment, Sea Lion-associated demands can easily be accommodated. In the event that FIG investment is significantly delayed, and there are capacity constraints, Navitas will rely upon standalone power generation for its onshore facilities until such time as increased municipal power generation is available. As such, it is not anticipated that the Upper Moderate risk will eventuate.	N/A
ED 179	Page 1011: Does this mean at the commencement of the project? If not, can existing flights meet requirements for personnel that will need to arrive in the Islands before drilling begins? Is there a provision for the dedicated charter flight to start earlier if needed?	Navitas acknowledges the limitations of existing air links and is monitoring progress with the provision of additional air links in regular consultation with FIG. Navitas will assess its anticipated seat demand and the capacity on air links prior to commencement of operations. If necessary, in consultation with FIG and MoD, ad hoc dedicated charter flights can be	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		implemented prior to the commencement of drilling to meet Sea Lion development related demand and limit impact on other industry and the general community. This aspect will be discussed further in the socioeconomic impact assessment.	
ED 180	Page 1019: EIS states that waste from the development will be disposed of at the FIG waste management facility at Megabid, and if these are not available then the waste would be incinerated at the supply base or shipped away to be dealt with in another country. Can you please confirm that this is correct?	That is correct. The anticipated wastes arising from Sea Lion was considered in the design and specification of the municipal waste facility. FIG's Public Works Department anticipates that this facility will be available in late 2026 which is prior to the commencement of Sea Lion operations. However, in the event that the municipal facility is significantly delayed, Navitas will temporarily store waste in a dedicated waste area within the onshore supply yards, and if the delay is prolonged has a contingency option to seek planning permission for the situation of a temporary containerised incinerator in the Supply Base facility. There is also the option to export waste for disposal elsewhere, as was undertaken in previous exploration drilling campaigns. This is covered in greater detail in the Waste Management Procedure which was issued to FIG in August 2024 (see ED 153).	N/A
ED 181	Page 1019: Section states that “the Falkland Island municipal waste facilities will become available in time for the project”; section 10.10 expresses confidence that this will be the case for the FIG incinerator; previous sections (such as those following) outline that FIG ‘plan to build’ a ‘facility that is expected to be ready for operation in advance of Sea Lion development campaign’ (5.11.1.2.2) (planned to be available 2024 according to section 10.10.4.2.3). While previous sections acknowledge that this may not be available at time of project (e.g., 5.11.4), and discuss the construction and use of own incinerator at base (e.g., 10.10.1), language and wording for this	Wording will be checked for consistency throughout. It is Navitas' intention to use the FIG incinerator, which is anticipated to be operational by the time Navitas operations begin. In the unlikely case that the FIG incinerator is not available, Navitas will provide a temporary incinerator to deal with their waste until the FIG one is operational. See the response to ED 180 for further information if required.	Section 11.7.2.4

Ref.	Representation	Navitas response	Changes in Rev 4
	particular section is not wholly consistent in conveying that this is a probable scenario (however likely), but implies instead that construction of facility will have happened.		
ED 182	Page 1053: Livestock will be sensitive to helicopter flights, particularly when corralled.	Agreed, this is highlighted in section 11.9.1.1.3, last bullet point and 11.9.4.1.2.	N/A
ED 183	Page 1057: Flight path MPC to Stanley- Does this impact on local settlements (Bluff Cove and Fitzroy)? Could this section be travelled by car? Would this also affect the livestock going to FIMCO?	Yes, it is noted in section 11.9.6.1.1 that helicopter flights will pass over settlements and this is included in the assessment. The base case is to travel the MPN-Stanley section by vehicle (likely minibuses) but an option to move personnel by helicopter is included as a worst-case.	N/A
ED 184	Page 1163: Benthic communities are not included in table 12.11. If there is no affect on it, should it still be included to show that this has been considered and it stated no impact on these?	Noted. Benthos will be included and stated as N/A. Other table will be checked to ensure consistency to indicate those receptors that are not included.	Table 12.11 Table 12.12 Table 12.13 Table 12.17 Chapter 14
ED 185	Page 1084: Tests are planned for pelt and fur adhesion - when are these tests going to happen? Why do tests in water temperature of 18C when the seawater temperature is about 5 degrees C here in the Falklands? Have the same tests been carried out in water 5 degrees C, and if so, does this alter the results? This should be included.	Tests are planned for pelt and fur adhesion and commitment to undertaking these tests is included within the EMMP. These tests haven't yet been undertaken due to difficulties in obtaining the import permits that are required for the tests to be undertaken at the CEDRE laboratory in France. If the project achieves production consent and Final Investment Decision, efforts to secure import permits for the pelt and fur will be reinvigorated. In the event that this is unsuccessful, the contingency option is for the testing to be undertaken within the Falkland Islands. This will require the importation to the Falklands of testing equipment and Sea Lion crude samples. There are limited specialist laboratories for undertaking oil behaviour tests. The water at the specialist testing facility in France was 18 degrees C.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		The results of the testing at that water temperature can be considered worst-case as at 5 degrees water temperature it is anticipated that Sea Lion crude would form a solid even more rapidly and be even less likely to sheen.	
ED 186	Page 1196: This figure, in the first map (a) shows that there is a low probability of surface oil around Cochon and Kidney Island. However, the second map (b) shows a high probability of oil on the shoreline of Cochon and Kidney Island under scenario 1.	Although the scales are the same, the figures represent different model outputs.	N/A
ED 187	Page 1200: Regarding dispersants - would these be used in the Falklands? They can be harmful to the environment, do Navitas have policies for the use of dispersants?	Dispersants are not proposed as marine receptors such as kelp are likely to be more affected by the chemicals and dispersed oil than by the oil remaining on the surface, see section 12.2.4.1. Furthermore, permission to use dispersants would have to be granted by FIG.	N/A
ED 188	Page 1200: Is there a procedure to deal with oil spill clean-up waste, how will this be stored or disposed of? Storage of oiled waste could also lead to contamination if not stored properly.	The preliminary OPEPs, which were issued by Navitas to FIG in August 2024, detail proposals for dealing with oil spill clean-up waste. In the highly unlikely event that a spill incident should occur, Navitas would be supported by international oil spill response contractors who have significant expertise and resources in the appropriate management of oil spill response waste. These response contractors would be deployed to the Islands in the event of a Tier 2 or 3 oil spill event. There will be oil spill response and waste storage capability on the offshore support vessels (OSVs) and at the TDF (Tier 1) and in the onshore supply base facility. An appropriate dedicated bunded area for the storage of oily waste is planned within the supply base yard. Navitas will check section 5.11.4.4.1	Section 5.11.4.4.1 Section 10.10.2.2.3 Section 12.1.1 Section 12.2.1 Section 12.3.1

Ref.	Representation	Navitas response	Changes in Rev 4
		and Sections 12.1 - 12.3 and add additional detail to the post-consultation EIS as necessary.	
ED 189	Page 1201: Why just highlight the south shore? This is slightly misleading as figure 12-46 shows there is a probability between 20-40% of onshore oil around large areas of Cape Pembroke which is known for shorebirds and marine mammals. All of Cape Pembroke is also a designated nature reserve.	Text will be amended.	Section 12.2.4.4.2
ED 190	Page 1201: During calm weather, the oil would be amenable to recovery given the buoyant nature of the wax masses. What about other weather states - not very often it is calm in FI?	In the highly unlikely event of a spill to sea, every effort will be made to effect the recovery operations. However, as noted in the EIS, there are operating limitations in the deployment and recovery efficiency of the oil spill response equipment identified as suitable for the characteristics of Sea Lion crude (as there is with any oil spill response). The optimum oil spill response approach would need to be determined in real-time during the incident and the approach would be dependent on: - the short, medium and long-term metocean conditions and their forecast - the spill modelling and tracking data - the consideration of the nature and size of spill As detailed both in the EIS and the Preliminary OPEPs, laboratory tests (by CEDRE) indicate that, given the nature of the Sea Lion crude, allowing for weathering and natural dispersion (which would occur faster in worse metocean conditions, when response equipment could not be deployed) may often represent the optimal response approach. In summary, Navitas has: - Modelled numerous oil spill event scenarios - Committed to recover as much spilled oil as possible - Submitted its Preliminary OPEPs to FIG	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		Most importantly, Navitas will operate within a regime and structure that should prevent the occurrence of such an incident happening in the first place.	
ED 191	Page 1235: Cumulative impacts (or impact interactions) are not covered in depth in chapter 13. Two pages for cumulative impacts does not seem enough detail, it is paying lip service at best, especially when some receptors such as seabirds and marine mammals could be impacted in multiple different ways. We expect the cumulative risks to be considered in more detail.	It is acknowledged that meaningful assessment of cumulative impacts is difficult. However, a colour-coded matrix in Section 13 has been included to give an idea of residual risk for each receptor. While this may overstate the impacts for some receptors, this is felt to be in line with the precautionary approach of the EIS. Thought will be given on the most effective way to summarise the non-project activities which contribute to cumulative impacts on each receptor. This presentation will be included within Chapter 13 of the post-consultation EIS and the title will be changed to 'Cumulative impacts and impact interactions'.	Chapter 13
ED 192	General: Continuous environmental monitoring hasn't been mentioned, which would allow for an understanding of any changes within the local environment potentially due to O&G activity. Will this be included?	Environmental monitoring to be conducted is detailed in the EMMP. Daily monitoring will be done offshore on any discharges (e.g., chemicals, produced water, if being discharged at the time, exhaust emissions etc) and these are reported regularly to the Regulatory authority (if the UK regime is to be followed). Monthly, quarterly and annual reporting is also conducted.	N/A
ED 193	General: Multiple variables from chapter 7.3 that are mentioned such as Tom and TOC levels, PAH, metal toxicity should be routinely monitored during the life of the project	These metrics are included in the benthic sediment surveys, which are proposed every 5 years throughout field life. Navitas will update the text to	Section 10.6.10.1 Section 15.6.2.1.1

Ref.	Representation	Navitas response	Changes in Rev 4
		ensure that this is clear in the relevant sections of the post-consultation EIS.	
ED 194	General: This may not come under environmental monitoring - however if IUCN status of species changes within the lifetime of the project - how would additional risk assessments address this?	This would be addressed in the 5 yearly revisions of the EIS.	N/A
ED 195	General: chapter 10.2 mentions disturbance of local populations due to helicopter flights. Will the number of flights be monitored - and surveys conducted to ensure the local bird populations are not affected?	Number of flights will be recorded. Baseline data and ongoing monitoring of noise will be conducted and all complaints monitored, see section 15.6.2.2.1. Surveys of local bird populations are not proposed as the assessed impact does not trigger the need for a monitoring action.	N/A
ED 196	General: What baseline data would be needed to be collected to be able to identify impacts of the project when it started? E.g., temperature, salinity, conductivity, presence of metals, suspended solids, etc. this needs to cover all seasons for multiple years to account for natural variability. Would also be useful to know the baseline composition of the communities at the drill locations to be able to identify the impact and regeneration of the community to look at impact but also inform the EIA for decommissioning of the oil field	Please see Chapter 7 of the EIS for baseline data at the field. Also there will be Remotely Operated Vehicle (ROV) surveys at each drill centre prior to the commencement of drilling.	N/A
Falklands Conservation			
FC 1	The International Energy Agency has stated that no new oil and gas fields should be opened if we are to achieve net zero emissions by 2050. This would be necessary to keep temperature rises under the safe 2°C limit, avoiding far more severe climate change effects on wildlife, ecosystems and people, including for the Falkland Islands. Opening a new oil field in the Falkland Islands would not align with this, therefore Falklands Conservation (FC) cannot support the proposal laid out in the Environmental Impact Statement (EIS).	Please refer to RSPB 7.	N/A
FC 2	The presented EIS is not fit for purpose FC believes the EIS sets out an avoidable and clearly environmentally damaging development proposal that is inconsistent with the Government's	Navitas refutes the assertion that the EIS has cut corners - it represents 14 years of investment in data acquisition, analysis, stakeholder engagement etc., in	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	objective to 'reduce our carbon emissions, in order to ensure we act as a responsible global citizen' (Islands Plan 2022). The EIS is an incomplete update to previous submissions. It remains inadequate in meeting key requirements of EIA process. It provides an incomplete picture of the risks to the Falklands environment. A major shortcoming is the failure to provide a firm commitment to offsetting all carbon emissions: the 9 million tonnes produced during the development and the more than 100 million tonnes from burning of Falklands oil. EIS statements regarding local offsetting guarantee nothing, are likely unachievable, and could easily be viewed as climate-washing. The EIS contains significant data omissions and errors. Key data, highlighted as required 10 years previous have still failed to be collected, existing data have not been included. Two sections looked at in detail, though not exhaustively, contain over 100 errors, omissions or uncertainties. These put Falklands and other globally significant wildlife at risk. FC believes the current EIS confirms a corner-cutting approach, which unnecessarily results in environmental and reputational impacts for the Falklands community, and one which has limited meaningful commitment to mitigating key environmental harms.	order to assess environmental risk and impact and shape the Phase 1 and 2 development so that residual risks and impacts are ALARP. Navitas notes that independent assessment of the EIS by leading UK industry bodies compliments the structure and content of the EIS, use of data and approach to data gaps. The JV [POEPL (now NPDP) and Rockhopper Exploration] has invested significant sums in data acquisition to inform this EIS and *via* FIPLA has contributed to the GAP project. It has also committed to additional data acquisition in advance of commencement of operations in order to validate the risk assessment. The FIG EIA Guidance states that 'data gaps do not make an EIS unfit for purpose as long as these are acknowledged and explained'; it is how they are treated in the risk assessment that is important (see sections 3.13 and 3.18 of the guidance for reference). Navitas believes that where data gaps remain the EIA has been considerably precautionary, and residual risk reduced to ALARP. Some of the identified data gaps are beyond the capability of an individual operator to fill. With regard to seabird data, for example, the EMMP workshop report (April 2019) notes that 'Challenges to the adequacy of data were raised during the EIS public consultation and were reiterated in the EMMP workshop. The workshop agreed that it would be	

Ref.	Representation	Navitas response	Changes in Rev 4
		useful to collect further data opportunistically from vessels associated with the Sea Lion development, but that a wider data collection effort to update seabird information was beyond the scope of the EMMP. It was also decided not to monitor seabird populations ashore due to the difficulty of attributing any change to activities in the Sea Lion field.' Globally there is no precedent that a developer will offset emissions from sold product (please refer to response to DMR 288). **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund.	
FC 3	The current legal framework is incomplete for good environmental governance In conjunction with the above concerns, FC believes that Falkland Islands Government (FIG) has not made the promised progress in three key areas of environmental legislation that would help ensure that environmental impacts are minimised and would therefore help guide any Environmental Impact Statements to best practice standards. These were 'polluter pays', updated wildlife ordinance and 'environmental case' legislation. The lack of any identified key marine features such as Marine Protected Areas and Vulnerable Marine Ecosystems, and associated protective policy is a significant weakness for risk assessment, decision-making and protection of the marine environment. There is risk that many new oil projects could become uneconomical before the intended project end-date. The lack of an early commitment to how decommissioning would happen in an environmentally sustainable manner is therefore a critical omission.	Navitas has submitted the Field Development Plan (FDP) and Environmental Impact Statement (EIS) in accordance with FIG's current legislative framework. Navitas continues to work with FIG and its key contractors to ensure that its arrangements are aligned with industry best practice and FIG's planned changes to legislation. On decommissioning, please see response to DGN 3. Navitas expects that FIG will comment separately on the EIS public consultation representations which cover FIG's Oil Readiness and planned legislation.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	If FIG gives a green light to this Environmental Impact Statement that does not meet best practice standards and before legislation is put in place, it makes the legal reliability of the agreement uncertain in case of any infringements and puts the government at risk of being sued if trying to impose standards later.		
FC 4	Recommendation FIG should not sanction unnecessary environmental impacts caused by a corner-cutting development proposal, under high-risk and inadequately legislated circumstances. Determining an EIS of this quality would be to endorse low standards and commitment that delivers a poor outcome for the environment and the community. The EIS should be re-submitted only once key gaps have been filled, errors addressed, and standards met.	Navitas notes the comment and opinion. Navitas continues to work within the legislative framework provided by FIG and has delivered amongst one of the industry's most comprehensive FDP and EIS. These have resulted in many environmental impact reductions including a reduced carbon intensity per barrel from the previously accepted EIS. Post FID / sanction, further environmental research / data collection will continue and validate the EIA's precautionary assessment and inform the EMMP. Navitas expects FIG to comment separately on the EIS Public consultation representations which cover FIG's oil preparedness and legislation.	N/A
FC 5	1. Carbon emissions and lack of commitment to offsetting The EIS lists CO_2 emissions from oil production at approximately 9 million tonnes (p.825). Emissions from the burning of Falklands Sea Lion field oil (a legitimate inclusion in the Statement1) are listed as more than 150 million tonnes if production were to be maximised. The developers have also indicated that further development phases could more than double production of Phases I and II. These are very large amounts of CO_2 that would launch a major increase in national carbon pollution and would make the Falkland Islands the highest per capita carbon emitting country in the world – but could be avoided as offsetting is a viable option right now. Comments regarding local offsetting guarantee nothing and are likely unachievable. FIG Guidance2 requires that mitigation and off-setting measures 'should not be hypothetical or unrealistic'. The EIS currently fails to	Navitas' issued the Carbon and Biodiversity Fund strategy to FIG in August 2024. In this paper the company's offsetting strategy has been detailed; this will be further discussed with FIG should the development be sanctioned. Local carbon and biodiversity offsetting opportunities require further evaluation and research to define the level of offsetting that can be achieved. This too is discussed at length within the strategy paper. Navitas is committed to follow FIG legislation, policy and guidance. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	provide a realistic and firm commitment to offsetting all carbon emissions and is inconsistent with FIG guidance. There needs to be a solid commitment in the EIS to offset all emissions. The EIS does not set out how the development will increase emissions in comparison to other local sectors, or the Falkland Islands national figures, as stated as required in FIG Guidance3. A comparison with UK budgets and emissions is neither in line with this guidance or consistent with use of UK comparisons in the rest of the EIS. At over approximately 60% of Falkland Island's recent annual emissions, the proposed development has an enormous and significant national impact. FC is concerned that the current approaches contradict FIG guidelines, good environmental assessment principles and global commitments, while also having negative reputational impacts for the Islands. Given that the amount of carbon emissions is presented as small in global terms, it is even more important that FIG ensure a real and viable commitment to offsetting all emissions within the EIS.	contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund. Emissions are compared to Falkland Island's emissions in the EIS, see section in 10.9.	
FC 6	2. Impacts on our wildlife and data gaps There still remain many gaps in information in the EIS – a number of these are acknowledged within the EIS itself. For such a major proposal and for a robust assessment these should be filled prior to the determination of any EIS, as is consistent with good practice, and to avoid significant risks to environmental features and processes. These are critical, given the Falklands economy is underpinned by a healthy environment. Data gaps include those on invasive species risk, bird strike, waxy oil implications for pinniped fur and cetaceans, impacts on benthos, as well as seabirds and cetaceans:	As noted in the April 2019 EMMP workshop: 'The workshop agreed that it would be useful to collect further [seabird] data opportunistically from vessels associated with the Sea Lion development, but that a wider data collection effort to update seabird information was beyond the scope of the EMMP.' Monitoring is included in the EMMP and this aims to fill gaps and confirm (precautionary) EIS Assessments once the project is sanctioned. In addition to the above response, please also refer to the response to FC 7 below.	N/A
FC 7	Seabirds The Falklands supports globally important breeding populations of penguins, albatross and prions during the breeding season. However, a much larger diversity of seabirds has been recorded in Falklands waters than simply	Navitas has aligned its EIS with the FIG EIA Guidance, which states: data gaps are to be acknowledged in the assessment and the risk assessment should be	Section 10.1.10.1 Section 15.6.2.1.2 Section 15.7.1

Ref.	Representation	Navitas response	Changes in Rev 4
	breeds. Seabirds can be extremely wide-ranging, particularly during winter migrations and consequently, birds from colonies hundreds or thousands of kilometres away occur in Falklands waters and could be at risk from the development proposals. These can include those of conservation concern such as the 'Vulnerable' wandering albatross including those from South Georgia, the 'Endangered' Atlantic petrel from St Helena, Ascension and Tristan, and the 'Vulnerable' southern royal albatross from NZ which have all been sighted in the Falklands even close inshore - however, the potential range of species at risk is much larger. The EIS identifies that seabirds are at risk from a number of impacts, including oil spills and bird-strike. In order to determine which seabirds could be at risk and how to avoid or mitigate such risk, up-to-date baseline data on the total range of seabirds that utilise potentially impacted areas are required. Species-focussed approaches, such as tracking studies, are no substitute for this all-inclusive baseline data4 as they inform on only those species, life-history stages and locations tracked. Neither are they an effective way to track changes in the use of the site by a changing seabird assemblage over time. The approach to delivering useful seabird data therefore needs to be area-based boat or aerial surveys, with a survey method that will provide appropriate representation of the diversity and abundance of all seabirds using the risk area. The only presented seabird data of a broadly appropriate type in the EIS is more than 20 years old. It is well-known that climate change is rapidly changing the distribution of seabirds and their prey at sea. Good practice in places such as the North Sea would expect data to be collected within five years. Projects are expected to provide comprehensive data on bird distributions and movements over a two-year period at considerable cost, before submitting consent applications. This is done ahead of projects being approved, and with all the associated risks of having to change the development. We would consider that this Environmental Impact Statement has cut corners in this potentially expensive but essential aspect of data collection.	precautionary where there are data gaps. The EMMP commits to Seabird and Marine Mammal Observation in the Sea Lion area for an initial 3 years to validate the impact assessment. Attendees at the EMMP workshop (April 2019) agreed that 'A wider data collection effort to update seabird information was beyond the scope of the EMMP.' It is not reasonable to expect an individual operator to fund and undertake a seabird data survey on the area wide scale and for the duration that would be required. However, as is specified in Section 10.1.10.1, 'Offshore, Navitas will use independent Seabird and Marine Mammal Observers (SMMOs) on support vessels and investigate the possibility of a collaborative survey with FIFD, potentially using the fisheries patrol vessel as a platform. A seabird distribution monitoring programme will be developed over several years with an understanding of ongoing work and in collaboration with FIFD, if possible. This will cover the offshore area, transit zones and targeted onshore colonies. Dedicated seabird observers will be deployed offshore during any initial well test and commissioning flaring to quantify any impacts.' As indicated in the EMMP workshop report 2019, the summary tables will be further developed post-sanction in consultation with an appointed advisory group.	

Ref.	Representation	Navitas response	Changes in Rev 4
	The consequences of a lack of appropriate data are strongly evident in the assessment of risk to seabirds in the EIS, these include: • Superfluous referencing to data that are not subsequently used, or analyses that could occur, but do not; • Acknowledgement of data weaknesses and data gaps that could have been addressed, but have not; • Inconsistent and inaccurate representation of data and analyses that are included; and • Unjustified and contradictory argument for use of data sets that are too old and do not follow good practice. Further detailed comments on these points are included in Appendix 1.		
FC 8a	Cetaceans The Berkeley Sound development area is proposed to operate within critical sensitive whale habitat. The extent of the global importance of these areas for whales has not been recognised through the omission of large whale datasets in the EIS. Important Marine Mammal Areas (IMMAs) have been designated for endangered sei whales and for wintering southern right whales. Such non-statutory designations of sites should be a standard part of any EIS that wishes to determine adequate risk categories and suitable mitigation e.g., how to adapt operations for animals engaged in sensitive behaviours including feeding and mating within Berkeley Sound. Information on whale distribution, movements, seasonality, behaviour, habitat, site fidelity, conservation status and population trends are provided in the supporting evidence for these IMMAs, almost none of which has been used to recognise the extent of whale sensitivities in the EIS which should be changed to Very High sensitivity. The EIS risk assessment relies on the identification of 'Key Environmental Sensitivities', and the sensitivity assessment is based on criteria including conservation status, critical habitat, seasonality, vulnerable parts of a species lifecycle etc. Consequently, it is essential to correctly identify and consider the latest available information on those Sensitivities. Eight years of data, primarily for sei whales and southern right whales in Berkeley Sound, has not	Chapter 7 is based upon the peer-reviewed papers that are in the public domain. Published papers related to the FC work in Berkeley Sound over the last eight years have been referenced, except for those from 2023/24 which will be added. Navitas recognises that there are metadata records in the data portal based on the work that is referred to here, however Navitas does not have access to the primary data so that it can't effectively be used for analysis. The IMMA detail will be updated in the document and Navitas will amend the text with new data where appropriate. Please note: the respondent was specifically invited to a dedicated scoping session (see Navitas emails 17th and 27th November 2023) with a view to discussing sensitivities and to explore available data to inform the assessment, but the invitation was declined. Please note: Given the limited extent of project	Section 7.5.2.3.5 Section 15.6.2.1.3 Section 15.6.2.1.4

Ref.	Representation	Navitas response	Changes in Rev 4
	been appropriately represented in the EIS. In addition, erroneous findings from early studies are perpetuated (e.g., that Berkeley Sound is a fin whale hotspot). The importance of nearshore Falklands waters for wintering southern right whale aggregations has been almost completely omitted from the EIS. Offshore: information on the offshore occurrence of cetaceans that would facilitate a robust assessment of the Key Environmental Sensitivities at the Sea Lion field is largely lacking. Efforts have not been made to implement offshore cetacean surveys as an environmental baseline assessment ahead of production commencing. However, a potentially useful year-round dataset was collected. Only 5% of this appears to have been fully analysed and used to inform the EIS.	activity in Berkeley Sound (the elimination of inshore ship-to-ship crude oil transfers from the Field Development Plan (FDP)), it was previously agreed that 'four impacts (oil spill effects on inshore seabirds, effects of underwater noise on marine mammals inshore, effects on squid spawning grounds and effects on intertidal/nearshore benthic habitats) were considered by the workshop to be now outside the scope of the EMMP. ' (EMMP Workshop Report 2019). Please note: It is not practicable for a single operator to implement offshore cetacean surveys pre-sanction of the development. Please refer also to RSPB 3. Efforts have been made to acquire data to inform the assessment. The comment itself acknowledges that a year round dataset that was specifically commissioned to inform the environmental baseline assessment for the project. Furthermore please note that ahead of production Navitas has committed to employ SMMOs on vessels operating between the Falkland Islands and the Sea lion Field for three years pre First-Oil. In addition, further acoustic work will be conducted. Regarding the comment on 5% of the year round dataset being used, please refer to Comment FC 129.	
FC 8b	Whale entanglement risk: there has been little recognition of the risks of cetacean entanglement in mooring equipment in the EIS. Foraging sei whales, that use subsurface lunge feeding, and breeding southern right	Thank you for the comment. Of note, Berkeley Sound is not a development area. It will only be used as an anchorage area for two LTVs over a cumulative (and	Figure 1-3 Section 10.11.2.2 Table 1.8

Ref.	Representation	Navitas response	Changes in Rev 4
	whales in Berkeley Sound are vulnerable to entanglement, potentially leading to mortality by drowning, unrecoverable injuries, or subsequent infections. Offshore cetaceans can also become entangled.	non-consecutive) period of 13 months. These are expected to take up 0.004% (excluding the exclusion zones) of the area in Berkely Sound. The LTV and FPSO anchor chains are large gauge (> 2 inches) and will be taut and therefore unlikely to lead to entanglement. Based upon a literature search, most cetacean entanglement is in relation to static fishing gear. Nonetheless, a risk assessment for entanglement inshore and offshore will be added to Chapter 10.11.	Chapter 14
FC 8c	Vessel collisions: the sections on vessel collisions make no acknowledgement of the existing Code of Conduct (endorsed by FIG) for the Falklands which provides guidance on suitable speeds, wide berths etc for avoiding injurious/fatal collision with cetaceans. Small cetaceans have been omitted despite local documented mortalities of dolphins from vessel strike. With regard to nearshore wintering southern right whale aggregations, reducing the risk of vessel collision would benefit from an expanded 'reduce vessel speed' (10 knots) zone between 1 June and 31 August to 10 km from the coast to match the IMMA and telemetry data showing highest-use habitats. This would greatly improve confidence that the vulnerable surface groups of mating southern right whales - which occur out from the coast - would be at lower risk of a fatal collision, and would be a better all round mitigation approach than only the use of visual observers (given there are 16 hours of darkness in winter).	Navitas fully commit to the Code of Conduct and this will be stated in the text. Small cetaceans will be added to the risk assessment. Navitas agree that speed restrictions are the most effective mitigation against vessel collisions with marine mammals and in the EIS propose reducing speed to 10 knots at the pMMA boundary (as industry standard mitigation (Section 10.11.5)) and then 8 knots within Berkeley Sound (as project-specific mitigation (Section 10.11.7)). Navitas will also commit to reducing speed to ≤10 knots in Port William. Please also refer to FC 188 and FC 162. The IMMA boundary has not been proposed as the limit for the speed restrictions as it is not a statutory boundary and the boundary may change over time.	Section 1.8.4.2.6.1 Section 1.8.4.2.6.2 Table 1.8 Section 10.4.1.1 Section 10.11.1.1 Section 10.11.2.2 Section 10.11.3 Chapter 14

Ref.	Representation	Navitas response	Changes in Rev 4
FC 8d	Information provided in the EIS indicates that the risk of injury/mortality to cetaceans from noise is negligible in both the offshore and Berkeley Sound environments. However, concerns remain about behavioural impacts, given the lack of data on cetacean residency (exposure time) in the Sea Lion field and the non-conservative approaches used in the EIS. The semi-enclosed waters, seasonally-high existing noise levels, and known importance of Berkeley Sound for feeding sei and mating right whales, raises concerns over the cumulative impacts of noise from moored vessels on whale behaviour and use of the Sound.	The EMMP workshop determined that effects of underwater noise on marine mammals inshore 'were considered by the [EMMP] workshop to be now outside the scope of the EMMP' due to the elimination of inshore ship-to ship crude oil transfers from the development plan. Nonetheless Chapter 10.5 is being revised. Please see also FIFD 54. In addition Navitas will employ SMMOs on vessels operating between the Falkland Islands and the Sea lion Field for three years pre First-Oil. In addition further acoustic work will be conducted.	N/A
FC 9	3. Environmental commitments and Falkland Islands legislation Commitments The Environmental Impact Statement presents a set of very significant environmental impacts, and it is therefore necessary for MLAs to compare policies and commitments that have been undertaken. We believe that the impacts are inconsistent with several key commitments: The Islands Plan 2022-2026: • "We will carry out work to measure and reduce our carbon emissions, in order to ensure we act as a responsible global citizen." (p. 8) 5 Falkland Islands Environment Strategy: • "Vision 2040: Renewable energy has been embraced, we play our role in tackling the climate emergency, and are able to understand and adapt to global change at a local level." (p.18)6 • "Our Strategic objectives: to reduce our carbon emissions through transitioning to using renewable (low carbon) energy sources for power generation" (p. 7)6 • "Our Strategic objectives: to conduct the extraction of non-renewable resources, including any hydrocarbon development, in a way that values and conserves our unique biodiversity and ecology, supported by effective regulation" (p.8)6	Thank you for your comment. Navitas continues to work within the legislative framework provided by FIG. Navitas expects FIG to comment separately on the EIS Public consultation representations which cover FIG's oil preparedness, policy and legislation.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
FC 10	Falkland Islands laws and policies are not 'oil-ready' FIG should have put in place rules before an Environmental Impact Statement. For good environmental protection and for Environmental Impact Assessments to work to the best standards, it is important to have a consolidated set of policies and laws to identify what elements of the environment should be protected strictly or to lesser degrees, and how projects can operate within the law. It is also important, so that if rules are infringed, reliable court challenges are possible. This is important for MLAs to know that they are making safe decisions when consenting projects – but also for potential investors in projects in order to see if their investments are safe. Before 2020, FIG recognised this and committed to updating standards in: • the Conservation of Wildlife and Nature Ordinance 1999 7 • establishing clear liability rules for polluters • introducing a form of technical environmental protection rules called 'environmental case'. Regrettably, none of these standards were completed before the Sea Lion Environmental Impact Statement was submitted. If MLAs give a green light to the Environmental Impact Statement before legislation is put in place, it makes the legal reliability of the agreement uncertain in case of any infringements and puts the government at risk of being sued if trying to impose standards later. The lack of this environmental framework means that international standards, as would be found in jurisdictions such as the North Sea, would be unable to be adopted. For example, there is a lack of national habitat categorisation and prioritisation in Falkland Island waters (equivalent to EU Habitats Directive, OSPAR and other UK categorisations). This makes it difficult to attribute value and risk to different sites and therefore suitable mitigation proposed.	Navitas expects FIG to comment separately on the EIS Public consultation representations which cover FIG's oil preparedness, policy and legislation.	N/A
FC 11	4. Decommissioning and spill risks Several studies have called into question how long certain oil developments can continue if the world is to meet international climate change goals which	Navitas is committed and legally obliged to fund and conduct decommissioning under Falkland Islands legislation. Navitas will have arrangements in place to	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	restrict warming to below 2°C. If these studies are correct, then there is a risk that many new oil projects will become uneconomical after a period of time. It is therefore important that the Sea Lion Environmental Impact Statement include decommissioning commitments up front with consent for the project. Commitment to clean and environmentally friendly decommissioning of the Sea Lion project is essential to avoid the 'cheapest option' being chosen once the economics have been agreed upon. This would avoid potential problems like those which have been seen with the decommissioning of Stanley's existing polluted barge port (FIPASS). Spills are a key risk to the environment. Whilst there is commitment to an Oil Pollution Emergency Plan (OPEP) there is insufficient information presented within the EIS on the nature of oil impacts and the wildlife likely to be impacted. Furthermore, any OPEP should be properly financed by the developer and that liability should not be passed to Falkland Islanders as part of the National Oil Spill Contingency Plan, which by its very nature is limited by local resource.	secure funding for any early or end of field life decommissioning and these arrangements need to be agreed with FIG prior to field development approval being granted. Navitas has prepared and submitted its preliminary (Pre-FID) OPEPs to FIG for their review and approval. These shall be finalised prior to the commencement of operations. Navitas is committed to mitigating the risks of such an event from occurring. Navitas is committed and legally obliged to demonstrate that it has adequate arrangements funding / insurance in place to fund any oil spill response activities and any environmental remediation and to compensate for adverse impact on the Falklands economy (including fishing and tourism) that would arise in the event of a worst-case spill event. In August 2024 Navitas submitted the 'Financial Liability Assessment for Oil Spill' to FIG for their review / approval. NPDP (formerly PEOPL) has invested significant resources in understanding Sea Lion crude behaviour and the metocean environment in order to predict the potential impacts on wildlife and inform optimum spill response equipment. Spill Response will be supported by specialist oil spill and wildlife response agencies with resources (equipment and manpower) available to respond at very short notice. The oil spill response arrangements are not reliant on	

Ref.	Representation	Navitas response	Changes in Rev 4
		the NOSCP and associated resources. The preliminary OPEPs have been prepared in order to interface appropriately with the NOSCP (as required and stipulated in the NOSCP) and Navitas has committed to regular engagement, training and joint spill response exercises with FIG to ensure that a spill response can be effected appropriately.	
FC 12	The risk analysis for seabirds is confusing and superficial, and the type of data ultimately considered and analysed for the purpose of this risk assessment is inappropriate for several reasons: (1) The EIS refers to several data that are not actually considered any further or are referred to as "additional analyses could be undertaken". This is misleading and makes it difficult to assess what information was actually used and how for the purpose of informing this EIS. (E.g., SAST data collected between Falklands and South Georgia 2003-2005, data from DPLUS139, data from Global Procellariiform Tracking Database and "its recent extension to penguins and other seabirds"). A similar approach is seen elsewhere in the EIS, e.g., in regard to zooplankton work which is yet to be conducted. (2) The EIS refers to the 3-year data collected in 1998-2001. However, the vulnerability index taken from Webb *et al.* (2001) is actually based on only 2 years of these data. This detail is, misleadingly, not highlighted in the EIS. Best practice advice for oil & gas developments asks for a minimum of three years of data (Webb *et al.,* 2014). (3) Data gaps are acknowledged but are not addressed (e.g., lack of seasonal and age-specific information from tracking data). (4) The EIS and previous responses to public concerns argue the suitability of the old ESAS data by referencing the independent review undertaken by Genesis (2017). However, a quick read of this report reveals a series of poorly supported and biased arguments with contradicting, distorted or incomplete information, and with key literature altogether missing. This superficial review process severely undermines the integrity of this EIS. a. Genesis (2017) did not conduct a power analysis to assess the suitability of	1) These data were collected through GAP and used in the EIS. They were used to compare tracking data with the White *et al.* (2001) vulnerability maps. Note that the availability of tracking data is continuously evolving with regards to local projects. 2) There were three years and some of the latter year's data were used to inform more inshore areas. 3) Data gaps are acceptable as long as they are treated appropriately in the assessment. In other words, the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they address the gaps in the assessment. Therefore the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained. When carrying out the risk assessment data gaps have been taken into account. The EMMP workshop agreed that it would be useful to collect further [seabird] data opportunistically from vessels associated with the Sea Lion development, but that a wider data collection effort to update seabird information was beyond the scope of the EMMP. It was also decided not to monitor seabird populations ashore due to the difficulty of attributing any change to activities in the Sea Lion field.	Section 15.6.2.1.2

Ref.	Representation	Navitas response	Changes in Rev 4
	the data to determine whether sufficient data exist to enable adequate baseline characterisation and robust assessment of changes that could arise should the project be approved. b. In regard to the suitability of the age of the data, the review compares the situation with UK examples, which are actually based on larger and more recent temporal extent and of more complete coverage. For example, Kober *et al.* (2010) used data from 24 years, and as recent as 6 years prior to analysis, compared to Falklands with 2-3 years of data, as recent as 23 years ago; "other projects" in the Atlantic Frontier (projects not specified in review of EIS) using data from 1979 – 1997. Modern developments actually use (boat-based) data from between 1980 – 2018 (see e.g., Rosebank EIS). c. Genesis (2017) distorts the information provided in Webb *et al.* (2014) with regards to data suitability. Webb *et al.* (2014) clearly state that surveys of less than 15 years old and certainly no more than 20 years be used to assess the sensitivity of seabird concentrations to oil pollution. d. Webb *et al.* (2016) was not considered in the review or the EIS. (Webb *et al.,* 2016, Sensitivity of offshore seabird concentrations to oil pollution around the United Kingdom: Report to Oil & Gas UK). This report refers to data suitability in terms of age and highlights why tracking data cannot act as a substitute for at-sea data. (5) Important information provided by Genesis (2017) in relation to data suitability and data gaps was ignored in the EIS and in responses to public concerns. Cherry-picking of information by the authors of the review further undermines the integrity of this EIS. E.g., Genesis (2017) states: "Pollock & Barton (2006) recommended that data over 20 years old should not be used for assessment purposes." The review also hints at Webb *et al.* (2014) recommendation, albeit in an incomplete and distorted fashion. Neither reference can be found in this EIS. b. Genesis 2017 expresses the need for updated boat data in particular for information on risk areas in case of an oil spill. This recommendation has not been considered in the EIS. c. Genesis 2017 states, "The seabird data collected in the Falkland Islands is	4) The SAST data are dated and are acknowledged as such. Data collection from SMMO observations is planned for three years prior to First-Oil. a) All acknowledge that this data set is old but it does inform the base line and the UD from tracking work overlaps well with SAST data. The available data is considered sufficient for the purposes of the risk assessment. The SAST data was a collaboration between FIG and industry in terms of funding and delivered by JNCC in conjunction with FC. Navitas would refer to the EMMP with regards to further data collection in the area pre First-Oil. It is not possible, practical or appropriate for a single operator to undertake this work pre-sanction. 5) Navitas has acknowledged the age of the dataset consistently and has agreed to collect more vessel based data as the field is developed, 3 years prior to First-Oil. This is referenced in the EMMP, but the point will be strengthened in the post-consultation EIS. Navitas has considered the age of the data in the EIS narrative. As a consequence of the age of the data, additional data acquisition was funded by FIG and industry under the GAP project and these additional data that has shown similar distributions for the species that were tracked to the SAST data suggesting that these data are complementary and the distributions still valid. The EIS discusses the static features that produce oceanographic patterns. Specifically this relates to the importance of the Patagonian Shelf around the Falkland Islands as foraging habitat for seabirds and marine mammals and static ocean features that are associated with	

Ref.	Representation	Navitas response	Changes in Rev 4
	less than 20 years old and therefore considered suitable for EIA and oil spill sensitivity purposes. However, it is noted that the data obtained from boat-based surveys in the Falkland Islands is becoming older and its suitability for assessment purposes may become less reliable in future years." This information has not been considered in the EIS. (6) This EIS has made no attempt at an updated, integrated analytical approach for refined seabird vulnerability assessments. Instead, the EIS simply reproduces the vulnerability maps produced by White *et al.* (2001) (which are based on 2 years of data and using an outdated method (see Webb *et al.,* 2016) and reproduces figures from Baylis *et al.* (2019) and (2021) which portray the results of predicted habitat use, which is different to a vulnerability assessment. Since 2001, there has been significant progress in the statistical approaches available for seabird vulnerability assessments, with more powerful methods now in use (see e.g., Webb *et al.,* 2016; Waggitt *et al.,* 2020).	enhanced primary productivity. On 6) To update the seabird vulnerability maps would require further area wide at sea data collection. This would have to be at the least to the scale of the northern FICZ/FOCZ to ensure that the coverage captured communities' structure and their dynamics at appropriate scale. The appropriate spatial/temporal scales would need to be informed by statistical analyses. What we can see from the GAP project is that the seabirds that were tracked show similar distributions and utilisation as the SAST data, so the vulnerability maps are considered appropriate. However it is acknowledged that the dataset is old. Navitas will be collecting additional data in the vicinity of the Sea Lion field. As stated previously, area wide data collection was considered beyond the scope of an individual operator and will require a FIG-Pan industry collaboration; an initiative which is considered needs to be coordinated by FIG. The EIS states 'Offshore Navitas will use independent Seabird and Marine Mammal Observers(SMMOs) on support vessels and investigate the possibility of a collaborative survey with FIFD, potentially using the fisheries patrol vessel as a platform. A seabird distribution monitoring programme will be developed over several years with an understanding of ongoing work and in collaboration with FIFD, if possible. This will cover the offshore area, transit zones and targeted onshore colonies. Dedicated seabird observers will be deployed offshore during any initial well test and commissioning flaring to quantify any impacts.' (Section 10.1.10.1).	

Ref.	Representation	Navitas response	Changes in Rev 4
FC 13	EIS: "the level of confidence in the assessment was used to inform the monitoring requirements for each potential impact / risk". FC: We understand that this informs monitoring requirements. However, it's less clear as to whether confidence level impacts the risk level provided. How can a risk be assessed with no data?	In the absence of site-specific data, where data gaps exist, the sensitivity of receptors and the severity of effect can be generically estimated using published and grey literature as well as prior personnel and industry experience. However, the fact that there is no site-specific data needs to be taken into consideration and is reflected in the confidence assessment which then alerts the need for further monitoring and data collection. Similarly, with regard to risk, the likelihood of an unplanned event occurring can be estimated using industry statistics but where there is any uncertainty in the fine details of the development, this is also reflected in the confidence assessment. Therefore, while the data gaps are considered and acknowledged when determining the sensitivity and severity, they are also reflected in the level of confidence thus ensuring appropriate monitoring is in place to ground-truth the EIA and inform additional mitigation/restorative efforts where necessary. The approach is intended to be precautionary.	N/A
FC 14	EIS: "POEPL commissioned SAERI to conduct a series of four seasonal coastal bird surveys in and around Berkeley Sound, which were carried out between February 2016 to May 2019. In the course of these surveys, the opportunity was taken to develop an initial shoreline classification index specific to the Falkland Islands for use in oil spill planning." FC: Tides and time of day, which significantly impact species number and types, were not considered. A baseline survey should be repeatable and allow detectability of change. However, this survey design fails in this aspect, due to the varying temporal and tidal conditions likely to be encountered at any particular season. At the very least, 3 years of seasonal data should be collected, as is the recommended period for seabird data.	Please note that this work was conducted when POEPL was considering inshore transfer which is no longer proposed. Navitas consider this data sufficient for the much smaller operations now proposed in Berkeley Sound (two vessels moored for a non-consecutive period of 13 months).	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
FC 15	EIS: "the baseline here was generated from extant literature" FC: Extant literature is practically non-existent, and this area is extremely data poor, as highlighted also by Van der Grient (2022). Also, up-to date references should be included, such as to highlight the importance of lobster krill to higher predators (incl. Baylis *et al.,* 2014; Kuepfer *et al.,* 2022; Kuepfer *et al.,* 2023).	Regarding extant literature, 7.4.1.3.1 includes the following references: (Harrison-Matthews, 1932; Arkhipkin *et al.,* 2001; Arata and Xavier, 2003; Laptikhovsky and Arkhipkin, 2003; Laptikhovsky, 2004; Clausen *et al.,* 2005; Brickle *et al.,* 2009; Michalik *et al.,* 2010; Quillfeldt *et al.,* 2011 and P. Brickle, pers. obs.). (Mouat *et al.,* 2001; Agnew, 2002; Brickle *et al.,* 2009) (Arkhipkin and Laptikhovsky, 2013). Padovani *et al.* (2012) (Tarling *et al.,* 1995; Boltovskoy, 2000) (Agnew, 2002). Navitas will modify the sentence 'Similarly, lobster krill can be found in dense shoals on the shelf where they constitute prey for seabirds, fish and baleen whales' to reflect krill constitute 'important' prey for higher predators.	Section 7.4.1.3.1
FC 16	EIS: "There is a PhD studentship (SAERI and the University of Aberdeen) currently working on inshore zooplankton dynamics in Berkeley Sound. However, the results of this study will not be available for another year (i.e., mid-2025)." FC: Again, the EIS lists superfluous information that is not actually considered for the assessment. This adds unnecessary bulk to this lengthy document and is misleading.	The intention here was to note the ongoing work which will be available once the PhD is complete.	N/A
FC 17	Section 7.4.5.2.1 EIS: "Although the JNCC Seabirds At Sea Team (SAST) surveys are 24 years old, it is unlikely that broad-scale animal distribution and movement patterns have changed significantly. Hence, the SAST data remains useful to characterise occurrence of species, particularly where no tracking data exists." FC: This statement is completely unfounded. Seabird assemblages are known to change, particularly in a changing climate. For example, in the UK, Webb *et al.* (2014) concluded that the abundance of some seabird species had changed significantly, and other species had shown an increase and	Regarding occurrence and distribution: The statement that the 'general distribution and animal movement patterns' are unlikely to have substantially changed, is supported by tracking data and modelling work. It specifically relates to the importance of the Patagonian Shelf around the Falkland Islands, as foraging habitat for seabirds and marine mammals and static ocean features that are associated with enhanced primary productivity. Specifically, Baylis *et al.* (2019) highlights that for nine-species tracked, the	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	subsequent decrease, compared to previous vulnerability assessments. (This was also highlighted in the Genesis 2017 review.) Also see e.g., Peron *et al.* (2010) which specifically refer to the effect of climate change on sub-Antarctic seabird distribution and abundance at sea. Webb *et al.* (2014) therefore recommended that data under 15 years old would be the most appropriate (with no data older than 20 years) when assessing sensitive seabird concentrations to oil pollution.	probability of occurrence is highest on the Patagonian Shelf, shelf slope and the Burdwood Bank (Fig 7-53, pg. 360). These findings are similar to the at-sea distribution presented for the same species (White *et al.,* 2002). This is likely to reflect productivity on the Patagonian Shelf, being linked to the Patagonian Shelf, slope and Burdwood Bank (static features, associated with predictable areas of enhanced productivity) (e.g., Fig 7-35, pg. 293). Based on the predictive models, and knowledge of local oceanography, the importance of the Patagonian Shelf around the Falkland Islands is unlikely to have changed over the past 24 years, hence animal distribution is still likely to be associated with the Patagonian Shelf. Peron (2010) is an interesting study, but is associated with oceanic fronts, rather than shelf-break fronts (i.e., static vs dynamic features). Regarding abundance: The statement specifically relates to the distribution and movements of animals. Data gaps remain for both Falkland Islands breeding species, and migratory visitors. Filling data gaps will improve our understanding of occurrence and distribution.	
FC 18	EIS: "Surveys commenced in 1998 and continued for three years" FC: Nowhere within this EIS is it highlighted that the OVI presented is actually based on just 2 years of data (see White *et al.,* 2002: "The results of the first two years of surveys were published as an atlas depicting vulnerability of seabird concentrations to surface pollution Vulnerable concentrations of seabirds in Falkland Islands waters (White *et al.,* 2001)".) As highlighted by Genesis (2017): Webb *et al.* (2014) recommend at least three years of data for assessment purposes. In addition, nowhere is it explicitly shown what the	This work was conducted by FC in collaboration with the JNCC. Note that further surveys will target the region for three years pre-First-Oil by deploying SMMOs.	Section 7.4.5.6.1 Section 15.6.2.1.2 Section 15.7.1

Ref.	Representation	Navitas response	Changes in Rev 4
	actual survey effort was, relative to area of interest, not just the drilling site, but also the risk area in the event of a spill.		
FC 19	EIS: "Over a two-year period between 2003 and 2005, additional data was collected by one of the original SAST observers using the same methodology *en route* between the Falkland Islands and South Georgia (Black, 2005b)." FC: These data are not actually considered further anywhere. Merely mentioning (potentially) useful data for informing this EIS is misleading and adds unnecessary bulk.	These data were included updating inshore observations; the data sets were re-analysed for this by one of the original SAST team.	N/A
FC 20	EIS: "There remain gaps in the SAST coverage but it is possible to infer the species assemblages that are likely to be found in these areas with the data available, therefore, White *et al.* (2002) has been used as a reference in the EIS." FC: Please elaborate on the methodology used for such inferences and provide results of such analyses.	Please refer to section 7.4.5.2.1.1 JNCC Seabirds At Sea Team (SAST) surveys for context. As stated 'The SAST distribution atlas (White *et al.,* 2002) and associated database remain the most useful description of seabird distributions within Falkland Islands waters, in terms of broad scale spatial and temporal patterns of distribution of breeding and non-breeding birds.' Hence, species assemblages, (the sentence following from this statement), refers to those species reported by White *et al.* (2002).	N/A
FC 21	EIS: "The [Genesis 2017] review concluded that the survey methods used, the coverage and the age of the data are comparable with existing datasets used to inform similar impact assessments undertaken in the UK" FC: This statement is deceptive and cherry-picks information provided within a highly biased and superficial review. FC make the following points: The Genesis 2017 report is not available online, reducing procedural transparency. FC appreciate that the report was provided to FC by Navitas for consideration upon request. • Even if data were comparable (which they are not), this does not mean that the approach is adequate. • Genesis 2017 did not conduct a power analysis to assess the suitability of the Falklands data to determine whether sufficient data exist to enable adequate baseline characterisation and robust assessment of changes that could arise should the project be approved. The review merely discusses the	Thank you for the comment. It is acknowledged that the data set is old. As mentioned above, the tracking work complements the SAST data (see response to FC 17). Navitas are committed to deploying SMMOs on vessels developing the field 3 years prior to First-Oil.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	results of a power analysis conducted on UK data. • The Genesis 2017 report misinterprets information that it uses for its arguments in relation to data suitability. For example, Kober *et al.* (2010) actually used data from 24 years ago, and as recent as 6 years prior to analysis, compared to Falklands with 2-3 years of data, as recent as 23 years ago. Other similar and more recent analyses to Kober *et al.* (2010) (e.g., Wilson *et al.,* 2014) used data from 2009 – 2011 (i.e., <7 years old), yet this very comparable example was not used as would be expected in a non-biased review. The review further states that "The data obtained in the Atlantic Frontier is widely used as the baseline information used to assess potential impacts and vulnerability of seabirds from oil and gas developments within waters to the north and west of Scotland." The specific projects are not actually referenced. Also, the data referred to spans from 1979 – 1997, and as highlighted in the review, "the survey effort is greater than that from waters around the Falkland Islands, particularly in the main areas of interest". • An example of an up-to-date O&G EIS in the UK is the Rosebank EIS, which uses the JNCC SOSI (data from 1995 - 2015), and analyses by Waggitt *et al.,* 2020 (data from 1980 – 2018). • Genesis 2017: "In their review of the ESAS data, Pollock & Barton (2006) recommended that data over 20 years old should not be used for assessment purposes." This information / reference is not considered in the EIS. • Genesis 2017: "Similarly, Webb *et al.* (2016) [should be Webb *et al.,* 2014] advised that data in excess of 20 years may be 'too old' for all species but as a 'compromise' data from 1995 could be used as this was when the quality of data improved through standardised survey techniques." This interpretation of the information is false and misleading. Webb *et al.,* 2014 recommended that surveys of less than 15 years old and certainly no more than 20 years be used to assess the sensitivity of seabird concentrations to oil pollution. Webb *et al.* (2014) further stated the recommendation "Revise and update maps of seabird distribution and of the sensitivity of seabird		

Ref.	Representation	Navitas response	Changes in Rev 4
	concentrations to oil pollution using only data in ESAS collected since the start of 1995". This statement does not negate the recommendation that surveys of less than 15 years old and certainly no more than 20 years be used. •Genesis (2017): "Additional surveys focussed on areas where survey coverage is relatively low would improve the information used in the baseline." This indirect suggestion was ignored in the EIS •Genesis (2017): "Oil spill modelling indicates that there is a risk of oil arising from a blow-out to occur in areas to the north of 47°S for which there are no published survey data. Consequently, there is a risk that seabirds that were infrequently recorded by White *et al.* (2002) may occur more frequently in the largely un-surveyed areas to the north, e.g., Atlantic petrel" This concern is not mentioned in the EIS. •Genesis (2017): "There are gaps in the data obtained from boat-based surveys undertaken between 1998 and 2001. Of most relevance and importance is the lack of data within the area which, in the event of a blow-out, would be at very high risk of sea surface contamination. … The collection of additional survey data using boat-based methods to reduce the gaps in the existing data may provide a more robust understanding of the temporal and spatial distribution of seabirds within the region. This, may help inform the risk to seabirds from either sea surface contamination or light attractions which, in turn, would help in the undertaking of EIAs." These indirect suggestions have not been considered. •Genesis (2017) states that, "The seabird data collected in the Falkland Islands is less than 20 years old and therefore considered suitable for EIA and oil spill sensitivity purposes. However, it is noted that the data obtained from boat-based surveys in the Falkland Islands is becoming older and its suitability for assessment purposes may become less reliable in future years." The data is now over 20 years old, and thus any inference of its suitability by Genesis 2017 is no longer a valid argument. •JNCC are currently looking to update their SOSI (which is based on data		

Ref.	Representation	Navitas response	Changes in Rev 4
	from 1995 – 2015), as these data are now considered too old (J. Black *pers. comm.*, Senior Marine Industries Ornithologist at JNCC).		
FC 22	EIS: "However, the survey effort is not dissimilar to the level of effort from the Atlantic Frontier waters located off the north and west coast of Scotland, where O&G exploration is also relatively new and developing" FC: Can this be substantiated by references to any specific projects or impact assessment? The Genesis report states: "The data obtained in the Atlantic Frontier is widely used as the baseline information used to assess potential impacts and vulnerability of seabirds from oil and gas developments within waters to the north and west of Scotland." However, no particular projects or impact statements are referenced. The Genesis report further states: "Although the survey effort is greater than that from waters around the Falkland Islands, particularly in the main areas of interest, the overall coverage is also not complete." An example of an up-to-date O&G EIS is the UK is the Rosebank EIS, which uses the JNCC SOSI (which uses data from 1995 - 2015), and analyses by Waggitt *et al.* (2020) (which uses data from 1980 – 2018).	It is acknowledged that the data set is old. Please refer to FC 17 with regards to tracking data and SAST derived distributions. Navitas are committed to collecting further data with SMMOs on vessels operating in the field for three years prior to First-Oil.	N/A
FC 23	EIS: "in addition to the SAST data, a significant amount of recent tracking data was collected and synthesised through the GAP process, which is also utilised in the impact assessment" EIS: "Preliminary results [from GAP tracking data] showing the range of each species, as derived from probability of occurrence data, support the known distributions of the species concerned. However, while vulnerability maps were produced, there is scope for additional work to interpret this data." (Also, in section 7.4.5.2.1.3) EIS: "The initial results of the GAP project are presented in Blockley and Tierney (2016) and Baylis *et al.* (2019). However, further work could potentially be undertaken to interpret this data with the aim of producing vulnerability maps." FC: It is unclear what work has actually been conducted with the GAP data specifically for the purpose of this EIS. It appears to be limited to reproducing the maps from Baylis *et al.* (2019) in the EIS with the location of the drilling site superimposed on them. The maps show predicted habitat use. They are	Vulnerability maps were not produced with the tracking data - the vulnerability maps were based on the at-sea data and White *et al.* (2001) (Fig. 7-73). The EIS compared tracking data with vulnerability maps produced by White *et al.* (2001) and these are therefore considered complementary. Note that the availability of tracking data is continually evolving with regard to local projects. To ensure clarity, Navitas will edit the statement 'However, while vulnerability maps were produced, there is scope for additional work to interpret this data." (pg. 348) in the post-consultation EIS.	Section 7.4.5.2.1.1

Ref.	Representation	Navitas response	Changes in Rev 4
	not vulnerability maps. Tracking data can provide useful complementary data, but they unfortunately do not compensate for the lack of up-to date at-sea data.		
FC 24	EIS "During the three years of the project major inter-annual variations in species distribution were not identified, perhaps because the study covered a relatively short time frame. Recent studies suggest that there may be significant inter-annual and spatial variation in foraging and migration patterns, for individuals of the same species breeding on the same island (Masello *et al.,* 2010) and on island breeding sites that are in close proximity (Granadeiro *et al.,* 2011; Catry *et al.,* 2013). This is likely to be the case for individual birds but whether this is reflected in the foraging ranges of populations as a whole remains to be seen." FC: This directly contradicts a statement the EIS made in section 7.4.5.2.1 and supports the need for further data. See also Peron *et al.* (2010) and Webb *et al.* (2014) for evidence of changes in seabird assemblages over time, including within the sub-Antarctic.	The at-sea seabird surveys highlighted that for the majority of species, spatial distribution was broadly consistent between years (White *et al.,* 2001 pg. 86). [While the majority of species were consistent, White *et al.* (2021) also highlight for some species - particularly migratory visitors - inter-annual variation existed. See FC 25)]. The reference to Masello *et al.* (2010) will be clarified. The statement draws attention to the spatial segregation and individual variability both within and between species, at a colony and individual level - which may impact distribution, but is generally not well understood. The EIS does state that 'whether this is reflected in the foraging ranges of populations as a whole remains to be seen'.	Section 7.4.5.2.1.1
FC 25	EIS: "The three years of SAST surveys did detect some inter-annual variation but most of these concerned non-breeding visitors to Falkland Islands waters." FC: This directly contradicts a statement the EIS made in section 7.4.5.2.1 and supports the need for updated at-sea data and integration of data from Procellariiformes tracking database.	Regarding occurrence and distribution: The statement that the 'general distribution and animal movement patterns' are unlikely to have substantially changed, is supported by tracking data and modelling work. It specifically relates to the importance of the Patagonian Shelf around the Falkland Islands, as foraging habitat for seabirds and marine mammals and static ocean features that are associated with enhanced primary productivity. Specifically, Baylis *et al.* (2019) highlights that for nine-species tracked, the probability of occurrence is highest on the Patagonian Shelf, shelf slope and the Burdwood Bank (Fig 7-53, pg. 360). These findings are similar to the at-sea distribution presented for the same species (White *et*	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		al., 2002). This is likely to reflect productivity on the Patagonian Shelf, being linked to the Patagonian Shelf, slope and Burdwood Bank (static features, associated with predictable areas of enhanced productivity) (e.g., Fig 7-35, pg. 293). Based on the predictive models, and knowledge of local oceanography, the importance of the Patagonian Shelf around the Falkland Islands is unlikely to have changed over the past 24 years, hence animal distribution is still likely to be associated with Patagonian Shelf. To reiterate, the general pattern will not have changed and this is supported by tracking data from the GAP programme and for the reasons outlined above. Individual variability will be inherent even over very small timescales. Navitas states that "major inter-annual variations in species distribution were not identified" but acknowledge that some variation occurred, specifically with some non-breeding visitors. Therefore, we do not consider this a contradiction.	
FC 26	EIS: "A total of 242 seabird surveys were conducted from January until May 2011 during a 3D seismic survey in the licence area PL001, which is adjacent to the block containing the Sea Lion Field (Geomotive and MRAG, 2011). In addition, 226 individual seabird surveys were conducted over a larger area covering many of the [North Falklands Basin] NFB licence blocks from the end of November 2010 to May 2011 (Polarcus, 2011) … Additionally, a mixture of line transect and point surveys were conducted in March and April 2012 as part of the Sea Lion Field environmental baseline survey (Gardline, 2013a)." FC: The numerous surveys listed sounds substantial, but this information is meaningless in the absence of effort details. For example, according to information on the MRAG website (https://mrag.co.uk/experience/marine-	Navitas are happy to provide these reports. Note that this was conducted by a variety of observers not just MRAG and Gardline. These data and many other data sets (survey and telemetry) were used to the develop the baseline.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	mammal-and-seabirds-observation-survey-north-falkland-basin) the effort of the 242 seabird surveys by Geomotive & MRAG 2011 totalled 308 hours and 1350 km, which equates to approx. 1.25 hours and 5.5 km per survey. No effort details are provided for Gardline 2013a.		
FC 27	EIS: Table 7.13 Number of seabird sightings during the PL001 and NFB Surveys FC: Table 7.13 lists the species for which tracking data are available within the FCZ. However, for several species (e.g., southern giant petrel, northern giant petrel, great shearwater, soft-plumaged petrel, white-chinned petrel, wandering albatross, northern royal albatross), most of which are Endangered, Threatened or Protected (ETP) species, these data are not further considered within this EIS. Again, the report is misleading by referring to data which are ultimately not considered further in the EIS.	Noted, however the assessments are precautionary. The assessment on seabirds considers all of the assemblage.	N/A
FC 28	EIS: "The initial results of the GAP project are presented in Blockley and Tierney (2016) and Baylis *et al.* (2019). However, further work could potentially be undertaken to interpret this data with the aim of producing vulnerability maps." FC: Why has this work not been undertaken, given data have been available for > 5 years? Also, see Webb *et al.* (2016), who explain why the use of tracking data is not suitable for producing vulnerability maps: "These [tracking] studies have contributed greatly to our understanding of individual movements of seabirds but fall short when attempting to describe seabird populations and seabird concentrations as is required for this project. The main shortcomings of these data are their focus on the movements of adult birds and their focus on the breeding season. This means that there are relatively little data available covering the non-breeding season and non-breeding full-grown or immature seabirds. Furthermore, data for some species is limited by their suitability for carrying tags (e.g., on account of their size, their foraging behaviour or their behaviour in response to the tags). In order to include tracking data to determine the sensitivity of seabird concentrations to oil pollution, data would be needed for all species and all age classes in reasonable sample sizes within and out of the study area."	Please see section 7.4.5.2.1. The ES draws attention to the fact more recent tracking data is complementary to the SAST data. Specifically, 'Hence, the SAST data are considered to be complementary to more recent occurrence data when undertaking the assessments in this ES. Limitations of the SAST data are described in the section below.' There are numerous peer reviewed publications that highlight the value of combining tracking data with at-sea surveys to improve occurrence and distribution estimates. Many of the gaps outlined in the comment, cannot be addressed through at-sea surveys - particularly gaps related to sex, breeding status and age. The EMMP aims to undertake further analysis of the satellite tracking data post sanction, pre-First-Oil and post-First-Oil.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
FC 29	EIS: "Tracking data for different age-classes, breeding stages and breeding colonies are limited for most species. This is particularly the case for immature / juvenile birds, periods outside of the breeding season and species that breed elsewhere (noting that most of the IUCN Endangered, Vulnerable and Near Threatened species encountered within Falklands waters do not breed on the Islands). So, although there has been a considerable research effort on tracking seabirds in recent years, there remain substantial data gaps." FC: Whilst the EIS recognises the limitations of available tracking data, particularly in terms of cryptic life stages and non-Falklands breeding birds, including ETP species, it fails to acknowledge that the best way to address the data gap is through at-sea surveys, as also highlighted in Webb *et al.* (2016).	Please see section 7.4.5.2.1. The ES draws attention to the fact more recent tracking data is complementary to SAST data. Specifically, 'Hence, the SAST data are considered to be complementary to more recent occurrence data when undertaking the assessments in this ES. Limitations of the SAST data are described in the section below.' There are numerous peer reviewed publications that highlight the value of combining tracking data with at-sea surveys to improve occurrence and distribution estimates. Many of the gaps outlined in the comment, cannot be addressed through at-sea surveys - particularly gaps related to sex, breeding status and age. The EMMP aims to undertake further analysis of the satellite tracking data post sanction, pre-First-Oil and post-First-Oil.	N/A
FC 30	In the previous EIS, it is stated: "Generally, small sample sizes and data gaps limit the ability to obtain statistically significant and biologically relevant results. Work is currently underway to address priority tracking data gaps in the Falklands (section 7.2.4.2), so that these data can be used in future assessments." The current EIS state "Generally, small sample sizes and data gaps limit the ability to assess vulnerability for all age-classes, breeding stages and in some instances, species. Further work is required to address priority tracking data gaps in the Falklands (Section 7.2.4.2), so that these data can be used in future assessments." FC: When will this additional work actually be undertaken? Also, see Webb *et al.* (2016), who state why use of tracking data is not suitable for producing vulnerability maps. Tracking data are not a substitute for the all-inclusive data that can be delivered by boat surveys. Instead, the data gap should be addressed using at-sea surveys.	At-sea observer data has limitations. For example, for many species it is not possible to identify sex, age and breeding status during at-sea observations. Hence, the EIS highlights tracking and at-sea observer data complements one another, and ultimately strengthens our understanding of species distributions. The EMMP aims to undertake further analysis of the satellite tracking data post sanction, pre-First-Oil and post-First-Oil. See also FC 7.	N/A
FC 31	EIS: "Notable additions to seabird tracking data since the GAP project, include a recent SAERI led tracking project (DPLUS139) that included six	At-sea observer data has limitations. For example, for many species it is not possible to identify sex, age and	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	species and 5 breeding colonies (Table 7.14). Combined with the GAP project data, this yields over 360,000 at-sea locations from 10 species (Figure 7-48). This data is yet to be formally analysed but could be integrated into future assessments. FC: This merely states the availability of more tracking data that have not actually been further analysed for the purpose of this EIS. Again, we highlight that tracking data are not suitable for producing vulnerability maps in the absence of much more all-inclusive at-sea data.	breeding status during at-sea observations. Hence, the EIS highlights tracking and at-sea observer data complements one another, and ultimately strengthens our understanding of species distributions. The EMMP aims to undertake further analysis of the satellite tracking data post sanction, pre-First-Oil and post-First-Oil.	
FC 32	EIS: "In addition, the Falkland Islands provides important foraging habitat for seabird species that breed elsewhere, particularly at South Georgia (e.g., Berrow *et al.,* 2000; Phillips *et al.,* 2006; Ratcliffe *et al.,* 2014). BirdLife International manages the Global Procellariiform Tracking Database (BirdLife International, 2004), which serves as a central repository for albatross and petrel tracking data from all over the world. The model has recently been extended to penguins (and other seabirds). Work is currently underway in the Falklands to collate, and determine how best to use, the tracking data available for seabirds breeding and visiting the Falkland Islands" FC: Again, the EIS refers to available data which could potentially provide useful complementary information without actually using the information. This is misleading and adds unnecessary bulk. The previous EIS already stated that data from the Global Procellariiform Tracking Database would be used to include more info from non-Falklands breeding birds. This has not happened. Instead, the current EIS merely repeats that this work will be conducted. Similarly, it was already mentioned in the previous EIS that "Work is currently underway in the Falklands to collate, and determine how best to use, the tracking data available for seabirds breeding and visiting the Falkland Islands". Although some additional raw data figures have been reproduced in the new EIS of Falklands breeding birds, no additional analyses have been undertaken, nor have any additional data for non-breeding birds been considered.	Figure 7-53 does indeed reflect global population for individual species. The prior EIS and associated development was not continued. Hence, no further work was carried out. The current EIS relates to Navitas and an updated development plan. The EMMP aims to undertake further analysis of the satellite tracking data post sanction, pre-First-Oil and post-First-Oil. Note: Baylis *et al.,* 2020 will be corrected to 2021.	Figure 7-53

Ref.	Representation	Navitas response	Changes in Rev 4
FC 33	EIS: "The EMMP (Chapter 15) will collect further data in the field, specifically using SMMOs on two vessels for the first three years of the project (post sanction, pre-First-Oil and post-First-Oil). Data collected here will allow of a comparison of the SAST data going forward'." FC: Such data should be collected and appropriately analysed pre-sanctioning to adequately inform the EIS of this development. This section identifies the issue of annual variation in foraging patterns, and limited temporal extent of tracking and boat-based data. Why has additional data not been collected to fill this gap?	Please refer to the response to FC 12.	N/A
FC 34	EIS: Table 7.14 Summary of deployments from a recent multi-colony tracking project. FC: Good to see additional tracking data from NW/SW Falklands which can serve as complementary information, although information continues to be scarce from north/northeast Falklands colonies. Importantly, we again stress the point that tracking data can only serve as complementary information to adequate at-sea data. The previous EIS version said that these additional data would be included in vulnerability analyses. As we understand the data presented, this work has not been conducted.	The EMMP aims to collect further data in the field, specifically using Seabird and Marine Mammal Observers on two vessels for the initial years of the project (post sanction, pre-First-Oil and post-First-Oil).	N/A
FC 35	EIS: Figure 7-48 Combined data, from both satellite (PTT) and GPS tags EIS: Table 7.16 Data derived from tags other than GLS tags FC: It would be useful to have a table showing how much data originates from individual colonies and years given the issue of inter-colony and inter-annual variation. Also, the original source of these data should be referenced.	Table 7.16 includes season and colonies from which tracking data was derived. Baylis *et al.* (2019) will be included as the data reference.	Table 7.16
FC 36	EIS: Figure 7-53 An overview of the GAP data from Baylis *et al.,* 2019 and Baylis *et al.,* 2020 FC: The reference should be Baylis *et al.,* 2021 not Baylis *et al.,* 2020. The percentage of global population plot is misleading, as this table is about the importance of the site to Falklands birds. Whilst this additional plot has been included, the previous EIS stated that these data would be considered as part of a vulnerability analysis. This work has not been conducted. Simply	Figure 7-53 does indeed reflect global population for individual species. The EMMP aims to undertake further analysis of the satellite tracking data post sanction, pre-First-Oil and post-First-Oil. The development outlined in the previous EIS (related to Premier Oil), was not continued. Hence, no further work was carried out. The current EIS relates to	Figure 7-53

Ref.	Representation	Navitas response	Changes in Rev 4
	superimposing the drilling area on a map is not a vulnerability assessment, particularly as a much wider area can potentially be at risk in case of a spill.	Navitas and an updated development plan. Note: Baylis *et al.,* 2020 will be corrected to 2021.	
FC 37	EIS: "the resources required to undertake simultaneous tag deployments on multiple predator species from multiple colonies is typically not feasible." FC: Resources should be made available to collect the necessary data prior to sanctioning a large project like this and though expensive, in relative terms to the development, is small. However, importantly, the focus should be on at-sea data collection, rather than tracking, for all the reasons highlighted previously.	Please refer to the response to FC 12.	N/A
FC 38	EIS: Figure 7-59 The locations of 30 gentoo penguins tracked during the winter and early summer from five locations FC: It would be helpful to see the drilling area superimposed on these maps, as well as the risk areas in case of a spill. In any case, it's not clear as to where these additional data fit in. Baylis *et al.* (2019) uses data from 25 + 45 individuals. Baylis *et al.* (2021) do not show these maps. Where do these 30 birds fit in? Is this additional data or is this the same data as shown elsewhere but presented in a different way? If this is additional data, this could be added within an updated analysis.	The comment is noted, thank you. This reference should be '25 gentoo penguins tracked'. This will be corrected and the drilling area superimposed in the finalised version of the EIS. Data are the same as Baylis *et al.,* 2019.	Figure 7-59
FC 39	EIS: "The best known and probably largest colony of sooty shearwaters (Ardenna griseus) is found on Kidney Island, in the mouth of Berkeley Sound, which is estimated to comprise 139,000 pairs (Wakefield *et al.,* 2017)." FC: Clark 2019 is a peer-reviewed publication of Wakefield *et al.,* 2017 report. Also see latest survey of WCP and SSW on Kidney and Top Islands (Kuepfer *et al.,* 2024 – appreciated this report was not available at the time of the EIS preparation).	Reference to Clarke *et al.,* 2019 will be included.	Section 7.4.5.2.2 (Sooty Shearwater)
FC 40	EIS: "There is a very small breeding population of white-chinned petrels (*Procellaria aequinoctialis*) in the Falkland Islands, estimated at 55-100 pairs (Reid *et al.,* 2007)." FC: See Kuepfer *et al.* (2024) for updated estimates at two of Falklands breeding sites – appreciate this info was not available at the time that the EIS was prepared.	This information was not available when the EIS was published. Wherever possible, Navitas will include a reference to reports published after the EIS was produced.	Section 7.4.5.2.2 White-chinned petrel

Ref.	Representation	Navitas response	Changes in Rev 4
FC 41	EIS: Table 7.17 FC: BBA dive to at least 19 m, not 10 m (see Guilford *et al.,* 2022). IUCN Red List needs correcting. MAG is Least Concern, not NT (See BirdLife International 2020). For BBA population estimate in FI, reference Crofts (2020), which lists data from the 2017 census.	Table 7.17 will be amended. to include IUCN status, and references.	Section 7.4.5.2.3
FC 42	EIS: Table 7.20 FC: This is a bit confusing. How can we know the long-term trend without knowing the short-term trend for certain species? KS Eagle Hill 2010 counts – where are these data from? The EIS states that 2022 data are from Stanworth 2014.	Table 7.20 has 'unknown' to reflect data gaps for some species/locations. Kuepfer and Stanworth (2023) will be included as a reference for Berkley Sound counts in 2022.	Table 7.20
FC 43	EIS: "all colonies are counted during the island-wide census, which takes place approximately every five years." FC: This is incorrect. The last census was 14 years ago.	The comment is acknowledged and the finalised version of the EIS shall be re-worded to reflect the island wide-census being undertaken 5-yearly until 2010, and no subsequent island-wide census since 2010.	Section 7.4.5.3.1.2
FC 44	EIS: "For example, on the basis of the most recent archipelago-wide census, the population trend for the black-browed albatross population in the Falklands is positive (Wolfaardt, 2012)" FC: Reference Crofts (2020) which lists information from the latest census in 2017.	Include reference to Crofts (2020).	Section 7.4.5.5
FC 45	EIS: "To assess the relative risk to different species, the JNCC developed an index to assess the vulnerability of bird species to the threat of oil pollution (Williams *et al.,* 1994). One of the main outputs of the SAST surveys in the Falkland Islands was the production of an Oil Vulnerability Atlas (White *et al.,* 2001)." FC: These Vulnerability maps do not consider the full dataset collected, and only include 2 years of data. This important detail is not highlighted to readers (see White *et al.,* 2002: "The results of the first two years of surveys were published as an atlas depicting vulnerability of seabird concentrations to surface pollution Vulnerable concentrations of seabirds in Falkland Islands waters (White *et al.,* 2001)"). As highlighted also in the Genesis (2017)	The maps were produced by SAST, an FC and JNCC collaboration, funded by industry and FIG. Navitas has acknowledged that whilst the data set is old; complimentary, additional surveys and tracking work have augmented and improved the baseline. Please also note that Navitas has committed to deploying SMMOs on the offshore support vessels (OSVs) for the first three years of operations.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	report, Webb *et al.* (2014) recommend at least three years of data for assessment purposes.		
FC 46	EIS: "Recently, JNCC have updated the OVI to include recent survey data and using a new method, which has been named the Seabird Oil Sensitivity Index (SOSI)" Page 20 of 57 FC: It's not clear why an OVI is used as opposed to the newer method of SOSI, which is highlighted by JNCC as an improved measure of seabirds' sensitivity to oil pollution.	The SAST used the OVI and therefore this was used as part of the risk assessment. Navitas are aware of the SOSI and this could be used with new data gathered in the future. Note that Navitas will deploy SMMOs on vessels developing the field for three years pre First-Oil.	N/A
FC 47	EIS: Figure 7-73 Seabird Vulnerability Maps for summer months FC: The OVI by White *et al.,* 2001 only used data from 2 out of 3 years of survey. So not only is the OVI based on very old data, but it also fails to consider all data available. According to Webb *et al.,* 2014, vulnerability maps for oil and gas should be based on at least 3 years of data. Additional tracking data have been collected and presented in current EIS, but this has not actually been included as part of an updated integrated vulnerability assessment analysis. The Falkland Islands waters are recognised as one of the most important seabird areas globally, and the EIS of such a large undertaking should produce a comprehensive and up-to-date seabird vulnerability index.	Noted - please see responses to previous comments above. Also note that the scale of a SAST like programme pre-sanction is not appropriate for a single operator (see FC 12). This would need to be an industry / government collaboration. Note that Navitas will deploy SMMOs on vessels developing the field for three years pre First-Oil.	N/A
FC 48	EIS: "Data collection and analyses are now complete as set out by GAPII objectives. However, it will take further analysis to determine how the results of this work can best be used to quantitatively assess the potential impact of the O&G industry in the Falkland Islands." FC: Although additional data have been collected, the EIS itself states that further analyses are required to adequately make use of these data to assess the potential impact of this project. GAP collected tracking data on 9 Falklands breeding birds, which does not provide information on all other species/ age groups/ colonies that utilise the area, many of which do not breed in the Falklands. The EIS itself states: "The SAST data set is also useful in that it includes species that do breed in the Falkland Islands but use its waters for foraging or as migrations corridors."	The EMMP aims to undertake further analysis of the satellite tracking data post sanction, pre-First-Oil and post-First-Oil. This will include reviewing data gaps. The additional analysis of the data collected by the GAP project, and indeed other projects associated with a wide-range of groups, is ongoing. Outcomes from this ongoing work which are relevant to the project will be used to inform the EMMP and project-specific data collection and monitoring requirements.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
FC 49	EIS: "Existing data will be collated and used to perform assessments through expert-led processes." FC: Can you clarify what is meant by "expert-led processes"? Any further analyses that can help inform this impact statement should be conducted and presented prior to the project being sanctioned.	An expert-led process in the analysis of telemetry data i.e., individual/s with expertise in animal telemetry and data analysis. The EMMP aims to undertake further analysis of the satellite tracking data post sanction, pre-First-Oil and post-First-Oil.	N/A
FC 50	EIS: "At the time of compiling this Environmental Baseline Description, initial analysis of data collected by the GAP project has been published by Baylis *et al.* (2019), Baylis *et al.* (2021) and by the seal by-catch project through SAERI (Riaz *et al.,* 2023). The results from this work are included and referenced in the relevant sections below." FC: Results from Riaz *et al.* (2023) are not referred to in any further sections. Hence, this is not relevant to the EIS.	The comment is noted, Navitas shall delete the sentence: 'The results from this work are included and referenced in the relevant sections below.' in the updated version of the EIS.	Section 7.2.4.2.1
FC 51	EIS: Gap results FC: This whole section simply regurgitates the results from Baylis *et al.* (2019, 2021). The EIS does not attempt to make the results relevant to the Sea Lion area, or the area at risk in case of a spill. As the EIS acknowledges, this tracking data can lead to misleading conclusions being drawn and important areas missed (annual variation / seasonal variation / age-specific variation).	The EMMP aims to undertake further analysis of the satellite tracking data post sanction, pre-First-Oil and post-First-Oil. This will include reviewing data gaps.	N/A
FC 52	EIS: "Vulnerable areas within Berkeley Sound, for seabirds, are linked to the location of colonies and aggregations associated with these colonies" FC: Are the many designations (KBA/IBA/NNR/ACAP breeding sites) assigned to colonies within Berkeley Sound being considered at all?	Please refer to sections 7.5.2.3.1.1 IBAs in Berkeley Sound and 7.5.2.3.4 Key Biodiversity Areas	N/A
FC 53	EIS: Table 7.34 FC: New Island – Landowner should be FC.	Noted, this will be updated.	Section 7.5.2.1 Table 7.34
FC 54	EIS: "The Kidney Island Group are designated as an Important Bird Area (Falklands Conservation, 2006). The most significant species contributing to the IBA status are shown in Table 7.36." FC: Kidney and Cochon Islands have National Nature Reserve (NNR) and Important Bird Area (IBA) designations. Kidney Island also has Key Biodiversity Area (KBA) designation. Kidney, Top & Bottom Islands represent ACAP breeding sites No. 80 and 81 for white-chinned petrels. The vicinity of Top & Bottom Islands is not considered in this EIS.	Noted, this will be updated.	Section 7.5.2.3.1.1

Ref.	Representation	Navitas response	Changes in Rev 4
FC 55	EIS: "Although there is some seasonal movement of birds between the Falklands and South America, the location of the Sea Lion Field and Berkeley Sound are not regarded to be on the route of migrating land …" FC: Please provide supporting references.	White *et al.* (2002) will be added. Note the sentence reads 'not regarded to be on the route of migrating land birds and therefore the potential risk to seabirds is of greatest concern'	Section 10.1.4.3.1
FC 56	EIS: "the impact of lighting has been estimated to extend to 3-5 km around offshore installations" FC: Please provide a reference for distance at which birds are affected by light sources.	The reference already provided for 3-5km was Marquenie (2007) - report is freely available online. Nevertheless, Navitas will update this clarify light pollution could impact birds differently (age/stage) and at different distances, and Navitas cannot rule out birds are attracted at a much greater distance.	Section 10.1.4.3.1
FC 57	EIS: "Data compiled from at-sea surveys, annual monitoring programs, coastal surveys and tracking data were used to indicate the seasonal abundance of the most susceptible species near the Sea Lion Field (Knipe and Pendoley, 2019)." FC: It would be helpful to make the work conducted in reports such as Genesis (2017) and Knipe & Pendoley (2019) publicly accessible for improved transparency. See above our comments why the seabird data used is inadequate / insufficient for the purpose of this risk assessment.	Noted. These are available upon request. The Genesis 2017 report has already been requested and provided.	N/A
FC 58	EIS: Table 10.3 FC: Southern rockhopper penguins are listed as Vulnerable, which does not appear to be considered in this table.	Noted. This will be amended.	Table 10.3
FC 59	EIS: "The available survey data indicate that there will be a low number of individuals of all of the potentially susceptible species present within the zone of influence of the Development (Section 10.1.4.3.1.4). Although accurate population estimates are not available for all species, the biogeographical populations are known to be very large. Therefore, it is anticipated that the assemblage of birds within the zone of influence of the Development, at any given time, will not be of geographical importance (i.e., <1 % of the local population). FC: "The biogeographical populations are known to be very large." - Please reference. This section makes assumptions based on inadequate data of bird	Biogeography is geographic distribution. Hence, the statement that there is no information on geographic distribution of species listed in Table 10.4, to which the statement pertains (petrels, prions, shearwaters) is incorrect. Reference to BirdLife International (2024) will be included.	Table 7.17 Table 7.23 (referred to in Section 10.1.6.1.2)

Ref.	Representation	Navitas response	Changes in Rev 4
	assemblages, insufficient data on bird-strikes, and non-existing data on biogeographical populations. Low fecundity rates and a relatively protracted time to reach maturity of procellariiformes means seemingly small impacts on survival rates can have large impacts on population viability, making them particularly vulnerable to lethal impacts. Cumulative threats will have additive impacts.		
FC 60	EIS: "While seabirds may be distracted from natural feeding behaviour or may expend energy flying in circles around the vessel which has the potential to affect the body condition of the birds, the impact will be short-lived (a matter of hours) and should not have long-term consequences provided there is no contact between the birds and the vessel." FC: Please provide supporting references for this statement. The distance from which birds may be attracted has not been considered here. This information may not be available; however, if birds are potentially attracted from several kilometres away, the adverse effects could greatly increase, as the number of birds impacted increases.	Thank you for the comment. This shall be taken into consideration. Navitas will provide a supporting reference in the post-consultation EIS.	Section 10.1
FC 61	EIS: "the LTV anchorage location is situated approximately 10 km inshore of the breeding colony, so birds will not routinely pass the site en route to the colony" FC: Please provide a reference. Particularly fledglings may become disorientated by lights up to 15 km, see e.g., https://www.dcceew.gov.au/campaign/light-pollution/seabirds.)	Bonnet-Lebrun *et al.,* 2020 will be included as a reference, and sentence clarified to refer to breeding SSW. While appealing, the 15 km stated in multiple Australian Government pamphlets on light pollution, it is derived from Rodriguez *et al.,* 2014.The authors simply state that 'This factory is located on mainland Australia about 15 km from the closest shearwater breeding colony (Cape Woolamai) and produced light pollution levels around 27 nW/sr*cm^2 during the construction phase, which is 5 times higher than the most light-polluted area on Phillip Island (Figure 1). In 2012, 237 fledglings were grounded at this site, which constituted the equivalent to one-quarter of all grounded birds on Phillip Island in the same year and supports the hypothesis that fledglings can be attracted to lights after reaching the ocean.' There is	Section 10.1.4.3.1 Section 10.1.4.3.1.4

Ref.	Representation	Navitas response	Changes in Rev 4
		no information on the distance from which birds were attracted to light, just a straight-line distance from the breeding colony to the grounding location.	
FC 62	EIS: "Significant as multiple seabird strikes are closely linked to weather conditions (Section 10.1.4.3.1.3) and are more likely to occur when visibility is reduced due to fog or snow. However, under these conditions, the deck lights of vessels may not be visible at a range of 10 km such that the zone of influence is effectively reduced." FC: Please reference what is visible to birds under various conditions. The literature suggests that collisions generally increase in conditions of poor visibility.	The context of the statement is in relation to the LTV being located 10 km inshore from the breeding colony, and the fact that tracking data shows that birds don't routinely travel inshore during foraging trips. Specifically, the EIS states 'However, the situation in Berkeley Sound is unusual in that the LTV anchorage location is situated approximately 10 km inshore of the breeding colony, so birds will not routinely pass the site en route to the colony. This is significant as multiple seabird strikes are closely linked to weather conditions (Section 10.1.4.3.1.3) and are more likely to occur when visibility is reduced due to fog or snow. However, under these conditions, the deck lights of vessels may not be visible at a range of 10 km such that the zone of influence is effectively reduced.' The sight-distance of birds at night in poor visibility is not something that features readily in scientific literature. The point being made is the LTVs will be 10km from the colony, and lighting will be minimised as far as practicable. Consequently it is thought unlikely that the vessel lights will be visible to birds some 10km away in weather conditions that result in poor visibility. Note also that the birds will be in burrows at night-time rather than in-flight.	N/A
FC 63	EIS: "Penguins are known to use contact calls to communicate when on the surface, however, there is little evidence to suggest that they vocalise underwater (O'Brian, 2002)." EIS: "EIS: "An SEL threshold of injury of 202 dB re 1µPa2 s was agreed on by the panel (SAIC, 2011). The threshold found for the marbled murrelet was	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and	Section 10.4 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
	applied here to estimate the underwater noise impacts to diving seabirds." FC: This EIS is missing some key up-to-date literature. The EIS suggests that there is no clear evidence that penguins are disturbed by noise, or that they use sound for communication underwater. However, see e.g., Sørensen *et al.,* 2020, Thiebault *et al.,* 2019, Pichegru *et al.,* 2022. - Sørensen *et al.* (2020) state: "The fact that penguins can detect and react to underwater stimuli may indicate that they make use of sound stimuli for orientation and prey detection during dives. Further, it suggests that penguins may be sensitive to anthropogenic noise, like many species of marine mammals." "strong reactions in more than 60% of the playbacks at 120 dB re 1 µPa" "The fact that penguins react strongly towards these rather weak sounds,…", "Another surprise was that the 20 dB increment in received level was sufficient to change the reaction of the birds from no observable response to a strong aversive response." - Thiebault *et al.* (2019) on use of vocalisation in hunting penguins (King, Gentoo, Macaroni) state: "All vocalisations were emitted during feeding dives and more than 50% of them were directly associated with hunting behaviour"	with consideration for the comments received. See also FIFD 54.	
FC 64	EIS: "Although anecdotal, these observations indicate that penguins do not strongly avoid areas where vessel noise is prevalent." Page 23 of 57 FC : See Pichegru *et al.* (2017, 2022): "African penguins likely relocated away from their traditional feeding zone to avoid the disturbance generated by the noise of the seismic vessels, rather than to follow their prey"	No seismic operations are planned as part of the proposed development and please also note that the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See also FIFD 54.	Section 10.4 Section 10.5
FC 65	EIS: Table 10.31 Summary of the impact assessment for underwater noise offshore FC: Behavioural disturbance to seabirds should be included given evidence from elsewhere (see comments above)	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See also FIFD 54.	Section 10.4 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
FC 66	EIS: "Disturbance and behavioural response thresholds: § Fish (Popper *et al.,* 2014), and § Marine mammals (Southall *et al.,* 2007)." FC: In light of information from up-to-date references, seabirds should also be considered here in terms of peak pressure level results.	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See also FIFD 54.	Section 10.4 Section 10.5
FC 67	Section 10.4.4.4.4.2 EIS: "For seabirds, there are no guidelines to determine what constitutes a behavioural disturbance or threshold sound level." FC: See e.g., Sørensen *et al.* (2020) who recorded strong reactions by Gentoo penguins in more than 60% of the playbacks at 120 dB re 1 µPa.	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See also FIFD 54.	Section 10.4 Section 10.5
FC 68	EIS: "levels of sound during inshore operations will be similar to the noise levels currently occurring within the Sound and therefore, there will be little or no additional impact from underwater noise on seabirds present in the area" FC: What about the additive effects of more noise?	This is considered in cumulative impacts, see section 10.5.9, noting that there will be only two additional vessels at any one time (and will they will mostly have their engines off and weather vaning for the duration of their stay in the sound).	N/A
FC 69	EIS: "Where artificial light, poor visibility and high seabird numbers coincide, 1,000's of birds may collide with a vessel on a single night. While there are no published records, light induced bird collisions with vessels, with varying numbers of birds affected, are a regular occurrence around the Falkland Islands (A. Black pers. obs.)," EIS: "Multiple bird strike events can result in hundreds of bird mortalities in a single night, however, these events usually occur close to land (i.e., breeding sites) where some birds congregate at dusk" FC: It is unfortunate that no efforts have been made to improve the bird-strike data. If you speak to captains from fishing vessels, it appears that larger-scale bird strikes away from shores are not uncommon. As the EIS states – "However, in conditions of poor visibility (due to fog, snow or rain) the problem is	In line with the BSMP, bird-strike data will be reported on all vessels. With regard to existing data from cargo/cruise /fisheries vessels etc. in the Falkland Islands, Navitas would welcome receipt of such reported data. Navitas believe the approach to be precautionary however papers suggested, such as, Coleman *et al.,* 2022 will be reviewed and changes made to the chapter if it is deemed appropriate. See also FC 78.	Section 10.1.4.3.1.2

Ref.	Representation	Navitas response	Changes in Rev 4
	exacerbated, and more individuals are likely to interact with vessels emitting light".		
FC 70	EIS: "Therefore, there is a need to identify opportunities for improvement through mitigation and controls, and to consult with project stakeholders" FC: When will this be done? This should be done pre project sanctioning. It is disappointing that no efforts have been made to try and fill this data gap.	The EMMP Summary table regarding EIS Artificial light was discussed with key stakeholders during the EMMP workshop (April 2019). This detailed proposed monitoring and management actions. The EMMP workshop also discussed governance and suggested that the EMMP board 'would be supported by an advisory committee including both non-technical stakeholders and relevant individuals with expertise in the subjects being monitored. The advisory committee would help draw up the specifications to be used in contracting particular monitoring work, and would be able to comment on the results of the monitoring - this would include giving advice as to whether any threshold had been passed, any further management that might be needed and reviewing whether monitoring efforts should be increased or could be reduced.'	N/A
FC 71	EIS: "With regard to the likelihood of a multiple bird-strike event occurring, such a strike is likely to occur less than once per year but more than once in 10 years." The assumption that this will happen less than once in a year is unfounded. It is very likely that multiple bird strikes are not uncommon (based on communications with fishing captains), but simply under-reported. See e.g., Coleman *et al.,* 2022.	Thank you for the comment. See FC 69 and 78.	N/A
FC 72	EIS: "The Falklands population has shown a long-term decline in numbers and is the subject of a dedicated management plan." FC: Please reference FISMP report (Kuepfer & Stanworth 2023): Breeding population (Falkland Islands): 1991–2022, stable; last 10 years, decreasing Breeding success (Falkland Islands): 1993–2022, decreasing; last 10 years: stable-decreasing	Noted, this will be updated. See also FIFD 54.	Section 10.4 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
FC 73	EIS: "Although anecdotal, these observations indicate that penguins do not strongly avoid areas where vessel noise is prevalent." FC: Please provide supporting references for such statements. Penguins are known to be sensitive to vessel noise and other marine noise pollution. See e.g., Pichegru *et al.,* 2022 who assessed vessel-derived underwater noise levels on a penguin population.	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See also FIFD 54.	Section 10.4 Section 10.5
FC 74	EIS: "Local feathers from nine species of Falkland birds were tested in dispersed oil at a concentration of 100 mg/l, and oil droplets of *c.* 100 microns were produced into the water column." FC: Would be useful to refer to the table here where the species are listed. It is unfortunate that this important report is not readily accessible to the public for independent assessment of the methods used.	Noted. The reference to the table will be added. All reports are available upon request.	Section 10.7.4.3.2
FC 75	EIS: "This species has a high potential for natural dispersion and is known to be established in Port William and may have reached Berkeley Sound already (P. Brickle *pers. comm.*)." FC: We feel that the use of *pers. comm.* for statements like these is inappropriate. Please provide an adequate reference or remove.	Thank you for the comment. Navitas believe this is valid as there is a great deal of expertise and many years of observation from those that imparted knowledge.	N/A
FC 76	EIS: "Feathers were dipped into a concentration of 100g/m2 oil in seawater: No oil was adsorbed by feathers" FC: how was it determined whether or not oil had been absorbed by feathers? Visual assessments under normal light conditions can be insufficient to detect sub-lethal oil concentration on feathers which may nonetheless have impacts on individual's performance and survival (See e.g., Fallon *et al.,* 2020)	The work was done by CEDRE. Based in France this company is considered internationally to be expert in accidental water pollution. CEDRE has five main activities: response support, contingency planning, training, analysis and testing and research. It conducts this research to a standard. It should be noted that Sea Lion crude is very waxy and at ambient temperatures does not stick to feathers. Under experimental conditions the oil had to be heated up for it to stick to feathers. The report can be shared for more information. The Fallon (2020) paper refers to crude from Macondo. This is very light and non-viscous in nature and therefore not a good comparison.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
FC 77	EIS: "A preliminary assessment of seasonal vulnerability of seabirds to oil contamination within Falkland Islands waters was performed on data collected by the Joint Nature Conservation Committee (JNCC) to produce an Oil Vulnerability Atlas, (White *et al.,* 2001)." FC: For reasons explained earlier, these data and analyses are inadequate for the purpose of a risk assessment. There is no evidence to suggest that bird assemblages and distributions have remained the same as documented 20+ years ago. The data are too old (see best practice advice by JNCC, Webb *et al.,* 2016). In addition, the vulnerability maps are based on 2 years of data, which is less than the recommended number of years of data (see Webb *et al.,* 2014, 2016).	The EMMP aims to collect further data in the field, specifically using Seabird and Marine Mammal Observers on two vessels for the initial years of the project (post sanction, pre-First-Oil and post-First-Oil).	N/A
FC 78	EIS: Table 14.1: Overall summary of EIA findings FC: Large scale bird strike with vessels is not "possible", it's at best "probable" ("Likely"). Efforts to collect appropriate data should be made pre-sanction. Cumulative bird strikes over the years and with other anthropogenic sources should also be considered. Small scale bird collision is not "likely", it is "certain". An effort to collect appropriate data should be made pre-sanction. Behavioural disturbance to seabirds from underwater noise is not considered, despite evidence that this can be an issue.	See also FC 69. Navitas understand that this data is not routinely collected on vessels. The likelihoods are based upon the data available. If data can be provided to better inform the likelihood of small and large-scale bird strikes, these will be considered within the impact and risk assessment. The underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See also FIFD 54.	N/A
FC 79	EIS: "where uncertainties in the EIS arise from lack of baseline data" FC: Baseline data need to be available prior to project sanctioning. Also, previous EIS have promised certain work that has not been completed. Given this history, what assurance do we have that any further information will be provided in a timely manner?	FIG EIA guidance (2016) acknowledges that the presence of justifiable data gaps 'does not make an EIS unfit for purpose' (Section 3.13) and that where there are data gaps a risk may be increased to reflect a higher level of uncertainty.' (Section 3.18) . Previous commitments undertaken during the 2020 EIS were made to collect additional data and undertake	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		additional work following project sanction. The project has not yet been sanctioned; however, Navitas has restated its commitment to gather this data and undertake additional work post FID and regulatory approval. FIG can condition project approvals on this further work being undertaken and has powers to sanction the Operator if these commitments not met.	
FC 80	Omission of relevant spatial areas identified as having global importance for marine mammals. Although the following areas are non-statutory, they have been identified and accepted by the IUCN. Section 7.5.2.3 (P475) of the EIS acknowledges that such areas should be considered during planning and risk assessment. However, Important Marine Mammal Areas (IMMAs) have not been mentioned in the EIS (despite both Important Plant Areas and Important Bird Areas being acknowledged as relevant and shown in Figures). While the FI IMMAs are relatively recent (2023 to 2024), the process has been ongoing since 2022 and been publicised locally. The areas relevant to marine mammals in the Falklands include: i. Key Biodiversity Area (KBA) for endangered sei whales (and more recently also for seabird species): www.keybiodiversityareas.org/site/factsheet/49174 The KBA is shown in Figure 7-96 and mentioned in Section 7.5.2.3.4 and briefly on P858, 1058 and 858. The KBA was accepted by the IUCN following independent review and its existence for sei whales warrants improved recognition in the EIS considering that Berkeley Sound falls within it; ii. Important Marine Mammal Area (IMMA) for endangered sei whales (and for marine mammal aggregations): https://www.marinemammalhabitat.org/factsheets/falkland-islands-malvinas-inner-shelf-waters-imma/ iii. Important Marine Mammal Area (IMMA) for wintering southern right whales: https://www.marinemammalhabitat.org/factsheets/north-east-falklands-malvinas-right-whale-wintering-area-imma/	Thank you for comments. They shall be taken into consideration.	Section 7.5

Ref.	Representation	Navitas response	Changes in Rev 4
	iv. Important Marine Mammal Area (IMMA) for foraging elephant seals: https://www.marinemammalhabitat.org/factsheets/south-western-patagonian-continental-shelf-imma/ v. Important Marine Mammal Area (IMMA) for breeding/moulting elephant seals and for killer whales: https://www.marinemammalhabitat.org/factsheets/sea-lion-islands-group-imma/ The latter two IMMAs do not overlap with either the Sea Lion field or Berkeley Sound, but are included here for information. The boundary of one additional IMMA (https://www.marinemammalhabitat.org/portfolio-item/slope-front-of-the-argentine-shelf-imma) is located approx. 100 km north-west of the Sea Lion oil fields and supports a high diversity of marine mammal species. This should be recognised and discussed in relation to the oil spill modelling results. The boundaries of the KBA, Inner Shelf Waters IMMA and North-east Falklands IMMA include the waters of Berkeley Sound and Port William, and their existence should be incorporated throughout the EIS in relation to their recognised high marine mammal sensitivity, especially in sections where other spatial sites (e.g., NNR, IBA) are discussed. A wealth of information on whale distribution, movements, seasonality, behaviour, habitat, site fidelity, conservation status and population trends are provided in the supporting evidence for the sites (see IMMA links and Weir, 2021), almost none of which has been used to recognise the extent of whale sensitivities in the EIS. • Identification of Key Environmental Sensitivities (KES). The risk assessment relies on the identification of 'Key Environmental Sensitivities (KES - also 'Environmental Receptors')', and the sensitivity assessment is based on criteria including conservation status, critical habitat, seasonality, vulnerable parts of a species lifecycle etc (Section 8.5.2.1 and Table 8.1). Consequently, it is essential to correctly identify and consider the latest available information on those KES. With regard to cetaceans, the eight years of work on baleen whales (primarily sei whales and southern right whales, SRWs) in the		

Ref.	Representation	Navitas response	Changes in Rev 4
	Berkeley Sound area has not been appropriately represented in the EIS. Erroneous findings from early studies are listed throughout the EIS (for example, that Berkeley Sound is a fin whale hotspot, and that 2017 was a 'one-off' year for Southern Right Whales). Key concerns regarding the cetacean sensitivity assessments are: i. Information on the offshore occurrence of cetaceans that would facilitate a robust assessment of the KES at the Sea Lion field is largely lacking, and the limited information presented has been over-interpreted and over-described in the EIS, risking making it appear to be a more reliable indicator of offshore cetacean occurrence than evidence suggests. For example: • the seismic MMO data is approximately a decade old (the last survey in FI waters was 2013). The total amount of data is small; • the White *et al.* (2002) report is two decades old (data collection from Feb 1998 to Jan 2001) and primarily used ESAS methods aimed at recording seabirds in a strip transect (rather than methods that optimise for cetaceans); • the Hipsey *et al.* (2013) report analysed only 5% of the data from a 1-year period (Jul 2012 to Aug 2013) of continuous acoustic monitoring, and the remaining 95% has not been assessed. Notwithstanding caveats (like animals might be present but not vocalising), this latter dataset could have potentially provided the best information on year-round occurrence of cetaceans at the Sea Lion field. Additionally, some conclusions reached in the Hipsey *et al.* (2013) report have since been shown to be erroneous (specifically they stated that they did not record Sei Whales, whereas Cerchio and Weir (2022) show that the vocalisations they attributed to Leopard Seals were Sei Whale song). The latter finding is significant in terms of confirming reproductive behaviour (singing) of sei whales at the Sea Lion field, but has not been mentioned in the EIS. While we accept that robust information for cetaceans at the Sea Lion field simply isn't available at this time, it's unfortunate that: (1) efforts haven't been made to implement such surveys as an environmental baseline ahead of production commencing; and (2) the existing year-round acoustic dataset hasn't been fully analysed and		

Ref.	Representation	Navitas response	Changes in Rev 4
	used to inform the EIS as would have been good practice. ii. Nearshore: Sei whales. Seven seasons of fieldwork on Endangered sei whales in the Berkeley Sound area have been conducted (each year except 2018). Despite this, it is repeatedly stated in the EIS that information on cetaceans in that area is scant (see detailed comments below). Only Weir (2017) is expanded upon in Section 7.4.6, with subsequent data either omitted or briefly mentioned. Consequently, there is significant under-representation of the importance of Berkeley Sound for sei whales. With regard to the criteria for determining sensitivity provided in Section 8.5.2.1: o The species is of high global conservation concern (IUCN: Endangered); o The numbers using nearshore FI waters are globally significant according to IUCN thresholds (see Weir, 2021 – KBA assessment) and the 1% thresholds applied in the EIS (Table 8.1); o The numbers using Berkeley Sound specifically are almost certainly also of global significance – over 400 individuals have been photo-identified in Berkeley Sound between 2017 and 2021 (excluding 2018, see Weir, 2022) which is 0.5% of the estimated global all-age population in the IUCN Red List assessment. (It is realistic that this value may double to 1% once the 2022–2024 data are analysed); o Mother-calf pairs of sei whales inside Berkeley Sound have been documented (Weir 2022), indicating that lactating adults and newly weaned juveniles also forage at the site. Moreover, Berkeley Sound is the only location globally where sei whale singing are not recognised within the EIS in the context of threats such as noise, entanglement, vessel strike or disruption of prey species. o There are important conservation habitats (KBA and IMMA) for the species in the FI, including Berkeley Sound, which should warrant a 'Very High' sensitivity (Table 8.1); o Their seasonality has been well documented from a 2-yr acoustic programme and effort-related visual datasets collected from 2017-2024 (see Cerchio *et al.,* 2022; Weir *et al.,* 2019; Weir, 2022). However, the EIS has focussed on presenting anecdotal and unconfirmed interview data as the		

Ref.	Representation	Navitas response	Changes in Rev 4
	supporting temporal information; o Their occurrence in the FI represents critical periods of the species lifecycle, specifically feeding (Weir, 2017; Weir *et al.,* 2019; Weir, 2022) and reproductive behaviour (singing: Cerchio and Weir, 2022). The fact that sei whales use Berkeley Sound as a foraging ground has not been appropriately recognised in this EIS (apart from brief mentions on p.444/454/697, but it isn't considered in the context of sensitivity to noise etc). Potential impacts on prey species (especially *Munida*, but also Themisto and other species – see Jackson *et al.,* 2022a for a full list of documented prey species) should therefore be expected to have indirect impacts on sei whales too, because the occurrence of those species inside Berkeley Sound is the primary reason why sei whales are present. This link hasn't been considered. o Nearshore & offshore: Southern right whales (SRWs). The importance of nearshore FI waters for wintering SRW aggregations has been largely omitted from the EIS, despite five years of research widely known within the local community. It is repeatedly stated within the EIS that the winter of 2017 saw an 'unprecedented influx' of SRWs. However, it is widely understood that coastal right whale aggregations have formed every year since. The evidence-base is extensive (boat surveys, aerial surveys, telemetry work), such that the nearshore waters in the north-east of the Falklands have been recently recognised as an IMMA for wintering southern right whales. The EIS fails to distinguish between the different uses of the FI by SRWs (which means that their occurrence at the Sea Lion field and in Berkeley Sound is in different seasons and for different behaviours), comprising: (1) a winter breeding/socialising area in coastal waters; (2) occurrence in pelagic waters perhaps year-round for foraging (and probably used also by SRWs from the South African breeding area: Vermeulen *et al.,* 2023); and (3) seasonal use in spring and autumn while making movements between wintering and foraging areas. Much of this is explained in the literature (Weir and Stanworth, 2019) and updated more recently in International Whaling Commission papers (Weir, 2021, 2024), yet these sources are not used. SRW has been treated as a species that just		

Ref.	Representation	Navitas response	Changes in Rev 4
	occasionally passes through the Berkeley Sound area (e.g., lumped with minke whales in Table 1.3 on P63), rather than as a KES for which nearshore FI waters (including Port William and Berkeley Sound) comprise a globally significant wintering area. The following details are relevant with regard to the criteria for determining sensitivity provided in Section 8.5.2.1: o The species has an IUCN conservation status of Least Concern; however, the south-west Atlantic population of SRWs is of regional conservation concern and there is an International Whaling Commission Conservation Management Plan (IWC-CMP) in place which is not mentioned in the EIS. Moreover, >1% of the global population occurring in FI waters would warrant a 'Very High' sensitivity category (P539/540) – this is the case for SRWs in the FI; o The numbers using nearshore FI waters are globally significant according to IUCN thresholds (results from 2023-2024 aerial surveys, available by Dec 2024) and will form the basis for a forthcoming KBA application; o There is an important conservation habitat (IMMA – see below) recognised for the species that includes Berkeley Sound which should warrant a 'Very High' sensitivity (Table 8.1); The annual (winter) and seasonal (mid-May to early September) aggregations in nearshore FI waters (including Port William and Berkeley Sound) has been well documented using a 2-yr acoustic programme (Cerchio *et al.,* 2022), satellite tracking (Falklands Conservation website), and effort-related visual datasets collected from 2017-2024 (Weir, 2021, 2022, 2024), yet the EIS repeatedly refers to an 'unprecedented' influx of SRWs in 2017 and does not acknowledge them as being an important KES in Berkeley Sound; o Their occurrence in the FI represents critical periods of the species lifecycle, specifically reproductive (mating and singing) behaviour (Cerchio *et al.,* 2022; Weir, 2021, 2022, 2024) which are sensitive to underwater noise (see Cerhio *et al.,* 2022 for example) and other disturbances.		
FC 81	Whale Omission of relevant data. The use of 'pers. comms.' and 'pers. obs.' has been widely applied within the EIS for cetaceans. While these are	Noted. References will be updated but please note that Navitas also consider pers. com. from experts to	Section 7.4.6

Ref.	Representation	Navitas response	Changes in Rev 4
	legitimate data sources, they should not be used as substitutes for available peer-reviewed and published information where available. Little or none of the published data or accessible telemetry data for SRWs and omission of the single most robust available report on whale occurrence in the Islands (distribution and seasonality during boat surveys; photo-identification (movements, fidelity); diet (faecal analysis and stable isotopes); genetics, suction cup tagging, and passive acoustic monitoring (seasonality, singing, behaviour) which has been available since 2022 (Weir, 2022) and none of the distribution or effort-related seasonal data are represented appropriately. Recognition of publicly accessible satellite telemetry data for whales is included on P444, yet no reference to the movements or maps is made elsewhere in the EIS, and although the telemetry data reveal extensive use of Berkeley Sound over weeks by individual sei whales then they are described elsewhere in the EIS as only using the area in transit (P453). The identification of KES is critical to the EIS and should use the evidence base available.	be valid. Please also note: Navitas invited the respondent to a dedicated scoping consultation session (see emails on November 17th and 27th 2023) and specifically asked for any data that may be considered relevant to the EIA process. The invitation to participate in scoping was declined.	
FC 82	Whale entanglement risk. There has been little or no recognition of the risks of cetacean entanglement in mooring equipment in the EIS. It should be recognised that anything in the water column (cables, ropes, lines, chains), particularly anything with slack around tides, has the potential to entangle whales. This includes gear that is looped off the seabed. There are numerous documented examples of whale entanglements, including in deep habitats (where sperm whales can become stuck in underwater cables) and in shallow habitats (most commonly vessel and aquaculture mooring gear, and fixed fishing gear such as pots and gillnets). While entanglement should be considered for all aspects of the project, it is especially pertinent to the Berkeley Sound area which is used by foraging sei whales (with vulnerable subsurface lunge feeding) and breeding southern right whales (*Eubalaena* spp. are highly vulnerable to entanglements, see published literature). Entanglement is both a welfare issue (when whales swim off carrying equipment) and likely to lead to mortality (by drowning or subsequent injury infections). It wasn't possible from the EIA to properly understand how the	The lines that will be placed in the water for the Sea Lion project include flowlines, risers and anchor chains. All of these are substantial and solid pieces of equipment, which Navitas believe pose a very low risk of entanglement to marine mammals. However, the requirement for such a Whale Collision and Entanglement Plan will be considered upon completion of the entanglement risk assessment which will be included in Section 10.11.	Entanglement risk has been added to all NTS summary tables, the ENVIID output tables and Section 10.11.2.2

Ref.	Representation	Navitas response	Changes in Rev 4
	moorings would work for various vessels, but entanglement consideration should be made in the planning of these. We would also recommend that a clear and transparent reporting system for large whale entanglements is introduced, such that expert advice can be sought for handing live entangled animals and the corpses of dead animals can be recovered for sampling/analysis.		
FC 83	Vessel collisions. The sections on vessel collisions make no acknowledgement of the fact that a Code of Conduct (endorsed by FIG) already exists for the FI and provides guidance on suitable speeds, wide berths etc for avoiding injurious/fatal collision with whales. The EIS has omitted small cetaceans from the vessel collision risk assessment, which is inappropriate considering there are documented mortalities of dolphins from vessel strike in the FI (see detailed comments below). With regard to nearshore wintering SRW aggregations, reducing the risk of vessel collision (considering there are 16 hrs of darkness in winter during which visual observation will not be valid) would benefit from an expanded 'reduce vessel speed' (10 knots) zone between 1 June and 31 August to 10 km from the coast to match the IMMA and telemetry data showing highest-use habitats. This would greatly improve confidence that the vulnerable surface groups of mating SRWs which occur out from the coast would be at lower risk of a fatal collision, and would be a better all round mitigation approach than the use of SMMOs (especially at night).	The Falkland Islands Code of Conduct will be added and referenced here. An assessment of vessel collisions with small cetaceans will be undertaken and added to the next revision of the EIS. Navitas agree that speed restrictions are the most effective mitigation against vessel collisions with marine mammals and propose reducing speed to 10 knots at the pMMA boundary (as industry standard mitigation (Section 10.11.5)) and then 8 knots within Berkeley Sound (as project-specific mitigation (Section 10.11.7)). The IMMA boundary has not been proposed as the limit for the speed restrictions as it is not a statutory boundary and the boundary may change over time.	Section 10.4.1.1 Section 10.11.1 Section 15.6.2.1.3 Section 15.6.2.1.4
FC 84	As a general comment, there is a heavy reliance on SMMOs for all of the mitigation listed for vessel collision, but there are obvious limitations with this: (1) SMMOs cannot see in the dark, and especially in winter then it is dark for two-thirds of the time; (2) SMMOs are engaged in simultaneous seabird observations (in a strip transect on one side of the boat if ESAS methods are being used) which means that they are not looking in a concentrated manner ahead of the boat on both sides as would be optimal for cetacean detection; (3) the weather is likely to be unsuitable most of the time in offshore areas for reliably detecting whales; and (4) whales are submerged for most of the time and may surface unpredictably close to a	Navitas agree that the best mitigation for collisions is speed reductions and propose reducing speed to 10 knots at the pMMA boundary (as industry standard mitigation (Section 10.11.5)) and then 8 knots within Berkeley Sound (as project-specific mitigation (Section 10.11.7)).	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	ship when it is too late to respond. The use of SMMOs is definitely preferable to no-one looking, but these limitations do need to be factored in. Mitigating vessel strike is not an easy thing to achieve.		
FC 85	Cumulative Impacts. Section 13 (3 pages) is inadequate. See detailed comments for examples.	Noted, see below for detailed response.	N/A
FC 86	The blue whale is recorded within the Falklands and has an IUCN status of Endangered, so there are actually two Endangered species of cetacean known in the Islands. The southern right whale is also of regional conservation concern (IWC-CMP) and, given their documented abundance in the FI, should also be listed here as a key marine mammal sensitivity in the FI. Given the lack of knowledge of the seasonality of almost all of the cetaceans in offshore waters, it is not clear why the monthly sensitivity (low, medium high) has been assigned. Certainly, key sensitive species such as sperm whale (Vulnerable) are present year-round (as is recognised on P429) and therefore the marine mammal sensitivity would better be considered high year-round. It is difficult to understand the shading for low/medium/high on Table 7.57, because the colours of the key at the top does not match the actual shading provided for the species.	Thank you for the comments. Navitas consider the assessment to be precautionary based on the activity, and risks. The text on blue whales, and the colours in Table 1.2 and Table 7.57 will be amended. In addition, SMMOs will be deployed on vessels developing the field for three years pre First-Oil in order to collect further data.	Section 7.4.6
FC 87	Marine mammals: There is very good information available on the seasonality of sensitive marine mammals in Berkeley Sound, which is not reflected here. The months from December through June should all be marked as high sensitivity for sei whales which are an endangered species which forage in this area throughout those months. The southern right whale aggregates in nearshore waters including Port William and Berkeley Sound from mid-May through to early September. The SRW uses this area for breeding purposes, and the SW Atlantic population is of regional conservation concern (IWC-CMP) - this species should be recognised as a KES within Berkeley Sound. Therefore, the entire period from December through to early September is of high sensitivity for baleen whales in Berkeley Sound (and adjacent waters), and these Tables should be revised accordingly.	Noted, tables will be revised.	Table 1.4 Table 7.58

Ref.	Representation	Navitas response	Changes in Rev 4
	• Commerson's and Peale's dolphins do breed in Berkeley Sound (i.e., this is a 'definite' not a 'likely'). • The influx of SRW in 2017 was not 'unprecedented' as stated in the Table – it has been repeated every year since. • Conservation sites: this table does not recognise that Berkeley Sound is part of three internationally-important sites for marine mammals – one KBA and two IMMAs.		
FC 88	Entanglement of cetaceans in mooring apparatus should be added to 'Environmental aspects' and considered in relevant Tables (e.g., 1.5, 1.6, 1.9, 2.2 etc.). The locations shown in Figure 5.5.2 (Section 5.5.1) are within high-use habitats for both sei whales and southern right whales (indicated by FC vessel data, aerial surveys, acoustic monitoring and satellite-tracking). Since the mooring locations seem to have some flexibility, it would be useful if consultation regarding anchorage locations also included whale experts in addition to FIMA/Fisheries in order to minimise disruption to both humans and whales. Same comment for P684 and P697.	This will be added to the ENVIID chapter (Chapter 9) tables, and the NTS with an assessment included in Chapter 10.11. Such consultations will be considered in discussion with FIG. See also FC 82.	Entanglement risk has been added to all NTS summary tables, the ENVIID output tables and Section 10.11.2.2 Section 5.5.1
FC 89	We suggest that the production of a Whale Collision and Entanglement Management Plan would be appropriate in order to raise awareness of these topics and of the sensitivity of local whale populations and to communicate commitments clearly to all key personnel.	Navitas will consider any additional credible measures and the requirement for such a report upon completion of the entanglement risk assessment (see FC 82, FC 88). Navitas is committed to following the Falkland Islands cetacean code of conduct.	Section 10.11.2.2
FC 90	Discussion "on the EIA requirements for the construction of any new facilities will be held with FIG prior to the submission of the relevant planning applications / requests for extension of existing planning permission." We take the opportunity here to highlight that pile-driving and other loud impulsive noise sources associated with construction has the potential to injure and disturb dolphins and other marine mammals within Stanley Harbour, and FC would seek reassurance that appropriate mitigation (i.e., the JNCC piling guidelines) would be followed during activities associated with Temporary Dock Facility (TDF) construction/expansion.	No pile driving will be required for the TDF causeway upgrade works. The previous EIS which is referred to is that of the one developed by Noble Energy Falklands Ltd for the original siting of the TDF.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	Especially since on P248 it states that "the full environmental baseline of Stanley Harbour is provided in the EIS previously submitted to support the construction of the Temporary Dock Facility (NEFL, 2013)" and so possibly an EIA/EIS has already been submitted for this? FC and SAERI have collected considerable data on dolphin sensitivity within Stanley Harbour in recent years that should be used to inform mitigation.		
FC 91	It is stated that the FI Data Portal has been consulted for the literature review. Metadata for the whale projects has been submitted to the Data Portal, yet whale information since 2017 is hardly represented in the EIS and FC has not been approached to discuss whale sensitivities.	Thank you from the comment. Metadata, such as that on the data portal, is information about data and does not contain raw data in a usable format. The baseline was constructed on published papers and data collected *via* research commissioned by Navitas. Please note: Navitas invited the respondent to a dedicated scoping consultation session (see emails on November 17th and 27th 2023) and specifically asked for any data that may be considered relevant to the EIA process. The invitation to participate in scoping was declined.	N/A
FC 92	"It is believed that many of the baleen whales recorded offshore within Falkland Islands waters are on passage …" As an important deduction this statement needs a reference. It may in fact be likely that sei whales and right whales forage routinely in offshore FI waters (i.e., it's a destination rather than just passing through) as shown by e.g., whaling catch data, Zerbini satellite data papers, etc. "It is thought that the productive inshore waters around the Falkland Islands (including Berkeley Sound) are of importance as feeding areas". Again, a reference would be needed. There are eight years of data demonstrating the importance of Berkeley Sound (and other areas) as a feeding area for sei whales. Additionally, the KBA and IMMA designated for sei whales both recognise the global importance of inshore FI waters as a feeding ground for this species.	Noted. The suggested references will be included. Navitas note that not all of the data to which the respondent refers is readily available. As noted elsewhere, the respondent was invited to a dedicated scoping session for this EIS and was also asked whether it had data relevant to the EIA (see emails sent on 17th and 27th November 2023) but the invitation was declined.	Section 7.4.6

Ref.	Representation	Navitas response	Changes in Rev 4
FC 93	This subheading should be 'relative abundance' not abundance as it does not describe actual abundance. • "However, the age of the dataset, and inherent limitations associated with at-sea surveys, raise uncertainty as to how representative it is of present day populations." While the reliance on White *et al.* (2002) is understandable (given the total absence of other effort-related data from offshore areas) it is clear that it does not represent contemporary populations (as highlighted at the July FIOHEF meeting) and this should be given greater acknowledgement in the EIS. For example, the White *et al.* (2002) report includes only 31 sightings of sei whales and 5 sightings of southern right whales from three years of year-round survey effort (both coastal and offshore). Currently, those numbers can be exceeded in a single day in Berkeley Sound area. There has obviously been substantial changes in whale populations over the 20 years since that report, and those sensitivities are simply not reflected in this EIS. • The Hipsey *et al.* (2013) report analysed only 5% of the one year of acoustic data collected at Sea Lion. It isn't clear why only 5% of that potentially very informative dataset has been analysed, especially when the EIS acknowledges (P422) that recent improvements in knowledge of species calls may mean that the Sea Lion acoustic dataset contains records of species hitherto overlooked. Since this dataset potentially comprises the best available source of information on the temporal occurrence of cetaceans at the exact location of the oil field, it is a pity that the other 95% has never been analysed and especially in light of recent findings (such as sei whale song – Cerchio and Weir 2022). • Figure 7-78: Using percentage to allocate months of importance for species for which there are few sightings is inappropriate and misleading. And also, this must be number of individuals not number of sightings as stated in the legend. Because White *et al.* (2002) reported only five sightings of southern right whales in total.	Thank you for the comments. Relative Abundance will be added. See previous responses on the age the SAST dataset (FC 7, FC 28). This is acknowledged. Also see previous comments on the AMAR data (FC 129). Note that SMMOs will be deployed for three years prior to First-Oil. Metadata, such as that on the data portal, is information about data and does not contain raw data in a usable format. The baseline was constructed on published papers and data collected *via* research commissioned by Navitas. Figure 7-78 will be reviewed.	Section 7.4.6.2.1 Figure 7-78
FC 94	"Additionally, there is limited knowledge regarding the range of vocalisations produced by each species. For example, Hipsey *et al.* (2013) did not record	The sei whale / leopard seal vocalisations are a matter for debate. The Cerchio and Weir (2022)	Section 7.4.6.2.1.2

Ref.	Representation	Navitas response	Changes in Rev 4
	any sei whales, although they are known to be regularly sighted during visual surveys". The study did record sei whales at the Sea Lion field, they just incorrectly assigned those vocalisations to leopard seals (this should be corrected in Table 7.27). See Cerchio and Weir (2022). As there have not been regular visual surveys in the areas of the acoustic deployments the source of the 'regularly sighted' statement is unclear. The presence of sei whale song at the Sea Lion field needs to be acknowledged in the EIS, as it implies higher acoustic sensitivity and sensitive behaviour of an Endangered species in the vicinity of a drilling operation and FPSO.	paper acknowledge that leopard seals can't be ruled out they but they 'consider that their spectrograms illustrate portions of sei whale song rather than aberrant leopard seal calls.' The paper suggest that leopard seals are not common in the Falklands based on surveys in Berkeley Sound. Leopard seals are very regular visitors to the Islands and are regularly seen around our coasts and at sea. Nonetheless, the text will be reviewed with respect to recent work conducted in Berkeley Sound. Based on the information that is available Navitas is confident in the marine mammal assessment. Note that SMMOs will be deployed prior to First-Oil in addition Navitas has committed to using hydrophones on the field.	
FC 95	It would be good to have the summary table (sightings and individuals) of species recorded during the MMO seismic datasets, since the same has been provided for White *et al.* (2002) and Hipsey *et al.* (2013). Which species were recorded by MMOs would be relevant.	Navitas consider that these data are summarised in an adequate way. These data are summarised in the text and considered in the assessments. These reports are available on request.	N/A
FC 96	The information presented here on southern right whales (SRWs) is very out of date. SRWs in the SW Atlantic were increasing, but in recent years that increase has levelled off (see papers by Crespo et al.) due to high calf mortalities and some mortalities also of adults. Consequently, since 2012 the SW Atlantic population of SRWs has been the subject of an International Whaling Commission (IWC) Conservation Management Plan (CMP) – see https://iwc.int/south-atlantic-southern-right-whale The regional conservation status of this population is therefore of higher concern (translating to higher sensitivity) than the species as a whole (globally Least Concern) which has not been acknowledged in the EIS. • "The migratory behaviour of southern right whales suggests that animals may travel through Falklands waters on passage between their Patagonian spring breeding grounds and summer feeding grounds near South Georgia	Thank you for the comment. The text will be updated with references accordingly. Please note that the SRW tracking data is not readily available, specifically for work conducted in the Falkland Islands.	Section 7.4.6.2.1.4

Ref.	Representation	Navitas response	Changes in Rev 4
	and Antarctica." This over-simplification is unhelpful for determining how any development should proceed sensitively. Whaling catches and satellite tracking show that SRWs utilise the entire SW Atlantic region – they aren't only breeding in Patagonia and they don't only feed in SG/Antarctica. They probably forage in pelagic FI waters year-round as well as using the area during migrations and, especially, as a wintering destination (for breeding and socialising) in nearshore waters around the FI. • "During the winter of 2017, an unusually high number of southern right whales was recorded in coastal waters around East Falkland (Section 7.4.6.3.1.1). This adds to the evidence of significant inter-annual variation in the number of these animals present within Falklands waters." Again, this is over-simplified. The winter of 2017 was the first year that a wintering aggregation was documented. However, it can no longer be considered 'unusual' but in fact occurs persistently every year – one of the reasons that an IMMA was identified for the species.		
FC 97	"Conversely, analysis of the acoustic data from the Sea Lion area did not contain any confirmed sei whale calls. … Acoustic detection of sei whales is further hampered by the absence of sei whale call descriptions for the South Atlantic." This information is two years out of date. Sei whale song was shown in spectrograms in the Hipsey *et al.* (2013) report but unfortunately, they reported them as leopard seal vocalisations. The repertoire of acoustic signals produced by SW Atlantic sei whales was published in 2022 and actually relates specifically to Berkeley Sound. The sei whale is now the best acoustically characterised species in the Falklands. See Cerchio and Weir (2022) and also the acoustic chapter by Cerchio *et al.,* in Weir *et al.* (2022). The full one-year acoustic dataset from Sea Lion could (and should) be re-analysed in this context, because the presence of sei whale song (linked to reproductive behaviour) in the Sea Lion oil field is a significant finding with regard to mitigation and sensitivity. "Three recent projects have surveyed the distribution of sei whales, and other cetaceans, in inshore waters (Thomson and Munro, 2014, Weir, 2017;	See responses to FC 94 for detail on sei / leopard seal calls. The text will be reviewed with respect to recent work conducted on Berkeley Sound.	Section 7.4.6.2.1.4

Ref.	Representation	Navitas response	Changes in Rev 4
	Costa and Cazzola, 2018). The preliminary results and anecdotal observations….” This statement is out of date. Eight years of boat-based surveys, aerial surveys, three years of 24/7 acoustic monitoring, diet analysis, genetic analysis, satellite-tracking and stranding attendance has been conducted. Much of this is available online.		
FC 98	Two species of minke whale occur around the Falklands, and it isn’t clear why this section focuses only on one of them. Same comment for Table 7.28, and for the summary on P454. At least one stranding in the FI has been genetically confirmed as *B. acutorostrata* not *B. bonaerensis* (C. Weir, *pers. comm.*). Humpback whales are not rare around the Falklands anymore – this information is out of date and does not represent what is currently known of species occurrence. Same comment for P455.	Noted. The text will be updated accordingly. See also FIFD 28.	Section 7.4.6.2.1.4 Table 7.28
FC 99	“Pilot whales were recorded on approximately 35 days throughout the year-long monitoring period (Hipsey *et al.,* 2013)” This is a meaningless/misleading statement considering that only 5% of the dataset was analysed. Southern bottlenose whales (and beaked whales in general) are almost certainly in the NFB year-round, given what we know of the site fidelity of beaked whale species globally. The fact they were not recorded in winter doubtlessly reflects weather conditions or is just a chance result (as the sighting rate of this species is anyway very low). Describing Long Finned pilot whales as ‘shallow divers’ is incorrect. Pilot whales are very capable divers reaching 1000 m – there are numerous published papers to support this.	See responses to FC 129 on the AMAR methodology. Currently there are no data to support Southern bottlenose whales (and beaked whales in general) abundance / distribution in the NFB. The pilot whale diving detail will be updated.	Section 7.4.6.2.1.4
FC 100	“This was subsequently supported by satellite tagging efforts by Falklands Conservation, which although preliminary (see https://falklandsconservation.com/sei-whale-tracking/), revealed long-distance movements of sei whales, both around the Falkland Islands and	This will be checked and updated where necessary. However, Weir *et al.* (2019) report on migratory movement of a single sei whale between Brazil and	Section 7.4.6.3

Ref.	Representation	Navitas response	Changes in Rev 4
	between the Falkland Islands and South America." This is incorrect, none of the tagged sei whales went to South America.	the Falkland Islands based on photo identification. The text will be updated accordingly.	
FC 101	The figure legend refers to section 1.5.2.3.4 but that section does not actually seem to exist in the report.	This reference will be removed.	Removed in course of QA process
FC 102	"Notably, of the species that are regularly observed within Berkeley Sound, sei whales are listed as 'Endangered' on the IUCN Red List…and all other cetaceans, are listed as species of conservation priority and are the subject of a Falkland Islands Cetacean Management Plan (FIG, 2008c)". They are not the focus of a FI CMP – cetaceans did have a Species Action Plan but it expired in 2018 and has not been renewed. This information also fails to acknowledge the SRW and the IWC-CMP that exists for the population. "For many years large numbers of sei whales (*B. borealis*) have been observed in inshore waters around the Falkland Islands (White *et al.,* 2002; Frans and Augé, 2016)". White *et al.* (2002) reported only 31 sightings in three years. "However, photo-identification within Berkeley Sound indicates that the animals are transitory with most animals spending a short period of time within Berkeley Sound (Weir, 2017)." This does not reflect current knowledge. Publicly available satellite-tracking for sei whales show sei whales remaining within Berkeley Sound continuously for periods of several weeks. This has to supersede the one-season of photo-ID data assessed in Weir (2017). More recent photo-ID data shows some individuals remaining a longer too (see photo-ID chapter in Weir, 2022).	Noted. Navitas will clarify and update references to reflect recent tracking work where it is possible. Note that these data are not readily available.	Section 7.4.6.3.1.6
FC 103	Sightings of fin whales in inshore waters are not supported (Weir, 2017). The report is that there aren't any confirmed (i.e., supplemented with photographs, video or genetic data) sightings of fin whales in inshore waters. Moreover, two years of acoustic monitoring in Berkeley Sound did not yield fin whale detection. Continuing to suggest that fin whales are common in Berkeley Sound is misleading. Given fin whales are an IUCN Vulnerable species, it isn't helpful for the industry if they are reported in the EIS as being	Fin whale - Weir (2017), while a valuable study, is not the only, nor definitive, cetacean sighting information available for the Falkland Islands. Indeed, Weir (2022) states that 'Fin whales (*Balaenoptera physalus*) have been anecdotally reported in coastal areas around the Falkland Islands, in some areas frequently enough to suggest that their occurrence might support a Key	Section 7.4.6 Section 10.11

Ref.	Representation	Navitas response	Changes in Rev 4
	present. "Once they arrive on their feeding grounds, southern right whales (*Eubalanus australis*) tend to be found in coastal or inshore waters (*c.f.* Black, 2005b)". This is likely incorrect. The feeding grounds of SRWs mostly comprise pelagic mid-latitude regions, including the outer Patagonian Shelf, the Argentine Basin, the subantarctic Islands etc. Not that many feeding grounds are located close to shore – this is the premise for most of the current satellite-tracking work going on for SRWs globally, aimed at locating their pelagic foraging areas. The whole section on SRWs under-represents what we know about the species in the FI currently and requires a major overhaul to properly reflect that species' occurrence and sensitivity. There is no recognition that SRWs aggregate in nearshore FI waters every year in winter for breeding and socialising, that satellite-tracking has revealed the durations that they stay on the FI coast, that they are part of the SW Atlantic population for which the IWC CMP exists, that their occurrence has warranted an IMMA, that the same animals return in different years, that Berkeley Sound is an important breeding habitat, etc.	Biodiversity Area (e.g., Frans and Augé, 2016; Taylor *et al.,* 2016). However, there is some debate over whether they actually occur on a regular basis in nearshore waters or if reported sightings are in fact misidentified sei whales (see Weir, 2017).' Given this debate is ongoing, it is both prudent and precautionary to include fin whales. Southern Right Whale - noted, Navitas will clarify and update references.	
FC 104	"Although there are no known records from Berkeley Sound, killer whales may visit the area". Killer whales were confirmed during the DOKE project around Kidney Island and FC has seen them inside Berkeley Sound and around Volunteer Point (see social media posts), local landowners (e.g., Adrian Lowe) have reported them anecdotally, etc. The Peale's dolphin section for some reason focuses on the 20-year-old JNCC surveys, while not citing at all recent information in Weir (2017, 2018) or Baines & Weir (2020). The same is true of the Commerson's dolphin section on P456.	Noted. Navitas Will update references.	Section 7.4.6.3.1.7
FC 105	The behaviour column contains a high number of inaccuracies. • SRW seasonality should be updated to reflect work done since 2019. See earlier points. • Fin whales: see previous comment.	Noted. Will update where relevant.	Table 7.28 Table 7.32

Ref.	Representation	Navitas response	Changes in Rev 4
	• Minke whales are not 'regularly sighted', occasional at best. • Humpback whales – They have been reported in Berkeley Sound. See Weir *et al.* (2022) report. • Killer whales - See comment above.		
FC 106	SRWs, fur seals and elephant seals have also been seen inside Stanley Harbour on occasion. Commerson's dolphins are significantly more common inside Stanley Harbour than Peale's dolphins – the distribution of the latter normally ends at The Narrows and we have seen them only very occasionally inside the Harbour itself. This section could be improved to make it clear that Commerson's dolphins and sea lions are the main sensitivities within the Harbour, with the other species far less common.	Noted. Will update where relevant.	Section 7.4.6.4
FC 107	This section (and subsequently Sections 7.5.2.3 and 7.6.2.1) fails to mention the IMMAs that are in existence for whales in the Falklands. Plus two additional IMMAs for elephant seals. As IMMAs are equivalent processes to IPAs and IBAs and are relevant to Berkeley Sound then they should be considered.	Noted. Reference to IMMA will be included in the section. Navitas note that the IMMA overlaps with the KBA, so there is multiple non-statutory designations overlapping one another, in the context of whales, based on the same data. IMMA and KBA boundaries are subject to change, as more data becomes available, and methods are improved.	Section 7.5.2.3.5
FC 108	It is not clear why some have ticks for an Action Plan (AP) plan required and others don't. If they are identified as conservation concern, then logically all might need an AP. There is no AP currently adopted by FIG solely for dolphins, and the globally Endangered sei whale should certainly be a priority species requiring an AP. APs in the past have been for all cetacean species grouped together, and currently none are valid beyond 2018.	Comment for FIG in terms of the status of Species Action Plans identified in the 2008 State of the Environment report. Navitas can update the table with the most recent cetacean action plan.	Section 7.4.6.3.1.7
FC 109	"While a range of taxa may be impacted by an oil spill, the assessment was predominantly based upon colonial seabirds for which census data are available." This seems inadequate with regard to sei whales and southern right whales for which extensive data are now available and which are species of global and regional conservation concern respectively. The potential impacts of oil spills (in all areas but especially in coastal high-use habitats) on baleen whales is not appropriately considered in this EIS.	Navitas would contest that there is extensive data available. Metadata, such as that on the data portal, is information about data and does not contain raw data in a usable format. The baseline was constructed on published papers and data collected *via* research commissioned by Navitas. Please note: Navitas invited the respondent to a dedicated scoping consultation session (see emails on November 17th	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		and 27th 2023) and specifically asked for any data that may be considered relevant to the EIA process. The invitation to participate in scoping was declined. Please note: only MGO will be used inshore by project vessels and project activities are small in scale and duration when considered alongside all other existing activity within Berkeley Sound.	
FC 110	Cumulative impacts are very difficult to measure and are likely to be complex. It should be acknowledged that Berkeley Sound is already an intermittently busy (with vessel traffic) and noisy environment for baleen whales, and that additional noise and traffic would need to be interpreted in a cumulative and additive context with that already present. Chapter 13 essentially consists of 2 pages in which both seabirds and marine mammals are evidenced as having the highest potential exposure to cumulative impacts but are not considered further.	Cumulative impacts are challenging to appropriately assess - following suggestion from SAMS, Navitas has qualitatively colour-coded the cumulative impacts to help present the impacts and risks, whist acknowledging this is a difficult thing to assess accurately.	Chapter 13
FC 111	In the list of 'environmental aspects' for the routes that activities might interact with the environment, no mention was made about the placement of objects in the water column – such as mooring lines, ropes, chains etc. Yet these have the potential to entangle whales. This risk has not been identified in this risk assessment.	The lines that will be placed in the water for the Sea Lion project include flowlines, risers and anchor chains. All of these are substantial and solid pieces of equipment, which Navitas believe pose a very low risk of entanglement to marine mammals. However, it is recognised that whale entanglement in anchor chains does occur, so a Whale Entanglement Management Plan will be put in place. Further detail on entanglement will be included in section 10.11.	Entanglement risk has been added to all NTS summary tables, the ENVIID output tables and Section 10.11.2.2
FC 112	Under 'large dropped objects', marine mammals have not been identified as a potential receptor. It should be noted that in other sensitive areas (e.g., the Beatrice field in the Moray Firth) then MMOs and PAM have been used during anchor-handling operations to limit impacts on cetaceans. As unlikely a risk as this might seem, it is acknowledged elsewhere and cetaceans were present in the pre-watches around the Beatrice anchor-handling tugs. Consequently, this risk could be recognised here, especially when	Suction Anchors will be lowered in a controlled manner from a dedicated Offshore Construction Vessel (OCV) as will the MODU's pre-layed moorings (which will be paid out by the AHTS.) Both operations are standard offshore practice. MMOs will be aboard the vessels and shall monitor the area prior to the operation commencing. The highly unlikely risk is	Table 9.1 Section 10.1.4.2.3

Ref.	Representation	Navitas response	Changes in Rev 4
	Endangered species (sei and blue whales) might occur in the offshore oil field. It could be mitigated simply by having a dedicated crew member on the tug look for whales before deploying any large mooring anchors (or other large objects). Although that would not help if performed during the dark. Chemicals and drill cuttings and oil spills offshore – Section 10.6 and 10.7. If these affect plankton, fish and squid, then they should be considered to affect the species that predate those prey groups. Artificial lighting offshore – Marine mammals are flagged here as requiring further assessment in relation to artificial light, but then no assessment is provided in Section 10.1 beyond two sentences on P597 and one sentence in P607. It is not clear if that is the extent of the assessment.	therefore mitigated to as low as reasonably practical. The assessment results in 'Low' and 'Very low' impacts to plankton, fish and squid from chemicals, drill cuttings and oil spills offshore. As the impacts are Low/Very low, impacts up the food chain are not considered further. Additionally, the area impacted is very small relative to the whole foraging area of species up the food chain. This is a typo, marine mammals will be removed from the table in Section 9.1.	
FC 113	Inshore physical presence is relevant to whales too – it excludes them from that area. The LTVs are around 160 m long (P172) which is large, and there will be two of them at a time. It's probably a relatively small effect alone, but in the context of all the other traffic already using Berkeley Sound then it should be acknowledged, especially if the LTVs anchor in a preferred whale foraging hotspot within Berkeley Sound. Artificial Light is considered to require further assessment for marine mammals in Offshore but is not flagged here for Inshore. Even though on P592 Inshore is flagged. The potential for attracting marine mammals may be higher inshore because of the specific case of foraging sei whales inside Berkeley Sound. If Munida is attracted to light (P596) and that sei whales use Berkeley Sound as a foraging area with Munida as a key prey species (Buss *et al.,* 2019; Jackson *et al.,* 2022 in Weir, 2022), then it should be considered likely that sei whales may also be indirectly attracted to vessel lights in Berkeley Sound at night. Thus inadvertently increasing their potential exposure to noise (briefly acknowledged on P607) and vessel strike. This	Navitas calculate that the LTVs physical presence in Berkeley Sound will take up 0.004% of the area available, which Navitas does not consider to be significant. The literature will be reviewed and Section 10.1 will be updated as necessary. Of note: marine mammal occurrence will be monitored and recorded by SMMO's as stated in the EMMP.	Section 10.1.4.2.3

Ref.	Representation	Navitas response	Changes in Rev 4
	likelihood isn't highlighted anywhere in the EIS with specificity to the clear case of the sei whale–Munida situation within Berkeley Sound.		
FC 114	There is no mention of Underwater Noise or Vessel Collision associated with the FIPASS/TDF facility, even though the Table considers physical presence of vessels at those facilities and there is acceptance that vessel traffic within the port will increase in association with OGP operations. Commerson's dolphins (and pinnipeds) are very common around FIPASS and the TDF, and there is already a documented instance of a launch striking and killing a Commerson's dolphin while coming alongside at FIPASS (S. Cartwright, pers. comm). The FI Code of Conduct for Cetaceans (adopted by FIG) highlights vessel manoeuvres within ports as a clear risk for dolphin strikes. It is not clear why increase in noise and vessel strike has not been included as a risk for marine mammals here.	Noted, this will be included.	Table 9.3
FC 115	"The current schedule expects that, during Stage 1, a maximum of two LTVs will be present in Berkeley Sound for only eight months (c. August-2022 to end March-2023), which supports the target of avoiding competition for sea room during the peak fishing period" These dates have expired, and so it isn't clear what months/years the LTVs are expected to be present as part of Stage 1 now. No indicative dates are provided here for Stage 2. The stated priority for planning is to avoid the peak fishing period (P591), even though the spatial overlap with the anchoring areas used by other vessels in Berkeley Sound is minimal (Fig 11-6, P930) and March is one of the busiest months for vessel traffic in Berkeley Sound (Figure 7-118). The single best approach with regard to mitigating potential impacts on baleen whales in Berkeley Sound would be to avoid them in time (since there is clear overlap in space). The documented seasonal peaks for whales in Berkeley Sound includes Feb–Apr for sei whales and Jun–Aug for SRWs. There hasn't been any consideration presented in the EIS for timing operations around those periods to minimise impacts on two important KES species.	The dates (months and year) noted here were included in error. Timings for periods of LTV operations are not yet fixed and consideration will be given to avoiding peak periods, but operational flexibility is required. The vessel traffic associated with the LTV operation represents a very small increase on the general vessel traffic in Berkeley Sound.	Section 5.5.1
FC 116	Not clear why lighting at the TDF/FIPASS included here, when vessels used throughout the operation will visit those port facilities. Presumably lighting	**Initial consultation response:** Noted. The TDF/FIPASS will be added to the list of receptors in Section 10.1.3 [This was the consultation response].	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	at those sites (at least at the TDR) will be expected to increase significantly in association with vessel visits and onshore safety requirements.	**Post-consultation comment:** Upon further review, Navitas determined not to add these to the list of receptors as Section 10.1 assesses the impacts of light to wildlife and all ecological receptors are listed as being offshore and inshore, therefore inherently including individual sites such as the TDF etc. Human populations living near sources of light onshore are included and assessed in Section 11.8.	
FC 117	"However, despite the growing volume of research this remains an area with many uncertainties, largely due to the difficulties of observing and measuring the impact of noise on animals in the marine environment." This is correct. Yet on P1235 the EMMP indicates that 'any adverse noise-related behaviour of marine mammals' will be investigated. No information is provided on how that will be achieved in practice, given that the limitations of doing so are highlighted here on P650. See below comment for text on P1235 too.	Agreed, this is a challenge. Underwater noise measurements will be undertaken during construction (see section 15.6.2) and SMMOs will be on board vessels to observe behaviour.	N/A
FC 118	TTS is also an injury to a marine mammal. From Nowacek *et al.* (2007): "Both PTS and TTS represent actual changes in the ability of an animal to hear, usually at a particular frequency, whereby it is less sensitive at one or more frequencies as a result of exposure to sound." I.e., TTS can still compromise a cetacean's ability to navigate and find prey, so it should be included here as a potential injury. Same comment for Table 10.18 with regard to defining 'injury threshold.' "it is an offence to intentionally or deliberately disturb any marine mammal in a way which is likely to…Impair its ability to…Survive, reproduce or rear / nurture their young, and / or Migrate… [or] Significantly affect the local distribution or abundance of the species to which it belongs" With regard to noise impacts within Berkeley Sound, it will be difficult to demonstrate that noise impacts from the vessels are not affecting reproductive behaviour	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See also FIFD 54.	Section 10.4 Table 10.27 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
	(singing activity) by both whale species, potentially affecting the feeding ability of sei whales, and potentially affecting local distribution by displacing whales from important habitats. Especially considering the cumulative impacts of the LTVs anchoring in a different area to all the other vessels within BS, thus causing cumulative disturbance over a wider area.		
FC 119	"In general, sound from drilling has been found to be predominantly low frequency (<1,000 Hz) with relatively low source levels. This appears to be a somewhat best-case and old (1987) example – 'in general' would imply the need for multiple examples to support the statement. There must be more recent studies published on sound levels produced by underwater drilling? A study by Greene (1987) quoted in Genesis (2016) found that the sound generated by drilling activities from a semi-submersible did not exceed local ambient levels beyond 1 km". Kyhn *et al.* (2014) report a drillship working in similar water depths to Sea Lion producing source levels of up to 190 dB re 1 µPa (rms) during maintenance and 184 dB re 1 µPa (rms) during drilling, with noise above ambient levels to a 38 km radius around the source. This section simply does not provide enough detail on the source and sound levels relevant to this specific project in order to assess likely impacts on marine mammals.	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation. See also FIFD 54.	Section 10.4 Section 10.5
FC 120	"Recoverable injury, refers to injuries, including hair cell damage, minor internal or external bleeding. None of these injuries are likely to cause direct mortality" No, but this is a little disingenuous because a deaf cetacean (at least odontocetes) cannot catch food or navigate, so indirect mortality is a possibility if TTS extends over days/weeks. This could be more objectively presented.	Noted, this will be considered as the underwater noise sections are revised. See also FIFD 54.	Section 10.4.4.5.3.2 Table 10.27
FC 121	This is the first mention of 'received noise levels' which is not defined in Table on P654. Received sound levels is a fundamental concept in discussing impacts of noise on marine mammals and should be properly defined. "Note however, that the audiograms for most marine species remain	This will be added to the definitions. Text will be added regarding the baleen whales.	Section 10.4.4.3 Table 10.18

Ref.	Representation	Navitas response	Changes in Rev 4
	unknown and those that have been published are often derived from a few individuals under artificial conditions." While it is good that this important caveat has been mentioned, more needs to be said. In particular, in the context of baleen whale sensitivities at the NBF.		
FC 122	The cetacean groups represented here comprise three odontocetes and one baleen whale. So, two cetacean hearing groups. It would be relevant to also include audiograms of beaked whales (as a marine mammal group found in the NFB and with particular sensitivities to human noise) and of NBHF species (audiograms are available for harbour porpoises for example, as a proxy for Peale's/hourglass). Erbe 2002 given in this Figure is not cited in the EIS reference list. Assuming it is this one (https://cradpdf.drdc-rddc.gc.ca/PDFS/unc09/p519661.pdf), it should be noted that this is not a measured audiogram for the humpback whale – it is a predicted one by Houser *et al.* (2001). Another important point is that some other baleen whale species (including blue, fin and SRWs – all found in the NBHF) may be more specialised for the use of very low frequencies than the humpback whale (see P134 of Southall *et al.,* 2019), and consequently the example of the humpback whale provided in Fig 1-11 may not adequately reflect the sensitivities of those species. It would be better to use Fig 9/10 from Southall *et al.* (2019) as the best available information on hearing sensitivity in the baleen whale group. No audiograms have been measured for baleen whale species and this is a significant and widely-acknowledged data gap in understanding and modelling noise impacts on baleen whale species (see P134 of Southall *et al.,* 2019 for example). This should be mentioned at the bottom of P662 when discussing baleen whales too. It would be appropriate to label the audiograms in this Figure according to whether they are measured or estimated, to give a better indication of uncertainty. Given that baleen whale sensitivities in the NFB may be high (singing	Noted. This will be amended.	Section 10.4.4.3 Figure 10-11

Ref.	Representation	Navitas response	Changes in Rev 4
	behaviour, conservation status etc), the data available on other baleen whale species should be included here, albeit estimated/modelled. This includes right whales, which is relevant to the NFB. See references on P130 of Southall *et al.* (2019).		
FC 123	"The auditory range of species can only be determined through field observations, which are extremely difficult for free-ranging animals in the marine environment". It can be determined through field experiments but also by experiments in captivity (for porpoises, dolphins and pinnipeds). It is not possible to 'observe' an auditory range.	Noted, experiments in captivity will be added as examples as the underwater noise sections are revised. See also FIFD 54.	Section 10.4.4.4.5.1
FC 124	Blue whale should be added. Beaked whales (as a group) should be added too – its not just bottlenose whales found in the NFB but also Mesoplodon species etc, which are of concern with regard to noise impacts (recognised in Table 10.23).	Noted, this will be amended where appropriate.	Section 10.4.4.4.5 Table 10.21
FC 125	"For cetaceans, published TTS data are limited to the bottlenose dolphin and beluga whale" Incorrect, Southall *et al.* (2019) state two additional NBHF species (i.e., porpoises) which should be included here as proxies for NBHF species found in the NFB (e.g., hourglass dolphins).	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. FIFD 54.	Section 10.4 Section 10.5
FC 126	The disturbance thresholds presented in Southall *et al.* (2019) weren't evident.	These are noted in section 10.4.4.3.4.5. Please note the noise chapters are being revised and updated, see FIFD 54.	Section 10.4 Section 10.5
FC 127	"This is a realistic snapshot of the proposed project, but this could be exceeded at times if a second installation vessel or supply vessel is present" Does two installation vessels mean two simultaneous drilling operations? If so then the cumulative noise impacts for this scenario should also be modelled as a precautionary approach?	An installation vessel refers to a ship which is involved in the construction of the field, there will only be one drilling operation at any one time.	N/A
FC 128	"The sound source levels for the Phase 1 & 2 activities were estimated using published data as shown in Figure 10-12 and described in Table 10.26." The drilling operation is not actually shown in Figure 10-12 or in Table 10.26?	This section is being revised to include drilling noise in the model. See FIFD 54.	Section 10.4 Section 10.5 Section 15.6.2.1.3

Ref.	Representation	Navitas response	Changes in Rev 4
	"The anchored drilling rig when operating has a low noise output, typically some 30 dB lower than the other marine sources present (vessels on dynamic positioning or using propulsion frequently) (DECC, 2011) and will not contribute significantly to noise in the presence of the other vessels noted." It is not clear where is this information presented in the EIS along with the Genesis (2016) report. Relevant information should be provided in the EIS if the report is not public. It would be beneficial for calibrated sound measurements to be made in the field during drilling to verify this information.	Monitoring of noise offshore will be done, see section 15.6.2.1.1, which will be used to verify this information.	
FC 129	"Although there are sightings from various surveys and recordings from an acoustic monitoring study, there are currently no population estimates for any cetacean species in Falkland Islands waters. However, the available data do not indicate that the area surrounding the Sea Lion Field is home to resident populations of marine mammals or is a feeding area of overriding importance for any species." As discussed earlier, the sightings surveys are very out of date and the acoustic monitoring report presents only 5% of available data and missed singing sei whales. The "available data" are therefore inappropriate for determining the importance of the Sea Lion field for cetaceans. Independent baseline surveys should be carried out prior to making statements such as this. "Given the lack of population estimates, the proportion of the available habitat within the area of disturbance and avoidance / displacement could be used as a proxy to assess the potential impact on marine mammals. However, the habitat is not uniform throughout Falkland Islands waters and the available information indicates that many species show clear distribution patterns (Section 7.4.6.2)." These sentences lack clarity. The Sea Lion field is on the upper continental slope, an area where water depths increase – slope habitats are usually associated with upwelling, currents and topography that make them some of the most important for marine mammals globally. Indeed, an IMMA is located just north-west of the Sea Lion field. It is likely	The comment on 5% is misleading: Five percent of the AMAR data from each recorder were analysed manually by two trained analysts visually examining spectrograms and listening to audio playbacks. For Phase 1, the first 90 seconds of each 30 minute file per AMAR each day were sampled for manual analysis. For Phase 2, the middle 45 seconds of each 13 minute 45 second file was analysed. For Phase 3, the middle 45 seconds of each 12 minute file was analysed. The analysts annotated one call per species per sample for all files and AMARs to record each species in the dataset. This is a considerable amount of work. Navitas believes it has taken a precautionary approach. Also note that SMMOs will be deployed on vessels for three years pre-First-Oil and will collect data on marine mammals in the area.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	that beaked whales and some other species such as sperm whales use those slope habitats year-round, and a precautionary approach (in the absence of the necessary field research data) would consider that likely. Thus we may expect behavioural disturbance in a ~20 km radius of the field. The importance of this simply cannot be ascertained, considering the absence of targeted cetacean field studies in that area and information on exact species present, their site fidelity etc (especially with regard to beaked and sperm whales, which often exhibit quite high fidelity to regions of slope).		
FC 130	"This is not, as yet, an established part of marine vessel hire, but may form part of future environmental considerations." As part of the contracting process these mitigations could clearly be requested/implemented in order to minimise noise. Same comment for the relevant text on P680. "At present, it is not clear whether vessels operating offshore will be equipped with fixed or variable pitch propellors." As above along with same comment for the relevant text on P680. "Although speed restrictions are not proposed offshore, vessels operating in the vicinity of the Sea Lion Field are likely to be operating at low speed" With regard to sperm whales and other sensitive species, speed vessels should be considered offshore as part of collision risk mitigation. Especially at night.	All of the offshore support vessels, the FPSO and the MODU (if a DP MODU selected) will have variable pitch propellors. This will be clarified in the post-consultation EIS.	Section 10.4.5.1
FC 131	In the absence of information on the noise of the drilling being provided in the EIS, best practice mitigation could be used to check that no marine mammals are close to the source prior to its use. E.g., JNCC Guidelines, requiring a visual/acoustic monitoring period before the drilling commences. This would increase confidence that injury would not occur due to animals present close to the source prior to its initiation.	The JNCC guidelines are more for impulsive noise such as pile driving, or wells using Vertical Seismic Profiling, rather than drilling noise. It is not felt that SMMOs would be an appropriate mitigation here as drilling noise is constant rather than intermittent and impulsive.	N/A
FC 132	"It is assumed that animals would move away from the source of noise before being subject to a sound exposure level that would cause injury and therefore the impact of vessel noise is assessed as disturbance (below) rather than the potential for injury." This assumption is one often debated! For example, humans regularly undertake activities known to be dangerous,	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and	Section 10.4.4.5.3.2 Section 10.5.4.4.3.2

Ref.	Representation	Navitas response	Changes in Rev 4
	including exposure to injurious sound levels (e.g., at concerts). It is recognised elsewhere in this EIS that whales might not move away from areas where their food is concentrated (for example) even if noise is high. On that basis it would be more precautionary to also consider vessel noise in the context of potential for injury.	with consideration for the comments received. See FIFD 54.	
FC 133	"Although it is unlikely that the area under the influence of vessel noise around the Development site supports resident populations of cetaceans" We simply cannot determine if this is correct based on the paucity of targeted cetacean surveys in the NFB (and total lack of surveys that might determine residency, such as satellite tracking or photo-identification at the Sea Lion field). In terms of likelihood, objectively one could expect beaked whale or sperm whales in particular to be resident to that region of slope, based on what we know of them elsewhere. But it is unknown and this statement is unsubstantiated. A precautionary approach would assume that resident populations might be present, and work to assess that risk.	**Initial consultation response:** Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See FIFD 54. **Post-consultation comment:** The underwater noise modelling was reworked using a more recent model. The conclusions are that injury to marine mammals is not considered to be a credible possibility. Two situations were considered both inshore and offshore: a) marine mammals remaining stationary in the presence of the introduced noise, and b) the case where they flee in response to the noise. For the stationary marine mammal situation, only the VHF cetaceans (for Scenarios 1 and 3) are predicted to exceed the cumulative SEL TTS threshold. However, this would only occur if the animal remained stationary for 24 hours within (worst-case) a 0.2 km^2 area of the sound source. For all other marine mammal hearing groups (LF and HF cetaceans, and PW and OW pinnipeds), the cumulative SEL thresholds for PTS and TTS were not	Section 10.4 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
		predicted to be exceeded over 24 hours in Scenarios 1, 2 or 3. If marine mammals are assumed to flee from the noise source then marine mammal PTS and TTS thresholds will not be exceeded for any marine mammal hearing group, in any offshore scenario, provided that they swim away at a speed of at least 1.5 m/s from the vessel location. Please see the revised noise chapters for further information.	
FC 134	"In terms of species sensitivity, the low-frequency cetaceans, such as fin and sei whales (both in the LF (7 – 3,500 Hz) hearing group), are considered the most sensitive receptors." SRWs should be added here, for reasons already explained.	Noted, this will be added. Please note the noise chapters are being revised and updated, see FIFD 54.	Section 10.5.4.3
FC 135	"However, if the source was located in an area that was regarded as an important feeding or breeding ground (not believed to be the case here) the impact would be more significant" There is no data to determine that this is not the case. Or that it is the case! The data needed to support this statement simply don't exist. But what data do exist suggest is that this topic needs more attention – for example, the presence of sei whale song at the Sea Lion field in the Hipsey *et al.* (2013) report (see Cerchio and Weir, 2022) indicate that the region may be more sensitive than is being portrayed here. This is just one example, but the true importance of that area for marine mammals has not been properly investigated – another reason why baseline targeted marine mammal surveys at the site should have been undertaken.	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See FIFD 54.	Section 10.4
FC 136	A major omission here is the total lack of measured hearing range data for baleen whale species. Yet it is not mentioned? In contrast, Southall *et al.* (2019) repeatedly mention this, along with many other caveats in the extrapolations of TTS and PTS thresholds to LF species. These inherent uncertainties need to be highlighted. "With regard to the uncertainty over marine mammal distribution, previous observational and acoustic surveys give a reasonable indication of the	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See FIFD 54.	Section 10.4 Table 10.21 Section 10.5 Section 15.6.2.1.3

Ref.	Representation	Navitas response	Changes in Rev 4
	species present but further surveys would help to determine the inter-annual variation in marine mammal abundance in the area and help to resolve the status of rare species" Actually, with regard to understanding the impacts of noise on cetaceans, one of the key relevant data gaps is the residency/site fidelity of cetacean individuals/populations in the NFB, and thus their exposure time? Potentially the acoustic data could inform on that for sperm whales (for the population as a whole). But otherwise, that kind of data requires telemetry or photo-identification datasets rather than SMMOs or other visual approaches. Same comment in Section 10.4.10.1. A programme of real-time calibrated sound measurements during drilling/production/decommissioning etc would help to validate the modelling results of this EIS.	Also see section 15.6.2.1.1: noise monitoring will be undertaken at the field of day-to-day operational noise and during various vessel scenarios.	
FC 137	The introduction focuses on the anchored LTVs but there will be additional vessel traffic introduced to the Berkeley Sound and Port William areas in relation to the offshore operations which should be considered too such as launches.	There will be minimal vessels attending the LTVs once they are moored in Berkeley Sound but text will be added to describe this.	Section 5.5.1 Section 11.2.2.2
FC 138	As indicated earlier in these comments, the information provided for sei whales and southern right whales in Berkeley Sound in 7.4.6.3 is outdated, non-inclusive and does not take into account the wealth of information that has been collected during 8 years of targeted whale research. In particular, it fails to recognise that: o Endangered sei whales use Berkeley Sound as a foraging ground, with individuals remaining for several weeks continuously and returning in different years; o Southern right whale aggregations utilise Berkeley Sound for breeding and socialising between mid-May and early September; o Berkeley Sound is the only location in the world where sei whale singing (indicative of reproductive activity) has been documented to occur (Cerchio and Weir, 2022); o There is already evidence for acoustic disturbance of SRWs from vessel noise inside Berkeley Sound (Cerchio *et al.,* 2022 in Weir, 2022);	Noted, Section 7.4.6.3 will be updated accordingly.	Section 7.4.6

Ref.	Representation	Navitas response	Changes in Rev 4
	o Berkeley Sound is included as a KBA for sei whales and as IMMAs for sei whales and southern right whales. • The available data need to be thoroughly represented in Section 7.4.6.3 if that section is then going to be referred to here as the basis for understanding the 'receptors' for noise assessment.		
FC 139	Cerchio *et al.* (2022, in Weir, 2022) provide some actual measurements of vessel noise inside Berkeley Sound and in relation to some specific vessel types (although it wasn't known how far away the vessels were from the hydrophone at the time). This information is relevant to include here. They also show a decrease in SRW calls in relation to the increase in noise, which is certainly relevant to the EIS because SRWs use Berkeley Sound to breed requiring that their contact calls (upsweeps) and song (gunshots) can be heard. "Greatest sound levels occur at low frequencies typically between 10 – 300 Hz with broadband sounds predominantly below 150 Hz and in some cases below 40 Hz (Ross, 1993; McKenna *et al.,* 2012)" Its widely documented that vessel noise swamps all of the low frequencies that baleen whales use (primarily <1000 Hz) and is loud across that range. An example of this over the 0–1000 Hz range can clearly be seen in the spectrograms in Cerchio *et al.* (2002).	Noted. This will be amended. Please note the noise chapters are being revised and updated, see FIFD 54.	Section 10.5.4.4.1
FC 140	Interesting. Cerchio *et al.* (2022, in Weir, 2022) recorded actual received sound levels at a hydrophone inside Berkeley Sound peak of 130 dB RMS re: 1µPa in relation to either a reefer or a tanker and without knowing how far away from the hydrophone the vessel was. This, and lower, were sufficient to apparently impact on SRW vocal behaviour within the Sound.	Thank you for this information. Please note the noise chapters are being revised and updated, see FIFD 54.	Section 10.5.4.4.1
FC 141	These figures don't seem to represent the actual anchoring locations shown in Figure 5-5. It would be more useful to show the sound levels around the LTS at the actual mooring locations proposed rather than in the middle of the Sound? Does the 120 dB zone then extend to the south coast? This is relevant to understanding impacts on SRWs in particular, which often travel along the coasts quite close to shore.	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and	Section 10.5 Section 10.5.9

Ref.	Representation	Navitas response	Changes in Rev 4
	"As can be seen from Scenario 3 below, these noise levels are within those already experienced in Berkeley Sound." While that may be true, Figure 11-6 shows quite clearly that large portions of inner Berkeley Sound are already heavily used by anchored vessels which cumulatively probably produce noise levels that exceed the disturbance threshold (appreciating that a high-use year was shown in the Figure, but a similar pattern will be evident in other years too). The LTVs will be anchored further east, thus extending this noisy area across even more of Berkeley Sound and introducing noise into a currently less noisy area. As can be seen from the acoustic results in Cerchio *et al.* (2022, in Weir 2022), sei whale vocal behaviour is highest at the mouth of Berkeley Sound, medium in the central area and lowest in the innermost Berkeley Sound. This perhaps represents responses to vessel anchoring or differences in how the lobster krill are distributed, but either way then adding LTVs to that part of Berkeley Sound is not an impact that should be considered alone but rather cumulatively with all the other noise. Especially as this section clearly indicates that noise levels sufficient to exceed the disturbance threshold extend in a 0.5 km radius around the anchorage. There will be two LTVs, leading to a 2 km area of noise that exceeds the stated disturbance threshold in addition to all the existing noise from other vessels further west. Since foraging and breeding are key life cycle activities for the two LF-sensitive whale species then these noise levels have the potential to impact their behaviour inside Berkeley Sound in tandem with the noise already there, and this should be fully acknowledged.	with consideration for the comments received. See FIFD 54.	
FC 142	"An example, based on the worst-case scenario (Scenario 1), of received SEL(cum) for marine mammals and fish moving away from the sound source at 1 m/s over a 14 hour period is presented in Figure 10-22" A more realistic 'worst-case' scenario modelling exercise might be a sei whale that remains inside Berkeley Sound for several weeks continuously and doesn't move away at all, as has been shown by satellite tracking data (links to tracking data are in Annex 1). It would be desirable to see this modelled and presented in the EIS for transparency. Another very plausible worst-case	**Initial consultation response:** Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See also, FIFD 54	Section 10.4 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
	scenario that should be investigated would be that whales are already feeding west of the mooring area when the LTV arrives, and so they cannot move out to sea for 14 hr in response to the sound levels but rather, given the semi-enclosed nature of Berkeley Sound, would actually have to travel towards it first (increasing their exposure) before they can get past and move away. The fact that whale calls from the same animals were heard simultaneously on FC hydrophones (placed 7 km apart) indicates that LF noise within Berkeley Sound does carry over considerable distance despite the properties of inshore coastal environments. This scenario should also be modelled with regard to SEL(cum), as it is something highly likely to happen in practice.	**Post-consultation comment:** The underwater noise modelling has been reworked using a more recent model. Noise modelling undertaken indicates that the displacement thresholds are not exceeded in Scenarios 1 or 2. However, the lower disturbance threshold is exceeded such that marine mammals of all hearing groups may exhibit altered behaviour within an area of 2 km^2 around the vessels. Noise generated by the transiting vessels could lead to disturbance *via* reduced communication and reduced feeding, swim speeds and dive intervals. Berkeley Sound is known to be a feeding site for sei whales and other marine mammals. Importantly however, noise from transiting vessels will be intermittent, of very short duration and the affected area accounts for only 1.1 % of the available area in Berkeley Sound. Once the vessels have stopped, noise levels will reduce to background levels. In consequence, any additional disturbance impacts will quickly return to existing background levels. Navitas calculate that the LTVs physical presence in Berkeley Sound will take up 0.004 % of the area available, which Navitas does not consider to be significant and as such believe there is sufficient space for whales to move from the inner to outer sound without impact.	
FC 143	The legend says a 14-hr period but the x-axis only goes to 1000 m. Over 14 hr a sei whale could be 50 km away. This figure legend needs a bit of clarification as it appears to relate to distance rather than time.	Noted this will be reviewed and amended.	Figure 10-22
FC 144	See comment above. These are not the realistic worst-case scenarios for whales, and this section should be revised accordingly.	**Initial consultation response:** Noted, the underwater noise modelling is currently being re-run to more	Section 10.4 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
		accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See FIFD 54. **Post-consultation comment:** Please also see response to FC 142 above	
FC 145	Same comment here as provided above to Figures 10-19 and 10-20 (P690-691). The concern is the cumulative impact and the location of the LTVs in a more sensitive part of Berkeley Sound for sei whales. Presumably Table 10.34 is for one LTV (the figure legend should be amended. to make this clear). It would be relevant to have data added to this Table to show the realistic scenario of two LTVs at the same time – what is the cumulative area disturbance impact.	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See FIFD 54.	Section 10.5.9
FC 146	"This is similar in extent to the current level of disturbance, (estimated to be 594 m for a mid-size tanker), caused by existing shipping in the area" It's actually 65% higher.	Noted, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation and with consideration for the comments received. See FIFD 54.	Section 10.5.9
FC 147	"Importantly however, noise from transiting vessels will be intermittent and very short duration (Section 10.5.2) and once the vessels have stopped, noise levels will reduce to background levels such that any additional disturbance impacts will quickly return to existing background levels." Here, and throughout this Section of the EIS, the noise introduced into Berkeley Sound by the LTVs has been repeatedly justified using the fact that other vessels in Berkeley Sound are also noisy. There is little acknowledgement that this is two more noisy vessels in an area of Berkeley Sound that other vessels haven't been using much (but whales do). Stating that the LTV noise levels are similar to other vessels misses the point that the introduction of	When at anchor and not offloading their cargo, the LTVs will maintain one generator to keep the ship's facilities running but otherwise they will be on the anchor, weather vaning, minimising the noise they produce. When offloading they will be fully powered to enable safe operations etc. This will be acknowledged in the revised underwater noise section. Please also see FIFD 54.	Section 10.5.2.1

Ref.	Representation	Navitas response	Changes in Rev 4
	the one or two LTVs is cumulative – its additional noise, it lasts continuously for consecutive months, and it extends the existing area of noise in Berkeley Sound over an increased area. There isn't a lot that can be done to mitigate that, but not to fully acknowledge it when Berkeley Sound is a high-use habitat for two acoustically sensitive whales that have both been regularly recorded singing and calling in the area seems inappropriate. And also the fact that the LTVs will (presumably) also be present in months that have historically been quieter with regard to vessels within Berkeley Sound such as the winter months when SRWs sing and call within the Sound as part of their mating behaviour. The final sentence in 10.5.9. is the only real acknowledgement of the bigger picture in this whole section, but is not expanded upon regarding the IMMA/KBA/acoustic data/behaviour for the two whale species that emphasise the importance of Berkeley Sound as habitat for them.		
FC 148	"The status of the potential receptors in Berkeley Sound is relatively well understood, although the influx of southern right whales in the winter of 2017 (Section 7.4.6.3.1.1) highlights that unusual years do occur and long-term trends can change" As per earlier comments, the importance of Berkeley Sound for whales has not been fully represented by Section 7. The influx of SRWs in 2017 was not unusual – it only appeared so in 2017, but has since been shown to be a predictable and repeated annual occurrence that is very well-documented by both FC research and the local community. "The inter-annual distribution and abundance of marine mammals are acknowledged as a data gap" This neglects seven seasons of whale work inside Berkeley Sound (every year since 2017 except 2018) which has also routinely recorded dolphins – the inter-annual distribution of cetaceans inside Berkeley Sound is better known than anywhere else in the Falklands and is very well-documented. That information wasn't represented in Section 7.	Noted, will amend text and update references accordingly.	Section 7.4.6 Section 10.5
FC 149	"Navitas will deploy hydrophones in the Sound to record marine mammal vocalisations for 1-2 years to establish the baseline." FC has already collected three years of acoustic data inside Berkeley Sound and published initial	Regarding the analysis of only 5% of one years acoustic data, please refer to FC 129.	Section 7.4.6 Section 15.6.2.1.3

Ref.	Representation	Navitas response	Changes in Rev 4
	results (Cerchio *et al.,* 2022, in Weir 2022; Cerchio and Weir 2022). The baseline is well documented but not represented in the EIS. Additionally, only 5% of the one year of acoustic data collected as a baseline at Sea Lion (Hipsey *et al.,* 2013) has been analysed and actually used to inform this EIS. This doesn't provide high confidence in an additional Berkeley Sound dataset being used to its full potential. "Marine Mammal Observers (MMOs) will be placed on the OCVs … a review of the MMO reports will be conducted after five years and used to improve knowledge of locations and behaviour of marine mammals." The data from MMOs on OCVs occasionally visiting Berkeley Sound will be used, but the 7 years of targeted research (including satellite-tracking, acoustics, photo-ID etc) inside Berkeley Sound is largely omitted from Section 7. "Two projects studying the inshore cetaceans of the Falklands, with a focus on Berkeley Sound, have recently concluded (Weir, 2020 and 2021)." The extensive work published in Weir (2022) would be the most relevant and substantial information on whales in Berkeley Sound available to date but has been omitted from this EIS.	The EMMP workshop determined that effects of underwater noise on marine mammals inshore 'were considered by the [EMMP] workshop to be now outside the scope of the EMMP' due to the elimination of inshore ship-to ship crude oil transfers from the development plan. Nonetheless, Chapter 10.5 is being revised (Please see also FIFD 54) and SMMOs will be deployed on vessels for three years pre-First-Oil. The suggested papers will be included in Section 7.4.6.	
FC 150	In 'Impacts on wildlife' pinnipeds are given as the only marine mammal example. It should be added that cetaceans are also vulnerable to entanglement in, and ingestion of, waste materials, including the whole range of species from small porpoises/dolphins to large baleen whales. From Weir and Prieto (In Press, available on request) – "From 2013 to 2020, three instances of live entangled sei whales were reported off the eastern USA seaboard, including one animal with plastic strapping around its rostrum … In cases where entanglements limit the mouth opening to feed, or are sufficiently severe to limit mobility, they are highly likely to cause mortality. Sei whale feeding methods are non-selective, and lunge-feeding in particular can result in the accidental ingestion of non-target items including plastics and other debris. Additionally, microplastics may occur within sei whale prey species, particularly when they are feeding coastally on shoaling fish (e.g.,	Noted. This will be amended.	Section 10.10.4.1.2.1

Ref.	Representation	Navitas response	Changes in Rev 4
	Scombridae, Clupeidae and Engraulidae) which have high potential for ingesting microplastics *via* their own prey (Burkhardt-Holm and N'Guyen 2019). Plastic ingestion may be an increasing threat, with plastic debris being recently identified in a sei whale faecal sample in Chile (Buchan *et al.,* 2021). Stranded sei whales have been found with plastic in their stomachs in the UK (Baulch and Perry 2014) and in the USA (Henry *et al.,* 2020), with the ingestion directly contributing to mortality in the latter case. Additionally, microplastics are readily trapped within baleen plates and where they are a fouling risk that prevents whales feeding efficiently (Werth *et al.,* 2019)." While this text refers specifically to sei whales, literature searches will reveal extensive documentation of cetaceans with plastic ingestion – offshore species including beaked whales and sperm whales also appear particularly prone to this.		
FC 151	"Most publication however focus in the larger whales. Schoeman *et al.* (2020) found that smaller animals are also affected and recommend the establishment of a species-specific necropsy protocol and a database for smaller species as well as the larger animals." This isn't correct there is a lot of information on smaller cetaceans too (a literature search reveals many papers). A key reference that should be included here would be Van Waerebeek *et al.* (2007) who completed a review of vessel collisions on small cetaceans worldwide, as well on baleen whales in the Southern Hemisphere. "Few vessels will visit other inshore waters e.g., Berkeley Sound" This is likely over-simplistic because no doubt there will at least be tankers, and likely regular launches attending the LTVs from Stanley for a variety of reasons (supplies, customs, maintenance, crew changes, medical visits etc) as do the other vessels in Berkeley Sound. For example, project use of launches hasn't been mentioned in this EIS.	Noted, this reference will be added. Vessel visits to the LTVs while they are in Berkeley Sound will be minimal. The LTVs will likely require one crew change, one bunkering top up and one resupply each during their time in Berkeley Sound meaning a couple of PSV trips for each LTV during their stay.	Section 1.8.4.2.6.1 Section 10.11.1 Section 10.11.3 Section 10.4.1.1 Section 15.6.2.1.3 Section 15.6.2.1.4
FC 152	While there isn't legislation, there are guidelines. A Code of Conduct for Cetaceans has existed in the Falkland Islands since 2020 and has been adopted by FIG. This should be included in the EIS.	Noted. This will be amended.	Section 10.11.1.1

Ref.	Representation	Navitas response	Changes in Rev 4
FC 153	"The receptors that may be subject to the risk of collision during the Phase 1 & 2 Development include a wide range of large cetacean species that are known to occur within Falkland Islands waters (Section 7.4.6). Small cetaceans (dolphins) are fast moving and agile enough to avoid vessels travelling at moderate speed and are likely to be at greater risk from small fast-moving craft rather than those associated with the Development…For these reasons, small cetaceans are not considered further in this assessment, which explores only the risk of collisions between Phase 1 & 2 vessels and large cetaceans (whales)." We strongly disagree with these sentiments. There is a large amount of published information worldwide showing small cetaceans being injured and/or killed by vessels, including very large vessels such as ferries. We would be happy to provide a list of applicable information on request. Small cetaceans are not agile enough to avoid vessels moving at moderate speed – this is a very misleading statement, and fails to account for the fact that calves or compromised animals may not be as responsive, or that much depends on the behaviour/responsiveness of individual animals and on what the platform is doing – erratic changes in direction or speed are especially an issue, given that dolphins in the Falklands are interested in propellers and often in close proximity to them. Indeed, as an example, a Commerson's dolphin was struck and killed by a launch coming alongside at FIPASS (see below), and we are also aware of an incident with Concordia Bay. Porpoises, dolphins and whales should all be included in a Vessel Collision assessment for the Falklands, especially since all of the offshore vessels will be coming into Stanley/Port William for crew changes and supplies and so it's not only offshore waters that need to be considered. Vessel strike was in fact identified in the draft cetacean Species Action Plan (SAP) by SAERI/DOKE as a likely threat to Commerson's dolphins. "Indeed, some species, such as Peale's dolphin (*Lagenorhynchus australis*), are attracted to large vessels to bow-ride. For these reasons, small cetaceans are not considered further." Most experts agree that this behaviour increases their risk, not eliminates it. See Van Waerebeek *et al.* (2007).	Noted, an assessment of vessel collisions with small marine mammals will be included in section 10.11.	Section 10.11.1

Ref.	Representation	Navitas response	Changes in Rev 4
FC 154	There is no "current Falkland Islands Species Action Plan for Cetaceans (FIG, 2008c)" - it expired in 2018. "…identifies a number of potential threats to cetaceans but does not regard ship-strike to be a problem in the Falklands." The 2008-2018 SAP expired and not including vessel strike was an oversight by those authors and does not reflect best available evidence. Any SAP proposed now would include vessel strike – see the draft SAP for all cetaceans by SAERI/DOKE, and the sei whale SAP that is currently in preparation by FC (to be completed before December 2024, but current draft available on request). "Indeed, there are no known records of collisions between vessels and cetaceans in the Falkland Islands." And similar on P864 and P867. This is incorrect and demonstrates a lack of familiarity with available information which includes: o A launch reporting a 'bang' as it made physical contact with a sei whale in 2017 in Berkeley Sound (Weir, 2017; draft cetacean SAP, SAERI); o A near-miss between Concordia Bay and a sei whale in Falkland Sound in 2017 (Weir, 2017; draft cetacean SAP, SAERI); o A 'bang' on the hull of Golden Fleece from an interaction with a sei whale on the west coast of the Falklands in 2018 (Weir, 2018; draft cetacean SAP, SAERI); o A Commerson's dolphin killed by a launch manoeuvring at FIPASS in the mid-1990s (S. Cartwright, pers.comm.; draft cetacean SAP, SAERI); o An anecdotal account of a Commerson's dolphin being fatally injured by Concordia Bay while manoeuvring at the jetty at Port Howard; o An anecdotal account of a launch hitting a right whale on the south coast of Berkeley Sound (no damage to the launch, no certainty on injury to the whale); and o Propeller wounds on the bodies of southern right whales photographed in the Falklands (available from FC), which could have occurred anywhere in the SW Atlantic but clearly demonstrate risk. In most of these cases, vessels were actually going slow <10 knots or	Noted. Reference to the Falkland Islands Species Action Plan for Cetaceans (FIG, 2008c) will be removed. Navitas would be grateful for sight of the FC draft of the SAP and will include these records in this section.	Section 7.4.6.3.1.7 Section 10.11.4.1

Ref.	Representation	Navitas response	Changes in Rev 4
	manoeuvring at the time of the incident. Regardless of the above evidence, it is clear from the published literature that all of the cetacean species occurring in coastal waters around the FI (and many of the offshore ones) have documented injuries or mortalities from vessel strikes (see Van Waerebeek *et al.,* 2007), and that local cetacean experts (Costa, Weir) that have worked in the FI understand the risk to be real for all species not just whales.		
FC 155	"Therefore, when assessing the impact and the likelihood of cetacean collisions it is important to consider…The known behaviour of different species which can make individuals of a particular species more likely to be involved in a collision". This has not happened in the EIS. There is little recognition that: (1) both coastal dolphin species are attracted to propellers and mill around boats while they are manoeuvring alongside at jetties; (2) sei whales are feeding in the Falklands during which they can become oblivious to boats; and (3) SRWs engaged in socialising and mating are largely oblivious to boats, and Eubalaena whales are anyway particularly vulnerable to vessel strike due to their buoyancy.	Noted, an assessment of vessel collisions with small marine mammals will be included in section 10.11.	Section 1.8.4.2.6.1 Section 10.11.1 Section 10.11.3 Section 10.4.1.1
FC 156	"The size of the southern right whale population that breeds off the Argentine coast is well studied and tripled since 1999 to 2006." The most relevant information is related to the Falklands to assess collision risk. Again, there is a failure to cite appropriate sources here (e.g., Weir and Stanworth, 2019). Once more, the misleading statement about the 2017 'influx' appears. The list is ambiguous. SRWs do not "tend toward a coastal distribution" – they occur in 5000 m water depth offshore in the Argentine Basin and all over the SW Atlantic (see many satellite telemetry papers). Their coastal occurrence is linked with wintering grounds, for the remainder of the year they are pelagic. A better representation of SRW vulnerability to collision would be: o Are particularly buoyant and slow moving, so can be slower to react to approaching vessels than many other whales; o Aggregate in nearshore waters around the Falklands coast during winter (but occur offshore year-round), where high densities overlap with vessel	Noted. This will be amended.	Section 10.11.4.3.1

Ref.	Representation	Navitas response	Changes in Rev 4
	traffic (especially Berkeley Sound and Port William); o When engaged in some behaviours (especially mating and socialising winter aggregations) can become oblivious to boats; Spend prolonged periods at, or near, the surface when engaged in social/breeding behaviour, or when resting between foraging dives.		
FC 157	"While the results of photo-identification are emerging (Weir, 2022) there is not sufficient survey data to determine an accurate population estimate, although there is anecdotal evidence that the number within Falklands' waters, and more generally within the south-west Atlantic, is increasing (Iñíguez *et al.,* 2010)." There is an abundance estimate published for sei whales in one part of the Falklands (Weir *et al.,* 2020), and also minimum population sizes (from photo-ID) provided for Berkeley Sound and other areas in published reports (Weir, 2017, 2018, 2022). These have been assessed in a global context (Weir, 2021) to support the fact that FI waters support a globally significant sei whale population. In lieu of all the targeted whale work carried out on sei whales in the Islands, a paper (Iñíguez et al) has been cited that refers to only 3 sightings in the FI between 2004 and 2008 as evidence that the species is increasing here. • "With regard to their behaviour, while there are records from around the world of collisions between sei whales and vessels (IWC database, 2014) they are considered to be at lower risk than most other large whale species (Vanderlaan and Taggart, 2007). This is primarily because they: Appear to respond to approaching vessels, Are relatively fast swimmers, and Tend to swim just below the surface leaving a clear trail of 'fluke prints' in their wake (Sea Watch Foundation, 2012). It should be noted that elsewhere in the world sei whales are considered to be an offshore species; however, in the Falklands this species is associated with relatively shallow inshore waters." We strongly disagree with most of these statements, which are outdated and relate to sei whales in other regions rather than in the Falklands. It should be realised that the work in the Falklands (and a couple of other geographic locations) is some of the first extensive field research carried out on sei whales anywhere globally, and lots of these misconceptions will be	Noted. This will be amended.	Section 10.11.4.3.2

Ref.	Representation	Navitas response	Changes in Rev 4
	rectified in the coming years. Reviews of sei whale collisions can be found in Prieto and Weir (2022) and Weir and Prieto (In Press, available on request). The fact that there are documented vessel strikes both globally and in the FI means that they don't always respond to vessels. While they can be fast swimmers, they can also be very slow. See Segre *et al.* (2021) for examples of slow skim-feeding in the FI. It is not clear what relevance the 'fluke prints' have, but they often appear at the surface 100s of metres away from where the animal actually is. There is little point in comparing sei whale behaviour in the North Atlantic and North Pacific (where many of these perceptions come from) with that in the FI, because sei whales in those areas generally use pelagic offshore habitats. Whereas sei whales in the FI also intensively use nearshore areas, where overlap with human activities is far higher. A better representation of sei whale vulnerability to collision would be: o Occur in high densities in nearshore waters during summer and autumn, including in Berkeley Sound; o Use nearshore waters as a foraging habitat, where their focus on feeding may make them less responsive to vessels; o Are especially vulnerable when surface skim- and lunge-feeding (Segre *et al.,* 2021) when they spend prolonged periods moving slowly near the surface; o Often behave unpredictably, making them difficult to spot and avoid by vessel crews.		
FC 158	"While there are limited data regarding cetacean distributions around the Falkland Islands, there is some very detailed information regarding shipping movements, although this has only been recorded since June 2014." Limited information offshore, but there is now a wealth of information in the nearshore waters…including in the shipping routes. See published literature.	Noted. This will be amended.	Section 10.11.4.4.2
FC 159	"With regard to the overlap in vessel activity and cetacean distribution, the distribution of right and sei whales in particular is not well understood (Section 10.11.4.3). However, the fact that both are sighted within the NFB, Berkeley Sound and near Stanley Harbour year-round suggests that these species have spatial and temporal patterns of distribution, which overlap	Noted. This will be amended.	Section 10.11.4.5

Ref.	Representation	Navitas response	Changes in Rev 4
	with shipping activity." Those are two species for which the distributions (at least coastally, but also some offshore data from telemetry) are actually particularly well understood. Their overlap with shipping is a fact, not a suggestion. See published literature.		
FC 160	This again overlooks support/supply vessels such as launches used during this project for moving supplies etc between Stanley Harbour and the LTVs.	Vessel visits to the LTVs while they are in Berkeley Sound will be minimal. The LTVs will likely require one crew change, one bunkering top up and one resupply each during their time in Berkeley Sound meaning a couple of PSV trips for each LTV during their stay.	N/A
FC 161	The existence of Falkland Islands-specific guidelines (adopted by FIG) since 2020 has been omitted here.	Noted, this will be added.	Section 10.4.1.1 Section 10.11.3 Section 15.6.2.1.3 Section 15.6.2.1.4
FC 162	"As part of Navitas' operating procedures, speed restrictions will be applied to vessels entering the boundary of the inshore proposed Marine Managed Area (pMMA); as vessels approach the inshore pMMA boundary line the maximum speed permitted will be ≤10 knots. Additionally, vessels generally will only transit the Sound during daylight hours, with daylight-only berthing and night-time departure by exception only." 10 knots is fine to reduce collision risk, but the EIS also refers to 8 knots in places e.g., P865. For clarity please can you confirm – is it ≤10 knots at the pMMA line but then further reduced to ≤8 knots in Berkeley Sound (defined as west of the Vol Pt-Mengeary Pt line). Ideally, it would be desirable to maintain speeds of ≤10 knots in Port William too between (at least) 1 June to the end of August in order to reduce the likelihood of injurious SRW strike (sei whales are uncommon inside Port William) – perhaps this is already covered in the areas above?	That is correct, vessels will reduce speed to 10 knots at the pMMA boundary, and then down to 8 knots in Berkeley Sound (west of the Volunteer point - Mengeary Pt line). Navitas will amend the text in the EIS to clarify that vessel speeds will also reduce to ≤10 knots within Port William.	Section 10.11.5 Section 10.11.7
FC 163	"With regard to the sensitivity of each receptor, southern right whales are considered to be susceptible due to their behaviour (Section 10.11.4.3.1)." Both species are susceptible due to their behaviour – surface feeding sei whales are just as susceptible as SRWs. •"This species is listed as 'Least Concern' by IUCN." Yes but the SW Atlantic	Noted. This will be amended.	Section 10.11.4.3.2 Section 10.11.6.1

Ref.	Representation	Navitas response	Changes in Rev 4
	population is of regional conservation concern (see earlier comments re. IWC-CMP). •"However, vessel speed will decrease and watch-keeper vigilance will be heightened as vessels approach land in response to the increased risks of navigating in coastal waters, which increases the likelihood of detecting and avoiding cetaceans" Even the most vigilant of watch-keepers cannot see at night. It should be noted that inshore SRW aggregations form in winter when daylight hours are the least and it will be too dark to detect whales visually for 16 hrs in each day. The reduction in vessel speed is the main thing. •This section omits any consideration of sperm whales. Sperm whales are regular in offshore waters of the FI, are an IUCN Vulnerable species, and are another species whose behaviour (long periods of logging at the surface between deep foraging dives) makes them particularly vulnerable to ship strike. See for example https://journal.iwc.int/index.php/jcrm/article/view/446		
FC 164	"In addition to the lookouts posted on the forecastle of the vessels as already referred to in Section 10.11.5" There is no mention of this in Section 10.11.5? Was it deleted? Is it still happening?	Lookouts are noted in 10.11.7, this will be re-worded and refer to the correct section.	Section 10.11.6.2
FC 165	It is not clear on what basis 'unlikely' has been determined for collisions in offshore waters. The data on offshore cetaceans don't exist to support that. And there has been no consideration of sperm whales, which were the most common species acoustically detected at the Sea Lion field suggesting they are relatively common there (acoustic findings in Hipsey *et al.,* 2013) and are also vulnerable to ship strike due to their behaviour? This should be amended. to 'Possible.' "The introduction of a 10 knot speed limit for the Falklands pMMA, in line with NOAA guidelines, is already considered as industry standard mitigation (Section 10.11.5)" Section 10.11.5 actually said that there wasn't any industry-standard mitigation?	Section 10.11.5 (Industry standard mitigation). states: 'As part of Navitas' operating procedures, speed restrictions will be applied to vessels entering the boundary of the inshore proposed Marine Managed Area (pMMA); as vessels approach the inshore pMMA boundary line the maximum speed permitted will be ≤10 knots.'. The initial impact assessment listed the likelihood of collision inshore as 'Possible'. However, Section 10.11.7 (Project-specific mitigation) states: 'To further reduce the risk of collisions in inshore waters, Navitas will limit vessel speeds to under 8 knots within Berkeley Sound.' In line with this the likelihood of occurrence is reduced to 'Unlikely'.	Section 10.11.5 Section 10.11.6.1

Ref.	Representation	Navitas response	Changes in Rev 4
		Further, 'Unlikely' has been applied as while whale strikes have occurred previously in the industry , there were none during previous exploration campaigns in the Falkland Islands in the same area. A number of controls would have to fail for this to occur (i.e., no watch keeping, not following speed restrictions etc.). Please refer to 10.11.6.1. Therefore, Navitas stand by the assessment. This section will be revised to include sperm whales.	
FC 166	"Additionally, during transit in Berkeley Sound, there will be two qualified Seabird and Marine Mammal Observers (SMMOs), most likely posted to the OSVs and they will advise the Ship's Master on the bridge of the need for evasive action. The OSVs are the most common vessels transiting Berkeley Sound to pick up equipment from the LTVs." Again, this doesn't take into account other vessels like launches that might be running to/from the LTVs, and it doesn't help at night. As stated above, vulnerable inshore aggregations of SRW occur in winter when night comprises two-thirds of a 24 hr period and MMOs will only be effective for the other third. These extra efforts are appreciated, but the reductions in vessel speed are the single most effective method especially in winter. • "Mariners should be made aware of the issue and how it relates to the Falkland Islands, educational materials, such as posters, will be produced to be displayed on the bridge of contracted vessels (see IFAW (2013) see Figure 10-50 below for example)" FC has already produced a poster (in Spanish and English) in liaison with Fortuna that outlines the Code of Conduct for FI waters and is available for use for awareness etc. Please contact us if you would like a PDF or to modify that to suit. • "On all vessels a lookout should be posted while transiting areas of high cetacean abundance" This is rather ambiguous. How are areas of high cetacean abundance going to be determined in real-time, and who is going to be the lookout? And of course this is no use at night.	It is agreed that the speed reductions are the most effective mitigation here. Thank you, Navitas would appreciate the information poster for distribution on project vessels. The Falkland Islands Code of Conduct will be followed and added to this section. In terms of reporting, this will be discussed and agreed with FIG.	Section 10.4.1.1 Section 10.11.3 Section 15.6.2.1.3 Section 15.6.2.1.4

Ref.	Representation	Navitas response	Changes in Rev 4
	• "If whales are spotted, speed should be reduced and animals given a wide berth." FI guidance should be followed to specify these distances. See the FI Code of Conduct. • "In addition to Navitas incident reporting and investigation, any incidents of collisions with marine mammals will be reported to FIG and the IWC" It would be nice if FC could be included in this loop, as the main organisation working with whales in the FI and producing Code of Conduct guidance. Near-misses (i.e., where whales pass <50 m from a ship, or where ships make diversions to avoid them) should also be logged/reported, in order to better understand risk. Same comment for P868. Additionally, FC may be able to attend dead whales floating at sea in the Berkeley Sound area (or subsequently washed up) and properly assess the nature of the injury, which could be useful to inform future risk assessments for industry.		
FC 167	"SMMOs coupled with the reduction to 8 knots within Berkeley Sound will reduce the likelihood of collisions between cetaceans and vessels from 'Possible' to 'Unlikely'." Most of the collisions evidenced in the inshore FI to date have been at low speed or while vessels are manoeuvring (see previous list). So the likelihood of contact is probably slightly decreased by reducing speed, but the chances of that contact then resulting in serious injury/death is what is significantly reduced. As such, this should probably remain 'Possible' (it makes no real difference to the assessment outcome anyway). As mentioned before, SMMOs might be reasonably useful in summer when daylight is long, but in winter their effectiveness is greatly limited by darkness.	Noted, no amendments proposed.	N/A
FC 168	"Sei and right whales are a common sight throughout the inshore waters of the Falklands during the summer and autumn but a complete survey is yet to be undertaken." Again, omission of eight years of data in inshore waters, including Berkeley Sound. Inshore SRWs are in winter, not summer. And again, what about sperm whales in the Sea Lion area, whose vessel collision assessment has not been mentioned.	Noted. The text will be amended. accordingly.	Section 10.11.4.3 Section 10.11.10

Ref.	Representation	Navitas response	Changes in Rev 4
FC 169	Small cetaceans and vessel collision risk inside Stanley Harbour at FIPASS/TDF both need to be considered in this Table, since dolphin mortality from vessel strike has been documented within Stanley Harbour.	Noted, see FC 153 above.	N/A
FC 170	Since fur and feathers were tested here, it could have been possible to also include baleen plates testing here, as mentioned on P1057. See Werth *et al.* (2019) for experiments with oil on whale baleen.	The EMMP workshop (April 2019) noted that 'The risk to marine mammals may lie in those whales that feed on the surface using baleen, but no data exist to assess the risk, and experimental evidence might be unethical to collect.' Given difficulties in trying to import seal pelt to the oil testing laboratory in France, Navitas imagines it will be very difficult to preserve whale baleen plates and transport them to the laboratory for testing. Navitas will review the Werth *et al.,* paper and incorporate into the EIS, but notes that Sea Lion is far from a typical crude so experiments with Sea Lion crude might yield different results.	Section 12.1.4.2.5.2
FC 171	The sei whale KBA is mentioned here, but the IMMAs are not.	Noted, the non-statutory KBA and IMMA will be added.	Section 7.5.2.3.5
FC 172	"Each recovery unit would have a boom encounter width of 15 m and a single skimmer capable of recovering 30 tonnes per hour (if that much oil is encountered by the boom) and could operate at a wave height of up to 2 m" Perhaps some information should be added here to clarify what proportion of time at the Sea Lion Field over a year has wave heights less than 2 m where recovering spilt oil would be plausible. Is there a Plan B for when it isn't? Would the incoming recovery vessels from South America/Africa have capacity to operate in higher sea states?	Thank you for your comment. Appendix 2 of the preliminary OPEPS identifies the oil spill response assets for each stage of the Sea Lion Development Phase 1 & 2. Oil spill response vessels can operate in high sea states, but they are reliant on the deployment of dedicated spill response equipment. As such the attendant vessels are not the limiting factor. According to the 'Metocean Criteria for the Sea Lion Development. Vol 2 ' (Premier Oil, 2015), wave height will exceed 2m *c.* 55% of the time. Therefore, mechanical recovery will often be challenging in South Atlantic sea states.	Section 5.11.1.2.3

Ref.	Representation	Navitas response	Changes in Rev 4
		However, as detailed both in the EIS and the Preliminary OPEPs, laboratory tests (by CEDRE) indicate that, given the nature of the Sea Lion crude, allowing for weathering and natural dispersion may often represent the optimal response approach and this will occur faster in the very metocean conditions which could prevent deployment of the response equipment. Recovery equipment will be available on station and would be deployed whenever conditions allowed. Please refer also to ED 190.	
FC 173	"Although the assumed response has a very modest effect and recovers 6.3 % (2,231 tonnes) of the oil…" At only 6.3% recovered, 'low/poor' might be a more realistic description.	6.3% is at the upper bound of actual recovery rates experienced during a review of 30 large oil spill incidents - Etkin and Nedwed (2021), which concluded that 2-6 % mechanical recovery is experienced in practice.	N/A
FC 174	Endangered blue whales are forgotten again. • "…marine mammals are not considered significantly at risk due to the semi-solid nature of the waxy crude…" Not sure why this makes them not at risk, since lunge- or skim-feeding baleen whales could presumably ingest such matter due to their indiscriminate feeding techniques. • The areas mentioned in 'Coastal' are also part of a KBA, and two IMMAs for whales which is not acknowledged. In particular, this area is used heavily by SRWs during winter.	Navitas will update the text accordingly.	Table 1.3 Table 7.57 Section 7.5.2.3.5
FC 175	The colour coding and overall risk assessment values used in these Tables is very confusing because it isn't clear why the final column has completely different verdicts to the descriptive text. Presumably this has been described somewhere in the preceding 1100+ pages, but it's not reasonable to have expected people to memorise it. The Table legends should make it clear why this is or refer the reader back to the relevant section with the explanation. As it stands, it is very difficult to comprehend	Navitas is not entirely sure it understands the concern raised. There is no expectation for the reader to memorise any text, but the basic methodology is outlined clearly in Chapter 8. Table 12.9 shows the risk assessment of a subsea blowout. This is tabulated owing to the number of receptors considered. There are no conclusions on this in the preceding text. The	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		table first indicates the impact (sensitivity of receptor x severity of effect) should it occur, which may be, for example, Moderate, and then factors in the likelihood of the blowout occurring which lowers the overall risk. The narrative preceding the table (Section 12.1.6.1.3) simply indicates the worst-case risk identified.	
FC 176	How is it possible that terrestrial tourists possibly noticing a small amount of oil on the coast (described as being 'very unlikely to come to their attention') is deemed to be of 'Moderate risk significance', but marine mammals that live in the immediate area of a spill are deemed 'Very Low risk significance'. This allocation of relevant importance should be reconsidered.	**Initial consultation response:** This will be revisited and the sensitivity of the marine mammals revised upwards. The high sensitivity assigned to tourists is based on the perception of an oil spill, which may impact the tourism economy. **Post-consultation comment:** Navitas has re-examined this concern and stand by the original assessment. The marine mammal sensitivity is high in the coastal region but is lower offshore as there is less potential for actual exposure to a crude spill given the space available. The assessment in relation to tourists is based upon their sensitivity to the negative *perception* of a spill rather than about them ever having sight of an oil spill, should one occur.	N/A
FC 177	"Cetaceans are more vulnerable to inhaling toxic vapour and are less affected by contact with the skin (Section 12.1.4.2.5)." The text in Section 12.1.4.2.5 does not support this statement – it merely describes both possibilities and does not assign relative importance. Recent papers from the Deepwater Horizon spill show that oil can adhere to cetacean skin, with unknown effects. Same comment as Table 12.11 re. how the overall risk significance can be deemed higher for land-based tourists than it is for Endangered marine mammals at the actual spill site.	Thank you for your comment. This is noted and the text will be clarified, the very different nature of the Sea Lion crude to that of the Deepwater Horizon means it is likely to have a different interaction with marine mammals, where ingestion is more likely. Please see FC 176 above.	Section 12.1.4.2.5.2

Ref.	Representation	Navitas response	Changes in Rev 4
FC 178	"There is no indication that the presence of a rig attracts associating marine mammals, although they could be attracted by potential prey species that may shelter near the rig." Incorrect, evidence is available online, for example: o Delefosse M, Rahbek ML, Roesen L, Clausen KT. Marine mammal sightings around oil and gas installations in the central North Sea. Journal of the Marine Biological Association of the United Kingdom. 2018;98(5):993-1001. doi:10.1017/S0025315417000406 ohttps://onlinelibrary.wiley.com/doi/full/10.1111/gcb.16134 ohttps://periodicos.ufsc.br/index.php/biotemas/article/view/2175-7925.2009v22n3p247	Text will be amended to include indirect impacts.	Table 12.13
FC 179	"While Oil Spill Response (OSR) equipment will be carried on the ERRV / MRSV and AHTS / ERRV offshore …in reality it is unlikely to be effective in the prevailing offshore weather conditions of the Sea Lion Field…oil spill response is not considered effective in respect of the largest events" Much of the discussion of OSR earlier can be negated by this statement that it would be ineffective.	While prevailing metocean conditions are likely to limit opportunities for effective deployment, Navitas is committed to ensuring that appropriate oil spill equipment is available so that in the unlikely event of a spill every effort can be made to minimise its impact.	N/A
FC 180	Same comment about terrestrial tourists being categorised of higher residual risk significance than Endangered marine mammals that are present at the immediate site of the spill.	**Initial consultation response:** This will be revisited and the sensitivity of the marine mammals revised upwards. The high sensitivity assigned to tourists is based on the perception of an oil spill, which may impact the tourism economy. **Post-consultation comment:** Please see response to comment FC 176.	N/A
FC 181	"The seasonal distribution of potential receptors in the NFB is reasonably well understood but further research is required to improve our knowledge of species distributions, and these are acknowledged as data gaps" We disagree, the seasonality of cetacean receptors at the NFB is not well understood.	Reasonable is a relative term and there are data from the field from at sea surveys and indeed PAM. A precautionary approach has been taken in the assessment where there are gaps.	N/A
FC 182	Apart from marine mammals being listed as a potential receptor in the list in 12.2.3, and the summary in Table 12.23, there seems to be no actual	The sensitivity of the receptor (marine mammals) is rated 'High' as 'A species with IUCN Endangered of	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	detailed consideration of the potential impacts of a marine diesel spill on marine mammals in Berkeley Sound. In Section 12.2.4.2 then it states that the majority of receptors have been considered in the offshore oil spill section (12.1), but this isn't adequate for marine mammals because the sensitivity in Berkeley Sound is significantly higher. The Sound is both a KBA and an IMMA based on its whale sensitivities, and foraging Endangered sei whales would be directly exposed and also indirectly exposed because oils accumulate within prey species (Werth *et al.,* 2019). The modelled spill areas in Figs 12-45 and 12-46 overlap with whale foraging areas.	Vulnerable status has notable presence in the zone of influence of the project'.	
FC 183	The fin whale hotspot fallacy in Berkeley Sound is repeated again here. However, southern right whales need to be added here as a KES in Berkeley Sound, as a species of regional conservation concern. • "Although it is possible that MGO from a spill of this size will not come into direct contact with any marine mammals, which occur in relatively low densities, this is not certain" This is incorrect. Berkeley Sound supports high densities of sei whales and SRWs. It would be surprising if a MGO spill inside Berkeley Sound did not come into direct contact with a marine mammal. • "Given the modest volatility of MGO, marine mammals could be susceptible to inhaling hydrocarbons upon surfacing to breath" In fact one of the most likely impacts would be accidental ingestion while sei whales are lunging or skimming to capture prey, both at the surface and subsurface. Same comment for Table 12.2.4 (P1166).	Section 7.4.6.3.1.6 (Fin whales) states that 'There are two apparent hotspots of fin whale sightings in inshore waters; one to the west of the Islands and the other in Berkeley Sound (Frans and Augé, 2016).' However the narrative goes on to state that Weir *et al.* (2017) refuted this as mistaken sightings. Southern right whales are also listed in Section 7.4.6.3.1.6. The sentence will be amended. to remove 'relatively low densities'. Section 12.1.4.2 details the nature of the impact to the key receptors of an oil spill. Section 12.2.4.2 describes the nature of the impact to additional inshore receptors. Section 12.1.4.2.5 (on marine mammals) will be updated to include ingestion of oil during lunge feeding as an example (should references be available for this) and Section 12.2.3 will be updated to refer specifically to the common receptors described in 12.1. [A recent set of tests involving whale baleen and six	Section 12.1.4.2.5.2

Ref.	Representation	Navitas response	Changes in Rev 4
		petroleum-based oils (Werth *et al.,* 2019) indicated that whale baleen is oleophobic and does not adsorb oil, and that oil is readily rinsed from the baleen by flowing water. There was minimal wrinkling or peeling of the baleen's cortical keratin layers in the tests and filter porosity was not appreciably affected. Oil ingestion risks remain although particle capture studies suggest potentially greater danger to mysticetes (baleen whales) from plastic pollution than oil.] Werth Alexander J., Blakeney Shemar M. and Cothren Adrian I. 2019Oil adsorption does not structurally or functionally alter whale baleenR. Soc. Open Sci.6182194 http://doi.org/10.1098/rsos.182194	
FC 184	"Should the monitoring of impacts indicate that the significance of the impacts and risks predicted in the EIS are not appropriate, and / or that mitigation is not effective, a revised mitigation measure and / or monitoring regime will be required." This may not be realistic. It is not clear how quickly monitoring would show impacts and how quickly after that would something change to address those impacts.	Regular review of the monitoring programme and results of the monitoring will be undertaken to see if any trends are emerging and the EMMP adapted accordingly.	N/A
FC 185	It is not clear how seabirds have ended up being rated as higher sensitivity to underwater noise than marine mammals. This doesn't make logical sense.	Seabirds are considered as having 'High' sensitivity. Initial impact to marine mammals assessed as 'Moderate' (sensitivity 'High' x severity 'Minor'). This demonstrates two ways in which the assessment leads to an EMMP action, either through high sensitivity coupled with uncertainty (in this instance seabirds) or through significant impact coupled with uncertainty (marine mammals), see Section 15.3.1.	N/A
FC 186	"Marine mammal observations prior to and during operations at the Sea Lion location and on Transits" Is the 'prior to' going to involve some targeted marine mammal surveys before anything happens? The data gap regarding	In accordance with the EMMP, SMMOs will be on board a number of the Sea Lion Offshore Assets. They will join the assets once they are on hire and in the	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	offshore cetacean occurrence at the Sea Lion field is a quite considerable one, and the little data that does exist is old.	area. The AHTS will commence their operations prior to the arrival of the MODU and SMMOs will be on board at this time.	
FC 187	The information in this Table is rather vague and it isn't easy to understand what is being proposed. But some of these are over-ambitious and unlikely to actually be achievable in practice. For example, "Investigate - Any adverse noise-related behaviour of marine mammals". There should be a plan/idea as to how that will be assessed before the surveys start, so that data collection can be steered accordingly. Identifying cetacean behavioural changes and linking them to an activity is extremely difficult and even dedicated research studies with ample resources and personnel often don't manage to do it (see all of the conflicting literature on marine mammals and noise impacts). And it takes a lot of time (several years) because of the need for adequate sample sizes to prove cause-effect. The likelihood of a behavioural response being identified by two SMMOs who aren't located on the noise-generating platform is virtually negligible. Also, the stated management action of "Scale back noisy activity" isn't viable – as part of the environmental approach then the project should already have scaled back noisy activities to the lowest levels needed to achieve the project goals, as that is standard industry best practice (and the ALARP approach stated in this EIS). "Adjust timing of operations" is also likely to be unrealistic in practice because industrial operations are constrained by weather and availability of platforms (and associated costs). We don't have better suggestions for handling this, the fact that offshore marine mammals will be disturbed by noise is probably a given side-effect of the project. But we do think that the stated Management Thresholds and Actions won't be achievable in practice with the resources that are being applied. • This table relates to 10.4 Offshore underwater noise. Where is the table for Inshore underwater noise and consideration of impacts in the sei whale foraging ground in Berkeley Sound? Especially the cumulative impacts? Why isn't this in the EMMP?	Navitas believes that noise generating activities have been avoided or scaled back as far as is reasonably practicable. The summary EMMP tables were prepared in discussion with stakeholders in the April 2019 EMMP workshop. The published workshop report notes that 'once the FDP has been approved and sanctioned, the EMMP will be transferred into a live document which will provide detail on: - Specific roles and responsibilities - Timelines, deadlines and 'frequency of execution' for actions identified - Progress and completion throughout the life of the field.' The workshop report proposes that an advisory committee including individuals with relevant expertise in the subjects being monitored will help draw up the specifications in any scope of work...and would also be able to comment on the results of the monitoring.' The EMMP workshop determined that effects of underwater noise on marine mammals inshore 'were considered by the [EMMP] workshop to be now outside the scope of the EMMP' due to the elimination of inshore ship-to ship crude oil transfers	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		from the development plan. Nonetheless Chapter 10.5 is being revised. Please see also FIFD 54.	
FC 188	• "SMMOs on board vessels periodically covering all seasons with particular focus at the time of year when animals are concentrated in the area of ship movements." It is not clear what this means. There are few data available for the NFB to show when animals would be concentrated in the area of ship movements. • "Reaction - Reduce vessel speed near marine mammals not attracted to the vessel" This is not clear. Presumably, if they are attracted to the vessel then they would be at higher risk of collision not lower. It would be better to simply commit to following the existing FI Code of Conduct which makes these things much clearer – dolphins approaching the vessel do not result in a reduction of speed but it is requested that vessels maintain their heading (or amend it only slowly) while there are dolphins around the vessel so that the animals have time to respond and maintain distance from the propellers. Also, something needs to be added here regarding vessels coming alongside at FIPASS/TDF with regard to dolphins, because there will be Commerson's dolphins in that area likely to approach the vessels while they manoeuvre alongside and already a documented example of a dolphin being killed during one such manoeuvre. • "Adaptation - Add marine mammal detection systems (e.g., infra-red camera systems); adjust timing of operations; consider use of deterrents" This would need to be tested on higher whale densities in Berkeley Sound probably before accepted as viable offshore. Reliable mitigation for vessel collision is currently to reduce overall speed and avoid sudden changes in both heading and speed. A commitment for project vessels to follow the existing Code of Conduct would address a lot of this.	Navitas will amend the EIS text to ensure that it refers to the Cetacean Code of Conduct and Navitas' commitment to adhere to it for all cycles of the Sea Lion Phase 1 and 2 Development. Navitas notes that it is already committed to vessel speeds in Berkeley Sound and Port William that are lower than those recommended by the Code of Conduct.	Section 10.4.1.1.1 Section 0 Section 10.5.7
Falkland Islands Company			
FIC 1	Sea Lion Environmental Impact Statement We have reviewed the above document and congratulate Navitas Petroleum on the breadth and depth of the analysis carried out, particularly as regards the potential impact of the project on Stanley and Berkeley Sound.	Thank you for your comments.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	While everyone would prefer that fossil fuels are eliminated sooner rather than later, it is generally accepted that they will continue to be required for the foreseeable future. Given this backdrop of demand, it is clearly better that oil continues to be supplied by responsible democracies, rather than leaving it to less desirable regimes around the globe. It is also notable that the Falkland Islands can help the UK maintain its energy security in a time when North Sea production is declining. The development of these oil reserves will also help to secure the financial future of the Falkland Islands by both directly and indirectly boosting the economy. Clearly, there are a number of further steps to go through as part of ensuring that the development is delivered responsibly, but we are encouraged by the thoroughness of the environmental impact statement and remain supportive of the process.		
Falkland Islands Fisheries Department			
FIFD 1	the following statement is unclear: << A mismatch in bathymetry and currents data can result in 'dead zones' near the seabed, which could adversely affect subsea discharges.>> Presumably, what was meant is that mismatch adversely affects the modelling of subsea discharges - ?	Thank you for the comment. The bathymetry in the area is well understood. The Sea Lion area was mapped using multibeam techniques as described in : Rockhopper Plc.,2012. Sea Lion Development Environmental Baseline Survey Scope of Work, 25-Jan-2012. Rockhopper Exploration Plc. Document Rev03 120125. Gardline. 2012. Sea Lion Field Development. North Falklands Licence Areas. PL032, PL033 and PL04. March and April 2012. Environmental Baseline Survey Report. Prepared for Rockhopper Exploration Plc. Reference: 9030.1. The FIFD 1 quote is taken out of context of the wider	Section 7.3.5.4

Ref.	Representation	Navitas response	Changes in Rev 4
		EIS narrative, the whole section states, "The bathymetry data supplied by BMT is precisely the same data that was used in the hydrodynamic modelling to produce the ocean currents dataset as discussed in section 7.3.3. This is important since it results in a perfect match between bathymetry and seabed currents data. [This is important to note because if there were] A mismatch in bathymetry and currents data can result in "dead zones" near the seabed, which could adversely affect subsea discharges."	
FIFD 2	<<…most likely to interact with oil and gas activity in Berkeley Sound, is the giant kelp…>> Why?	As stated, in 7.4.2.2.1.1, this is because 'This species is one of the largest (growing up to 60 m in length) and most abundant of the brown algae found around the coast of the Falkland Islands (van Tussenbroek, 1989).'	N/A
FIFD 3	<<Tree Kelp … have an order of magnitude greater biomass than Giant Kelp (*Macrocystis pyrifera*). If confirmed, … (P. Brickle *pers. comm.*)>> So how well is the biomass known?	*Lessonia* spp. are likely to have a biomass that is an order of magnitude greater that Macrocystis. This is based on observation and also what is known about Macrocystis biomass. However the biomass of Lessonia remains unknown.	N/A
FIFD 4	<<[Green algae] are anecdotally highly diverse and will be subject to study on how refugia (like the Falkland Islands) in the last glacial maximum contributed to this diversity>> Will be subject to study by who? Study in relation to oil?	This is part of the baseline description and provides context. The work is part of a PhD studentship and also a collaboration with South American Institutions and BAS. A reference will be added to the post-consultation EIS (Emma Beaton, 2019)	Section 7.4.2.2.2
FIFD 5	In the second paragraph, this sentence seems to be incomplete: << This suggests that of those taxa with a 50 % or greater predicted probability of being present in the area, are likely to be low density (not in aggregations) and / or rare, given that they went undetected in the Gardline (2013a) survey. >>	This will be amended to: This suggests that of those taxa with a 50 % or greater predicted probability of being present in the area, these taxa are likely to be low density (not in	Section 7.4.3.2.3

Ref.	Representation	Navitas response	Changes in Rev 4
		aggregations) and / or rare, given that they went undetected in the Gardline (2013a) survey.	
FIFD 6	<< This study will inform a marine invasives species monitoring program, as recommended at the EMMP workshop. >> Any information on the scope or timeline of the monitoring program?	See Section 15 EMMP for further details on monitoring.	N/A
FIFD 7	<< … parts [of NS] are heavily trawled throughout the year for finfish and skates. >> Skate trawling is no longer active.	Thank you for your comment. This is noted and agreed. Skates are no longer targeted but are caught as by-catch. The narrative will be amended for clarity.	Section 7.4.4.2.1.1
FIFD 8	<< The abundance of southern rock cod has increased several-fold in recent years, and it is currently the most abundant finfish on the Falkland Islands shelf and has become one of the most important finfish fisheries in the Falkland Islands (FIG, 2013c). >> This is obsolete. Rock cod has decreased considerably since 2013, and it is no longer the most abundant groundfish or important catch.	Noted and agreed. Hake is the most abundant. Rock cod still remain important but are not reported as by catch accurately. The text will be amended for clarity.	Section 7.4.4.2.3.2
FIFD 9	<< Although the JNCC Seabirds At Sea Team (SAST) surveys are 24 years old, it is unlikely that broad-scale animal distribution and movement patterns have changed significantly. >> It is important to stress that SAST seabird & marine mammal data was not only collected opportunistically, but were mostly recorded by a single observer (White et. al, 2002). In addition, throughout the years ecosystem changes have occurred, fish stocks have reduced, megafauna populations have recovered, and interactions with offshore human activities have increased. Considering the Falkland Islands are a hotspot for seabirds and marine mammals, in order for FIG to apply best practice for planning, mitigating and monitoring impacts of the Sea Lion Field, the collection of new data is required. Surveys must be carried out independently and applying the best scientific methodology and technology available: standardised sampling for megafauna (transects and distance-sampling), include a team of eight observers to work on shifts, specialised equipment (big eyes, infrared	Thank you for the comment. Navitas will collect data through SMMOs on vessels developing the field in the three years pre First-Oil and also collect acoustic data where / when practical too.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	cameras, multi-frequency acoustic array), and a PAM (passive acoustic monitoring) team.		
FIFD 10	<< In order to ensure that the JNCC SAST data provided an appropriate dataset on which to base the environmental impact assessment, POEPL commissioned Genesis to undertake a review of the data (Genesis, 2017). >> Considering the Falkland Islands are a hotspot for seabirds and marine mammals, FIG needs to apply best practice for planning, mitigating and monitoring impacts of the Sea Lion Field. In consequence, independent evaluations of the data and the EIA are a must.	FIG DMR has commissioned independent reviews of the EIA/S from the Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) and the Scottish Association of Marine Science (SAMS) and may choose to comment further. See also FIFD 9.	N/A
FIFD 11	<< With permission from Falklands Conservation (FC) and JNCC, the SAST survey data was re-examined to highlight the species recorded in the vicinity of the Sea Lion area. >> Contradicts what is stated on page 4 (Acknowledgements).	Thank you for your comment. This is noted and the acknowledgments will be checked.	Acknowledgements Section 7.4.5.2.1.1
FIFD 12	inconsistent use of the common name <<southern sea lion>>, elsewhere it is <<South American sea lion>>.	Thank you for your comment. This is noted and the text will be checked for consistency.	Section 7.4.6.1.2
FIFD 13	Black browed albatross: besides the local breeding population of black-browed albatross, the South Georgia population also occurs in the Falkland Islands (Frankish *et al.,* 2020a). The black-bowed albatross from South Georgia is an ACAP Priority Population (>10% of the global total for each species and declining >3% per annum) (Phillips *et al.,* 2023).	Thank you for your comment. This is noted and reference to other BBA populations will be added.	Section 7.4.5.2.2 Table 7.17 Section 7.4.5.3.2 Table 7.23
FIFD 14	White chinned-petrel: there is a recent tracking paper that links movements of the WCP South Georgia population to the FI (Frankish *et al.,* 2020b).	Thank you for your comment. This is noted and Navitas will add the reference.	Section 7.4.5.2.2 Table 7.17 Section 7.4.5.3.2 Table 7.23
FIFD 15	Northern royal albatross: there are tracking papers that link movements of the NRA breeding sites in New Zealand to the FI (Nicholls *et al.,* 2002, 2005; Bose *et al.,* 2023).	Thank you for your comment. This is noted and Navitas will add the reference.	Section 7.4.5.2.2 Table 7.17 (sources added)
FIFD 16	Grey-headed albatross: besides being IUCN-Endangered, since 2011 the grey-headed albatross from South Georgia is an ACAP Priority Population	Thank you for your comment. This is noted and Navitas will add the reference.	Section 7.4.5.2.2

Ref.	Representation	Navitas response	Changes in Rev 4
	(Phillips *et al.,* 2023). Tracking research links movements of the SG population to the FI (Clay *et al.,* 2016)		Table 7.17 (sources added)
FIFD 17	Wandering albatross: besides being globally Vulnerable, the wandering albatross from South Georgia is locally Endangered (Jiménez *et al.,* 2016). In addition, since 2011 the WA from SG is an ACAP Priority Population (Phillips *et al.,* 2023). Fine-scale research links the SG population with FI waters (Carneiro *et al.,* 2022) and supports previous research in the FI (Otley *et al.,* 2006).	Thank you for your comment. This is noted and Navitas will add the reference.	Section 7.4.5.2.2 Table 7.17 (sources added)
FIFD 18	Black-browed albatross can dive to 19 m (Guilford *et al.,* 2022). And, the table does not include WCP from SG.	Thank you for your comment. This is noted and Navitas will amend the table.	Table 7.17 Table 7.23
FIFD 19	The last paragraph omits that SG populations of BBA, GHA and WA are ACAP Priority Populations.	Thank you for your comment. This is noted and Navitas will amend text and add SG populations.	Section 7.4.5.2.2
FIFD 20	White-chinned petrel: should include the size of the colony in Kidney Island; omits the fact that most of the individuals seen in the FI are from SG.	Thank you for your comment. This is noted and Navitas will amend text to include size and reference to White-Chinned population on Kidney Island.	Section 7.4.5.3.2 (White chinned petrel) Table 7.23
FIFD 21	omits GHA, WA, WCP and BBA from SG.	**Initial consultation response:** Likely Table 7.13 not 7.32. Note the table highlights ' Metadata from https://data.seabirdtracking.org/dataset. ' Hence, while data exists for the species listed, it may not have been deposited in the seabird tracking database. Navitas will re-check and amend where relevant. **Post-consultation comment:** Navitas reviewed the relevant table (Table 7.23). WA and GHA were not added as they occurred in very low abundances. In addition, it would have not been possible to discern whether WCP or BBA were from the Falkland Islands or South Georgia. Please note that the table references above are incorrect. Table 7.23 summarises the inshore bird species.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
FIFD 22	Omits ACAP Priority Population of BBA from SG. Black-browed albatross can dive to 19 m (Guilford *et al.,* 2022).	Please see response to FIFD 18.	N/A
FIFD 23	Omits WCP population from SG.	Please see response to FIFD 21.	N/A
FIFD 24	<< In 2019, the FIFD changed the way in which observed seabird mortalities were extrapolated to total mortalities in the fleet by including a 3:1 assumption of 1 mortality for every 3 heavy contacts observed based on Parker *et al.* (2013). >> FIFD did not change the way in which observed seabird mortalities were extrapolated to total mortalities in the fleet. Because in 2019 observer seabird dedicated effort was <2% and no seabird mortality was observed, possible minor injury contacts were used as a mortality proxy. Consequently, estimated seabird mortality numbers are precautionary.	Thank you for your comment. This is noted and the text will be amended for clarity.	Section 7.4.5.5.1
FIFD 25	<< "ACAP is a daughter agreement to the Convention on the Conservation of Migratory Species of Wild Animals (CMS), which the Falkland Islands are signatories to." >> The U.K is a direct signatory to both ACAP and CMS, not the FI. However, these do fully/partially extend to some UKOTs.	Thank you for your comment. This is noted and the text will be amended to reflect this.	Section 7.4.5.5.2
FIFD 26	Omits that in 2011 ACAP identified nine seabird Priority Populations for conservation, which represent >10% of the global total for each species and are declining >3% per annum. These include South Georgia populations of the WA, BBA, and GHA (Phillips *et al.,* 2023). In addition, the WA is locally Endangered (Jiménez *et al.,* 2016).	Thank you for your comment. This is noted and the text will be amended to reflect this.	Section 7.4.5.2.2 Section 7.4.5.5.2
FIFD 27	<< It is generally considered that there are insufficient data available to describe the foraging and breeding areas, seasonal distribution and abundance, and diet of most marine mammal species in the Falklands… Nonetheless, the available data is sufficient to indicate likely species presence on a seasonal basis. Both the visual and acoustic survey methods described below have recognised limitations which need to be acknowledged. However, datasets have been used in a complementary manner to provide a better overall picture. >> Regarding the acoustic data collected during one year (August 2012-August	Thank you for the comment. The AMAR data were collected over a period of a year. However, although old, the SAST did detect some beaked whales. Please see FC comment on the AMAR methodology (FC 129). Navitas believes it has been precautionary in our assessments. In addition, Navitas will be deploying SMMOs in the field three year pre First-Oil.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	2013), the usual sampling rate of the autonomous recorders (48Hz) was too low to collect beaked whale vocalizations, which are the most vulnerable cetaceans to anthropogenic noise (Taylor *et al.,* 2000; Prideaux, 2016; Harding & Cousins, 2022). Beaked whale vocalizations energy peaks range between 35-45 Khz (Rafter *et al.,* 2021); in addition, only 5% of the recordings were analysed (Hipsey *et al.,* 2013).		
FIFD 28	<<minke whale>> refers here to the Antarctic minke whale (*B. bonaerensis*), however White *et al.,* 2002 refers to the dwarf minke whale (*B.acutorostrata*). The document must clarify that the FI are in the distribution range of both species, which at sea are undistinguishable and which can also be confused with the pigmy right whale (*Caperea marginata*) (Otley, 2012). So, under the term <<minke whale>> could be at least three different species.	Thank you for your comment. This is noted and the text will be amended to reflect this.	Section 7.4.6.2.1.4 (Minke whale)
FIFD 29	omits the fact that the Falkland Islands are a beaked whale hotspot (MacLeod & Mitchell, 2006). Although beaked whale habitat normally occurs in deep waters (≥1000 m), Otley (2012) suggested that in the FI beaked whales do use shallower waters, which is known to occur elsewhere (Filatova *et al.,* 2024). S. 7.4.6 also omits to mention that beaked whales are highly vulnerable to anthropogenic sound, which can displace the animals from foraging areas, cause permanent damage, or cause incidental mortality (Barlow & Gisiner, 2006; Weilgart, 2013; Joyce *et al.,* 2018; Feyrer *et al.,* 2024). However, quantifying impacts in open sea is extremely difficult, as the arrival of carcasses to the shore depend on environmental features and human population density (Faerber & Baird 2010; Williams *et al.,* 2011; Prado *et al.,* 2013).	Thank you for your comment. This is noted and the text will be amended to reflect this.	Table 7.28 Section 10.4.4.4.5
FIFD 30	Beaked whales: all the information from Hyperoodon and Mesoplodon sightings should be included in the same paragraph. On this page it is omitted that sightings of Hyperoodon were carried out at the N, NE and E of the FI (White *et al.,* 2002).	The hyperoodon refers to seasonal variability, while the mesoplodon explains the difficulty in identifying beaked whale to species level - hence the need to separate into different paragraphs. Navitas will	Section 7.4.6.2.1.4

Ref.	Representation	Navitas response	Changes in Rev 4
		update the location of southern bottlenose whale sightings.	
FIFD 31	Omits to define “large whale species”. In the text this is also not defined.	The figure text will be clarified to explain that large whale species refers to unidentified large whales.	Section 10.11.4.3.2 Table 7.31
FIFD 32	<< During this period an increased but small number of >> Incomplete sentence.	Thank you for your comment. This is noted and the typo will be amended.	Section 7.4.6.2.1.2
FIFD 33	Fin whale: following Lanfredi, 2012, add Herr *et al.,* 2022 (large fin whale foraging groups in Gerlache Strait)	Thank you for your comment. This is noted and this reference will be added.	Section 7.4.6.2.1.4
FIFD 34	Southern bottlenose whale: should be together with Mesoplodon under the title <<beaked whales>>. The text omits that Hyperoodon sightings by White *et al.* (2002) took place in the N, NE, and SE of the FI.	Please see response to FIFD 30. These are separated on the basis of data availability. Specifically, one species has seasonal data, while the other are unidentified species of Mesoplodon. Text regarding location of sightings will be added.	Section 7.4.6.2.1.4
FIFD 35	Unidentified beaked whales (*Mesoplodon* spp.): Ziphiids (beaked whales) include genus Hyperoodon, Ziphius, Berardius, Mesoplodon, and Indopacetus, of which the first four have been recorded in the Falkland Islands (Otley *et al.,* 2011). The sentence “Beaked whales (*Mesoplodon* spp.)” is not correct. << All sightings occurred in waters over 1,000 m deep, with the majority coming from the region of the Falkland Trench to the south-east of the Islands >>. Although *Mesoplodon* sightings from White *et al.* (2002) took place in waters over 1000m deep, Otley (2012) suggested that in the FI beaked whales do use shallower waters; beaked whales can specialise in the use of coastal habitat (depth <300m) (Filatova *et al.,* 2024). Hyperoodon sightings by White *et al.* (2002) took place in the N, NE, and SE of the FI. << Stranding records indicate that a number of *Mesoplodon* species could be present within Falkland Islands waters (Otley *et al.,* 2012) >> The correct reference is Otley *et al.,* 2011. The text omits to say that the Falkland Islands are a beaked whale hotspot (MacLeod & Mitchell, 2006) and that beaked whales are highly vulnerable to	Thank you for your comment. This is noted and the text will be updated.	Section 7.4.6.2.1.4 Section 10.4.4.4.5

Ref.	Representation	Navitas response	Changes in Rev 4
	anthropogenic sound, which can displace the animals from foraging areas, cause permanent damage, or cause incidental mortality (Barlow & Gisiner, 2006; Weilgart, 2013; Joyce *et al.,* 2018; Feyrer *et al.,* 2024). Quantifying impacts in open sea is extremely difficult, as the arrival of carcasses to the shore depend on environmental features and human population density (Faerber & Baird 2010; Williams *et al.,* 2011; Prado *et al.,* 2013).		
FIFD 36	<<The acoustic monitoring survey recorded an unidentified odontocete species (toothed whale; including killer whale and dolphins).>> This sentence is not correct. The killer whale is a dolphin species; the term "toothed whale" includes the sperm whale, beaked whales, dolphins, and porpoises.	Thank you for your comment. This is noted and the text will be amended.	Section 7.4.6.2.1.4 (Hourglass dolphin)
FIFD 37	<< (*Arctocephalus* species) >> The text should mention the actual scientific names of species included in this term.	Thank you for your comment. This is noted and australis and gazella will be added.	Section 7.4.6.2.2.1
FIFD 38	Southern right whale. << Widespread in the southern hemisphere >>. The distribution is circumpolar in the Southern Hemisphere. << Growing population breeds off the coast of Argentina in September, migrates to Southern Ocean in the summer >> is not correct. The southern right whale breeds between July-November in Península Valdés (Argentina) and Santa Catarina (Brazil) (Danilewicz *et al.,* 2016; Mandiola *et al.,* 2019; Renault-Braga *et al.,* 2022) Antarctic minke whale: << Globally, the most common of the rorquals >> is not correct. Southern Hemisphere distribution (Cooke *et al.,* 2018). Dwarf minke whale (*Balaenoptera acutorostrata* subspecies). Omitted in the whole report. Distribution in mid and lower latitudes of the Southern Hemisphere, up to 69º (Cooke, 2018). Pygmy right whale (Caperea marginata). Omitted in the whole report. Circumpolar distribution, between 30-55ºS (Cooke, 2018a).	**Initial consultation response:** Thank you for your comment. This is noted and the table will be updated. **Post-consultation comment:** Table 7.28 has been updated. However, dwarf minke and pygmy right whales were not considered prevalent enough to warrant inclusion within the summary table.	Table 7.28

Ref.	Representation	Navitas response	Changes in Rev 4
	Beaked whales: only contains one beaked whale species (*Hyperoodon*). The table omits the rest of available information (i.e., unidentified beaked whale species.) Sei whale: << …. progress can be followed by 'fluke prints' left on the surface in the animal's wake >>. That is a common feature with other whale species, not exclusive for sei whales.		
FIFD 39	Antarctic minke whale (*Balaenoptera bonaerensis*): These are sympatric species; impossible to distinguish them at sea. White *et al.,* reported all their sightings as *B. acutorostrata*. The term <<minke whale>> should either include all the species, or clarify that under the term "small whale species" there could be at least three species: *B. acutorostrata*, *B. bonaerensis*, and C. marginata. Otley (2012) also states that the 3 species were not differentiated during JNCC surveys. Minkes stranded in the FI were also not differentiated to species level (Otley 2012).	Thank you for your comment. This is noted and the text will be clarified.	Section 7.4.6.2.1.4 (Minke whale)
FIFD 40	Killer whale: Here omits that there are likely to be resident populations. Seen year-round from longline vessels fishing to the north-east of the Sea Lion Field (Yates & Brickle, 2007). Orcas are occasionally seen from Loligo trawlers (FIFD unpublished data).	Thank you for your comment. This is noted and the Yates and Brickle reference will be added sightings to North of the NFB will be clarified in the text.	Section 7.4.6.2.1.4 (Killer whale)
FIFD 41	Right whale, Antarctic minke whale, Dwarf minke whale, Pygmy right whale, Sei whale: see comments on Table 7.2.8.	Thank you for your comment. This is noted and the table shall be updated accordingly. See also FIFD 38.	Table 7.28
FIFD 42	<< As during the 2015 exploration drilling campaign, Navitas will develop and implement a BSMP … >> <<Detailed monitoring requirements have been established during the Environmental Monitoring and Management Plan workshop (Chap. 15).>> It would be useful to see some details of what the 2015 BSMP provided. Chap. 15 does not provide any real detail.	The Sea Lion Phase 1 & 2 Biosecurity Management Plan will be developed after project sanction and prior to the commencement of operations. This will build upon the 2015 exploration Biosecurity Management Plan. The EMMP advisory group will be invited to review and input in to the draft Biosecurity Management Plan prior to its finalisation and issue.	N/A
FIFD 43	In this section the document omits to provide information on each step on the Field development and operation, including the types of equipment to be used, the number of each equipment to be used, and the characteristics	Detail on the full operation is given in the development description, Chapter 5, which is referenced in section 10.4.	Section 10.4.1.1 Section 10.4.5.1

Ref.	Representation	Navitas response	Changes in Rev 4
	of the noise to be generated by each of them. << Underwater noise will be generated in the Sea Lion Field throughout the Development and will result from the use of vessels. >> This sentence is incorrect. Besides shipping and vessel traffic, the development and operation of the Sea Lion Field might imply the production of underwater noise by different types of equipment, like: -seismic surveys; -high power sonar (SBES, MBES, boomers, etc.); -explosions; -drilling; -position transponders; -separators, injectors, pumps; -production maintenance. << The properties of sound in water (range and speed of travel) are exploited by many marine animals as a means of communication, navigation and detecting prey or predators. Sound travels at approximately 1,500 m/s in water (about five times faster than in air) and low frequency sound can propagate over hundreds to thousands of kilometres, although the effective range of most biological functions is tens of kms. >> Marine wildlife does not exploit the properties of sound in the water, but actually rely on sound for vital life functions, including communication, prey and predator detection, orientation and for sensing surroundings. Species living in the marine environment are adapted to the natural sound (ambient noise), biological (marine animals) and physical processes (earthquakes, wind, ice and rain). Sound propagation in the water is complex and requires many variables to be carefully considered before it can be known if a noise-generating activity is appropriate or not. It is inappropriate to generalize sound transmission without fully investigating propagation in the actual place.	No seismic surveys are planned, no high power sonar will be used and no explosives are planned to be used in drilling, unless stuck pipe occurs but in this instance explosives would be downhole. Transponders will not be required to site the FPSO or MODU. During construction, transponders may be used to site subsea equipment - these will be used for short period and removed once the subsea construction phase is complete. This will be noted in the section. Also note that the underwater noise modelling is being refined and will be presented in the next iteration of the EIS. See FIFD 54.	

Ref.	Representation	Navitas response	Changes in Rev 4
	<< Human-made (anthropogenic) noise in the marine environment can interfere with these processes and is recognised as having the potential to cause harm to marine animals. Consequently, under-water noise is regarded as a form of pollution. >> Because of diverse activities, in the last century human-made (anthropogenic) noise in the marine environment has increased (Prideaux, 2016). The term "harm" must be specified (e.g., physical, physiological, behavioural impacts). It is known that wildlife exposed to elevated or prolonged anthropogenic noise can suffer direct injury and/or temporary or permanent auditory threshold shifts. Noise can mask important natural sounds, such as the call of a mate, or the sound made by prey or predator. Anthropogenic noise can also displace wildlife from important habitats. These impacts are experienced by a wide range of species including finfish, crustaceans, cephalopods, pinnipeds, sea turtles, and sharks (Prideau et al, 2016).		
FIFD 44	Omits the Convention of Migratory Species (CMS), which has published Family guidelines on EIA for marine noise generating activities. All the marine mammal and seabird species, the porbeagle, and their prey are covered by CMS. Regarding pinnipeds and cetaceans, the FI has cetacean and pinniped Action Plans approved by EXCO, which highlight the following actions: 1) To assess and manage acoustic disturbance – including the application of appropriate licence conditions under the Offshore Minerals Ordinance. To assess and manage physical disturbance and development activities such as aquaculture, oil pollution and exploration and extraction industries, including the application of environmental impact assessment where appropriate.	Thank you for your comment. This is noted and will be added	Section 10.4.1.1
FIFD 45	Because sound exposure can cause mortality, injury to tissues, affect the physiology of living beings, damage to the auditory system, masking of biologically important sounds, and behavioural changes (feeding, breeding, spawning, migration, displacement from ecologically important areas) (CMS, 2017), the Falkland Islands needs to develop new policy regarding Mineral	Navitas refers the respondent to FIG DMR regarding their policy on noise. Note the EIS does include propagation modelling, please see section 10.4.4.4.2.	Section 10.4 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
	Resources. This new and specific policy should require the EIA to include propagation modelling. The noise models need to be confirmed by acoustic measurements in the field. The EIA needs to describe the methods chosen to reduce or baffle unnecessary high frequency noise, taking account of the noise spectrum before and after the addition of the mitigation measures. Cumulative effects from multiple temporally overlapping or consecutive surveys need to be considered. It is important to mention that the UK permitting systems also requires a detailed impact assessment to support the applications that clearly specifies the potential impacts (OSPAR, 2020). Also, Following CMS (2017), Prideaux (2016) and Weilgart (2023), this section omits to provide a comprehensive description of: 1) Each of the equipment's to be used; 2) The noise to be generated by each of the equipment's (intensity and frequency); 3) The occurrence of activities like seismic surveys and explosions, with detailed information on equipment, type of explosive, sound intensity level in water @ 1 m, frequency range, and number of detonations and interval time; 4) Description of noise counter measures, as bubble curtains, noise dampers and cofferdams, including a description of technology, best environment practice (BEP), or best available technology (BAT); 5) Identification of other activities having an impact in the region during the planned activity, accompanied by the analysis and review of potential cumulative or synergistic impacts. The EIA needs to provide an explanation of all activity technologies available and why each proposed technology is chosen, including consideration of noise-free installation methods. The EIS needs to specify the total duration of each proposed activity; the proposed timing of operations (i.e., season and time of day, during all weather conditions); sound intensity level (dB peak to peak) in water @ 1 metre and frequency ranges.	No seismic surveys are planned but please note cumulative modelling has been undertaken in section 10.4.4.4.3.2 showing the noise from all activities (drilling, production vessels and offtake vessels at once). Navitas note the OSPAR 2020 guidelines suggested are primarily for 'noise mitigation measures to be applied during pile-driving as well as alternative low noise foundation concepts especially for offshore wind turbines'. As no pile driving is proposed, it is not felt these are most appropriate for the Sea Lion development activities. The vessels modelled and their noise profiles are provided in Table 10.26. No seismic surveys or explosions are planned. Well completion approach now utilises Open Hole Gravel Pack (OHGP) rather than TCP guns. Please also note that the underwater noise modelling is being refined and will be presented in the next iteration of the EIS. See response to FIFD 54.	

Ref.	Representation	Navitas response	Changes in Rev 4
FIFD 46	Moderately intense low frequency noise can cause severe acoustic trauma and mortality in cephalopods. Effects have also been seen in zooplankton lobsters and epibenthos, among others (Harding & Cousins, 2022).	Thank you for your comment. This is noted and the reference will be added and included.	Section 10.4.4.2 Section **Error! Reference source not found.** Section 10.5.6.2
FIFD 47	The EIA focus on the sound pressure, however fish and invertebrates are more susceptible to particle motion (Prideaux, 2016; Popper & Hawkings, 2018; Harding & Cousins, 2022).	Thank you for your comment. This is noted in sections 10.4.4.3.1.1 and 10.4.4.3.2.1. Please note the noise chapters are being revised and updated. Please also refer to FIFD 54.	Section 10.4.4.4.2.1 Section 10.4.4.4.3.1 Table 10.19
FIFD 48	<< An SEL threshold of injury of 202 dB re 1µPa2s was agreed on by the panel (SAIC, 2011). The threshold found for the marbled murrelet was applied here to estimate the underwater noise impacts to diving seabirds.>> The threshold of 202 dB is not appropriate. Hansen *et al.* (2020) demonstrated that the common murre elicits a behavioural response at 110 dB re 1 mPa, similar to the sound levels that affect the harbour porpoise. In addition, it has been published that penguins response to seismic surveys within 100km of their colony, penguins avoiding their preferred foraging areas, which made them increase their foraging effort (Pichegru *et al.,* 2017).	The 202 dB threshold is used as an injury threshold, not a disturbance (behavioural change threshold), Navitas will review the papers suggested. Please note the noise chapters are being revised and updated. Please also refer to FIFD 54.	Section 10.4 Section 10.5
FIFD 49	<< Anthropogenic sources of sound in the ocean can disturb marine mammals, evoking behavioural responses, similar to the response to predator risk, and can trigger physiological stress responses (Tyack, 2008; Rolland *et al.,* 2012). >> Impacts of anthropogenic sounds include much more than behavioural responses and stress. Anthropogenic noise can cause physiological damage and mortality, being beaked whales extremely vulnerable (Taylor *et al.,* 2000; Barlow & Gisiner, 2006; Hildebrand, 2005; Prideaux 2016; Weilgart 2013; Joyce *et al.,* 2018; Chollewiak *et al.,* 2017).	Thank you for your comment. This is noted and this will be added in revised Sections 10.4 and 10.5. Please also refer to FIFD 54.	Section 10.4 Section 10.4.4.4.5 Section 10.5
FIFD 50	This section of the document also omits the fact that the Falkland Islands are a beaked whale hotspot (MacLeod & Mitchell, 2006). Although beaked whale habitat normally occurs in deep waters (≥1000 m), Otley (2012) suggested	Thank you for your comment. This is noted and Section 10.4.6.3.2 will be amended to clarify data gaps associated with beaked whales, which are	Section 10.4 Section 10.4.4.4.5 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
	that in the FI beaked whales do use shallower waters, which is known to occur elsewhere (Filatova *et al.,* 2024). In addition, this section of the document omits to mention that beaked whales are highly vulnerable to anthropogenic sound, which can displace the animals from foraging areas, cause permanent damage, or cause incidental mortality (Taylor *et al.,* 2000; Barlow & Gisiner, 2006; Weilgart, 2013; Joyce *et al.,* 2018; Feyrer *et al.,* 2024). However, quantifying impacts in open sea is extremely difficult, as the arrival of carcasses to the shore depend on environmental features and human population density (Faerber & Baird 2010; Williams *et al.,* 2011; Prado *et al.,* 2013).	vulnerable to disturbance. Please note the noise chapters are being revised and updated. Please also refer to FIFD 54.	
FIFD 51	<< Of the species of cetacean present in the NFB (Section 7.4.6.2), many are capable of diving to depths in excess of 450 m, although due to the difficulties of working with these animals in an oceanic environment, the maximum dive depths of many species remain unknown. >> There are plenty of research on diving capabilities of teutophagic cetaceans. The sperm whale, the pilot whale, beaked whales and orcas are extreme divers, with deeper and longer foraging dives than any other mammal species (Tyack *et al.,* 2006; Schorr *et al.,* 2014; Towers *et al.,* 2019). Following habitat utilisation of beaked whales elsewhere, it is presumed that sighted individuals from fishing vessels operating in the Falklands might be residents (e.g., Gowans *et al.,* 2000; MacLeod & Zuur 2005; McSweeney *et al.,* 2007; Falcone *et al.,* 2009).	Thank you for your comment. This is noted and Navitas will update the section with references and dive depths from other locations. Please note the noise chapters are being revised and updated. Please also refer to FIFD 54.	Section 10.4 Section 10.4.4.4.5 Section 10.5
FIFD 52	<< Further, it should be noted that behavioural changes in response to anthropogenic noise, such as moving away from an area for a short period of time, changes in dive-time, masking of communication signals or echolocation clicks for short periods, do not necessarily result in detrimental effects on the animals involved. A reaction lasting less than 24 hours, and not recurring on subsequent days, was not regarded as particularly severe by Southall *et al.* (2007). >>	Agreed, this will be added in revised section. Please see response to FIFD 54.	Section 10.4 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
	Impacts of anthropogenic sounds include much more than behavioural responses and stress. Anthropogenic noise can cause physiological damage and mortality, being beaked whales extremely vulnerable (Taylor *et al.,* 2000; Barlow & Gisiner, 2006; Hildebrand, 2005; Prideaux 2016; Weilgart 2013; Joyce *et al.,* 2018; Cholewiak *et al.,* 2017).		
FIFD 53	<<The injury thresholds for each marine mammal group have been reviewed and updated by the National Marine Fisheries Service (NMFS, 2018) and Southall *et al.* (2019) and are summarised in Table 10.24.>> The SEL metrics reported by NOAA (2018) and Southall *et al.* (2019) only account for the cumulative exposure to one source in the hearing range of an individual. They do not consider the cumulative or aggregate effect of multiple sources. NOAA (2018) provided advice on how to combine multiple datasets and determine appropriate surrogates when little or no data exists. Southall *et al.* (2019) stated some important assumptions and limitations for the PTS and TTS thresholds that are proposed. They reported that the TTS and PTS thresholds are derived using median values of available data in several areas. However, they reported that impacts may relate to variability in susceptibility of individuals and the context of exposure scenarios. As such, single threshold criteria underestimate potential effects for some or in some scenarios and overestimate effects for others, the extent of each potential outcome depending on the degree of individual variability as well as key contextual aspects of exposure. The exposure criteria should therefore be used as a guide to predict the potential for PTS and TSS, but not used as an absolute. NOAA (2018) also reported that thresholds do not represent the entirety of an effects analysis, but rather serve as one tool to help evaluate the effects of noise produced during a proposed action on a marine mammal. Other aspects that should be considered within an overall assessment of risk include behavioural impact thresholds, auditory masking assessments and evaluations to help understand the ultimate effects of an impact on an individual's fitness and on populations.	Thank you for your comment. This is noted and Navitas will ensure these caveats are clarified. Please note the noise chapters are being revised and updated. Please also refer to FIFD 54.	Section 10.4 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
FIFD 54	The noise-generating modelling presented in the EIA does not provide enough information to provide decision makers with credible and defensible information. The available modelling is not based in local propagation features. In consequence, the document neither identifies the acoustic footprint of the noise that will be generated in the Sea Lion Field, nor provides levels of noise propagation to make informed decisions. New modelling should be carried out following CMS Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities (Prideaux 2016; CMS 2020): 1. Independent, scientific modelling of noise propagation should be impartially conducted. a) Models chosen should be peer-reviewed, scientific source models (as opposed to industry black box models); b) Modelers should have enough knowledge of, and experience with, the models they are using. Modellers should understand the physics of under-water noise propagation to ensure the correct models are used and that the results are accurate and make physical sense; c) Modelling results should be reviewed by subject matter experts, and experienced modellers with a strong theoretical understanding of underwater acoustics. 2. Propagation models should be: a) based on accurate input data, and for seismic surveys specifically the official calibration figures supplied by the survey vessel to be charted; b) able to accommodate the activity noise frequencies, the water depth, seabed topography, temperature and salinity, and spatial variations in the environment. Model methodology/s used should be stated;	The modelling was conducted by independent experts using models developed in house (by the independent consultant). However, further modelling techniques have since been developed and as such Navitas has chosen to revise and update this entire section. Please note that the sources of noise originate from the rig and a number of vessels that will be operating in the area. There is no pilling or other source of impulsive sound; anchors will be suction piled as opposed to impact piling. Navitas are confident the impact assessments are valid but has committed to updating this assessment with results from the new modelling now available.	Section 10.4 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
	c) specific to the source, region and environmental conditions. d) based on accurate input data including seismic source data and environmental data, such as: - geo-acoustic properties, including bottom sediment types and their layer depths for the region to be modelled, ideally down to several hundred metres into the bottom. - bathymetry mapping grid resolution greater than 450m - seasonally relevant Sound Speed Profiles (SSPs), salinity, temperature and depth data (in tabulated form). e) chosen based on the treatment of environmental conditions, with an appropriate rationale for the modelling choice provided in the modelling report. f) given special consideration for fiords and deep-water canyons and may require high-resolution 3D models. g) biologically relevant and able to handle a wide range of frequencies, including very high and very low frequencies, regardless of the proponent's frequency focus. The computational difficulty of modelling very high frequencies is not a reason for disregard. 3. Propagation modelling should include: a) the received sound levels at given distances from the noise source to determine propagation loss. b) full frequency bandwidth of a proposed anthropogenic noise source. c) the intensity/pressure/energy output within that full range. d) the principal or mean/median operating frequency of the source(s). e) the same season/weather conditions as the proposed activity accounting for local propagation features (depth and type of sea bottom, local propagation paths related to thermal stratification, SOFAR or natural channel characteristics). f) sound propagation and cumulative exposure data that is appropriate to		

Ref.	Representation	Navitas response	Changes in Rev 4
	the full range of concurrent noise generating activities. These should include separate modelling of each noise generating activity (i.e., shipping, support vessels, sonar, seismic surveys), as well as a cumulative model of all these activities combined. g) appropriate single shot modelling that is correctly reprehensive of the survey region. Biologically important sub-regions may require additional focus. h) representation of cumulative exposure over time (i.e., 24 hours). i) acoustic ground-truthing of the chosen model (to ensure model credibility). 4. Propagation modelling reports should demonstrate: a) propagation from point source out to a radius where the noise levels generated are close to natural ambient sound levels. b) particle motion propagation to assess the impact on invertebrates and fish species. c) proposed exclusion zones designed for the protection of specific species and/or populations should be identified and mapped and should demonstrate how noise will not propagate into these areas, taking into consideration the local propagation features. d) border thresholds will not be breached for exclusions zones and biologically important areas. e) that all modelling assumptions are clearly stipulated and comprehensively justified.		
FIFD 55	Besides shipping and vessel traffic, the development and operation of the Sea Lion Field might imply the production of underwater noise by different types of equipment, like: -seismic surveys; -high power sonar (SBES, MBES, boomers, etc.); -explosions; -drilling; -position transponders;	See response to FIFD 43.	Section 10.4.1.1 Section 10.4.5.1 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
	-separators, injectors, pumps; -production maintenance. However, the EIA omits to provide a comprehensive description of the equipment, the activities, the individual noise and accumulated noise that will be produced in the Sea Lion Field. In Section 10.4.5 <<Industry standard mitigations >> the EIA only includes vessel noise, and wrongly says that "there are no industry-standard mitigation measures specifically designed to reduce the impact of vessel noise on fauna". The CMS in June 2023 published Best Available Technology (BAT) and Best Environmental Practice (BEP) for Mitigating Three Noise Sources: Shipping, Seismic Airgun Surveys, and Pile Driving – Technical Series No. 46 (Weilgart, 2023). The EIA omits to provide a comprehensive description of: each of the equipment's to be used; the noise to be generated by each of the equipment's (intensity and frequency); the occurrence of activities like seismic surveys and explosions, with detailed information on equipment, type of explosive, sound intensity level in water @ 1 m, frequency range, and number of detonations and interval time; description of noise counter measures, as bubble curtains, noise dampers and cofferdams, including a description of technology, best environment practice (BEP), or best available technology (BAT); identification of other activities having an impact in the region during the planned activity, accompanied by the analysis and review of potential cumulative or synergistic impacts.		
FIFD 56	Moderately intense low frequency noise can cause severe acoustic trauma and mortality in cephalopods. Effects have also been seen in zooplankton lobsters and epibenthos, among others (Harding & Cousins, 2022). The EIA focus on the sound pressure, however fish and invertebrates are more susceptible to particle motion (Prideaux, 2016; Popper & Hawkings, 2018; Harding & Cousins, 2022). The threshold of 202 dB is not appropriate	Thank you for your comment. This is noted and he underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections of the EIS are also being updated with relevant citations suggested during the public consultation and with	Section 10.4 Section **Error! Reference source not found.** Section 10.5 Section 10.5.6.2

Ref.	Representation	Navitas response	Changes in Rev 4
	for seabirds. Hansen *et al.* (2020) demonstrated that the common murre elicits a behavioural response at 110 dB re 1 mPa, similar to the sound levels that affect the harbour porpoise. In addition, it has been published that penguins' response to seismic surveys within 100km of their colony, penguins avoiding their preferred foraging areas, which made them increase their foraging effort (Pichegru *et al.,* 2017). Regarding marine mammals, impacts of anthropogenic sounds include much more than behavioural responses and stress. Anthropogenic noise can cause physiological damage and mortality, being beaked whales extremely vulnerable (Taylor *et al.,* 2000; Barlow & Gisiner, 2006; Hildebrand, 2005; Prideaux 2016; Weilgart 2013; Joyce *et al.,* 2018; Cholewiak *et al.,* 2017). The exposure criteria should therefore be used as a guide to predict the potential for PTS and TSS, but not used as an absolute. NOAA (2018) also reported that thresholds do not represent the entirety of an effects analysis, but rather serve as one tool to help evaluate the effects of noise produced during a proposed action on a marine mammal. Other aspects that should be considered within an overall assessment of risk include behavioural impact thresholds, auditory masking assessments and evaluations to help understand the ultimate effects of an impact on an individual's fitness and on populations.	consideration for the comments received. Please also refer to FIFD 54.	
FIFD 57	<< Each vessel will have its own individual 500 m exclusion zone. >> Meaning exclusion from any other vessels being anchored within 500 m, or traversing within 500 m? Does this help to mitigate underwater noise?	Yes, exclusion from any other vessel being anchored within that 500m or from traversing that 500m exclusion zone. Exclusion zones are not proposed as mitigations to the effect of underwater noise but for vessel safety.	N/A
FIFD 58	<< The goal was a phase-out of discharge of these chemicals by 1st January 2017, and this was largely achieved >> Meaning it was achieved in general globally, or in the Falkland Islands particularly, and if so how much is <<largely>>?	The phase out of Substitution chemicals is required under OSPAR Recommendation 2006/3 on 'the environmental goals for the discharge by the offshore industry of chemicals that are, or which contain, substances identified as candidates for substitution'. The OSPAR Convention is a legal agreement that guides international cooperation to protect the	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		marine environment of the North-East Atlantic. The OSPAR Convention's contracting parties include: Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Luxembourg, The Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom. In the UK, operators have to report annually (production) and per project (for drilling/workovers etc) on their progress in selecting non-Substitution chemicals and where non-substitution chemicals are still used, or alternatives are not yet available, this must be justified.	
FIFD 59	The CMS in June 2023 published Best Available Technology (BAT) and Best Environmental Practice (BEP) for Mitigating Three Noise Sources: Shipping, Seismic Airgun Surveys, and Pile Driving - Technical Series No. 46 (Weilgart, 2023). This report demonstrates that the regulation of vessels speed, routes, and avoidance of steaming parallel to the coast comprise best practice for shipping and reduce the noise footprint, mitigate collisions with whales, reduces fuel consumption and greenhouse emissions. It is crucial BAT and BEP are enforced in the Sea Lion Development.	Thank you for your comment. This is noted and vessel speed and maintenance of vessels are included in mitigations for noise reduction and speed reduction is included as a mitigation for minimising the risk of collision with marine mammals. Navitas will also follow the Falkland Islands Cetacean Code of Conduct. The EIS will be amended so that the Code of Conduct is added to the guidelines.	Section 10.4.1.1 Section 10.11.3 Section 15.6.2.1.3 Section 15.6.2.1.4
Falkland Islands Maritime Authority			
FIMA 1	1.3.1 – Regulatory Overview (page 30). Maritime Ordinance 2017 should be listed.	Thank you for your comment. This is noted and will be amended.	Section 1.3.1 Section 3.1.7.3
FIMA 2	2.2.3.2 – Installation (page 76). 'FIG Marine Authority' (and other name variations) should be read as 'Falkland Islands Maritime Authority' throughout the document.	Thank you for your comment. This is noted and will be amended throughout.	Section 2.2.3.1 and throughout document
FIMA 3	3.1.7.1 – International treaties and legislation relevant to the Falkland Islands. To note that the following international conventions listed have not yet been extended to the Falkland Islands by the UK:	Thank you for your comment. This is noted and will be amended.	Section 3.1.7.1

Ref.	Representation	Navitas response	Changes in Rev 4
	a. International Convention on Maritime Search and Rescue 1979. b. International Convention on the Control of Harmful Anti-fouling Systems on Ships 2001. c. International Convention for the Control and Management of Ship's Ballast Water and Sediments 2004 . Notwithstanding the issue of extension, under the Convention all vessels flagged to signatory states are required to hold certification confirming compliance with performance standard D-2 and to hold onboard an approved Ballast Water Management Plan.		
FIMA 4	3.1.7.3 – Falkland Islands national legislation. Maritime Ordinance 2017 should be listed.	Thank you for your comment. This is noted and will be amended.	Section 3.1.7.3
FIMA 5	3.2.8 – Emergency Response. An FIG Integrated Offshore Emergency Response (IOER) plan is currently (July 2024) in draft and will be shared with Navitas to ensure coherence with their Emergency Response Plans.	Noted thank you, Navitas look forward to collaborating with FIG on Emergency Response to ensure integrated plans. Navitas does not propose an amendment to document.	N/A
FIMA 6	3.2.18.1 – Sea Lion Field Northern Development Area management plans. FIMA looks forward to working with Navitas on the Harbour Management Plan (HMP).	Noted thank you for the comment.	N/A
FIMA 7	4.5.9 – Oil Spill Offshore. This section discounts dispersants and skimmers as viable options to respond to offshore oil spills because the oil is too waxy. No alternative options are offered here, although a return to the subject is promised later in the Statement.	Dispersants and oleophilic and weir skimmers are not considered suitable for this crude type. For Sea Lion crude, the CEDRE 2017 report states that 'oleophilic skimmers should not be recommended, as well as weir skimmers'. However, the report indicates that belt skimmers and nets would be appropriate. Weir skimming devices have been selected to respond to MGO spills. This equipment is specified in the Preliminary OPEPs submitted to FIG for review. Please see section 12.1.1.1.3 and the OPEPs for more detailed information. See also DMR 55. The text regarding the use of skimmers will be clarified in the relevant sections of the EIS.	Section 4.5.9

Ref.	Representation	Navitas response	Changes in Rev 4
FIMA 8	5.4.3 – Mobile Offshore Drilling Unit (MODU). Clarity needs to be established regarding how and by whom the 500m exclusion zone around the MODU (required under the Offshore Minerals Ordinance 1994) will be enforced. There will also be requirements to amend hydrographic publications and disseminate the information.	A dedicated ERRV (Emergency Response and Rescue Vessel (also known as "standby vessel") will be on standby at all times and ward off incoming 3rd party vessels and ensure no infringement of the 500m zone will occur. Vessel entry into the 500m zone will be controlled by permit and in accordance with the MODU Marine Operations Manual and MODU Safety Case. It is expected that marine activity close to the MODU will significantly reduce once the installation is on location and the relevant authorities and marine maps are updated.	N/A
FIMA 9	5.5.1 – Large Transport Vessel support. a. The indicative Large Transport Vessel (LTV) anchorages are noted. Final positions will be determined during future meetings between Navitas, FIMA, pilotage providers etc. b. Similarly to 5.4.3 above, clarity needs to be established regarding how, by whom and under what powers any 500m exclusion zone around the LTVs in Berkeley Sound will be enforced. There will also be requirements to amend hydrographic publications and disseminate the information. c. In order to put appropriate harbour management plans in place, more detail will be required on the LTVs themselves and activities likely to be associated with them, including the types of vessels rafting up, the frequency and duration of visits – and activity associated with visits such as the transfer of fuels, chemicals and large cargo. d. More detail is required on how will these vessels be serviced with regard to the discharge of food wastes, sullage and other discharges.	These are all good points. Navitas shall work closely with FIMA throughout the planning and execution stages of the development to ensure that: - final positions for the LTV anchorage sites are agreed and well communicated to mariners and other users of the sea - Activity Specific Operating Guidelines (ASOGs) are developed for the vessels operating in the area - FIMA is advised of all vessels planning to operate in the area - FIMA is advised of the activities and equipment / product transferred between vessels.	Section 5.5.1

Ref.	Representation	Navitas response	Changes in Rev 4
FIMA 10	5.11.1.1 – Port facilities. Although the majority of berthing activity will be centred on the Temporary Dock Facility (TDF) the wider impact of much increased maritime traffic using Stanley Harbour, Port William and Berkeley Sound needs to be fully examined to ensure de-confliction with other key users, adequate resourcing of harbour operations (anchorages, berths, pilotage, tugs) and ultimately the safe management of harbour operations.	Please refer to Section 11.2 Other users of the sea inshore for further detail on the planned use of the TDF and vessel movements within Stanley Harbour and Berkeley Sound. Navitas will work with FIMA as plans develop. As noted in the response to FIMA 9, Navitas agrees with these comments and is keen to work closely with FIMA throughout the planning and execution of the development.	N/A
FIMA 11	5.11.1.1.1 – The Temporary Dock Facility (TDF). This section makes reference to a requirement to increase the depth of water at the TDF. Falkland Islands legislation currently lacks provisions to support dredging operations however FIMA are liaising with AG Chambers over future legislative requirements.	The Falkland Islands planning process (including EIA) will be followed. Navitas will prepare a planning application and associated EIA as directed by the FIG Planning Department. Planning Permission was previously awarded to dredge an additional 0.5 m along the TDF berthing face but has now expired. Navitas will liaise with FIG Planning and FIMA, and the AG's Chambers as necessary, throughout.	N/A
FIMA 12	5.11.2 – Use of vessels. It is acknowledged that the figures cited assume a maximum number of vessels to provide a worst-case for impact and risk. That said, the estimate of total extra vessel 'days' for Stage 1 is 5,373 over 31 months, equating to an average of 5.6 extra vessels per day and for Stage 2 the total is 7,072 over 35 months, equating to an average of extra 6.5 vessels per day. The impact of this increase in traffic on harbour control, pilotage services, harbour launch provision, tug support, anchorages and berths needs to be fully scoped, understood and planned for, including the allocation by FIG of adequate resources to ensure harbour operations can be safely conducted.	As noted in the response to FIMA 9, Navitas agrees with these comments and is keen to work closely with FIMA throughout the planning and execution of the development. These numbers have significant contingency built in and Navitas will refine these requirements should approvals be granted.	N/A
FIMA 13	5.11.3.2 – Search and Rescue (SAR) exercises. Close liaison between Navitas and the FI SAR Committee will be required in order to ensure coherence with the FI SAR Strategy and FI SAR Plan, both updated in June 2024.	Agreed - Navitas looks forward to working closely with FIG in this regard.	N/A
FIMA 14	7.6.2 – Sensitivity of north Falkland coastline to offshore oil (Crude/diesel) spills.	Part a. In the very unlikely event of an oil spill, each spill	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	a. Whilst assessing the north Falklands coastline (particularly on East Falkland) as the most likely site of coastal contamination, this section however goes on to highlight the need for prioritization in response to any spill, saying: 'A pragmatic compromise will need to be reached that balances the importance of a site with the level of resources that are required. This may mean that some important sites may not be tackled in favour of other more accessible sites…'. The lack of alternative suggestions regarding further mitigation indicates that more work is required on this issue. b. Contamination of the north Falklands coastline would clearly be most likely in the event of consistent northerly winds. Whilst noting that any oil would take a number of days to reach the north Falklands coastline, those same northerly (rotor-inducing) winds are likely to impact on the arrival of responders from overseas in the event of a major spill.	would be considered on a case-by-case basis with a net environmental benefit analysis (NEBA) completed. The preliminary OPEPs and the work completed in the EIS are illustrative examples based on historical metocean and weather datasets and volume / type of oil assumptions but would be refined should such an incident occur. Part b. This is a valid point. However, the likelihood of sustained Northerlies (for over 30 days) is not expected and the resources (both equipment and personnel) to manage a response in the event of international support delay is available on the islands.	
FIMA 15	7.7.3.2 – Other users of Berkeley Sound and the east coast. Although this section acknowledges the role of Berkeley Sound in support of the fishing industry, it does not fully capture how busy the Sound can be during successful fishing seasons. For example, in March 2024 there were as many as 7 reefers, 2 tankers and 30+ fishing vessels in the Sound on a daily basis.	Noted, thank you a 'pers. comm' observation will be added to this effect to reflect the busy period noted in March 2024.	Section 7.7.3.2
FIMA 16	7.7.4.1.3 – Port facilities in Berkeley Sound. Although routinely used by the fishing industry for transhipping, Berkeley Sound is also regularly used by vessels of all kinds for shelter in adverse weather conditions. All vessels crossing the Reporting Line report to 'Stanley Port Control', not the Fisheries Department.	Thank you for your comment. This is noted and will be amended.	Section 7.7.4.1.3
FIMA 17	10.7.1.1 – Relevant legislation. Part 14 of the Maritime Ordinance 2017 (Dumping and Deposits at Sea) should be listed under 'Relevant Falklands legislation'.	Thank you for your comment. This is noted and will be amended.	Section 10.7.1.1
FIMA 18	10.7.1.1.5 – The PON 8 and oil sheen reporting. In addition to the Department of Mineral Resources (DMR), all oil sheen reports should also be made to FIMA. Further reporting guidance is contained within the NOSCP.	Thank you for your comment. This is noted and will be amended. Navitas note that the preliminary OPEPs submitted to FIG acknowledge that PON 8	Section 10.7.1.1.5

Ref.	Representation	Navitas response	Changes in Rev 4
		notifications/oil sheen reports will also be made to FIMA	
FIMA 19	10.11.5 – Industry-standard mitigation measures (to reduce the risk of collisions between vessels and marine animals). The reference to Navitas' operating procedures to limit maximum vessel speeds to 10 knots or less in certain areas is welcome and will complement existing procedures which see FIMA promulgating warnings and advisory speed limits in Port William and Berkeley Sound if whales have been reported in the vicinity.	Thank you for your comment. Navitas note that project specific mitigation reduces speed further to 8 knots at the entrance to Berkeley Sound. This is expected and reasonable and shall form part of the Vessels operating procedure and Area Specific Operations Guidelines (ASOGs).	N/A
FIMA 20	11.1.1.1.1 - Navigational Compliance. The expansion of Rule 7 to include reference to Automatic Identification System (AIS) should be removed or amended., as the current wording implies that it can be used as a stand-alone collision avoidance system. AIS can however be used with discretion and in combination with other systems and/or visual tracking.	Thank you for your comment. This is noted and will be amended.	Section 11.1.1.1.1
FIMA 21	11.1.1.1.2 – Offshore Exclusion Zones (safety zones). a. If retained, 'Notes to Mariners' should be changed to read 'Notices to Mariners'. b. Instead of the bulleted list in this paragraph, suggest replace with 'details of exclusion zones to be promulgated *via* Maritime Safety Information (MSI) under Coastal State obligations'. This wording will ensure that all means of promulgation are covered, not just those listed.	Thank you for your comment. This is noted and will be amended as per point b.	Section 11.1.1.1.2
FIMA 22	11.1.2.3 – Additional vessels. The phrase "while at sea, all Navitas project vessels which are not at anchor will maintain 24hr watchkeeping using radar, AIS and visual sightings" suggests (likely unintentionally) that Navitas project vessels at anchor will not maintain 24hr watches, which they are required to do under COLREGS 1972.	Thank you for your comment. This is noted and was not the intention. The text will be amended accordingly.	Section 11.1.2.3
FIMA 23	11.1.5.3 - Vessel operations. There is much emphasis on AIS in mitigating the risk of collision, which is relevant but AIS, if fitted, must be used in concert with the use of radar and visual lookout.	Thank you for your comment. This is noted and will be clarified.	Section 11.1.5.3

Ref.	Representation	Navitas response	Changes in Rev 4
FIMA 24	11.2.2.2.2 – LTV presence in Berkeley Sound. As noted in this section, final positions for the LTVs will be determined during future meetings between Navitas, FIMA, pilotage providers etc.	Thank you for your comment. This is noted and agreed.	N/A
FIMA 25	11.2.4.4.1 – Exclusion Zones. Clarity needs to be established regarding how, by whom and under what powers any 500m exclusion zone around the LTVs will be enforced.	Thank you for your comment. This is noted. Please see above response to comment FIMA 8. The potential for an exclusion zone and how this will be managed will be discussed with FIMA (notice to mariners, guard vessel, etc.) The future approach to selecting the final LTV locations, and determining the specifics of any proposed exclusion zone in consultation with FIMA will be noted in the post-consultation EIS.	Section 11.2.2.2
FIMA 26	11.2.4.4.1.1 – Reduced anchorage availability. Aside from bunkering and trans-shipment operations, vessels also use Berkeley Sound for shelter in adverse weather. Sheltering vessels will not always anchor.	Thank you for your comment. This is noted and will be amended.	Section 11.2.4.4.1.1
FIMA 27	11.2.5.2 – Vessel Operations. Navitas' harbour management plans for hydrocarbons-related shipping will be developed in close cooperation with FIMA, which exercises overall control of shipping movements in Stanley Harbour under the Harbours and Ports Ordinance 2017.	Thank you for your comment. This is noted and agreed.	N/A
FIMA 28	11.2.6.1.1 – Disturbance to other users within Stanley Harbour. Assessing the severity of the effect of additional vessels fuelling at FIPASS as 'Minor' may underplay the level of disturbance during busy periods in the fishing and cruise ship seasons, especially if a dedicated fuel line is not added to the TDF. In addition, a greater understanding is required regarding the capacity of those delivering pilotage services to cope with increased demand.	A dedicated fuel line from Stanley Services tank farm to the TDF is planned therefore it is expected that Navitas' use of FIPASS will be very limited. The comment on pilotage services is well noted and Navitas will work closely with FIMA and the pilotage service throughout the planning period and during operations to ensure that the service is not overwhelmed and that additional capacity can be sourced as required.	N/A
FIMA 29	11.2.6.1.2 – Loss of anchorage space due to exclusion zones in Berkeley Sound. To say that Berkeley Sound is 'largely unregulated' is not true. Although anchorages have not hitherto been formally allocated in the Sound, vessels are still required to make entry and departure reports and whilst	Thank you for your comment. This is noted and will be amended.	Section 11.2.6.1.2

Ref.	Representation	Navitas response	Changes in Rev 4
	using it vessels are subject to the same general regulatory regime as those using Port William and Stanley Harbour.		
FIMA 30	11.2.6.1.3 – Potential positive impact of the presence of Phase 1 and 2 Vessels. Noted and very welcome. When plans are mature enough, FIMA will be keen to learn what tug capability Navitas may deploy to the Stanley Harbour area.	Navitas shall keep FIMA advised of the vessels it has chartered and their capabilities.	N/A
FIMA 31	11.2.6.2.1 – Collisions in Stanley Harbour. Although the seasonal nature of traffic using Stanley Harbour is acknowledged elsewhere in the EIS, the phrase in this section “it will remain a relatively quiet port” is an over-generalization. Risks of collision need to be measured against the busy periods for the fishing and cruise ship industries when the port is anything but quiet.	Thank you for your comment. This is noted and the text has been amended to 'A relatively quiet port with notable busy periods during cruise ship and fishing seasons'. The precautionary approach of this assessment does include assessing the risk of collisions at busy times.	Section 11.2.6.2.1
FIMA 32	11.2.9.2 – Berkeley Sound. Although the context of the statement is understood, it is not correct to say “any vessel at anchor effectively has an exclusion zone around it”.	Thank you for your comment. Navitas will clarify the text.	Section 11.2.9.2
FIMA 33	11.2.10.4 – Monitoring required. Agreed.	Noted	N/A
FIMA 34	12.1.1.1 – Legislation relevant to oil and diesel spills. Under Falkland Islands Legislation, reference should be made to the Maritime (Ship to Ship Transfer) Regulations 2023, which came into force on 30th November 2023.	Thank you for your comment. This is noted and will be amended.	Section 12.1.1.1
FIMA 35	12.1.1.1.1 – National Oil Spill Contingency Plan (NOSCP). The NOSCP will need a root-and-branch review to ensure coherence between it and Navitas’ Oil Pollution Emergency Plan (OPEP), including clearly defining where responsibilities for shoreline protection and clean-up lie.	Thank you for your comment. This is noted and Navitas look forward to working with FIMA/FIG on this. Navitas has prepared and submitted preliminary OPEPs for FIG review (August 2024). Operational OPEPs will be completed and submitted to FIG for approval at least 6 months prior to commencement of operations.	N/A
FIMA 36	12.2.1.1 – Relevant legislation. As highlighted under 12.1.1.1, reference should be made to the Maritime (Ship to Ship Transfer) Regulations 2023.	Thank you for your comment. This is noted and will be amended.	Section 12.2.1.1
FIMA 37	12.2.7 – Project-specific mitigation measures. Close coordination between Navitas and FIMA over harbour management plans will be key. Bunkering	Thank you for your comment. This is noted and agreed.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	operations will also need to conform to the provisions of the Maritime (Ship to Ship Transfer) Regulations 2023.		
FIMA 38	12.3.4.1.3 – Vessel approaches. The point has been made earlier in this response but the phrase in this section "by international standards the harbour is not regarded as a busy port and collisions and groundings should be readily avoidable" down plays how crowded the port can get during busy periods for the fishing and cruise ship industries. It also does not take into account the significant impact of strong winds on the likelihood of groundings, as manifested in the grounding of the reefer FRIO CHIKUMA in April this year.	Please see response to comment FIMA 31 above.	Section 12.3.4.1.3
FIMA 39	12.3.5.2 – Vessel approaches. Already noted under earlier sections but – agreed - close coordination between Navitas and FIMA over harbour management plans will be key.	Thank you for your comment. This is noted and agreed.	N/A
FIMA 40	12.3.10 – Confidence. There is no need to rely on 'collective memory' regarding fuel spills, collisions and groundings, as official records are held by FIMA dating back to the 1990s. These can be made available to Navitas in support of further reporting.	These records have now been provided by FIMA and will be utilised to update the EIS.	Section 12.3.10
Fortuna Ltd. Group			
FOR 1	It is noted that the intention now is for 'direct offtake' at the oil field with no STS operation for crude oil in Berkeley Sound. There is a requirement for 2-3 large transport vessels (LTV), with exclusion zones, for up to c 13 months. Berkeley Sound is the main harbour used for seasonal *Illex* squid transhipment operations. Reliance on a range of services from Stanley supporting these transhipments means there are no realistic alternatives. The EIS assesses that the loss of anchorage space due to the LTVs will be low impact, which we hope will prove to be the case. We also hope that there will be no great impact or restriction on *Illex* transhipping operations which take place on a 24/7 basis.	These are all good points. Navitas shall work closely with FIMA and consult with FIFCA throughout the planning and execution stages of the development to ensure that: - final positions for the LTV anchorage sites are agreed and well communicated to mariners and other users of the sea - Activity Specific Operating Guidelines (ASOGs) are developed for the vessels operating in the area The LTVs (and 500m radius exclusion zones around both vessels) will take up 1.349% of the area of Berkeley Sound so are not considered to pose a significant impact to other users of the area.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		Of note: there will only be two LTV's in Berkeley Sound at any time.	
FOR 2	The EIS states that 'over-trawlable' subsea infrastructure is not considered necessary due to water depth and lack of fishing activity. That may be now, but it is not necessarily the case for ever. There are areas fished now which were not fished 30 years ago. This links to decommissioning as whilst the Sea Lion exclusion zones are in place trawling should only be at some distance. Once the site is abandoned/decommissioned it will be another matter. It is indicated that the decommissioning plan/commitment is a separate exercise and for the future. Our view is that the approach to decommissioning should be made clearer now and that the seabed should not be left fouled.	The Sea Lion subsea infrastructure will remain within exclusion zone whilst the field is operational. In accordance with Falkland Islands Government legislation decommissioning is subject to a separate EIA but it should be noted that the regulations state once a field is decommissioned all subsea infrastructure shall be removed, consequently there would be no requirement for overtrawlable structures. See also DGN 3.	N/A
FOR 3	Page 464: There are 3 charts showing valid fishing areas. Chart b) may be correct for finfish, but chart c) is not correct for *Illex* (it looks like a duplicate of b). The valid area for *Illex* covers a different area and includes and extends beyond the Sea Lion location. It is recognised that fishing for *Illex* does not extend to the full extent of the valid licence area for *Illex* licences. However, *Illex* fishing and *Illex* migrations occur closer to the Sealion area than portrayed by this chart.	Thank you for your comment. This is noted and the corrected charts will be placed in the post-consultation EIS. Additional information demonstrating the location of *illex* fishing in relation to the Sea Lion Field was presented in the FIFCA EIS presentation and will be published in the post-consultation EIS. The information demonstrates that there is no fishing overlap but vessels do occasionally transit over the Sea Lion field area.	Section 7.5.1.4 Figure 7-107
FOR 4	Page 484: The paragraph on the Falkland Islands economy characterises the fishing economy as "in 1990, the bulk economic activity shifted to the sale of fishing licences to foreign vessels" & "income from license fees fluctuates". It is noted that the EIS is quoting from other publications, but it is an obsolete characterisation which sells the FI fishing industry short. FIG Treasury data and other sources will show that corporate tax take from FI fishing companies is a very significant revenue stream but which also reflects the wider economic activity of FI fishing companies, investment and operation of FI registered vessels as well as partnering with overseas companies and vessels. A summary of GVA/GDP is added below showing that the fisheries sector accounts for *c.* 60%.	Navitas is required to assess oil spill financial liability and provide this as a separate regulatory submission to FIG for review and approval. This includes assessment of the worst-case impact on the Falkland Islands environment and economy (including specific fisheries and tourism analysis incorporating information from case studies from elsewhere and Falkland Islands specific information). This requires Navitas to demonstrate that it will have sufficient insurance in place to cover the assessed worst-case cost of oil spill response and clean up and the	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	The important point is that if there is an activity or accident which has a negative impact on the fishery in terms of magnitude it is not a few foreign licence fees at stake it could be a serious chunk of the entire FI economy.	financial impact on broader industry and the Islands economy.	
FOR 5	*Illex* (or Argentine Shortfin squid) are one of the most significant resources in the Southwest Atlantic and seasonally in FI conservation zones. The major potential pollution events of a blow-out or loss of FPSO cargo are indeed hopefully highly unlikely. There is some overlap between the *Illex* distribution both in FI zones and on high seas with the modelling of oil dispersion from those pollution events. In view of the significance of the *Illex* resource it is considered that there might have been more scope to model the potential interaction of *Illex* and oil. The table at page 1154 does capture the potential severity of impact to a degree. A spill which affects part of the fishery might have a wider reputational impact, or wider spread measures and restrictions due to a precautionary approach.	See response to FOR 4. In addition to this, within the Oil Spill Financial Liability Assessment actual and reputational damage as well as long term marketing impact have been considered thus demonstrating the maximum level of compensation (and therefore Navitas' insurance) to cover such an (albeit highly unlikely) event.	N/A
Falkland Islands Government Health and Safety			
H&S 1	Hazardous waste legislation is devolved in the UK and these amended. regs are only used in Scotland. Does this mean that all hazardous waste exported to the UK will arrive into Scotland, otherwise reference needs to be made to the Hazardous Waste (England & Wales) regulations 2005 as well.	If waste does need to be transported back to the UK, it is expected that it will arrive in Scotland and be managed / treated / disposed of in Scotland as was the case in the previous exploration drilling campaigns.	N/A
H&S 2	Oily wastewater will usually be classified as either EWC 13:05:07* or possibly 19:08:10* (if arising from a registered waste treatment facility) both of which are Absolute Hazardous Waste entries in WM3. In this case, how can it be discharged to foul sewer under a consent (particularly as there are currently no treatment facilities on the islands)?	The post-consultation EIS will clarify that onshore oily waste water will not go into the Stanley sewerage system. Onshore operations which may result in oily water discharge will be completed in a bunded area which will contain the oily water, this will then be treated, incinerated or dealt with away from the sewerage network and shall align with Navitas' Waste Management Procedure. It is understood that the FIG Stanley Incinerator will be operational by end 2026. This aligns with Navitas'	Section 10.10.2.2.1 Table 10.86 Section 10.7.2.8

Ref.	Representation	Navitas response	Changes in Rev 4
		operational schedule. Should the FIG Stanley Incinerator not be available Navitas would: 1. Store the waste in suitable containers onshore until the FIG incinerator is once again available; or 2. Store the waste in suitable containers onshore until offshore treatment on board either the MODU or FPSO is available 3. Store the waste in suitable containers onshore until a suitable volume is ready for export under the Basel Convention to the UK. Waste oils from this process shall always be candidates for re-use, incineration is a secondary solution.	
H&S 3	The disposal option for the aerosol and gas cylinder waste stream identifies Hazardous Landfill as one of the options: Most of this waste stream will be classed as “Flammable” (as propane is usually used as the propellant gas nowadays) and all flammables are banned from landfill disposal under the Landfill Directive (Article 5(3)b).	Understood, these waste streams will not go to landfill, the text in the chapter will be checked for clarity in the post-consultation EIS.	Section 10.10.4.4.1 Table 10.86
H&S 4	The disposal option for the hazardous electrical waste stream identifies Hazardous Landfill and Recovery (which is usually EfW) as the options: Waste electronics and electrical equipment is classed as “WEEE”, and the current UK WEEE regulations legally require all such waste to be diverted from landfill or incineration (which means producers of WEEE in any form have a responsibility to recycle and reuse any electrical waste where possible).	Understood, these waste streams will not go to landfill, text in the chapter will be checked for clarity in the post-consultation EIS.	Table 10.86
H&S 5	The disposal option for the non-hazardous electrical waste stream identifies Hazardous Landfill and Recovery (which is usually EfW) as two of the three options: As above, waste electronics and electrical equipment is classed as “WEEE”, and the current UK WEEE regulations legally require all such waste to be diverted from landfill or incineration (which means producers of WEEE in any form have a responsibility to recycle and reuse any electrical waste where possible).	Understood, these waste streams will not go to landfill, text in the chapter will be checked for clarity in the post-consultation EIS.	Table 10.86

Ref.	Representation	Navitas response	Changes in Rev 4
H&S 6	The disposal option for the oily water waste stream identifies Treat to Sewer as the option: Are sewage treatment facilities available on the islands, if not, then this should be, treat to registered discharge (covering discharges that go direct to a controlled water source). The consent limits are likely to be different in this case (and it would probably not be allowed).	Onshore oily waste water will not go into the Stanley sewerage system. This will be clarified in the post-consultation EIS. Onshore operations which may result in oily water discharge will be completed in a bunded area which will contain the oily water, this will then be treated, incinerated or dealt with away from the sewerage network and shall align with Navitas' Waste Management Procedure. It is understood that the FIG Stanley Incinerator will be operational by end 2026. This aligns with Navitas' operational schedule. Should the FIG Stanley Incinerator not be available Navitas would: 1. Store the waste in suitable containers onshore until the FIG incinerator is once again available; or 2. Store the waste in suitable containers onshore until offshore treatment on board either the MODU or FPSO is available 3. Store the waste in suitable containers onshore until a suitable volume is ready for export under the Basel Convention to the UK. Waste oils from this process shall always be candidates for re-use, incineration is a secondary solution.	Section 10.10.2.2.1 Table 10.86
H&S 7	Footnote 3 states that: “Any food waste returning to the supply base, for example if offshore macerators are not working, would be incinerated unless future opportunities arise in collaboration with FIG for composting of such resources”: Will this be classified as International Catering Waste (ICW)? which would then be classed as a Cat I Animal By Product (ABP). If this is the case, then it would need to comply with additional controls for storage, transport, and disposal.	Understood.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
Individual representations			
IND1 1	I am responding to your request for input to the public consultation on the Environmental Impact Statement (EIS) for the Sea Lion Field Northern Development Area, Phase 1 and 2, as published on your website (both the Non-Technical Summary and full document). I am sending this response to the consultation as a private individual and not on behalf of any organisation. In summary, my conclusion it that this project carries the risk of an accidental oil discharge resulting in severe environmental damage that would undermine the twin pillars of the current prosperity and future economic growth in the Falkland Islands, namely your Fisheries and Tourism industries. The current high GDP per capita of the Falkland Islands and its potential for further growth would be placed at risk in order to develop a new oil sector that will be a transient source of income. Furthermore, in the event of an oil discharge potential damage to the environment in the South Atlantic risks undermining your relationships with countries bordering that ocean. I give details of my analysis below.	Risk of oil spills are described in the document and the potential impact to tourism and fisheries is considered. Navitas is also required to assess oil spill financial liability and provide this as a separate regulatory submission to FIG for review and approval. This includes assessment of the worst-case impact on the Falkland Islands environment and economy (including specific fisheries and tourism analysis incorporating information from case studies from elsewhere and Falkland Islands specific information) and requires Navitas to demonstrate that it will have sufficient insurance in place to cover the assessed worst-case cost of oil spill response and clean up and the financial impact on broader industry and the Islands economy.	N/A
IND1 2	The risk that concerns me most is that of an unconstrained well blow out and oil release, similar to the 2010 Deepwater Horizon incident in the Gulf of Mexico. The industry has learnt from that incident by improving well design to reduce the risk of an unconstrained release of oil and by deploying well capping stacks in established oil producing regions so that a release can be contained quickly. The issue for the Falkland Islands is that as a new oil production region the specialized equipment needed to deal with an incident would need to be transported there after a problem has occurred.	Navitas will ensure industry best practice mitigation measures to minimise the risk of an uncontrolled release to oil. Capping Devices that can be transported by air in the event of an incident are readily available. Analysis of the location and number of capping devices available indicates that a capping device could be deployed to contain a well blow out at the Sea Lion field within 14 days, with 21 days being the worst-case expected scenario.	N/A
IND1 3	Section 1.7.4.3.1 'Accidental releases of crude oil or MGO to sea offshore' on page 38 of the Non-Technical Summary looks at the above risk but does not go into detail. For the details you need to go to Section 12.1 'Accidental and chronic oil pollution offshore' starting on page 1073 of the full EIS. Table 12.3 indicates that the assumed worst-case scenario for the duration of oil	Navitas is required to assess the potential impact of an oil spill event on the Falklands environment and economy and demonstrate to the Government that it will have sufficient insurance in place to cover this liability should an oil spill event occur. Revenues that	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	release from a well blow out is 21 days, based on the time taken to transport (by air) and deploy a well capping stack (details in Table 12.7). In reality there could be other complicating factors such as the need to extinguish fires on rigs and clear debris from a damaged wellhead so a capping stack can be deployed. Models of the dispersion of the released oil indicate it primarily moving in a Northern direction based on prevailing currents and wind (see for example Figure 12-4 on page 1110). The potential severity of the effect of a well blow out on the human population of the Falkland Islands *via* its impact on Fisheries and Tourism is considered to be 'High' but when the likelihood of occurrence is taken into account ('Unlikely') the overall risk significance is reduced to 'Moderate' (see Table 12.9). There are two major problems with using the above conclusions in the EIS to support development of the Sea Lion project. First, the GDP per capital of the Falkland Islands is relatively high by international standards but income from Fisheries and Tourism are significant contributors to this prosperity and its future growth (State of the Falkland Islands Economy 2020). Risking the viability of the two most promising sectors of the economy and the foundation of future prosperity of the Falkland islands to develop a third sector, that will provide only transient income, would be an unwise trade off.	would arise from the Sea Lion Phase 1 and 2 development would enable FIG to secure long term economic sustainability and insulate the Islands from the fluctuations in income associated with fishing and tourism.	
IND1 4	Second, the projected dispersion of any oil released in a Northern direction due to prevailing currents and wind, and away from the coast of the Falkland Islands, may seem like a positive. However, the countries in the region that the Falkland Islands has key relationships with may not see it that way as the potential environmental impacts in the wider South Atlantic would be severe, damaging international relations.	The oil spill modelling suggests that oil waxlets would disperse and degrade in the water column. Likelihood of oil beaching in detectible quantities is very low. Oil spill modelling indicates that by the time any oil crosses a transboundary line it would likely be undetectable with waxlets small and spread out, see Section 12.1.4.4.2.	N/A
IND1 5	In the interest of balance I note that the project design includes a gas injection well and associated gas compression facilities on the FPSO vessel in order to eliminate the routine flaring of produced gas during normal production (Table 1.1). There is therefore no reason to conclude that the carbon intensity of oil production in this project will be high by global standards. I will leave it to others to comment on links between oil	Thank you for your comments. Navitas notes the comment that there is no reason to conclude that the carbon intensity of oil production in this project will be high by global standards.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	production from a specific non OPEC+ project, such as this, and any incremental global oil consumption with associated carbon emissions. The above analysis and views are entirely my own. My conclusion is that this project is not in the long-term interest of the people of the Falkland Islands.		
IND2 1	Throughout the entire EIS there is a extreme lack of up to date data gathering and in date evidence provision.	Navitas will provide a table of new data acquired. This will be provided as an appendix to the post-consultation EIS.	Appendix 4
IND2 2	Table 4.4 Page 118, (Tanker Manoeuvring and Maintaining appropriate positioning) The reported simulation of 30 knots of winds and 3 meter seas show a total lack of understanding and knowledge of the seas and wind conditions often prevailing within the Sealion production area again showing total lack of any real time and up to date research.	Navitas strongly disagrees with this statement. Site specific metocean data collected over a 3 year period alongside the creation of a detailed metocean model drawing upon all the available datasets for the region demonstrates that the metocean conditions at the Sea Lion Field are similar to the UK Central North Sea. This modelling demonstrates that there will be sufficient berthing availability for direct offtake operations to be conducted safely.	N/A
IND2 3	No new up to date and accurate bird species data is evident for any of the inshore and offshore areas of operation, why was not survey work conducted within the areas by the company to show a commitment to having the correct UpToDate datasets not data from up to 20 years out of date. The environment has changed immensely in the last 10 years and the old data set information is now not current. The bird strike information is from 2015 and totally out of date.	There are new data from the GAP project, specifically tracking data. Regarding occurrence and distribution. The importance of the Patagonian Shelf around the Falkland Islands, as foraging habitat for seabirds and marine mammals and static ocean features that are associated with enhanced primary productivity. Baylis *et al.* (2019) highlights that for nine-species tracked, the probability of occurrence is highest on the Patagonian Shelf, shelf slope and the Burdwood Bank (Fig 7-53, pg. 360). These findings are similar to the at-sea distribution presented for the same species (White *et al.,* 2002). This is likely to reflect productivity on the Patagonian Shelf, being linked to the Patagonian Shelf, slope and Burdwood Bank (static features, associated with predictable areas of	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		enhanced productivity) (e.g., Fig 7-35, pg. 293). Based on the predictive models, and knowledge of local oceanography, the importance of the Patagonian Shelf around the Falkland Islands is unlikely to have changed over the past 24 years, hence animal distribution is still likely to be associated with the Patagonian Shelf. Regarding abundance: The statement specifically relates to the distribution and movements of animals. Data gaps remain for both Falkland Islands breeding species, and migratory visitors. Filling data gaps will improve our understanding of occurrence and distribution.	
IND2 4	10.1.6.1.2 page 603 the used data is not up to date and why did the company not carry out a full survey of the sealion field area of operation covering the entire year to get a full and in-depth analyses of all the species that do live and migrate through this area as this part of water in the FOCZ has very rich waters so attracts birds and whales at different times of the year.	Passive acoustic monitoring (PAM) data has been collected at the Sea Lion Field for one year. Whenever vessels associated with Sea Lion Field geotechnical, geophysical, seismic, exploration and appraisal operations have been in the area seabird and marine mammal observers (SMMOs) have been on board and collected data. These datasets, alongside other regional data (e.g., the GAP project with a large investments from both industry and government) have been compiled to inform this environmental impact assessment. It is understood however, that there are data gaps and this has been risk assessed through the EIA and the precautionary principle applied. In the EMMP Navitas has committed to continuing data collection within this area in order to verify the validity of the impact assessments and inform ongoing management and mitigation.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
IND2 5	10.1.6.1.3 page 604 this statement is very wrong that the sooty shearwaters only congregate at the entrance of Berkeley sound these birds use the entire length and breadth of Berkeley sound both in the early morning and evening when departing and returning to their nesting site. So being 10 kilometres from kidney is not a Low impact it is still a high one and all other bird species that are found in Berkeley sound also can be found in all areas, the tankers at anchor will impact highly with all flying bird species while at anchor in the sound, again no study has been conducted by the company on the abundance or areas of travel of birds within Berkeley sound showing yet again a total lack of concern for the wildlife environment.	Thank you for the comment. Observation by a number researchers suggest the greatest loafing abundances are in the region of Cochon and Kidney Islands during dawn and dusk. The sensitivity of the receptor is high because they represent a significant proportion of the biogeographic population (i.e., >1 % of the South Atlantic population). Navitas' operations in Berkeley Sound are limited to two anchored LTVs (not tankers) in clearly designated areas and the offtake of their cargo (infrastructure) over a period of 13 months. Navitas welcome the respondent to review the research on the benthic, birdlife, inter-tidal, coastal sensitivity which has been completed by the Company should they so desire.	N/A
IND2 6	10.1.6.2.1 page 605 How can the company say that single and multi bird strikes within the sealion field be low when they have not conducted any bird species or abundance of birds across a 12 month time scale, this again shows a total lack of interest or ability to gather the correct data and information for the EIS.	Thank you for the comment. Data are available from SAST surveys and other sources at the Sea Lion Field and in Berkeley Sound. See Chapter 7. The EMMP workshop report (April 2019) notes that workshop attendees (including environmental NGOs, independent experts and FI Fisheries Department) concluded that 'bird strikes caused by light attraction, where they occur tend to be very episodic and thus difficult to detect and monitor. There were no offshore bird strikes during the exploration and appraisal campaigns in the Sea Lion area and very few made during observations by FIFD in brightly-lit squid jigger fleet in waters to the north of the Falkland Islands.' Further surveys using qualified SMMOs will be conducted over 3 years before First-Oil. Of note, the presence of vessels in Berkeley Sound is limited to	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		two vessels for a total of 13 non-consecutive months and Navitas will also develop a Bird Strike Action Plan as part of the EMMP (Chapter 15).	
IND2 7	10.1.6.2.3, 10.1.6.2.4 pages 606,607 again the company has shown that there is no survey data conducted within Berkeley sound that they have not even commissioned an up to date and relevant survey when they knew that there was a big data gap in a very sensitive seabird area, having the impact as low yet again shows total lack of any concern for the wildlife environment of Berkeley sound with endangered species known to use the area intensely when breeding.	Thank you for the comment. Please see Ch7. Bird surveys in Berkeley Sound were conducted in all four seasons over a period of two years. Also note that the activities in Berkeley Sound are limited to two vessels over a period of 13 months. Navitas will also establish a Bird Strike Action Plan that includes Berkeley Sound and the Sea Lion Field.	N/A
IND2 8	The fishing industry has had very minimal shipping activity within Berkeley sound over the last 10 years which will have resulted in limited light pollution within the seabird breeding times.	Data from FIFD and FIMA would suggest that Berkeley Sound is regularly used by vessels, and Navitas would not consider it to have 'minimal shipping activity'.	N/A
IND2 9	10.5.6.1.3 page 703,704 the statement that transiting vessels will have a short duration of noise pollution time when entering Berkeley sound is not correct as once the vessels are anchored they will still emit large amounts of noise from the vessel into the water Colum from generators, also there will be significant noise from traveling launches and other supply vessel going to and from the vessels while they are moored. This additional traffic has not even been mentioned so having a slight as a disturbance is again showing total lack of understanding of the whale types who are present within Berkeley sound a anticipated kbi for Sei whales who are extremely sensitive to any additional noise levels.	When at anchor and not offloading their cargo, the LTVs will maintain one generator to keep the ship's facilities running but otherwise they will be on the anchor, weather vaning, minimising the noise they produce. When offloading they will be fully powered to enable safe operations etc. This will be acknowledged in the revised underwater noise section which will be included in the-post-consultation EIS.	Section 10.5
IND2 10	Table 10.35 under mitigation/prevention/control there is Project specific none proposed why is the company not actively looking at all additional ways to address these headlines with a project specific proposal thus actually showing that the known noise disturbance is being worked on and reduced not that it is being ignored.	No mitigations are proposed here as the potential impacts from two vessels anchoring in Berkeley Sound for up to 13 months have been assessed as 'Low' and 'Very low'	N/A
IND2 11	There is no UpToDate data or even any sign of the company attempting to establish the extent of the whale population and species types that will be highly effected within Berkeley sound and also the FICZ FOCZ of operations for the proposed oil field, no study or area information gathering work has	Thank you for the comment. Please note: Navitas (previously POEPL) invested significantly in data gathering to inform the environmental baseline of the Sea Lion Field and	Section 7.4.6

Ref.	Representation	Navitas response	Changes in Rev 4
	been carried out and this part of the EIS feels like an after thought the whale populations and species around the Falkland islands and the waters are increasing and this is widely known (with over 8 years of comprehensive study by Falkland Conservation) but the company has shown little or no regard to this information or even reaching out to get the up to date and relevant information to actually make any risk assessment and mitigation works for the whale and dolphin populations.	inshore areas relevant to the proposed development. The Hipsey report gathered Sea Lion specific data over a 14-month period. Please note, given the limited operations now proposed in Berkeley Sound (i.e., no inshore transfer and only two vessels anchored for a non-consecutive period of 13 months) the EMMP workshop screened out the need for further Berkeley Sound Marine Mammal data. The baseline information was up to date at the time of writing and will be updated further as part of the post-consultation submission process. Navitas is committed to further data collection - see Chapter 15. The FIG 2016 guidance states that the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained. When carrying out the risk assessment data gaps can be taken into account and within the EIS are factored into the precautionary approach and the confidence ratings within the EIS.	
IND2 12	I fully support and agree with all of the Falkland conservation EIS reply statement, the entire Navitas EIS is not fit for purpose.	Navitas strongly disagrees with this statement. We refer the reader to the responses to Falklands Conversation (FC) comments.	N/A
IND3 1	The EIS indicates that in the majority of the oil spill scenarios considered the impact on squid and the associated fisheries would be “Low” or “Very Low”, with the exception of Scenario 1, where the impact is assessed as “Moderate”. I believe this is an underestimation of the sensitivity of the squid species that inhabit Falklands waters. Please find my detailed comments below: 1. Baseline biological information is incomplete or inaccurate	Thank you for the comment. Navitas will amend the text with new information from Chemshirova *et al.* (2023). Their abundances are likely to be low during that period. Arkhipkin *et al.* (2012), based on data from 13,044 commercial bottom and pelagic trawls between 2000 and 2010 mainly within the FCMFZ, and from 1,272 research trawls taken between 1999 and 2011 reports that they are 'practically absent	Section 7.4.4.2.2.2 Section 7.4.4.2.3.2

Ref.	Representation	Navitas response	Changes in Rev 4
	Sections 7.4.4.2.2.2 and 7.4.4.2.3.2. Table 7.9. Argentine shortfin squid: This table contains inaccurate information regarding the presence of this species in the Northern Slope habitat zone, namely it characterises this species as "Absent" in Winter, which is incorrect. The annual Falkland Islands Fisheries Department groundfish survey reports from July surveys show that this species persists throughout the region. Moreover, the individuals that are found during these periods are juveniles, which are more susceptible to possible environmental impacts of the project. Recent research has also highlighted the importance of these seemingly small assemblages of squid which help maintain the species' flexibility and adaptivity to adverse environmental conditions (Chemshirova *et al.,* 2023). The omission of this information leads to the underestimation of importance of these individuals and thus subsequently an underestimation of the possible impact of the development on this commercial species, valuable to the Falkland Islands fisheries	from the Patagonian Shelf and slope'. Also note that the assessment is based on a combination of the sensitivity of the receptor, severity of the effect and the likelihood of occurrence. Which in the case of oil spill is unlikely. Please see Chapter 8 on methodology. Navitas is required to assess oil spill financial liability and provide this as a separate regulatory submission to FIG for review and approval, this assessment was issued to FIG in August. This includes assessment of the worst-case impact on the Falkland Islands environment and economy (including specific fisheries analysis incorporating information from case studies from elsewhere and Falkland Islands specific information) and requires Navitas to demonstrate that it will have sufficient insurance in place to cover the assessed worst-case cost of oil spill response and clean up and the financial impact on broader industry and the Islands economy.	
IND3 2	Section 7.4.4.3 This section states that a summary of the ecology of each species is provided - "their seasonal abundances in relation to the Berkeley Sound Area, their seasonal spawning migrations and their principal diet." However, in the relevant section (7.4.4.3.2.1) when discussing "Loligo (Patagonian long-finned squid)" only superficial mention of "zooplankton" is made with regards to diet, despite extensive research on the topic being widely available (Büring *et al.,* 2022; Jones *et al.,* 2023). The summary also omits recent literature that highlights the importance of D. gahi as a keystone species in the Falkland Islands ecosystem (van der Grient, 2023; Büring *et al.,* 2024). The lack of information presented in this section leads to further misconceptions that result in the environmental impact of the development being underestimated.	Thank you for the comment. Navitas will update the text where relevant. The Büring *et al.,* 2024 and Jones *et al.,* 2023 papers were not available at the time of writing. Additional detail has been added on loligo diet, however, as this is a layman's summary it is felt adding detail on the stable isotopes using gladii (the subject of Jones et al) is too detailed for this EIS.	Section 7.4.4.3.2.1

Ref.	Representation	Navitas response	Changes in Rev 4
IND3 3	2. Misrepresentation of fishing activity relating to jigging and trawling vessels Section 7.7.3.1.1 The statement made here: "However, further analysis of Vessel Monitoring System (VMS) data indicates that most of the vessels reporting catch in this square were in fact fishing elsewhere." There doesn't seem to be any evidence presented to support this. Furthermore, whilst the subsequent sentence acknowledges the variability of *Illex* catches and the connection between high catches in the relevant grid square and years of high *Illex* abundance, the conclusion is drawn that "the area is rarely fished". This is an erroneous conclusion, one of the key characteristics of the *Illex* fishery is the inter-annual fluctuations frequently associated with environmental drivers (Chemshirova *et al.,* 2021). The current impact assessment subsequently minimises the possible effects the development may have by completely ruling out the possibility of the fishery utilising the same areas simply on the basis of population fluctuations.	Thank you for the comment. Navitas has also analysed AIS data and it is clear that the *Illex* fleet fish on the shelf break and sometimes report either their midday or midnight positions in the relevant grid square XFAK but do not fish in there. The AIS data corroborates the VMS data. Navitas is required to assess oil spill financial liability and provide this as a separate regulatory submission to FIG for review and approval, this assessment was issued to FIG in August, 2024. This includes assessment of the worst-case impact on the Falkland Islands environment and economy (including specific fisheries and tourism analysis incorporating information from case studies from elsewhere and Falkland Islands specific information) and requires Navitas to demonstrate that it will have sufficient insurance in place to cover the assessed worst-case cost of oil spill response and clean up and the financial impact on broader industry and the Islands economy.	N/A
IND3 4	3. Underwater noise - Offshore - omissions of recent relevant literature: Section 10.4.4.3.1 This section aims to assess the effect of the noise generated by the project on the invertebrates with a focus on squid. However, recent and relevant research on the topic is omitted. Recent literature investigating the effect of anthropogenic noise in the range of 20 - 1000 Hz shows negative effects on *Doryteuthis pealeii* feeding behaviour (Jones *et al.,* 2021). The proposed project's estimated noise level is <1000 Hz, this falls within the range investigated by the previously cited study. Furthermore, this section states "...commercially exploitable aggregations of squid are not known to occur within the area of the Sea Lion Field…", this also serves to underestimate the impact of the development as addressed in point 2 above.	Thank you for your comment, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. These sections are also being updated with relevant citations suggested during the public consultation. See FIFD 54.	Section 10.4 Section 10.4.4.2 Section **Error! Reference source not found.** Section 10.5 Section 10.5.6.2

Ref.	Representation	Navitas response	Changes in Rev 4
IND3 5	4. Ecotoxicity tests not performed on cephalopods and effects of contamination not fully considered. Section 12.1.4.1.1.1 and Section 12.1.4.2.3.2 The ecotoxicity tests of the crude oil only investigated the effects on embryonic zebrafish. This is insufficient evidence for potential impact on squid eggs, which differ significantly from a freshwater fish. Additionally, there were no tests performed on any of the paralarval/juvenile stages which are more vulnerable than egg masses or adults for two reasons: a) they are not as mobile as adults and often subject to current transport; and b) previous studies on O. pallidus showed that newly hatched animals were more sensitive to the toxic effects of crude oil (Long & Holdway 2001). Overall, the omission of this information and lack of testing further leads to the inaccurate assumption that crude oil would have negligible effect on newly hatched individuals, again underestimating the risk and impact of the development. Furthermore, there is an omission of research that clearly shows that molluscs including cephalopods are more susceptible to polycyclic aromatic hydrocarbons due to their reduced ability to metabolise these compounds, thus leading to higher likelihood of bioaccumulation compared with other organisms (Lacoue-Labarthe *et al.,* 2016; Rodrigo & Costa, 2017). This further serves to minimise the negative impact that the potential development may have on squid populations.	Thank you for the comments. These are noted. See response to IND10 1. An oil spill is an unplanned risk and impact that could be caused by multiple stakeholders - not just the oil industry. Additional data acquisition will not change mitigation, but may help better predict effects of a spill event. Navitas would consider participating in research effort to explore oil spill effect on squid egg masses. Ecotoxicity tests using Sea Lion crude were carried out on zebra fish eggs at the CEDRE laboratory. It was not possible to transport and import Falkland Islands squid eggs to France and maintain their integrity to enable lab testing. The CEDRE report notes that 'Concerning the toxicity of the oil on fish eggs, no acute toxicity was observed. A slight subacute toxicity (larval malformation <3%) was noted for the highest concentrations (between 29% and 100% of the water saturated with PAHs).' The concentrations employed in the lab testing are highly precautionary being far greater than the concentrations that would be expected in a spill event, and the crude would form solid masses on contact with the sea-water, limiting potential for contamination. While not fully understood, the current thinking is that the major spawning grounds are on the Eastern sea-board, whilst it is also acknowledged that loligo may spawn all round the Falklands: it is important to note that in a spill event the modelling suggests that none of the oil reaches these areas. In the worst deterministic case the modelling suggests that oil might reach the northern coast in extremely low concentrations.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
IND3 6	5. Incomplete information on *D. gahi* life span Section 12.1.4.2.3 This section makes the case for the life span of all squid being only one year, thus any effects of a spill would be minimal. This is inaccurate. Recent research found that a proportion of the population lives longer than one year (Jones *et al.,* 2019). This means that any adverse effects could be magnified across time and space. This again leads to the incorrect conclusion that the impact of the development on the squid population in the region would be minimal.	Thank you for the comment. Navitas will update the text stating this; however, it should be noted that the majority of loligo only live for ~ one year. The Jones *et al.* (2019) paper is on super bull males. The results suggest that superbulls provide temporal connectivity and arise through phenotypic plasticity, likely providing connectivity (between cohorts) as a side effect of body shape and size rather than a genetically selected advantage. Please note that they represent a small proportion of the population.	Section 12.1.4.2.3.1
IND3 7	6. Underestimation the wider effect on squid population dynamics Section 12.1.4.2.3. This section does state that squid are sensitive to environmental conditions, but omits the fact that whilst the general short life span of squid (see point 5) may limit bioaccumulation, squid populations can be very volatile. Therefore, once knocked out of equilibrium there is a risk of the population entering a boom and bust cycle, which can be very damaging for squid fisheries in the long term (Rodhouse 2008). Again, I believe this section underestimates the extent of the impact of this development by not considering or presenting key aspects of squid biology.	Thank you for the comment. Considering the nature of the oil and the likelihood of a large spill / blow out Navitas has been precautionary. Navitas is required to assess oil spill financial liability and provide this as a separate regulatory submission to FIG for review and approval, this assessment was issued to FIG in August. This includes assessment of the worst-case impact on the Falkland Islands environment and economy (including specific fisheries and tourism analysis incorporating information from case studies from elsewhere and Falkland Islands specific information) and requires Navitas to demonstrate that it will have sufficient insurance in place to cover the assessed worst-case cost of oil spill response and clean up and the financial impact on broader industry and the Islands economy.	N/A
IND3 8	7. Omission of cephalopod biology and recent research on the effects of oil contaminants on cephalopods Section 12.1.4.2.3 All squid species perform vertical diel migrations, this makes them more susceptible to the adverse effects of contaminants from an oil spill (Sutton et al, 2022). Furthermore, due to these migrations, they are more likely vectors of the transfer of said contaminants (Arkhipkin,	Thank you for the comment. Both these papers are the subject of Macondo oil spill which is very light non-viscous volatile crude which is in great contrast to the Sea Lion crude. The latter is buoyant and will be solid due it is pour point. The modelling also shows that it will be carried in a north easterly direction for	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	2013). Previous work on investigation of oil spill contaminants has shown that the exposure of squid to these contaminants has been previously underestimated (Romero *et al.,* 2020). Additionally, the duration of the exposure of said contaminants was also longer than previously expected (Romero *et al.,* 2020). Finally, this again contributes to the overall underestimation of the potential risks associated with the proposed development.	the most frequent metocean conditions. Navitas has been precautionary in the risk assessment. All matters to do with fisheries have been assessed as significant. Navitas is required to assess oil spill financial liability and provide this as a separate regulatory submission to FIG for review and approval, this assessment was issued to FIG in August, 2024. This includes assessment of the worst-case impact on the Falkland Islands environment and economy (including specific fisheries analysis incorporating information from case studies from elsewhere and Falkland Islands specific information) and requires Navitas to demonstrate that it will have sufficient insurance in place to cover the assessed worst-case cost of oil spill response and clean up and the financial impact on broader industry and the Islands economy.	
IND3 9	8. No commitment of investigation of D. gahi spawning grounds. Section 1.6.1.1.2 Identifies the lack of information on D. gahi spawning grounds as a "key data gap". Section 7.2.4.1 it is stated that "the prevalence of these bottom-attached masses remains unclear". However, there is no evident commitment or attempt made to investigate this further, beyond some of the shallow surveys near Berkley Sound. This is insufficient, and contributes to the prolonged underestimation of the impact of this development on the squid populations in the Falkland Islands.	There is no inshore transfer of oil in the current project proposal: the activity in and nearshore is restricted to vessels transiting between Stanley and Berkeley Sound and the Sea Lion field. In addition there will be two LTVs in Berkeley Sound for a duration of 13 months. and in the unlikely event of an oil spill the modelling undertaken determines that very little oil arising from an offshore spill would reach the near shore. Navitas discussed the possibility of testing loligo eggs but it was not possible to keep them alive and get them to the CEDRE laboratory in France. Navitas has been precautionary in the risk assessment. Please also see response to IND 3 10.	N/A
IND3 10	Recommendations Based on the analysis described above, I do not recommend the	The industry committed through GAP to support research into loligo spawning grounds. At that time	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	commencement of the project. Further studies should include establishing up-to-date and baselines for the squid populations of the region; obtaining accurate locations of the possible spawning sites for D. gahi and performing ecotoxicity tests on squid egg masses, paralarvae and juveniles.	Premier was intending on crude oil transfer in Berkeley Sound; this is no longer the case. An oil spill is an unplanned risk and impact that could be caused by multiple stakeholders - not just the oil industry. Navitas would consider participating in research effort to explore oil spill effect on squid egg masses. Ecotoxicity tests using Sea Lion crude were carried out on zebra fish eggs at the CEDRE laboratory. It was not possible to transport and import Falkland Islands squid eggs to France and maintain their integrity to enable lab testing. Additional data acquisition will not change mitigation, but may help better predict effects of a spill event. Navitas is required to assess oil spill financial liability and provide this as a separate regulatory submission to FIG for review and approval, this assessment was issued to FIG in August, 2024. This includes assessment of the worst-case impact on the Falkland Islands environment and economy (including specific fisheries and tourism analysis incorporating information from case studies from elsewhere and Falkland Islands specific information) and requires Navitas to demonstrate that it will have sufficient insurance in place to cover the assessed worst-case cost of oil spill response and clean up and the financial impact on broader industry and the Islands economy.	
IND3 11	Conclusion In conclusion, the proposed oil drilling project may have a significant effect on local cephalopod populations. I urge the Falkland Islands Government and the Members of the Legislative Assembly to carefully consider these factors before making a final decision.	The Sea Lion Field is not a significant area of cephalopod migration - as such, fishing in the area is minimal. Navitas will provide additional clarity on the location of the fishery in relation to the Sea Lion field in the post-consultation EIS.	Section 12.1 Section 12.2

Ref.	Representation	Navitas response	Changes in Rev 4
		As detailed in the EIS an oil spill event would be highly unlikely and is heavily mitigated against. Should such an event occur Navitas' Oil Spill Financial Liability Assessment (issued to FIG in August 2024) details the coverage that Navitas will have in place to compensate stakeholders affected by a spill. Laboratory testing has shown that Sea Lion crude has prolonged buoyancy, low solubility, low polycyclic aromatic content and relatively low toxicity which would likely limit the biological effect on squid. Biological recovery is likely to occur in one year. The Financial Liability Assessment notes however that a spill event would likely have a marketing impact, such that stakeholder compensation would be required.	
IND4 1	There will be significant carbon emissions as a result of the burning of oil produced. There is little commitment to offsetting these emissions. FIG have frequently pushed their environmental credentials and a desire for net zero but appear happy to contribute significant amounts of CO_2 to the atmosphere without proper offsetting in place.	The subject of Emissions is extensively detailed in Section 10.9 of the EIS. Navitas remains committed to exploring opportunities to further reduce its emissions; an example of this is the Emissions Reduction Action Plan (ERAP) for the Floating Production Storage Offtake (FPSO) during the Front End Engineering and Design (FEED) project and will continue throughout the life-cycle of the Sea Lion Field. Carbon and biodiversity offsetting opportunities require further evaluation and research to define the level of offsetting that can be achieved locally. Navitas is committed to complying with FIG's offsetting guidelines and policies. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting	Section 10.9.7 Section 10.9.11

Ref.	Representation	Navitas response	Changes in Rev 4
		fund. It would not be possible for Navitas to control the use of the product once it has been sold or monitor and manage emissions, thus the end user's emissions will be their responsibility to monitor, manage and offset; their scope 1 & 2 and will be considered our scope 3. A conservative assumption of Navitas' Scope 3 sold emissions (all being combusted) were included in the EIS.	
IND4 2	There is likely to be significant impacts on wildlife and there is still a lot of data missing on this (EIS even acknowledges there are data gaps) - imo far more robust data should be in place. Falkland's tourism and lifestyle is very much based around wildlife. Risking this by potentially going ahead without full data in place is very concerning.	Please note that under FIG's guidance (FIG, 2016) the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they are dealt with in the risk assessment. Therefore the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained and indeed a precautionary approach is taken.	N/A
IND4 3	Going ahead with a huge oil development such as this appears at odds with FIGs commitments to net zero. Indeed it is likely to lead to the Falkland Islands having the highest CO_2 emissions per head anywhere in the world (we cannot and should not wash our hands of the emissions created once the oil has been exported)	Thank you for your comment. This is noted. However, it is not for Navitas to comment on FIG policy and would refer this comment to FIG.	N/A
IND4 4	There is little information on how the oil will be decommissioned if/when it becomes uneconomical.	Falkland Islands legislation requires Navitas to fund full decommissioning and to ensure that all infrastructure is designed so that it can be fully decommissioned. FIG will undertake assurance to ensure that adequate funds for decommissioning are in place throughout life of field. Please also refer to DGN 3.	N/A
IND4 5	Although spill risks are mentioned there is little information on how specific species will be affected	Note there are three chapters on oil spills and details on species affected, see sections 12.1, 12.2 & 12.3.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
IND4 6	Impacts on cetaceans in Falklands waters have not been fully explored. Much of the data is inadequate and the latest information has not been used/taken into account as far as I can see (for example impact of noise on cetaceans or entanglement issues do not appear to have been fully explored)	Underwater noise impacts on cetaceans inshore and offshore are covered in section 10.4 and 10.5. . The lines that will be placed in the water for the Sea Lion project include flowlines, risers and anchor chains. All of these are substantial and solid pieces of equipment, which Navitas believe poses a very low risk of entanglement to marine mammals. However, it is recognised that whale entanglement in anchor chains does occur, so a Whale Entanglement Management Plan will be put in place. Further detail on entanglement will be included in section 10.11. See also FC 82, FC 88).	Section 10.4 Section 10.5 Section 10.11.2.2
IND4 7	The EIS identifies over 30% of negative impacts as moderate or upper moderate - this includes atmospheric emissions (which in the middle of a climate crisis to me seems completely unacceptable - especially with no commitment to offsetting as above), collision with marine mammals (which is an unacceptable risk imo) and introduction of invasive species (we have seen the impact invasive species have had on many islands and how they have decimated seabirds. We have also seen the impact earwigs have had in Stanley - do we really want to have a moderate risk of this occurring?). It also lists competition for freshwater resources as upper moderate - with a drying climate and water scarcity likely to get worse this is deeply concerning.	Navitas has been very precautionary in all the impact and risk assessments. Risk of collision with marine mammals is not a risk specific to the oil industry but is present in relation to all marine traffic. Navitas has committed to vessel speeds below those recommended by guidance in order to minimise the risk to as low as reasonably practicable (Section 10.11.7). The impact for invasive species introduction is rated highly because of the impact that would arise if it were to actually occur despite all the preventative measures. Competition for freshwater is rated highly currently as the assessment has conservatively assumed that the planned increases to freshwater catchment and treatment will not be in place. If FIG makes these planned investments then the rating for this impact will decrease. In the event of a water shortage the project would be lowest priority for freshwater -	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		community and other industry needs would come first.	
IND4 8	The table (page 32) mentions competition for accommodation as an "upper moderate" risk. Housing in Stanley is already in short supply and prices high. There is a very real risk that people will be pushed into poverty by increasing rents (there are already a number of examples of rents rising due to people anticipating increased demand - houses are being bought by big companies with the intention of renting to oil for huge sums). As well as potential increase in poverty there is the very real risk of homelessness/people leaving the islands due to lack of affordable accommodation. This has not been addressed in the EIS beyond a brief mention in the table.	Sea Lion Phase 1 & 2 requirements and housing supply will be discussed further in the Socio-economic impact assessment. Navitas is committed to provision of increased housing to meet Sea Lion Phase 1 & 2 demand and to working closely with FIG to assist in the monitoring and management of this potential adverse impact, which extends beyond the potential Sea Lion Phase 1 & 2 development, and is a feature of Falkland Islands economic growth generally.	N/A
IND5 1	In reviewing the presented Environmental Impact Statement (EIS), several fundamental issues emerge that call into question the adequacy of the document for its intended purpose: 1. The EIS is Not Fit for Purpose: The current EIS fails to meet the necessary standards for a thorough and reliable assessment of the proposed project's environmental impacts. It lacks the comprehensive detail and rigor required to make informed decisions about the project's viability and its long-term effects on the environment. The gaps and deficiencies in the document suggest that it is not fit for purpose and requires significant revision.	The EIS meets international best practice and with regards to gaps it is important to note that under FIG's guidance (FIG, 2016), the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they are dealt with in the risk assessment. Therefore the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained and indeed a precautionary approach is taken.	N/A
IND5 2	2. Carbon Emissions and Lack of Commitment to Offsetting: The EIS inadequately addresses the project's contribution to carbon emissions and fails to present a clear commitment to offsetting these emissions. Given the global urgency of combating climate change, the absence of a robust carbon management and offsetting plan is a critical oversight. The project must include specific targets and strategies for reducing and offsetting carbon emissions to align with international climate goals and to be consistent with FIG Guidance.	The subject of Emissions is extensively detailed in Section 10.9 of the EIS. Navitas are committed to exploring opportunities to further reduce emissions and to offsetting. Carbon offsetting opportunities require further evaluation and research to define the level of offsetting that can be achieved locally. Offsetting approach is being confirmed with FIG and	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		will be consistent with FIG legislation, policy and guidance. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund.	
IND5 3	3. Impacts on Wildlife and Data Gaps: The EIS presents significant data gaps concerning the potential impacts on local wildlife. These gaps and outdated data hinder the ability to assess how the project may affect vulnerable and endangered species and ecosystems. The document lacks a comprehensive analysis of the risks to wildlife, particularly concerning habitat disruption, pollution, protected areas. Addressing these data gaps through further research and ongoing monitoring is crucial for protecting biodiversity. Most of the data is over 10 years old. In example, I would like to highlight the lack of current data regarding Southern right whales, species that have been seen increasingly since 2017 and occurs persistently over the years, showing a clear use of Falklands Islands Waters. No current data published has been included in the EIS.	Thank you for the comment. There are lots of examples of recent data including tracking data from the GAP project and indeed more recently. New references will be added to the text and as with the response to the comment IND5 ,1 under FIG's guidance (FIG, 2016) the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they are dealt with in the risk assessment. Therefore the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained and indeed a precautionary approach is taken.	N/A
IND5 4	4. Decommissioning and Spill Risks: The EIS inadequately addresses the risks associated with decommissioning and potential spills. A detailed and enforceable decommissioning plan must be included, along with a robust spill response strategy. Historical evidence indicates that spills can cause long-lasting damage to ecosystems, and the current EIS does not provide sufficient assurances that such risks will be effectively managed and the responsibility should not be passed to Falkland Islands Government.	Decommissioning is subject to a separate EIS. Navitas is legally obliged to decommission offshore infrastructure. See DGN 3. Spills are covered in sections 12.1, 12.2 and 12.3. Risks are managed in accordance with accepted industry best practice. Preliminary Oil Pollution Emergency Plans have been submitted to FIG along with a document that assesses potential financial liability associated with oil spill events (including the potential impact on fishing and tourism) and demonstrates that Navitas will have sufficient	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		funding/insurance cover in place to cover liability arising. Navitas recognises that the Polluter Pays Principle will be enforced, as such liability arising will not fall to FIG.	
IND5 5	5. Incomplete Legal Framework for Environmental Governance: In addition to the concerns above; the existing legal framework is insufficient to ensure effective environmental governance in the context of this project. Current regulations do not provide adequate safeguards or enforcement mechanisms to protect the environment from potential harm. Strengthening the legal framework is essential to ensure that environmental risks are properly managed and mitigated.	Navitas has submitted the Field Development Plan (FDP) and Environmental Impact Statement (EIS) in accordance with FIG's current legislative framework. Navitas continues to work with FIG and its key contractors to ensure that its arrangements are aligned with industry best practice and FIG's planned changes to legislation. Navitas expects that FIG will comment separately on the EIS public consultation representations which cover FIG's Oil Readiness and planned legislation.	N/A
IND5 6	In summary, the presented EIS is inadequate and requires substantial revisions to address its deficiencies. The document falls short in its assessment of environmental impacts, lacks alignment with both local and international environmental legislation, and fails to provide sufficient safeguards against potential risks. A more rigorous, detailed, and legally compliant EIS is essential for responsible decision-making and for the protection of the environment in the Falkland Islands.	ExCo 118/24 confirmed that the EIS submitted for public consultation was legislatively compliant. The document also meets international and more specifically UK best practice.	N/A
IND6 1	My knowledge of the oil industry is limited, but after reading the EIS and spending some time researching, slightly more knowledgeable than a few weeks ago. I read the non-technical EIS summary and found it a comprehensive risk assessment profile. Historically oil around the Falkland Islands could be thought of as 'political,' oil has featured in strategies and decisions made by British and Argentine governments since at least the 1960s, swinging from wanting/keeping sovereignty of the Falkland Islands to war; always simmering below the surface. This hampered oil development, but now, with advanced technology and political changes, the time is right.	Thank you for your comments. In answer to your questions: 1. Navitas is working closely with FIG and the local business community to ensure that all stakeholders are prepared for the Sea Lion Development. This public and private dialogue will continue throughout the planning and execution stages of the development. 2. In August 2024 Navitas submitted its Carbon & Biodiversity Offsetting Fund Strategy to FIG. Once the strategy is agreed by all parties application for local	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	The fishing industry, despite fears, has not wiped out our marine species; in fact, whales are thriving. Once the platforms and measures for species protection is in place I doubt there will be any difference than the present fishing fleet effect, regarding movements, light at sea at night, or with careful management, noise. There always will be damage/change, as there is with anything humans undertake. Species adapt to the environment. Is FIG sufficiently prepared with essential services - electricity, water, sewage, waste management and accommodation? I have not heard or read anything that gives me confidence that FIG is prepared. I also think sending ash/waste to landfill in UK, or anywhere else, is unacceptable, a facility should be built on the islands. Offsets usually refer to like-for-like [replanting a forest or replacing natural features]. The Falkland Islands are different in natural features, the replacement of a stand of rock, part of a stone run, or beach tidy would be superficial, practicality is needed. I hope the internal fund will go toward these services. It will be interesting to learn how emissions can be offset. How much say will FIG have in what happens to 'our' oil, will they have any influence. Falkland Islanders now have the right to self- determination, to freely pursue economic development and freely dispose of natural wealth and resources, written in our Constitution and endorsed by the UN. Yet…I expect, apart from a percentage per barrel and tax revenue FIG will not have any influence in a wider sense; probably wishful thinking for anything more and this development will go the way of other bonanzas. Is Navitas Petroleum an ethical company? How do/did Navitas view/choose their investors for the Sea	and international offsetting projects will be welcomed. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund. 3. Sea Lion crude will be sold on the open international market (subject to trade embargoes, international sanctions etc.). 4. Navitas is an ethical company, the depth and detail of the Environmental Impact Statement is a clear example of this. Further information on Navitas can be gained on the company website: www.nativaspet.com. 5. Navitas is a publicly traded company and is subject to clear legislative rules and investment / investor requirements. 6. As above, in the response to question 5, Navitas is publicly traded. The Sea Lion Field Carbon & Biodiversity Offsetting Fund will illustrate the company's commitment to the energy transition. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund. 7. Navitas is unable to comment on the opportunities that FIG will be able to develop as a consequence of the Sea Lion revenues and this question would best be answered by FIG. 8. Navitas is unable to comment on the opportunities	

Ref.	Representation	Navitas response	Changes in Rev 4
	Lion/Rockhopper development? Israeli investors are eager for access to oil and gas assets. It would be abhorrent morally to humanity if the riches from our 'oil' filtered into weaponry and contributed to the genocide and wars in the Middle East. It would be more ethical if part of our fortune be put into resourcing and investing in technologies working for cleaner energy for that distant future when oil is no longer needed. The Falkland Islands have a small population, we will per capita be extraordinarily rich in the short term, but what of the future? Where is the Falkland Islands going- will we just go with the flow or have an ambitious goal and steer for it? I worry we might flounder. There is going to be many practical, social, political, and ethical issues to debate in the next few years. I support this development but would like to know what is envisioned for our long-term future by FIG, HMG and Navitas.	that FIG will be able to develop as a consequence of the Sea Lion revenues and this question would best be answered by FIG.	
IND7 1	Overview The Sea Lion development proposed by Navitas Petroleum Development & Production Ltd within their 2024 EIS is, in most respects, a further iteration of the Sea Lion development concept that has been underway since 2011. Although further work has been carried out optimising the understanding of the geological aspects, and on the technical aspects of the development, the major features of the project appear substantially unchanged to several previous iterations of the FPSO-based development, and in particular the most recent Sea Lion project proposed by Premier Oil within their EIS, accepted by FIG in 2020.	Agreed, the project is substantially unchanged with some improvements.	N/A
IND7 2	Project design and operation The project proposal appears substantially similar at a technical level to the previous projects, with a small number of material technical changes such as	Agreed, using a repurposed FPSO does reduce environmental impacts overall.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	the change to well completions and the change to a repurposed FPSO rather than a new build. I do not have any material observations on these changes, and do not believe they will substantially impact either the planned environmental impacts of the project, or the risks of an unplanned major impact arising. Some choices made (such as using a repurposed FPSO) may arguably reduce the overall environmental impact of the project by reducing the lifecycle footprint, and as long as critical technical and safety requirements are met, these do not appear to raise any specific concerns and are aligned with established industry practice elsewhere. Detailed technical and safety aspects are for FIG's external technical and safety advisers to review within the field development plan and relevant safety submissions, and are beyond the scope of the EIS consultation.		
IND7 3	Data and risk Some concerns have been expressed that environmental data used in the EIA process is outdated and that insufficient data has been gathered in recent years. FIG and oil companies jointly funded two projects of gap analysis and data gathering over a period of several years. It is always true that more data could be gathered, but FIG and stakeholders should aim to take a pragmatic approach to determining what is necessary versus what might be desirable, and in particular, make some judgement on whether further data, or improving on identified uncertainties, would be likely to have a material impact on any decision to proceed with the project. My view is that it would not be likely to impact that decision, because a precautionary approach has generally been taken where there are uncertainties.	Agreed - note FIG EIA Guidance re data gaps (Sections 3.13 and 3.18 in particular).	N/A
IND7 4	Planned environmental impacts – and the bigger picture The planned impacts of the project appear to be broadly aligned with previous iterations of the project. If the project is delivered using good oilfield practice then the planned impacts over the life of the project appear acceptable and in line both with previous iterations of the development, and with the impact that might be expected from this type of project delivered elsewhere.	Thank you for your comments. Navitas confirms that it is working within FIG's legislative framework (as illustrated by the Environmental Impact Statement process). This is closely aligned to the UK regulatory framework which is considered world leading. In addition Navitas is working closely with leading international contractors all of whom have significant industry experience and	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	Global climate change concerns and carbon emissions are of course a developing issue for all projects of this type, and managing mankind's impact on our planet will remain a major challenge for decades. In considering this, it is important to recognise that global emissions from hydrocarbons are produced by global oil and gas consumption which stems from the demand for, and usage of, the commodities. In common with most mobile and globally traded commodities, consumption levels are not particularly affected by whether specific production opportunities in specific locations are pursued. Reducing emissions is therefore ultimately a function of reducing consumption, which in turn will reduce production. It is also important to recognise that the transition to a low-carbon future will necessarily take time (likely to be 20 years or more) and that regardless of how much carbon sits within any future energy landscape, it is more than likely that manufacturing industry will still require substantial volumes of oil and gas into the distant future. The notion of "Just Stop Oil" is therefore an idealistic and impractical concept at every level, and none of the proponents of such an approach are able to articulate a credible alternative. In the event that the Falkland Islands declined to provide consent to the project's Field Development Plan (for any reason), that decision would not inherently mean that any less oil will be used worldwide, or that any less carbon would be produced into the global atmosphere. It simply means that demand for the commodity will be satisfied from new supply somewhere else, which might produce either more or less carbon emissions depending on the nature of that project. It simply cannot be predicted with any reliability. The impacts on individual national statistics such as the carbon emissions per capita of the Falkland Islands can be highly misrepresented, and should	most of whom are public traded and consequently openly demonstrate their environmental social governance (ESG) policies.	

Ref.	Representation	Navitas response	Changes in Rev 4
	therefore be discounted. Using per-capita metrics, we would be proposing to ban sheep farming in the Falkland Islands because the emissions of sheep methane per capita are probably easily the highest of any country in the world. Decarbonisation is a whole-planet problem which must eventually have a whole-planet solution to reduce demand and deliver alternative technologies wherever possible. The Falkland Islands cannot meaningfully influence either of those things with a decision on a single project. This means that the principal role of the Falkland Islands is to ensure that any projects that are operated within its jurisdiction meet criteria such as: • The project meets normal industry expectations for a responsible operator working in a developed country, and is delivered using recognised best practice and best available technology to minimise planned emissions and maximise efficiency and safety • The project is regulated to a high standard by the host Government throughout its life including ensuring proper decommissioning		
IND7 5	Unplanned environmental impacts Significant unplanned environmental impacts mainly arise from the risk of a major accident of some sort, and the EIS sets out a number of such cases which appear to have been chosen and described adequately. Managing unplanned impacts is very much a matter of prevention, by reducing all material risks to as low as reasonably practicable (ALARP).	Thank you for your comment. This is noted and agreed.	N/A
IND7 6	Human and economic impact The impact on the population of the Falkland Islands and the nature of economic opportunities are both fairly well understood. There is a natural alignment between delivering an efficient project by not deploying unnecessary people and resources to a remote project location, and minimising adverse socio-economic impacts on the Falkland Islands, and it appears that the project proponents intend to continue to operate in this way. In simple terms, nothing will be deployed here if it is not necessary for the project. Previous rounds of exploration activity have been shown to be	Thank you for your comments. Navitas confirms that the project has been designed to minimise adverse socio-economic impacts and optimise the benefits for the Falkland Islands stakeholders. A separate Socio-Economic Impact Assessment undertaken by an independent UK based consultancy with recent relevant experience in the	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	quite manageable for the Falkland Islands, with modest impacts but considerable opportunities, and the onshore impacts of a single development as proposed in this EIS is likely to be "exploration plus" – a little more of everything, and for a longer period, but still manageable. Additional concurrent phases of development activity, not described in this EIS, may require more careful consideration in the event that any arise. The overall economic impact on the Falkland Islands will be generally extremely positive. The author is aware that a detailed economic model was compiled by FIG and the previous operator for past project iterations, and it is assumed that this has been updated. FIG has an extensive wish list for capital investment and aside from offsetting commitments that the project sponsor may make, developing a new industry would allow FIG to invest substantially in moving the Falkland Islands further along the path towards net zero and energy independence as a country.	Falkland Islands will be issued to FIG in Q1 2025. Navitas is unable to comment on the opportunities that FIG will be able to develop as a consequence of the Sea Lion revenues.	
IND7 7	Decommissioning and response planning Ensuring thorough, safe, and financed decommissioning at the end of project life is essential to protect the Falkland Islands. It is normal for decommissioning at this point to be in the form of a broad commitment rather than detailed plans which can only be designed closer to end of field life, so the content of the EIS appears acceptable in this regard, and the applicant's commitments to remove all parts of the development above the sea bed are in line with expectations. Response measures to unplanned events, that will in due course be set out in the oil spill contingency plan / oil pollution emergency plan will also need careful review, alongside the financial capacity arrangements to support this response.	Thank you for your comment.	N/A
IND7 8	Regulatory framework It is unclear from the EIS what the current status is of revised legislative provisions to bring in the UK's 2015 Safety Case provisions, and the new Environment Case legislation. Although there is mention of the ongoing work	Thank you for your comment. This is noted and Navitas shall update the EIS text to clarify the licensing regulations that apply. Navitas has submitted the Field Development Plan	Section 3.1

Ref.	Representation	Navitas response	Changes in Rev 4
	in section 3.1.7.3.1, references within the EIS document only appear to be to existing/legacy legislative provisions with no indication as to the expected date of changes coming into force, nor of any expected transitional provisions to new legislation when it emerges. It is assumed that the Sea Lion project is intended and designed to comply with forthcoming legislative changes, as these should by now be well understood, with detailed legislative drafting having commenced several years ago following policy approval. Completing the update work on the Offshore Minerals Ordinance 1994 (and other related legislative provisions) remains essential, as does maintaining sufficient expertise within FIG to ensure robust and effective regulation throughout the project. It is noted that some earlier identified legislative priorities such as updating the Conservation of Wildlife & Nature Ordinance 1999 appear not to have progressed, and other public information suggests that this Ordinance has been deprioritised in favour of unrelated environmental legislation. The effect of this should be clearly understood by decision-makers prior to granting any final production consent. The EIS suggests that the relevant licensing legislation for the project is the Offshore Petroleum (Licensing) Regulations 1995. In fact the majority, perhaps all, of the Sea Lion development sits within Production Licence PL032, which was issued under the Offshore Petroleum (Licensing) Regulations 2000. This is a separate (if substantially similar) piece of legislation, not an amendment to the 1995 regulations as suggested. The two sets of regulations provide for different model clauses, fees, licence terms and other key differences, and co-exist in law to regulate different production licences. However, this error is administrative and not particularly material to the EIS content.	(FDP) and Environmental Impact Statement (EIS) in accordance with FIG's current legislative framework. Navitas continues to work with FIG and its key contractors to ensure that its arrangements are aligned with industry best practice and FIG's planned changes to legislation. Navitas expects that FIG will comment separately on the EIS public consultation representations which cover FIG's Oil Readiness and planned legislation.	
IND7 9	Summary The project set out in the Navitas Sea Lion EIS is substantially similar to that previously accepted by Executive Council in 2020, with some iterative design	Noted, thank you.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	changes that are relatively minor in terms of the overall project. The function of an EIS is to describe the impact of a project on the environment should it go ahead, so that this impact can be taken into account in making a final determination on the development plan that the applicant must also submit to gain consent for production operations. The submitted document adequately describes this, and the planned and unplanned impacts appear to be in line with what would be expected for a project of this type. The EIS therefore appears to be acceptable. Consideration of whether the environmental impact described for the project is ultimately acceptable when balanced against the wider risks and benefits of the project to the Falkland Islands falls within the process of final project approval, and the granting of consent to a Field Development Plan.		
IND8 1	Global warming and climate change due to burning of fossil fuels is at last recognised as undisputable fact The International Energy Agency said in 2021 ''If governments are serious about the climate crisis, there can be no new investments in oil, gas and coal, from now – from this year." I do not see how a responsible government can proceed with approving a new oil development at this stage in our planet's history.	Refer to RSPB 7.	N/A
IND9 1	1. Presentation, length, language and style This project represents the most significant development in the Falkland Islands in the past 40 years. Given the proposed commitment of the Falkland Islands Government and community to environmental stewardship, it is essential that this EIS document is accessible and comprehensible to a wide audience. In this regard, I have some initial comments on the presentation, language and style used in the Environmental Impact Statement (EIS). In the same manner as choosing to name the oil field "The Sea Lion Field", featuring a cover image of penguins on a pristine coastline is misleading and inappropriate. This approach seems intended to evoke a sense of	Sea Lion was the name given to the initial prospect identified by RKH. Navitas is keenly aware of the beauty and special nature of the Falklands environment and the cover image was photographed by a member of the Navitas team. Regarding the length of the document, this is a complex development project in an area where the baseline was previously not known very well. EIAs of *c.* 400-500 pages are generally appropriate for explorations EIAs as opposed to development EIAs in	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	environmental harmony that starkly contrasts with the true nature of the proposed development. Such imagery may lead the public and stakeholders to underestimate the potential ecological risks involved. The EIS should accurately reflect the serious environmental implications of this project, rather than attempting to soften its impact with misleading visuals and branding. The EIS document is significantly longer than comparable documents, which typically range between 400 to 500 pages. While the length itself is not an issue, the extensive contradictory statements, redundancy and verbosity in the text complicates the review process for stakeholders. For example, the routine inclusion of institutional information and acknowledgements for grants and funding is unnecessary within the main body of the document. There are also instances where information is mentioned for past, current and future studies that form no part of this EIS. These factors may discourage community members from reading the document, limiting the opportunity for widespread public engagement and input.	a new area. Other technical reviewers have complimented the structure and readability of the document.	
IND9 2	2. Failure to identify fish related data gaps and missed opportunities Section 7.2.4. Data gaps: It is concerning that the Falkland Islands Offshore Hydrocarbons Environmental Forum (FIOHEF) did not appear to identify a single critical data gap regarding the potential for impacts of oil development on fish populations in the northern slope area of the Falkland Islands, and area that is data poor. Given the vital role of fisheries in the Falkland Islands' economy and ecosystem, this appears to be a major oversight.	One aspect of scoping is to identify any data gaps and available data that could inform the assessment. This was not identified as a data gap in scoping.	N/A
IND9 3	Missed Opportunities: The Falkland Islands Government's Directorate of Natural Resources, Fisheries Department (FIFD), has conducted various surveys, including fisheries-independent demersal surveys from 2015 to the present. However, these surveys generally do not extend beyond the 200-250 m depth contour in the north of the Falkland Islands. The reason for this is that they cover the area in which shelf-based commercial fishing takes place. As a result, they do not cover the proposed development area, particularly the NS slope area (250-600 m), which remains critically data	Thank you for the comment and suggestion. Navitas would welcome such an opportunity for more data collection on the NS. Note that much of the data we have comes from Arkhipkin *et al.* (2012) and this review used data from 13,044 commercial bottom and pelagic trawls between 2000 and 2010 mainly within the FCMFZ, and from 1,272 research trawls	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	poor. The earlier consultations presented an opportunity to address these data gaps. By negotiating the inclusion of one to two additional days of sampling within the proposed development area, much-needed baseline data could have been collected, significantly enhancing the baseline for understanding of the local fish ecology and biology, setting a platform for ongoing monitoring and providing a more robust data collection strategy for assessing impacts.	taken between 1999 and 2011. Some of which were conducted on the NFB.	
IND9 4	3. Fish baseline data limitations The EIS for the proposed offshore oil development in the Falkland Islands waters presents significant shortcomings in its characterisation and presentation of baseline data for fish populations. Notably, it omits crucial updated information that could influence the assessment's accuracy. 3.1. Outdated and insufficient baseline data for fish populations Section 7.2: The baseline data for fish populations is reported to be sourced and collated through literature reviews. However, there seems to be a complete absence of current literature. Specifically, the median year from which references were sourced is 2012. There are no references cited in the section more recent then 2016. There has been an abundance of research undertaken with new findings on fish and cephalopod populations over the last decade. Given the significant ecosystem changes documented over this period (Laptikhovsky *et al.,* 2013; Arkhipkin *et al.,* 2023), the reliance on outdated data is concerning and undermines the relevance of the assessments. The EIS should incorporate recent research and extend its focus to include deeper waters adjacent to the proposed development to provide a comprehensive and accurate assessment of the potential environmental impacts.	Thank you for the comment Navitas will update the text where relevant. The Laptikhovsky *et al.* (2013) is cited and referenced and Navitas will update the text with the Arkhipkin *et al.* (2023) reference and indeed any new relevant literature.	Section 7.4.4.2
IND9 5	7.4.4.2.2.1: The seasonal abundances of fish and squid populations on the Northern Slope (NS) are based entirely on research undertaken by Arkhipkin *et al.* (2012b) using data acquired from mixed commercial fisheries and	Thank you for the comment. Arkhipkin *et al.* (2012b) represents the most comprehensive review to date and its intention was to show patterns in the	Section 7.2.4.1

Ref.	Representation	Navitas response	Changes in Rev 4
	research surveys between 1999 and 2011. While this research provides some foundational baseline data for the shelf area around the Falkland Islands, its use as the sole baseline for assessing the proposed development area and the wider Northern Slope (NS) zone is problematic for several reasons: Geographic, and Temporal Data Gaps: The study's sampling sites do not comprehensively cover the Northern Slope (NS) area, particularly the deeper waters where the proposed development and dispersal pathways occur. The limited spatial and temporal coverage undermines the ability to accurately predict species distribution and biomass trends across the NS. As described above, this data is also outdated given large changes that have occurred in the ecosystem. Methodological Flaws in Biomass Estimation: The study assumes uniform species distribution across different habitats, extrapolating data from sampled areas to unsampled ones. This assumption, coupled with the limitations of using CPUE as a biomass proxy (particularly from selective fishing gear and strategies), results in inaccurate biomass estimates, especially in under-sampled deeper waters. Inadequate Consideration of Species' Life-History Stages: The use of selective data from commercial fisheries and inappropriate biomass estimates negates the importance of non-targeted species and life-history stages, such as juveniles, adults, and spawning individuals. This gap, along with the other methodological issues, further compromises the accuracy of the abundance trends described for the NS area.	movement of nekton around the islands including the NS which covers the NFB. This is acknowledged as a data gap (added to section 7.2.4.1). In this regard our Risk Assessment for fisheries is precautionary.	
IND9 6	3.2. Specific comments on various fish populations My concerns particularly focus on the following aspects of fish populations in the area: Critical Life-History Stages of Skates: The data limitations significantly hinder understanding the life-history patterns and vulnerabilities of skate species, which are crucial for effective management and conservation.	Thank you for the comments. The Risk Assessment with regards to fisheries is precautionary. Also note that under FIG's guidance (FIG, 2016) the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they are dealt with in the risk assessment.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	Foraging Areas for Migratory Fish: The EIS downplays the importance of foraging areas for key commercial and recovering fish stocks and lacks sufficient information to reliably assess and monitor the potential impacts of the proposed development on their distribution, biology, and abundance. Deep-Sea Vulnerability: The proposed development on the NS slope area intersects critical life-history stages and connectivity pathways of vulnerable deep-sea species. The potential impacts of the development on these should be considered in the EIS.	Therefore the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained and indeed a precautionary approach is taken.	
IND9 7	3.2.1. Critical life-history stages of skates The only skate species mentioned in any level of detail in the EIS is the yellownose skate (*Dipterus chilensis*). This species was redescribed five years ago as consisting of *D. chilensis* (only occurring in the Pacific), and *D. lamillai*, the warrah skate, thought to be endemic to Falkland Islands waters (Concha *et al.,* 2019). The proposed development area on the Patagonian shelf and slope is a globally recognized hotspot for skate species, with over 22 recorded species, including those of commercial significance (Arkhipkin *et al.,* 2012a, 2023). This region supports: Commercially important species*: Bathyraja brachyurops*, *B. albomaculata*, *B. griseocauda*, and *Dipturus lamillai*. Commercially valuable bycatch species: *Bathyraja cousseauae*, and *B. multispinis*. Smaller bycatch species and juvenile: These play crucial ecological role. Many of these species are keystone species essential for maintaining ecosystem stability. However, they are particularly vulnerable due to their long life spans, slow growth rates, and low fecundity (Grosell and Pasparakis 2021). Declines in abundance have been reported for several of these populations according to the IUCN (Winter and Arkhipkin 2022), with B. albomaculata listed as vulnerable, B. griseocauda as endangered, and D. lamillai, appearing to be endemic to the Falkland Islands (Concha *et al.,* 2019).	**Initial consultation response:** Thank you for the comments. Navitas will update the text where appropriate. The risk assessment with regards to fisheries is precautionary. Also note that under FIG's guidance (FIG, 2016) the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they are dealt with in the risk assessment. Therefore the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained and indeed a precautionary approach is taken. **Post-consultation comment:** After review of the relevant sections, Navitas consider that sufficient information has been provided to enable the relevant assessments. In addition, the warrah skate (*D. lamillai*) is likely not endemic to the Falkland Islands. The species was described from a specimen captured in the Falkland Islands (Concha, *et al.*, 2019). This does not mean that warrah skate has limited range, simply that its range is not known.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	The proposed development is likely to overlap with areas crucial to these species, including during key life-history stages such as spawning and recruitment (Arkhipkin *et al.,* 2012a, 2023). The failure to delineate the areas during which these critical stages occur, and their overlap with the proposed development, represents a significant data gap (Lee *et al.,* 2022; Ramos *et al.,* 2023; Ramos *et al.,* 2024). Without precise identification and protection of recruitment, juvenile, and spawning areas— many of which likely coincide with the development site— the potential impacts on these vital skate populations cannot be accurately monitored, assessed, or mitigated. This oversight could result in irreversible harm to species that are already vulnerable or endangered.		
IND9 8	3.2.2. Foraging areas for commercially significant migratory fish species The proposed development area overlaps with critical foraging and migratory pathways for several commercially and ecologically significant fish species in the Falkland Islands. The Environmental Impact Statement (EIS) seems to downplay the importance of the Northern Slope area to these populations. This is likely due to the use of outdated references and data as described above. The following key species are of particular concern: Common hake (*Merluccius hubbsi*): Since 2015, common hake has become the dominant fish biomass around the Falkland Islands, surpassing rock cod and becoming the primary target of finfish fisheries. Observational data from FIFD research surveys suggests that a key feeding and migratory pathway occurs to the north of the Falkland Islands in waters deeper than 200 m (NS area), which overlaps with the proposed development area. Recent survey and commercial data suggest that the deeper waters are important for larger female individuals as they migrate to southern feeding areas in the SS and SEOS areas. However, baseline data to describe the full distribution range of common hake is not available, and their dynamics within Falkland Islands waters are poorly understood. Without this information, the potential impacts on these populations cannot be accurately monitored, assessed, or	Thank you for your comment. This is noted and the text will be updated where appropriate. The baseline here was informed by the most recent review in Arkhipkin *et al.* (2012). This paper was based on an analyses from 13,044 commercial bottom and pelagic trawls between 2000 and 2010 mainly within the FCMFZ, and from 1,272 research trawls taken between 1999 and 2011. Some of these were conducted on the NFB. Migration pathways are not likely to have changed since this work. However, the assemblage has changed dramatically due to a mixture of environmental change and over exploitation of rock cod and southern blue whiting, with hake now being the dominant commercial species. As described in Arkhipkin *et al.* (2012), hake is a shelf species and southern blue whiting is a shelf break species. The Sea Lion Field sits beyond the shelf break in 450 m on the deeper parts of the North Slope (NS). As noted by the commenter, there are some gaps in	Section 7.4.4

Ref.	Representation	Navitas response	Changes in Rev 4
	mitigated. This gap in research has been identified by the FIFD and must be addressed to prevent unintended consequences on this vital fishery. Blue whiting (*Micromesistius australis*): The proposed development area also intersects key feeding and migratory pathways for blue whiting, a species that has previously experienced a significant population collapse and is currently in recovery (Laptikhovsky *et al.,* 2013). This life-history stage, where blue whiting migrates and forage, is critical for their growth and subsequent spawning success (Busbridge *et al.,* 2020). Disruption to these pathways due to the proposed development could severely hinder their recovery, potentially leading to another population decline (McKeown *et al.,* 2017). Given the fragile status of blue whiting, continuous monitoring of their abundance and population structure in this area is essential. Baseline data is critical for assessing the impact of any changes resulting from the development to ensure that the species' recovery is not compromised.	knowledge. However not all gaps can be filled, practically, economically and logistically. Under FIG's guidance (FIG, 2016) the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they are dealt with in the risk assessment. Therefore, the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained and indeed a precautionary approach is taken.	
IND9 9	3.2.3. Life-history stages of vulnerable deep-sea fish The proposed development area intersects with critical life-history stages of deep-sea species, such as the Patagonian toothfish (*Dissostichus eleginoides*) and ridge-scaled grenadier, both of which are highly vulnerable to anthropogenic and environmental pressures (Roberts 2002; Laptikhovsky 2011; Lee *et al.,* 2019). Patagonian toothfish (*Dissostichus eleginoides*) The EIS presents outdated information on the ecology and population structure of the Patagonian toothfish, failing to incorporate the latest research. Recent studies reveal that the development area directly intersects with key life-history periods and connectivity pathways, posing significant risks to the population's sustainability (Arkhipkin and Laptikhovsky 2010; Brown *et al.,* 2013; Lee *et al.,* 2018, 2021, 2022, 2024; Troccoli *et al.,* 2023; Kim *et al.,* 2024).	Please see comments and responses to IND9 10, IND9 11, IND9 12. Navitas will update the text and references with any new material.	Section 7.4.4.2.3.1

Ref.	Representation	Navitas response	Changes in Rev 4
IND9 10	Key findings related to the development area: Population discreteness: The EIS mentions a wide distribution around the sub-Antarctic. However, it fails to acknowledge the patchy distribution and discrete population structure that occurs across this wide distribution. Around the Falkland Islands the species consists of a discrete population consisting of contingents from Chile, Burdwood Bank, and local groups, arising through egg and larval dispersal (Laptikhovsky *et al.,* 2006; Rogers *et al.,* 2006; Arana 2009; Ashford *et al.,* 2012; Lee, B 2022; Arkhipkin *et al.,* 2022; Lee *et al.,* 2024). Species exhibiting such population structure are considered vulnerable, and the preservation of this diversity is crucial for ecological stability and resilience (Hilborn *et al.,* 2003; Schindler *et al.,* 2010). Egg and larval dispersal pathway: While there is no evidence to suggest that Patagonian toothfish spawn in the NS, eggs and larvae from southern spawning areas are dispersed northwards across the NS (Ashford *et al.,* 2012; Lee *et al.,* 2024). These would likely be susceptible to associated pollution risk and should be considered in the impact assessment. Adult site fidelity: The EIS describes a migratory life-history for adult Patagonian toothfish. Adult life-history stages exhibit strong site fidelity with no evidence of seasonal migratory behaviour (Brown *et al.,* 2013; Lee *et al.,* 2018, 2022; Troccoli *et al.,* 2023). A significant portion (75-95 %) of the population remains resident in deep-sea habitats adjacent to the proposed development area throughout their life. This means that any impacts from the development are likely to have long-lasting and potentially severe consequences for the population. Adult large-scale movements: A small percentage (5-25 %) of the population undertakes large-scale movements (home-range relocations) towards southern spawning grounds (Lee *et al.,* 2022; Troccoli *et al.,* 2023). The northern slope, adjacent to the development area, serves as a vital movement corridor linking northern deep[1]sea habitats (both in Falkland and High Seas waters) with these southern spawning grounds. Disruption to this movement corridor could hinder these essential migrations, potentially	Thank you for the comment. Navitas will update the relevant baseline section with more recent reference including Kim *et al.* (2024) on toothfish movement. Population discreteness: patchy distributions in species are inherent and acknowledged and we are fully aware of what is known about Patagonian toothfish to date, it is likely that some larvae and eggs are present in the area and are likely present around the whole Falkland islands. We feel this detail is perhaps beyond what is required for this EIA. This area is not well studied and there is little in the literature. Egg and larval dispersal: Again, there is little information in the literature on this, we know eggs and larvae come from a couple of sources (Burdwood Bank area and Diego Ramirez area) however large assumptions would have to be made about what is around the North Falklands basin. The Patagonian shelf is not a seamount. In the case of toothfish, they are inherently patchy but this is a scale dependent thing. They are caught everywhere in the fishery. Adult site fidelity: references added Large-scale movements: references added Recruitment and early ontogenetic movement: References added. We disagree that important nursery areas lie adjacent to development area. 'Adjacent' needs context and nursery area and the	Section 7.4.4

Ref.	Representation	Navitas response	Changes in Rev 4
	affecting reproductive success and the overall sustainability of the population. Recruitment and early life-history movements: Important nursery areas lie adjacent to the development area, with connectivity pathways that link these nurseries with adult deep-sea habitats, passing directly through the development area. Key nursery areas have been identified south of the Falklands (inshore of Beauchene), west (Jason Islands), and north (inshore of the development area) (Ashford *et al.,* 2012; Lee *et al.,* 2021, 2024). Recruitment into these areas shows strong temporal variability, occurring in sporadic pulses every 5-10 years (Arkhipkin and Laptikhovsky 2010; Lee *et al.,* 2021). This life-history aspect increases the vulnerability of the species. During their ontogenetic development, these nursery areas are linked to adult habitats in the north (offshore of the development area) and east by persistent connectivity pathways (Arkhipkin and Laptikhovsky 2010; Lee *et al.,* 2021, 2024). These downslope movements through the connectivity pathways are protracted, extending directly through the development area over a 4–10-year period. Protecting these nursery areas and connectivity pathways is essential for maintaining the sustainability of the species – and the proactive development of management measures has been a clear focus point by FIFD, particularly for implementation during years of high recruitment.	population structure of that needs to be clarified. Again this is considered too much detail for this EIS. Toothfish are distributed throughout the Patagonian shelf in deep water, in similar depths to the development but this is not the only location toothfish are found. Nursery areas are found around the FI, can the commenter provide some context on 'adjacent' to the development. The NFB is not the only connectivity pathway around the FI. This is a floating FPSO, which, in the context of the NFB is a small area. Adding more information on this will add to an already lengthy document	
IND9 11	Ridge-scaled grenadier (*Macrourus carinatus*) The EIS provides limited information on the ridge-scaled grenadier, a species with characteristics indicating high vulnerability (Lee *et al.,* 2019). This species is believed to consist of a single reproductive stock within the waters surrounding the Falkland Islands (401–1391 m) (Laptikhovsky 2011). Spawning occurs year-round, including within the proposed development area to the north of the Falkland Islands (Laptikhovsky *et al.,* 2008; Laptikhovsky 2011; Lee *et al.,* 2019). Given the ridge-scaled grenadier's restricted distribution and the year-round spawning within the development area, the potential impacts of the	Navitas has been precautionary with regard to fisheries. Please note that the rough-scaled grenadier is widely distributed around the Falkland Islands and the southern ocean and has wide spawning and reproductive distribution. There are spawning grounds around the Falkland Islands and so the Sea Lion field as an area is considered small within this wider distribution and any impact is likely to be short-lived and reversable with little impact to the overall population given the abundance and distribution.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	proposed activities on this vulnerable species warrant serious consideration. Failing to account for the species' life-history characteristics and habitat requirements could lead to significant, long-lasting impacts on its population viability.		
IND9 12	Table 7.10: The high abundance of Patagonian toothfish on the NS is the same throughout the year (not just restricted to Summer and Autumn). The high abundance of common hake on the NS is throughout the Autumn-Winter (not restricted to Summer). Survey data shows that kingclip is prevalent throughout the year. Ridge-scaled grenadier should be added to the table. Other important skate species should be included, such as *B. albomaculata*, *B. brachyurops*, *B. griseocauda*, *B. cousseauae*, *B. multispinis*. The catshark (Schroederichthys bivius) is another abundant species not considered in the EIS.	Fisheries species are considered collectively with the exception of the major target species. Note this is a summary. Navitas will update the table where appropriate. Much of these data were from Arkhipkin *et al.* (2012) which represents the most comprehensive review of this type to date. This work analysed seasonal changes in relative abundance and biomass of nektonic predators were analysed on the eastern Patagonian Shelf and continental slope.	Table 7.10
IND9 13	12.1.4.2.3.1 The following statement is inaccurate - "Typically, adult fish are not considered highly sensitive to impacts of oil spills." Adult fish are indeed capable of avoiding water with high hydrocarbon concentrations (Hjermann *et al.,* 2007), however, this does not negate their sensitivity to associated ecosystem and long-term effects. There are numerous references in this regard (Balk *et al.,* 2011; Ainsworth *et al.,* 2018; Cave and Kajiura 2018; Grosell and Pasparakis 2021). Just to provide two specific examples, an ecosystem model that was used to assess the impacts from the Deepwater Horizon oil spill of fish guilds suggested that the biomass of large reef fish decreased by 25-50 %, and large demersal fish by 40-70% (Ainsworth *et al.,* 2018). This was a result of the impacts on demersal foraging areas leading to starvation. Recovery in high turnover populations was predicted to occur within 10 years, but slower-growing populations over 30 years to fully recover. In another study in the North Sea (Balk *et al.,* 2011), haddock and Atlantic cod populations were shown to be under significant environmental stress due to the chronic effects of oil-related pollution, leading to reduced health, reproductive success, survival and subsequent declines of these fish populations.	Noted, thank you. These references will be reviewed.	Sections 12.1.4.2.3.1 & 12.1.4.2.3.2

Ref.	Representation	Navitas response	Changes in Rev 4
IND9 14	12.1.4.2.3.2 “Sea Lion crude on zebra fish (*Danio rerio*) eggs found that the crude is unlikely to impact these fish eggs in the event of a spill.” Zebrafish are a tropical, freshwater, highly adaptable species, capable of surviving and being reared in a wide range of conditions – thus the likely use of them as the species in these toxicity tests. However, this also makes comparisons with species in the Falkland Islands (a marine, temperate, cold-water environment) difficult. Specifically, warm-water organisms are more robust to toxicity test procedures compared to their cold-water counterparts, such as for example cod (Hjermann *et al.,* 2007).	Thank you for the comment. The Hjermann *et al.* (2007) paper review examines the effects of a hypothetical oil spill on fishes in this area, with a focus on effects on the egg and larval stage of the 3 dominating fish stocks: NE Arctic cod *Gadus morhua*, Barents Sea capelin *Mallotus villosus*, and Norwegian spring-spawning herring *Clupea harengus*. Data on egg and larval dispersal are not available for most species in the Falkland Islands. Zebra fish eggs are the standard laboratory test in ecotoxicology. These tests were done under laboratory conditions with Sea Lion crude. Zebra fish eggs are the standard laboratory tests because there are protocols for handling them and they survive well under laboratory conditions. These are why they are used as an analogue. Testing of cold water eggs would be extremely difficult for marine fish here in the Falkland Islands; although this has been done on research cruises for embryology experiments, the eggs do not survive well outside of their natural conditions and it would be very difficult to understand what factors are causing mortality in addition to any toxicological factors. The properties of Sea Lion crude are such that a toxicological impact on cold water fish eggs at the concentrations expected in a spill event and in cold water temperatures would be negligible at worst. See also responses to IND 3 5, IND 3 9 and IND 3 10.	N/A
IND9 15	5. Recommendations To address the significant concerns identified in the EIS, the following recommendations are proposed: Acknowledge and Address Data Gaps: The EIS should explicitly recognize and address the existing data gaps, especially concerning the critical life-history	Navitas believe gaps have been acknowledged and a precautionary approach has been taken. In addition, under FIG's guidance (FIG, 2016) the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	stages and habitat use of skates, migratory fish, cephalopods, and deep-sea fish. This acknowledgment is crucial for developing an accurate and comprehensive environmental impact assessment.	which they are dealt with in the risk assessment. Therefore the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained and indeed a precautionary approach is taken.	
IND9 16	Enhance Surveys: Initiate discussions and collaborate with the Falkland Islands Fisheries Department to include additional survey stations in the proposed development area. This will help address the substantial data gaps, particularly those related to the life-history stages and habitats of key species.	Thank you for the comment. Collaboration would be welcome and this can be discussed in the FIG proposed long-term monitoring plan.	N/A
IND9 17	Update Baseline Information in the EIS: Incorporate the latest research and data from surveys conducted by the Falkland Islands Government's Directorate of Natural Resources, Fisheries.	Thank you for the comment. Navitas will update the text with relevant references where appropriate.	Chapter 7
IND9 18	Improve Monitoring: Collaborate with relevant stakeholders to design and implement a comprehensive monitoring plan that specifically targets the NS area. This plan should aim to improve understanding and management of these ecologically significant regions, focusing on the species and habitats most at risk. Implementing these recommendations will help ensure that the EIS reflects the best available science and provides a framework for managing the environmental impacts of the proposed development.	Please refer to section 15.1, the EMMP included in the EIS details the actions and plans required to: • Measure and monitor the predicted and potential impacts (primarily the 'Severity of Effect') of the Development, • Check the efficacy of the project-specific mitigations in place, and • Address uncertainties, such as spatial / temporal data gaps, to increase the level of confidence in the impact / risk assessment. Should the monitoring of impacts indicate that the significance of the impacts and risks predicted in the EIS are not appropriate, and / or that mitigation is not effective, a revised mitigation measure and / or monitoring regime will be required. A workshop to consider the content of the EMMP was held and attended by 25 interested stakeholders, comprising FIG, POEPL, industry bodies and NGOs.	Chapter 15

Ref.	Representation	Navitas response	Changes in Rev 4
		The EMMP will be managed by a governance board consisting of representatives of FIG and Navitas, supported by an advisory forum including both non-technical stakeholders and relevant individuals with expertise in the subjects being monitored and managed.	
IND10 1	Notwithstanding the myriad of data gaps, inconsistencies and errors this document contains - as identified by a number of informed, professional parties and individuals - my comment here relates to the foolhardiness of opening up oil and gas fields in the Falklands. Our oil industry aspirations date back to the efforts of FIG civil servants in the early 1990s, when the role of the oil and gas industry in precipitating climate change and greenhouse gas emissions had not yet entered mainstream political consciousness, and certainly not that of the Falklands. 30 years on times have changed dramatically and it is now no longer seen to be politically or globally acceptable for a self-styled environmentally responsible country to be opening its doors to an industry that is widely acknowledged as the cause of human-induced environmental damage on a scale never seen before. To quote the statement from Falklands Conservation: "The International Energy Agency has stated that no new oil and gas fields should be opened if we are to achieve net zero emissions by 2050. This would be necessary to keep temperature rises under the safe 2°C limit, avoiding far more severe climate change effects on wildlife, ecosystems and people, including for the Falkland Islands. Opening a new oil field in the Falkland Islands would not align with this..." No matter how robust (or otherwise) the EIS statements are regarding environmental and social impacts, risks and sensitivities, and associated	Thank you for your comment. This is noted. However, Navitas considers these comments are for FIG consideration.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	proposed mitigation measures, they are of no relevance to the central issue which is we should not be part to the opening up of new oil and gas fields.		
IND11 1	Regulatory and Legal Framework The Falkland Islands is not ready for hydrocarbons production. Oil Readiness has languished, and whilst MLAs have re-prioritised work in recent months, this has not resulted in demonstrable revisions to the legislation and regulation required to oversee a production industry. The Department of Mineral Resources is under resourced and this consultation itself demonstrates that: "The EIS consultation process and further detailed review can be managed with current staff through reprioritisation of other activities. Future resourcing requirements for the regulation of offshore hydrocarbons are addressed in other ExCo papers." FIG has failed to adequately prepare for this EIS submission and is currently not able to regulate a hydrocarbons industry to international best practice. This is a significant risk to the Falkland Islands environment and brings risk of contingent liability to the UK Government. Whilst "It is considered that this EIS will generally be compatible with future planned legislation", this legislation is not in place, and Navitas cannot be held to legislation that is not in force. This risks legal challenge and future lawsuits if attempting to ensure higher standards are adhered to later. 10.2.1 of 118-24P states that the new environmental legislation will be in place by 2025 – this seems wholly unachievable when viewed against the FIG legislative program and the continued failure to move this project beyond policy and drafting instructions. Without robust environmental legislation in place for the EIA process and proposed Environment Case (policy approved in 2018), there are significant gaps in the current regulatory framework (e.g., lack of Polluter Pays and liability, identified gaps in the Conservation of Wildlife and Nature Ordinance) which have been highlighted for almost a	Navitas continues to work with FIG and its key contractors to ensure that its arrangements are aligned with industry best practice and FIG's planned changes to legislation. Navitas expects that FIG will comment separately on the EIS public consultation representations which cover FIG's Oil Readiness and planned legislation.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	decade. Commitments made by FIG to have best practice environmental and safety legislation in place prior to hydrocarbons development have not materialized.		
IND11	The ExCo paper that sought approval for public consultation on the EIS contains errors and had the incorrect version of the EIS appended (incorrect CO_2 emission figures) – the document approved by ExCo should be the document which is consulted upon – this failure to follow due process is concerning but consistent with FIG decision making in recent years.	The EIS was updated to present additional emissions data following publication of the ExCo paper that sought approval for public consultation. The updated EIS was subject to Public Consultation and will be considered by ExCo.	N/A
IND11 3	The EIS consultation process appears muddied, with the role of FIG as regulator and Navitas as developer unclear at times and occasionally appearing to carry direct conflicts of interest.	Navitas has followed FIG's EIA Guidance regarding the Public Consultation process.	N/A
IND11 4	The EIS is inconsistent with FIGs objective to 'reduce our carbon emissions, in order to ensure we act as a responsible global citizen' (Islands Plan 2022). FIG cannot continue to state that the environment is of great value and importance whilst taking actions that directly conflict with these statements. A hydrocarbons industry would be good for the economy, not the environment, it is that simple.	Thank you for your comment. This is noted. However, it is not for Navitas to comment on FIG policy and we would refer the representation to FIG.	N/A
IND11 5	The EIS is largely based on the previous Premier submissions, but with amendments to the development to cut costs (e.g., smaller repurposed FPSO and direct offtake to tankers of opportunity brings greater spill risks – FIG is currently not in a position to adequately control or regulate this oil spill risk).	Amendments to the former Premier proposals are not, as suggested, driven by cost considerations. The field development approach adopted by Navitas enables a more carbon intensity efficient approach to the development. Premier's proposal to utilise a larger FPSO would have led to utilisation inefficiencies in later field life as production declined. In addition, by redeploying an existing facility Navitas is removing the additional environmental impact arising from construction of a new vessel. There will, however, be considerable investment in upgrades and modifications to the candidate FPSO prior to its deployment to the Islands to ensure that it	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		is optimally configured for the Sea Lion Phase 1 & 2 development. Direct offtake to tankers of opportunity was a feature of the previous Premier proposal, and removes the need for double handling of cargos and the inshore spill risk which was associated with Premier's initial inshore transfer oil export concept. The Direct Offtake to tankers of opportunity is considered a connected activity - as such it will be regulated both under FIG's Offshore Safety legislation which it is anticipated will have been fully updated prior to operations commencing, and Falkland Islands Maritime Legislation. Navitas is committed to following international best practice for tanker operations, and will instigate extensive vessel vetting procedures prior to tankers being selected to offtake cargos.	
IND11 6	Whilst FIG has failed to bring in new legislation for this proposed development, Navitas has also failed to provide new data to inform their EIS submission. It is the responsibility of the developer to ensure that adequate, site-specific data is available for the proposed development. The GAP project (jointly funded) did populate some data gaps for use in environmental impact statements, but there remain outstanding pieces of work that are directly relevant to Sea Lion (such as impact of Sea Lion crude on pelts/feathers that Premier had previously committed to). The age of seabird data has previously been criticized. Data collection should be proportionate to the development, but Navitas does not appear to have directly undertaken any studies to inform this updated EIS.	Thank you for the comment. The age of the SAST data has been acknowledged and Navitas commit to collecting new data *via* SMMOs for three years pre First-Oil. The oil was tested extensively at a world leading laboratory in France (CEDRE). Many seabird feathers were tested. Fur seal pelts were not tested because import permits were not able to be obtained. Please refer to the EMMP Chapter 15. Efforts to acquire import permits (to France) will recommence and if acquired, testing of pelts is anticipated to occur between project sanction and First-Oil.	N/A
IND11 7	Carbon emissions and offsetting “Future operator-led direct and indirect offsetting in the Falkland Islands	Perhaps the use of the word 'Internal' has been misconstrued - the Fund will be funded internally, but	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	including carbon and biodiversity offsetting that includes Falklands-specific habitat restoration projects. To enable this, Navitas will create an internal fund which will initially be used to commission research and feasibility studies that lead to pilot offsetting schemes that can be expanded to enable large scale in-Falklands habitat restoration (Carbon sequestration) and biodiversity offsetting. Navitas will monitor opportunities to fund/undertake direct and indirect offsetting throughout Field Life." OPRED queried "How offsetting projects would be identified and managed" – this is still unclear in the EIS and remains an area of concern. Utilising an internal fund fails to demonstrate independent input and verification. FIG previously approved legislation for an Environment Trust to be put in place for this purpose (which has not been enacted). The Environment Trust proposal would prevent either a developer or FIG from utilizing the Fund for non-additional projects and instead would aim to achieve net environmental benefit.	the intent is that the oversight and governance will have FIG and Independent NGO representation as well as independent technical/environmental advisors. Navitas has prepared and submitted a briefing paper to FIG that outlines the intent of the fund. Navitas believe that this aligns with FIG policy and legislative requirements. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund.	
IND11 8	The carbon emissions will dramatically increase the Falklands national emissions figures. That should be recognized and reflected in the context of the EIS, not just as a comparison to wider UK GHG emissions. Continuing to develop hydrocarbons is not in line with Net Zero aspirations, neither for the Falklands nor the UK, but would bring economic gain. The flaring base case appears to have increased from the previous Premier submission, with associated increases in emissions, is this increase justified?	Section 10.9.4.3.1 sets the context for the Falkland Island emissions. Comparison to Falkland Islands emissions is presented in Section 10.9.4.5.1. POEPL did not specifically itemise flaring that may result from unplanned process upsets and Navitas has included this potential, with a highly conservative (high) estimate. The only flaring POEPL referred to is that associated with commissioning and they estimated 862 t/d *vs.* the 389.2 t/d estimated by Navitas (Table 10.63). Navitas are committed to a zero routine flaring philosophy (Section 5.8.4.4) and flaring emissions are not higher than those proposed by POEPL.	N/A
IND11 9	If the EIS is to be accepted, then conditions should be applied including consultation on proposal for environmental monitoring plans, offsetting, oil spill plans.	Thank you for your comment. This is noted. However, Navitas is unable to comment on what controls (if any) FIG should place on the project's acceptance. It	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	Ultimately, the Falklands is not oil ready and whilst there may be substantial economic gain on the horizon, is it worth the risk if we can't prevent our national resources and environment? It is laudable to be aiming at international best practice, but we aren't there, and we don't have the resources to get there any time soon.	should, however, be noted that: 1. Conditions can be applied to any acceptance. 2. Navitas has already committed to an Environmental Management and Monitoring Plan, a Carbon & Biodiversity Offsetting Fund and has issued preliminary OPEPs to FIG These examples indicate the 'best practice' that is already being applied to the development. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund.	
IND12 1	1) Social effect - competition for resources 1.1 – Housing Sections 7.7.4.5.1 and 11.3.6.1.2 of the EIS recognise the risk of competition for resources as a social impact as "low" and sensitivity of the effect as "minor" - this assessment significantly underestimates the real-world implications that such competition is likely to have on the community. The EIS does not present extensive quantitative data on the real issue of the effect of increased cost of housing on the community, and there is substantial anecdotal evidence from past instances where oil development was anticipated. In these cases residents have reported sharp increases in rental prices and sale prices of properties as a direct consequence of the speculative behaviour of businesses. Land-banking has continuously exacerbated the housing crisis, driving up accommodation costs for both purchase of land and for private rental. These impacts disproportionately affect vulnerable populations of the islands, who may be priced out of their homes or face a sharp drop in quality of life due to rent increases and a lack of options for alternative residence due to the	Socio-economic aspects of the development (e.g., house prices etc.) were scoped out of the EIS in agreement with FIG (Section 6.2.2.1) whereas social impacts, such as competition for resources were scoped in, which is captured in the FIG EIA Guidelines. A socio-economic impact assessment will consider pressure on housing (both supply and demand and potential house price/rental inflation, construction constraints) in more detail. The socio-economic monitoring and management plan will monitor impacts throughout the project life-cycle and enable Navitas and FIG to explore potential mitigations and management actions as the project matures. Issues associated with land availability and housing are relevant to Falkland Islands economic development in general and not specific to the Sea Lion phase 1 & 2 development.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	sudden surge in demand. The experiences shared by those who lived through previous cycles of oil development are crucial indicators that should not be overlooked or downplayed. While these impacts may not always be fully captured in statistical data, they reflect genuine hardships which the community may face, and thus, the potential severity of these social impacts deserves a more thorough and realistic assessment in the EIS. The EIS also significantly overlooks the increased demand for tradespersons driven by the oil industry. This surge in demand will likely reduce the speed at which new residential properties can be constructed in the Falklands—a region already grappling with limitations on how quickly housing can be built. The current shortage of tradespersons is a known issue, and the influx of oil-related work will only exacerbate this problem. As tradespersons gravitate toward the more lucrative opportunities in the oil sector, the availability of labour for residential construction will decrease, slowing down the rate at which new homes can be built. This shift will also drive up the cost of labour, as tradespersons become accustomed to higher rates of pay from the oil industry. Consequently, even those who can afford the already increasing housing prices may struggle to find available builders, further intensifying the housing crisis. Moreover, this situation will disproportionately affect individuals and families who cannot compete with the higher wages offered by the oil sector. The increased cost of construction services will make it even harder for them to afford new homes, potentially leading to greater inequality in housing access and worsening the existing housing shortage. The EIS fails to account for these dynamics, which are crucial in understanding the full scope of the oil project's impact on the local housing market.		

Ref.	Representation	Navitas response	Changes in Rev 4
IND12 2	1.2 – Electricity The EIS also appears to underestimate the potential impact of increased competition for electricity (section 11.5), which poses a significant risk to the Falkland Islands' already outdated power infrastructure. The current electricity grid and power station are operating beyond their optimal capacity, and the additional demand generated by the project will place an even greater strain on these systems. As the demand for electricity rises, the burden on existing generators will likely accelerate the need for their replacement. The government's current approach to infrastructure funding involves passing a portion of the costs for depreciation and replacement onto the public. This model suggests that the increased strain on the electricity system will not only drive up the immediate costs of electricity but will also result in a continuous cycle of rising expenses for consumers. These costs could escalate further if the new generators are not promptly replaced, especially given the logistical challenges associated with the Falklands' remote location. Moreover, any delays in replacing or repairing generators could exacerbate the situation, leading to potential outages or further price hikes. The EIS does not fully account for these risks, which could have far-reaching consequences for the local population. The assumption that new generators will be readily available or that upgrades will be seamlessly implemented underestimates the complexities involved in such a remote environment as the Falklands. This could lead to a significant and sustained increase in electricity costs, disproportionately affecting residents and businesses alike. None of these issues are addressed by measures offered such as off-peak power utilisation and sustainable design, as there will always be an increased burden on the electricity supply resource of the Falklands, and therefore the above issues of reduced service periods and stress on existing staff and systems.	Competition for electricity is assessed as 'Upper Moderate', to reflect this issue. FIG have confirmed increased power will be available by the start of operations and Navitas will work closely with FIG to ensure their energy needs can be met without compromising the community's needs. Cost of electricity to the consumer is controlled by FIG.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
IND12 3	1.3 - Water access and infrastructure capacity The issue of water access is another area where the Environmental Impact Statement (EIS) appears to underestimate the potential strain on existing infrastructure. The current water system in the Falkland Islands is already operating at full capacity, struggling to meet the demands of the population and existing industries. While the EIS acknowledges that work is planned to upgrade and expand the water infrastructure, these upgrades are primarily designed to accommodate a gradual increase in the population and typical industrial and commercial growth. However, the scale of development associated with the oil industry far exceeds the projections on which these upgrades are based. The oil project, along with the necessary ancillary developments—such as new residential properties, higher industrial water usage, and other significant infrastructure projects—will demand a much greater increase in water capacity than currently planned. Even if the proposed water infrastructure developments are completed on time and reach their expected capacity, they would likely only just meet the needs arising from this natural growth. Adding the significant additional demands from the oil industry could push the water system beyond its limits almost immediately upon completion. This scenario raises serious concerns about the sustainability and resilience of the water supply. The potential for delays or shortfalls in the planned upgrades could lead to severe water shortages, further exacerbated by the increased demand from oil-related activities. The EIS does not appear to fully account for these risks, nor does it provide a comprehensive plan to address the additional pressure that oil development would place on the water infrastructure. If the capacity of the water system is reached or exceeded, this could result in rationing, increased costs for consumers, or the need for emergency infrastructure investments, all of which would have significant social and	Competition for water resources is assessed as Upper Moderate, reflecting the challenge, and notes that without changes to the current water system Sea Lion will exceed Stanley's capability to produce water in Stage 1. Navitas are working with FIG to ensure the water system will be suitable for Sea Lion development and have included a trickle feed and other water saving measure (e.g., all vessels arriving with water makers and loaded with potable water, seawater being used for drilling) to minimise water usage. Navitas has provided FIG with projected requirements, and FIG expects to be able to accommodate these. The SIA will build upon the commentary already included in the EIS re water, electricity etc.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	economic impacts. It is essential that the true scale of water demand from the oil industry and associated developments is accurately assessed and factored into the planning and execution of infrastructure projects to avoid a critical shortfall.		
IND12 4	1.4 - Fuel and bunkering, economic stability as affected by fuel stocks The Environmental Impact Statement (EIS) acknowledges that Stanley Services Limited stocks fuel according to demand. However, it fails to fully consider the broader implications of this practice on the local economy and the community's cost of living. As Stanley Services adjusts fuel pricing based on the ratio of what remains in the tanks to what needs to be restocked, any increase in demand—such as that driven by the oil industry—would have a significant and potentially destabilising impact on fuel prices. With the advent of the oil project, fuel demand will likely fluctuate more dramatically, particularly during peak periods of oil-related activity. This increased and unpredictable demand would lead to more frequent and potentially sharper adjustments in fuel prices. The community, already sensitive to fluctuations in the cost of living, would face a rolling impact as fuel costs rise more rapidly and unpredictably. This volatility would not only affect household budgets, particularly for kerosene and diesel, which are critical to daily life, but also complicate financial planning for businesses and government projects alike. For government and commercial entities, the unpredictability in fuel costs could lead to inaccurate economic forecasting and budgeting, causing delays or cost overruns in key projects. For the average resident, the increased cost of fuel would ripple through the economy, affecting the prices of goods and services that depend on fuel for transportation and production. This could lead to a less predictable and more challenging economic environment, where the cost of living becomes increasingly difficult to manage, particularly during periods of heightened oil activity.	Thank you for your comment. Navitas has spoken with Stanley Services Ltd (SSL). They have commented that 'the comments are factually inaccurate with both domestic fuel and bunker fuel prices having separate pricing mechanisms with one not reliant on the other but are based around world fuel prices. As part of the fuel license agreement between FIG & SSL, SSL has to keep minimum stocks of certain grades for domestic fuel. The minimum stock level is calculated on average sales, any large change in sales will have a negligible impact on pricing and if anything larger sales will assist in keeping prices lower for domestic fuel grades. Bunker fuels are treated differently and there is no requirement for any minimum stock levels. However, an increase in bunker fuel sales will more likely have a minimal positive effect in reducing domestic fuel prices rather than raising them'.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	The EIS does not adequately address these potential economic impacts, nor does it propose measures to mitigate the increased volatility in fuel prices that would result from the oil industry's influence on fuel demand. It is crucial that these factors be taken into account to ensure that the economic well-being of the Falklands community is protected in the face of such significant developments.		
IND12 5	1.5 - International flights The proposal to monitor use of existing airlinks for potential impact is not sufficient to address the potential impact of additional use of the flights. While it is asserted that charter flights could be used by oil companies at various points, it is not addressed that there will be a profit incentive for Navitas to use the existing airlinks where possible. This will have substantial negative impact, with room for a rolling impact in various scenarios. Additional use of existing airlinks, even if it is not considered significant by oil interests, would not have to be high to have a substantial impact on availability of flights for both members of the public travelling to and from the islands for holidays - or visits to home countries for migrants. Existing airlinks already operate at capacity, and in the case of the existing South America link a heavier push on existing capacity is likely to increase prices - either affecting the cost to consumers or the cost to government, indirectly affecting residents by tax revenue usage. Additionally, the airbridge connection also operates at capacity, and is regularly delayed. At this time there are regular cases where residents are waitlisted when there are delays causing merged flights, causing significant expense to travellers and major inconvenience to local businesses and government. With additional strain on capacity to the airbridge such delays would only cause more significant clashes and frustration, longer waitlists, and disproportionately affect those who are least able to afford the delays - particlarly as those who are prioritised on waitlists are senior government	The usage of both the Airbridge and LATAM is discussed in section 7.7.4.3. The impact assessment is covered in Section 11.6. Airlinks will be discussed further in the socioeconomic impact assessment. The current stretch/difficulties regarding air links are keenly understood. The difficulties associated with existing air links noted in the comment explain why Navitas has committed to its own charter flight during the development, SIMOPs and production phases of the Sea Lion development. Currently Navitas would not be able to run its operations using the existing airlinks given both the limited seat availability and waitlisting arrangements, and that an international airframe needs to remain on the ground for sufficient time for the helicopters to complete the offshore crew change. Navitas will work closely with FIG and BFSAI prior to operations to ensure that its charter flight operations can be accommodated at Mount Pleasant International Airport. Oil industry charter flights were accommodated at MPA during previous exploration campaigns.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	officers and BFSAI staff. Each of these issues could face yet more compounded negative effects which are not given due significance as the Mount Pleasant Complex has a majorly limited capacity for inbound and outbound flights. As such, even were charter flights used this would limit the windows in which delayed flights could enter and depart the islands, leading to greater delays, frustration for then public, and expense for government and local businesses and residents.		
IND12 6	2) Effect on quality of life for Falklands residents The basis of pursuing the establishment of an oil industry, it is asserted, is to be able to fund work and projects to increase quality of life for Falklands residents. Here I highlight a number of areas which show that there are a range of areas of negative effect for quality of living in the Falklands. 2.1 – Access to employment It is often asserted that the introduction of an oil industry will improve employment and provide funds for a range of infrastructure projects for the Islands. These claims are universally made for oil projects in various countries, and have been shown to be false. It has been shown that for migrants oil has no positive effect on likelihood of employment, and that the effect on hired jobs in both high and low oil regions of hydrocarbon exporting nations is significant negative (Sigal, 2016). Also, areas where oil is located over time tend to suffer from lower economic growth and lower per capita incomes than the rest of the country, greater dislocations, higher environmental and health hazards, and higher levels of conflict. Economically, petroleum fails to offer long-term sustainable employment alternatives at the local level, but it can seriously disrupt pre-existing patterns of production. The promise of new jobs that new oil exploitation seems to offer typically attracts large numbers of migrants to an exploitation area. The rapid influx	The comments are noted. They are out of scope for the EIS (Section 6.2.2) however this they are covered in the Social Impact Assessment (SIA). It should also be noted that the full employment situation in the Falkland Islands mean that the Islands are distinct from other studies. FIG maintain a local content code of practice. The Sea Lion SIA will detail employment mitigations and a Social Effects Monitoring and Management Programme (SEMMP) will monitor effects and determine appropriate management action throughout the development lifecycle.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	of people and the higher relative salaries of oil project workers inflate the local prices of key goods and services, bringing about a significant increase in the cost of living, even for those who do not share in the benefits of an oil project (Karl, 2007) This effect is particularly visible in communities which have any presence of farming. Universally where oil is introduced farming activity, by employment numbers and production, falls significantly (Sigal, 2016).		
IND12 7	2.2 – Effects on health The effect of oil exposure in a nation for health is even more drastic. Presence of disabilities, both at birth and by injury, increase significantly – and offspring survival rate drops (Sigal, 2016). This has been shown to be the case even when controlling for levels of education and base levels of public healthcare in the area. The only exception for this is where oil is introduced in an area where there is a pre-existing range of private healthcare options in the area – and even in this case there is only a slightly less significant increase in proportion of disabilities by injury, and a less significant decrease in offspring survival rate, and in both cases, only for the highly educated and higher earners, (Sigal, 2016). It was also found that there were significant effects on the health of resident populations where oil is extracted, increasing the presence of various health complications, including asthma, bronchitis, asthma related complications, and lung-condition related deaths - for the United States resulting in a $77 billion direct cost in total health impacts (Buonocore, et al, 2023).	These effects noted in the publication referenced (Sigal, 2016) do not appear relevant to the Sea Lion Phase 1 & 2 Development in which oil is produced offshore and away from human populations. Potential impacts to human health will be considered further in the socioeconomic impact assessment.	N/A
IND12 8	2.3 - Noise pollution The Environmental Impact Statement (EIS) presents an analysis of the potential noise impact from oil activities in areas such as Berkley Sound, Stanley, and regions closest to the port. However, the data and assumptions underlying this analysis are fundamentally flawed. The studies cited in the	Noise surveys were undertaken to understand the baseline levels of noise around Stanley and Berkeley Sound, see section 7.7.5.1.1, as this is indeed a quieter soundscape than an urban environment. The sensitivity of the receptor (human population) is	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	EIS largely reference noise levels considered acceptable in urban environments—areas that already experience a significant degree of background noise. These studies fail to account for the unique context of the Falklands, where many areas, particularly those affected by the oil project, are rural with much lower levels of pre-existing ambient noise. The EIS does not adequately consider the heightened sensitivity of both the resident population and local wildlife to noise disturbances in these quieter, more natural environments. In rural settings like those around Berkley Sound and Stanley, even small increases in noise levels can have disproportionately large effects. The noise data provided in the EIS is not only inappropriate for the Falklands context but also risks severely underestimating the potential disruption caused by oil-related activities. Wildlife in these areas, which is accustomed to a relatively quiet environment, may experience significant stress and behavioural changes due to the sudden and sustained increase in noise. Similarly, residents who are used to low ambient noise levels could face considerable discomfort, sleep disturbances, and other negative health effects, which are not accurately reflected in the urban-centric studies referenced in the EIS. In the particular case of heavy vehicle noise, as has been better tested in regard to aircraft, ambient noise is usually dominated by road traffic noise and community noise (Fields, 1992). Fields suggests that levels of ambient noise may have little effect on reactions to aircraft noise. Nevertheless the responses from the focus groups in the study of Heaver (2002) and those of Diamond *et al.* (2000) suggest that those in areas with high ambient noise level are less annoyed by an additional source than those in an otherwise quiet environment (Sanchez *et al.,* 2015). Lim *et al.* (2008) concurred, finding that subjective responses to aircraft noise decreases with increasing background noise levels.	assessed as being Moderate within the assessment and Navitas will conduct noise monitoring once into operations and monitor and respond to all complaints.	

Ref.	Representation	Navitas response	Changes in Rev 4
	In short, the data used to assess noise impact is not just inadequate—it is fundamentally misaligned with the conditions of the Falkland Islands. The EIS must take into account the lower baseline levels of ambient noise and the greater sensitivity of both humans and wildlife in these rural areas - and take into account the lower difference in noise level required to cause a stress response. Without this adjustment, the true severity of the noise impact cannot be accurately assessed, potentially leading to a gross underestimation of the environmental and social costs associated with the project. It is important to note that as this information is incorrectly founded, the effects can be severe. Once ambient noise levels exceed what a population are accustomed to, the health effects can be severe. Increased noise can lead to significant sleep disruption and psychological distress, which can, in turn, elevate the risk of cardiovascular problems and weaken the immune system. Studies have shown that in areas where there's a sudden and sustained rise in noise levels, the frequency of hospitalizations often increases due to these stress-related health impacts. A consistent increase in noise disturbances can have profound and lasting effects on community health and well-being (Mucci, 2020).		
IND12 9	2.4 - Lack of stability in post-oil scenarios The Environmental Impact Statement (EIS) fails to address the critical issue of what will happen to the Falklands in a post-oil scenario or during periods of oil market instability. The EIS overlooks the potential long-term risks associated with becoming heavily reliant on the oil industry. History has shown that when regions or industries become dependent on oil, they are vulnerable to severe economic disruptions if oil reserves dwindle, if there are fluctuations in global oil prices, or if the industry declines for other reasons. A downturn in the oil market can lead to widespread job cuts, leaving many people unemployed and leading to a range of social issues, including increased homelessness and poverty as has been seen in Aberdeen and	Such effects are outwith the scope of the EIS - potential impacts on employment and quality of life will be considered further in the socioeconomic impact assessment. The Social Effects Monitoring and Management Plan can monitor potential impacts throughout the Phase 1 & 2 development lifecycle.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	other cities which developed an oil reliance. Businesses that thrive during the oil boom may struggle or close down entirely when the industry contracts, resulting in a loss of economic diversity and resilience. Additionally, infrastructure investments made to support the oil industry may become underutilised or abandoned, leading to a deterioration of public assets and a further strain on government resources. The domino effect of an economic downturn in a post-oil scenario can be devastating, with negative impacts spreading across various sectors and deeply affecting the community's quality of life. The EIS does not adequately consider these risks or propose strategies for mitigating them. While it may be challenging to fully predict and plan for a post-oil future, it is essential that the government takes a cautious and forward-looking approach, ensuring that the Falklands is not left vulnerable to the boom-and-bust cycles often associated with oil dependency. The potential consequences are too significant to ignore, and a more robust plan is necessary to ensure long-term stability and sustainability for the Falklands		
IND12 10	3) Falklands Government functionality 3.1 - Global perceptions of the Falklands The Falkland Islands have long marketed themselves as a place where "nature is still in charge." This branding is not just about attracting tourists who come to experience the unique wildlife, including penguins, seals, and whales, but also plays a crucial role in the Islands' political narrative on the global stage. The Falklands are presented as responsible custodians of this part of the South Atlantic, committed to preserving the natural environment for future generations. This image is integral to the Islands' efforts to garner international support for self-determination, particularly during engagements with the United Nations and other global bodies. By positioning the Falklands as a region that prioritises environmental stewardship, legislators have successfully leveraged this perception to build political alliances and strengthen the case	Thank you for your comment. This is noted. However, it is not for Navitas to comment on FIG policy and approach to public diplomacy.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	for maintaining autonomy. However, the development of oil and the associated environmental risks could seriously undermine this carefully cultivated image. The global perception of the Falkland Islands as a pristine, environmentally conscious region is at risk of being tarnished by the realities of oil extraction and the environmental impacts that accompany such activities. If the project proceeds without adequately addressing these concerns, it could damage the Falklands' reputation, leading to a loss of credibility in both tourism markets and international political arenas. Moreover, any negative environmental outcomes could diminish the appeal of the Falklands to eco-conscious travellers, which would have direct economic consequences. This would not only affect the tourism sector but also weaken the Islands' ability to use their environmental record as a tool in political diplomacy. It is essential that these potential impacts on global perception are given serious consideration in the Environmental Impact Statement, as they could have long-lasting effects on the Falklands' economic and political standing.		
IND12 11	3.2 - Public infrastructure support and wider functionality The development of the oil industry in the Falklands is likely to introduce significant challenges to the functionality of the Falklands government, particularly in terms of public infrastructure support. One key concern is the increased use of the air bridge between the Falklands and the UK. With oil-related activities increasing demand for air travel, there will likely be longer delays for government officers travelling to and from the Falklands. These delays could hinder the efficiency of government operations, reducing the ability of officers to respond promptly to critical issues. Moreover, the longer and less reliable travel times may deter potential recruits from moving to the Falklands, as well as dissuading current residents from staying, exacerbating the challenges of maintaining a skilled and stable workforce within the government.	Thank you for your comment. This is noted. However, it is not for Navitas to comment on matters regarding FIG policy and infrastructure investment.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	In addition to the strain on travel infrastructure, the oil industry will place an additional burden on the Falklands' already strained public works sector. The increased use of roads for transporting oil-related materials and personnel will accelerate the wear and tear on the road network. Given that the road works team within public works is already operating at maximum capacity, this added pressure will likely lead to delays in essential road maintenance and other public works projects. The ripple effect of these delays could extend to other critical infrastructure as previously mentioned, such as electricity, water access, fuel and bunkering, housing, and healthcare services, all of which are already facing capacity challenges. The EIS does not fully address these potential impacts, which could severely compromise the government's ability to maintain and develop the infrastructure necessary to support both the oil industry and the wider community.		
IND12 12	4) Method of consultation of EIS I would also like to make known my significant concern in regards to the Non-Technical Summary and the presentation of this document. While I understand the necessity of simplifying information to increase likelihood of responses by members of the public, I feel that the document overly condenses and simplifies various areas and at times even downplays areas of significant risk with the possibility of misleading stakeholders and members of the public who may not have time to read the large complete EIS. While there is little specific response that can be made in regard to this, I would urge that legislators and officers thoroughly consider the high barrier for complete responses which exists for members of the public in regard to the EIS, as almost all but those who would have professional capacity and reason to read the complete EIS; or those who have no significant	Navitas followed FIG EIA guidance on the Public Consultation process.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	professional or personal time commitments, would have time to review and respond to the complete EIS. This being the case, I would urge that Legislators in particular consider the views of their electorate when considering the EIS and it's responses - and do their best to imagine the views of the electorate who may be effected in the future by the decision to pursue hydrocarbons, and would not have had the opportunity to respond to this document, either due to capacity, age, commitment, or fear of negative consequences from their employer or future prospective employers - especially due to the heavily politicised view which is taken of anti-oil stanced individuals.		
IND12 13	5) Acceptability of risk While I do not claim to have expertise in environmental science, biology, or related fields, I am deeply concerned about the lack of attention given to what is considered an acceptable level of risk by the government. The Falkland Islands have long been promoted as a place where nature is in charge, a region that values environmental stewardship and care for its unique ecosystems. Given this, I strongly believe that the burden of what is deemed an acceptable level of environmental risk should be extremely low. The EIS, however, proposes risk levels that range from moderate to high, which are simply not acceptable by any reasonable standard for a place that prides itself on environmental preservation. These mixed moderate, upper moderate, and high-risk assessments should not be allowed to progress unchecked. It is vital that the government upholds the principles of environmental care that have long been associated with the Falklands. Allowing such significant risks to move forward would not only undermine these values but could also lead to irreversible harm to the very environment that the Falklands has committed to protecting.	Thank you for your comment. This is noted. Navitas followed a robust EIA methodology (Chapter 8) and applied the precautionary principle in accordance with FIG EIA guidance.	N/A
IND12 14	Conclusion In conclusion, I believe that the proposed oil drilling project is ill advised from a social perspective, environmental perspective, and from the	Thank you for your comment. This is noted. However, it is not for Navitas to comment on FIG policy.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	perspective of the functionality of government. I also believe that it would be completely misaligned with the Falklands Government goals and responsibility of the Falklands Government and people to contribute to the global environment and - as the Islands Plan states: "reduce our carbon emissions in order to ensure we act as a responsible global citizen."		
IND13 1	Response to the public circulation of the Navitas Petroleum Environmental Impact Statement Thank you for the opportunity to comment, I do so having acute regard for over 4 decades of personal time spent lobbying for the opportunity, which thankfully now lies within grasp. Let us not be blind-sided by a biased environmental rant, sans substance. 30 years ago following due public consultation, FIG launched the First-Oil licensing round in London. There were no dissenting voices, and even Falklands Conversation, then present, did not express objection. In May 2010, Rockhopper Exploration discovered the Sea Lion field. It has taken 14 years to embrace the real possibility of an emerging new industry; it is a once-in-a-generation opportunity. The Sea Lion Environmental Impact Statement (EIS) issued by Navitas Petroleum for consultation, requires responsible consideration of the opportunities, risks and impacts, both positive and negative. The EIS is in accordance with the Islands Plan 2022–2026, that states "This Assembly will… progress extractive industries in an environmentally conscious way." The EIS recognises other relevant FIG policies involved in decisions making and consultation, include those charged with protecting the environment and biodiversity, and climate change. In the Falklands, especially across the rural communities, we all see the impacts of global climate change. We all have our part to play in combating this, through restoration, and the development of Sea Lion will provide the financial resources to fast track land management, best scientific led bio-diversity restoration, and healing of the landscape.	Thank you for your comments.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	The inconvenient reality is that oil has to be a declining part of the energy mix during the Energy Transition in the coming decades. We use oil to fly to and from the Falklands, heat and light our homes, fly FIGAS to boost tourism, take winter vacation, encourage marine tourism, drive vehicles and power fishing vessels, cargo and cruise ships. It is hypocritical therefore, for anyone, and especially Falklands Conservation, to state that whilst we use oil, it should be produced elsewhere, often with lower environmental and ethical standards, by corrupt and dictatorial regimes. Without an air bridge and UK land, sea and air security commitment to the Falklands, we would soon become an irksome remnant of a bygone era. Having lived through the Falklands darkest economic times with little future potential, I cannot recommend any return to such an era. The EIS has identified the risks, and mitigations, with few residual planned negative impacts. This is because oil development is mainly a contained, sub-surface activity. The biggest risks are from unexpected incidents. A modern, high quality development will minimise the risk of such an event. The EIS mitigations show that this can be done. As an example, the likelihood of oil beaching in the Falklands is assessed as 'Low'. The industry will bring with it sea and air units to daily underpin any risk which might surface, and commitments to call in the mobilisation of time critical international resources in the unlikely event of spillage. No other industry, working within the Falklands environment, provides such safeguards. Risks of development are recognised and managed elsewhere, as in the UK, which has 120 producing oil sites, including new sites under development, and from where the Falklands has modelled its offshore Health, Safety and Environment legislation. Even environmentally conscious Norway, has 90 oil-producing sites, and an unimaginable sovereign wealth fund to prepare for the future without fossil fuels. For risk of development to be acceptable in the UK, then it should be acceptable in the Falklands. We have one environment, which we need to protect, but also we desperately need to restore the terrestrial element of our environment – it should not be a simplistic excuse, as Falklands Conservation posits, not to		

Ref.	Representation	Navitas response	Changes in Rev 4
	sustainably develop our economy for the benefit of future generations health, wealth and education, and land restoration. We have a duty to promote, protect and nurture our environment. For some years, I have been in the field restoring Falklands' habits and trying to reduce the loss of peat land, and the only party to have undertaken a first and only ground-truthing survey in one sector of the Falklands. The rural community, called Camp, leads by example having invested substantially in renewables, significantly reducing fossil fuel use. Stanley will energy transition over some years with weighty reserves cost implications. The Falklands are fragile in many ways. Nationally we have experienced the severe financial and social impacts of the long-term decline in the Falklands' historically dominant sector, wool producing. Responsibly, the Falklands needs to diversify its economy. We cannot rely forever on maintaining current financial reserves – they stand to dwindle. Our standard of living and the services we currently enjoy, substantially depend on a single, underpinning activity, fishing. Fishing also has a significant impact on the marine environment. FIG scientifically monitors the fisheries and makes fishery management decisions. Many of the risks in the EIS also are relevant to existing marine activities. Nationally we will be able to educate, train, and employ future generations of home- grown environmentalists, naturalists and future land managers, from an oil industry, which hitherto has not been possible due to lack of commitment and finance. Investing in home-grown talent, educated in our current restricted setting, pursuing further education in the scientific arena, fills a waiting vacuum. Today's students should become our scientific advisors of the future. Political lobbying for the Falklands to have its oil and gas regime commenced decades ago. Let us not cast aside prior strategic thinking and vision done at that time, and our nation's economic future, because of some pseudoscience pedalled by Falklands Conservation. [Redacted personally identifying information], I interpret its 57-page response as nothing short of a rant, whilst on the other hand it annually has arms gleefully outstretched to		

Ref.	Representation	Navitas response	Changes in Rev 4
	receive tens of thousands of £s, of taxpayers funded subvention. Double standards, worthy of public criticism, if not a PAC review. Some years ago the Falklands bunker supplier revealed that >1million tonnes of marine diesel had been transferred in Berkeley Sound, this figure fell short of including all transfers for reefer and jiggers for prior decades. It is therefore wrong of Falklands Conservation to finger the Sea Lion development assets as having the only capability of striking a whale. The Falklands has a National Oil Spill Contingency Plan (NOSCP), but on page 10 of the Falklands Conservation response, oil spills only get one paragraph out of 57 pages! The NOSCP is based on being proportionate to the risk, and at the moment, does not consider oil production, so to make reference to it as Falklands Conservation has done, is misleading or at best, naïve. The Falklands equivalent to the Merchant Shipping Act already provides the basis for a Falklands equivalent to the UK SOSREP with the powers of intervention - but why bother mentioning that when Falklands Conservation appear unaware of Chapter 4 of the Ordinance: Liability for Oil Pollution, or Chapter 5: International Oil Pollution Compensation Fund. To say the EIS is not fit for purpose, reckons with a biased ranting response, which does not even name the author(s). Fast-forward from 1995, we are fortunate to be able to comment on this development EIS in a transparent way. I endorse the well thought through EIS and its focus on delivering the best mature environmental protection against known and likely risks to enable development, while delivering a sustainable future for upcoming generations across both our terrestrial and marine environments.		
IND14 1	Response to Environmental Impact Statement: The Sea Lion Field Northern Development Area As an member of public I am writing to express my profound concerns regarding the Environmental Impact Statement (EIS) for the Sea Lion Field Northern Development Area. As an individual and a Marine Biologist with extensive experience at sea, I have briefly reviewed the EIS and found	Thank you for your comments, the underwater noise chapters are being revised and Navitas will be sure to review the paper suggested. See FIFD 54.	Section 10.4 Section 10.5

Ref.	Representation	Navitas response	Changes in Rev 4
	several critical issues that I believe warrant immediate attention. 10.4.4.3.2.1 Fish hearing thresholds The EIS appears to have been finalized prior to the publication of critical research that directly relates to the project's potential impacts. Specifically, paper Anthropogenic noise disrupts early-life development in a fish with paternal care - ScienceDirect, presents findings that were not considered in the EIS. This study indicates that anthropogenic noise can lead to a decrease in egg number and a reduction in yolk sac size in fish. These findings have direct implications for fish populations, particularly in sensitive habitats such as those around the Falkland Islands. The observed effects in the study- namely, reduced egg numbers and smaller yolk sacs- suggest significant developmental disruptions that could impact fish survival rates and population dynamics. Such disruptions are particularly concerning for species with critical early-life stages and could exacerbate the adverse impacts on fish populations predicted in the EIS.		
IND14 2	1.7.3.1.1 Direct offsetting: The EIS outlines various options for offsetting but does not specify a clear, actionable plan for addressing the carbon emissions resulting from oil extraction, production, and combustion. Given the significant carbon footprint that the project will likely contribute-particularly in the context of the Falkland Islands' relatively high per capita emissions-it is crucial that a definitive strategy for carbon offsetting be established. Considering the Falkland Islands' remote location and limited resources, offsetting measures may indeed be challenging. Without a clearly defined and robust plan for compensation, the environmental impact of the Sea Lion oil field could be substantial. It is essential to have a detailed, written commitment to offsetting that includes calculations and strategies tailored to the unique circumstances of the Falkland Islands. The EIS includes examples such as reforestation in nearby areas where	Thank you for your comment. This is noted. The example of reforestation provided in EIS section 8.11.2.1 was not intended to refer to the Falkland Islands, it was included to provide an example of what would constitute direct or 'like-for-like' offsetting. Please also refer to the response to comment IND 11 7.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	construction has cleared trees. We are clearly not talking of Falkland Islands and EIS is clearly lacking seriousness and commitment for offsetting. Specific, context-appropriate offsetting strategies should be developed rather than relying on generalized examples that may not address the unique environmental and logistical challenges of the region. Given the lack of a clear and actionable plan for offsetting, and the specific challenges posed by the Falkland Islands' remote location, I recommend that permission for the Sea Lion oil field extraction and further oil exploration be put on hold until a comprehensive and feasible offsetting plan is developed. This plan should include detailed calculations and strategies that are specifically tailored to the conditions and capabilities of the Falkland Islands.		
IND14 3	Spatial Overlap with Fishing Licences: The proposed Sea Lion oil field is situated within the geographical boundaries of fishing areas designated under B licence.	Thank you for your comment. This is noted and is discussed in Section 7.7.3.1.1.1, which details the fishing activity within that licence and notes the low levels of fishing in the area and the specific square in which Sea Lion is located.	N/A
IND14 4	And finally, I would like to express a significant concern regarding the Falkland Islands preparedness for potential accidents related to oil exploration. The remoteness of the Falkland Islands, coupled with their limited resources, raises serious doubts about the ability to mount a prompt and adequate response in the event of an environmental incident.	Navitas has prepared and submitted its preliminary (Pre-FID) OPEPs to FIG for their review and approval. These shall be finalised prior to the commencement of operations. Navitas is proactively committed to mitigating the risks of such an event from occurring. Navitas Petroleum Development and Production Ltd. (formerly POEPL) has invested significant resources in understanding Sea Lion crude behaviour and the metocean environment in order to predict the potential impacts on wildlife and inform optimum spill response equipment. Extensive Tier 1 and Tier 2 response equipment has been specified and will be available on the support vessels, and stored in the Supply yard. Tier 3 Spill Response will be supported	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		by specialist oil spill and wildlife response agencies with resources (equipment and manpower) available to respond at very short notice. The oil spill response arrangements are not reliant on the NOSCP and associated resources. The preliminary OPEPs have been prepared in order to interface appropriately with the NOSCP (as required and stipulated in the NOSCP) and Navitas has committed to regular engagement, training and joint spill response exercises with FIG to ensure that a spill response can be effected appropriately.	
Royal Society for the Protection of Birds			
RSPB 1	SEA LION FIELD DEVELOPMENT PHASES 1 & 2, ENVIRONMENTAL IMPACT STATEMENT (EIS) 2024 CONSULTATION RESPONSE The RSPB welcomes the consultation offered by the Falkland Islands Government and offers comments with the aim of contributing to the shared objective of environmentally sensitive economic development. We offer these comments from the perspective of UK and international policy. This contribution builds upon RSPB consultation responses to oil Environmental Impact Assessments in the Falklands over several decades. The RSPB's view is that, due to the five reasons outlined below, the EIS is insufficient to currently meet the standard of an environmentally safe development and should be resubmitted once FIG's more robust planned governance framework is in place. The comments outlined below are not exhaustive.	Please see responses below.	N/A
RSPB 2	1)The proponent's baseline data survey work has major shortcomings a)The incorporation of new pinniped and avian data is welcome. This helps narrow risk and current uncertainty in impacts upon vulnerable seabird and marine mammal populations. It helps identify the presence of a number of species. However, it is our view that inadequate effort has been made between the exploration and extraction applications to survey offshore	Navitas disagrees that the baseline data survey work has major shortcomings. The RSPB comment suggests that additional data should have been gathered in the time available between exploration and extraction. Navitas	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	baseline ecological data on birds and cetaceans. It remains hard to understand why these known gaps could not have been filled by the proponent in the time available.	Development and Production Limited, formally POEPL, has invested considerable resources both independently and *via* the industry-FIG funded 'GAP' project to acquire and analyse data, including seabird and cetacean data, to inform the baseline. While some of this data was available in time to inform exploration Environmental Impact Assessments, it was not commissioned for the exploration stage, but was commissioned specifically to inform the baseline for the purposes of the development impact assessment. While the Seabirds at Sea Team dataset is old, this has been analysed alongside and is complemented by other more recent data and the data is considered valid for the purposes of the risk assessment. There are some data gaps in the SAST dataset, which are acknowledged in the EIS. FIG EIA Guidance states that 'the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they address the gaps in the risk assessment' and where there are data gaps a risk may be increased to reflect the higher level of uncertainty. To update the seabirds at sea dataset would require a multi-year, multiple vessel survey effort across the entire Falklands offshore area. It is considered that this is beyond the scope of an individual operator. The EMMP Workshop considered the (post-regulatory approval/project sanction) data acquisition, monitoring and management	

Ref.	Representation	Navitas response	Changes in Rev 4
		requirements at all stages of the project life-cycle. The workshop concluded that it would be useful to collect further [seabird] data opportunistically from vessels associated with the Sea Lion development, but that a wider data collection effort to update seabird information was beyond the scope of the EMMP.' It was also decided in the EMMP workshop not to monitor seabird populations ashore 'due to the difficulty of attributing any change to activities in the Sea Lion field.' Despite it being suggested by the EMMP workshop that a wider [seabird] data collection effort was beyond the scope of the EMMP, Navitas has committed in the EIS to collaboration with FIFD in this regard post sanction (Section 10.1.10.1).	
RSPB 3	b)Surveys in the 'zone of influence' –a key concept in EIA – are important. Wider tracking data for species is helpful to help build a partial picture. However, this is not a substitute for rigorously designed surveys. In the North Sea, offshore windfarm developers are expected to provide comprehensive data on bird distribution and movements (as well as data on other animals' distribution and movements) over a two-year period and often over potentially very large areas, prior to submitting consent applications. Developers typically undertake offshore distribution and movement pattern surveys, often at considerable cost. This is done so ahead of project approval, with full knowledge of potential associated risks to that development. The need for up-to-date baseline data is also a required under North Sea oil EIA regulations (Statutory Instrument 2020 No. 1497). c)One of the principal reasons for the recognition of the need for up-to-date survey work is that evidence from around the world suggests that seabird populations are changing in their distribution and abundance, including in the sub-Antarctic1. Given the global importance of this marine region to	The context here is that the Sea Lion field is the only one in the Falklands Islands that is currently being looked at for development and it is not reasonable, practically or financially for a single operator to undertake this work in isolation. This work is more appropriate for a collaboration of industry and FIG. Navitas Petroleum Development and Production Limited (previously POEPL) has invested considerable sums in data gathering alongside investment in the GAP project. See also response to RSPB 2.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	seabird populations, and potential risks from oil developments, similar data would be expected to be presented.		
RSPB 4	d)We commend the use of precautionary risk categories. However, the use of these categories has limits if rigorous and up-to-date baseline information fails to be presented. These data gaps ensure there is unnecessary uncertainty regarding the significance of impact on receptors. Consequently there is insufficient confidence in the targeting and efficacy of any mitigation measures that are proposed for individual species that may have different behavioural or lifecycle characteristics e.g., are they vulnerable to light pollution, do they form seasonal local aggregations etc..	The assessments in in the EIS are precautionary and all consider gaps in the data. Under FIG's guidance (FIG, 2016) the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they are dealt with in the risk assessment. Therefore the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained and indeed a precautionary approach is taken.	N/A
RSPB 5	e)A compounding concern is that much of the North Falkland Basin east of the drill site has no SAST data in sensitive months, a significant data gap, particularly when considering impacts from possible spill events.	Thank you for the comment. This gap is acknowledged in the document. Note that Navitas will deploy SMMOs on vessel operating in and from the field for a period of three years pre-First-Oil.	N/A
RSPB 6	f)Best practice Environmental Impact Assessment, for example presented by the UK Government2, considers the use of baseline data gathering once consent has been given, or as part of a 'consent condition' to be poor practice. This would include the deferral of baseline data collection to the Sea Lion Environmental Monitoring and Management Plan. This has the potential to put decision makers in a difficult position as engineering plans are advanced, leverage is reduced and development plans therefore less likely to be altered later as the costs would be potentially much higher. g)It is therefore our view that the avian data presented does not allow FIG to make sufficiently informed decisions on potential impacts and therefore methods of possible mitigation of impacts in engineering or operational procedures.	See response to comment RSPB 2, 3, 4 and 5.	N/A
RSPB 7	2)Carbon emissions from unabated development of the Sea Lion field a)The International Energy Agency has highlighted the risk of new long term oil developments to the safe limits described in the UNFCCC Paris Agreement:	The subject of emissions is transparently and extensively detailed in Section 10.9 of the EIS. Navitas is committed to exploring opportunities to further reduce its emissions; an example of this is the	Section 10.9.7.1 Section 10.9.4.4.4 Section 10.9.4.4.5

Ref.	Representation	Navitas response	Changes in Rev 4
	To align with a 1.5 °C scenario, these [industry] emissions need to be cut by more than 60% by 2030 from today's levels and the emissions intensity of global oil and gas operations must near zero by the early 2040s. [...] In a scenario that hits global net zero emissions by 2050, declines in demand are sufficiently steep that no new long lead-time conventional oil and gas projects are required3. b)The estimated unabated carbon emissions outlined in the EIS are approximately 9 million tonnes from production and >111 million tonnes from combustion of the oil. Extraction is proposed to extend beyond 2050, the deadline for net zero. This, alongside the lack of credible offsetting plans (see below), ensure that this development is not compatible with environmentally safe development. c)The proponent has publicly stated a desire to further develop the basin with no mention of emission abatement plans4. If this were to happen unabated, the unfavourable emissions scenario would be significantly compounded.	Emissions Reduction Action Plan (ERAP) for the Floating Production Storage Offtake (FPSO) vessel during the Front End Engineering and Design (FEED) project. Navitas also commits to seeking further emissions reduction initiatives throughout the life-cycle of the Sea Lion Field. EIS Section 10.9.4.4.4 notes that currently expected emissions from Sea Lion are 17.9 $kgCO_2e$/boe. This section also notes that 'when the personnel transportation, drilling and vessel emissions are excluded to enable like-for-like comparison with UKCS emissions reported to the NSTA, the carbon intensity is estimated to be 14.2 $kgCO_2e$/boe (section 10.9.4.5.4).' Consequently, Sea Lion will bring oil to market at a carbon intensity lower than the UK average for an FPSO (36 $kgCO_2e$/boe for FPSOs of 11-25 years of age and 20 $kgCO_2e$/boe for FPSOs of 0-10 years old), indicating that the development is comparatively efficient. This is without the additional emissions reduction measures that will be considered in Front End Engineering Design (FEED) and the Emissions Reduction Action Plan (ERAP). Were the development not to be sanctioned, oil would be sourced from the international market from existing, declining fields with a likely higher carbon intensity. With regards to offsetting, Navitas is committed to	**Note:** the estimates mentioned in the response column have subsequently reduced following changes to the gas conversion rate in response to Xodus 46. Section 8.11

Ref.	Representation	Navitas response	Changes in Rev 4
		offsetting significant impacts. Local offsetting will be prioritised over international schemes. Carbon and biodiversity offsetting opportunities require further evaluation and research to define the level of offsetting that can be achieved locally. Navitas' offsetting strategy has been detailed in a paper which was issued to FIG in August 2024; this will be further discussed and agreed with FIG and will be consistent with FIG legislation, policy and guidance. Navitas does not consider it is possible to give more information on credible potential offsetting plans with a path to physical delivery, including pilot projects, until further research has been undertaken. EIS section 8.11.2.2 states that at this stage it has not been possible to develop potential indirect offsetting projects to the level of maturity required by the EIA guidance, and it cannot make ad hoc commitments to indirect offsetting projects that are not fully understood. 8.11.4 states that 'As feasibility of various potential operator-led direct and indirect offsetting initiatives cannot be confirmed prior to research, analysis and development, Navitas is not in a position to specify offsetting required by the 2016 FIG Offsetting Guidance at this time. Given this, Navitas will initiate a Falklands-specific fund which will initially address and inform the feasibility of large scale carbon and biodiversity offsetting through commissioned research and investigation. It is intended that following this feasibility stage, Navitas will provide funding to the viable projects identified in order to discharge its offsetting obligation.' Note that some potential indirect offsetting initiatives are indicated at	

Ref.	Representation	Navitas response	Changes in Rev 4
		8.11.2.2 but this list is not exhaustive. It is not clear at this stage which of these potential projects would achieve the greatest environmental benefits. Furthermore, at the scale required to achieve meaningful offsetting, these projects may require environmental and socio-economic impact assessment in their own right. The majority of the land in the Falkland Islands is in private ownership, so landowners will need to be content to embrace the offsetting projects proposed. It is difficult to contemplate that landowners can commit to supporting such offsetting initiatives prior to regulatory approval and sanction of the project and prior to there being additional clarity on the environmental benefits such projects will achieve. For these reasons, it was not possible to confirm offsetting initiatives at this stage. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund.	
RSPB 8	3)Bird strike a) The EIS states (p.605): The Sea Lion Development is 220 km offshore, in an area that supports relatively low seabird densities throughout the year, and therefore it is not considered likely that multiple bird strikes will occur on a regular basis. It is our view that the avian survey data has not been presented to allow the proponent to ensure this statement's veracity (see above). b) The category of 'low' sensitivity of the seabird receptors impacted by artificial light and flares would therefore be unable to be verified. c) The EIS suggests that With regard to the likelihood of a multiple bird-strike	a) Although there are some temporal gaps in the SAST data Navitas believe that it has been precautionary in the risk assessment. Diurnal albatrosses and petrels (i.e., active during the daytime) are less likely to be involved in light induced bird-strikes than birds that are active at night. b) The low sensitivity refers to sea birds that will be vulnerable to light at night – for example prions etc. Most of these are listed as 'least concern' under the	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	event occurring, such a strike is likely to occur less than once per year but more than once in 10 years (p.606). Again, our view is that the data presented are insufficient to be able to make this statement with reliability and therefore the planned mitigation are potentially unreliable. d) Species that are listed as potentially susceptible to bird strike (section 10.1.4.3.1.4 p.599) have not been surveyed at the field site and data presented do not substitute for well-designed surveys that would test for bird strike susceptibility as is found in survey work for offshore wind in the North Sea when conducted to high standard. e) The EIS states that Navitas has limited control over third-party vessels (table 10.6) and proposes minimal stipulations in relation to bird strike. All contractors should apply relevant standards as part of the development. Good practice would see this built into contracts. f) Where insufficient data is available and considering this region is of global significance for seabird populations, good practice would assume a precautionary approach. However, the proposed mitigation measures presented offer few investments beyond industry standard practice. Few Innovative proposals for mitigation are made. These should include the use of radar, modified protocols during high risk periods at key times of the year, Clear sky lighting and other proven methods to reduce the impacts of the development, all part of a structured and internationally expert-reviewed plan.	IUCN red list. c) Thank you for the comment. Our assessment is based on evidence available and the likely taxa affected. The area will be surveyed post sanction and 3 years prior to First-Oil and the data generate here will improve Navitas' Bird Strike Action Plan. d) See response in c). Note that further data will be collected by SMMOs in the field three years pre First-Oil.The EMMP workshop concluded that 'a wider data collection effort to update seabird information was beyond the scope of the EMMP.' The context here is that the Sea Lion field is the only one in the Falklands Islands that is currently being looked at for development and it is not reasonable, practically or financially, for a single operator to undertake this work in isolation. This work is more appropriate for a collaboration of industry and FIG. Navitas has indicated its desire to collaborate with FIFD to collect area wide multi-year data - see section 10.1.10.1. e) With the exception of the CTT's, third party vessels on direct hire to the Sea Lion development will be part of the Bird Strike Action Plan with monthly bird strike reports sent to FIG. Lighting on vessels will be outwith Navitas' control and will be governed by safety regulations, although all in-field vessels will be asked to optimise lighting and utilise on site mitigations e.g., black out blinds etc. f) Thank you for the comment. Navitas will develop a	

Ref.	Representation	Navitas response	Changes in Rev 4
		Bird Strike Management Plan for all operations in Berkeley Sound and at the Sea Lion Field. Navitas has committed to exploring whether further mitigations can be applied during Front End Engineering Design, but as these project specific mitigations cannot yet be confirmed they have not been factored into the residual impact assessment.	
RSPB 9	4)Carbon and biodiversity offsetting proposals are not yet viable a)The proponent has put forward possible options in relation to offsetting carbon and biodiversity impacts under various scenarios. However, as freely identified in Table 8.9 (p.552) the plans are not sufficiently advanced to be able to show viability. b)FIG's Hydrocarbons Environmental Impact Assessment Guidance states that Whilst the EIS is not itself necessarily the basis for implementing or enforcing the mitigation, it should demonstrate that the proposed mitigation is realistic 5 . The proposals do not fulfil FIG's standard currently. This critical part of the EIS appears to have been presented prematurely.	Offsetting is the final step in the mitigation hierarchy. Navitas is committed to offsetting significant impacts. FIG guidance requires local offsetting to be prioritised over international schemes. Carbon and biodiversity offsetting opportunities require further evaluation and research to confirm viability and define the level of offsetting that can be achieved locally. This feasibility stage is underway, but requires data acquisition over a number of years. Where direct offsets are not available, Navitas will undertake indirect offsetting (EIS section 8.11.2.2). Navitas' offsetting strategy has been detailed in a paper which was issued to FIG in August 2024; this will be further discussed with FIG and will be consistent with FIG legislation, policy and guidance. See also commentary on offsetting in response to RSPB 7. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund.	N/A
RSPB 10	5)FIG's planned environment regulation regime is incomplete and therefore not yet 'oil-ready' a)FIG has recognised the need to improve regulation for the environment in order to secure safe standards of environmental governance and to address	Navitas notes this comment. Navitas expects FIG to address responders' comments on legislative matters separately.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	potential conflicts of interest as would be found in other jurisdictions such as the UK. b)In 2013 ExCo approved plans to separate the environmental regulatory function from the licencing function to avoid any potential conflicts (ExCo paper No. 70/13). This function is separate in the UK's North Sea regime. Whilst there is currently no evidence of any real conflict arising between licensing and safety regulation there are potential conflicts of interest between these functions, and most modern oil regimes separate the regulation of licensing/production from the regulation of safety and environmental matters (indeed in other regimes separation of these functions has followed major safety incidents (Piper Alpha in the UK and Macondo in the USA)). […] The Islands would be wise to learn from this experience and avoid some of the mistakes made elsewhere. This will ensure that the inherent conflict of interest between issuing economically and commercially valuable production licences and the approval of safety and environmental practices is avoided, and will better ensure the protection of the unique environment of the Islands and the safety of its inhabitants and transient workforces6. c)This recommendation has not been completed. The licencing authority is now considering the approval of the EIS. Arguably the licencing authority is now faced with this potential conflict. d)In the same paper there was the following commitment: That ExCo confirm that new legislation and guidance is needed to compel operators to submit an 'Environmental Case'. This recommendation has not been completed. e)In 2020 ExCo paper 97/20 noted The wider Falklands environmental regulatory framework has been noted as a concern for the UK Government in relation to the offshore Sea Lion development; and there is a need to demonstrate substantial progress regarding a number of items of legislation including the CWNO [Conservation of Wildlife and Nature Ordinance] in advance of project sanction. […] The FI wildlife legislation is dated and inappropriate for the globally significant wildlife supported by the Islands		

Ref.	Representation	Navitas response	Changes in Rev 4
	and includes little guidance for dealing with breaches. As the EIS correctly points out there are no equivalent 'Disturbance licences', so it is difficult for developers to know what the next steps are to be compliant with legislation and policy. f) In 2017 ExCo approved plans (ExCo paper 5/17) to put in place a 'polluter pays' law: The proposed legislation seeks to extend the focus of those onto prevention as well as remediation by placing an obligation on operators to take necessary steps to prevent environmental damage, and giving FIG suitable powers to issue specific directions. This is in line with the UK Environmental Damage (Prevention and Remediation) Regulations 20157. This recommendation has not been completed. g)If FIG logic is to be followed, the environmental governance framework is not yet sufficiently complete to approve the current EIS to a sufficiently safe governance standard.		
Seafish (Falklands) Limited			
SEAFISH 1	Discharge of drill cuttings – Looking for reassurance that this activity won't interfere with squid – what is the previous relevant literature in this area? It would be helpful to show the discharge of cuttings from the drilling and their spread across the seabed.	Navitas does not anticipate any impact from drill cuttings on squid life-cycles. As indicated in Section 10.6 the footprint of the cutting piles is very small in comparison to the extent of the habitat available. Further, spawning grounds for *illex* are off the southern coast of Brazil and the eggs are pelagic. The impacts of drill cuttings and discharges on fish and squid are captured in Section 10.6.4.2.5.	N/A
SEAFISH 2	Mobile Offshore Drilling Unit – The scale of the necessary exclusion zone around the FPSO and associated underwater infrastructure is not clear. There is a 500m zone and a 1,275m zone referenced, but also references to other items at the site that require exclusions zones as well. A map outlining the total area that will be closed to fishing vessels would be ideal.	Section 5.4.3 on the MODU makes reference only to the 500m exclusion zone around the MODU Section 5.5.4 on the arrival and positioning of the FPSO makes reference to the 1,275m exclusion zone around the FPSO Section 11.1.2.2 on Disturbance to other users provides a figure showing the combined offshore exclusion zones. Navitas is unclear as to where the confusion lies.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		A 500m exclusion zone is required around the MODU whilst drilling. A similar 500m zone is upheld for the SURF vessels whilst they are completing their workscopes. Once the FPSO is in steady state production a 1,275m exclusion zone will be established. The increase in distance is required as it covers a greater amount of subsea infrastructure to that of the MODU or the SURF vessels. Notices to Mariners will be issued each time the MODU moves and once the FPSO is located. Navitas has also committed to working closely with FIMA and regularly advising FIFCA. A field detail (albeit not to scale) is included in Section 1.4, this provides a detail of how the surface and seabed will look in steady state production. Charts with the Sea Lion Field infrastructure and offshore assets will be provided to other users of the sea prior to operations commencing. Please also refer to the response to FOR 3.	
SEAFISH 3	How is the size of the offsetting fund set, is there a risk that Fisheries are asked to contribute to this in the future? Is there any precedent for this happening in other jurisdictions?	Navitas issued its Carbon & Biodiversity Offsetting Fund strategy to FIG in August 2024. The size of the offsetting fund will be agreed in conjunction with FIG. Navitas has specified that this fund will be related only to the Sea Lion field. Previously FIG's proposed Environment Fund was designed by FIG in consultation with stakeholders with the view that it could service offsetting contributions /ambitions of industries beyond oil and gas in future. Any regulation requiring broader industry contribution is a decision for FIG,	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		consequently Navitas cannot offer any further comment on this matter. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund.	
SEAFISH 4	How are the international tankers that collect the oil for export regulated and what is the risk level of an accident with one of them in or around FI waters? What routes will they be using for transit in FI waters?	Thank you for your comment. Tankers are vetted according to the criteria noted in section 5.10, which includes (but is not limited to): - Compliance with MARPOL 73/78 - Validity of SOPEP - Compliance with IMO Ballast Water requirements - Biofouling management - All CTTs must be double-hulled - Must be equipped with 8 wire mooring lines on fixed drums - The CTT will have aft towing bits with a minimum 80 tonne SWL (Safe Working Load). - Will have an amidships crane with minimum SWL of 15 T with a 4.5 m outreach; - Manifolds will be fully compliant with OCIMF recommendations; - Must have helicopter landing / winching area. Risks of collisions are assessed in a bespoke collision risk assessment report by Anatec (2024), which is reported in section 11.1 and oil spill risks are assessed in section 12.1. With regards to the routes that the CTTs are likely to take this is, as yet unknown as the CTTs will be	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		chartered from the international market. However, it is reasonable to expect that the CTTs will enter the Sea Lion field from the north or northeast as most they are expected to come from the Americas or the African continent.	
Uplift			
UP 1	1. We write in response to the consultation by the Department for Mineral Resources regarding the Environmental Impact Statement (EIS) for the Sea Lion Field Development. The EIS has been submitted by Navitas Petroleum Development and Production Ltd (Navitas) who intend to develop Phase 1 and 2 of the field with Rockhopper Exploration (Rockhopper). 2. Uplift is a UK-based not-for-profit research organisation that supports a rapid transition from oil and gas production on a timeline consistent with a safe climate. We are interested in and concerned about the proposal to	Thank you for your comments. Responses to the questions and commentary by Uplift are addressed in the responses below.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	develop a new oil extraction project in the Falkland Islands as a UK overseas territory due to its impact on the climate and incompatibility with UK climate obligations. 3. In reviewing the Sea Lion Development EIS, we consider that it fails to comply with the requirements of the relevant Falkland Islands legislation1; with the UK's and the Falkland Islands' international legal obligations; and with Falkland Islands Government (FIG) guidance2. We consider that the EIA fails to properly assess the environmental impacts of the development, in particular a meaningful assessment of the development's transboundary and cumulative climate impacts. Our comments will set out our concerns about how the EIS falls short in the following areas: a. Combustion emissions. b. Production emissions. c. Mitigation and offsetting of significant environmental impacts. d. Other international legal obligations.		
UP 2	Combustion emissions are not "outwith the control" of the developer 4. The EIS incorrectly concludes that the combustion emissions from the Sea Lion Development are outwith the control of the developer. The atmospheric emissions associated with the combustion of the sold product are identified as "Upper Moderate" in terms of significance, but are described as "outwith Navitas' control" (EIS, Section 16.4, page 1290). 5. The UK Supreme Court recently held in the case of Finch v Surrey County Council3 that the Environmental Impact Assessment (EIA) for an oil extraction project must assess the effect on climate of the combustion of the oil to be produced, and rejected the reasons for disregarding those impacts as flawed (Finch, paragraph 178). 6. The argument that combustion emissions are outwith the control of the developer was expressly rejected by the court. At paragraph 103 of the decision, the Supreme Court held that: "The combustion emissions are manifestly not outwith the control of the site operators. They are entirely within their control. If no oil is extracted, no combustion emissions will occur. Conversely, any extraction of oil by the site operators	Please note: Navitas included the worst-case emissions resulting from the product once sold, however, it remains the case that there is currently no guidance regarding estimation or assessment of such emissions. The narrative will be reworded to state that "Once the oil is produced and sold, it is beyond the ability of Navitas to determine where, when and how the end-use emissions will be created and thus Navitas has very little ability to influence these aspects." The arguments made in the Finch *vs.* Surrey County Council case are understood by Navitas, including the statement that emissions from the sold product are within Navitas' control in that they could be prevented if Navitas chose not to produce the oil in	Section 10.9

Ref.	Representation	Navitas response	Changes in Rev 4
	will in due course result in GHG emissions upon its inevitable combustion. It is true that the time and place at which the combustion takes place are not within the control of the site operators. But the effect of the combustion emissions on climate does not depend on when or where the combustion takes place. Those factors are irrelevant to the size and significance of the environmental impact". 7. The EIS notes that the environmental legislation that applies to oil and gas in the Falkland Islands is based upon the regulatory requirements for the UK Continental Shelf, and that legal compliance and preparation of required consents would be based on current FIG legislation, where it exists, and with reference to UK legislation and guidance (EIS, Section 1.3.1, page 30). We consider the UK Supreme Court ruling in Finch on the correct interpretation and requirements of the EIA process to be relevant and instructive to the Department for Mineral Resources when considering whether this EIS from Navitas is satisfactory. 8. In our view, consistent with that of the UK Supreme Court, the significant combustion emissions that would inevitably result from Sea Lion Development are manifestly not outwith Navitas' control.	the first place. However, this EIS is in support of the FDP which is actively seeking approval to develop the oil field and produce the oil and gas. To this end, the EIS presents an assessment of the environmental and social impacts and risks of doing so. It is then the decision of FIG, to determine whether or not the impacts and risks, alongside the associated EMMP, are considered to be tolerable when balanced against the economic and social gains. Navitas continue to work closely with FIG as their legislative framework develops.	
UP 3	Inadequate identification and assessment of combustion emissions 9. While maintaining that the combustion emissions are outwith their control, Navitas does state that those emissions were estimated for P10, P50 and P90 production cases on the assumption that 100% of the product would be combusted. The figure for those combustion emissions is not provided in the EIS, thereby failing to properly identify and assess the significant effects of the development in the EIS in a clear manner that the general public can understand, as required by the regulations and relevant guidance. 10. Instead, Navitas states that the Sea Lion production per day for a P50 case "represents only 0.03 % of global daily emissions" (EIS, Section 1.7.4.2.4, page 53). For the purposes of the EIS, the only relevant scenario is the P10 case, which would reflect the worst-case impacts. By using the P50 case, the EIS has failed to assess the worst-case impacts as required by	9. The combustion emissions associated with the sold product, assuming 100% combustion, are stated for each of the P10, P50 and P90 cases in 10.9.4.4.8. 10 & 11. The comparison of the total emissions to the daily global demand is not intended as anything other than a means of providing perspective in the context of global demand. Navitas will amend the narrative and present the P10, P50 and P90 case as a percentage of the global demand instead of just the expected P50 case. 12. As emissions are a global impact, the contribution of project in the context of global demand is an appropriate comparison to make. The comparison is not intended to hide the fact that the emissions are	Section 10.9

Ref.	Representation	Navitas response	Changes in Rev 4
	the legislation and guidance. 11. Assessing the combustion emissions as a percentage of global daily emissions is not a meaningful or informative measure for the purposes of EIA, nor is it in line with legal and regulatory requirements or Falkland Islands guidance. 12. A comparison with a global daily average, or even with the UK daily average emissions, is not sufficient for the purposes of the EIA. Comparing emissions to a global total in a manner which will necessarily result in the emissions from a particular project representing a small proportion of that total are neither instructive nor reflective of their true environmental impact.	considered significant, as is indicated by both the Moderate and Upper Moderate impact assessment outcomes provided.	
UP 4	13. We recommend that the assessment of combustion emissions must include an assessment of all quantifiable impacts including the impact on temperature increase, extreme weather events, and whether there is room within the carbon budget for meeting the 1.5°C temperature goal for these further emissions. Rather than comparing one project to a global daily total of emissions, there are a number of more appropriate and telling benchmarks that could be assessed to present the impact in a manner that the general public will understand. a. FIG Guidance on Hydrocarbons Environmental Impact Assessment dated 7 July 2016 (EIA Guidance 2016) states that FIG need to know how the industry will increase emissions in comparison to other local sectors and that "an assessment of atmospheric emissions compared with FI emissions figures is required" (EIA Guidance 2016, paragraph 3.15). This comparison is not provided by Navitas in the EIS. There is insufficient environmental information provided to properly and meaningfully assess the impacts of the combustion emissions. b. The decision of the UK Supreme Court in Finch noted that the direct production emissions in that case were calculated as a proportion of total UK carbon budget, allowing the effects to be described in that context as "negligible" when compared to the national total. However, the court notes that, had it been included, the figure for the combustion emissions would	Thank you for your comment. It is impossible to determine the impact of a single project on climate change parameters such as temperature and weather events. a. An assessment of atmospheric emissions compared with Falkland Islands emissions figures is provided in Section 10.9.4.5.1 (footnote 72) and is referenced in the impact assessment in Section 10.9.6.1.1. While the EIA Guidance suggests that FIG needs to know how the industry will increase emissions in comparison to other local sectors, and that FIG can provide data (FIG EIA Guidance 3.15), FIG Environment was not able to provide sufficiently detailed data to enable any meaningful sectoral comparisons to be made. 10.9.4.3.1 notes that the Falkland Islands emissions do not include emissions from international aviation and shipping and that these and other omissions must be taken into account when making direct comparisons. It states further that all comparisons between the Phase 1 & 2 emissions and Falkland Islands emissions must be	Section 10.9.4.5.1

Ref.	Representation	Navitas response	Changes in Rev 4
	have been nearly two orders of magnitude greater and "could not have been dismissed as 'negligible' in that way" (Finch, paragraph 82). c. The EIS should not just calculate and identify the total combustion emissions, but also assess whether there is room for those emissions in the global carbon budget for meeting the 1.5C temperature goal. Projected CO_2 emissions from existing fossil fuel infrastructure, without additional abatement, would exceed the remaining global carbon budget for 1.5°C4. Therefore, any new fossil fuel developments need to be matched by production reductions elsewhere to avoid fossil fuel oversupply and breaching the goals of the Paris Agreement. The EIS makes no attempt to prove these emissions would be substitutive rather than additive. d. The decision of the UK Supreme Court in Finch highlighted the importance of the production gap, i.e., the difference between countries' planned fossil fuel production and global production levels consistent with limiting global warming to 1.5°C or 2°C. The UK Supreme Court notes that the general picture is that many governments continue to support, finance and expand fossil fuel production, even though such policies are "irreconcilable with global climate commitments", referencing the UNEP Production Gap Report 2023 (Finch, paragraph 142). e. The EIS does not make any reference to the production gap and the wider significance and environmental impact of expanding fossil fuel production to which the Sea Lion project would contribute. The fact that such expansion is recognised by expert bodies and the UK Supreme Court as irreconcilable with global climate commitments is not addressed in the EIS. f. The impacts of atmospheric emissions are necessarily cumulative and must not be assessed in isolation. As the International Tribunal for the Law of the Sea (ITLOS) made clear in its recent Advisory Opinion on Climate Change and International law5, in the context of pollution of the marine environment from anthropogenic GHG emissions, "planned activities may not be environmentally significant if taken in isolation, whereas they may produce significant effects if evaluated in interaction with other activities" (ITLOS Advisory Opinion, paragraph 365).	caveated. Noting these caveats, in 10.9.4.5.1, Navitas has provided an assessment of the Phase 1 & 2 development in comparison to Falkland Islands emissions using the data available (see footnote 72). b. Navitas does not conclude that the emissions associated with the development, production or of combustion of the sold product are negligible, and this is indicated throughout the assessment chapter and in all summaries. c - f. This is not the role of a single operator that does not have view of all sources of emissions from projects that are sanctioned, or in the process of being sanctioned. The cumulative impact of emissions is global and long-term and is the driver behind the numerous international instruments in place to manage and reduce global emissions while ensuring sufficient fossil fuel is available to meet demands during the transition to sustainable energy. .	

Ref.	Representation	Navitas response	Changes in Rev 4
UP 5	Production emissions 14. The EIS compares the development's production emissions to the total UK carbon budgets, which is not a legally or scientifically relevant metric by which to assess the significance of their environmental impact. A comparison between the direct emissions from the Sea Lion Development and the projected future UK direct emissions is shown in Table 10.71 of the EIS, showing the Sea Lion production emissions as relatively small percentages of the annual allowance of the UK's 4th, 5th and 6th carbon budgets. This comparison is included to "provide a context within which to assess the 'severity of effect'" (EIS, 10.9.4.5.5, page 833). 15. However, calculating the impact as a percentage of a national or global budget will necessarily always show any individual project making a small contribution to the total, and is not a meaningful comparison on which to base an assessment of environmental impact. Even if the Sea Lion emissions did contribute to the UK's carbon budgets, this assessment is meaningless without indicating how much of that budget has already been used by existing or other planned developments. 16. Nor is the comparison with the UK carbon budgets or a UK total emissions in line with the requirements of the FIG Guidance, which explicitly requires a more local comparison with the Falkland Islands emissions figures (EIA Guidance 2016, 3.15). The annual emissions are demonstrated in the context of Falkland Islands emissions in Table 10.70 based on 2021 emissions data. It is unclear why the EIS uses 2021 data when more recent data is available, and casts doubt on whether the EIS is based on the most up to date environmental information as required by the guidance. In using that baseline of 2021 emissions, the Sea Lion development being responsible for 65% of the Falkland Islands emissions represents a very significant environmental impact. This is the most legally relevant comparison for the Department for Mineral Resources to consider. 17. An assessment of Sea Lion's production emissions as a percentage of all emissions from UK Overseas Territories would also be more instructive than a comparison to the UK's carbon budgets - which based on the figures	14 & 15: Navitas recognises that the contribution of any project taken in isolation will amount to a small percentage of aggregated emissions and does not claim that the small percentage contribution leads to a negligible impact. The sensitivity of the atmosphere as a receptor is recognised to be Very High as indicated in Section 8.5.2.1.1 and the overall impacts associated with the emissions are rated as Moderate and Upper Moderate. Mitigations to minimise the impacts are built-in to the basis of design and all emissions will be recorded and monitored. When the worst-case carbon intensity of the project is compared with that provided by the NSTA, as shown in Section 10.9.4.5.4, they are shown to be less than the UKCS average, even when using the lower P90 production rate and including all other emissions which are not factored into the NSTA data e.g., personnel transportation, vessels and drilling emissions. 16. Comparison with the Falkland Island emissions is presented in Section 10.9.4.5.1 and is referred to in Section 10.9.6.1.1. The 53 % contribution is acknowledged as being high but this also needs to take account of the fact that the data set provided by FIG is currently incomplete and does not include emissions from aviation, large-scale fishing, shipping or previous offshore O&G activity, all of which are significant contributors. The data used are the most current data (at the time of writing) supplied by FIG in January 2024. 17 & 18: It is recognised that the UK Carbon Budgets do not yet include emissions from all OT/CD's (see	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	provided would be approximately 10% of production emissions from UK Overseas Territories party to the UK's ratification of the UN Framework Convention on Climate Change (UNFCCC)6. 18. However, if Navitas and the Department for Mineral Resources consider the UK carbon budgets to be a relevant measure, then the mechanisms for meeting those carbon budgets should also be considered. The UK government has committed, within the North Sea Transition Deal (NSTD) to specific targets for the offshore oil and gas industry, which seek to achieve a 50% reduction in greenhouse gas emissions by 2030 against a 2018 baseline within the sector7. The EIS does not demonstrate that Sea Lion would be consistent with the NSTD emissions targets, nor the clear direction of travel in UK oil and gas policy that it reflects.	response to DMR 231) but in the absence of any other benchmark, and with the ITCU commitment to progress their inclusion, the UK budgets are used at this time. Should budgets for OT/CDs be established, these will be used in future. Whichever benchmark is used for comparison, Navitas conclude that the emissions are a significant impact, as all emissions now are, and the decision falls to FIG on whether or not these can be considered tolerable in balance with the potential gains. As a single operator, it is not for Navitas to determine how much of a carbon budget has been used already, or will be used by all other future projects, and nor are such data available to them. The UK Government is a statutory consultee to FIG and it is the role of FIG, in consultation, to determine the fate of the proposed project in full consideration of the environment and social impacts.	
UP 6	19. As Navitas appear to consider the UK as a relevant comparator, the comparatively high carbon intensity of Sea Lion's production emissions when assessed against UK oil and gas should also be considered. Emissions estimates based on Phase 1 and 2 of the Sea Lion development indicate a carbon intensity of 25.8-35.2 kg CO_2 equivalent per barrel of oil produced (EIS, 1.7.4.2.4). Navitas seek to downplay this poor operational emissions performance by comparing the carbon intensity of this new development to existing, producing FPSO-developments operating in the North Sea (EIS, 10.9.4.5.4 and 10.9.4.3.2.3). 20. In fact, the carbon intensity for the Sea Lion development is significantly higher than the average for UK offshore oil and gas (19.8 kg CO_2/boe in 20228, 26-58 % less than Sea Lion). Recent Environmental Statements approved in the UK have had average emissions intensities significantly below the UK average. The proposed Sea Lion development also has an	The average stated by NSTA and used for comparison in the EIS is based on *actual* intensities of just the production phase for the fields (and excludes personnel transportation, vessel use and drilling), whereas the Sea Lion EIS necessarily has to report potential worst-case. Emissions intensity for the Sea Lion 'current expected case' is 17.9 kgCO_2e/boe for the whole development at the P50 production case. In order to align with the methodology for emissions reported to the NSTA, it is necessary to consider the production phase only (i.e., excluding the personnel	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	intensity significantly above the global average (18 kg CO_2/boe) and median (22 kg CO_2/boe). 21. The Sea Lion development would therefore perform poorly against UK standards and the NSTD metrics, and would be unlikely to pass the North Sea Transition Authority's effective net zero test for new developments. We note that FIG has no equivalent mechanism to the NSTD or an effective net zero test, suggesting lower standards of regulatory governance compared to the UK. Given that the EIS acknowledges that the regulatory regime is based on that of the UKCS and will look to UK legislation and guidance where the FIG regime is silent (EIS, Section 1.3.1, page 30), we recommend that the Department for Mineral Resources implement their own effective net zero test as part of the approval process for new developments, including Sea Lion.	transportation, vessels and drilling emissions); the current expected emissions intensity is below the UK average at 18.2, 14.2 and 13.1 kgCO_2e/boe at the expected P90, P50 and P10 production cases, respectively.	
UP 7a	Mitigation and offsetting 22. The Offshore Minerals Ordinance 1994 requires the EIS to describe the measures that are envisaged to eliminate or reduce significant adverse effects, remedy those effects if possible, and offset them. FIG Guidance requires that mitigation and off-setting measures "should not be hypothetical or unrealistic, but measures which the applicant is proposing to use and is confident will be practicable and effective within the local context" (EIA Guidance 2016, paragraph 3.22). The EIS should demonstrate that the mitigation is realistic (EIA Guidance 2016, paragraph 3.22). There are a number of impacts and risks of concern that cannot be mitigated at all, or for which the EIS proposes mitigations which are not realistic. It is concerning that a number of environmental impacts and risks remain significant, with no mitigation or offsetting identified.	These comments are noted. 1. Navitas is committed to offsetting impacts that are significant. 2. This includes the offsetting of impacts that are uncertain or intermittent. 3. The EIS does not propose offsetting for unplanned impacts (e.g., full inventory loss of oil from the FPSO). 4. Table 8.9 refers to direct offsetting opportunities of impacts that are assessed to be significant (moderate or above). 5.Where direct offsets are not available, Navitas will deploy indirect offsetting. This will be clarified in Table 8.9 in the post-consultation EIS. 6.EIS Section 8.11.4 explains that offsetting projects that benefit the Falkland Islands environment will be prioritised over international schemes; this is in line with FIG guidance. 7. FIG has developed further offsetting guidance since	Section 8.11.2.2 Table 8.9

Ref.	Representation	Navitas response	Changes in Rev 4
		their EIA Guidance 2016 was published. This includes the option of contribution to an environmental fund to directly commission, manage and oversee offsetting projects. 8. Navitas is funding additional research in order to be confident that the offsetting measures currently under consideration will be practicable and effective within the local context. 9. Navitas' Offsetting approach will align with FIG's Policy and Legislation. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund.	
UP 7b	23. The EIS acknowledges that a number of environmental risks "remain significant" even after consideration of both base-case and project-specific mitigations. These include the risk of bird strikes due to artificial light and risk of collision between marine mammals and vessels, which remain "Moderate", and others including the impacts from atmospheric emissions associated with combustion of the oil remaining "Upper Moderate" (EIS, Table 1.6, page 51).	Navitas note these comments.	N/A
UP 7c	24. There are a number of significant impacts for which no realistic mitigation or offsetting can be identified. Table 8.9 shows that no realistic direct offsetting of the bird strike or injury to marine mammals from collision could be identified. In relation to the impacts of atmospheric emissions, Table 8.9 notes that there are no emissions trading schemes in the Falkland Islands and that other carbon offsetting initiatives have been identified but require further research and analysis "to determine their efficacy and the quantum of potential offset prior to such initiatives being taken forward". As for indirect	Navitas will update Table 8.9 in the post-consultation EIS to ensure it is clear that where there is no direct offset identified, indirect offsetting will be undertaken. Please refer to EIS Section 8.11.2.1 on indirect offsetting. Feasibility of various identified potential direct and indirect offsetting initiatives cannot be confirmed without further research, analysis and development. Navitas is committed to funding the required	Table 8.9

Ref.	Representation	Navitas response	Changes in Rev 4
	offsetting, Navitas accepts that they have not been able to identify indirect offsetting projects to the level of maturity required. It is not satisfactory that some of the most significant environmental impacts remain without mitigation or offsetting, notwithstanding the questionable efficacy of offsetting as a strategy to mitigate emissions.	feasibility studies, empirical data gathering and pilot programmes to inform the feasibility of large-scale carbon and biodiversity offsetting. Navitas' Offsetting approach will align with FIG's Policy and Legislation. **Note:** Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund. Please see response to comment UP 7e.	
UP 7d	25. Where project-specific mitigations are identified to reduce some risks, those mitigations are not realistic and the downgrading of risks in this way without clear mitigation or off-setting plans undermines the precautionary approach.	It is not clear what examples are being referred to here. Navitas believes that the EIS presents a thorough and robust assessment, that project-specific mitigations are realistic, and the precautionary approach has been applied appropriately.	N/A
UP 7e	26. While the combustion emissions that would occur when Sea Lion's oil is burned are included in the EIS, to the limited extent that they are described only as a percentage of the global daily average, there is no attempt to mitigate, eliminate, reduce, or offset their significant environmental impacts.	Navitas' offsetting strategy has been detailed in a paper which was issued to FIG in August 2024. Navitas is committed to comply with FIG legislation, policy and guidance. Following regulatory approval, Navitas will implement a dedicated carbon and biodiversity offsetting fund that will be financed by contributions from Navitas and governed by a steering group comprising Navitas, FIG and NGO stakeholders and technical advisors. The performance of Navitas' offsetting programme will be reported.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
		Note: Since the public consultation FIG has developed its offsetting policy and Navitas has agreed to contribute to the environment trust fund rather than a Sea Lion specific carbon and biodiversity offsetting fund. Please note that once the oil is produced and sold, the title transfers and then it is beyond the ability of Navitas to determine where, when and how the end-use emissions will be created, and thus Navitas has very little ability to influence these aspects. Please also refer to UP 2.	
UP 8	Other international legal obligations 27. The UK must report its emissions, plus those Crown Dependence and Overseas Territories which have had the UK ratification of the UNFCCC extended to them, under the UNFCCC process. The UK has extended its ratification of the UNFCCC to the Falkland Islands9. While the Paris Agreement has not been extended to the Falkland Islands, it is clear that Navitas consider it to be relevant legislation, and the UK may consider extending the Paris Agreement to other Overseas Territories. The UK is already not on track to meet its Nationally Determined Contribution and will need to put forward additional plans for reduction emissions if this was to be extended to the Falkland Islands and the Sea Lion project is approved.	Navitas expects that FIG will comment separately on the EIS public consultation representations which concern FIG's Policy and Legal Obligations.	N/A
UP 9	28. The UK's status as a party to the UN Convention on the Law of the Sea (UNCLOS)10 extends to the Falkland Islands. UNCLOS includes obligations to adopt laws and regulations to prevent, reduce, and control pollution of the marine environment from land-based sources and from the atmosphere. Measures must include "those designed to minimize to the fullest possible extent" the "release of toxic, harmful or noxious substances from land-based sources" and pollution from vessels or installations at sea (UNCLOS, Article 194). 29. Article 194 of UNCLOS requires states to take "all necessary measures" to	Navitas notes this comment. Navitas expects FIG to address responders' comments on legislative matters separately.	N/A

Ref.	Representation	Navitas response	Changes in Rev 4
	prevent, reduce and control pollution of the marine environment from "any source". The recent unanimous Advisory Opinion of ITLOS confirms that anthropogenic GHG emissions constitute pollution of the marine environment and that the obligation to take all necessary measures applies to such pollution (ITLOS Advisory Opinion, paragraph 197). 30. The ITLOS Advisory Opinion makes clear that the obligations under UNCLOS are not satisfied by simply complying with the obligations and commitments of the Paris Agreement (ITLOS Advisory Opinion, paragraph 223). Rather, it seems that "all necessary measures" requires, at the very least and only as a minimum, compliance with those emissions reductions obligations. 31. We recommend that the Department of Mineral Resources should aim to go beyond the bare minimum compliance with its obligations under the legislation and its regulatory regime if it hopes to comply with its obligations under UNCLOS. It is clear following the ITLOS advisory opinion that states and signatories must take very significant action to prevent pollution from any source, including greenhouse gas emissions, to comply with their UNCLOS obligations.		
UP 10	Conclusion 32. We consider the EIS for the Sea Lion Development to be inadequate and the project unfit for approval in light of its excessive emissions, which have not been adequately assessed or disclosed, as well as transboundary and cumulative impacts, including on the marine environment and the climate, which have not been properly assessed. 33. There is strong scientific evidence and consensus that new oil and gas production is not compatible with net zero emissions by 2050, which is the relevant target within the comparable UK regime, or with a 1.5°C or 2°C pathway. 34. On this basis, and the numerous inadequacies of the EIS, consent for the Sea Lion Development should not be granted.	Navitas notes this comment but disagrees with its conclusions. As detailed in the EIS, Navitas acknowledges the energy transition. Navitas has presented a field development plan which shall have a lower carbon per barrel intensity than the average North Sea production. Please refer to response to RSPB 7.	N/A

Table 17.2: Requests for information made under section 66 of the Offshore Minerals Ordinance

Reference	Request for information	Navitas response	Addressed
Department of Mineral Resources			
DMR 1	Page 4: "Environment Unit" should be "Environment Department", "Department of Natural Resources" should be "Directorate of Natural Resources" (the latter comment applies to several other references to the Department of Natural Resources in the document).	Thank you for your comment. This is noted and these will be updated.	Acknowledgements
DMR 2	Page 8: Formatting of appendix 1 is messed up (the page number is not right-aligned).	Thank you for your comment. Formatting will be checked.	Formatting will be checked throughout the EIS
DMR 3	Page 9-16: Listing of figure 7-6 includes a note; listings of several other figures include sources, urls or other extended text that are not needed for the contents section and make it hard to read.	Thank you for your comment. This is noted and the text will be amended.	Contents pages
DMR 4	Pages 17-24: Similarly listings of several tables include sources or other extended text not needed for the contents section	Thank you for your comment. This is noted and the text will be amended.	Contents pages
DMR 5	Page 27: It would be helpful to state that the Health, Safety and Security policy and Environment and Biodiversity policy are given in full in section 3.2.1 (also, the name of the policy is “Environment” not “Environmental”)	Thank you for your comment. This is noted and the text will be amended.	Section 1.1
DMR 6	Page 28: There are no statutory consultees for an EIS in the Falkland Islands. This comment also applies to several other mentions of statutory consultees (pages 80, 216, 223)	Thank you for your comment. This is noted and the text will be amended to 'expected consultees'.	Section 1.1.2 and throughout the document
DMR 7	Page 29: Figure 1-1 is extremely low quality and the text barely legible. The same applies to figure 1-2 on page 74.	Thank you for your comment. Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout in the post-consultation version. Please note a hi-resolution copy of the EIS may be requested if required.	All Figures checked for resolution and improved / replaced where possible
DMR 8	Page 30: The sentence "Environmental legislation that applies to Oil and Gas (O&G) activities within the Falkland Islands is based upon the regulatory requirements for the United Kingdom Continental Shelf (UKCS)." could perhaps be better reworded as "Falkland Islands environmental	Thank you for your comment. This is noted and the text will be amended.	Section 1.3.1

Reference	Request for information	Navitas response	Addressed
	legislation that applies to Oil and Gas (O&G) activities is largely based upon the regulatory requirements for the United Kingdom Continental Shelf (UKCS)." as the original wording could be read as UK law being applied in the Falklands, whereas the Falkland Islands has its own legislation.		
DMR 9	Page 30: The Offshore Petroleum (Licensing) Regulations 2000 is a standalone piece of legislation, not an amendment to the 1995 regulations, and should be listed separately	Thank you for your comment. This is noted and the text will be amended.	Section 1.3.1
DMR 10	Page 31: In the final paragraph, it would be helpful to state how many wells will need to be drilled to start production, and how many will be drilled during the SIMOPS period.	Thank you for your comment. This is noted and a summary will be added.	Section 1.5.1.1
DMR 11	Page 34: References “remote GI well(s)” but earlier states there will be only one.	The reason for the ‘(s)’ is to indicate that while there will only be one completed and functioning GI well, two may actually be drilled should the first one be insufficient. However, the sentence in question is referring to the operational GI well of which there will be only one and the sentence will be updated to reflect this.	Section 1.5.1.4
DMR 12	Page 34: References a single tanker – perhaps should be plural to make it clear there will not only be one tanker offloading from the FPSO?	Thank you for your comment. This is noted and wording will be checked for clarity.	Section 1.5.1.5
DMR 13	Page 36: There are no local authorities in the Falklands – it is presumed this refers to FIG?	Thank you for your comment. This is noted and the text will be amended.	Section 1.5
DMR 14	Page 42: Table 1.4 references two types of fisheries but gives three catches by weight (49.5%, 25.1% and 5.2%). The missing one appears to be Patagonian rock cod (which is 5.2% of the 2013-2022 catch).	Thank you for your comment. This is noted and the text will be amended.	Section 1.6
DMR 15	Page 45: In the Project Activities section of figure 1-3: • Why is there onshore helicopter disturbance from oil export but not other project phases? • Will there not be underwater noise from subsea works or oil export (e.g., from the tankers)? The text on page 672 on noise scenarios includes the installation of subsea infrastructure, while on page 656 CTTs are included as	Thank you for your comment. This is noted and Figure 1-3 will be reviewed and updated as necessary.	Section 1.8.1 Figure 1-3

Reference	Request for information	Navitas response	Addressed
	sources of underwater noise. • Oil export will have atmospheric emissions from tankers. In the Environmental aspects section: • Would atmospheric emissions not affect regional air quality (particulates etc)? • Would increased vessel presence not affect seabirds? • Would seabed disturbance not affect archaeology? • Other users of the sea could be affected by competition for onshore resource if they also use onshore facilities		
DMR 16	Page 47: The "(see section 1.7.3)" is self-referencing	Thank you for your comment. This is noted and the text will be amended.	Section 1.8.3
DMR 17	Page 47: Table 2.8 is referenced but does not exist	Thank you for your comment. This is noted and the text will be amended.	Section 1.8.3.1
DMR 18	Page 51: In table 1.6 the section numbers are wrong for "Behavioural disturbance to marine mammals from underwater noise offshore" (should be 10.4) and "Impacts of drill cuttings discharge" (should be 10.6).	Thank you for your comment. This is noted and the text will be amended.	Section 1.8.4.2
DMR 19	Page 52: It would be helpful to note here and in other locations (such as 4.5.1 and 5.4) that details of what Non-Aqueous Drill Fluid is composed of are given in section 10.6.4.1.3.1	Thank you for your comment. This is noted and reference to the relevant section will be added.	Section 1.8.4.2.3 Section 4.5.2
DMR 20	Page 53: Regarding the carbon intensity figures given, it should be mentioned that these are a worst-case, not the expected case. It would also be preferable to reference Falkland Islands emissions rather than UK emissions, as this is not a UK development.	The NTS summary will be updated to clarify this and to include reference to the Falkland Island emissions, although as in the body of the EIS this will be caveated with the fact that the Falkland's Islands data set is incomplete and currently omits some big contributors (e.g., air traffic, fishing, aviation).	Section 1.8.4.2.4
DMR 21	Page 57: While Falkland Islands law requires well designs to be peer reviewed by an independent well examiner, it is not a legal requirement for them to be reviewed by the UK HSE, although this may be considered good practice.	Thank you for your comment. This is noted and the text will be amended to clarify. Previous DMR guidance and practice has been that PON4 applications to drill, including well designs and	Section 1.8.4.3.1

Reference	Request for information	Navitas response	Addressed
		geological well evaluations, have been reviewed by DMR with support from UK HSEx and BGS.	
DMR 22	Page 58: AIS is mentioned but the initialism is not explained until the following page.	Thank you for your comment. This is noted and the text will be amended.	Section 1.8.4.3.1
DMR 23	Page 61: Table 1.7 does not appear to be consistent with the environmental impacts identified in figure 1-3 – for example, artificial light was identified as having an impact on marine mammals and human populations in figure 1-3, but these are not rated in table 1.7. Similarly, seabed disturbance was identified as affecting water quality in 1-3 but not rated in 1.7. There are many other such inconsistencies between the table and figure.	Thank you for your comment. These will be checked and cross-referenced and updated where necessary.	Section 1.8.5 Figure 1-3 Table 1.8 Table 13.2
DMR 24	Page 66: An EMMP group is referenced but not defined. Who would this include? Assume FIG, Navitas and possibly relevant stakeholders?	Thank you for your comment. Please refer to the EMMP Workshop Report (April 2019). Please also refer to EIS Section 15.5 on EIS Governance. Navitas will expand the information on the EMMP governance and advisory group provided in Ch15 in the post-consultation EIS to ensure it is clear.	Section 1.9.3
DMR 25	Page 68: “Implementation of the Biosecurity Management Plan (BMP)” should also be listed in the “Introduction of non-native marine species” row, as (according to p108) it appears to be intended to cover both.	Thank you for your comment. This is noted and the text will be amended.	Section 1.9.3 Table 1.10
DMR 26	Page 74: Figure 2-1 is extremely low quality.	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	All Figures checked for resolution and improved where possible
DMR 27	Page 75: It would be helpful to state how many wells are expected in each stage.	Thank you for your comment. This is noted and will be added.	Section 2.2.3.1
DMR 28	Page 76: The second paragraph mentions an exclusion zone and references figure 2-2, but the figure does not show an exclusion zone.	Thank you for your comment. This is noted and the reference to the figure will be removed.	Section 2.2.3.2

Reference	Request for information	Navitas response	Addressed
DMR 29	Page 76: It would be helpful to explain what “treated seawater” is.	Thank you for your comment. This is noted and the text will be amended.	Section 2.2.3.3
DMR 30	Page 77: MRSV is mentioned for the first time but not explained.	Thank you for your comment. This is noted and the text will be amended.	Section 2.2.3.5
DMR 31	Page 79: The scope of the EIA now also includes emissions from use of the oil.	Thank you for your comment. This is noted and the text will be amended.	Section 2.4
DMR 32	Page 80: The text references a decommissioning-specific EIA being “in accordance with the approach taken in the UK with regard to developments on the UK continental Shelf (UKCS) and the DECC (now BEIS) Decommissioning Guidelines (BEIS, 2018)).” However, the Falkland Islands will have its own requirements. The reference to BEIS (in red) should now be DEZNZ.	Thank you for your comment. This is noted and the text will be amended.	Section 2.4
DMR 33	Page 81: Table 2.1 is missing the offsetting section.	Thank you for your comment. This is noted and the text will be amended.	Section 2.5.1
DMR 34	Page 91: The Offshore Petroleum (Licensing) Regulations 2000 is a standalone piece of legislation, not an amendment to the 1995 regulations, and should be listed separately.	Thank you for your comment. This is noted and the text will be amended.	Section 3.1.7.3
DMR 35	Page 92: FIG is not planning to repeal the 1994 OMO. There will be a new Safety and Environment Ordinance and the 1994 OMO will be amended. to remove the safety and environmental areas covered by the new bill and updated to cover other areas as required.	Thank you for your comment. This is noted and the text will be amended.	Section 3.1.7.3.1
DMR 36	Page 93: The new legislation will not “align with UK best practice” – the aim is to bring in standards at least as high as the UK and may go further than the UK in some areas.	Thank you for your comment. This is noted and the text will be amended.	Section 3.1.7.3.1
DMR 37	Page 93: As per the record of Law and Regulations- the 1995 Regulations were never amended. However, the 2000 Regulations were amended. subsequently in 2004, 2005 and 2009.	Thank you for your comment. This is noted and the text will be amended.	Section 3.1.7.3.2
DMR 38	Page 93: The relevant enactment is Falkland Islands (Continental Shelf) Proclamation 1991. There is no ordinance to this effect.	Thank you for your comment. This is noted and the text will be amended.	Section 3.1.7.3.3

Reference	Request for information	Navitas response	Addressed
DMR 39	Page 95: The Falkland Islands Environmental Trust Ordinance 2021 has yet to be commenced.	Thank you for your comment. This is noted and the text will be amended.	Section 3.1.7.3.17
DMR 40	Page 96: One PON has been missed off the list: PON11 - Loss or dumping of materials at sea from offshore oil and gas installations.	Thank you for your comment. This is noted and the text will be amended.	Section 3.1.7.4
DMR 41	Page 100: In item 3 of table 3.2, "the provision of appropriate resources to meet objectives are available delivering a sustainable and predictable business outcome" does not seem to make sense. Similarly, "Change into our organisation is managed" in item 8 may be an error.	Thank you for your comment. This is noted and the wording will be amended to clarify.	Section 3.2.1.1
DMR 42	Page 107: It would be useful to say who the key stakeholders that have been identified are (or confirm that they are the ones listed in table 6-2)	Thank you for your comment. This is noted and the text will be amended.	Section 3.2.17
DMR 43	Page 107: The timing of the OPEPs is a bit unclear. It is expected they are available around the same time as the EIS is published for consultation (the EIS guidance recommends they are published at the same time as the EIS), but the text refers to them being "developed during the Execute stage"	Thank you for your comment. The preliminary OPEPs were submitted to FIG in August 2024. Prior to the commencement of operations, the OPEPs will be updated and supplemented in order to produce operational OPEPs. They will have an approved lifespan of five years from the date of first approval by FIG and shall be submitted in their entirety for re-approval 2 months before that time.	N/A
DMR 44	Page 111: It says that "Between 2012 and 2020, the relevant licences were owned by Premier" but then "POEPL was bought by Navitas Petroleum in September 2022" – what was the status between 2020 and 2022?	Thank you for your comment. The text will be clarified to explain that in 2020 the parent company of Premier Oil Exploration and Production Ltd (POEPL), Premier Oil and Chrysaor merged to form Harbour Energy Plc. Harbour Energy Plc then sold POEPL to Navitas Petroleum in September 2022.	Section 1.4 Section 2.1.1 Section 4.1
DMR 45	Page 113: The text states three options were shortlisted and then lists four options.	Thank you for your comment. This is noted and the text will be amended.	Section 4.3.2.1.1
DMR 46	Page 116: Why are emissions from fuel gas usage reported in megawatt thermal?	Thank you for your comment. This Chapter is on the consideration of alternatives and Table 4.3 shows only the screening differentiators between an FPSO and a TLP, both of which were considered by POEPL in	Table 4.4

Reference	Request for information	Navitas response	Addressed
		the early stages of the project development. The MWth figures simply indicate the likely thermal power of the two installations which has a bearing on the emissions. The table is not intended to indicate the actual emissions. Navitas recognise that the parameter ('Air Quality (emissions from fuel gas usage)') could be misleading and this will be changed to 'Thermal Power' and footnoted to explain that this is an indicator for potential fuel gas usage.	
DMR 47	Page 117: It is stated twice that table 4.4 covers seven key differences, but the table only contains six.	Thank you for your comment. This is noted and the text will be amended.	Section 4.3.2.1.1
DMR 48	Page 118: The table heading says seven key areas, but there are six.	Thank you for your comment. This is noted and the text will be amended.	Section 4.3.2.2.1
DMR 49	Page 119: The table references a 500m exclusion zone, but the exclusion zone will be 1,275m during operations (the 500m zone is for the MODU).	Thank you for your comment. This is noted and the text will be amended.	Section 4.3.2.2.1
DMR 50	Page 120: Table 4.5 twice mentions removing three vessels from the field, but it is not clear which vessels would be removed if a CTT is used rather than an FPSO.	Thank you for your comment. The comparison is made between 'Direct Offtake within the Sea Lion Field' and 'Ship to Ship transfers in Berkeley Sound' (which had been planned in a previous EIS but has since been discounted.) With ship to ship transfers in Berkeley Sound an Offshore Loading Shuttle Tanker (OLST) would have been required to carry the product from the FPSO to the awaiting CTT in Berkeley Sound, a launch would then have been required to take the pilots out to the OLST in Berkeley Sound and a tug to hold back the OLST. With the selected 'direct offtake' method, the OLST, the Berkeley Sound pilot boat and hold back tug are no longer required hence the reduction in 3 vessels.	N/A

Reference	Request for information	Navitas response	Addressed
DMR 51	Page 120: The previous EIS was not approved, it was accepted (FIG does not approve EISs).	Thank you for your comment. This is noted and the text will be amended.	Section 4.3.2.2.2
DMR 52	Page 121: The last sentence references document SBS-PLN-00001-05 but the latest version is SBS-PLN-00001-06.	Thank you for your comment. This is noted and the text will be amended.	Section 4.4.2.2
DMR 53	Page 123: It is stated in the section on mitigation measures not considered appropriate that an HP flare ignition was investigated but is not currently sufficiently proven. However, this contradicts information elsewhere stating that an automated ignition system will be investigated (table 1.9, section 10.1.10.1, 10.9.7, table 10.73, and is a commitment in the EMMP (15.7.2.1).	Thank you for your comment. This is noted and the text will be amended.	Section 4.5.4
DMR 54	Page 123: It states that the use of slick paints is being investigated, but section 4.5 is for mitigation measures that are not proposed for use and not considered appropriate. This should either be removed or the section description changed.	Thank you for your comment. This is noted and the text will be amended.	Section 4.5.6
DMR 55	Page 124: It is stated that “skimmers were not a viable response” to Sea Lion Crude. However, use of skimmers is still mentioned in the oil spill response sections 12.1.1.1.3, 12.1.4.4.6 and 12.1.4.6.2.	Thank you for your comment. This is noted and Navitas acknowledge that the EIS is not clear on the differentiation between the skimmer types and that the statement in Section 4.5.9 is misleading. The EIS will be updated for clarity and consistency. For Sea Lion crude, the CEDRE 2017 report states that 'oleophilic skimmers should not be recommended, as well as weir skimmers'. However, belt skimmers would be appropriate. This equipment is specified in the Preliminary OPEPs submitted to FIG. Note that weir skimming devices have been chosen to respond to MGO spills. The text will be clarified in the relevant sections of the EIS.	Section 4.5.10
DMR 56	Page 133: Inshore infrastructure is referenced in table 5.1, but there is no planned inshore infrastructure.	Thank you for your comment. This is noted and the text will be clarified.	Table 5.1

Reference	Request for information	Navitas response	Addressed
DMR 57	Page 135: Figure 5-2 is very low quality, making it quite hard to read (the colours of the pipelines is hard to follow).	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	All Figures checked for resolution and improved where possible
DMR 58	Page 141: What does “Once the produced water ‘breaks-through’” mean?	Thank you for your comment. This refers to the point at which the reservoir starts producing water as well as oil. The narrative will be updated to make this clearer.	Section 5.4.4
DMR 59	Pages 141-142: It is stated that there will be eight wells and then lists a possible nine. It may be best to reword to make it clearer that there may be more than eight.	Thank you for your comment. The potential 9th well states that this a contingency. However the text can be amended to reiterate there will ultimately be only one gas well and therefore eight functioning wells.	Section 5.4.4.1
DMR 60	Page 142: It would be helpful to note that details on what sweeps are composed of are given in section 10.6.4.1.3.1.	Thank you for your comment. This is noted and the text will be amended.	Section 5.4.4.4
DMR 61	Page 146: The first bullet point might be simpler to understand to the average reader if “a ‘kick’ of formation fluid” (neither term in red is defined in the document) was replaced with just “oil/gas”.	Thank you for your comment. This is noted and the text will be amended.	Section 5.4.5.3
DMR 62	Page 146: In the sentence “ensure that the concentration of NADF is less than 1 % by dry weight”, “NADF” should be “oil”.	Thank you for your comment. The narrative will be amended to state: “ensure that the oil concentration of NADF on cuttings is less than 1 % by dry weight”.	Section 5.4.5.3.1
DMR 63	Page 147: “If any cuttings are sampled that are not <1% by weight on cuttings” doesn’t seem to make sense.	The narrative will be amended to state: “If any cuttings are sampled and the concentration of entrained oil is not <1% by weight on cuttings”.	Section 5.4.5.3.1
DMR 64	Page 147: “mud pits” are referenced but not explained. Where are they located?	Thank you for your comment. This is noted and a footnote will be added to the text.	Section 5.4.5.3.1

Reference	Request for information	Navitas response	Addressed
DMR 65	Page 150: The Sea Lion Completion Basis of Design (SLN-CMP-WEL-BOD-00001-00) document was not provided as part of the FDP document set. When is it expected?	This BoD is an internal document and does not form part of the FDP submission. The completion design will be detailed in each PON 4 submission to FIG for approval prior to drilling commencing.	N/A
DMR 66	Page 150: CaCo3 should be CaCO3 (assuming it refers to calcium carbonate, not calcium cobaltite).	Thank you for your comment. This is noted and the text will be amended.	Section 5.4.6.1
DMR 67	Page 152: It states that "All explosives will be stored as described in Section 5.11.1.2" but section 5.11.1.2 does not describe how they will be stored (it only states "Explosives which require a bespoke and secure storage facility").	Explosives may be required in the event of stuck-pipe, to release a pipe should it get stuck down-hole. Detail will be added to Section 5.11.1.2 to describe storage.	Section 5.11.1.2
DMR 68	Page 155: It is not clear why gas needs to be flared during commissioning of the systems (generating 1,000 tonnes of CO_2 per day), as the FPSO has capacity to start building up an inventory of gas. Can it be explained why gas needs to be flared and cannot be stored?	Associated gas is liberated from the oil producing wells. There needs to be sufficient volume of gas liberated to meet with the minimum operating parameters of the gas compression system to allow for safe start up of the gas compression process. During commissioning, the initial start up of the gas compression system takes longer than normal start up as control system and instrumentation systems need to be calibrated and tuned before handing over to normal operations. Navitas will review methodology to determine the 389.2 figure (Refer to Development Description section 5.4.9) and clarify as necessary in the post-consultation EIS. Navitas has taken a conservative approach to the volume of gas we would flare at start up as we will be making modifications to the existing systems; when adding new units to existing systems, these often	Section 5.4.9

Reference	Request for information	Navitas response	Addressed
		present more difficult challenges compared to all new systems when starting up. However, a robust approach to pre-commissioning prior to sail away and keeping core competent resource from the existing crew will ensure the commissioning exercise has the best opportunity in reducing flared volumes below the current conservative volumes.	
DMR 69	Page 155: The third bullet point seems unnecessary given the content of the second one (perhaps they could be merged)?	Thank you for your comment. This is noted and the text will be amended.	Section 5.4.10
DMR 70	Page 155: It states that "Detail on the installation and operation of the X-mas tree is provided in Section 5.8.1", but section 5.8.1 on gives a very brief explanation of what an X-mas tree is, not how it is installed or operated.	Thank you for your comment. This is noted and the text will be amended.	Section 5.4.10
DMR 71	Page 156: It is not explained how and why the indicative locations of the moorings were chosen. This would be useful.	Thank you for your comment. These indicative locations were previously identified in consultation with the FIG Harbour Master as they appeared to offer sufficient sea-room for the mooring and offload of the LTVs, without hindering other Berkeley Sound users, and were not considered to be of particular environmental sensitivity. Final locations will be determined in consultation with FIG with decision criteria covering both environmental and socio-economic (other users of Berkeley Sound) considerations. This will be clarified in the post-consultation EIS.	Section 5.5.1
DMR 72	Page : It is not clear why the sentence "Detail on the installation process, quantities and / or dimensions of each bit of infrastructure are provided Table 5.12 below." is included as this section is not about infrastructure.	Thank you for your comment. This is noted and the text will be amended.	Section 5.5.1

Reference	Request for information	Navitas response	Addressed
DMR 73	Page 158: The second paragraph in this section says that "Additional clump weights and tethers may also be required". The third paragraph then starts "However, in addition to the above, temporary deposits such as clump weights and tethers may also be required."	Thank you for your comment. This is noted and the text will be amended.	Section 5.5.3.3
DMR 74	Page 158: The final paragraph references table 5.13, but it should be 5.12.	Thank you for your comment. This is noted and the text will be amended.	Section 5.5.3.3
DMR 75	Page 159: The first paragraph incorrectly references table 1.13 (it should be 5.13), but mention is not needed as the table is referenced earlier in the same sentence.	Thank you for your comment. This is noted and the text will be amended.	Section 5.5.3.3
DMR 76	Page 164: Figure 5-6 is very low quality and the text is illegible in places	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	Figure 5-6
DMR 77	Page 165: Figure 5-7 is very low quality and the text is illegible in places	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	Figure 5-7
DMR 78	Page 168: The paragraph references "Table x" – presumably supposed to be figure 5-8?	Thank you for your comment. This is noted and the text will be amended.	Section 5.8.2.2.1
DMR 79	Page 169: What is the "2C" referenced in figure 5-8?	2C refers to the contingent resources versus proven resources and shows the mid-case, best technical estimate. It is similar to the P50 estimate but is not quite synonymous. For the sake of clarity, the EIS will be updated to show the P10-P50-P90 production profiles (the P50 estimate being almost identical to the 2C case).	Section 5.8.2.2.1 Figure 5-8

Reference	Request for information	Navitas response	Addressed
DMR 80	Page 169: Is the consumption of 5mmscfd of fuel gas per day per GTG or for all three? (this is specified for diesel)	The estimated fuel gas usage includes all GTGs and is for all three turbines. Of note, mmscfd = million standard cubic feet per day. Navitas will ensure this is clear in the post-consultation EIS.	Table 5.15
DMR 81	Page 170: R134a does not have a low GWP and as a result a 2006 EU Directive recommended its phase out, which started in 2010. The United States has also started phasing it out. R-1234yf or similar products are ones with a genuinely low GWP.	Thank you for your comment. This is noted and agreed. The example of R134a will be removed. Although the commitment to use low GWP F-gases remains.	Section 5.8.3.2
DMR 82	Page 171: Reference is made to table 17 – it is assumed this is meant to be 5.16? It also references “Table 10.9” but this potentially should be “Section 10.9”.	Thank you for your comment. This is noted and the text will be amended.	Section 5.8.3.3
DMR 83	Page 172: The final paragraph references section 3.2, but it is not clear why (as section 3.2 is not about detailed design).	Thank you for your comment. This is noted and the text will be amended.	Section 5.8.3.4.2
DMR 84	Page 174: There is another reference to section 3.2, but it is not clear why (as section 3.2 is not about detailed design).	Thank you for your comment. This is noted. The reference to Section 3.2 is that the OMS describes the project development process. However the reference will be removed.	Section 5.8.3.5
DMR 85	Page 180: Figure 5-9 is very low quality and the text illegible in places	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	Figure 5-9
DMR 86	Page 182: If there was a significant reduction in injectivity, would consideration be given to drilling more WI wells?	Thank you for your comment. Yes, this would be considered but only after the root cause of decline has been identified and alternative remediation methods have been attempted.	N/A
DMR 87	Page 183: It is stated that it will not be necessary to heat the injected water after the first year. Is the temperature spec in table 5.20 only for the first year? If so, perhaps that could be made clear in the table.	Thank you for your comment. This is noted and Table 5.20 will be edited to make it clear that heated WI is only for the first year.	Section 5.8.5.8 Table 5.20

Reference	Request for information	Navitas response	Addressed
		Heated water injection will be required for the initial period of production lasting 12 months. Further details and assumptions are also provided in Section 10.9.4.4.1 and Table 10.63.	
DMR 88	Page 184: Under what circumstances would produced water be deemed unsuitable for reinjection?	Thank you for your comment. Produced water compatibility tests have been performed to demonstrate that it can be reinjected into reservoir and process equipment has been designed to ensure the water meets the standards to be reinjected. The provision for overboarding of treated produced water would be a short term contingency provision for unforeseeable circumstances. A note will be added to the post-consultation EIS to ensure this is clear.	Section 5.9.1.1
DMR 89	Page 190: The FPSO/MODU will also presumably not use the TDF? Will all other vessels listed in table 5.24 except CTTs and LTVs use the TDF? The start date given for upgrading the causeway (Q2 2024) appears to be out of date. The second paragraph references “H1 2024” – is this meant to be Q1, and if so, is it still correct?	Thank you for your comment. Neither the FPSO nor the MODU will use the TDF, indeed neither will visit any location in the Falkland Islands and will remain at the Sea Lion field only. The CTTs will not use the TDF either. They will call into the Sea Lion field accept their cargo from the FPSO then continue on their international voyage. The LTVs will only use Berkeley Sound (and will not call into the TDF). It is also highly unlikely that the OCVs will use the TDF (due to draft). The vessels which will use the TDF are the OSVs and ad hoc freighters (i.e., the supporting vessels, all with a draft less than 7m). These vessels will all use the TDF in line with the project description. With regards to the timing of the TDF Causeway upgrade the correction is noted. It is expected,	Section 5.11.1.1.1

Reference	Request for information	Navitas response	Addressed
		subject to project sanction and planning approval, that the causeway upgrade will commence in 2025. The contractor has been selected and budget allocated.	
DMR 90	Page 192: The top two rows (supply base and mud plant) state the duration of requirement as five years. However, the two drilling campaigns start in year 2 and end in year 9 – is five years correct?	Thank you for your comment. The text will be clarified. The mud plant will only be in active use for ~5 years during the Phase 1 and Phase 2 development drilling campaigns. However, due to the scheduling of the programme, it will be in place a short time prior to the commencement of Phase 1 during the break between Phase 1 and Phase 2 and throughout Phase 2. If no further drilling activity is planned after Phase 2 it shall be dismantled. So, in answer to the question, the mud plant (LMP) will be in situ for up to 9 years but only active for ~5. With regards to the supply base, this is similar. The supply base will increase and decrease in size and activity levels throughout the stages of the development programme. It will be at its busiest and largest during SIMOPs and smallest and least active during steady state operations. The supply base will remain throughout the lifecycle of the Sea Lion Field.	Section 5.11.1.2
DMR 91	Page 193: The new incinerator is expected to be ready for operation in Q1 2026 – is this “well in advance of the Seal Lion development campaign”?	Thank you for your comment. At the time of writing the EIS, the incinerator was expected in 2024. Latest estimate from PWD (provided August 2024) is end 2026. There are mitigations/contingency plans detailed in the EIS in the event that the incinerator is not ready prior to the commencement of Sea Lion operations.	N/A

Reference	Request for information	Navitas response	Addressed
DMR 92	Page 195: Final sentences references EIA rather than EIS.	**Initial consultation response:** Thank you for your comment. This is noted and the text will be amended. **Post-consultation comment:** The use of EIA is appropriate in this sentence which refers specifically to the impact and risk assessment sections.	Section 5.11.2
DMR 93	Page 199: EIA is used instead of EIS.	Thank you for your comment. This is noted and the text will be amended.	Section 5.11.3.1
DMR 94	Page 200: It is estimated that there will be 17 SAR training flights per month. However, in table 5.25 it states there will be 20 hours per month and 3 hours in each flight, which would be 6.7 flights per month. The 6.7 figure (incorrectly rounded to 6.6 here and elsewhere) is used later in the EIS in table 10.9. Would there really be more than this many training flights for the whole length of the project?	Thank you for your comment. Table 5.25 is correct. The UK CAA (in CAP 999) states in section 3.9 and 3.10, that the helicopter operator is responsible for the number of SAR training hours. Navitas' selected helicopter operator states that 20 hours per month is the expected number of SAR training hours required per month. The text will be amended to correct this in the post-consultation EIS.	Section 5.11.3.2 Table 5.25 Section 10.2.4.2.1 Table 10.9 Section 11.9.4.3.1 Table 11.45
DMR 95	Page 202: How will Navitas “encourage the private sector to increase rental housing stock to meet demand”?	Thank you for your comment. Navitas will tender for the construction of rental housing units. An expression of interest exercise has already determined that there is interest and capability in the Falklands private sector in responding to this demand and engaging in the competitive tender process. Navitas will ensure that this is clear in the post-consultation EIS.	Section 5.11.4.1
DMR 96	Page 202: The Accommodation type section only covers the hostels. Could details be given of the temporary accommodation unity and in-transit accommodation unit?	Thank you for your comment. 'Hostel-type accommodation' perhaps misrepresents the intent of this section. Elsewhere in Public Consultation Presentations and those to the Chamber of	Section 5.11.4.1

Reference	Request for information	Navitas response	Addressed
		Commerce as well as the Expression of Interest (EOI) in the Penguin News, this requirement was called a 'hotel'. Apologies for this confusion. The described hostel type/hotel accommodation will be for the transitory / offshore personnel so is synonymous with the temporary accommodation unit / in-transit accommodation unit. For longer term shore-based personnel, houses will be procured. The EOI for this requirement was issued in the Penguin News in February 2024 and should the Sea Lion development be approved, further action shall be taken on this requirement. Navitas will ensure that this is explained in the post-consultation EIS.	
DMR 97	Page 205: The assume Stanley Potable water supply limit (82m³/day) is confusing the readers at this point in the document as it is not explained that this is the unused supply capacity until chapter 11. It would also be helpful if existing demand could be explained here so the impact of the additional demand can be put in context.	Thank you for your comment. This is noted and details will be added.	Section 5.11.4.2
DMR 98	Page 206: The waste treatment facility is not yet under construction.	Thank you for your comment. This is noted and the text will be amended.	Section 5.11.4.2.4
DMR 99	Page 207: The average water usage figure for personnel and accommodation in table 5.27 (70m³/day) equates to 233 people at 300 litre per person per day. This is far higher than the maximum number of people expected to be onshore at any given time in table 5.26 (26 permanently onshore, 74 temporarily onshore and 62 in transit). The same comment applies to table 11.23 on page 989.	Yes, this includes offshore personnel as well (to account for a worst-case in the event of a 'down man'). Otherwise, water will be mostly made up offshore by watermakers on the MODU/FPSO for personnel use. A note will be added to the table to clarify.	Table 5.27
DMR 100	Page 209: “Waste Management Strategy” – should this be “Waste Management Plan” in line with language elsewhere (assuming it is the same thing).	Thank you for your comment. At the current time, Navitas has developed a Waste Management Procedure which has been submitted to FIG for review. This procedure will be used to develop	Section 3.2.18

Reference	Request for information	Navitas response	Addressed
		project-specific Waste Management Plans which will be tailored to each operation in line with the current infrastructure on Island and in line with relevant FIG / UK legislation. Navitas accept the comment and will update the EIS (Section 3.2.18 and Chapter 10.11) to ensure consistency of language.	
DMR 101	Page 213: The legislation referenced should be the Offshore Minerals Ordinance 1994 rather than the Offshore Minerals Ordinance (Amendment) (2011).	Thank you for your comment. This is noted and the text will be amended.	Section 5.15
DMR 102a	Page 230: Section 3.2 does not appear to refer the extent of liability in relation to CTTs.	Thank you for your comment. Navitas OMS Elements 5 (Operations Management) and 6 (Production Management) are relevant to offtake operations between the FPSO and the Conventional Trading Tanker (CTT). Furthermore, EIS 5.10 provides detail on the Navitas Assurance Process for purchasers' tankers and indicates that a dedicated berthing crew will board the CTTs for each offtake to ensure competency and consistency of the operation, aligned with Navitas' agreed offtake operating procedures. The Conventional Trading Tanker itself is not under Navitas direct control or liability, and the field operator will not have title or liability for the crude transferred once it is discharged from the offloading flange on the FPSO. In the event of an incident involving the CTT, the liability would sit with the crude offtaker/tanker owner and would be covered by the tanker P & I Club Cover, and insurance under CLC 1992.	Section 3.2.6

Reference	Request for information	Navitas response	Addressed
DMR 102b	Page 230: The “Disturbance to fisheries spawning grounds and migration routes” row references section 0.	The 'find and replace' function in Word indicates there are no occurrences of 'Section 0' . This error may have occurred in the transition to PDF. This will be checked and any cross-referencing errors will be corrected.	Whole document
DMR 103	Page 244: Figure 7-1 is very low quality and the text barely legible in places	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	Figure 7-1
DMR 104	Page 246: The link to the SAERI data portal does not work (possibly as the portal is offline?)	Thank you for your comment. This is noted and the link is restored. The portal is now working.	N/A
DMR 105	Page 246: The final paragraph references “survey data” being shown in figure 7.6. It might be more accurate to describe this as “survey information”.	Thank you for your comment. This is noted although 'data' is considered to be a suitable description as it contains information on species and sediments.	N/A
DMR 106	Page 249: It would be useful to add to the key for figure 7-5 to state what the lighter blue box is in the left-hand map (which the middle map is presumed to be a zoomed in version of).	Thank you for your comment. The light blue box are actually light blue dots representing survey stations and are listed in the key.	N/A
DMR 107	Page 250: Figure 7-6 is very low quality and the text barely legible in places	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	All Figures checked for resolution and improved where possible
DMR 108	Page 254: Reference is made to the IMS-GIS Data Centre, but it is not explained what it is.	Thank you for your comment. The acronym refers to 'Information Management System and Geographic Information Systems' Centre. This will be added to the text.	Section 7.2.4.2.2

Reference	Request for information	Navitas response	Addressed
DMR 109	Page 256: It is assumed the minimum temperature should be -5.1ºC not 5.1ºC	Thank you for your comment. This is noted and should be -5.1ºC. The text will be amended.	Section 7.3.2.1.2
DMR 110	Page 256: The figure given for mean annual rainfall (2,856mm) seems very high – annual figures from 1930 to 2010 were between ~400 and ~860mm (is the figure a total over the three years of records rather than an annual mean?). Figure 7-12 suggests an annual average of around 20-40mm/month, which would be around 240-480mm a year.	Thank you. This will be corrected to 285.6 mm.	Section 7.3.2.1.3
DMR 111	Page 259: The text states October has 21mm of rainfall but the figure shows it as being 20mm.	Thank you for your comment. This is noted and will be changed in the text.	Section 7.3.2.2.3
DMR 112	Page 265: Some of the text in figure 7-14 (particularly the light grey labels in the map) is barely legible. The key mentions “QC stations” but this is not explained.	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	All Figures checked for resolution and improved where possible
DMR 113	Page 266: Figure 7-15 is very low quality and the text illegible in places.	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	All Figures checked for resolution and improved where possible
DMR 114	Page 267: Figure 7-16 is very low quality and the text illegible in places.	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	All Figures checked for resolution and improved where possible
DMR 115	Page 271: The text states that seabed currents are typically less than 10cm/s but figure 7-21 shows a large proportion of currents are in the 10-15cm/s range.	Thank you for your comment. This is noted and the text will be amended to 5-15 m/s.	Section 7.3.5.2

Reference	Request for information	Navitas response	Addressed
DMR 116	Page 272: Figure 7-22 is quite hard to read.	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	All Figures checked for resolution and improved where possible
DMR 117	Page 274: The text states that wind speeds are typically less than 10m/s but figure 7-24 shows a large proportion in the >10-15m/s range.	Thank you for your comment. This is noted and the text will be amended to 6-12 m/s.	Section 7.3.5.3.3
DMR 118	Pages 281-287: The low quality of figures 7-26, 7-28, 7-29, 7-30, 7-31, 7-32, 7-33 and 7-34 means the numbering of the stations marked by red or blue dots is illegible. This means the text in the section referencing certain stations cannot be cross-referenced.	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	All Figures checked for resolution and improved where possible
DMR 119	Page 290: The text in the summary column on first row on page 290 appears to be a duplicate of the row beneath.	Thank you for your comment. This is noted and the typo will be corrected.	Table 7.3
DMR 120	Page 292: There is no annex C to schedule 4 of the OMO. The information is just in schedule 4. This comment also applies to section 8.4, page 532.	Thank you for your comment. This is noted and the text will be amended.	Section 7.4 Section 8.4
DMR 121	Page 300: Should the list also include the EIA on offshore underwater noise? On page 657 it is stated that invertebrates including crustaceans are potential receptors, while on page 663 it is stated that mussels are affected by noise.	Thank you for your comment. This is noted and will be reworded for clarity.	Section 7.4.3.2
DMR 122	Page 300: Is the GAP project still ongoing? We understand it to have finished after GAP II.	Thank you for your comment. The GAP project has now finished - text will be amended to clarify.	Section 7.2.4
DMR 123	Page 303: Should the list also include the EIA on inshore underwater noise?	Thank you for your comment. This is noted and will be reworded for clarity.	Section 7.4.3.3
DMR 124	Page 313: The first number in the table should be 21,613.9 not 21.613.9	Thank you for your comment. This is noted and will be amended.	Section 7.4.3.3.2.2
DMR 125	Page 316: Figure 7-42 is very low quality and the text illegible in places.	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The	All Figures checked for resolution and

Reference	Request for information	Navitas response	Addressed
		original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	improved where possible
DMR 126	Pages 318-319: Figures 7-44 and 7-45 are low quality and the text barely legible in places.	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	All Figures checked for resolution and improved where possible
DMR 127	Page 324: The first confirmed vessel landing in the Falklands occurred in 1690 (17th century)	Thank you for your comment. This is noted and the text will be amended.	Section 7.4.3.3.5
DMR 128	Page 328: The first section of table 7.8 is on NFB and the Sea Lion Field, but the cell containing the summary of the offshore benthic flora and fauna row is about Berkeley Sound (it is an exact copy of the summary of the Berkeley Sound Deeper water flora and fauna four rows below).	Thank you for your comment. This is noted and will be corrected.	Table 7.8
DMR 129	Page 335: It is stated that southern rock cod Is currently the most abundant finfish on the Falkland Islands shelf. However, this is outdated and the most abundant finfish is now the common hake.	Hake is the most important catch however rock cod remains abundant, just not targeted. See ZDLT1-2023-02 for example the abundance of rock cod within this ground fish survey is number 2 and falls slightly behind the most abundant hoki, text will be amended.	Section 7.4.4.2.3.2
DMR 130	Page 339: “Within the kelp *P. cornucola* inhabit the benthos particularly in algal litter” doesn’t seem to make sense.	Thank you. Navitas thinks it does make sense but will amend to make clear. Note algal litter is found on the benthos in areas of low energy.	Section 7.4.4.3.1.1
DMR 131	Page 347: Note three on table 7.12 states “The species names relating to the species codes are found in Section 7.4.5.2.3”, but they are not given in that section. It would make this table easier to read if species names could be written out (accepting this would need a reduction in font size).	Thank you for your comment. This is noted and the Section reference will be amended.	Table 7.12

Reference	Request for information	Navitas response	Addressed
DMR 132	Page 348: Section 1.4.5.3.1.3 and table 1.13 are referenced but do not exist.	Thank you for your comment. This is noted and the text will be amended.	Removed
DMR 133	Page 352: It would be useful context to add the Sea Lion location to the maps in figure 7-48.	**Initial consultation response:** Thank you for your comment. This is noted and will be added. **Post-consultation comment:** The figure was examined and it was found that the track marks would be obscured if the Sea Lion location was added with a marker. Therefore, the figure remains the same as the public consultation version of the document. **Update:** Sea Lion location added to Figure	Figure 7-48
DMR 134	Page 353: There seems to be a numbering/formatting error in the paragraph beneath the one on GPS tags.	Thank you for your comment. This is noted and will be amended.	Section 7.4.5.2.1.4
DMR 135	Page : In the penultimate paragraph it mentions figures 7-49, 7-50 and 7-51 show animal tracking. It should be 7-50, 7-51 and 7-52.	Thank you for your comment. This is noted and will be corrected.	Section 7.4.5.2.1.4
DMR 136	Page 354: It is stated that “rockhopper penguins, which foraged beyond the Patagonian Shelf and slope during incubation, in water > 600 m deep”. Is this correct, as figure 7-50 suggests that it is during the chick-rearing stage that they do most foraging in the deep water (the incubation period map only has a very small number of trips into deep water)?	Thank you for your comment. This is noted and the text will be corrected.	Section 7.4.5.2.1.4
DMR 137	Page 359: The label of the map in the upper right of figure 7-52 should read “Elephant seal” rather than “Elephant sea”	Thank you for your comment. This is noted and will be corrected.	Figure 7-52
DMR 138	Page 362: The section on white chinned petrels states they are in decline twice in one sentence.	The typo will be corrected.	Section 7.4.5.2.2
DMR 139	Page 371: Footnote 2 has been improperly formatted in the header row to appear the same size as normal text.	Thank you for your comment. This is noted and will be corrected.	Table 7.17 Table 7.23
DMR 140	Pages 378-379: Figures 7-60 and 7-61 are low quality and some text barely legible	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be	All Figures checked for resolution and

Reference	Request for information	Navitas response	Addressed
		checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	improved where possible
DMR 141	Page 382: Note three on table 7.19 states "The species names relating to the species codes are found in Section 7.4.5.2.3", but they are not given in that section. It would make this table easier to read if species names could be written out (accepting this would need a reduction in font size).	Thank you for your comment. This is noted and the correct section will be referenced.	Table 7.19
DMR 142	Page 383: Regarding the statement "There is some evidence that food availability has been poor in the 2015/16 season", could this be cross referenced with fishing catch data for that year?	The statement about food availability relates to the cited FISMP report (Crofts and Stanworth, 2017), and the observed low breeding success and starvation in moulting adult penguins. There are no studies that link fishery catch to low breeding success and starvation in penguins. Fishery catch is not necessarily a useful or relevant index of penguin food availability.	N/A
DMR 143	Page 384: Table 7.20 shows an increase in the number of Gentoo pairs at Cow Bay between 2010 and 2022, but the final column states there is decrease since 2010. Similarly, there was a large decrease in the number of Gentoo pairs at Volunteer Point but the final column states the population was steady since 2010. The footnote is confusing as the column header states "since 2010" whereas the footnote suggests the trend is since 2015. The trend for Rockhoppers at Diamond Cove suggests a stable population despite a 35% decrease in pairs since 2010, while the trend for Kings is steady despite a 31% increase in the number of chicks.	The EIS Table 7.20 is correct. The table shows the long-term trend (1995-2022) and short term trend (2010-2022). The 2010 versus 2022 counts, may appear to contradict the population trend in the table (stable, increase or decline). However, comparing two years (e.g., 2010 versus 2022), is not the same as a trend over time (e.g., 12 years between 2010 and 2022). Navitas will update the Table footnote text to avoid confusion over time period.	Table 7.20
DMR 144	Page 388: It is stated that the Imperial Shag is "by far the most abundant species recorded during the winter months" but its winter population is much smaller than several other species It was by far the most abundant species in summer – is this what it should have said? The meaning of the sentence "So although imperial shags were not observed on the coast in the winter, they are still abundant within inshore waters during the winter months" is also unclear.	Thank you for your comment. This is noted and the text will be updated to clarify summer and winter abundance of shags.	Section 7.4.5.3.2

Reference	Request for information	Navitas response	Addressed
DMR 145	Page 396: Table 7.23 gives the Falkland population of Sooty shearwaters as 100,000 pairs, 0.5% of the global population; elsewhere in the document the figure is given as 139,000 / 0.1%	Thank you for your comment. This is noted and the text will be checked for consistency and corrected where relevant.	Table 7.23
DMR 146	Page 399: Table 7.23 states that the global population of tussac birds is unknown but the report also states that they are endemic to the Falklands – would this not mean that the global population is the same as the Falklands population (c. 15,000-28,000 pairs)?	Thank you for your comment. This is noted and the text will be corrected.	Table 7.23
DMR 147	Page 400: There is a footnote 3, but no use of it in table 7.23.	Thank you for your comment. This is noted and will be corrected.	Table 7.23
DMR 148	Page 401: Are the Poncet surveys still ongoing?	Yes, these are annual surveys.	N/A
DMR 149	Page 404: The figure of 291 mortalities in 2022 does not seem to align with table 7.25.	Thank you for your comment. This is noted and will be corrected.	Section 7.4.5.5.1
DMR 150	Page 405: The figures in table 7.25 do not seem to align with the text in page 404, which states that it is assumed there is one mortality for every three heavy contacts; in the first row the number of mortalities is 20 times higher than the number of contacts, whilst for Loligo, the number of extrapolated mortalities is three times the actual. If the numbers in the table are correct, can the discrepancy/workings be explained?	Having re-checked the 2019, 2020, and 2022 Bulletins (seabird mortalities were not reported in 2021), the number the commenter is referring to seems to the 291 mortalities in 2022, vs 875 mortalities for 2022 in the table. 875 is correct, and the text will be amended for clarity. The error came from exploration of the 2022 data where heavy contacts were not reported explicitly, and so when exploring the basis for extrapolated numbers, 875/3 = 291, which was mistakenly used in the text.	Section 7.4.5.5 Table 7.25
DMR 151	Page 406: The final sentence states that “Table 7.26 shows the species listed under ACAP that occur within Berkeley Sound waters” (eight species) but the table is actually about the Falkland Islands in general rather than Berkeley Sound (it lists 12 species and includes the BBA as a ‘common breeder’ despite it not breeding in Berkeley Sound).	Thank you for your comment. This is noted and will be amended.	Section 7.4.5.5.2
DMR 152	Pages 409-412: Figures 7-73 to 7-76 are low quality and some text barely legible	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be	All Figures checked for resolution and

Reference	Request for information	Navitas response	Addressed
		checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	improved where possible
DMR 153	Page 421: The final paragraph of the section ends with an incomplete sentence: “During this period an increased but small number of…”	Thank you for your comment. This is noted and will be corrected.	Section 7.4.6.2.1.2
DMR 154	Page 421: How do observations mitigate the impacts of seismic surveys?	MMOs keep watch for any marine mammals in the area. If any marine mammals are seen, the surveys are not allowed to take place, as per the JNCC Guidelines. Of note, no seismic surveys are planned.	N/A
DMR 155	Page : In the sentence “The concurrent survey within Licence Block PL001 was conducted other a period of 109 days”, presumably “other” should be “over”	Thank you for your comment. This is noted and will be corrected.	Section 7.4.6.2.1.3
DMR 156	Pages 422-427: Is there a reason there are distribution maps for some species (e.g., Peale’s dolphin) but not others (e.g., killer whales)?	Killer whales were very rarely observed and therefore distribution maps were not possible.	N/A
DMR 157	Page 423: Does the statement that “Acoustic detection of sei whales is further hampered by the absence of sei whale call descriptions for the South Atlantic” take into account the recent research by Caroline Weir?	This has been looked at by Cerchi and Weir (2022). It would seem that juvenile leopard seal calls and sei whale vocalisations may be similar but Cerchi and Weir (2022) consider that they are sei whales. However the conclusions are not categoric and will require further research. Navitas will reference the recent research in the post-consultation EIS.	Section 7.4.6
DMR 158	Page 429: It would be useful if the key of figure 7-88 included an explanation of the difference between maps A and B. The key’s wording is also a little odd saying “South American fur seal, predicted habitat use (predicted presence) breeding on the Falklands” instead of “Predicted habitat use (predicted presence) of South American fur seals breeding on the Falklands”. There is also a repetition of text in the key, with “(2019). The pink dot represents the drill centre” appearing twice.	Thank you for your comment. This is noted and the text will be clarified.	Figure 7-88

Reference	Request for information	Navitas response	Addressed
DMR 159	Page 430: The key for figure 7-89 has the same wording issue as 7-88 (saying "Southern elephant seal, predicted habitat use (predicted presence) breeding on the Falklands").	Thank you for your comment. This is noted and the text will be clarified.	Figure 7-89
DMR 160	Page 430: It is stated that table 7.28 "provides a summary of marine mammal abundance in the NFB, distribution, life-cycle and behavioural characteristics" but it only lists cetaceans and does not include pinnipeds. Was there supposed to be one including pinnipeds?	**Initial consultation response:** Thank you for your comment. This is noted and pinniped data will be included. **Post-consultation comment:** Upon further review, Navitas recognise that Table 7.28 was never intended to include seals and sea lions which are difficult to spot at sea and are unlikely to be consistently prevalent over 200km offshore. Therefore the table legend was considered to be in error and has been amended.	Table 7.28
DMR 161	Page 434: It is mentioned that there was an influx of southern right whales in 2017 and then states that "Whether this is simply an unusual year or the start of a long-term trend is yet to be determined" As there have been six winters since then, is data not available to determine this trend? The same comment is applicable to the southern right whale part of section 7.4.6.3.1.6 on page 449.	Thank you for your comment. This is noted and the text will be updated.	Section 7.4.6.3.1.1
DMR 162	Page 443: Figure 7-95 is not referenced in the text.	Thank you for your comment. This is noted and the reference will be added.	Section 7.4.6.3.1.3 (now Figure 7-94)
DMR 163	Page 444: It would be useful to mention how the number of sightings was translated into the estimated population given in table 7.31, particularly as the numbers of sightings and population do not appear to be proportional.	There is a ratio between sightings, dive (submergence times) and population estimate. The ratio is different for each species. The text will be amended for clarity.	Table 7.30
DMR 164	Page 447: In the genetic diversity section, the first two bullet points appear to be contradictory, saying there were highly significant differences in the first point and saying there was no evidence of population differentiation in the second.	Thank you for your comment. This is noted and will be clarified in the text.	Section 7.4.6.3.1.4

Reference	Request for information	Navitas response	Addressed
DMR 165	Page 457: There is also a sea lion haul-out site on Cochon Island.	Thank you for your comment. This is noted and will be added.	Table 7.32
DMR 166	Page 461: The section references “priority conservation habitats (Section 7.5.2.4)”, but the section in question is titled “Threatened terrestrial Habitats”. Similarly, it references “three priority conservation species” but the section referenced (Section 7.5.3) is titled “Threatened species”.	Thank you for your comment. This is noted and will be corrected.	Section 7.5
DMR 167	Page 463: Mallard ducks should be listed in the first bullet point as they also have no protection. Arguably the birds in the second bullet point are protected, albeit only for part of the year.	Mallard ducks are not listed, because they are infrequently sighted. For example, Woods and Woods (1997) report one Mallard duck at Goose Green in 1994. They were not reported by White *et al.* (2002), nor during extensive coastline monitoring surveys around Stanley Harbour and Cape Pembroke (Poncet, 2021). Regarding the second bullet, the text will be amended for clarity.	Section 7.5.1.3
DMR 168	Page 467: It is stated that NNRs are established under 1999 regulations but table 7.34 lists several that were established in the 1960s or 1970s.	Navitas understand that the NNRs established prior to 1999 were retrospectively included in the 1999 ordinance. See Conservation of Wildlife and Nature Ordinance 1999, 13(2).	N/A
DMR 169	Page 478: The low resolution of image 7-111 makes the key hard to read (is red high, purple medium?).	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	All Figures checked for resolution and improved where possible
DMR 170	Page 481: Some of the colours used for the key are too similar and hard to distinguish on the map. It might be helpful to add labels to the sections of each colour to allow readers to identify them.	Navitas notes DMR's comments and will review the post-consultation EIS to ensure that the colours can be clearly distinguished and/or labels are added.	Section 7.6.3 Figure 7-113
DMR 171	Page 482: Stanley is now a city rather than a town.	Thank you for your comment. This is noted and the text will be amended.	Section 7.7.2.2

Reference	Request for information	Navitas response	Addressed
DMR 172	Page 485: The statement "Patagonian rock cod has increased in importance over recent years" is not correct anymore – it hasn't been important for the last eight years after the huge drop in catches between 2015 and 2016. The timeline of the statement "experiencing 20-30 fold increase in catches" needs adding for it to make sense in the context of table 7.41, which only shows data since 2013. The statement that it "represented only 5.2 % of the catch in 2022" is incorrect. It was only 0.5% of the catch in 2022.	Text will be amended to: ''Patagonian rock cod has previously been an important commercial species but has decreased in importance since the drop in catches in 2015-16. From 2016 the catches of this species have decreased significantly and represented only 5.2 % of the reported catch between 2013 and 2022.'	Section 7.7.3.1.1
DMR 173	Page 487: The third paragraph is a repeat of text midway through the second paragraph.	Thank you for your comment. This is noted and paragraph 3 will be removed.	Section 7.7.3.1.1.1
DMR 174	Page 488: This section is about fisheries operating in the approaches to Berkeley Sound but the third sentence refers to a map of the sea lion field (Figure 7-115). Presumably this sentence should have been in the section above (Section 7.7.3.1.1.1) or figure 7-115 should be a map of the loligo fishery squares around Berkeley Sound.	Thank you for your comment. This is noted and the text will be amended.	Section 7.7.3.2.1.1
DMR 175	Page 491: It is not clear what the purpose of the sentence "A summary of all vessel use in Berkeley Sound is provided in Section 7.7.3.2.5" is.	This is to refer the reader to an overview of the vessel usage in Berkeley Sound, which is presented in section 7.7.3.2.5., this highlights the seasonal nature of the cruise ship season, which is mentioned above.	N/A
DMR 176	Page 491: It is stated that "the summary of all vessel use in Berkeley Sound (Section 7.7.3.2.5) shows that there is very limited use of Berkeley Sound by military vessels", but section 7.7.3.2.5 does not break vessels down by type.	Thank you for your comment. This is noted and the reference will be removed.	Section 7.7.3.2.3
DMR 177	Page 491: The "(see Section 7.7.3.2.5)" is irrelevant as the section in question does not break vessels down by type.	Thank you for your comment. This is noted and the reference will be removed.	Section 7.7.3.2.3
DMR 178	Page 494: Regarding table 7.44, presumably the huge decrease in vessels in Stanley Harbour in 2022 (compared to 2018) is due to COVID, but this is not stated anywhere in the section to give context (it is in section 11.2.4.2.1.1). 2023 data may be more useful if available. The same applies to table 7.45 (page 496) and every sub-section of 7.7.4.1.4 on pages 495-497.	Thank you for your comment. This is noted and detail will be added to Tables 7.44 and 7.45, and section 7.7.4.1.4 to this effect.	Section 7.7.4 Table 7.44 Table 7.45

Reference	Request for information	Navitas response	Addressed
DMR 179	Page 495: The text states that "2015 fishing vessel data is presented" but table 7.45 has figures for 2014/2018/2022.	This should refer to Figure 7-117, which shows the higher number of vessels withing Berkeley Sound during the 2014-15 season. This will be amended.	Section 7.7.4.1.4.1
DMR 180	Pages 494-496: Tables 7.44 and 7.45 do not appear to be consistent. For example, table 7.44 show 0 tankers entering Stanley Harbour in 2022 but table 7.45 states that 13 tankers docked at FIPASS in 2022. Similarly, 7.44 shows 1 cargo ship visit to the Harbour in 2022 but 7.45 states there were 25 vessel visits to FIPASS.	This data was provided by FIMA. They confirm that the vessel's destination is recorded (i.e., if it is anchoring in Stanley Harbour, it is recorded as Stanley Harbour but if it is just transiting the harbour to get to FIPASS, its location is recorded as FIPASS). So the tankers recorded at FIPASS will have transited Stanley Harbour and Port William to reach FIPASS but as this is a relatively short transition it is not recorded by the Harbour Authority. This will be footnoted in the text for clarity.	Section 7.7.4 Table 7.44 Table 7.45
DMR 181	Page 497: It is not clear why table 7.44 is referenced.	Thank you for your comment. This is noted and the reference will be removed.	Sections 7.7.4.1.4.5 & 7.7.4.1.4.9
DMR 182	Page 497: All of the main road between Stanley and MPC is now asphalted.	Thank you for your comment. This is noted and the text will be amended.	Section 7.7.4.2
DMR 183	Page 499: The reference to figure 7-113 should presumably be to figure 7-120 instead?	Thank you for your comment. This is noted and the text will be amended.	Section 7.7.4.2.1
DMR 184	Page 507: Presumably the lower-than-expected fall-back and general increase in electricity usage is linked to the increased number of homes/other buildings?	This would be a fair assumption yes.	N/A
DMR 185	Page 508: The footnote references in the table header are the same size font as the header, which could be confusing. Is there a reason the table does not include 2022/23 figures (which are given in the text on page 506)? The first cell of the final row states that 2012/13 s the base year, but the third cell states that 2013/14 is.	Thank you for your comment. This is noted and the footnote references and base year references will be amended. The 2022-23 figures were missed in Table 7.49 in error, these will be added.	Section 7.7.4.5.5.1 Table 7.49
DMR 186	Page 511: Agriculture is the third largest employment sector according to the 2021 census.	At the time of writing, census data tables and specific data requests were kindly provided by FIG Policy,	Section 7.7.4.7

Reference	Request for information	Navitas response	Addressed
		Economy and Corporate Services prior to the census being issued. These showed Agriculture as the fifth biggest employer in the islands. It is understood that a lot of work was put into accounting for those not present on census night to reflect the FI's stats more accurately - could this account for the change from fifth to third? However, as this is not what was reflected in the 2021 census once published, the EIS will be amended to reflect the published census figures.	
DMR 187	Page 519: Were there any vessels in Berkeley Sound at the time of the sound recording? It would be useful to state this for context as to whether the 'background' noise level includes vessels.	It was not recorded whether there were any vessels in Berkeley Sound during the baseline noise recordings, this will be checked against the FIMA data to see whether there would have been any vessels in Berkeley Sound at the time, and this will be noted in the document.	Section 7.7.5.2.1
DMR 188	Pages 525-527: The dark blue table headings with black text are hard to read and would benefit from the text colour being changed to white.	These will changed to white in the post-consultation EIS.	Section 7.8 Table 7.57 Table 7.58 Table 7.59
DMR 189	Page 525: The key for table 7.57 does not match the colours used in the rest of the table. Two cetacean species are listed as endangered (not one); sei whales and blue whales	Thank you for your comment. This is noted and the text will be amended.	Section 7.8.1 Table 7.57 Table 7.58 Table 7.59
DMR 190	Page 527: "Patagonian long-finned squid" should be "Patagonian rock cod"	The text will be revised in the post-consultation EIS.	Table 7.59
DMR 191	Page 530: Is a bird strike due to light outwith Navitas' control if is due to the presence of lights (as lights are within control to some extent)?	Navitas recognise that the use of light is a planned activity and that this will definitely have the impact of attracting birds. It is also recognised that the 'planned' *vs.* 'unplanned' usually refers to the activity rather than the impact itself. However, after	N/A

Reference	Request for information	Navitas response	Addressed
		considerable internal discussion and debate, the decision to consider bird strike a risk rather than an impact was taken so that the likelihood of occurrence could be factored into this particular impact. Within the risk assessment, the impact and the risk largely came out the same, with the exception of small scale strikes in Berkeley Sound. Here the impact was considered Low but given that the 'likelihood of occurrence' was 'Likely', the overall risk was considered to be Moderate and was therefore considered significant ensuring it would be flagged for monitoring and an EMMP action. Navitas does not consider the FPSO to be excessively illuminated over and above minimum safety requirements. Navitas has also committed to constraining the outward facing lighting. See also response to RSPB 8 - e and f.	
DMR 192	Page 535: The hyperlink in note 8 does not work.	Noted. Navitas apologise that this link no longer works and while revisiting the soil/seabed sensitivity Navitas has also now included reference to the IEMA 2022 guidance to ensure it is up to date with current thinking. The footnote will be amended to: Adapted from: Link and IEMA (2022).	Table 8.1
DMR 193	Page 539: Elsewhere in the document the field life is stated to be 30 years rather than the 23 stated several times in table 8.2.	Thank you for your comment. This is noted and the text will be amended.	Section 8.5.2.2 Table 8.2
DMR 194	Page 540: It looks like there is meant to be a footnote against the UK EA screen out threshold but there is not one visible.	Thank you for your comment. This is noted and the link will be changed to:	Section 8.5.2.2 Table 8.2

Reference	Request for information	Navitas response	Addressed
		https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.	
DMR 195	Page 553: For the risk of introducing non-native species, one offsetting proposal could be the development of an eradication programme, subject to viability.	Noted, thank you for the suggestion. EIS Section 8.11.2.2 discusses Indirect Offsetting. Pest and invasive species eradication/control is listed as one of the potential indirect offsetting initiatives. Navitas will update table 8.9 in the post-consultation EIS to clarify that where direct offsets have not been identified, indirect offsetting will be undertaken.	Table 8.9
DMR 196	Page 554: DMR's view is that an internal Navitas fund is not appropriate. DMR would like Navitas to commit to an offsetting studies budget that would be managed by a panel consisting of FIG representatives, Navitas and appropriate Falkland Island stakeholders that would decide which studies to progress, and would also like a clear commitment on the amount of funding provided for studies per annum starting immediately after FDP approval. DMR would also like Navitas to clarify what it considers to be a "meaningful" level of scope 1 and 2 carbon offsetting and commit, and to commit to start putting money into a carbon and biodiversity offsetting projects fund from First-Oil.	Perhaps the use of the word 'Internal' has been misconstrued - the Fund will be funded internally, but the intent is that the oversight and governance will have FIG and Independent NGO representation as well as independent technical/environmental advisors. Navitas has prepared and submitted a briefing paper to FIG that outlines the intent of the fund. Navitas believe that this aligns with the FIG DMR sentiments in this comment and FIG policy and legislative requirements. Footnotes added to 8.11.1 and 8.11.4	Sections 8.11.1 & 8.11.4
DMR 197	Pages 561-585: Questions regarding the impacts identified in table 9.1: • How does placement of objects on the seabed and large dropped objects (p561) impact the human population? • Why do large dropped objects (p561) not impact the sea bed and soil? • Why does the discharge of chemicals during drilling (p562) impact fish but not marine mammals? • Why was plankton deemed to be impacted by noise from explosives but not benthos (p562)? • Why do the operational discharges listed on page 563 and 564 that	Thank you for your comment. This is noted and Navitas will check Table 9.1, 9.2 and 9.3 and update where appropriate.	Table 9.1 Table 9.2 Table 9.3

Reference	Request for information	Navitas response	Addressed
	impact fish not affect benthos or marine mammals? • Why does the discharge of fluid during valve actuation (p564) impact benthos but not other sea life? • Why does the discharge of hot water (p565) impact plankton but not other life, while subsea heat generation (p566) affects benthos and fish? • Why is underwater noise (p566) not deemed to impact benthos (as on page 663 it is stated that mussels are affected by noise)? • Why does the pilot light flare (p567) not impact sea birds (when other forms of flaring do)? On p596 it is stated that seabirds are impacted by flares. • Why does discharge of liquid waste streams to the sea impact fish and birds but not marine mammals? Applies to both pages 567 and 576 • Why does loss of containment of solid waste or liquid offshore not impact all marine life (solid waste is listed as only impacting birds and mammals while liquid waste only impacts plankton and fish)? Applies to both pages 568 and 576 • Would a topside release of reservoir hydrocarbon (p571) not also potentially impact commercial fisheries? • Why does a build-up of oil in the top of the PW discharge caisson (p573) impact fish and birds but not marine mammals? • Why do the oil spills due to collisions during offtake or hose rupture (p573) not impact the seascape? • Could the introduction of marine invasive species to Berkeley Sound (p577) impact commercial fisheries if it interferes with loligo reproduction? • Would “Presence of additional personnel on Falkland Islands” (p579) not impact the human population?		
DMR 198	Page 570: The FPSO exclusion zone is 1,250m not 500m	Thank you for your comment. As described in Section 5.5.4 the FPSO will have an exclusion zone of 1,275m. This will be checked and updated throughout the document to check for typos.	Section 9.2

Reference	Request for information	Navitas response	Addressed
DMR 199	Page 591: The text twice makes reference to three LTVs – elsewhere in the document the number of LTVs is given as four	It is expected no more than four LTVs will be utilised to support the project, with a maximum of two LTVs present, anchored in Berkeley Sound, at any one time. All sections will be checked for consistency.	Section 5.5.1
DMR 200	Pages 592-593: The colour of the light is also an influencing factor (as stated on page 610). As this is a known mitigation measure, why is this not considered in 10.1.7?	As indicated in Section 10.1.10.1 and 15.7.2.1, the practicalities of adopting the OSPAR green lighting strategy will be investigated during the project engineering phases as a potential mitigation against bird-strike. As yet green-lighting has not yet been adopted as a definite project-specific mitigation as the investigation is still ongoing.	N/A
DMR 201	Page 601: Part of the key for table 10.4 is not legible due to the lack of contrast between black text and very dark blue cell colouring.	Moderate and High text will be changed to white to ensure visibility in the post-consultation EIS.	Section 10.1.4.3.1.4 Table 10.3
DMR 202	Page 608: Reference is made to “Chapter X” – presumably meant to be chapter 15	Thank you for your comment. This is noted and the text will be amended.	Section 10.1.7.1
DMR 203	Page 611: It is stated that “The year 2007 was chosen as this represents an ‘average’ fishing year within the available data range.” However, 2007 was an unusually good year and saw the highest total catch between 2001 and 2013.	The figure will be updated where possible from the NOAA database and text added to clarify.	Section 10.1.9.2 Figure 10-5 Figure 10-6
DMR 204	Page 612: The caption of table 10.7 references the NFB but the table includes Berkeley Sound. Should fuelling vessel(s) also be included for Berkeley Sound?	The legend will be updated to include Berkeley Sound and additional vessels included.	Section 10.1.9.2 Table 10.7
DMR 205	Page 620: Does helicopter noise also affect cetaceans when they are at/near the surface?	When they are at/near the surface marine mammals may be briefly affected by helicopter overflight noise but as the helicopters fly over quickly, and at heights over 3,400 ft (apart from take-off and landing) and marine mammals are generally spending lesser amounts of time at the surface (compared to hauled	Section 10.2.3

Reference	Request for information	Navitas response	Addressed
		out seals or bird colonies), the impacts are not considered significant and it is not considered further in the assessment. The Sea Lion helicopters will follow the FILFH Guidelines.	
DMR 206	Page 626: It is stated that flights between Stanley and the CTT would be "mostly over the sea and should not pose a significant risk to wildlife aggregations onshore." However, they would presumably take a similar flight path as helicopters between Stanley and the FPSO and pass over Seal Bay and close to other very sensitive areas.	Flight paths out to the CTT would be generally similar to those going out to the FPSO but may range slightly further east or west depending on from which direction the CTT is arriving at the field. It is not possible to predict their exact routes at the moment but all flights out to the CTT (as with all Sea Lion helicopter flights around the islands) will comply with the Falkland Islands Low Flying Handbook. Text will be amended to clarify the broad routes, i.e., that they will be similar to those going to the FPSO.	Section 10.2.4.2.4.2
DMR 207	Page 626: Was the Falkland Islands Low Flying Handbook Guidance published in 2015 or 2017? The document inconsistently refers to "FILFH, 2015" and "FILFH, 2017" in multiple places, sometimes on the same page (e.g., pages 627 and 1064).	FICAD confirm the FILFH is updated regularly, the references to this guidance will be updated throughout the EIS as 'FILFH, 2024'.	Section 10.2 Section 11.9, Section 10.3.4.3.1
DMR 208	Page 641: Figure 10-9 is very low quality and text illegible in places.	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	All Figures checked for resolution and improved where possible
DMR 209	Page 642: Why is the total for all MODU anchor placements equivalent to 20 areas being disturbed when there are ten anchor placements and ten removals. Will the placements and removals not be the same area being disturbed?	The chapter refers to 20 moves, not 20 locations (10 anchor placements and 10 anchor removal events, albeit in the same areas). The narrative will be updated to clarify.	Section 10.3.4.3.1 Table 10.14
DMR 210	Page 650: The figures given for the number of losses from mobile unit crane decks does not appear to add up. It is state that there were 0.034 losses per	The OGP Risk Assessment Data Directory Report No. 434 – 17, March 2010, has been checked and the	Section 10.3.6.2.1

Reference	Request for information	Navitas response	Addressed
	year over a 19-year period, which is equivalent to less than one loss (0.6) over the entire period, which is presumably not correct. Is the figure meant to be 0.034% (i.e., 83 losses)?	narrative has been updated from: 'With regard to the likelihood of objects being dropped, data gathered between 1980 - 1999 indicate that in a yearly average of 24,480 lifts from mobile unit crane decks, only 0.034 losses per year occurred (OGP, 2010).' TO: Over a period of 37 years (1970 - 2007), only one dropped object was recorded worldwide from units ranging from FPSO's to semi-submersibles (OGP, 2010). This amounts to a frequency of 0.027 incidents per year. According to the OGP (2010) on mechanical lifting failures, the probability of a dropped object from a mobile unit is 0.0000014 per lift. An additional reference has been included: OGP. 2010. International Association of Oil and Gas Producers: Mechanical Lifting Failures. Report No. 434 – 08 March 2010.	
DMR 211	Page 664: The sentence “However, it is likely that particle motion is equally important as sound pressure in fish (and invertebrate), perception of sound.” does not appear to make sense.	The text will be clarified in the post-consultation EIS.	Section 10.4.4.4.3.1
DMR 212	Page 672: As the number of wells, the size of FPSO and CTT arrangements has changed from the previous operator’s plans, is using their modelling of scenario 1 (installation of subsea infrastructure and drilling of wells) and 2 (steady state production) still appropriate?	These are snapshots of operations which will be very similar to those in the previous EIS but please note that underwater noise modelling is being further revised and refined with new models. Navitas does not anticipate any change to the impact assessment as the operational footprint is smaller than the	Section 10.4 Section 10.5

Reference	Request for information	Navitas response	Addressed
		previously proposed Premier development. See also FIFD 54.	
DMR 213	Pages 674-675: The data in figure 10-12 and table 10.26 does not appear to be consistent. The peak noise levels in the table do not match the ones in the figures (for example, in the figure the peak noise for the tanker is around 192dB while in the table it is around 198-201dB).	Refer to DMR 212. The figure shows generic levels for a number of vessels etc. and the table shows the specific, and conservative, levels used in the modelling. A foot note has been added to clarify and table/figure titles amended.	Section 10.4 Figure 10-12 Table 10.25
DMR 214	Page 701: It is stated that "The PK injury thresholds for each marine mammal hearing group are shown in Table 10.23". However, they are in table 10.24.	**Initial consultation response:** Thank you for your comment. This is noted and the text will be amended. **Post-consultation comment:** The revised noise risk assessment incorporates updated noise modelling. Given the absence of impulsive sound sources, the PK injury thresholds are no longer included.	N/A
DMR 215	Page 715: The Cranford *et al.,* experiment was for ten days. How long does Navitas envisage surface drilling discharges lasting during each individual drilling? If it is a significantly longer period, are there any studies that consider longer-term impacts?	Over the course of the Phase 1 drilling campaign, discharges will occur for a cumulative (but non-continuous) total of *c.* 286 hrs (11.91 days). For example, drilling a 36' top-hole would result in *c.* 8 hours of time with muds being circulated and discharged. A few days later, there will be 18 hours of circulation and discharges when drilling the 17 1/2' top-hole. Therefore discharges will occur episodically. This will be similar for the Phase 2 drilling campaign carried out a number of years later.	N/A
DMR 216	Page 737: The metocean dataset covers only three years – is this deemed sufficient to cover long-term current changes (for example the occasional stronger Falkland current that disrupts Loligo fisheries at irregular intervals)? DNR has datasets going back to the mid-1990s.	Navitas (then POEPL) acquired metocean data from various sources including modelling and measurements. These data underwent independent peer review to determine that they were sufficient.	N/A

Reference	Request for information	Navitas response	Addressed
		Specifically, the data sources included: - Dedicated wind, wave and current models from the UK Met Office and BMT Argoss to inform the design and operational criteria. In situ measurements included: - Directional wave data from wave buoy (FOSA 1997-98, Premier Oil 2014 - 16) - Current moorings (FOSA 1997-98, Rockhopper 2011-12) - Wind data from drilling rigs (Borgny Dolphin 1998, Erik Raude 2015-16) Therefore, the metocean data used for the modelling are considered sufficient. Navitas note the comment on data sets held by DNR, however, these are not suitable for the modelling that was undertaken.	
DMR 217	Page 743: It is stated that “the impacts associated with other discharges to sea e.g., drill cuttings discharges and ballast water and warm water from cooling systems are described elsewhere in this document as indicated in Table 2.2.” However, table 2.2 has no mention of ballast water or warm water from cooling systems.	Thank you for your comment. This is noted and Table 2.2 will be updated.	Table 2.2
DMR 218	Page 750: Why are benthos, cephalopods and marine mammals not considered potential receptors to operational discharges?	Thank you for your comment. This is noted and these will be specifically listed in the receptor section although the impact assessment section refers to 'marine organism' collectively to avoid repetition.	Section 10.7.3
DMR 219	Page 751: Regarding the claim that discharging water at depth aiding mixing and dispersion, are ocean currents not slower at depth, and therefore less helpful for mixing and dispersion?	Yes, surface currents can be strong compared to deeper currents due to wind, tides, etc. However, because the ocean is highly stratified, it cannot be assumed that currents are weaker with increasing	N/A

Reference	Request for information	Navitas response	Addressed
		depth, with each strata having different physical properties (i.e., density) as well as movement where deep water can move in different horizontal directions and speed compared to strata above or below. With respect to discharges, mixing and dispersion are also dependent on the difference in density (combination of temperature and salinity) of the discharged water compared to the receiving water, as well as the amount of water movement and force at which the discharged water is being expelled. The density differential will mean that discharged water will either rise or fall, which in itself will cause turbulent mixing irrespective of currents. Considering mixing due to difference in density as well as discharges being expelled into a turbulent ocean, mixing and dispersion is likely to occur very quickly in a highly localised space. This is detailed in 10.7.4.1.2.2 Behaviour and fate of PW discharges.	
DMR 220	Page 752: It would be helpful if the reason for the differences in concentrations in water phase in early and late field life set out in table 10.42 were explained.	This is related to declining oil rates and increasing water cut over time and the partitioning co-efficient of the chemicals between the oil and water phase. The narrative will be updated.	Section 10.7.4.1.2.1 Table 10.46
DMR 221	Page 758: “the necessary dilution to achieve a No Effect Concentration (NEC) would be reached at <10 to 100 m and usually less than 500 m” does not appear to make sense (it infers that it is always between <10 and 100m, but then states usually less than 500m).	The text will be amended to state: 'the No Effect Concentration (NEC) would usually be reached at <10 to 100 m and always less than 500 m'.	Section 10.7.4.2.2.1

Reference	Request for information	Navitas response	Addressed
DMR 222	Pages 768-769: The titles of figures 10-30 and 10-31 state that yellow equals 5% risk but the (barely legible) key states yellow is 1-5%. Due to the low quality of the graphics, the distance marker is also barely legible and the depth axis of the lower figures is not legible.	The 5% refers to the worst-case of the yellow range (1-5%). The figure legend will be reviewed in the post-consultation EIS to ensure clarity.	Section 10.7.4.5.2.3
DMR 223	Page : The plumes appear to go lower than the maximum depth shown in the lower graphs in the figures. Could the figures be extended so the entire depth of the plume is visible?	The green colouring denotes no significance and the important area to note is the yellow which is the area of 5% risk where risk (EIF) is counted. The rest gives a sense of the shape and structure of the plume.	N/A
DMR 224	Page 781: Would the Conservation of Wildlife and Nature Ordinance 1999 not be relevant to thermal discharges given that some discharges will be at up to 90ºC (as stated on page 782) and therefore could cause harm to wild birds (penguins) that approach the discharge outlet.	We understand the comment. We can add the ordinance to the legislation section. However, discharge into 4 degree seawater at the rate designed would mean the hot water would disperse rapidly. Furthermore, Navitas considers that, if there was a tangible temperature gradient then penguins would swim away from any warmer water.	Section 10.8.1.1
DMR 225	Page 782: There will also be some active heating of subsea infrastructure in certain circumstances (the circulation of hot oil set out in table 5.18)	This was omitted in error and will be added to the sources section in the post-consultation EIS.	Section 10.8.2
DMR 226	Page 783: Given the potentially high temperature of some discharges, would cephalopods, marine mammals and sea birds not also be potential receptors as well?	Thank you for your comment. This is noted and these will be specifically listed in the receptor section although the impact assessment section refers to 'marine organism' collectively to avoid repetition.	Section 10.8.3
DMR 227	Page 787: Why are the temperatures at the point of release shown in figure 10-35 (maximum of around 14ºC) so much lower than the temperatures of the cooling and produced water (50ºC and 90ºC) in table 10.53?	These graphs show the temperature difference from ambient seawater around the discharge, not the temperature of the discharge itself. Of note, and as stated in the figure, the high volume of CW and stable plume creates a stable temperature change near the discharge point whereas the small volume of PW is dispersed almost immediately.	Section 10.8.4.3.3.3
DMR 228	Page 796: Perhaps it should be clarified that the Falklands are one of the overseas territories that ratification was extended to.	The narrative will be amended for clarity to explain that:	Section 10.9.1.1.1

Reference	Request for information	Navitas response	Addressed
		The UNFCCC ratification has been extended to the Falklands Islands but as yet, the Paris Agreement and the need for the NDC has not yet been. In 1992, the UN Framework Convention on Climate Change (UNFCCC) was adopted. It has the objective of stabilising greenhouse gas levels in the atmosphere at a safe level. Of the Territories, Bermuda, Gibraltar, the Cayman Islands, and the Falklands have had UK ratification of the UN Framework extended to them (to 2022). No OT has had the Paris Agreement on climate change extended to them, though in the 2021 Joint Ministerial Council between the UK and the Territories, some expressed an interest: The UK warmly welcomed the ongoing interest from some Overseas Territories in being covered by the Paris Agreement, and confirmed that the UK stands ready to support these Overseas Territories. The Paris Agreement was adopted in 2015 and requires ratifying parties to submit plans for climate action, known as nationally determined contributions, with a view to limiting global warming to 2ºC. Ref: House of Commons Library .2023. International treaties and the Overseas Territories. Research Briefing. 26 January 2023. Number 9707	
DMR 229	Page 800: Should a fire on board a vessel be considered for the list of emissions from unplanned or emergency events?	Thank you for your comment. This is noted. Fires are usually dealt with as a safety matter rather than an	N/A

Reference	Request for information	Navitas response	Addressed
		environmental one. We are not aware of any precedent for including emissions from crude oil fires in an EIS.	
DMR 230	Page 811: The figures in table 10.59 and 10.60 appear to be UK only. The UK Greenhouse Gas Inventory, 1990 to 2021 (which is the UK's official annual report to the UN) includes overseas territories like the Falkland Islands – would this be a better dataset to use, especially given that section 10.9.4.3.3 starts with the statement that "Emissions in the Falkland Islands are covered by the UK and must be reported in the UK GHG inventory."	The data used in Tables 10.59 and 10.60 use raw data from the Final UK greenhouse gas emissions national statistics 1990-2021 (DESNZ, 2023b). In error, data from Table 1.1 were used which include only the UK emissions and did not include the emissions listed in Table 3.1. The data will be updated to include all emissions from Overseas Territories and Crown Dependencies and all associated narrative regarding comparisons has been updated accordingly.	Section 10.9.4.3.2.1 Table 10.63 Table 10.64
DMR 231	Page 814: Emissions from overseas territories and crown dependencies are not included in UK carbon budgets, so it is not clear that discussion of UK carbon budgets is relevant. This comment also applies to sections 10.9.4.5.5 (p833) and 10.9.6.1.1 (p835).	It is acknowledged that the Falkland Island emissions are reported to the UNFCCC as part of the UK emissions totals, but that UK ratification of the Paris Agreement has not yet been extended to the Falkland Islands as an Oversea Territories. Therefore emissions from all OTs and Crown Dependencies are not included within the UK Nationally Determined Contribution (NDC) and are therefore not included in the UK Carbon Budget. At the time of writing there are no budgets assigned to Falkland Islands and there is little guidance on what such allowances may be. However, the Information to facilitate Clarity, Transparency and Understanding (ICTU) which accompanies the UK NDC makes a commitment to 'Updating on the progress made in expanding the territorial scope of the NDC to include the UK's Crown Dependencies and Overseas Territories'. It is anticipated that should the Carbon Budgets be	Section 10.9.4.3.3 Table 10.67

Reference	Request for information	Navitas response	Addressed
		extended to include the OT/CDs, they will not be dramatically increased and the UK Carbon Budgets as they stand have been used as the only point of comparison available at this time. Table 10.62 will be updated with a footnote to explain the above and Navitas will follow all guidance and future legislation that results should the UK ratification of the Paris Agreement be extended to the Falkland Islands.	
DMR 232	Page 816: The fourth bullet point in the second cell of table 10.63 starts “d water” – presumably there is a missing word (“heated”?)	Thank you for your comment. This is noted and the text will be amended.	Section 10.9.4.4.1 Table 10.69
DMR 233	Page 823: The first two hyperlinks in the footnotes do not work.	Thank you for your comment. This is noted and the text will be amended.	Section 10.9.4.4.3 Table 10.71
DMR 234	Page 833: The percentage figures for NOx and SOx are a little misleading as they are comparing whole project life emissions with annual emissions. It would be better to compare the annual emissions like-for-like.	Agreed. This is a typo as the narrative indicates that the 'worst-case annual baseline Phase 1 & 2' is compared, BUT then the Phase 1&2 total is used, which creates an overestimation of the contribution. The narrative will be updated to reflect the annual NOx and SOx emissions as follows: - NOx = total 31,522 tNOx / 32.6 years = 967 tNOx per year = 0.14% - SOx = total 1,799 tSOx / 32.6 years = 55 tSOx per year = 0.04% Also, the graphic showing the indirect emissions graphically will be replaced with a table showing the actual data over time as taken from Table ES 3 in the Final UK greenhouse gas emissions national statistics 1990-2021.	Section 10.9.4.5.6
DMR 235	Page 834: There are more frequent testing thresholds for higher tonnages (e.g., at least 6 months for 50-500 tonnes, 3 months for 500+).	Thank you for your comment. This is noted and the text will be amended.	Section 10.9.5.2

Reference	Request for information	Navitas response	Addressed
DMR 236	Page 843: There is some partially-hidden text to the bottom right of figure 10-42.	Thank you for your comment. This is noted and the text will be amended.	Section 10.10.1
DMR 237	Page 846: It is surprising that LTVs are missed off the list of sources of waste.	It is expected that the LTVs will generate very little waste. They shall arrive with their cargo ready to be installed. The small amount of waste that they do generate shall be passed onto the OCVs and field support OSV and has been included in their figures. Dunnage and packing materials which are not transferred over to the other vessels shall be transported back to their point of origin when the vessel returns from the project. Navitas will ensure that there is clarity regarding LTV waste in the post-consultation EIS.	Section 10.10
DMR 238	Page 849: Is the atmosphere not a receptor (for emissions from incineration, the shipping of waste and landfill)?	It is not the base case that there will be a standalone waste incinerator on the supply base; the base case is that all waste incineration will be handled by the FIG municipal facility. Equally Navitas will not own the landfill facility used for any waste falling to landfill. Therefore, emissions resulting from the combustion during waste incineration, and the emission of methane from landfill sites are included within the GHG Protocol Scope 3, Category 5 emissions and therefore qualify as Scope 1 emissions for those who are managing the waste facilities. While Navitas recognise that the inclusion of the category 11 Scope 3 emissions was the subject of the Surrey *vs.* Finch Supreme Court ruling, in the absence of formal guidance on the ramifications of this, the emissions associated with waste managed by other parties is considered to be outwith the scope of this EIS.	Section 10.10.3 Table 10.72

Reference	Request for information	Navitas response	Addressed
		Nonetheless, emissions from waste incineration are relatively small and have been itemised in a footnote in Table 10.72. The emissions associated with any shipment of waste back to the UK on returning freighter vessels are included within the vessels emissions captured within Chapter 10.9. If Navitas were to include emissions both from the shipment of waste and arising from local incineration, this would constitute double-counting - the emissions arising from shipping the waste constitute the worst-case and these are included in the assessment. However, 'atmosphere' has been added as a potential receptor for waste in 10.10.3.	
DMR 239	Page 853: The planned incinerator will not be operable in 2024 – more likely to be Q1 2026.	At the time of writing the EIS, the incinerator was anticipated in 2024. Communication from FIG suggests that it is now anticipated towards the end of 2026. Navitas will update the post-consultation EIS accordingly.	Section 10.10.4.2.3
DMR 240	Page 860: In table 10.76 the total amount of waste is given as 28,537 tonnes, but the total of the stages is 28,569. This difference seems too large to be accounted for by rounding errors.	This will be checked and corrected in the post-consultation EIS.	Table 10.85
DMR 241	Page 861: Why are different years' figures used for recycling and landfill rates?	These are the figures reported on the DEFRA website (DEFRA, 2023). Navitas will ensure that consistent years figures are provided in the post-consultation EIS.	Section 10.10.4.5 Table 10.87
DMR 242	Page 872: The correct name of the law is "Marine Mammals Ordinance 1992"	Thank you for your comment. This is noted and the text will be amended.	Section 10.11.1.1
DMR 243	Page 874: The hyperlinks in figure 10-46 do not work.	Thank you for your comment. This is noted and the text will be amended in the post-consultation EIS.	Section 10.11.4.2

Reference	Request for information	Navitas response	Addressed
DMR 244	Page 876: The text about sei whales appears to be contradictory, stating "Tend to swim just below the surface leaving a clear trail of 'fluke prints'" but then goes on to state that they are "relatively difficult to detect visually" and exhibit "relatively inconspicuous behaviour on the surface".	Both statements are correct but will be reworded for clarity in the post-consultation EIS.	Section 10.11.4.3.2
DMR 245	Page 876: The sentence "This process that 10 species have populations which trigger global KBA criteria…" does not appear to make sense. Is there a word missing?	Thank you for your comment. This is noted and the text will be clarified in the post-consultation EIS.	Section 10.11.4.3.2
DMR 246	Page 878: Is the 0.9 on the y axis 0.9% or 90%?	Thank you for your comment. This is noted and the text will be clarified in the post-consultation EIS.	Section 10.11.4.4.1 Figure 10-51
DMR 247	Page 885: Is there more recent data on port visits than 2014?	Yes and the section reference will be added in the post-consultation EIS.	Section 10.11.9
DMR 248	Page 916: Earwigs first appeared in the Falkland in the 1990s according to SAERI.	The exact date is not known. SAERI has commented to Navitas that, anecdotally, it is likely they arrived in the mid 90s.	Section 10.13.4.1.1
DMR 249	Page 918: It is stated that "The TDF will be equipped with monitoring devices and equipment to clean any cargo that does not meet the specified standards." Will it have a designated cleaning area where runoff from cleaning is captured for disposal rather than potentially entering waterways?	Thank you for noting this. This is an error. In accordance with Navitas' shipping instructions and Biosecurity Management Plan all imported goods / cargo will be inspected and treated prior to departure from their point of loading. However, in the unlikely event of an incident the supply base (not the TDF) will have a dedicated biosecurity area where non-conforming cargo can be quarantined, inspected and treated. Any waste generated from this exercise will be dealt with in accordance with the operational Waste Management Plan. The (currently draft) waste management procedure will be upgraded to an operational waste management plan prior to operations commencing. A biosecurity plan will also be prepared pre operations. In the event of a biosecurity incident, FIG Biosecurity will be informed	Section 10.13.5.1.1

Reference	Request for information	Navitas response	Addressed
		and asked to advise on required treatment and disposal. A dedicated biosecurity bin can be provided in the supply yard waste area to ensure appropriate segregation and disposal. The post-consultation EIS will be updated to ensure that the narrative discussing biosecurity monitoring and management is clear. See also SAMS 24.	
DMR 250	Page 926: The third paragraph refers to table "11." which is presumably meant to be 11.1.	The typo will be corrected in the post-consultation EIS.	Section 11.1.1
DMR 251	Page 926: The note states that "other impacts associated with vessel use, competition for resource and the installation of subsea infrastructure etc. are described elsewhere in this document, as described in Table 11.1" but table 11.1 does not state where these are described. Should this refer to table 2.2 instead?	The typo will be corrected in the post-consultation EIS.	Section 11.1.1
DMR 252	Page 932: As well as damage to subsea infrastructure, should oil spillage be added a potential outcome/impact of snagging of fishing gear from trawlers? Same comment applies to table 11.8 (page 942).	The Jee report (2013) presented in the EIS concluded that there is negligible risk of snagging with subsea infrastructure and that there is, therefore, no need to make the subsea infrastructure over trawlable. The risk of loss of hydrocarbons is negligible and is therefore not assessed further.	N/A
DMR 253	Page 949: Why has a different analogous ship been used for OCVs for offshore (*Skandi Skansen*) and inshore (*Seven Arctic* Inst vessel)? Why has a different analogous ship been used for PSVs for Stanley Harbour and Berkeley Sound (the one for Stanley Harbour (Pacific Leader) is the same one listed for offshore comparison)?	These vessels are all similar and it is important to have a range of vessels (albeit limited) to provide the comparative information. For example there are over 400 suitable PSVs in the global market for this project. Availability, locality, maintenance record, environmental features and commerciality will all come into the mix when selecting the vessels and so providing a couple of analogous vessels throughout the EIS should not be a concern and reflects the depth of the market and Navitas' experience.	N/A

Reference	Request for information	Navitas response	Addressed
DMR 254	Page 950: 2023 vessel visit data be better (if available) than the COVID-affected 2022 data. 2022 is not an appropriate baseline.	2023 data will be requested and included in the post-consultation EIS.	Section 11.2.4.2.1.1 Table 11.13
DMR 255	Page 951: It is stated that "the annual variation is related to the catch recorded in the *Illex* jigging fishery which has varied hugely over the past ten years; from virtually zero in 2009 to almost 200,000 tonnes in 2021 (FIG, 2023) (Table 11.15)." However: • Table 11.15 does not include data for 2009 (it only goes back to 2013). • The highest catch on the table was in 2015 (357,722 tonnes) • 2021's catch was 172,537 tonnes, which is probably not correctly described as "almost 200,000"	Navitas will clarify in the text in the post-consultation EIS.	Section 11.2.4.2.1.2
DMR 256	Page 965: The statement that "socio-economic impacts are out of scope for this EIS" is contradicted by the statement later on the same page that "the social impacts of competition for resources such as accommodation was considered to be within the scope of the EIS". This comment also applies to section 11.4.1 (page 979) and 11.7.1 (page 1017)	As noted in section 6.2.2.1.1, discussion with FIG in 2015 determined what socio-economics aspects should be included in an EIS. Socio-economic impacts were considered out of scope but social impacts were included. This is reflected in the FIG Hydrocarbons Environmental Impact Assessment Guidance Note (2016). The post-consultation EIS text will be reviewed to explore whether it can be made more clear.	Section 11.3.1
DMR 257	Page 971: Does Navitas believe there is sufficient time to identify and purchase a site and then build the hostel-type accommodation before operations start?	Navitas has already engaged with local supply chain regarding accommodation requirement and issued an expression of interest to gauge interest, capacity for construction and availability of land. The accommodation can be constructed in a phased fashion, so that not all of the requirement needs to be available at the outset. There are temporary pre-fabricated solutions that can be deployed in the early stages if there is a challenge in constructing more permanent accommodation solutions prior to the	N/A

Reference	Request for information	Navitas response	Addressed
		commencement of operations. These have been deployed successfully for previous exploration campaigns.	
DMR 258	Page 974: DMR disagrees that the significance of the impact on housing is low. There is a severe housing shortage and even only 26 additional homes is still equivalent to 2% of the 2021 level (1,148).	Rather than increasing pressure on existing (limited) supply, Navitas is committed to the construction of additional accommodation units to meet its direct housing requirement, therefore we consider the rating appropriate. The measures being taken to accommodate the workers have been taken into account when considering the severity of effect. As the addition of accommodation required by Navitas is only 2 % change, the assessment looks at the worst-case and is precautionary, Navitas feel the assessment is appropriate. Currently the assessment is sensitivity Low 'The receptor is tolerant of change without detriment to its character, or unacceptable to a handful of stakeholders' and Severity Minor: 'Short-term minor impact on livelihood and/or health, inconvenience of resource use, minor levels of disturbance to local pop, concern to a handful of stakeholders'. Wider aspects of the impact of the development on accommodation are considered in the SIA.	N/A
DMR 259	Page 981: Would the natural environment also be a potential receptor if more water needed to be extracted for use in Stanley?	This section of the EIS focusses on the competition of a resource (water) on the human population. As such, the natural environment would not be considered a receptor in this case. The volume of water to be extracted from the natural supply is managed by FIG and Navitas will be one of many end users.	N/A

Reference	Request for information	Navitas response	Addressed
DMR 260	Page 981: The number of Stanley households is 1,148 (not 1,147) according to the census figures.	At the time of writing, census data tables and specific data requests were kindly provided by FIG Policy, Economy and Corporate Services prior to the census being issued. The census data tables sent through by FIG prior to the census being published noted 1,523 resident households (1,147 in Stanley). This will be updated to reflect the final census report numbers.	Section 11.4.4.1
DMR 261	Page 989: Why is the estimated water use for MODU drilling and vessel requirements so much lower for the project than the 2015 exploration?	This difference arises because the 2015 exploration wells were drilled with WBM and the development wells are to be drilled with NADF. This is noted in Table 11.22, Navitas will add a reference so this is clearer.	Table 11.23
DMR 262	Page 1002: Is the heliops hangar for Sea Lion expected to be the same size as the one used for the exploration campaign? What if SAR operations also have to be provided from Stanley Airport (if MOD will not agree to Navitas using theirs)	Full specification/design of the helicopter hangar to be determined, but it will be designed with sufficient capacity to store and maintain the airframes anticipated. The hangar is expected to be of a similar size to the RUBB hangar that serviced the 2015-16 exploration campaign at Stanley Airport. That hangar housed 2 crew change helicopters and a dedicated SAR airframe (SAR was not provided by the MoD in the 2015-16 exploration campaign). As such a hangar of this size would be capable of meeting maximum anticipated airframe storage requirements.	N/A
DMR 263	Page 1005: Why have roof-mounted solar PV panels not been considered as a way of reducing demand on grid power, especially given the highest power demand (midday) correlates with peak solar radiation?	PWD Power Station indicated to Navitas their view that individual roof mounted solar panels are not optimally compatible with Stanley's existing power generation and distribution infrastructure. This is because any excess energy generated by these cannot be easily absorbed/disposed of, nor can the spikes in demand created on dull days in which the panels are	N/A

Reference	Request for information	Navitas response	Addressed
		less efficient be accommodated by grid power generation. This situation will be monitored in close consultation with FIG as the project progresses and as power generation and distribution infrastructure and technologies advance.	
DMR 264	Page 1010: Presumably personnel will also need air transportation mid-contract for holidays etc, rather than just at the start and end of contracts?	To present the worst-case scenario that the EIS figures have been based on, all positions (other than the Country Manager role) have been made rotational (28 days on - 28 days off) therefore holidays are part of the 28 days off and no 'mid-contract' breaks are expected.	N/A
DMR 265	Page 1011: Presumably it should be “9 seats / week on the air-bridge”, as 9 seats / flight would mean the weekly unallocated capacity was 112 seats rather than 103.	Thank you for your comment. This is noted and will be amended.	Section 11.6.4.1
DMR 266	Page 1012: Do the figures in table 11.29 account for holiday/school trips by staff based permanently in the Falklands (and their family members)?	The figures account for holidays but not for extended family members' school trips as Navitas does not yet know the make up for the full team and so focused purely on the position and not their potential extended family. Direct Sea Lion staff will either be expats employed to work in the Falklands on a rotational, and unaccompanied, basis or they will be existing Falkland Islands residents who transfer employment to work in the Sea Lion project. It is most likely that existing Falkland Islands residents will be the only Sea Lion staff who have dependents within the Falkland Islands and as such their demand for flights will be unchanged. If rotational staff are permitted to utilise the charter flight for family members, this will only be prioritised in the event of spare capacity.	N/A

Reference	Request for information	Navitas response	Addressed
		It is anticipated that there will be spare capacity on charter flights which can be utilised by personnel engaged on the project and/or their dependents, or otherwise (with the agreement of FIG) on-sold to community members. Air passenger seat availability will also be covered in the Socio-Economic Impact Assessment.	
DMR 267	Page 1018: Would Navitas consider committing to covering the cost of fully sealing the Coastel Road as part of its project preparation?	Navitas was a signatory to a joint industry letter to FIG (led by FIFCA) requesting that Coastel Road be sealed (sent on 22/01/24 to the Director of PWD by James Bates). At this time Navitas would not consider to committing to covering the cost of fully sealing the Coastel Road.	N/A
DMR 268	Page 1024: Would a degradation in air quality from diesel particulates not be a potential impact to the human population?	Air quality is listed as a receptor in Section 11.7.3 and an impact assessment section will be added.	Section 11.7.3 Section 11.7.6.1
DMR 269	Page 1043: Why has turning off yard lights when not required not a mitigation measure?	This is a valid point. It was not specifically mentioned because it is simply expected that lights will be switched off when all yard activity has finished at night. This will be standard practice. To be clear there will be a number of security lights but yes, the operational lights and office lights will all be switched off each evening once operations have ceased for the day. This is considered standard practice rather than a mitigation as such. However Navitas can add clarity to the post-consultation EIS text to explain that it will be normal practice to switch off any lighting that is not required operationally.	Section 11.8.7.1

Reference	Request for information	Navitas response	Addressed
DMR 270	Page 1057: There is not currently a heliport in or close to Stanley.	Navitas intends to develop a heliport at Stanley airport in conjunction with FIG and that this will be constructed in time to support Sea Lion Phase 1 and 2 operations. Stanley Airport has previously supported helicopter operations for the various exploration drilling campaigns. The text will be amended for clarity.	Section 11.9.4.3.3
DMR 271	Page 1059: Was noise from lifting and loading on the TDF or in the yard considered for table 11.48? What would these noise levels be?	Lifting and loading noises were not specifically included but reversing alarms were as well as the noise of vessels, see Table 11.48. It is anticipated the lifting and loading at the base will be less than that experienced during an offload of the Unispirit as the vessels and cranes will be smaller. Navitas will add a note to the post-consultation EIS explaining that noise sources are a selection of the significant noise sources of different levels and characters to judge the likelihood of nuisance.	Section 11.9.4.3.3
DMR 272	Page 1061: Was lifting and loading noise modelled? Only engine noise appears to have been considered despite lifting/loading noise being identified as an issue in table 11.49. What noise levels would be expected from lifting and loading?	Engine noise makes up the vast amount of noise generated during lifting and loading operations as the vessel engines will be on to enable safe manoeuvres, and the cranes will be operating using generators on the vessels. Navitas will add a note to the post-consultation EIS to clarify that lifting and loading noise is included in the vessel noise estimate.	Section 11.9.4.5.2 Section 11.9.4.4.1 Table 11.47
DMR 273	Page 1077: The Offshore Petroleum (Licensing) Regulations 2000 should also be listed.	Thank you for your comment. This is noted and the text will be amended.	Section 12.1.1.1
DMR 274	Page 1084: When are tests on pelts and fur adhesion likely to take place?	This will be conducted prior to drilling commencing and in sufficient time to inform key operational documents including ERPs and OPEPs, subject to	Section 1.7.1.1.2 Section 7.2.4.1 Section 15.7.6

Reference	Request for information	Navitas response	Addressed
		import permits (for France). Navitas will include indicative timing in EMMP Chapter 15.	
DMR 275	Page 1084: Is sheen formation expected to be higher or lower at lower sea temperatures?	Sea Lion crude does not produce a visible sheen at 18 degrees. It will is therefore not expected to produce a sheen a lower water temperatures, please refer to Table 12.1 on sheen formation.	N/A
DMR 276	Page 1103: Is 21 days a worst-case scenario for stopping a well blow-out? Macondo took 86 days to stop the flow of oil and was located in an area that is not as hard to transport equipment to as the Falklands.	Navitas has assessed the availability of capping stack devices and the timing for their deployment to the Falkland Islands. 21 days is considered a credible worst-case timeline for deployment. Capping stack availability has advanced since the Macondo spill in 2010 and capping stacks that can be transported by air have been developed.	N/A
DMR 277	Page 1137: Due to the low quality of the images, the legend of the scale bar is illegible in figures 12-33 and 12-34.	Navitas notes DMR's comments in relation to Figures and suggest this may be a compression issue. The original figures are all high resolution and will be checked throughout for this issue. Please note a hi-resolution copy of the EIS may be requested if required.	All Figures checked for resolution and improved where possible
DMR 278	Page 1138: The 180 cubic metres being recovered seems unlikely to equate to up to 60% of the post-evaporation spillage given previously it is suggested (page 1,121) that only around 7% of Sea Lion crude would evaporate at the surface.	This represents two very different scenarios and time lines. The transfer spill can be contained more rapidly. The 7 % relates to the quantity modelled for an FPSO release.	N/A
DMR 279	Page 1148: Rather than rely on bringing in a well capping device if there is a blow-out, can Navitas not keep one in the Falklands for the duration of the project in case one is required?	There are a limited number of specialised well-capping devices and supporting equipment and resources available globally. They form part of a shared contingency plan across the wider Oil and Gas Industry. To locate one in the Falkland Islands long term would be difficult logistically and would hinder contingency plans for other operators.	N/A

Reference	Request for information	Navitas response	Addressed
DMR 280	Page 1157: In the first paragraph, the % of oil reaching the shoreline and mass of beached oil is stated to higher in the loss of FPSO crude inventory scenario compared to the well blowout scenario, but the text goes on to state “The potential deposition in sediments is also much smaller”. This is confusing.	This will be clarified in the text.	Section 12.1.6.2.1
DMR 281	Page 1178: The FPSO exclusion zone is 1250m not 500m.	Thank you for your comment. As described in Section 5.5.4 the FPSO will have an exclusion zone of 1,275m. This will be checked and updated throughout the document to check for typos.	Section 12.1.12
DMR 282	Page 1201: Re “a wide spectrum oil skimmers”, would there be one of these or several?	There will be several; 2 skimmers on each Offshore Support Vessel and 10 in the Stanley supply base. The typo will be addressed in the post-consultation EIS. See also DMR 55.	Section 5.11.1.2.3 Section 12.2.5.1
DMR 283	Pages 1207-1210, 1211: Given the large difference in spillage volumes between the two scenarios and the same level of likelihood (unlikely), it seems odd that the overall significance of the risk to various receptors is the same for both scenarios – one would expect that a spill 120 times larger (1,200 tonnes *vs.* 10 tonnes) would have a much higher overall risk significance, particularly on seabirds and marine mammals given large areas of the eastern end of Berkeley Sound that they are concentrated in would be covered by a sheen in the 1200 tonnes scenario.	This is due to the precautionary approach. It is expected that the likelihood of a vessel collision resulting in a release of 1,200 tonnes of MGO would be 'Very Unlikely' ('Impact almost never observed, few if any events in the industry, failure of nearly all operational controls would be required'). However, as there will be vessels in Berkeley Sound which are operated by third parties e.g., fishing vessels etc, adherence to operational control will be outwith Navitas sphere of influence. Therefore, the likelihood of occurrence was elevated to 'Likely' to take a precautionary approach.	N/A
DMR 284	Page 1211: How would “Enhanced crew bunkering competency” be attained?	This will be attained as follows: 1. Identified by Navitas' Offshore Bunkering Procedure and the Area Specific Operational Guidelines (ASOGs),	Section 12.2.7

Reference	Request for information	Navitas response	Addressed
		2. Achieved by a Hazard Identification and Risk Assessment (HIRA) once the marine contractor for the OSVs has been selected, and 3. Verified by Job Safety Assessments and Tool Box Talks prior to each operation. In addition, regular drills and Navitas' Audit and Assurance Procedure will assure crews achieve and retain the required level of competency. Please note that Section 5.10 and Table 4.4 both refer to the use of dedicated tanker berthing crews to supplement the CTT crew thus ensuring the required standard of competency is met for every offtake operation. Explanation of measures to ensure bunkering crew competency will be added to the post-consultation EIS.	
DMR 285	Page 1214: The HMP is listed as a project-specific mitigation for the risk to Berkeley Sound, but wording elsewhere (page 108) suggest the HMP will only cover Stanley Harbour.	Text will be clarified in section 12.2.12 to indicate only Stanley Harbour is included in the HMP.	Section 12.2.12
DMR 286	Page 1219: Would tourism not be a potential receptor given Stanley Harbour is one of the most visited locations in the Falklands?	Thank you for your comment. This is noted and will be added.	Section 12.3.3
DMR 287	Page 1236: Table 13.1 does not seem to be consistent with the contents of table 9.1. For example, table 9.1 identifies Placement and presence of objects on the seabed as affecting benthos, the seabed/soil and human population. Table 13.1 identifies disturbance to seabed/placement of objects as affecting plankton, benthos, fish, seabed and water quality, but not humans. Several of the same queries raised above re table 9.1 apply here (e.g., why are benthos not deemed to be impacted by underwater	These will be checked and cross-referenced and updated where necessary. Footnotes have been added where necessary for clarity.	Chapter 9 Section 13.2

Reference	Request for information	Navitas response	Addressed
	noise). Other queries include: • Are humans not impacted by artificial light and onshore disturbance from helicopters? • Are other users of the sea not potentially impacted by the placement of objects on the sea bed due to the potential for trawling nets to be caught? • How does unplanned venting of gas affect commercial fisheries?		
DMR 288	Page 1263: Combustion of sold product fits the requirements for needing an EMMP action (risk being upper moderate and confidence being uncertain) but is not included.	While the impact assessment rating for emissions from sold product theoretically meets the criteria for inclusion in the EMMP, there is no policy guidance for this at this juncture, and it is difficult to conceive of a Monitoring and Management Action that would provide a consistent and auditable end use. All quantities of export volumes will be recorded. It is beyond the seller's ability to influence the use of the product once it has been sold or monitor and manage emissions arising, thus the end user's emissions will be their responsibility to monitor, manage and report; their scope 1 & 2 and will be considered Navitas' scope 3. A conservative assumption of Navitas' Scope 3 sold product emissions (all being combusted) were included in the EIS. The confidence rating is uncertain as it is not possible to determine what the end uses of the product will be, and consequently a worst-case has been applied to the assessment.	Section 10.9.10
DMR 289	Page 1288: Combustion of sold product is missing from the list of significant residual impacts.	Thank you for your comment. This is noted and the text will be amended.	Section 16.2
DMR 290	Page 1300: Should the definition of Endemic be “Native to or confined to a particular region”?	Typo, this will be corrected.	Chapter 18

Reference	Request for information	Navitas response	Addressed
DMR 291	Page 1365: The IUCN statuses should be updated to 2024.	Will check and amend where necessary to 2024 listing.	Appendix 1
Offshore Petroleum Regulator for Environment and Decommissioning			
OPRED 1	For the UKCS we would anticipate a commitment to using chemicals in line with the Offshore Chemical Notification Scheme (OCNS) but it is understood that the chemical requirements for FIG may differ. The section states chemicals will be chosen to minimise environmental impact however there is no committal within section 5.9.1 of these being OCNS ranked products. Although this is stated in section 10.6.1.1.2 it would be beneficial to be clear at the front end of the documentation for all chemical usage.	Thank you for your comment. This is noted and will be amended.	Section 5.9.1
OPRED 2	The onshore construction is stated within the EIS to have an anticipated start date of Q3 2024. To note, this is likely out of date due to being in Q3 and the project being examined at this point	At the time of writing the EIS it was anticipated that replacement of the TDF causeway would commence in Q4 2024. The regulatory approval timeframe has extended so that such onshore construction works are not anticipated to commence until 2025. Navitas will update the target date for commencement of the TDF causeway replacement in the post-consultation EIS.	Section 5.11.4.2.4
OPRED 3	The UKCS has a clear seabed principle with respect to end of field life. The aim should be not to leave subsea equipment in situ. . Decommissioning in design is also a requirement of International Maritime Organisation (IMO) regulations. Whilst the decommissioning aspect of the field will be subject to a further impact assessment at the time it should be clear that the field development meets the criteria of decommissioning in design and clear seabed principles.	As stated in the EIS, 'Decommissioning will be carried out in accordance with the legislation in place at the time'. At the time of writing, the project defers to the current UK legislation and its sources. OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations prohibits dumping, and leaving wholly or partly in place, of disused offshore installations within the OSPAR maritime area. While derogation from this prohibition may be sought for qualifying installations, e.g., large steel or concrete footings of fixed platforms, this will not apply to the proposed project which will utilise an FPSO with	Section 5.12

Reference	Request for information	Navitas response	Addressed
		subsea wellheads and infrastructure. Under OSPAR, all subsea structures must be removed with any associated piles, well conductors etc. cut to a level below the natural seabed which ensures they remain below the seabed in the face of prevailing conditions. Of importance, pipelines and other structures which are listed in a UK Pipeline Works Authorisation are excluded from OSPAR Decision 98/3 and in the UK, decommissioning of these is managed in line with the Petroleum Act 1998 (Part IV) and the Pipeline Safety Regulations 1996. These require a similar assumption of complete removal where reuse of the pipeline and associated structures for further hydrocarbon development is not possible. However, under the UK regulations, there are certain pipelines and/or circumstances in which a pipeline may be wholly or partially left in situ e.g., pipelines that are adequately buried or trenched and are not subject to development of spans, and are expected to remain so. However, the decision to do so would need to be informed by an EIS which is supported by a formal Comparative Assessment of the options which must include a robust assessment of the environmental impact of removal *vs.* that of leaving wholly or partially in situ. Part V of the Offshore Minerals Ordinance 1994 confers obligations for decommissioning. A decommissioning programme has to be approved by FIG in advance. FIG has powers under the Ordinance to develop additional regulations in relation to field	

Reference	Request for information	Navitas response	Addressed
		decommissioning. As stated in Section 5.12 of the EIS: '…in line with the current legislation, the Phase 1 & 2 Development infrastructure has been designed to enable complete removal of all structures. Equally, the flowlines will be surface laid and will not be trenched or buried thus facilitating complete removal (noting that the seabed is very soft, so flowlines may self-bury which could change the methods required for complete removal).' Also in line with legislation, all relevant 'As Left' surveys will be carried out to ensure that the seabed is left clear. The Sea Lion Phase 1 and 2 offshore installation and subsea infrastructure has been designed so that it can be removed completely and the seabed left clear. Therefore the project has been designed with compliance to current regulation in mind and Navitas will comply with the prevailing legislation at the time of decommissioning.	
OPRED 4	The production profile of the P50 case in the EIS does not appear to align with the production profile in the field development plan (FDP) with differing P50's provided with the exception of table 14 within the FDP. This makes it difficult to read across from the FDP to the EIS to be able to confirm/interpret (Section 4.2.2 of FDP). In addition, this section fails to demonstrate the profile over the field life e.g., OPRED would expect tables to describe expected production for that year in both the FDP and the EIS in the same units to fully confirm that this aligns and has been assessed properly. Table 10.63 also appears to have a typographical error as power generation	Both P50 production profiles within the EIS and FDP deliver 306.9 MMBO over a 30 year production life. All volumetric references in the EIS are rounded to 1 decimal place (306.9 MMBO), whilst the FDP doesn't round to decimal places (307 MMBO). Production tables were provided to FIG using the Standard Economic Template (SET). Section 5.8.2.1.1 and Table 10.63 will be checked to ensure consistency in metrics used. Figure 5-8 will be updated to include the production profiles of P10, P50 and P90.	Section 5.8.2.2.1 Figure 5-8 Table 10.69

Reference	Request for information	Navitas response	Addressed
	is presented as P50 306.9 Mstb whilst combustion of sold product contained within the same table is presented as 306.9 MMstb. There is also an error in the text which states “Table x presents the production profile of oil”.		
OPRED 5	There is a typographical error - “medium sized” - should this be “medium sized”?	Thank you for your comment. This is noted and will be amended.	Section 7.4.4.2.3.2
OPRED 6	A date has been stated for construction which is in the past. However, the current schedule expects that, during Stage 1, a maximum of two LTVs will be present in Berkeley Sound for only eight months (c. August-2022 to end March-2023). The EIS should be based on future works and as stage 1 construction has not yet started this date is incorrect.	Thank you for your comment. This is noted and will be amended.	Section 10.1.2
OPRED 7	The section states “Monitoring of light-related impacts forms part of the EMMP (Chapter X) and further mitigation will be discussed should adverse impacts be identified.” However, the section is project specific mitigations, and the subsequent table of impacts (Table 10.8) shows the impact of bird strike for offshore and inshore lighting to be moderate. The statement within the EIS and conclusions drawn in the table are contradictory.	Navitas does not consider monitoring to be synonymous with mitigation. The initial impact assessment re bird-strikes is listed as Moderate. Because this is significant, project-specific mitigations are then considered. While numerous mitigation measures exist, at this time and stage in the project Navitas identify only two measures ('Reduce light pollution by auditing and, dousing of unrequired lights') as reasonable. While these will be deployed, they are not considered to be sufficient to reduce the impact in the residual assessment and it is recognised that further mitigation will be required. The main mitigation measure is to follow the guidelines of the OSPAR Agreement 2015-08, the purpose of which is to minimise pollution of the northeast Atlantic and North Sea including light pollution. However, this in turn requires a series of options to be investigated and balanced with safety	Section 10.1.8 Section 15.6.2.1.2 Section 15.7.1

Reference	Request for information	Navitas response	Addressed
		and operational imperatives. The practicalities of adopting the OSPAR green lighting strategy will be investigated during the project engineering phases as a potential further mitigation against bird-strikes but, until this is done, green lighting is not included as a means to reduce the residual impact/risk and is not factored into the assessment. In short, until the feasibility of further options has been explored in FEED, the residual impacts remains Moderate. Navitas will review the narrative in the post-consultation EIS to clarify that further mitigation measures will be explored in the FEED process and that the monitoring will serve to ground-truth the impact assessment and adjust the use of mitigation measures as necessary.	
OPRED 8	It is unclear why it is only wellbore clean-up and completion fluids which are planned to be selected in line with OCNS. It would be expected that all the chemicals in the table should be. Please confirm - described later in section however should be clear throughout.	Thank you for your comment. This is noted and will be amended.	Section 10.7.4.1.1 Table 10.45
OPRED 9	The use of Risk Based Approach (RBA) for Produced water (PW) is stated as a mitigation/control measure. OPRED question if this is feasible given the distance away from laboratory facilities capable of undertaking this and the degradation time of the sample.	There will be a de-gasser and OiW monitor automatic instrumentation and ongoing laboratory analysis twice a shift by a lab tech on board the FPSO, with appropriate laboratory analysis equipment. Navitas is committed to having appropriate laboratory facilities and equipment available, and to independent verification. Laboratory facilities will be developed onshore as necessary.	Section 10.7.5

Reference	Request for information	Navitas response	Addressed
OPRED 10	There is insufficient detail provided within this section. The single statement does not include any trends. OPRED would consider that figures are not stable and would incur fluctuations. For example, it is unlikely to remain stable over the field life. A graph reflecting the trends over time would be much more meaningful as a baseline.	Navitas recognise that the use of a single number to indicate global energy demand is less than ideal. However reliable data on trends in global demand/supply are difficult to establish as most information has a bias toward the continued sanction of O&G projects, or the cessation of all development. Therefore it was difficult to identify a measured and unbiased baseline trend. In the absence of trustworthy, unbiased and respectable sources for such a data set, Navitas opted to use the data provided by the IEA (2023). While a forecast is provided in this report, it extends only from 2017 to 2030 and therefore didn't seem fit for purpose. While a range from various sources could be added to provide a context, the chapter is already a complicated one and Navitas opted to avoid adding numerous extra figures. To overcome this concern re bias, in the post-consultation EIS Navitas will reference the 'Resources for the Future' which synthesises 15 different projections of oil demand including the BP Energy Outlook; https://media.rff.org/documents/Report_23-02_NPKKYws.pdf	Section 10.9.4.3.4 **Error! Reference source not found.** Section 10.9.4.5.7 Table 10.80 Section 10.9.6.1.3
OPRED 11	Inclusion over how long phase 1 and phase 2 will be in comparison to the field life duration would provide context to the figures presented. An assessment of trends cannot be made with the information presented.	**Initial consultation response:** Total project time = 32.6 years Stage 1- 2.6 years = 8% of total project time Stage 2 - 2.9 years =9% of total project time Stage 3 - 27.1 years = 83% of total project time	N/A

Reference	Request for information	Navitas response	Addressed
		These figures will be added to the relevant table headers throughout the chapter. **Post-consultation comment:** Efforts were made to include these extra indicators of stage durations but the tables became excessively cluttered and the decision was made that the cost to clarity in an already 'busy' table outweighed the benefit.	
OPRED 12	Within the base case the flare pilot light assumes 0.5mmscfd. The worst-case is 0.7mmscfd. A justification as to why this has increased would be beneficial It is usual that the worst-case operations in terms of impacts would be those experienced within P10 operations as with increased production.	The fuel gas used for the pilot light is realistically expected to be 0.5mmscfd but for the worst-case assessment was elevated to 0.7 mmscfd. Consideration of the P10 - P90 cases was not a part of this decision as the pilot light fuel usage will remain consistent regardless of production rates. Navitas notes the comments and will reduce this to 0.5mmscfd in the worst-case assumptions in the post-consultation EIS and reference the guidance which states that uncertainty is accommodated in this figure.	Section 10.9.4.4.1 Table 10.69
OPRED 13	Sections 10.9.4.4.5.1 and 10.9.4.4.5.2 discusses the emergency/unplanned events, and the a VRP malfunction. The associated figures in Table 10.69 should be included in the worst-case figure. These two scenarios include elevated emissions but have not been included in either the baseline or worst-case scenarios. Table 10.63 - It is unclear why the P50 has been used for the emissions profile. In addition, the average over the field life produces a flat emissions level however this is not the case for operations. Assessing this way reduces	Emissions from process shutdowns and emergency blowdowns are already factored into the emissions estimate. The narrative on flaring provided in Table 10.63 will be updated to state 'process upsets and emergency blowdowns'. Further, for Table 10.66, footnote 4, will be updated to ensure transparency. Therefore the estimates in Table 10.66 do indicate the worst-case emissions of all activities. However it is recognised that this is not reflected in the section	Section 10.9.4.4.1 Table 10.69 Figure 10-40 Section 10.9.4.4.4 Table 10.72 Section 10.9.4.4.5 Table 10.75

Reference	Request for information	Navitas response	Addressed
	the emissions profile over the field life. It also presumes a constant rate of emissions for the life of the field and therefore in early years/higher production years the emissions will exceed what has been assessed in the EIS. This needs re-examining with the inclusion of the production profile anticipated per year and emissions per year of the project presented. Furthermore, it is unclear if the offload vessels energy requirements/heated tanker aspect has been factored in as part of the emissions profile. It is therefore difficult to ascertain if this is correct or not as the information has not been presented.	heading or narrative which indicates 'planned' activities, which will be updated. Of note: - The background calculations were shown and explained to FIG on the 19th August 2024. - Section 10.9.4.4.5 itemises the potential for unplanned emissions that would result from an emergency blowdown / VRP failure. They are unlikely to happen but as stated above, these are captured in the production emissions of Table 10.66. This will be made clearer in the text. - The CO_2e number and totals in Table 10.69 (now Table 10.75) have errors resulting from a copy and paste of tracked changes. These will be corrected and the emissions resulting from a single blowdown are 612 tonnes CO_2e. - The cargo tank sizes on the likely FPSO have now been confirmed and the tonnage of HC gas that would be vented in the worst-case event of VRP failure is now 38.84. - Table 10.69 69 (now Table 10.75) will be updated to reflect this. - The cold gas venting EF will be checked in Table 10.65 (now Table 10.71) Table 10.63 (now Table 10.69). The worst-case production rate commensurate with P10 will be listed in the worst-case column in the table. However, as the emissions estimated are not based on the production rate, this will not effect the actual	

Reference	Request for information	Navitas response	Addressed
		emissions which already encompass the potential for the higher production rate. The P50 production profile, showing the decline in production over time is already presented in Section 5.8.2.2.1 (Development Description) and the P10 - P90 profiles are shown in Section 10.9.4.5.4 on carbon intensity. However, for the sake of context, a figure showing the three production profiles will be added to Section 10.9.4.4.1 and referenced to in Table 10.63 (now Table 10.69 to show the context. Further, the emissions as they occur over the project-lifespan will be presented in Section 10.9.4.4.4 alongside the tabulated estimation figures. Emissions associated with the offload vessels were confirmed by FIG as being outside the boundary of the EIS scope (ref email from DNR 17/05/24).	
OPRED 14	The unit $MtCO_2e$ is used until this is converted to intensity $kgCO_2e/boe$. The text then uses $MtCO_2e$ to include the four well flow back contingency upping the worst-case baseline to 8.99 $MtCO_2e$. This appears to be out of order. Why is this not included in the worst-case prior to converting to intensity? This would allow for a complete comparison with the base case intensity. For transparency, a reference to the conversion methodology to generate the intensity should be included.	The sentence order will be changed to indicate that the carbon intensity data include the four well tests and the wording will be changed in Section 10.9.4.5.4 to indicate that this is not the worst-case baseline intensity but is in fact the worst-case baseline plus contingency intensity.	Section 10.9.4.4.4
OPRED 15	References numbered 5, 6 and 7 are within the body of the text in sections 10.9.4.4.7 and 10.9.4.4.8 but no full references are included in footnotes as per the rest of the document.	These will be included, also note that the background calculations were shown and explained to FIG on the 19th August 2024.	Sections 10.9.4.4.7 Sections 10.9.4.4.8
OPRED 16	It is unclear why the P50 carbon intensity is discussed in this section. The section needs to be expanded to be transparent. The section states that the P90 case is the worst for carbon intensity, and this is presented in figure	The range of carbon intensity is provided in the section already. Therefore, Navitas understand this comment is in relation to the last paragraph in the	Section 10.9.4.5.4

Reference	Request for information	Navitas response	Addressed
	10.39. This is greater than the carbon intensity for the P50 case as shown in figure 10.40. However, the section assesses the P50 and not the P90 case making it unclear.	section which refers to P50 only. The paragraph will be updated to include the range of intensities and to indicate that even the lower production case (P90) carbon intensity, including all vessel and drilling emissions etc, is lower than the NSTA benchmark of 36 kgCO_2/boe.	
OPRED 17	There is insufficient information on the calculation method included. The units should be comparable to ensure that the calculation as well as the assessment is transparent. It is not currently possible to easily emulate your conclusions given that the sold product emissions is given for all products over the entire field life of 30 years compared to a daily global figure. The assessment does not include a realistic like-for-like comparison which can be assessed for the significance impact.	Thank you for the comment. The text is comparing tCO_2e from Sea Lion to total global production in barrels. Navitas will expand on the calculation method and do a similar calculation based on the global production figure using the same emissions factor so the units match. A table will be added to fully show all the emissions cases.	Section 10.9.4.5.7 Table 10.80
OPRED 18	The text states that the average production per year would be 27,800bopd. Does this mean that there will be 27,800 barrels of oil produced every day of that year given bopd means barrels of oil per day? In addition, the jumping between the units MMstb to bopd makes it difficult to follow the trends and is not very transparent when trying to demonstrate the base case for comparison and therefore assessment of this aspect	Yes. The P50 case averaged over the field life is 28,356 bopd. A figure showing the production profile over the field life will be added to Section 10.9.4.4.1 and the conversion of boe to MMstb will be added in brackets alongside the bopd figure. See also response to OPRED 13.	Section 10.9.4.4.1 Table 10.69 Figure 10-40
OPRED 19	It is stated that Sea Lion will not be able to facilitate a zero-flaring approach. Therefore the associated GHG intensity of emissions from operational flaring should be included. There is an inability to meet BAT in line with projected future UK emissions. All routine operational flaring is prohibited for new developments in the UKCS.	Navitas are committed to a zero routine flaring approach and the narrative will be re-worded accordingly. The only baseline flaring that will occur is that associated with commissioning of the GI system and that occurring for safety reasons during unplanned process upsets/emergency blowdowns. The contingency is retained for four well tests should they be deemed necessary. All of the above have been accounted for in the emissions estimate. Zero flaring will occur during routine operations.	Zero routine flaring is already referenced throughout the document. Table 10.74 has been updated.

Reference	Request for information	Navitas response	Addressed
OPRED 20	The section states that in "absolute terms the maximum (P10) estimate of emissions from combusted product is a significant contribution." However, this is not what has been assessed or presented so it is unclear given the P50 case has been used.	The P10 case is assumed to ensure a worst-case estimate for assessing the impact of sold product, as is indicated in Section 10.9.6.1.3. The worst-case assumptions listed in Table 10.63 for the production level will be changed to reflect the P10 case. However, the production level is not indicated in the climate change assessment (Section 10.9.6.6.1) so it is not clear what exactly the comment is referring to. Of note the assumptions listed in Table 10.63 are considered sufficient to encompass emissions associated with the P10 case so changing the production level does not directly affect the emissions estimate. Navitas will update this EIS section to ensure language is clear.	Section 10.9.6.1.3
OPRED 21	It is stated that the worst-case assumption of 100% combustion has been presumed. However, this uses the P50 and the P10 case, which is not what is presented and does not align with the statement made in Section 10.9.6.1.3. Please clarify	Navitas is a little confused by the comment as this section does not specify P50 or P10 and just makes reference to Section 10.9.4.4.8 which provides the full range from P10 - P90. Table 10.72 shows the estimated total atmospheric emissions resulting from O&G operations in the NFB during Field Life and intentionally does not include the emissions that will results from the product once sold. Relevant sections of the post-consultation EIS will be reviewed to ensure that the language is clear.	Section 10.9.6.1.3

Reference	Request for information	Navitas response	Addressed
OPRED 22	The paragraph states that all monitoring requirements will be managed *via* the EMMP. However, table 15.2 does not include emissions (and therefore presumably the EMMP plan) and thus is in contradiction to the statement within the paragraph.	Thank you for your comment. This is noted and the text will be amended accordingly.	Table 15.2
OPRED 23	Section 10.9 (emissions) concludes that impacts remain as moderate and upper moderate for the sold product. However, emissions are not included in the EMMP. Using the criteria (table 15.1) it is not clear why emissions have not been screened in given the impact is certain for project emissions and uncertain for global sold product	See response to DMR 288.	Section 10.9.10.1 Section 15.2
OPRED 24	This does not include an end product emissions rating which was upper moderate - this seems to be an omission in this section.	Thank you for your comment. This is noted and will be included.	Section **Error! Reference source not found.**
OPRED 25	There are multiple responses where the chapter/section has not been cross referenced and XX stated.	This is done to show that the requirement is addressed in multiple chapters, and in the same section within each chapter. For example, acknowledged uncertainties and data gaps are noted in section 10 of each assessment chapter, which is expressed as X.X.10. In chapter 10.1 (artificial light), the uncertainties are noted in section 10.1.10 and so on.	Appendix 2
Scottish Association for Marine Science			
SAMS 1	In the case of Designated Sites, the linkage between Designated Site status and the health of qualifying constituent features has been overlooked (i.e., the reasons as to why sites have received Designated status). Whilst impacts on qualifying features such as birds are relatively robust, there has been a failure to carry through the consequences and relate potential decline in species populations to associated Designated Site status.	Thank you for the comment. Navitas will review and update.	Section 7.5.2
SAMS 2	Regional Air Quality is clearly indicated as a receptor during the ENVironmental Impact IDentification (ENVIID) workshops, with Table 9.1 in Chapter 9 clearly stating that Regional Air Quality had been scoped in, with	The previous EIS submitted by POEPL had a full chapter discussing the potential for impacts from inshore and onshore emissions to air quality, the	Chapter 9 Section 10.9

Reference	Request for information	Navitas response	Addressed
	'further assessment required 'in Chapter 10.9. The subsequent assessments make no recognition of potential impacts at a regional level, with page 795 stating that… "As described in Chapter 9, impacts to air quality have been screened out owing to distance of the offshore location from environmental and social receptors." There is a clear disparity here between what has been highlighted as a result of the ENVIID workshops for consideration within the EIS, and what has received attention. Whilst some of the emissions data presented do have relevance at a regional scale, they are only assessed on a global level. It is likely that an explicit definition of what is regarded as a 'regional' versus 'global' level is required, and data re-examined under this consideration	primary source of which was incineration of waste at the supply base. In the absence of AQO's for the Falkland Islands, those from rural Britain were used as a conservative proxy. Even with a precautionary approach, all the impacts to the receptors (namely the human population and vegetation) were identified as Very Low. In the proposed Navitas Phase 1 & 2 development, an incinerator at the supply base is no longer a base case requirement, in discussion with FIG, it is considered that the municipal incinerator will have capacity to a accommodate the project incinerable wastes. Therefore, when reviewing the potential impacts and risks during the Navitas ENVIID, emissions from a standalone incinerator were scoped out to prevent double counting with FIG emission impacts. Even should a temporary incinerator be required at the supply base in the event that the FIG facility is not yet available, this would be very short-term. Therefore the only source of emissions that could impact regional air quality are those that result from two LTV vessels at anchor in Berkeley Sound for a cumulative duration of 13 month with periodic visits to these LTVs from installation vessels. The impact of emissions from these are considered to be negligible and so following the ENVIID process described in Chapter 9, further assessment of these was scoped out. This is indicated in Tables 9.2 and 9.3. However, it is noted that all the line entries in Tables 9.1 to 9.3 that refer to combustion activities include an 'F'	

Reference	Request for information	Navitas response	Addressed
		under regional air quality indicating that the impact to air quality from offshore activities would be impact assessed. However, in the absence of any key receptors to changes in air quality offshore, this impact is scoped out and the ENVIID tables should state 'S' indicating that this has been scoped out. This change has been made within the post-consultation EIS and Chapter 10.9 continues to consider the global impacts of project associated emissions. Navitas has considered reinstating the inshore/onshore air quality chapter, however with minimal and very short-term sources of impact, the impacts are considered to be so low as to warrant remaining scoped out. The relevant tables have been updated in the post-consultation EIS. A definition of 'regional' will also be included.	
SAMS 3	Within Chapter 9 describing the ENVironmental Impact IDentification (ENVIID) workshops and identification of areas to be covered within the EIS, the terminology 'Screened out' is used when referring to whether impacts and risks should be excluded from the EIS. It is recommended that it may be better to adopt the terminology 'scoped out' instead	Thank you for your comment. This is noted and will be amended.	Chapter 9 and throughout whole document as necessary
SAMS 4	Whilst it is acknowledged that meaningful assessment of cumulative impacts is very hard to make, it is felt that more could have been done with this chapter considering the work undertaken in the EIS chapters. For example, colour coding the assessed residual risk for each receptor under each activity would give the reader an idea of cumulative risk.	Thank you for your comment. This is noted and a colour-coded assessment of cumulative impacts will be added to provide a better picture of cumulative impacts, although it is acknowledged this will be qualitative and likely very precautionary.	Chapter 13 Section 13.2
SAMS 5	Regional air quality: The assessment of impacts on 'regional air quality' from development activities are not fully explored in the EIS. More clarity is needed on what is considered to be 'regional', and a re-focus on how to assess activities and any associated impacts that may arise at that scale.	See comment SAMS 2 above.	Table 9.1 Table 9.2 Table 9.3

Reference	Request for information	Navitas response	Addressed
	Section 10.9 Atmospheric Emissions fails to explicitly mention regional impacts, despite being highlighted in Table 9.1 as the section in which impacts on this receptor will be assessed.		
SAMS 6	Seabirds: However, the overall synthesis of seabird distribution information needs improving as it is difficult to relate the levels of risk that are assigned throughout the assessment tables with the information presented in the descriptive ecology chapters given the data gaps that are present, and the different methodologies involved in the studies that are described.	Thank you for the comments - Navitas will review and improve. **Post-consultation response:** As per the note in Section 7.4.5.1, this was not considered to be feasible following review	Section 7.4.5
SAMS 7	Social: However, the depth of understanding of the data in relation to social impacts of the environmental effects is not equal to that of environmental impacts and the opportunity for significant analysis of data emerging from stakeholder consultations may have been overlooked.	A separate Socio-economic Impact Assessment is underway which will detail these more thoroughly.	N/A
SAMS 8	The major point of concern is the assumptions of offshore habitat conformity, and appropriately evidencing this assumption within the EIS itself. The reviewer feels that there could be more detail within the EIS on offshore benthic communities from different sampling stations, considering the repeated assumption of offshore habitat homogeneity. Whilst this maybe a fair conclusion from associated reports, this evidence is not clearly displayed within the EIS.	Navitas will add more detail here. Thank you for the comment.	References to survey report throughout the EIS and in Appendix 4
SAMS 9	However, the EMMP outlines the use of Remotely Operated Vehicle (ROV) surveys to visually identify habitats of conversation importance at the well locations (Section 15.6.2.1.5). Whilst this a standard method for marine surveys, it should be noted that this is limited to the observation of epifaunal taxa/communities and will not provide any data on the infaunal community of the benthic sediments.	Ninety stations were sampled using grabs, with drop-down cameras, in a previous survey (2012) carried out in the Sea Lion field. Analysis of these indicated a relatively homogenous infaunal environment such that visual ROV surveys of the well locations are considered sufficient to identify and habitats of conversation importance. Seabed grabs for sediment characterisation, benthos, chemistry and heavy metal analysis will take place post first drilling. Navitas will update the EMMP chapter in the post-consultation EIS in this regard.	Section 10.6.10.1 Section 15.6.2.1.1

Reference	Request for information	Navitas response	Addressed
SAMS 10	The calculation of the 'Permanent footprints' within Table 10.14 is not clear, although alteration of the figures is unlikely to change the resulting impact assessments.	The Table describes the impact of the moorings and anchors for the MODU and the FPSO. The MODU is temporary and so have no 'permanent' (until decommissioning) footprint. The FPSO temporary footprint includes a wider area of disturbance that will result from laying of the anchors initially (length 780 m on the seabed * 10 m disturbance corridor around the chain)*12). This is to account for physical impact of laying. The permanent footprint describes that resulting from the chain once settled on the seabed. Navitas will review the chapter and make changes to the text and tables where necessary in the post-consultation EIS.	Section 10.3.4.3
SAMS 11	No summaries are presented within the EIS to explicitly show that offshore environmental samples are indeed comparable (e.g., a table detailing univariate metrics such species numbers, total individuals, species diversity indices, dominant taxa identified etc.; alternatively figures showing similarity or cluster plots).	Thank you for this comment. Navitas has the supporting material and the documents can be supplied on request. Navitas made a conscious decision not to include this in the text as it would add to what is already considered a very large document.	N/A
SAMS 12	The offshore data is undoubtedly found within the supporting reports, but it feels like an omission not to include more evidence within the main body of this EIS, considering the assumptions made on habitat homogeneity.	Please see SAMS 11.	N/A
SAMS 13	There was little mention, however, of contingency planning for if a marine Non-Native Species was introduced by the operations detailed and a biosecurity management plan (BMP) for marine Non-Native Species should be developed. Whilst a BMP for marine species is indicated in the Non-Technical Summary on page 108, it is only mentioned in relation to terrestrial species in Table 1.9, and a marine BMP it is not mentioned	The Biosecurity Management Plan will cover both terrestrial and marine invasive species, this will be clarified in the relevant sections.	Section 10.12 Section 10.13

Reference	Request for information	Navitas response	Addressed
	explicitly within Chapter 10.12 as a tool to reduce impacts or mitigate risks in the body of the text.		
SAMS 14	The design of monitoring methods, however, should focus on increasing detection probability. Therefore, it is recommended that scrapes of biofouling present on artificial structures closely associated with the operations (e.g., Inshore Mooring Buoy) be included in the monitoring activities. Likewise, a combination of panels deployed for short periods (6-12 weeks) and longer periods (annual inspection) will ensure that late succession species are included in the overall species list whilst ensuring sufficient frequency of monitoring.	The proposed monitoring for marine invasives in described in Section 10.12.10.1 which includes: • The deployment of settlement plates in Stanley Harbour, Berkeley Sound and other appropriate locations, • The use of metagenomic technology to detect genetic material from non-native species in the environment (water samples), and • In the event that marine invasives are found, pathway analyses will be conducted to determine where / how invasives are being brought into the Islands. The EMMP Sections 15.6.2.1.4 and 15.7.2.2 describe the planned work. Of note, the proposed project does not require an inshore transfer mooring buoy and all reference to this has been removed from the EIS.	N/A
SAMS 15	Table 9.1 detailed that 'the introduction of marine invasive species to the offshore environment is not considered to be a concern over and above the introduction to inshore waters' and was thus screened out of the EIS. In the reviewer's opinion, this should have been screened in due to the potential transfer of marine invasive species between the FPSO and Berkeley Sound by vessels, particularly in the installation phase.	Thank you for the comment. The reason this was scoped out is that the environment around the Sea Lion field is highly dynamic and the likelihood of transfer/settlement is extremely low. The open ocean is not a suitable environment for the transfer and establishment of fouling species and the risk is further reduced by the duration the vessels are in proximity. The Conventional Trading Tankers will be at a distance of c200m on a hawser so transfer between these vessels and the FPSO is not possible.	Table 9.1

Reference	Request for information	Navitas response	Addressed
		Furthermore, all the vessels within Navitas' control will have clean hulls and anti-fouling paint. As a consequence of all these factors, the likelihood of transfer was considered low. The likelihood of establishment depends on suitable habitat and invasive species being in a reproductive state at the site.	
SAMS 16	The pathways for Marine Invasive Species introduction are under-represented in some of the summary tables examining pathways of impact from activities on the environment. For example, Figure 1-3 should include a tick under Marine Invasive Species Introduction next to (i) drilling operations and (ii) sub-sea works since specialised vessels required for this work could introduce marine invasive species to the area *via* hull fouling. In addition, add a tick for Marine Invasive Species under 'Human Population' since certain invasive species have been known to have an impact on human health and/or the economy where they have been introduced. Similarly, Table 2.2 should include a tick in the 'Drilling operations', 'Installation' and 'Offloading from FPSO to CTT' boxes for marine invasive species. In Table 1.7 the 'Risk of introducing marine invasive species' is only highlighted under the 'Biosecurity' label; however, there is also the possibility of a 'moderate' impact from introduced species on the 'benthos/habitats' category.	Navitas has committed to making sure all vessels undergo hull inspections and where necessary cleaning before they arrive. Navitas will amend the tables as appropriate. Thank you for the comment.	Chapter 1 Figure 1-3 Table 2.2
SAMS 17	Data predicting the probability of Non-Native Species introduction, establishment and spread is sparse, although a horizon scanning exercise was completed in 2019 and published in 2022 (Dawson *et al.,* 2022), which would be a good resource for this report. The data presented, however, was of good quality, although in certain sections the references were over a decade old and should be updated.	The references will be reviewed and Dawson 2022 will be included.	Section 10.12.4 Section 10.12.4.4
SAMS 18	There is a section on 'Coastal Sensitivity to Oil Spills' (Section 7.6, pg. 475), examining types of habitats and associated sensitivity to oil spills. A similar	Thank you for the comment Navitas will examine this to see whether it is appropriate.	Section 10.12 Section 10.12.4.4

Reference	Request for information	Navitas response	Addressed
	exercise can be undertaken looking at the risk of introducing marine invasive Non-Native Species - see Dawson *et al.* (2022).	Reference to Dawson *et al.* included. However, on review, it is felt this is an enormous task and requires extremely refined baseline data for all of the coastal areas, which means understanding their ecology, community structure not just in spatial but in temporal scales, which is not available. It is important to note that the coastal sensitivity analysis refers to coastal type in broad categories and so this analyses is not appropriate.	
SAMS 19	Whilst a variety of survey methodologies have been employed in the shallow marine environment, there is no mention of any settlement panel work or ROV surveys of any artificial structures in and around Berkeley Sound (although it was noted though that settlement panel work has been done over three years in Stanley Harbour at the Temporary Docking Facility; pg. 325). 'Sheltered artificial structures' were named as a habitat type in Neeley *et al.* (2010), but very little information has been given in the EIS, especially considering their importance for initial colonisation by Non-Native Species. For marine invasive Non-Native Species, these structures be the first place to monitor within the Sound.	Monitoring is planned, see Section 10.12.10.1 but, of note, there will be no permanent structures in Berkeley Sound associated with the development.	N/A
SAMS 20	It was noted that plankton surveys have not carried out by Navitas for this report, and that the literature reviewed is mostly over a decade old.	Yes this is correct. There is some recent work that has just been published. Navitas will update the text with this. There is also some one going work by a PhD student but the work is not at a stage in which it can be cited.	Section 7.4.1.3.1
SAMS 21	Key assumptions made regarding the risk posed by different vessels are appropriate, although the origin of the vessels that will potentially be visiting the Sound was vague.	The origin of the vessels that will visit Berkeley Sound is still to be confirmed. These vessels are subject to a future competitive tender. Educated assumptions (based on where the majority of Owners and similar activity areas are) have been made as to their	N/A

Reference	Request for information	Navitas response	Addressed
		expected origin at this stage. All vessels will be subject to stringent vetting process.	
SAMS 22	It is stated in Section 3.2.18.1, pg. 108 that "Biosecurity Management Plan: Provides a framework for the processes intended to reduce the likelihood of introducing terrestrial or marine non-native species, which may then become invasive to the ecosystem of the Falkland Islands". This statement does include terrestrial and marine Non-Native Species in the BMP, but throughout the remainder of the EIS document the BMP is just related to terrestrial Non-Native Species (e.g., Section 1.7.4.2.8, pg. 55). Clarity is required whether the BMP relates to both terrestrial AND marine and if it is just for the former, then a marine BMP should also be included.	The Biosecurity Management Plan will cover both terrestrial and marine invasive species, this will be clarified in the relevant sections.	Sections 10.12.5, 10.12.5.3, 10.12.10, 10.13.5.1, 10.13.10.1, 15.3, 15.4, 15.7.2
SAMS 23	Furthermore, under 'Potential Management Options' from marine invasive species in Section 15.6.2.1.4 there are no mentions of any control/eradication measures, with text focusing on prevention of another introduction event. This weakness is also replicated in Section 15.7.2.2 Marine Invasives, with no mention of potential management options. Table 1.9, pg. 68 states that "Settlement plates and pathways analysis [will be conducted] in the event of any incursions" – Settlement plates and pathway analysis should be implemented as part of the routine marine Non-Native invasive species monitoring programme, not just in the event of any incursions/introductions.	Thank you for your comment. As part of the 'Proposed Survey Activities' listed in Section 15.6.2 in the summary EMMP chapter, Section 15.6.2.1.4 states the following Management Objective: 'Confirm that presence of non-native species is not increased beyond levels of background change.' The associated action is to place settlement plates in the vicinity of the LTVs in Berkeley Sound, and on the TDF, prior to activity commencing with a view to providing early detection of the settling of any non-native species that may result from ballast water exchange or bio-fouling. In the event that a new marine invasive species is discovered, a pathway analysis will be conducted to attempt to determine where / how the species had been brought into the Islands, at which time and Navitas will review all Potential Management Actions. Of note, the table in Section 15.6.2.1.4 lists the	Section 15.6.2.1.6 Section 15.7.2

Reference	Request for information	Navitas response	Addressed
		relevant 'Adaptive Management Thresholds' and the Potential Management Actions'. Under the 'Post-Sanction and Pre-First-Oil' section of the proposed 'Research and Studies' (Section 15.7), Section 15.7.2.2 includes the following Scope of Work: 'In the event marine invasives are discovered in the course of normal monitoring, pathways analysis will be conducted to determine where / how invasives are being brought into the Islands'. These ensure that monitoring will be conducted pre-First-Oil and throughout the life of the development (Table 15.7) to ensure the early detection of any non-native species. If detected and identified through genetic analysis, subsequent pathway analysis will provide likely origin. The origin and history of Navitas chartered vessels will be known. However, it is correct that no eradication measures would be undertaken by Navitas as these are notoriously difficult and ineffective for marine spp. The focus with regard to managing the risk of invasive species is indeed on prevention of occurrence. Such measures include, for example, the application of D3 ballast water management plans with a D2 level of ballast water treatment for all vessels (Section 10.12.7.1) and hull inspections of LTV's prior to entry into Berkeley Sound. That said, if obvious invasive non native species were detected then Navitas would commission cleaning/removal should it be safe to do	

Reference	Request for information	Navitas response	Addressed
		so. A Biosecurity Plan will be prepared prior to the commencement of operations. All invasive species management protocols will be reviewed and any introduction detected will be communicated to FIG.	
SAMS 24	Related to the above, there is no consideration of total Non-Native Species 'waste' to be disposed of at landfill (i.e., within Table 5.30) if they are detected on the FPSO platform and have to be removed.	The FPSO will be dry-docked for its refit and anti-fouling paint will be applied to the hull prior to its departure for the Falkland Islands to prevent fouling of the steel by marine growth. Management of waste arising from any invasive species detected will be described within the Biosecurity Management Plan but ultimately, all disposal methods would be agreed with FIG in the event they were needed.	N/A
SAMS 25	Direct off-setting (Table 8.9) was not considered possible, but the reviewer would suggest that other indirect off-setting (control/eradication of a potentially high risk invasive marine Non-Native Species) is costed and included in the Internal Carbon and Biodiversity Offsetting Fund (Section 8.11.3).	Navitas notes this comment. Indirect offsetting *via* the control or eradication of marine or terrestrial invasives may be candidate projects that are considered under the offsetting fund in due course. Public Consultation EIS Section 8.11.2.2 'Indirect Offsetting' says 'Navitas is also committed to exploring indirect offsetting opportunities locally. These may include habitat restoration projects, pest and invasive species eradication/control and conservation, biodiversity educational initiatives and the research required to inform them.'	N/A
SAMS 26	Within the impact assessment chapters, the linkages between Designated Sites and the potential impacts on their constituent features are not fully drawn out... To avoid such amplification of risk, it is perhaps something that	Thank you for your comment. This is noted and Section 13 has been revised to colour-code each receptor and assessment to give an overview of the	Chapter 13

Reference	Request for information	Navitas response	Addressed
	could be addressed more thoroughly within Chapter 13 of the EIS. For example, a table detailing species a, b, & c have been identified as potentially at risk from the development, which in turn will impact on the status of Designated Areas x, y, & z.	impact interactions. Navitas has also added where a designated site or species may be affected.	
SAMS 27	Table 9.1 shows that Designated Sites have not been considered as receptors when constituent features (e.g., seabirds) are assessed as being potentially impacted. If population level impacts occur to bird species for which protected areas are designated, the integrity of the Designated Site will also be under threat. Designated Sites have only been identified as a receptor for seabed disturbance in Berkeley Sound, waster generation, introduction of terrestrial invasive species, and under Oil Spill scenarios. This omission is best demonstrated with an example. In Chapter 10.1, examining the impact of artificial light, the EIS assesses the potential impact on 'The colony of the IUCN 'Near Threatened' sooty shearwaters on Kidney Island' (pg. 604). Kidney Island is a designated as Natural Nature Reserve (NNR) and as an Important Bird Area (IBA), likely due to the sooty shearwaters amongst other birds; thus any impact on this population would arguably impact the integrity and status of this site as a NNR and IBA.	Thank you for your comment. This is noted and Section 13 has been revised to colour-code each receptor and assessment to give an overview of the impact interactions. Navitas has also added where a designated site or species may be affected.	Chapter 13
SAMS 28	Although Section 7.5.2.3.3 reports only two sites being put forward for consideration as new Ramsar Sites. There are currently 18 proposed Ramsar Sites within the Falkland Island	Navitas will revise as appropriate. Thank you for the comment.	Section 7.5.2.3.3
SAMS 29	A strong precautionary approach would be to assume that the 18 proposed Ramsar sites as 'designated' when assessing the environmental landscape of the area, in addition to any other 'in progress' protected areas.	See SAMS 28.	N/A
SAMS 30	For fish there is emphasis on commercial species although non-commercial species are also mentioned. While this is understandable because much of the baseline data derives from fisheries surveys, in a few areas it skews the writing perhaps giving the impression that non-commercial species are of less importance – even though they may have important ecological functions. For example, on pg. 596 when discussing the effects of light,	Thank you for this Navitas will updated and amend. Much of the data came from Arkhipkin *et al.* (2012) which also contains important species that are not targeted. See Arkhipkin, A., Brickle, P., Laptikhovsky, V. V., Pompert, J. & Winter, A. (2012). Skate assemblage on the eastern Patagonian shelf and	Section 7.4.4

Reference	Request for information	Navitas response	Addressed
	information is repeated from an earlier section which focuses on commercial species. This repetition is not really needed because this section should be discussing the known effects of light on squid and fish, rather than just repeating which species are found in the area.	slope: structure, diversity and abundance. Journal of Fish Biology 80, 1704–1726.	
SAMS 31	Uncertainties have been acknowledged in the report. This leads to a confidence evaluation for some of the risks. It feels perhaps some of these have been over cautious. For example, on pg. 1179 the impact of a spill during offshore transport on toxic effects on plankton, squid and fish is evaluated as 'very low' but with 'Uncertain' confidence. Yet the supporting evidence argues rather strongly that there has been experimental testing of oils from this site using zebra fish as a model and that quite a lot is known about toxicity of crudes to fish at least (Section 12.1.4.2.3).	Thank you for the comment. The uncertainty remains because zebra fish are an analogous species.	N/A
SAMS 32	The impact of the emissions on global issues such as global warming and oceanic water quality (via Ocean Acidification) have been reasonably considered, however, the background literature presented should be updated to include up to date literature, particularly in the area of ocean acidification. Two key pieces of literature that could be useful in this section include Watson (2020) and Shaw *et al.* (2023).	Thank you for your comment. This is noted and will be amended.	Section 10.9.4.2
SAMS 33	It is slightly disappointing not to have more information presented on possible issues that drilling and spills may have on green and red species, as the EIS only really presents potentially impacts and mitigations linked to brown species of macroalgae (albeit limited mainly to kelps and not to other intertidal species of brown macroalgae). There is also a need to recognise that structures put in the water for oil drilling offer a potential new habitat for marine species including seaweed.	Thank you for the comment. The taxonomic status of many of our seaweeds, in terms of understanding, is a work in progress. There is a draft report that is cited in the report. Brodie, J. & Mrowicki, R. 2019. A draft checklist of the seaweeds of the Falkland Islands. Natural History Museum, London. 31 July, 2019. Navitas will update the text regarding the offshore structures as potential new habitat for seaweeds. They identified 253 taxa from two surveys. Gaps remain in distribution and abundance.	Section 10.3.4.2.1.3

Reference	Request for information	Navitas response	Addressed
SAMS 34	The methodology used for macroalgal species is only on kelp species and misses, as highlighted in Table 12.20, that there may be a species related response to oil spills.	Thank you for your comment. This is noted and acknowledged. There this little known about the phycology of the Falkland Islands. Kelp was chosen as it is a key species to ecosystem function in the Falkland Islands.	N/A
SAMS 35	Table 12.27 contains a summary of risks for oil spill scenarios, and highlights that the toxic effects for kelp are likely to be moderate with a low initial risk. Mitigation aspects have been highlighted, but there is uncertainty around the confidence of this event/risk occurring. However, this only covers kelp species, and nothing is presented that links to the seaweed ecosystem as a whole.	Thank you for the comment. The confidence is uncertain as the impact of oil on Falklands kelp species specifically were not tested. Analogues from the Northern Hemisphere were tested. Navitas did not assess other groups as very little is known about the taxonomy and therefore abundance and distribution. Navitas will update the text in the document to reflect this.	Section 12.2.4.2.1
SAMS 36	Within the EIS, only data for kelp has been discussed. There are other macroalgal species present and as highlighted in Liu *et al.* (2019), oil spills can cause stress to *Ulva pertusa*. Other research also suggests a shift in seaweed/macroalgal assemblies/populations after an oil spill, which is important to consider when evaluating the risks and mitigations linked to the potential toxic effects of an oil spill.	Thank you for the comment. Navitas will update the text accordingly.	Section 12.2.4.2.1
SAMS 37	There is lack of information on potential risks to green and red species of macroalgae. Most of any discussion around associated risks is linked solely to kelp beds and two main brown seaweed species. Considering there are around the 253 species presented in the Falkland Islands as a whole, this presents a large gap	Thank you for the comment. This should be 253 taxa (not species) and will be updated. This is what has been identified by phycologists on a recent project (Brodie and Mrowicki. 2019). However, their distribution and abundance are not known. See also SAMS 33. Brodie, J. & Mrowicki, R. 2019. A draft check-list of the seaweeds of the Falkland Islands. Natural History Museum, London. 31 July, 2019.	Section 7.4.2

Reference	Request for information	Navitas response	Addressed
SAMS 38	In the event of an oil spill, there is likely to be a shift in intertidal populations as highlighted by Zhou *et al.* (2019), with responses dependant on whether a species is tolerant, opportunistic or an equilibrium type.	Thank you for the comment. Navitas will update the text accordingly.	Section 12.1.4.2.6 Section 12.2.4.2.5
SAMS 39	Described insufficiencies have arguably influenced some of the impact assessments, especially the omission of updated literature on underwater noise impacts of Mobile Offshore Drilling Units (MODU) and some vessel types, as well as the increased knowledge about sei whales around the Falkland Islands should be integrated more in certain sections of the report.	Thank you for the comment. Whilst Navitas has been precautionary in the assessment for underwater noise there are other new developments in noise modelling and Navitas will update these sections with new noise modelling and also update the relevant chapters. See also FIFD 54.	Section 10.4 Section 10.5
SAMS 40	Particular attention should be made with respect to the addition of literature published on the different species in the region over the past 10 years, as currently most citations within the report provide information up to 2013 only. Suggestions include Baines & Weir (2020), Franchini *et al.* (2020) Weir & Stanworth, (2020), Weir *et al.* (2021) and Cerchio & Weir, (2022), but also see specific recommendations in the sections below.	Thank you for the comment - Franchini *et al.* (2020); Weir and Stanworth (2020) will be updated. The other references are cited.	Section 7.4.6
SAMS 41	With respects to mitigation and monitoring for underwater noise (e.g., Section 10.5.10.1 & Chapter 15) it should be laid out in more detail how acoustic monitoring will be carried out to decrease uncertainty in operational noise levels and potential impacts on marine mammals. It would be good to elaborate on the 'hydrophone recordings' that will be used to validate noise levels, i.e., how many recorders will be used at what distances to the sources, and how will be deployed. Anchored static systems would be best for the task and all recordings should follow international standards for monitoring of underwater noise (e.g., Hannay *et al.,* 2023; Ainslie *et al.,* 2022).	Chapter 15 provides indicative EMMP summary tables and the EMMP workshop report proposes that an advisory committee including individuals with relevant expertise in the subjects being monitored will help draw up the specifications in any scope of work...and would also be able to comment on the results of the monitoring.' Therefore, levels of detail such as the number of hydrophones etc. are yet to be agreed. In the post-consultation EIS Navitas will state in Ch 15, and 10.4/5 if necessary, that details on monitoring will be developed with the advisory committee, and ensure the timing for this (post sanction) is clear.	Section 15.6.2.1.3

Reference	Request for information	Navitas response	Addressed
SAMS 42	The scope of work of noise monitoring (Section 15.6.2.1.1) should include a more comprehensive assessments of noise levels at various distances and potential impacts on cetaceans from acoustics – only monitoring noise levels near the operations is not going to fill the existing data gaps. A design using moorings or landers at different distances from the working area would provide a good dataset for future assessments (see Martin *et al.* (2023) for an example array design). Noise assessments and acoustic surveys for marine mammals can easily be aligned and provide valuable data for future assessments and to reduce uncertainty re impacts on marine mammals.	The EMMP (section 15) gives an outline of monitoring to be undertaken and a full work up of the noise monitoring programme will be developed post-sanction. See also response to SAMS 41 regarding timing for the development of detailed specifications and scopes of work for monitoring. Thank you for the Martin *et al.,* reference. The noise monitoring programme may also been informed by the updated noise modelling that will be included in the post-consultation EIS.	Section 15.6.2.1.3
SAMS 43	Monitoring for underwater noise is intended to be undertaken by Seabird and Marine Mammal Observers (SMMOs) on board specific vessels. These should be supported by Passive Acoustic Monitors (PAM) (e.g., towed hydrophone or fixed archival for impact assessment and collection of baseline data); real-time PAM buoys should also be considered for mitigating impacts especially during construction/decommissioning. Monitoring of marine mammal responses to various stages of the project at different distances, using PAM landers, should also be undertaken to reduce uncertainties in some of the cited assessment parameters (Section 10.4.10.1).	Please refer to SAMS 41. Navitas will consider the use of PAM in consultation with the EMMP advisory group. Navitas will update the post-consultation EIS to include this clarification.	Section 10.4.10.1 Section 15.6.2.1.3
SAMS 44	The investigation of low noise thrusters is welcomed (Section 15.7.2.3) but a stronger commitment to using noise reducing technologies with respect to propellers and other solutions for future vessels could be made, given the risk of continuous noise from on-site Dynamic Positing (DP) vessels to noise-sensitive species.	Vessels will be dry docked in accordance with their classification requirements. Hulls and propellers will be cleaned accordingly. Engines shall be maintained similarly and DP will be used only when necessary. All these actions will minimise underwater noise from all vessels. Navitas will update the post-consultation EIS to include this clarification.	Section 10.4.10.1 Section 15.7.3
SAMS 45	For example, there are data on sei whale acoustics from the South Atlantic now available (e.g., Cerchio & Weir, 2022) that should be included (pg. 423). Similarly, update is recommended for Antarctic minke whales (pg. 423),	**Initial consultation response:** Thank you, these references will be reviewed and included.	N/A

Reference	Request for information	Navitas response	Addressed
	which have been described since 2014 (Risch *et al.,* 2014) and numerous publications from the South Atlantic have followed since. The species-specific review in Section 7.4.6.3.1.6 appears to omit description of available acoustic data. It would be good to cite the actual ambient noise levels recorded by Hipsey *et al.* (2013) rather than just giving a qualitative description. Re-analysis of the existing (and new) acoustic data should be recommended especially regarding Antarctic minke and sei whales. There is further information (e.g., Clark & Gagnon 2022) available for other species on the range of sound emitted by cetaceans that it would be advisable to include within Table 10.22.	**Post-consultation comment:** This table was removed from Section 10.4 during the chapter revision as the data were not actively used in the assessment. Therefore, these suggested changes are no longer relevant.	
SAMS 46	Summary tables for marine mammals (e.g., Tables 7.28 & 7.32) would be enhanced by including citations for each statement 'Behaviour' column. The content of Behaviour column should be also reviewed as it is a mixture of behaviour and distribution related comments; the relevance is unclear. It may be advisable to use categories, i.e., foraging, migration, distribution etc. for each species and fill in known facts about the South Atlantic populations of this species and/or global populations if data from the South Atlantic is missing.	Thank you for the comment. This will be taken into consideration.	Table 7.28 Table 7.32
SAMS 47	The review of potential oil spill consequences on cetaceans (Section 12.1.4.2.5.2) should be updated with the latest literature, particularly lessons learned from the deepwater horizon spill (e.g., Frasier *et al.,* 2020; Schwacke *et al.,* 2022; Marques *et al.,* 2023). In addition, the statement that there is no indication that marine mammals associate with oil rigs (Table 12.13) has been shown to be untrue - see for example Delefosse *et al.* (2020) and Todd *et al.* (2024).	Thank you for the comments - Navitas will update this section.	Section 12.1.4.2.5.2
SAMS 48	Some assumptions on underwater noise and source signals could be updated with newer literature (see comments below on MODU signal assessment) and newer vessel literature/databases e.g., the Joint Monitoring Programme for Ambient Noise North Sea (JOMOPANS) and	Thank you for your comment, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. The underwater noise sections (10.4 and 10.5) are also being updated with relevant	Section 10.4 Section 10.5

Reference	Request for information	Navitas response	Addressed
	Enhancing Cetacean Habitat and Observation (ECHO) project databases on vessel noise.	citations suggested during the public consultation. Please also refer to FIFD 54.	
SAMS 49	There appears to be a general underestimate of when potential impacts from underwater noise should be considered. For example, underwater noise is not considered during installation (e.g., Table 2.2), but anytime there are vessels on site for extended periods, the issue of noise pollution and potential for behavioural responses/stress on receptors should be considered. In addition, recent studies (Martin *et al.,* 2023) has demonstrated impacts from the USBL signals used for positioning during MODU operations on marine mammals. These signals (at 25-27 kHz) and their potential effects, especially for odontocetes, should be considered within the EIS (e.g., within Table 10.26, Section 10.4.2.1 & Section 10.4.8).	Thank you for your comment, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. The underwater noise sections (10.4 and 10.5) are also being updated with relevant citations suggested during the public consultation. Please also refer to FIFD 54.	Section 10.4 Section 10.5 Table 2.2 Table 10.21
SAMS 50	Marine mammals might also be disturbed from impulsive, shorter term noise during drilling and construction phases of the project (Table 8.9), with concerns including behavioural responses and injury. This should be highlighted and explained better throughout the EIS. Possibilities regarding mitigation and offsetting should also be described more comprehensively and the relevant literature be cited (e.g., Martin *et al.,* 2023; and many more).	Please note that there is no source of impulsive sound in the proposed project. Thank you for your comment, the underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. The underwater noise sections (10.4 and 10.5) are also being updated with relevant citations suggested during the public consultation. Please also see FIFD 54. Navitas has been unable to identify any offsetting possibilities in the literature cited. Please note that Table 8.9 does not indicate that there is no impact, only that identifying a realistic and effective direct offsetting project for this impact has not been possible.	Table 8.9 Section 10.4.2
SAMS 51	Continuous vessel presence offshore will create underwater noise which might impact marine mammals and other noise sensitive species and should	This is covered in Sections 10.4 and 10.5. Table 9.1 will be reviewed and checked.	Section 10.4 Section 10.5 Table 9.1

Reference	Request for information	Navitas response	Addressed
	be further assessed. This is similar for the presence of Large Transport Vessels (LTVs) in Berkeley Sound (Table 9.1, pgs. 565 & 569).		Table 9.2
SAMS 52	The EIS states that underwater noise impacts on marine mammals are most likely (Section 1.7.4.2.2). However, possible impacts on other parts of the ecosystem including seabirds, plankton, fish and benthic invertebrates can also be expected. There is growing evidence and several reviews published that show the impact underwater noise can have on the whole ecosystem, so this statement should be rephrased to not downplay effects on other species.	The underwater noise modelling is currently being re-run to more accurately reflect Navitas' proposal for the Sea Lion field and Berkeley Sound. The underwater noise sections (10.4 and 10.5) are also being updated with relevant citations suggested during the public consultation. Please also refer to FIFD 54.	Section 1.8.4.2.2
SAMS 53	The literature on marine litter and impacts on seabirds and cetaceans need to be considered more throughout the document, especially to literature from the last ten years (2015-2024) Examples include the study by Padula *et al.* (2023) on debris impacts on odontocetes in the SW Atlantic, and Phillips & Waluda (2020) on seabirds and debris impact.	Thank you - Navitas will update this section.	Section 10.10.4.1.2.1
SAMS 54	Although page 795 states that "… impacts to air quality have been screened out owing to distance of the offshore location from environmental and social receptors…", this statement is inconsistent with the presentation of scoping of activities and receptors within Chapter 9.	See comment SAMS 2 above.	N/A
SAMS 55	Further clarification on the distinction between 'Regional' and 'Global' air quality is recommended. This definition should be noted in the EIS and then put into practice throughout the document. Even if the impact regionally is considered insignificant, this needs to be documented within the report.	Thank you for your comment. This is noted and will be addressed in the narrative.	Table 9.1
SAMS 56	The outcomes of ENVIID workshop clearly demonstrate that concerns existed over how regional air quality could be impacted by the activities associated with the proposed development. However, assessments explicitly related to regional air quality have not been drawn out in the impact assessment chapters. The reviewer wonders whether the lack of a clear definition of what is regarded as 'regional' versus 'global' is a reason why this omission exists, and is perhaps indicative of a flaw in the methodological approach. More clarity is needed on what is considered to	See comment SAMS 2 above.	N/A

Reference	Request for information	Navitas response	Addressed
	be 'regional', and a re-focus on how to assess activities and any associated impacts that may arise at that scale.		
SAMS 57	Although it is accepted that DREAM/ParTrack has a history use within the Oil & Gas sector (Section 10.6.4.3.1) for use in particle dispersion modelling, many other more recently developed an updated particle tracking models are available (e.g., MIKE, Delft). It would be interesting to see whether the model results produced by DREAM/ParTrack are validated by alternative models, as it would add confidence to the predictions and assessments made.	PW modelling will be redone after PW is produced (section 15.7.3.1), an update particle tracking model such as those suggested can be used to corroborate the DREAM/ParTrack model and to refresh the model with real PW data. Text will be amended in this section to reflect that an alternative model may be used.	Section 10.7.5 Section 15.7.4
SAMS 58	Seabird survey coverage within the drilling campaign area is not present during April, May and September (noted in Section 7.4.5.2.1.1). Whilst attempts have been made to overcome this through the Gap Analysis Programme (GAP) (Section 7.4.5.2.1.4), this study was restricted to a number of larger species that tracking devices could be deployed on. The report acknowledges this; however, it is not clear how this shortcoming is incorporated during the risk assessment process.	Thank you for the comment. This is an acknowledged gap and Navitas has applied the precautionary principle and a confidence rating to the assessment. Navitas are committed to filling this gap with SMMOs deployed on vessels for three years pre First-Oil.	N/A
SAMS 59	'Seabird vulnerability to oil spill' (Section 7.4.5.6) relies on data from White *et al.* (2001; 2002), which as previously noted is more than 20 years old. It would be desirable to try and update this classification using more recent data collected during the GAP project, and from other sightings surveys that are noted in the document.	Navitas recognise that the data is old. As noted in the EMMP workshop report (2019): 'The workshop agreed that it would be useful to collect further data opportunistically from vessels associated with Sea Lion development, but that a wider data collection effort to update seabird information was beyond the scope of the EMMP.' Update to the seabird vulnerability to oil spill atlas can only be updated with a broader area wide at sea data collection effort which would require an FIG and multi-industry collaboration and investment.	N/A
SAMS 60	Data sources for the EIA appear relatively sound and comprehensive. Overall, the quality of the data presented is very good. The type and level of	Thank you for your comment. This is noted and Navitas has commissioned a separate Socio-Economic	N/A

Reference	Request for information	Navitas response	Addressed
	risk for environmental factors appears to have been well assessed, but the social impacts of these, where not as readily quantifiable, were more weakly presented. The EIA would benefit from improved analysis of the social impacts.	Impact Assessment which will analyse the social impacts in more detail.	
SAMS 61	Particular attention is drawn to the identification of shipping routes (Section 11.1) and the associated risk assessment which were conducted well, as much of this assessment was informed by vessel Automated Identification System (AIS) data and collision risk modelling that is widely used. Stakeholders within FIG and from the fishing industry were consulted three times over the evolution of the project, yet data from these consultations is minimally represented in this chapter as part of the confidence assessment. Again, in Section 11.2, stakeholder opinions gathered through the consultations were summarised briefly (11.2.4.4.1.3), but it is unclear how many vessel Captains/owners were consulted.	Local fishing companies (who are in some cases vessel owners) and vessel agents have been consulted throughout the evolution of the Sea Lion project. The nature of the Falklands fishing industry is such that ship's captains are not particularly accessible (they spend limited, if any time onshore, and often do not speak English). Navitas will seek to include more detail on the consultation and industry responses into Section 11.2.4.3 and all other relevant sub-sections on stakeholder input.	Section 11.2.4.3
SAMS 62	There are some inaccuracies in statements and the use of literature in some cases could be elaborated on. Some of the cited literature is 20 years old, and there may be more recent studies with applicable data available for consideration.	Thank you for the comment. Navitas will review and update literature in the post-consultation EIS.	All
SAMS 63	The cumulative effect of PW discharges including traces of oil, Polycyclic Aromatic Hydrocarbons (PAHs) and chemicals could be more specific, and using more up-to-date literature to describe the impact should be considered. Similarly, except for chemical characteristics, it is important to include loading (concentration x volume) (see Gagnon *et al.,* 2011). No effect on combined factors is discussed, for example temperature and hypersalinity, which may have wider consequences on ecosystems (e.g., Smyth & Elliott, 2016); possible effect on pH is not discussed either.	Thank you for the comment. At the time of writing, dosages and quantities of chemicals that will used will be further defined pre-operations and will be submitted to FIG for pre-approval. Although, as stated in ED 118 (and numerous other comments), all chemicals will be selected from the OCNS ranked listing to minimise environmental impact. Further, the PW will be monitored in line with the RBA as described in Section 10.7.1.1.1.2 and 15.7.3.1. Nonetheless, the section will be updated with further literature review.	Section 10.7.4.2.2 Section 10.7.5 Section 15.7.4

Reference	Request for information	Navitas response	Addressed
SAMS 64	'Disturbance to seabed', 'Oil spill – offshore' and 'Fuel Oil spill – inshore' are not directly considered as activities that may have an impact on water quality (see Table 1.7). Whilst the presence of oil within water and associated impact on other receptors is considered within Chapter 12, the impact on water quality is not explicitly highlighted. Disturbance to the seabed may led to resuspension and dispersion of pollutants and materials that would otherwise be settled on the seafloor	Thank you for the comment. All summary tables will be reviewed and amended as necessary.	Table 1.8
SAMS 65	Examination of Figure 12-39 reveals that more than 50% of oil from a bunkering spill leaves the model domain after six days, which is a substantial portion of the pollutant to lose from the model and still be confident of predictions of end behaviour. A larger domain would likely be more appropriate to better understand the behaviour of Marine Gas Oil (MGO) after such a spill.	As stated in Section 12.1.4.3.4.1: 'Model results are collated and reported *via* a 3D grid, and for each scenario the grid layout has been chosen that maximises the accuracy of the outputs by focusing on the area occupied by the vast majority of oil particles for the period when they are most likely to present significant environmental impacts.' Owing to the volatility of MGO and the highly dynamic environment at the Sea Lion location regarding wind and wave action, the grid size is selected to demonstrate the worst-case outcome of the MGO spill. Section 12.1.4.8.1 states, 'the surface MGO is expected to decline very quickly, as it gets dispersed by wave action, and also evaporates and biodegrades. The model predicts that after 2 days from discharge, no MGO will remain on the surface. By 4 days, 31% will have evaporated, 25% will have biodegraded, and the remainder of the discharge will either be dispersed in the water column or dissolved. The MGO also starts to exit the modelling grid at 4 days, and the trend of the dispersed oil being degraded continues in	Section 12.1.4.8.1

Reference	Request for information	Navitas response	Addressed
		the water column beyond this point, no MGO is predicted in sediments.'	
SAMS 66	Within Section 7.3.3.3 it is unclear whether the current speeds presented for the Sea Lion Field result from actual measurements from contracted survey work, or if the information is based on published data from other sources.	This data came from BMT Argoss. 2015. Sea Lion Hydrodynamic Modelling – Final Report. Reference Number: A14043_Final_Report_r1. Prepared for Premier Oil Exploration and Production Limited and the reference will be added.	Section 7.3.3.3
SAMS 67	The presence of Naturally Occurring Radioactive Materials (NORM) within PW is discussed in Section 10.7.4.1.2.1, although there are some inaccuracies. The statement about gamma radiation is incorrect, as not all radionuclides emit gamma rays. Indeed, the two described radionuclides, 226Ra and 228Ra, are α and β- emitters respectively. The activity of these radionuclides can be, however, estimated *via* their gamma emitting parents or daughters when aiming at the particular energy peaks of the gamma spectrum. There is no information on any existing data pertaining to the radioactivity of the ground water, and a lack of information about possible impacts. This section needs an update as it has been shown that radioactivity in the environment may be elevated due to discharges of PW (e.g., Eriksen *et al.,* 2006; Ahmed *et al.,* 2021).	Thank you for your comment. This is noted and the text will be amended with updated references for clarity. NORM build up typically takes time and only becomes a concern when Produced Water (PW) breakthrough occurs. The base case is to reinject the produced water (PWRI).	Section 10.7.4.1.2.1 (NORM)
SAMS 68	Within Section 10.10.2.2.1 it states that 'some oily wastewater from the onshore mud plant' may go to sewer under consent, or alternatively be sent offshore for processing. It is not clear whether this has been taken into account in the figures used, although suspected to be a minimum quantity comparatively as thus likely accommodated within the assessments made.	Onshore oily waste water will not go into the Stanley sewerage system unless under consent from FIG. Onshore operations which may result in oily water discharge will be completed in a bunded area which will contain the oily water, this will then be treated, incinerated or dealt with away from the sewerage network and shall align with Navitas' Waste Management Procedure. This will be clarified in the post-consultation EIS.	Section 10.10.2.2.1 Table 10.86

Reference	Request for information	Navitas response	Addressed
SAMS 69	Section 10.7.4.1.5 discusses the discharge of hypersaline water from vessels, using Roberts *et al.* (2010) as a primary source. This study is based on nearshore, shallow water environments. An example of more up to date literature is Dewar *et al.* (2022), which describes plumes of hypersaline water in open ocean environments, and thus arguably could help inform this section further. It is unclear if the second paragraph in this section still refers to Roberts *et al.* (2010) or to an experience with such plumes from the past. Turbidity impacts due to hypersaline discharges are omitted from this section. Similarly in Sections 10.7.4.2.5 & 10.7.4.3.1 only Roberts *et al.* (2010) is cited, while more relevant and up to date literature may be available and would add value to the assessments made.	Thank you for your comment. This is noted and the subject matter will be reviewed and the narrative updated where necessary.	Section 10.7.4.1.5 Sections 10.7.4.2.5 Section 10.7.6.1.5
SAMS 70	• Species scientific names are not always italicised and need some attention. Examples include Patagonotothen ramsayi & T. gaudichaudii on pg. 294; P. brevicauda on pg. 339; D. gahi on pg. 340; Allothunnus fallais in Collette reference on pg. 1315. • Figure 1-1, pg. 29. The text within the figure is small and of low resolution, making it difficult to read. • Section 7.2.2, pg. 246. Typographic error, with a space missing – 'Figure 7-4and Figure 7-5' • Figure 7-22, pg. 272. The size and resolution of the Figure means that the data (wind vectors) is not easily readable. • Section 7.3.7.1.2.1, pg. 279. Units for PAH concentrations are given as 10 µg/g-1; this should be either µg/g or µg -1. Comparing this section to section 7.3.7.2.2 shows units written as µg.g-1 – for consistency, it may be worth revisiting how units are expressed across the whole document. • Table 7.2, pg. 289. There is no indication of the units for the metal concentrations provided within the table; presumably these are all µg.g-1. • Section 7.4.1.2.1, pg. 292. Typographic error in the 4th paragraph, there are two spaces between 'community' and 'shows'. • Figure 7-41, pg. 314. Typographic error in the legend for the Figure, which	Thank you for your comment. This is noted and will be amended.	General correction of typos listed

Reference	Request for information	Navitas response	Addressed
	reads 'intertidal habit map…'; this should be 'habitat'. • Table 7.8, pg. 328. The entry for 'Offshore benthic flora & fauna' in the 'NFB and the Sea Lion Field' contains text related to Berkely Sound, not the NFB/Sea Lion field. • Section 7.4.4.3.1.1, pg. 339. The last paragraph cites Brickle (2005); within the reference list there is Brickle *et al.* (2005a) or (2005b), and Brickle *et al.* (2005) (pg. 1311). It is assumed that the in-text citation should be Brickle *et al.* (2005c), and the last reference should be amended. • Section 7.4.6.1, pg. 413. There seems to be an omission - baleen whales may also feed on small schooling fish, not just plankton. • Section 10.1.6.1.1, pg. 603. The text states there are 'negligible numbers of any species of geographical importance'. This is written in quotes, and thus implies that it has been taken from some other paper or report, but no source is given. • Section 10.4.1.1, pg. 655. Marine Strategy Framework Directive (MSFD) regulations should be included within the relevant legislation for underwater noise impact assessments. • Section 10.4.4.3.1, pg. 663. In text citation is written as CeliMonica *et al.,* 2015; the reference list details Celi *et al.,* 2015. • Figure 10-27, pg. 729. The Figure legend states "Total environmental risk to the sediment at the NA-P-01 DC at end of drilling, 5, 10 and 20 years after drilling"; however, there are only panels provided to show 'end of drilling' and '20 years after drilling' – the 5, 10 & 20 years are absent. • Figure 10-30, pg. 768 & Figure 10-31, pg. 769. Both Figures have very small axis font sizes, particularly the bottom panels, resulting in a lack of clarity over the orientation and the scale of the plume. • Figure 10-36, pg. 788. Similar to the above comment, Figure axis labels are small and illegible. • Table 10.63, pg. 816. Within the 'Currently expected base case' for 'Power generation on the FPSO', the third sub-bullet point starts 'd water'. It		

Reference	Request for information	Navitas response	Addressed
	appears that the beginning of the lie is missing, with the line likely supposed to read 'produced water'. • Section 12.1.4.2.1, pg. 1091. Typographic error in species names; should be 'Euphausia lucens' not 'Euphauis lucens'; 'Acartia tonsa' not 'Arcatia tonsa' • Section 12.1.4.2.3.2, pg. 1093. The sentence on testing of Sea Lion crude on zebra fish eggs is clumsily worded and could be mis-interpreted that zebra fish are found at the project site. The wording should be revised to make clear that zebra fish were used as a model test organism. Furthermore, larvae may be more sensitive to pollution impacts than eggs and this should also be made clear so that the experimental data are not over-interpreted. • Figure 12-33, pg. 1137. There are no scale bars/legend provided for the panels to aid in interpreting the different colour ramps displayed. • Table 15.2, pg. 1263. For row '10.6 Drill muds and cuttings', 'Table 15.4' is repeated under the 'EMMP action' column. • Section 15.4, pg. 1265. Formatting error, with a change in font for 'Table 15.4 and Table 15.5 respectively.' • Table 15.5, pg. 1273. The row for 'Nuisance to the human population' appears incomplete, with blank boxes. Following convention used in Table 15.4, a '-' or 'N/A' should be added as appropriate if there is no information for these boxes. • Reference List & pg. 663. Hawkins and Popper (2017) & McCauley *et al.* (2001) are not in the reference list. • Reference List & pg. 665. Richardson *et al.* (1995a) is missing from the reference list, or mis-typed. • Reference List & pg. 717. Cranford *et al.* (1998a) is missing from the reference list • Reference List, pg. 1307. In the reference list, Balushkin 1992 and		

Reference	Request for information	Navitas response	Addressed
	Balushkin 1994 are in the wrong order because of a missing comma in the former.		
Xodus Group			
Xodus 1	Page 170: There is no evidence presented to demonstrate the selection or analysis process used to assert that fuel use will be minimised, other than reference to the use of electric drives (rather than mechanical turbine drives for pumps/compressors).	Navitas has committed to reducing and minimising its emissions. By way of example, in FEED for the FPSO Navitas has instructed the contractor to implement practical technologies to minimise emissions. Navitas shall continue to consider and implement reduction measures throughout execution and operations phases of the development and, as explained in the EIS, these shall be detailed in the EMMP and Navitas shall be accountable against this. It should be noted however, The Field Development Plan and EIS is based upon using an existing FPSO and there is a balance between the potential benefit of reusing existing equipment and replacing with new equipment within the constraints of the existing facility.	N/A
Xodus 2	Pages 170/171: There is significant difference in terms of potential efficiency gains by employing a CCGT, in the region of 15 to 20% and we would expect to be considered in an analysis of the energy efficiency of the system.	Refer to Xodus 1 above	N/A
Xodus 3	Page 171: VSDs (usually employed as Variable Frequency Drives) offer a huge potential to reduce energy usage and associated emissions. It is a well-established, widely adopted, and proven technology. Fixed speed motors cannot be considered ALARP, unless offset by careful sizing and sparing strategy that would make the additional capital excessive.	Refer to Xodus 1 above	N/A

Reference	Request for information	Navitas response	Addressed
Xodus 4	Page 171: Power factor correction is reducing reactive power, through addition of capacitors or other measures, to reduce overall power consumption required for the same useful output. This is a well proven technology, widely used in onshore and industrial applications, but not traditionally employed in offshore oil and gas developments.	Refer to Xodus 1 above	N/A
Xodus 5	Page 171: It is apparent by inspection that through the application of readily available technology and carefully matching the electrical demand to the power plant output then a significant reduction in fuel use related emissions can be achieved over that currently proposed. For example, if sufficient design changes were implemented to reduce the apparent load to allow operation on one gas turbine at maximum efficiency, fuel gas savings of nearly 50% would be possible, over those values currently stated	During the FEED phase the Electrical Load List will be further refined to minimise power demand. Motor starting cases and options (including the potential selective use of VFD's, soft starters, low in-rush motors, Voith couplings, etc.) will be reviewed with the goal to minimise fired power generation units online within the practical constraints of a redeployed FPSO.	N/A
Xodus 6	Page 169: Proposed use of gas fired steam boiler for heating injection water and maintaining available auxiliary steam boilers are a concern. This heating duty could potentially be met with heat supplied from the WHRU. Our experience of new build FPSO design provides a comparative example with heating of oil and produced water (to 90°C *vs.* the stated 70°C for the Navitas FPSO), and all marine system heating being served with heating medium carrying waste heat and heat integration. Heat integration does not appear to have been considered. Technical justification should be provided to show why an additional steam boiler is required and that the duty cannot be met with waste or integrated heat.	Refer to Xodus 1 above Additionally, it should be noted that a further optimisation of the Pre-FEED design has been completed since the submittal of the EIS and the additional steam boilers have been removed from the design and the existing Auxiliary Boiler will be converted to fuel gas service from liquid fuel. Please note that WHRUs do exist on the current Gas Turbine Power Generation Units and it is not practical to retrofit on the redeployed FPSO.	N/A
Xodus 7	Page 169: The requirement to have auxiliary boilers (and to run them for 1 day per month) should also be reviewed. With adequate design, a high availability should be able to be achieved for the WHRU and heating medium system (the WHRU is simply a mechanical linkage attached to a louver in the exhaust stack, with very little to go wrong).	Please see response to Xodus 6.	N/A

Reference	Request for information	Navitas response	Addressed
Xodus 8	Page 154: There is no immediately apparent technical reason why any continuous flaring would be required to commission and start up the gas compression system. Small, transient amounts will be flared if the system is shutdown and restarted multiple times as would be required during commissioning, however each start/shutdown cycle would be, indicatively, in the region of a few tonnes of gas. Our recommendation would be that concurrent flaring to allow oil production is unacceptable and technically unnecessary. The plant start up should prioritise production of the highest GOR well possible to provide hydrocarbon gas for starting the gas plant, prior to commencing oil train start-up, or detailed technical justification provided as to why this is not possible.	The FDP and EIS plan to execute a start-up with minimal flaring of Associated Gas, we have provided for the normal sequence of an oil production facility. Normal practice is to start Utilities, then introduce production fluids through the separation system, establishing steady state flow. During this temporary short term period, Associated Gas is flared, until the Gas System can be put online. The EIS has made an allowance for flaring during these commissioning activities however Navitas will work to minimise these periods during design and operations phases.	N/A
Xodus 9	Page 177: Section 5.8.4.3 Gas Management System, states: “Where possible, any gas not required for fuel or lift gas will be reinjected into the GI well.” “Where possible” is very non-committal language for a crucial part of operating philosophy, with respect to minimising emissions. Flaring of produced gas with a no export route constitutes routine flaring and would be at odds with World Bank Zero Flaring initiative.	To clarify, there is no plan for routine flaring, this is clear in our FDP. Any excess gas not being used for lift gas or used for fuel gas will be re-injected and flare reduced to minimum safe flare.	N/A
Xodus 10	Page 182: Section 5.8.5.4 Produced water process describes the use of a degasser and potentially gas floatation unit. Both of these will have a low-pressure hydrocarbon vent stream – it should be confirmed that this stream is recovered to the flare and/or VRU.	We can confirm the use of Hydrocyclones and a Compact Gas Floatation Unit (CGFU) for Produced Water processing. It is confirmed that vapours from the low pressure CGFU will be captured *via* the VRU.	N/A
Xodus 11	Page 801: By inspection the rated power for some of the process pumps appear very low considering the proposed design rates, notably the “Degassed Water Pumps” – at 72 kW.	Produced water processing rates for the Sea Lion FPSO align with the current design rate of the analogous FPSO for the purposes of the EIA, and as such the rated power is deemed adequate.	N/A
Xodus 12	Page 795: Given the links between the Falklands and the UK, the NSTD and OGA Plan for emissions reduction guidance should be referenced and the applicability discussed.	The EIS complies with FIG regulation, and the NSTD / OGA policy guidance referred to has not been adopted by the Falkland Islands.	N/A

Reference	Request for information	Navitas response	Addressed
Xodus 13	Page 799: Review and document selection of main power generation technology, considering as a minimum CCGT; other hybrid and or renewable generation (e.g., wind) may also be considered to supplement gas power generation.	Please refer to Xodus 1.	N/A
Xodus 14	Page 815: A holistic and integrated review of power generation usage profiles, taking into account the above possibilities to ensure that fuel use and related emissions are minimised. Ensure all power users are accounted for and dynamic loads (power *vs.* throughput curves) used for main items of equipment, e.g., compressors and water injection pumps.	Please refer to Xodus 5	N/A
Xodus 15	Page 820: Recalculate and provide justification for FPSO power generation fuel use. The fuels gas use values appear to be arbitrary, with the incorrect assumption that power use declines with oil production and no calculation or justification provided. The fuel use should be linked to the fluid processing rates, equipment capacities and include consideration of generator efficiency curves.	Power use will reduce over time for the FPSO. As Oil production decreases so does Associated (Produced Gas), requiring less compression power as Re-injection Gas rates will decrease. Water heating requirements will reduce over time and the injection power requirements will remain at approximately the same level until Total Produced Liquids rates fall below the nameplate capacity of the facility and, therefore, voidage replacement requirements decrease.	N/A
Xodus 16	Pages 34, 130, 168, 177, 591, 603, 797, 1269: Provide clear commitment to, and design basis for, gas reinjection: i) there is an apparent discrepancy with produced gas rates and ability to re-inject this gas should be clarified	There is no discrepancy between Produced Gas Rates and Re-injection in Phase 1. Sufficient Gas Compression capacity exists to re-inject all Associated Gas. Gas Lift rates will vary within the Gas Compression design limits to ensure Gas Injection is maintained.	N/A
Xodus 17	Emissions spread-sheet: ii) assumed availability of gas re-injection is 98.4% (shutdown for 6/365 days per year) - this should be backed up by calculation to show that this high availability is achievable based on equipment selection, sparing and maintenance plans, e.g., through RAM,	RAM studies will be completed during FEED to validate the assumed availability. If the reliability is lower, production will be temporarily curtailed	N/A

Reference	Request for information	Navitas response	Addressed
	and reference to OREDA (Offshore Reliability Database) values, or similar, and matched to predicted production profiles, referencing P10/50/90 cases as applicable.	thereby not negatively impacting emissions. Furthermore, see response to Xodus 19	
Xodus 18	Page 827: Provide clear design basis for vapour and flare gas recovery, considering stripping gas rates, reasonable valve leakage rates and purges. It should document operability, maintainability and resultant availability of the lowpressure flare and vapour recovery systems, backed up through calculation, e.g., through RAM modelling, and reference to OREDA (Offshore Reliability Database) values, or similar, and matched to predicted production profiles, referencing P10/50/90 cases as applicable. The terminology "VRP" or "VRU" is often used to describe a type of scrubbing system that removes volatile organic components (VOCs) or nonmethane NM-VOCs. This system recovers some of the heavier components from the vent stream, while the residual methane is vented. Best practice would be to integrate the VRP with the FGR and recover the HC gas back to the process.	HP Flare will have no continuous feeds to the flare system. HP system purge will be Nitrogen. LP Flare will have several continuous feeds to the flare system including Cargo Tank fuel gas blanketing, LP system fuel gas purge, various low pressure feeds from Process Systems (e.g., Produced Water CPFU, Oil Treater Overheads, etc) – as the LP Flare system will be a closed system, all will be captured *via* the VRU.	N/A
Xodus 19	Page 820 & Emissions spread-sheet: The production uptime is assumed to be 100% for the calculations, however there are conflicting statements within the EIS. In Table 10.63 it is stated that "Fuel gas is expected to be available for 93 - 95% of the time. Downtime of the fuel gas relates to times of no production due to planned or emergency shutdowns", however in Section 5.8.3.2 "it is expected that fuel gas will be available for 100% of the time once the system is fully commissioned." We would expect uptime to be between 85 – 95% of the time, and the emissions calculations adjusted to reflect this.	In presenting emission values based on 100% uptime Navitas has presented the conservative values which provides an over estimate of emissions to cover all scenarios, essentially bounding the upper limit which is in accordance with the agreed EIS philosophy. This scenario assumes 100% uptime of gas whereas the downtime is factored in for diesel use i.e., fuel gas and diesel both in use when fuel gas is down.	Section 10.9 Table 10.69
Xodus 20	Emissions spread-sheet: It is recommended to align the production uptime with that used in the economic and reservoir/production modelling.	Please refer to Xodus 19.	N/A
Xodus 21	Page 816: The production profile, Figure 5-8, shows gas, total fluids and water injection rates all increase until year 15. The oil rate reduces but this	Power requirements will reduce over the life of the field. After Year one, heating of the Injection Water	N/A

Reference	Request for information	Navitas response	Addressed
	could only account for a small portion of the reduction perhaps a 100 kW, and likely and oil transfer pumps would simply be in recycle. Further the water handling rate increases offsetting any reduction. The statement: The need for power over the life of field decreases as production volumes decline appears to be fundamentally incorrect. The entire premise of fuel gas use calculation appears questionable. This is of major concern as these emissions make up approx. 80% of the total life time emissions.	will no longer be required. Oil heating requirements will reduce with lower oil production rates. Injection Water/Produced Water pump power demands will remain approximately equal until Total Produced Fluids drop below nameplate (once Oil rates cannot make up the difference between the capped Produced Water Treatment capacity and the Total Fluids processing capacity) and the voidage replacement requirement starts to decrease.	
Xodus 22	Page 169: In our experience, the peak efficiency of a Solar Mars on fuel gas is around 35%. We did an approximate calculation for the fuel gas rate to the turbines in years 1 and 2, assuming a 50/50 split of fuel gas turbines, on full load and a fuel gas composition of approximately 75% CH4, and the resultant efficiency was around 20%. This suggests that the turbines are operating inefficiently for the majority of the asset life and possibly indicates an overestimation of fuel gas requirements	The Sea Lion EIS has utilised conservative efficiencies which provides an over estimate of emissions to ensure we capture all potential scenarios. The Aoka Mizu was used as an analogous vessel for the purposes of the EIS.	N/A
Xodus 23	Page 800: The key consumers of electricity (Table 10.55) have single assigned values for power demand. This is incorrect, especially for intermittent sources such as offloading and propulsion. In addition, the sources do not include any associated equipment for FGR or the VRP. We would typically expect an increased power consumption resulting from the inclusion of additional equipment such as a compressor. If this is incorporated into Table 10.55 it should be clearly labelled as such. However, given the statements above, the power use profile appears not to have been used in estimating the fuel gas consumption	Navitas did not use the power use profile. A flat fuel consumption profile was assumed that will be conservative in the related emissions estimates. The post-consultation EIS will be reviewed to ensure that this is clear.	Table 10.59
Xodus 24	Page 828: There is misalignment in the approach to inclusion of indirect GHGs, as the language in Section 10.9.4.5.1 suggests omission of these would be an underestimate of emissions. However, IPCC reporting does not include indirect gases, and therefore any reference to these being an underestimate should be treated with caution.	Navitas will delete the sentence: “Further, they do not include the indirect gases.”	Section 10.9.4.5.1

Reference	Request for information	Navitas response	Addressed
Xodus 25	Page 819: The required [HP purge and pilot] rate [is] affected by flare tip and seal design, and should be carefully considered, with a view to minimising. Robust means to measure and control the purge rate are also essential. We would also suggest investigating the option of an inert gas purge (e.g., nitrogen) to reduce continuous emissions and maintain the integrity of the flare.	The purge rates for the Aoka Mizu have been confirmed to be significantly lower than originally informed in the EIS – additionally, refer to the clarifications provided to the comment on Page 827 above (Comment #18). Navitas shall update the Post-consultation EIS accordingly to this effect.	Section 10.9.4.4.5
Xodus 26	Page 177: We would typically expect consideration of a ballistic ignition system for FGR, allowing the pilot to be removed while providing a reliable spark. This does, however, require a robust flare monitoring system. Several sections of the EIS refer to the removal of a pilot as "not currently sufficiently proven", however this has been routine in Norway for a number of years. Although not suitable for every installation, it is something we would expect to be assessed for the development.	Navitas will review and monitor the technology and consider implementation when appropriate. Navitas will review the post-consultation EIS to ensure that this commitment is clear and consistent throughout.	Section 10.1 Section 15.7.1
Xodus 27	Page 826: The inventory blowdown calculation (Section 10.9.4.4.5.1) is based on a specified time and gas rate, based on the 15 min API requirements. However, depressurisation will continue beyond this 15 min period in reality. A simple and more accurate approach is to consider the change in mass of gas using the actual pipe/vessel volume and the start and end pressures. This would provide a more realistic and accurate representation of the inventory release. It is also noted there is an error in the total calculated CO_2e emissions in Table 10.69 (missing decimal point).	The missing decimal point will be corrected in the post-consultation EIS. Due to the typical pressure decay curve associated with a blowdown the mass inventory remaining after 15 minutes would be relatively insignificant in comparison. Please note that the inventory blowdown calculation will be refined during FEED.	Table 10.75
Xodus 28	Page 827: Inert gas changeover: Section 10.9.4.4.5.2 Venting emissions offshore states a value for the HC gas emitted during the changeover, which is reasonable, but this value is not included in the calculations, on the basis the availability of the VRP cannot be estimated, yet the this is comparable to the number of ESDs	The cargo blanket gas has been updated to Fuel Gas from Inert Gas so this comment should be satisfied. The Fuel Gas blanketing the Cargo Tanks will be recovered *via* the VRU.	N/A

Reference	Request for information	Navitas response	Addressed
	assumed, or the assumed number of days per month that gas injection is not available. The residual methane and VOCs evolved from the stabilised crude when blanketed within inert gas are also not included.		
Xodus 29	Page 827: Section 10.9.4.4.5.2 states "venting estimates are not included in the overall estimates of the development emissions, or annual average, as it is not possible to credibly estimate how often this may be required". However, the emissions are then estimated as 78 tonnes.	The RAM study to be conducted during FEED will help inform the anticipated number of venting events. Operational data will be used from First-Oil to inform the Sea Lion Emissions model. During the commencement of Production and over the first year of production, it is reasonable to assume spurious trips will be more frequent then decrease as the Operations team becomes more experienced in the operation of the FPSO and any residual Commissioning issues are addressed. Navitas will review the statements on venting in the post-consultation EIS, and will include an estimate for fugitive emissions.	Section 10.9 Table 10.69
Xodus 30	Page 130: "This associated gas will be used for fuel on the installation, for 'gas blankets' in cargo / slops tanks and for 'gas lift' to improve the oil recovery. Any surplus gas will be re-injected into the GI well." It is noted that there is "dehydration" gas process which typically uses fuel gas as stripping gas. There is no mention of this fuel gas user. Query if this is the case, and if so, should be captured in emissions etc. or discussed as a user that is recovered in the closed flare or VRU	Stripping Gas from the Gas Dehydration Unit will be recovered *via* the LP Flare system to the VRU.	N/A
Xodus 31	Page 168: Table 5.14. Is gas handling capacity going to be upgraded prior to Phase 2? There is no mention of this. Important as gas production would exceed Phase 1 design rate and will result in large amounts of flaring.	Emission calculations are consistent with our plan to deliver Phase 1 & 2 production. Navitas will update	Section 5.8.2.2 Table 5.14

Reference	Request for information	Navitas response	Addressed
		Table 5.14 in the post-consultation EIS, and ensure that the information presented is consistent in the FDP. Section 5.8.2.2 will be edited to read; 'The FPSO will be designed to deliver the FDP production profile for both Phase 1 and 2. Minor upgrades to topsides equipment or updated operating procedures may be implemented to achieve target rates.'	
Xodus 32	Page 176: "Flare purge and pilot" It is noted that there is no inclusion of Flare Purge rates within Chapter 10.9, and therefore no emissions associated. Specifically, important for purge rates on HP flare as current design states that this flare is not closed.	Please refer to the comments made to Xodus 18.	N/A
Xodus 33	Page 177: "The FPSO has a gas handling / compression capacity of 50 mmscfd." Table 5.14 states that gas handling for Phase 2 will be 130 MMSCFD. 50 MMSCFD may not cover anticipated production profile, or gas lift requirements. This may result in additional flaring and increased emissions.	Emission calculations are consistent with our plan to deliver Phase 1 & 2 production. Navitas will update Table 5.14 in the post-consultation EIS, and ensure that the information presented is consistent in the FDP. Section 5.8.2.2 will be edited to read: 'The FPSO will be designed to deliver the FDP production profile for both Phase 1 and 2. Minor upgrades to topsides equipment or updated operating procedures may be implemented to achieve target rates.'	Section 5.8.2.2 Table 5.14
Xodus 34	Page 169: It is unclear if the production P50 profiles, e.g., in Figure 5-8 is the associated gas rate, or the total gas rate, including gas lift (which is essentially circulated). It would be good to see a clear balance of associated produced gas profile, or maximum rates compared with the gas injection capacity, and the total gas plant rate matching with compression train capacity	The simulated production profile displays produced gas, which does not include gas lift. Navitas can deliver the profile within the stated facility constraints.	Figure 5-8

Reference	Request for information	Navitas response	Addressed
		Navitas shall update the Post-consultation EIS to this effect.	
Xodus 35	Page 177: "On the High Pressure (HP) flare system there are no continuous sources such that no recovery system is required" It is best practice to close the HP flare by design. It is anticipated that the HP flare system would have purge gas, typically fuel gas, which would be considered a continuous source to flare. Additionally, closed flare system would allow for the capture of any other intermittent sources, or for example passing valves.	Please refer to Xodus 18. It is common practice in recent developments to apply a Closed Flare design to the LP Flare system (as is being done here). Applying a Closed Flare design concept to the HP Flare (in addition to the elimination of any continuous flare sources, including purge gas, as noted above) is much less common, due to the inherent increased consequence of a failure in the fast-acting valve system and additional safeguards.	N/A
Xodus 36	Page 177: "The pilot flames are expected to burn approximately 0.5 - 1 mmscfd." Flare pilot rate is stated to be very high (based upon EIS 0.5 MMSCFD = approx. 14 tonnes per day). It is generally anticipated that flare pilot typically be an order of magnitude lower.	The statement, as written, is overly conservative these values include continuous flare sources, including fuel gas purges (which, as noted above, have either been eliminated *via* Nitrogen purge for the HP Flare, or captured back to the VRU for the LP Flare). Navitas shall update the Post-consultation EIS accordingly to this effect.	Section 5.8.4.4 Section 10.9 Table 10.69
Xodus 37	Page 193: "use of fuel for the back-up generator would be offset against the reduced fuel use at the power station such that no additional emissions would result." No calculation to back this up.	The comment assumes that power generation efficiency is equivalent. Navitas shall update the Post-consultation EIS accordingly to this effect.	Section 5.11.1.2.1
Xodus 38	Page 211: "No routine flaring during normal production (notwithstanding the flare pilot light), "Use of a Flare Recovery Package during normal operations," Continuous flare source would also include flare purge (assuming that this is	Please refer to the comments made to Xodus 18.	N/A

Reference	Request for information	Navitas response	Addressed
	fuel gas purge). This would be recovered in LP flare, however as HP Flare is not closed this would be continuous emissions to atmosphere.		
Xodus 39	Page 797: Global Methane Pledge - OGMP 2.0 Framework should be referenced as best practice.	The UK has signed up to the Oil and Gas Methane Partnership (OGMP) 2.0 in 2022, but Navitas' understanding is that this does not include the Falkland Islands. EIS Section 10.9.1.1.2 currently includes the statement that 'Navitas strive to comply with the principles of the Methane Pledge with the target of zero cold venting as part of the Phase 1 & 2 Development basis of design, and similarly with the ZRF initiative to achieve zero routine flaring. ' Navitas are aware of the updated GMP 2.0 Framework and that the UK has signed up to this. Once UK legislation has been amended to enact the requirements of the GMP 2.0, Navitas will review the requirements, and its commitments, in discussion with FIG. This will be added to the post-consultation EIS for clarity.	Section 10.9.1.1.2
Xodus 40	Page 800: Table 10.55 Power demand rates should consider transient operations, particularly propulsion and offloading.	The Load Study will be revised during FEED. Propulsion power requirements are expected to be very low, which will be reflected in the Demand Factor of the Load Study and is not expected to impact overall Power Requirements. Offloading cases will be defined specifically in the Load Study – Load Shedding may be implemented.	N/A

Reference	Request for information	Navitas response	Addressed
Xodus 41	Page 804: To mitigate any uncertainty, only AR5 without climate feedback should be presented in the main body of the report and used for the subsequent calculations	All calculations have been carried out using the AR5 W/O feedback. Different GWP values are only used to enable like-for-like comparisons where the dataset being compared to used GWP's other than AR5 w/o carbon feedback. Where this is necessary, this is indicated within the relevant EIS section.	N/A
Xodus 42	Page 808: Ocean acidification - unclear why this is included but not any other element of the physical environment.	Ocean acidification is itemised as this is a separate impact resulting from CO_2 emissions and does not fall under the umbrella of impacts associated with climate change. The known impacts of emissions are described in Section 10.9.4.2 on the 'Nature of the Impact' which itemises the broad physical impacts associated with climate change, ocean acidification and acid deposition. The climate change impact assessment does not itemise each physical impact e.g., sea level rise, changing climate zones etc. as it is not possible to meaningfully assess the severity of effect that may result from Navitas' emissions alone. Of note, The DMR EIA guidance requires the EIS to look specifically at the impact of emissions on water quality (4c of Schedule 4), see Appendix 2 of the EIS.	N/A
Xodus 43	Page 817: Table 10.63 – "Production levels at the P50 case" Inclusion of associated produced gas for context of fuel gas usage would be beneficial.	This is shown in the 2C production profile (Figure 5-8).	Table 10.69
Xodus 44	Page 812: Figure 10-37 Figure is outdated, and more relevant information is available from NSTA for current operations. No indication of boundaries of this figure (e.g., scope of emissions).	Navitas shall update the Post-consultation EIS with a graph detailing the actual numbers.	Table 10.65 (replacing the figure)

Reference	Request for information	Navitas response	Addressed
Xodus 45	Page 816: "the average fuel gas consumed will be *c.* 5.5 mmscfd." The approach of averaging the fuel gas consumption does not account for the gas turbine efficiency or adequate capacity for different operating modes. This could result in the equipment being undersized for the required capacity.	The Fuel Gas System will be designed to accommodate peak Fuel Gas Rates as dictated by the Power Generation System.	N/A
Xodus 46	Page 817: "POEPL assumed a conversion rate of 1 mmscf gas = 27.8 t, which, based on the samples, Navitas consider to be highly conservative" One gas composition (and therefore conversion rate) should be used for both cases. As the gas composition is available, we would expect asset specific emissions factors for flaring and venting estimates, as this would provide more accurate figures. The gas composition is changed between base and worst-cases, which is the source of about ~60% of the difference in FPSO related emissions (gas conversion rates given in Table 10.63). Typically, we would expect this to remain constant for a fair comparison, with a sensitivity for both cases if the composition is unknown.	Updated conversion factors and emissions factors will be considered by Navitas in the future update of the EIS and/or when reporting annual emissions. Navitas used a conservative conversion rate for the worst-case but will use the Navitas calculated conversion rate for both cases in the post-consultation EIS following consultation with FIG. The post-consultation EIS will be checked to ensure that the quoted gas composition is consistent throughout.	Table 10.69 Table 10.72 Table 10.73 Table 10.74 and all references to numbers in the text throughout
Xodus 47	Page 819: Table 10.63 implies that combustion of the sold product emissions is considered for the worst-case only. The boundary of the assessment should be clearly defined and consistent for both cases.	Table 10.63 will be clarified in the future EIS update to reflect that Combustion of sold product would be the same for both worst-case and current expected scenarios. At this stage the final use of sold product is not known, so Navitas has assumed a worst-case that all is combusted. Navitas will update the post-consultation EIS and merge cell across both columns of table 10.63 to reflect this.	Table 10.69
Xodus 48	Page 820 Emissions spread-sheet: Vessel fuel consumption The fuel consumption is calculated as an average of different activities.	The daily vessel consumption is based on an averaged consumption rate. This provides the clearest, fairest and most logical approach to establishing the long-	N/A

Reference	Request for information	Navitas response	Addressed
	For clarity each activity fuel consumption and expected days should be outlined.	term vessel usage and emissions. Taking the example of a PSV (Pacific Leader): - 7.5mt per 24 hours in transit at economical speed (11 kts) - 14mt per 24 hours in transit in heavy weather at 14 kts - 5.55mt per 24 hours station keeping on DP alongside the MODU or FPSO - 3mt per 24 hours when “drifting” on a single engine outside the 500m zone of the MODU / FPSO awaiting loading / discharge operations - 2mt per 24 hours when alongside a harbour (such as the TDF) Splitting the vessel usage timings across a 30-year schedule on this basis would be unrealistic. Again, looking at the PSV usage by way of example, a 48-hour period could consist of the following activities: - 12 hours transit at 11 kts from TDF to FPSO - 2 hours waiting on the FPSO to be ready (drifting on a single engine) - 3 hours on DP offloading cargo - 2 hours drifting - 3 hours on DP backloading cargo - 14 hours transit at 11kts from FPSO to TDF through heavy weather - 9 hours go to anchor awaiting a berth at the TDF - 3 hours alongside the TDF The averaged consumption rate for all example vessels has therefore been based upon:	

Reference	Request for information	Navitas response	Addressed
		1. Expected usage patterns 2. Previous analogous experience and 3. Case studies using typical vessel types Navitas believe that this provides a conservative, true and fair usage / emissions benchmark across the lifetime of the emissions model and will work to optimise and reduce this during the field life.	
Xodus 49	Page 821: Table 10.64 – "Unplanned Events" Does this capture flaring on start-up following the shutdown, as well as the emissions associated with the shutdown event itself?	Navitas can confirm that the table includes flaring during startup post an unplanned shutdown.	N/A
Xodus 50	Page 822: Table 10.65 Emissions factors use multiple sources. Suggest for each activity a single source is used. For consistency this should be one data source. Where gas composition is available, asset specific factors should be used for flaring and venting.	EEMS was not used because there are more recent EFs available from reputable sources for calculation of direct GHGs. Calculation of the annual GHG Inventory must be carried out by Navitas during operations according to the GHG Protocol and ISO14064 standards which requires the most recent emissions factors available – EEMS is outdated for direct GHGs, but UK government factors do not include indirect EFs. Indirect GHGs are not included in the total CO_2e calculation, therefore use of multiple sources is not impacting CO_2e calculations. Once operations commence, this will be considered for annual recording & reporting going forward.	N/A

Reference	Request for information	Navitas response	Addressed
		Project Specific Emission Factors will be prepared once validated process data becomes available.	
Xodus 51	Page 826: Emergency blowdown calculation The volume of gas released should be calculated using pipe volume and pressures.	Please refer to response Xodus 27.	N/A
Xodus 52	Page 827: "Note that venting estimates are not included in the overall estimates of the Development emissions, or annual average, as it is not possible to credibly estimate how often this may be required." Recommended that assumptions are made for this and captured in worst-case project emissions forecast.	Please refer to response Xodus 29.	Table 10.69
Xodus 53	Page 827: In Table 10.69 there is a mix of significant figures and data errors.	This has already been identified by Navitas. Statements explaining the rounding will be added to the revised Emissions Chapter.	Section 10.9 Table 10.75
Xodus 54	Page 831: "These show that the average carbon intensity estimates per annum, based upon the worst-case assumptions itemised in Table 10.63 above, range from 25.8 – 35.2 $kgCO_2$/boe" Confirm how these carbon intensities have been calculated. From Figures 10-39 to 10-41 this seems low.	Total Worst-case life-of-field Emissions Intensity ($kgCO_2e$/boe) = (Total emissions over life of field in tonnes CO_2e x 1,000 to convert to kg) / (Total oil production in barrels for each production case). e.g., 'worst case' P50 average EI = (7,332,951 tCO2e * 1,000)/(310.5 MMbbl * 1,000,000) = 23.6 kgCO2e/boe . Navitas will add this as a footnote in EIS Section 10.9.4.5.4.	Section 10.9.4.5.4 **Note:** the estimates mentioned in the response column have subsequently reduced following changes to the gas conversion rate in response to Xodus 46
Xodus 55	Page 831: "Assuming the producing installation will be a 'lease and operate' FPSO, refitted between 11 - 25 years ago, the average P50 carbon intensity, and indeed all the carbon intensity estimates above, can be compared to the UK average carbon intensity of 39 $kgCO_2$/boe (Section 10.9.4.3.2.3) indicating that the Development is comparatively efficient."	At the time of publishing the EIS, the 2023 NSTA Emissions Monitoring Report was most recent which stated carbon intensity (i.e., CO2 only) for Floating Installation 11-25 years = 36 $kgCO_2e$/boe. NSTA Emissions Monitoring Report 2024:	Section 10.9.4.3.2.3 Section 10.9.4.5.4

Reference	Request for information	Navitas response	Addressed
	Not equivalent comparison. The development should be treated as a new FPSO.	Emissions intensity of Floating Installation 0-10 Years = 20 $kgCO_2e$/boe Emissions intensity of Floating Installation 11-25 Years = 36 $kgCO_2e$/boe Note – NSTA averages reflect actual reported operational emissions intensity (Scope 1), whereas EIS presents worst-case. Navitas shall update the post-consultation EIS with the 2024 NSTA report. EIS Section 10.9.4.4.4 notes that currently expected emissions from Sea Lion are 17.9 kgCO2e/boe. This section also notes that 'when the personnel transportation, drilling and vessel emissions are excluded to enable better like-for-like comparison with UKCS emissions reported to the NSTA, the carbon intensity is estimated to be 14.2 $kgCO_2e$/boe (section 10.9.4.5.4).' Consequently, Sea Lion current expected case carbon intensity benchmarks under the NSTA average for an FPSO of 0-10 years. This is without the additional emissions reductions measures that will be considered in FEED and the ERAP.	
Xodus 56	Page 829: Comparison with UKCS emissions Assumptions are not consistent with those from UKCS (e.g., EEMS is standard in UKCS for unknown emissions factors) and the scope of assessment is different. It is not correct to compare the averaged annual	UKCS numbers used for the comparison represent an average of all fields which include production from fields at all phases of field life, so comparing to the Sea Lion total average number is not unreasonable	N/A

Reference	Request for information	Navitas response	Addressed
	emissions for the development, it should be compared on an annual basis. We would expect EEMS to be used as standard if asset specific emissions factors are not available.	and more representative than using just a single arbitrary year from Sea Lion. Reported UKCS emissions are actual operational emissions (Scope 1 only).	
Xodus 57	Emissions spread-sheet: Cold venting uses the OGP emissions factors, with a value of 7 for methane given in Table 10.65. We suspect this is a typo and should be 0.7. However, we would be expecting EEMS to be used to be consistent with other emissions factors. We suspect methane has been overestimated in the current calculations by use of 7 tCH4 / t pollutant as the emissions factor, given in Table 10.65.	Navitas will work with FIG to determine the required methodology that will be adopted for emissions reporting. This will not be to OPRED *via* EEMS but Navitas consider it is likely to be aligned with GHG protocol/ISO 14064 standards.	N/A
Xodus 58	Page 833: Comparison with UK carbon budget This comparison is incorrect. We would recommend estimating emissions from the development for each relevant 5-year budget period and presenting as a percentage of the 5-year budget	Navitas note this comment and the post-consultation EIS will be updated to reflect this.	Table 10.79
Xodus 59	Page 837: Cumulative impact (Section 10.9.9) seems to solely consider other oil and gas activity. It is unclear why this is the case, as we would expect GHG emissions from all activities to contribute to cumulative impacts, making the assessment challenging. Setting this in the context of carbon budgets or net zero targets (for example) enables some consideration to be achieved but this comparison shouldn't be limited to oil and gas. We also noted that the source of NEFL and POEPL emissions numbers in Table 10.72 should be referenced	As described in 10.9.4.3.1, historical GHG emissions from other sectors e.g., fishing, O&G, shipping, aviation and other industries in the region are not available within the Falkland Islands data set, and nor are projections available. The predicted O&G emissions data provided in Table 10.81 (previously Table 10.72) were taken from the previous EIS's submitted and these were used and itemised as the only data available. While Table 10.62 (previously Table 10.58) does provide a breakdown of historic Falkland Island emissions by sector (albeit without data from the above activities), these are of little value when considering the future project emissions. Data from Table 10.62 could be extrapolated but this is considered to add little value and while the	Sections 10.9.4.5.1 & 10.9.9 Table 10.81

Reference	Request for information	Navitas response	Addressed
		reported Falkland Islands emissions should go down as efficiencies improve, in reality they will go up when aviation, shipping etc. are included. The data in Table 10.81 will be referenced in the updated EIS. Section 10.9.4.5.1 has been updated with a footnote. **Note:** comparisons with LULUCF and waste were not included as these are not 'sectors'. We have received 2023 data from the FIG Environment Dept, we did not feel it appropriate to include this data as this would be deviating from data that was provided in the ES during public consultation. As data matures, Navitas will monitor the opportunity to undertake more robust sectoral comparisons.	
Xodus 60	Page 838: "compare 'like-for-like' emissions data" A like-for-like comparison has not been carried out. The calculated emissions from the development should be presented in such a way that a direct comparison can be taken, such as defining scope 1, 2 and 3 emissions, instead of stating that they "may be over-represented". We would suggest a table outlining the scope 1, 2 and 3 emissions with inclusions and (where applicable) exclusions with justification.	Navitas is not clear on the comment as the only reference to 'like-for-like' on page 838 is in Section 10.9.10 which is the confidence assessment. This reference to 'like-for-like' is simply making the point that, where possible, comparisons were made using comparable GWPs etc. However, it is recognised that true like-for-like comparison is not possible as North Sea operators all use different boundaries, emissions factors and GWPs etc. What is presented is based on the best information available to provide the reader with a like-for-like comparison. Nonetheless, the reference will be removed to avoid confusion. Navitas has provided an estimate of all direct and indirect operational emissions across the full life of	Section 10.9.10

		the project. This will include Scope 1, 2 and 3 emissions. However, it is premature to assign the estimated emissions to particular Scopes at this stage of the project. According to the GHG Protocol, assignment of Scope 1, 2 and 3 relies on specific criteria around operational and financial control. Since no contracts are yet in place for this project, it is not clear which categories some sources would be assigned to, risking presenting a misleading view of emissions by scope at this point in the project. Annual reporting of actual GHG emissions will be done according to the GHG Protocol, an internationally recognised standard for emissions accounting, and will include classification of emissions by scope as part of that reporting. While the EIA Guidance suggests that FIG needs to know how the industry will increase emissions in comparison to other local sectors, and that FIG can provide data (FIG EIA Guidance 3.15), FIG Environment was not able to provide sufficiently detailed data to enable any meaningful sectoral comparisons to be made. 10.9.4.3.1 notes that the Falkland Islands emissions do not include emissions from international aviation and shipping and that these and other omissions must be taken into account when making direct comparisons. It states further that all comparisons between the Phase 1 & 2 emissions and Falkland Islands emissions must be caveated. Noting these caveats, in 10.9.4.5.1, Navitas has provided an assessment of the Phase 1 & 2 development in comparison to Falkland Islands emissions using the data available.	

Reference	Request for information	Navitas response	Addressed
Xodus 61	General: We would encourage inclusion of embodied carbon for construction and drilling, providing a full picture of the development emissions. As scope 2 and 3 emissions are already incorporated, including the end use of the product, we feel like embodied carbon should also be considered	Embedded carbon emissions are not required under the FIG EIA guidance. Furthermore, OPRED and SAMS did not suggest this be considered in their compliance review. **Note:** Embedded carbon is a large, detailed piece of work and not commonly included in other UKCS emissions estimates for a development EIS. e.g., Rosebank EIS does not include embedded emissions.	N/A

Byron Holdings Limited
Byron House
No 3 'H' Jones Road
Stanley
Falkland Islands FIQQ 1ZZ

Tel: +500 22245
Fax: +500 22246

Email: dlclifton@byronmarine.com

A member of the Byron Group of Companies

13th August 2024

The Director of Minerals Resources
PO Box 893
Ross Road
Stanley
Falkland Islands

To Whom it May Concern

A response to 57-page Falklands Conservation submission to the Navitas Petroleum EIS.

We wish to comment on the widely circulated 57-page Falklands Conservation submission to the Navitas EIS.

Falklands Conservation states it works "*In partnership with government, industry and the global community…*" Accordingly, it should provide balanced environmental comments, positive and negative.

Falklands Conservation does not put its submission in the current Falklands environmental context: fishing, cruise, tourism and agricultural industries and civilian and military activities. The latter daily delivers the Falklands critical security. The main Falklands economic activities are significant, including:

- Cruise ships make approx. 200 calls to ports and islands in the Falklands. Each cruise ship spends days at sea to and from the Falklands. In addition, cruise passengers typically fly long haul to join the vessels that visit the Falklands.
- The fishing industry can have well over 100 hundred large fishing vessels operating in Falklands waters. Additionally, these vessels are supported by tankers, reefer vessels and a patrol ship.

The uncomfortable reality for us all, is that all human economic and most social activities produce emissions. While carrying out these activities, we seek to minimise the emissions. This includes the Falklands, where economic, social and governmental activities are necessary to sustain the Falklands and its Community. The Environmental Impact of the Sea Lion development needs to be considered in the context of current Falklands activities.

Registered No. 10417
Directors: S.P. Clifton, J.M. Morris, D.L. Clifton

The environmental impact of the Sea Lion development and operation will be a fraction of current Falkland Islands activities i.e. Sea Lion development will use state-of-the-art efficient vessels for:

A. Drilling & Installation. 18 months – 7 vessels. The Drilling Unit ('rig') will be supported by two Offshore Support Vessels (OSV) and an Emergency Response and Rescue Vessel (ERRV). These three support vessels will also support the field's construction and installation, including the Floating Production Storage & Offloading (FPSO). In addition, four Large Transport Vessels (LTVs) will be used to support the construction and installation operations, with a maximum of two vessels anchored in Berkeley Sound at any one time, for a combined total period of c. 13 months.
B. Production - c. up to 25 years – 3 vessels. The FPSO will be supported by an OSV and an ERRV.

This relatively low impact, in comparison to its size, is because most of the Sea Lion activity is contained, under the sea bed.

In their submission, Falklands Conservation highlight multiple issues. There is no environmental impact comparison with the current Falklands activities:

- CO^2 emissions. There is not a single reference to the emissions from current activities, which will be far greater than Sea Lion emissions. Current activities are not required to offset their emissions. The Sea Lion development plans to offset its emissions from drilling through production.

  The emissions from the final user using the oil produced by Sea Lion will be significant. However, it should be for the user of the oil to decide whether to offset these or not. No country, including the UK, USA, Norway, etc., makes a producer do this. It is up to the user to decide firstly what energy source to use, and then if they wish to offset any GHG produced. This seems fair and in line with 'User Pay' principles.

- bird strikes (including the incidental bycatch of sea birds)
- bird landings on vessels
- mammal entanglement or collisions - fishing by its nature requires extensive nets and lines
- underwater noise
- Berkeley Sound & Kidney Island. There is no comment at all about existing activities. A causal reader of the Falkland Conservation submission would think there are no commercial activities in Berkeley Sound or Port William! There is no recognition of fish transhipping and tanker bunkering activities. There is no comparison of the number of existing vessel movements, emissions and risks. In contrast, Sea Lion development will have a maximum of two vessels anchored in Berkeley Sound at any one time, for a combined total period of c. 13 months.

  The Falklands Conservation submission comments extensively about whales in Berkeley Sound. There is:
  - A much bigger risk of collisions with the Sei whales from fish transhipping and tankers bunkering fishing vessels operations and entering/departing
  - Sea bird colonies

Registered No. 10417
Directors: S.P. Clifton, J.M. Morris, D.L. Clifton

- Artificial Light – these are 24-hour operations and transhipping and bunkering require a significant amount of light to safely conduct

- Port facilities – Falklands Conservation raise TDF pile driving and dolphin sensitivity! The TDF causeway does NOT require piles! Falklands Conservation make no comments about the FIPASS port replacement with a much bigger causeway and quayside, which will require pile driving! This is an example of how biased their submission is.
- Sensitivity to oil spills - it would be helpful to compare the risks given the bunkering operations carried out by the usual two tankers, which carry out a lot of vessel bunkering in Berkeley Sound and offshore—all with NO tug assistance. In contrast, specialist OSVs will support the Sea Lion development movements.
- Artificial light inshore - the light pollution from Berkeley Sound and Port William transhipping operations radiates into Stanley. The number of vessels using FIPASS is many times the number of vessels scheduled to use the TDF, which is at greater distance from the Stanley residential area.
- Artificial light offshore— over a hundred jiggers can be operating at any one time. Cruise ship days throughout the Falklands inshore and offshore waters are significant. In contrast, the number of Sea Lion vessels and their light emissions will be proportionately much less.

It appears that current economic and social activities are acceptable to Falklands Conservation, as it is not agitating for these activities to have Environmental Impact Assessments or reduce their scale. Sea Lion development environmental impacts will be significantly smaller than existing Falkland Islands activities.

Falklands Conservation's 57-page submission does not include a single constructive comment. From their submission, Falklands Conservation are just anti-Sea Lion development. This is despite recognising that Oil and Gas will be part of the energy transition for the coming decades. Their submission is selective and one-sided and does not represent a balanced, fair submission.

Sea Lion development will likely have less impact on the points that Falklands Conservation has raised compared with the existing fishing and cruise industries. The fishing industry (catch and operations) has a bigger impact on sea birds and marine mammals than Sea Lion development will have.

Sincerely

D L Clifton

Director

Registered No. 10417
Directors: S.P. Clifton, J.M. Morris, D.L. Clifton

Figure 17-1: Response from Byron Holdings Ltd. to Falklands Conservation

18 ABBREVIATIONS

Abbreviation	Definition
ACAP	Agreement on the Conservation of Albatrosses and Petrels
ACC	Antarctic Circumpolar Current
AFS	Anti-Fouling Systems
AHT	Anchor Handling Tugs
AHTS	Anchor Handling Tug Supply
AHV	Anchor Handling Vessels
AIS	Automatic Identification System
AIW	Antarctic Intermediate Water
ALARP	As Low As Reasonably Practicable
AMAR	Autonomous Multichannel Acoustic Recorder
API	American Petroleum Institute
ART	Antarctic Research Trust
ASD	Azimuth Stern Drive
AVS	Area Vulnerability Score
BAS	British Antarctic Survey
BAT	Best Available Techniques
bbl	Barrel
bbl/d	Barrels per day
BCF	Bio-Concentration Factor
BFMP	Biofouling Management Plan
BGS	British Geological Survey
BOP	Blow-out Preventor
BRB	Biofouling Record Book
BMP	Biosecurity Management Plan
BSL	Benthic Solutions Ltd
BSMP	Bird Strike Management Plan
BTEX	Benzine, Toluene, Ethylene and Xylene
BWMP	Ballast Water Management Plan
BWRB	Ballast Water Record Book
CBD	Convention on Biological Diversity
CBFSAI	Commander of the British Forces South Atlantic Islands
CCR	Central Control Room
CDP	Carbon Disclosure Project
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CFSR	Climate Forecast Systems Reanalysis
CHARM	Chemical Hazard And Risk Management
chl-a	Chlorophyll-a
CITES	Convention on the International Trade in Endangered Species
CLC	International Convention on Civil Liability for Oil Pollution Damage
CMS	Convention on Migratory Species
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COLREGs	International Regulations for Preventing Collisions at Sea (1972)
CoP	Cessation of Production
COSHH	UK Control of substances Hazardous to Health
COW	Crude Oil Washing
CPA	Closest Point of Approach
CRMS	Craft Risk Management Standard
CTD	Conductivity, Temperature and Depth

Abbreviation	Definition
CTT	Conventional Trading Tanker
DC	Drill Centre
dB	Decibel
DBEIS	Department of Business, Energy and Industrial Strategy (formerly DECC)
DECC	Department of Energy and Climate Change
Defra	Department of Environment, Fisheries and Rural Affairs
DESNZ	Department for Energy Security and Net Zero
DMR	Department of Mineral Resources
DNR	Department of Natural Resources, now the Directorate of Natural Resources (as at 2023)
DoA	Department of Agriculture
DOSRV	Dedicated Oil Spill Response Vessel
DPR	Dairy Paddock Reservoir
DREAM	Dose-Related Risk and Effects Assessment Model
DS	Deep Slope
DWT	Dead Weight Tonnes
E&B	Environment and Biodiversity
EAC	Environmental Audit Committee
EC	European Community
ECMP	East Cove Military Port
EEDI	Energy Efficiency Design Index
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMMP	Environmental Monitoring and Management Plan
ENVIID	ENVironmental Impact IDentification
EnvSys	Environmental Systems
EOWR	End of Well Reports
EPD	Environmental Planning Department
EPB	East Plateau Basin
EPS	European Protected Species
ERA	Environmental Risk Assessment
ERL	Effect Range Low
ERM	Effect Range Median
ERP	Emergency Response Plan
ERRV	Emergency Response and Rescue Vessel
ESI	Environmental Sensitivity Index
ESP	Electrical Submersible Pumps
ExCo	Falkland Islands Government Executive Council
FC	Falklands Conservation
FCO	Foreign and Commonwealth Office
FLC	Flow Line Circulation
FEED	Front End Engineering Design
FIBU	Premier Oil Falkland Islands Business Unit
FICAD	Falkland Islands Civil Aviation Department
FICZ	Falkland Islands Interim Conservation and management Zone
FIFCA	Falkland Islands Fishing Company Association
FIFD	Falkland Islands Fisheries Department
FIG	Falkland Islands Government
FIGAS	Falkland Islands Government Air Service
FILFH	Falkland Islands Low Flying Handbook

Abbreviation	Definition
FIOHEF	Falkland Islands Offshore Hydrocarbons Environmental Forum
FIMBAr	Falkland Islands Marine Biological Archive
FIMSP	Falkland Islands Marine Spatial Plan
FIPASS	Falklands Interim Port And Storage System
FIRS	Falkland Islands Resupply Service
FITB	Falkland Islands Tourist Board
FMCF	Falkland / Malvinas Current Front
FOAO	Food of Animal Origin
FOCZ	Falklands Outer Conservation Zone
FOSA	Falklands Offshore Share Agreement
FPB	Falkland Plateau Basin
FPSO	Floating Production Storage and Offloading
FPV	Fisheries Patrol Vessel
FSO	Floating, Storage and Offloading Vessel
FTC	Fast Transit Carriers
GAM	Generalised Additive Models
GAP	Gap Analysis Programme
GC	Gas Chromatography
GC-FID	Gas Chromatography with Flame Ionisation Detections
GEBCO	General Bathymetric Chart of the Oceans
GHG	Greenhouse Gases
GIS	Geographic Information System
GOMO	Guidelines for Offshore Operations
GOR	Gas Oil Ratio
GPI	Gas Production / Injection
GRE	Glass Reinforced Epoxy
GRI	Global Reporting Initiative
GWP	Global Warming Potential
HAB	Harmful Algal Bloom
HC	Hydrocarbon
HLCV	Heavy Lift Cargo Vessels
HLV	Heavy Lift Vehicles
HMCS	Harmonised Mandatory Control Scheme
HMP	Harbour Management Plan
HP	High Pressure
NADF	High Performance Oil Based Mud
HF	High frequency
HS&S	Health Safety and Security
HSEx	Health and Safety Executive
HSP	Hydraulic Submersible Pumps
HUC	Hook-Up and Commissioning
HVAC	Heating, Ventilation and Air Conditioning
Hz	Hertz
IACS	International Association of Classification Sociteies
IAPP	International Air Pollution Prevention
IBA	Important Bird Area
ICAO	International Civil Aviation Organisation
ICSS	Integrated Control and Safety System
ICTU	Information, Clarity, Transparency and Understanding
ID	Inner Diameter
IEA	International Energy Agency

Abbreviation	Definition
IFC	International Finance Corporation
IMO	International Maritime Organisation
IMP	Iceberg Management Plan
INSITE	INfluence of man-made Structures In The Ecosystem
IOGP	International Association of O&G Producers
IOR	Improved Oil Recovery
IPA	Important Plant Area
IPMS	Integrated Production Management System
IPU	Integrated Production Umbilical
IS	Inner Shelf
ISV	Inshore Support Vessel
ITQ	Individual Transferrable Quota
IUCN	International Union for the Conservation of Nature
IWC	International Whaling Commission
JNCC	Joint Nature Conservation Committee
KBA	Key Biodiversity Area
KEMH	King Edward VII Memorial Hospital
km	kilometres
KPI	Key Performance Indicator
lb	Pounds
LAQM	Local Air Quality Management
LED	Light Emitting Diode
LOA	Length Over All
LF	Low Frequency
LP	Low Pressure
LTOBM	Low toxicity Oil Based Mud
LTV	Large Transport Vessel
LULUCF	Land Use, Land Use Change and Forestry
m	metres
MARPOL	International Convention for the Prevention of Pollution from Ships (1973)
MEPC	Marine Environment Protection Committee
MGO	Marine Gas Oil
MLA	Member of the Legislative Assembly
MMbls	Million barrels
MMO	Marine Mammal Observer
MMPA	Marine Mammal Protection Act
mmscfd	Million standard cubic feet per day
MMS	Maintenance Management System
MoD	Ministry of Defence
MODU	Mobile Offshore Drilling Unit
MPA	Marine Protected Area
MPC	Mount Pleasant Complex
MPN	Mount Pleasant International Airport
MPFM	Multiphase Flow Meters
MRM	Mercury Removal Materials
MRSV	Multi-Role Support Vessels
MSL	Mean Sea Level
MSP	Marine Spatial Planning
MTTR	Mean Time To Repair
MWth	Mega Watts Thermal
NADF	Non-Aqueous Drilling Fluid

Abbreviation	Definition
NCEP	National Centres for Environmental Prediction
NDC	Nationally Determine Contribtions
NEF	North East Front
NEMO	Nucleus for European Modelling of the Ocean
NERC	Natural Environment Research Council
NFB	North Falkland Basin
nm	nautical mile
NNR	National Nature Reserve
NORM	Naturally Occurring Radioactive Material
NOSCP	National Oil Spill Contingency Plan
NPD	Naphthalene, Phenanthrene and Dibenzothiophene
NPR	Non-Permanent Residents
NRB	Northern Rift Basin
NS	Northern Slope
NWOS	North Western Outer Slope
O&G	Oil and Gas
OBM	Oil Based Mud
OBO	Oil / Bulk Ore
OCNS	Offshore Chemical Notification Scheme
OCV	Offshore Construction Vessel
OCW	Other Marine Carnivores in Water
OD	Outer Diametre
ODS	Ozone Depleting Substances
OEUK	Offshore Energies UK (previously Oil and Gas UK, OGUK)
OHEF	Offshore Hydrocarbon Environmental Forum
OHGP	Open Hole Gravel Pack
OMS	Operating Management System
OPEP	Oil Pollution Emergency Plan
OPEX	Operational Expenses
OPF	Organic Phase Drilling Fluids
OPRC	Oil Pollution Preparedness, Response and Co-operation
OSCAR	Oil Spill Contingency And Response
OSPRAG	Oil Spill Prevention and Response Advisory Group
OSR	Oil Spill Response
OSCP	Oil Spill Contingency Plan
OSV	Offshore Support Vessel
OVI	Oil Vulnerability Index
P&D	Production and Development
PAF	Potentially Affected Fraction
PAH	Polycyclic Aromatic Hydrocarbons
PAM	Passive Acoustic Monitoring
PEP	Project Execution Plan
PCS	Production Control System
PCW	Phocid Carnvores in Water
PHCB	Patagonia High Chlorophyll Band
PLANC	Permits, Licences, Authorisations, Notification and Consents
PLONOR	Pose Little Or NO Risk
PON	Petroleum Operations Notices
ppb	Parts per billion
PPD	Pour Point Depressant
ppm	Parts per million

Abbreviation	Definition
psia	Pounds per square inch absolute
PSR	Project Safety Review
psu	Practical Salinity Unit
PSV	Platform Supply Vessel
PTS	Permanent Threshold Shift
PW	Produced Water
PWD	Public Works Department
PWRI	Produced Water Reinjection
RAM	Reliability, Availability and Maintainability
RIDDOR	Reporting Of Injuries, Disease and Dangerous Occurrences
Rockhopper	Rockhopper Exploration PLC
Ro-Ro	Roll On- Roll Off
ROV	Remotely Operated Vehicle
SAAS	South American Atlantic Service
SAERI	South Atlantic Environmental Research Institute
SAR	Search And Rescue
SAST	Seabirds At Sea Team
SASW	South Atlantic Surface Water
scf	Standard cubic feet
SD	Standard Deviation
SDU	Subsea Distribution Units
SECE	Safety and Environmentally Critical Equipment
SEEMP	Ship Energy Efficiency Management Plan
SEL	Sound Exposure Level
SEMP	Social Effects Monitoring Programme
SEOS	South Eastern Outer Slope
SF	Southern Front
SFB	South Falkland Basin
SG	Specific Gravity
SIA	Socio-economic Impact Assessment
SIMOPs	Simultaneous Operations
SINTEF	Stiftelsen for industriell og teknisk forskning
SIRE	Ship Inspection Report Programme
SIS	Safety Instrumented System
SLOES	Sea Lion Oil Export Selection
SMSG	Shallow Marine Surveys Group
SOLAS	Safety Of Life At Sea
SOPEP	Shipboard Oil Pollution Emergency Plan
SPL	Sound Pressure Level
SPS	Subsea Production Systems
SRB	Southern Rift Basin
SS	Southern Slope
SSL	Stanley Services Limited
ST	Shuttle Tanker
stb	Stock tank barrels
SURF	Subsea / Umbilical / Riser / Flowline
SWL	Safe Working Load
SWOS	South Western Outer Slope
TCC	Thermo-mechanical Cuttings Cleaner
TDF	Temporary Dock Facility
TEG	Triethylene glycol

Abbreviation	Definition
TEMPSC	Totally Enclosed Motor Propelled Survival Craft
THC	Total Hydrocarbon Concentration
TIC	Total Inorganic Carbon
TLP	Tension Leg Platform
TOC	Total Organic Carbon
TOM	Total Organic Matter
TSS	Total Suspended Solids
TTS	Temporary Threshold Shift
TVD	Total Vertical Depth
TZ	Transient Zone
UCM	Unresolved Complex Mixture
UEL	Upper Exposure Limit
UKCS	United Kingdom Continental Shelf
UKOT	United Kingdom Overseas Territory
UPS	Uninterruptable Power Supply
UVR	Ultra Violet Radiation
UXO	Unexploded Ordinance
VHF	Very High Frequency
VIT	Vacuum Insulated Tubing
VME	Vulnerable Marine Ecosystem
VMS	Vessel Monitoring System
VOC	Volatile Organic Compounds
VPQ	Vessel Particulars Questionnaire
VRP	Vapour Recovery Package
VTMS	Vessel Traffic Management System
W	Watts
WAT	Wax Appearance Temperature
WET	Whole Effluent Toxicity
WHRU	Waste Heat Recovery Units
WIF	Western Inshore Front
WBM	Water-based Mud
WMP	Waste Management Plan
WOF	Western Offshore Front
WRF	Weather Research and Forecasting
WRP	Wildlife Response Plan
ZRF	Zero Routine Flaring

19 GLOSSARY

Acronym / Term	Definition
Anthropogenic	Relating to human activities, or man-made
As Low As Reasonably Practicable (ALARP)	Often used in reference to mitigation measures where the benefit of the mitigation is weighed up against the relative cost and effort required to achieve that benefit.
At-shore	The shoreline and edge of the water.
Base-case	The design of the field before any project-specific mitigations are added to avoid, limit or ameliorate environmental impacts and risks.
Barrel	One barrel, equivalent to 159 litres (0.159 m^3) or approximately 35 imperial gallons
Bathymetry	The measurement of water depth in oceans, seas and lakes
Benthic fauna	Organisms that live on, associated with or in the seabed sediments.
Berthing pocket	Area of seabed at a berth that is deeper than the surrounding seabed to allow vessels to berth. Created by dredging material or by stirring up the sediment with the vessels' props.
Best Available Techniques (BAT)	The latest stage of development (state of the art) of processes, facilities or methods of operation, which indicate the practical suitability of a particular measure for limiting discharges, emissions or waste. Definition of 'available' includes demonstrated techniques, timescales as well as economic considerations. 'Techniques' include both the technology used and the way in which the field is designed, built, maintained, operated and dismantled.
Best Practicable Environmental Option	The option that offers most benefits and least damage to the environment within technical means, at acceptable cost in the long and short-term.
Biodiversity	The diversity of plant and animal life. Diversity is the measure of the variety of species contained within a habitat.
Biogenic	Produced by a living organism.
Bioturbation	The mixing of sediments or particles by fauna.
Black water	Sewage.
Block	Division of the FICZ / FOCZ into units. A Block is a subdivision of a Quadrant. There are 30 Blocks within one Quadrant. Block 14/05 is the 5th Block in Quadrant 14.
Blow-out	When the subsurface pressure in a well is greater than the pressure being applied from the rig or platform and there is an uncontrolled release of oil or gas into the wellbore and sometimes to the surface, wellbore or casing.
Blow-out preventer (BOP)	Hydraulically operated device placed on top of each well at the seabed to prevent uncontrolled releases of reservoir fluids from a well.
Casing	Large-diameter pipe lowered into the well and cemented into place to protect the well structure.
Clean-up	After a well has been drilled the drilling chemicals and rock in the hole will be flowed back to the rig or FPSO, this is known as cleaning up the well.
Completion	Preparing the well for production, including the assembly of downhole tubulars and equipment required to enable safe and efficient production from the well.
Conductor	The conductor extends from the drilling deck to the seabed and provides a guide and access to the well. It is sealed to enable circulation of drilling fluids.

Acronym / Term	Definition
Cuttings pile	A pile formed on the seabed as a result of the deposition of cuttings, which are produced whilst drilling the well.
Decommissioning	Shutdown of the Development including system cleaning and dismantling of facilities.
Define (FEED)	The process of developing the design of the project to the point where it can be passed onto a yard to start building.
Demersal	Living or occurring in the water at the bottom of a water body.
Demulsifier	A chemical used to break down crude-oil water emulsions. The chemical reduces the surface tension of the film of oil surrounding the droplets of water. The water then settles to the bottom of the tank.
Development well	Any well drilled in the course of extraction of reservoir hydrocarbons, whether specifically a production well or injection well.
Displace (a well)	The act of removing one fluid (usually liquid) from a wellbore and replacing it with another.
Drilling	The mechanical process where a wellbore is drilled from an offshore rig into the seabed to access the underground reservoir below.
Drill cuttings	Chips and small fragments of rock generated while drilling a well, which are brought to the surface by the flow of the drilling mud being circulated.
Drilling mud	Special clay, water and chemical additives pumped downhole through the drill pipe and drill bit. The mud cools the rapidly rotating bit, lubricates the drill pipe as it turns in the well bore, carries rock cuttings to the surface and serves as a plaster to prevent the wall of the borehole from collapsing.
Drill string	Lengths of steel tubing roughly 10 m long screwed together to form a pipe connecting the drill bit to the rig. It is rotated to drill the hole and delivers the drilling fluids to the cutting edge of the drill bit.
Duty of Care	This is a requirement that a person / organisation act towards others and the public with watchfulness, attention, caution and prudence that a reasonable person / organisation in the circumstances would. If a person's / organisation's actions do not meet this standard of care then the acts are considered negligent and any damages resulting may be claimed in a lawsuit for negligence.
Dynamic positioning	Use of thrusters, instead of anchors, to maintain the position of a vessel.
Echolocation	The locating of objects using reflected sound.
Ecosystem	Consists of all the organisms living, including non-living physical components of the environment, with which they interact – a biological community and its environment.
Endemic	Native to or confined to a particular region.
Environmental Impact Assessment	Process to identify and assess the impacts associated with a particular activity or plan.
Environmental Impact Statement	Document detailing the environmental impact assessment process.
Environmental Monitoring and Management Plan (EMMP)	Based on the findings of the EIS, this document, or set of documents sets out how the company will manage and monitor their environmental impacts. It includes, for example, surveys, research and monitoring of emissions.
Epifauna	Benthic organisms that inhabit the surface of the seabed.
E-Rep	Voluntary environmental representative who works offshore, responsibilities include checking waste consignments, performing

Acronym / Term	Definition
	audits on, for example, environmentally critical valves to ensure they are in the correct position.
Exclusion zone	An area where access is restricted or prohibited and where specific safety measures or protocols are in place to minimize risk or hazards.
First-Oil	First production of hydrocarbons from the reservoir to the FPSO
Flare	On the MODU and FPSO, a vent for burning unwanted gases or to burn off hydrocarbons which, due to temporary malfunction of maintenance of process plant, cannot be safely stored or retained in the process vessels.
Floating Production, Storage and Offloading vessel (FPSO)	The ship-shaped vessel used to produce the oil from the field, remaining in place offshore for the full Field Life.
Flow assurance	The various methods (heating, chemicals) used to keep the oil flowing through the flowlines offshore.
Flowline	Pipe laid on the seabed for the transportation of production or injection fluids. It links the subsea structures together or to the FPSO. Its length can range from a few hundred metres to a few kilometres.
Gas blanket	Inert gas used to cover liquid hydrocarbons in a tank to prevent ignition by removing oxygen from the atmosphere
Gas production / injection well	A well that can either produce gas from the reservoir to the FPSO or inject gas from the FPSO into the reservoir.
Gas lift	Adding reservoir gas into the well at the seabed to mix with the oil that is flowing to the surface to help move the oil from the seabed to the FPSO.
GIIP	Gas Initially In Place, the volume of gas in a reservoir before production.
Graben	Depressed block of land bordered by parallel faults.
Greenhouse gas	Gases in the atmosphere that absorbs and emit radiation within the thermal infrared range.
Grey water	Wastewater from kitchens, showers and sinks.
Hawser	A thick rope tied between two vessels used to moor or tow a vessel
Hook up and commissioning	The process of connecting up all the offshore pipelines, FPSO, wells etc. before production can commence. This also includes testing all the connections to make sure they are sound.
Hydrates	Crystalline solids composed of gas molecules trapped inside water molecules. They are stable at low temperatures and relatively high pressures. Once hydrocarbon hydrates are formed they can plug pipelines, which can affect production.
Hydrotest	A pressure test using water, sometimes dosed with chemicals.
Inert gas	A non-reactive gas.
Inshore transfer	The process to transferring oil from one vessel to another in an enclosed bay.
Intervention	The downhole re-entry of a well inside the existing completion equipment.
Jumper	A short flexible or rigid pipe used to connect a flowline to a subsea structure or two subsea structures close to each other.
Manifold	An area that contains all the valves for controlling the incoming and outgoing streams.
Mattress	A structure to support and protect subsea structures during installation and pre-commissioning activities and to provide dropped object protection to flowlines.
Migration	Any regular animal journey along well-defined routes, particularly those involving a return to breeding grounds.

Acronym / Term	Definition
Mitigation	Process, activity or piece of equipment that would make a consequence less severe.
Mobile Offshore Drilling Unit (MODU)	Also called a 'rig'. The MODU is only in field to drill the wells, it will then move to another job elsewhere.
Mud	This is generally synonymous with drilling fluid and encompasses most fluids used in hydrocarbon drilling operations, especially fluids that contain significant amounts of suspended solids, emulsified water or oil.
Open Hole Gravel Pack	A type of sand-control well completion in which the gravel pack screen is packed off in an open hole section with no casing or liner to support the producing formation. The open hole interval is often prepared by underreaming a section of reservoir below the last casing shoe. As OHGP do not require the use of explosives to perforate the well, there is very little debris downhole and wells require no clean-up operation after completion.
P50 reserves	Probable reserves for recovery.
Pelagic	Referring to the water column and the organisms living therein.
Petrogenic	Of hydrocarbon origin.
Photic zone	The upper water column which receives enough light for photosynthesis to occur.
Physio-chemical	Parameters such as temperature, nutrients or chemicals.
Phytoplankton	Microscopic planktonic plants such as diatoms and dinoflagellates.
Piling	Tubular steel shafts driven into the seabed to anchor a structure.
Plankton	Tiny plants and animals that drift in the surface water of seas and lakes. Of great economic and ecological importance as they are a major component of the marine food chain.
Polychaete	Bristle worms. Segmented worms, generally marine.
Produced water	Water that is produced from the reservoir along with oil and gas.
Production packer	A device used to isolate the annulus of the well and anchor or secure the bottom of the production tubing string.
Production well	A well drilled to produce hydrocarbons from the reservoir back to the FPSO.
Project sanction	When Navitas decide to commit spending to start building the infrastructure for the project. 'Project sanction' may also refer to a decision by FIG to approve the project. The two are often simultaneous.
Project-specific mitigation	Mitigations that are over and above the standard mitigations used by the Oil and Gas industry
Pyrogenic	Produced under conditions involving intense heat.
Ramsar site	Statutory areas designated under the Ramsar convention (the Convention on Wetlands of International Importance), especially as waterfowl habitat.
Recruitment	Young fish joining the main adult fish population.
Reservoir	A porous, permeable sedimentary rock formation containing oil and / or gas enclosed or surrounded by layers of less permeable or impervious rock – a structural trap.
Riser	Also known as a 'marine riser'. A pipe that goes from the seabed to the surface and is used to transfer produced fluids (oil, water and gas). Risers may be flexible or rigid.
Seawater sweeps	Drilling fluid which uses seawater as the bulk fluid for drilling the top sections of a well.

Acronym / Term	Definition
Separator	A pressure vessel used to separate reservoir fluids into gas and liquid components with the aid of chemicals and heat.
Sessile	An organism that is attached to another structure by its base and is unable to move freely.
Sidetrack	A directional hole drilled in a well to bypass an obstruction in the well that cannot be removed or damage, such as collapsed casing that cannot be repaired. Sidetracking may also be done to deepen a well or relocate the bottom of the well to a more productive zone.
Simultaneous Operations (SIMOPS)	The time when the rig is drilling wells whilst the FPSO is producing oil from the reservoir.
Social Impact Assessment	A impact of the social impact the project may have on the community. This looks at things like access to healthcare and schools. This is submitted separately to the EIS.
Spud / spudding	Starting to drill a well.
Stakeholder	Any individual or groups of people who are affected by or have interest in, the activities and / or outcome of the Development.
Stock-Tank Oil Initially in Place (STOIIP)	The volume of oil in a reservoir prior to production.
Suction anchor	Anchor that is partly hollow inside. When installed the hollow part of the suction anchor sinks into the seabed. The suction anchor is then closed, creating a vacuum inside the anchor.
Suezmax	A large tanker which, historically, was able to fit through the Suez canal. Now defined by the size range: max. beam 77.5m, max. height 68m, max. draft 20.1 m, unlimited length.
Topsides	The equipment situated on a platform (such as an FPSO) including the oil production plant and accommodation block.
Trophic	Relates to feeding.
Tubing hanger	A device attached to the topmost tubing joint in the wellhead to support the tubing string.
Umbilical	Any of various lines transmitting electricity or fluids to one portion of a system or between systems subsea.
Vapour recovery / vapour balancing	When vapour (fumes) is prevented from release to the atmosphere (recovery) often by transferring it to another vessel (vapour balancing).
Venting	Discharge of unwanted, un-burnt gases or hydrocarbons which, due to temporary malfunction or maintenance of process plant, cannot be safely stored or retained in process vessels.
Viscosity	The resistance of flow of a liquid.
Water injection well	A well for flowing water into the reservoir to provide support to the reservoir and to 'push' the oil in the rock towards the oil producing wells.
Wellhead	A top of casing and the attached control and flow valves. The wellhead is where the control valves, testing equipment and take-off pipe are located.
Workover	A maintenance job on a well, usually to replace equipment or stimulate production.
X-mas tree	The assembly of valves and fittings on the seabed at each well to control and monitor the flow from the reservoir.
Zooplankton	Animals that drift in the plankton, mostly microscopic.
Anthropogenic	Relating to human activities, or man-made

20 REFERENCES

Aas, E., Baussant, T., Balk, L., Liewenborg, B., Andersen, O.K., 2000. PAH metabolites in bile, cytochrome P4501A and DNA adducts as environmental risk parameters for chronic oil exposure: a laboratory experiment with Atlantic cod. *Aquatic Toxicology*. 51: 241–258.

Aas, E., Beyer, J., Jonsson, G., Reichert, W., Andersen, O.K., 2001. Evidence of uptake, biotransformation and DNA binding of polyaromatic hydrocarbons in Atlantic cod and sea partridge caught in the vicinity of an aluminium works. *Marine Environmental Research*. 52: 213–229.

ACAP. 2016. Agreement on the Conservation of Albatrosses and Petrels. Species assessments. http://www.acap.aq/en/acap-species.

ACAP. 2019. Agreement on the Conservation of Albatrosses and Petrels. http://www.acap.aq.

Acha, E.M., Mianzan, H.W., Guerrero, R.A., Favero, M. and Bava, J. 2004. Marine fronts at the continental shelves of austral South America: Physical and ecological processes. *Journal of Marine Systems*. 44: 83-105.

Agnew, D.J. 2002. Critical aspects of the Falkland Islands pelagic ecosystem: distribution, spawning and migration of pelagic animals in relation to oil exploration. *Aquatic Conservation*. 12: 39-50.

AGR Petroleum Services. 2012. Falkland Islands Fisheries and risk to subsea infrastructure. Report to Premier Oil, 18 February 2012.

Aguayo-Lobo, A., Acevedo, J., Brito, J.L., Acuna, P. and Bassoi, M. 2011. Presence of the leopard seal Hydrurga leptonyx (De Blainville, 1820), on the coast of Chile: an example of the Antarctica – South America connection in the marine environment. *Oecologia Australis*. 15: 69-85.

Ainsworth, C.H., Paris, C.B., Perlin, N., Dornberger, L.N., Patterson III, W.F., Chancellor, E., Murawski, S., Hollander, D., Daly, K., Romero, I.C. & Coleman, F. 2018. Impacts of the Deepwater Horizon oil spill evaluated using an end-to-end ecosystem model. *PloS one*. 13(1): p.e0190840.

Alemany, D., Acha, E.M. and Iribarne, O. 2009. The relationship between marine fronts and fish diversity in the Patagonian Shelf large marine ecosystem. *Journal of Biogeography*. 36: 2111-2124.

Alloy, M., Baxter, D., Stieglitz, J., Mager, E., Hoenig, R., Benetti, D., Grosell, M., Oris, J. and Roberts, A. 2016. Ultraviolet Radiation Enhances the Toxicity of Deepwater Horizon Oil to Mahi-mahi (*Coryphaena hippurus*) Embryos. *Environmental Science Technology*. 50: 2011−2017.

Almeda, R., Wambaugh, Z., Wang, Z., Hyatt, C., Liu, Z., and Buskey, E.J. 2013. Interactions between Zooplankton and Crude Oil: Toxic Effects and Bioaccumulation of Polycyclic Aromatic Hydrocarbons. *PLoS ONE*. 8(6): e67212.

Almeda, R., Baca, S., Hyatt, C. and Buskey, E.J. 2014. Ingestion and sublethal effects of physically and chemically dispersed crude oil on marine planktonic copepods. *Ecotoxicology*. 23: 988-1003.

Almeda, R., Harvey, T.E., Connelly, T.L., Sarah Baca, S. and Buskey, E.J. 2016. Influence of UVB radiation on the lethal and sublethal toxicity of dispersed crude oil to planktonic copepod nauplii. *Chemospere*. 152: 446-458.

Altwegg, R., Crawford, R.J., Underhill, L.G. and Williams, A.T.J. 2008. Long-term survival of de-oiled Cape gannets *Morus capensis* after the Castillo de Bellver oil spill of 1983. *Biological Conservation*. 141: 1924-1929.

Anatec, Ltd. 2013. Collision Risk Assessment Sea Lion FPSO (Technical Note). Ref: A3140-PRE-RA-1. Report for Argos Ltd/Noble Energy.

Anatec, Ltd. 2024a. Sea Lion Offshore Development (Falklands) Vessel Traffic Survey. Date: 03 April 2024. Rev 01, Reference: A5274-NVP-VTS-1.

Anatec, Ltd. 2024b. Sea Lion Offshore Development Vessel Collision Risk Assessment. Date: 24 May 2024. Rev 00, Reference: A5274-NVP-VCRA-1

Anderson, S.L., Harrison, F.L. 1986. Effects of radiation on aquatic organisms and radiobiological methodologies for effects assessment. U.S.EPA Report No. 520/1 -85-016. Washington, DC: United States Environmental Protection Agency.

Andersson, J.G. 1906. Solifluction, a Component of Subaërial Denudation. *The Journal of Geology*. 14: 1-22

Andreassen, I. and Sørheim, K.R. 2013. Fram crude oil-properties and behaviour at sea. SINTEF: Norway.

Andriashev, A.P. 1964. On the composition and origin of the Antarctic pelagic fish fauna. *Biologie Antarctique.* Carrick, R. Holdgate, M. and Prevost, J., (Eds). 271-272. Paris: Hermann.

API. 2021. Compendium of greenhouse gas emissions methodologies for the natural gas and oil industry. American Petroleum Institute. Prepared by: Lisa Campbell; Julia Toolen; Denise Grubert; and Gary Napp. ERM. 4140 Parklake Avenue, Suite 110, Raleigh, NC 27612. pp 898.

Aquateam COWI. 2014. Characterising Thermal Treated OBM Drill Cuttings. Sampling, characterisation, environmental analysis and risk assessment of offshore discharges. Report No. 14-028.

Arata, J. and Xavier, J.C. 2003. The diet of black-browed albatrosses at the Diego Ramirez Islands, Chile. *Polar Biology*. 145: 593-610.

Arcos, J.M. and Oro, D. 2002. Significance of nocturnal purse seine fisheries for seabirds: a case study off the Ebro Delta (NW Mediterranean). *Marine Biology*. 141: 277-286.

Arkhipkin, A.I., Laptikhovsky V. and Middleton D.A.J. 2000. Adaptations for the cold water spawning in squid of the family Loliginidae: *Loligo gahi* around the Falkland Islands. *Journal of Molluscan Studies*. 66: 551-564.

Arkhipkin, A., Brickle, P., Laptihovsky, V., Butcher, L., Jones, E., Potter, M. and Poulding, D. 2001. Variation in the diet of the red cod, *Salilota australis* (Pisces: Moridae), with size and season at the Falkland Islands (south-west Atlantic). *Journal of the Marine Biological Association of the United Kingdom*. 81: 1035-1040.

Arkhipkin, A.I. and Middleton, D.A.J. 2002a. Inverse patterns in abundance of *Illex argentinus* and *Loligo gahi* in Falkland waters: possible interspecific competition between squid? *Fisheries Research*. 59: 181-196.

Arkhipkin, A.I. and Middleton, D.A.J. 2002b. Sexual segregation in ontogenetic migrations by the squid *Loligo gahi* around the Falkland Islands. *Bulletin of Marine Science*. 71: 109-127.

Arkhipkin, A.I., Middleton, D.A.J., Portela, J.M. and Bellido, J,M. 2003. Alternative usage of common feeding grounds by large predators: the case of two hakes (*Merluccius hubbsi* and *M. australis*) in the south-west Atlantic. *Aquatic Living Resources*. 16: 487-500.

Arkhipkin, A.I, Grzebielec, R., Sirota, A.M., Remeslo, A.V., Polishchuk, I.A. and Middleton, D.A.J. 2004a. The influence of seasonal environmental changes on ontogenetic migrations of the squid *Loligo gahi* on the Falkland shelf. *Fisheries Oceanography*. 13: 1-9.

Arkhipkin, A.I., Middleton, D.A.J., Sirota, A.M. and Grzebielec, R. 2004b. The effect of Falkland Current inflows on offshore ontogenetic migrations of the squid *Loligo gahi* on the southern shelf of the Falkland Islands. *Estuarine, Coastal and Shelf Science*. 60: 11-22.

Arkhipkin, A.I., Laptikhovsky, V., Sirota, A.M. and Grzebielec, R. 2006. The role of the Falkland Current in the dispersal of the squid *Loligo gahi* along the Patagonian Shelf. *Estuarine Coastal and Shelf Science.* 67: 198-204.

Arkhipkin, A.I., Baumgartner, N., Brickle, P., Laptikhovsky, V., Pompert, J.H.W. and Shcherbich, Z. N. 2008. Biology of the skates *Bathyraja brachyurops* and *B. griseocauda* in waters around the Falkland Islands, South-west Atlantic. *ICES Journal of Marine Science*. 65: 560-570.

Arkhipkin, A.I., Brickle, P. and Laptikhovsky, V. 2010. Usage of the island water dynamics by spawning red cod, *Salilota australis* (Pisces: Moridae) on the Falkland Islands shelf (South-west Atlantic). *Fisheries Research*. 105: 156-162.

Arkhipkin, A.I, Brickle, P., Laptikhovsky, V., Pompert, J. and Winter, A. 2012a. Skate assemblage on the eastern Patagonian shelf and slope: structure, diversity and abundance. *Journal of Fish Biology*. 80: 1704-1726.

Arkhipkin, A.I, Brickle, P., Laptikhovsky, V. and Winter, A. 2012b. Dining hall at sea: feeding migrations of nektonic predators to the eastern Patagonian Shelf. *Journal of Fish Biology*. 81: 882-902.

Arkhipkin, A.I. and Laptikhovsky, V. 2013. From gelatinous to muscle food chain: rock cod *Patagonotothen ramsayi* recycles coelenterate and tunicate resources on the Patagonian Shelf. *Journal of Fish Biology*. 83: 1210-1220.

Arkhipkin, A.I, Brickle, P. and Laptikhovsky, V. 2013. Links between marine fauna and oceanic fronts on the Patagonian Shelf and Slope. *Arquipelago. Life and Marine Sciences*. 30: 19-37. http://hdl.handle.net/10400.3/2083.

Arkhipkin, A.I, Gras, M. and Blake, A. 2015. Water density pathways for shelf/slope migrations of squid *Illex argentinus* in the South-west Atlantic. *Fisheries Research*. 127: 234-242.

Arkhipkin, A.I., Nigmatullin, Ch.M., Parkyn, D.C., Winter, A. and Csirke, J. 2023. High seas fisheries: the Achilles' heel of major straddling squid resources. Reviews in Fish Biology and Fisheries. 33: 453-474.

Arnbom, T., Fedak, M.A. and Boyd, I.L. 1997. Factors affecting maternal expenditure in southern elephant seals during lactation. *Ecology*. 78: 1772-1781.

Arthur B., Hindell M., Bester M., de Bruyn N., Trathan, P., Goebel, M. and Lea, M.A. 2017. Winter habitat predictions of a key Southern Ocean predator, the Antarctic fur seal (*Arctocephalus gazella*). *Deep Res Part II Topical Studies in Oceanography.* 140: 171–181.

Atlantic, O.C.S. 1988. Synthesis of effects of oil on marine mammals. Geraci, J.R. and Aubin, D.J.S. (Eds.). Department of the Interior, Minerals Management Service, Atlantic OCS Region.

ATSDR, 1997. Agency for Toxic Substances and Disease Registry, Public Health Statement: Hydraulic fluids.

Augé, A.A. 2016. Anthropogenic debris in the diet of turkey vultures (*Cathartes aura*) in a remote and low-populated South Atlantic island. *Polar Biology*. 40: 799-805.

Augé, A. A., Otley, H., Rendell, N. and Frans, V. 2016. Spatial distribution of cetacean strandings in the Falkland Islands to define monitoring opportunities. *Journal of Cetacean Research Management*. 19: 1-17.

Augé. A.A., Otley, H., Rendell, N. and Frans, V.F. 2018. Spatial distribution of cetacean strandings in the Falkland Islands to define monitoring opportunities. *Journal of Cetacean Research and Management*. 19: 1-7.

Baines, M., and Weir, C.R. 2020. Predicting suitable coastal habitat for sei whales, southern right whales and dolphins around the Falkland Islands. *PLoS One*. 15(12): e0244068.

Baird, P.H. 1990. Concentrations of seabirds at oil-drilling rigs. *Condor*. 92: 768-771.

Balk, L., Hylland, K., Hansson, T., Berntssen, M.H.G., Beyer, J., Jonsson, G., Melbye, A., Grung, M., Torstensen, B.E., Børseth, J.F., Skarphedinsdottir, H., Klungsøyr, J., 2011. Biomarkers in natural fish populations indicate adverse biological effects of offshore oil production. e19735 PloS One 6, 19710.

Balushkin, A.V. 1992. Classification, phylogenetic relationships, and origins of the families of the suborder Notothenioidei (Perciformes). *Journal of Ichthyology*. 32: 90–110.

Balushkin, A.V. 1994. A fossil notothenioid, but not gadiform, fish *Proeleginops grandeastmanorum* gen. et sp. nov. (Perciformes, Notothenioidei, Eleginopsidae) from Late Eocene of Seymour Island, Antarctica. Voprosy *Ikhthyologii.* 34: 298–307, (in Russian).

Banner, A. and Hyatt, M. 1973. Effects of Noise on Eggs and Larvae of Two Estuarine Fishes. *Transactions of the American Fisheries Society*. 101: 134-135.

Bargelloni, L., Marcato, S., Zane, L. and Patarnello, T. 2000. Mitochondrial phylogeny of Notothenioids: a molecular approach to Antarctic fish evolution and biogeography. *Systematic Biology*. 49: 114–129.

Barlow, M.J. and Gisiner, R. 2006. Mitigating, monitoring and assessing the effects of anthropogenic sound on beaked whales. *Journal of Cetacean Research and Management*. 7(3): 239-249.

Barlow, M.J. and Kingston, P.F. 2001. Observations on the Effects of Barite on the Gill Tissues of the Suspension Feeder *Cerastoderma edule* (Linne) and the Deposit Feeder *Macoma balthica* (Linne). *Marine Pollution Bulletin*. 42: 71-76.

Barón, P.D. 2001. First description and survey of the egg masses of *Loligo gahi* (D'Orbigny, 1835) and *Loligo sanpaulensis* (Brakoniecki, 1984) from coastal waters of Patagonia. *Journal of Shellfish Research*. 20: 289-295.

Barrett, R.T. 1979. Small oil spill kills 10-20,000 seabirds in North Norway. *Marine Pollution Bulletin*. 10: 253-255.

Barratt, I. and Allcock, L. 2014a. *Onykia ingens*. The IUCN Red List of Threatened Species 2014: e.T163131A975198.

Barratt, I. and Allcock, L. 2014b. *Illex argentinus*. The IUCN Red List of Threatened Species 2014: e.T163246A989453.

Barron, M. G. 2012. Ecological Impacts of the Deepwater Horizon Oil Spill: Implications for Immunotoxicity. *Toxicologic Pathology*. 40: 315-320.

BAS. 2014. Sea Lion marine growth study investigation of probable marine growth types, thickness, mass, density, roughness and drag on the Sea Lion Field Development, South Atlantic.

BAS. 2023. Research Ships. Polar research facilities - British Antarctic Survey.

Baulch, S. and Perry, C. 2014. Evaluating the impacts of marine debris on cetaceans. *Marine Pollution Bulletin*. 80. 210-221.

Baumgartner, M.F., Van Parijs, S.M., Wenzel, F.W., Tremblay, C.J., Esch, H.C. and Warde, A.M. 2008. Low frequency vocalisations attributed to sei whales (*Balaenoptera borealis*). *Journal of the Acoustical Society of America*. 124: 1339-1349.

Bayley, D.T.I., Brickle,P., Brewin, P.E., Golding, N.and Pelembe, T. 2021. Valuation of kelp forest ecosystem services in the Falkland Islands: A case study integrating blue carbon sequestration potential. *One Ecosystem*. 6:e62811.

Baylis, A.M.M. 2012. 2010 archipelago-wide census gentoo and rockhopper penguins Falklands Conservation. Unpublished Report.

Baylis, A.M.M., Crofts, S. and Wolfaardt, A.C. 2013a. Population trends of Gentoo Penguins Pygoscelis papua breeding at the Falkland Islands. *Marine Ornithology*. 41: 1-5.

Baylis, A.M.M., Wolfaardt, A.C., Crofts, S., Pistorius, P.A. and Ratcliffe, N. 2013b. Increasing trend in the number of Southern rockhopper penguins breeding at the Falkland Islands. *Polar Biology*. 36: 1007-1018.

Baylis, A.M.M., Orben, R.A., Pistorius, P., Brickle, P., Staniland, I. and Ratcliffe, N. 2014. Winter foraging site fidelity of king penguins breeding at the Falkland Islands. *Marine Biology*. 162: 99-110.

Baylis, A.M.M., Orben, R.A., Arnould, J.P.Y., Peters, K., Knox, T., Costa, D.P. and Stanilands, I.J. 2015. Diving deeper into individual foraging specialisations of a large marine predator, the southern sea lion. *Oecologi*a. 179: 1053-1065.

Baylis, A.M., Tierney, M., Orben, R.A., Staniland, I.J., and Brickle, P. 2018. Geographic variation in the foraging behaviour of South American fur seals. *Marine Ecology Progress Series*. 596: 233-245.

Baylis, A.M.M. and Tierney, M. 2018. Analytical methods for establishing marine higher predator movements in Falkland Island waters. Report prepared as part of the GAP Project (Phase II) for the Falkland Islands Offshore Hydrocarbons Environmental Forum (FIOHEF). South Atlantic Environmental Research Institute, Falkland Islands.

Baylis, A.M.M., Tierney, M., Orben, R.A., Warwick-Evans, V., Wakefield, E., Grecian, W.J., Trathan, P., Reisinger, R., Ratcliffe, N., Croxall, J., Campioni, L., Catry, P., Crofts, S., Boersma, P.D., Galimberti, F., Granadeiro, J., Handley, J., Hayes, S., Hedd, A., Masello, J.F., Montevecchi, W.A., Pütz, K., Quillfeldt, P., Rebstock, G.A., Sanvito, S., Staniland, I.J. and Brickle, P. 2019a. Important at-sea areas of colonial breeding marine predators on the Southern Patagonian Shelf. *Scientific Reports*. 9: 8517.

Baylis, A.M.M., Orben R., Arkhipkin A, Barton, J., Brownell Jr, R.L., Staniland, I.J. and Brickle, P. 2019b. Re-evaluating the population size of South American fur seals in the Atlantic and conservation implications. *Aquatic Conservation Marine Freshwater Ecosystems.* 29: 1988-1995.

Baylis, A. M. M., de Lecea, A.M., Tierney, M., Orben, R.A., Ratcliffe, N., Wakefield, E., Catry, P., Campioni, L., Costa, M., Boersma, P.D., Galimberti, F., Granadeiro, J.P., Masello, J.F., Pütz, K., Quillfeldt, P., Rebstock, G.A., Sanvito, S., Staniland, I.J. and Brickle, P. 2021a. Overlap between marine predators and proposed Marine Managed Areas on the Patagonian Shelf. *Ecological Applications*. 31:e02426.

Baylis, A.M.M., Tierney, M., Orben, R.A., González de la Peña, D. and Brickle, P. 2021b. Non-breeding movements of Gentoo Penguins at the Falkland Islands. *Ibis*. 163: 507-518.

Beaton, E.C. 2020. Shallow benthic and intertidal ecology of the Falkland Islands. PhD Thesis. University of Aberdeen. pp 198.

Becker, A., Whitfield, A.K., Cowley, P.D., Jarnegren, J. and Naesje, T.F. 2013. Potential effects of artificial light associated with anthropogenic infrastructure on the abundance and foraging behaviour of estuary-associated fishes. *Journal of Applied Ecology*. 50: 43-50.

BEIS. 2018. Guidance Notes. Decommissioning of Offshore Oil and Gas Installations and Pipelines. November 2018.

BEIS. 2020. The United Kingdom Risk-Based Approach Programme. A risk-based approach to the management of produced water discharges from offshore installations. Version 3.1.

BEIS. 2022a. Guidance Notes for Preparing Oil Pollution Emergency Plans.

BEIS. 2022b. Updated energy and emissions projections 2021 to 2040.

BEIS. 2022c. OPPC Guidance Notes on The Offshore Petroleum Activities (Oil Pollution and Control) Regulations 2005. OPPC_Guidance_Notes_Feb_22.pdf.

Belkin, I.M., Cornillon, P.C. and Sherman, K. 2009. Fronts in large marine ecosystems. *Progress in Oceanography*. 81: 223-236.

Beresford, N.A., Barnett, C.L., Howard, D.C., Toner, M., Dale, P. & Jenkinson, S. 2011. Screening level assessment of releases from oil and gas platforms on marine *Natura 2000* sites.

Berman-Kowalewski, M., Gulland, F.M.D., Wilkin, S., Calambokidis, J., Mate, B., Cordaro, J., Rotstein, D., St. Leger, J., Collins, P., Fahy, K. and Dover, S. 2010. Association Between Blue Whale (*Balaenoptera musculus*) Mortality and Ship Strikes Along the California Coast. *Aquatic Mammals*. 36: 59-66.

Berrow, S.D., Wood, A.G. and Prince, P.A. 2000. Foraging location and range of white-chinned petrels *Procellaria aequinoctialis* breeding in the South Atlantic. *Journal of Avian Biology*. 31: 303-311.

Beyer, J., Goksøyr, A., Hjermann, D. Ø., Klungsøyr, J. 2020. Environmental effects of offshore produced water discharges: A review focused on the Norwegian continental shelf. *Marine Environmental Research*. 162.

Beyer, J., Trannum, H.C., Bakke, T., Hodson, P.V. and Collier, T.K. 2016. Environmental effects of the Deepwater Horizon oil spill: A review. *Marine Pollution Bulletin*. 110: 28-51.

Beylot, A. and Villeneuve, J. 2013. Environmental impacts of reisidual Municipal Solid Waste incineration: A comparison of 110 French incinerators using a life cycle approach. *Waste Management.* 33(12): 2781-2788.

Bianchi, A., Massonneau, M. and Olevera, R.M. 1982. Analisis estatistico de las caracteristicas T–S del sector austral de la Plataforma Continental Argentina. *Acta Oceanologica Argentina*. 3: 93-118.

BirdLife International. 2004. Tracking ocean wanderers: the global distribution of albatrosses and petrels. Results from the Global Procellariiform Tracking Workshop, 1-5 September, 2003, Gordon's Bay, South Africa. Cambridge, UK. Birdlife International.

BirdLife International. 2008. Seabirds suffer from eating 'junk'. Presented as part of the BirdLife State of the world's birds website. http://www.birdlife.org/datazone/.

BirdLife International. 2014a. Country profile: Falkland Islands (Malvinas). http://www.birdlife.org/datazone/.

BirdLife International. 2014b. IUCN Red List for birds. http://www.birdlife.org.

BirdLife International. 2015. IUCN Red List for birds. http://www.birdlife.org.

BirdLife International. 2016. Species factsheet: *Ardenna gravis*. http://www.birdlife.org.

BirdLife International. 2017. Species factsheet: Cobb's Wren Troglodytes cobbi. Downloaded from https://datazone.birdlife.org/species/factsheet/cobbs-wren-troglodytes-cobbi.

BirdLife International. 2019. Country profile: Falkland Islands (Malvinas). http://www.birdlife.org/datazone/.

BirdLife International. 2020a. IUCN Red List for birds. http://www.birdlife.org.

BirdLife International. 2020b. Species factsheet: *Thalassarche melanophris*. http://www.birdlife.org.

BirdLife International. 2024. IUCN Red List for birds. http://www.birdlife.org.

BirdLife International. 2025. IUCN Red List for birds. Downloaded from https://datazone.birdlife.org on 16/07/2025

Black, A. 2005a. Light induced seabird mortality on vessels operating in the Southern Ocean: incidents and mitigation measures. *Antarctic Science*. 17: 67-68.

Black, A.D. 2005b. The distribution of seabirds and marine mammals in South Georgian waters. Unpublished report by Falklands Conservation to the Government of South Georgia and the South Sandwich Islands.

Black, A.D., Parker, G., Rexer-Huber, K., Sommer, E. and Cuthbert, R.J. 2012. Kerguelen petrel (*Lugensa brevirostris*): a 'new' breeding species for South Georgia. *Antarctic Science*. 25: 69-70.

Black, K.P., Brand, G.W., Grynberg, H., Gwyther, D., Hammond, L.S., Mourtikas, S., Richardson, B.J. and Wardrop, J.A., 1994a. Environmental Implications of Offshore Oil and Gas Development in Australia Production Activities. Australian Petroleum Exploration Association (APEA), Energy Research and Development Corporation (ERDC), pp. 344–385.

Black, K.P., Brand, G.W., Gwyther, D., Hammond, L.S., Mourtikas, S., Noyes-Fitzsimmons, R.L., Smith, J.M. and Richardson, B.J. 1994b. Environmental Implications of Offshore Oil and Gas Development in Australia Coastal Facilities. Australian Petroleum Exploration Association (APEA), Energy Research and Development Corporation (ERDC). pp. 460–492.

Blockley, D. and Tierney, M. 2016. Addressing priority gaps in understanding ecosystem functioning for the developing Falkland Islands offshore hydrocarbon industry – the 'Gap Project'. Phase 1 Report. SAERI 2016.

Blockley, D. and Tierney, M. 2017. Addressing priority gaps in understanding ecosystem functioning for the developing Falkland Islands offshore hydrocarbon industry – the 'Gap Project'. Final Report. SAERI 2017.

Blockley, D., Tierney, M. and Brickle, P. 2020. Addressing priority gaps in understanding ecosystem functioning for the developing Falkland Islands offshore hydrocarbon industry – the 'GAP Project'. Phase II Final Report, 2020. Report prepared for the Falkland Islands Offshore Hydrocarbons Environmental Forum (FIOHEF). South Atlantic Environmental Research Institute (SAERI), Stanley, Falkland Islands. pp 484.

Blom, E-L., Dekhla, I. K., Bertram, M.G., Manera, J. L., Kvarnemo, C., Svensson, O. 2024. Anthropogenic noise disrupts early-life development in a fish with paternal care. *Science of the Total Environment*. 93.

BMT Argoss. 2015. Sea Lion Hydrodynamic Modelling – Final Report. Reference Number: A14043_Final_Report_r1. Prepared for Premier Oil Exploration and Production Limited.

BMT. 2005. EIA study for heliport at Yung Shue Wan Lamma Island.

Boltovskoy, D. (Ed). 2000. South Atlantic zooplankton. Backhuys Publishers, Leiden.

Bonn Agreement. 2009. Bonn Agreement Aerial Operations Handbook.

Bonnet-Lebrun, A.S., Catry, P., Clark, T.J., Campioni, L., Kuepfer, A., Tierny, M., Kilbride, E., Wakefield, E.D. 2020. Habitat preferences, foraging behaviour and bycatch risk among breeding sooty shearwaters *Ardenna grisea* in the Southwest Atlantic. Marine Ecology Progress Series. 651:163-181.

Bose, S., Bell, M. and Taylor, G. 2023. Northern Royal Albatross tracking from Motuhara, Chatham Islands, and Taiaroa Head in 2021. DOC NZ.

Boulenger, G.A. 1900. A list of fishes collected by Mr. Rupert Vallentin in the Falkland Islands. *Annals and Magazine of Natural History*. Series 7. 6: 52-54.

Bowmer, C.T., Gimeno, S., Foekema, E.M. and Kaag, N.H.B.M. 1996. An environmental evaluation of cleaned drill cuttings using a long-term model bioassay. The Physical and Biological Effects of Processed Oily Drill Cuttings. E&P Forum Report.

Boyd, J.N., Kucklick, J.H., Scholz, D.K., Walker, A.H., Pond, R.G. and Bostrom, A. 2001. Effects of oil and chemically dispersed oil in the environment. Health and Environmental Sciences Department, Scientific and Environmental Associates, inc. Cape Charles, Virginia, Publication number 4693.

Breeding, J.E, Jr., Pflug, L.A., Bradley, M., Walrod, M.H. and McBride, W. 1996. Research Ambient Noise Directionality (RANDI) 3.1 Physics description. Naval Research Laboratory. NRL/FR/7176--95-9628.

Breuer, E., Howe, J.A., Shimmield G.B., Cummings, D. and Carroll, J. 1999. Contaminant Leaching from Drill Cuttings Piles of the Northern and Central North Sea: A Review. SAMS (Scottish Association for Marine Science) and Centre for Coastal and Marine Sciences, Dunstaffnage Marine Laboratory.

Brickle, P., Olson, P.D., Littlewood, D.T.J., Bishop, A. and Arkhipkin, A.I., 2001. Parasites of Loligo gahi from waters off the Falkland Islands, with a phylogenetically based identification of their cestode larvae. *Canadian Journal of Zoology*, *79*(12), pp.2289-2296.

Brickle P., Laptikhovsky, V., MacKenzie K., and Arkhipkin, A. 2003. Scientific report, The Falkland Mullet *Eleginops maclovinus*: Biology and Fishery in Falkland Islands' waters. Stanley, Falkland Islands Government Fisheries Department.

Brickle, P., Arkhipkin, A., and Shcherbich, Z. 2005a. Age and growth in a euryhaline notothenioid, *Eleginops maclovinus* (Cuv., and Val., 1830). *Journal of Marine Biological Association of the United Kingdom*. 85: 1217-1221.

Brickle, P., Laptikhovski, V. and Arkhipkin, A. 2005b. Reproductive strategy of a primitive temperate *Eleginops maclovinus* (Cuv., and Val., 1830) (Notothenioidea: Eleginopidae). *Journal of Fish Biology*. 66: 1044-1059.

Brickle, P., Shcherbich, Z., Laptikhovsky, V., and Arkhipkin, A. 2005c. Scientific Report. Aspects of the biology of the Falkland Islands' rock cod *Patagonotothen ramsayi* (Regan, 1913) on the southern Patagonian Shelf.

Brickle, P. and Mackenzie, K. 2007. Parasites as biological tags for *Eleginops maclovinus* (Teleostei: Eleginopidae) around the Falkland Islands. *Journal of helminthology*. 81: 147-153.

Brickle, P. Arkhipkin, A., Laptikhovsky, V., Stocks, A.F. and Talyor, A. 2009. Resource partitioning in two large planktivorous fishes *Micromesistius australis* and *Macruronus magellanicus* in the South-west Atlantic. *Estuarine, Coastal and Shelf Science*. 84: 91-98.

Brickle, P. Laptikhovsky, V. and Arkhipkin, A. 2011. The reproductive biology of a shallow water morid (*Salilota australis* Gunther, 1878), around the Falkland Islands. *Estuarine, Coastal and Shelf Science*. 94: 102-110.

Brickle, P., Schuchert, P.C., Arkhipkin, A.I., Reid, M.R. and Randhawa, H.S. 2016. Otolith Trace Elemental Analyses of South American Austral Hake, *Merluccius australis* (Hutton, 1872) Indicates Complex Salinity Structuring on their Spawning/Larval Grounds. *PLoS ONE.* 11(1): 0145479.

Brodie, J. and Mrowicki, R. 2019. A draft checklist of the seaweeds of the Falkland Islands. Natural History Museum, London. 31 July.

Brooks, S. and Waldock, M. 2009. The use of copper as a biocide in marine antifouling paints. In: Advances in Marine Antifouling Coatings and Technologies. C. Hellio and D. Yebra (Eds). pp.492-521, Woodhead Publishing.

Brown, J. Laptikovsky, V. and Dimmlich, W. 2010. Solitary spawning revealed – an *in situ* observation of spawning behaviour of *Doryteuthis (Amerigo) gahi* (d'Orbigny, 1835 in 1834–1847) (Cephalopoda: Loliginidae) in the Falkland Islands. *Journal of Natural History*. 44: 2041-2047.

Brown, J., Brickle, P. and Scott, B. E. 2013. Investigating the movements and behaviour of Patagonian toothfish (*Dissostichus eleginoides* Smitt, 1898) around the Falkland Islands using satellite linked. *Journal of Experimental Marine Biology and Ecology*. 443: 65-74.

BS7445. 2003. British Standards Institution BS7445-1:2003. Description and measurement of environmental noise. Guide to quantities and procedures.

BS5228. 2009: Noise and Vibration Control on Construction and Open Sites.

BS4142. 2014. British Standards Institution BS4142:2014 Method for rating industrial and commercial sound.

BSL. 2008a. Regional Benthic Environmental Survey of the Southern North Falklands Basin. Report for Desire Petroleum Plc. Rockhopper Exploration Plc. Arcadia Petroleum Plc.

BSL. 2008b. Burdwood Bank, South Falklands Basin. Regional Benthic Environmental Survey. Report for Borders and Southern.

BSL. 2015a: Geophysical and Environmental Programme Berkeley Sound. 1506 Volume 3: Geophysical survey. Unpublished report by Benthic Solutions Limited to Premier Oil Exploration and Production Limited.

BSL. 2015b. Geophysical and Environmental Programme Berkeley Sound; 1506 Volume 4: Habitat Assessment Report. Unpublished report by Benthic Solutions Limited to Premier Oil Exploration and Production Limited.

BSL. 2015c. Geophysical and Environmental Programme Berkeley Sound; 1506 Volume 5: Environmental Baseline Survey Report. Unpublished report by Benthic Solutions Limited to Premier Oil Exploration and Production Limited.

Buchan, S. J., Vásquez, P., Olavarría, C., Castro, L. R. 2021. Prey items of baleen whale species off the coast of Chile from fecal plume analysis. *Marine Mammal Science*. 2021: 37: 1116-1127.

Buehler, D., Oestman, R., Reyff, J., Pommerenck, K. and Mitchell, B. 2015. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish.

Burger, A.E. 1993. Estimating the mortality of seabirds following oil spills: effects of spill volume. *Marine Pollution Bulletin*. 26: 140-143.

Burger, A., and Fry, D. 1993. Effects of oil pollution on seabirds in the north-east Pacific. In: The Status, Ecology, and Conservation of Marine Birds of the North Pacific. Vermeer, K., Briggs, K., Morgan, K., Siegel-Causey, D (Eds). Canadian Wildlife Service Special Publication, Ottawa.

Burger, C., Schubert, A., Heinänen, S., Dorsch, M., Kleinschmidt, B., Žydelis, R., Morkūnas, J., Quillfeldt, P. and Nehls, G., 2019. A novel approach for assessing effects of ship traffic on distributions and movements of seabirds. *Journal of environmental management*, *251*, p.109,511.

Büring, T., van Der Grient, J., Pierce, G., Bustamante, P., Scotti, M., Jones, J.B., Rocha, F., Arkhipkin, A. 2024. Unveiling the wasp-waist structure of the Falkland shelf ecosystem: the role of *Doryteuthis gahi* as a keystone species and its trophic influences. *Journal of the Marine Biological Association of the United Kingdom.* 104: e2, 1–27.

Burke, C.M., Davoren, G.K., Montevecchi, W.A. and Wiese, F.K. 2005. Seasonal and spatial trends of marine birds along offshore support vessel transects and at oil platforms on the Grand Banks. In: Offshore oil and gas environmental effects monitoring: approaches and technologies. Armsworthy, S.l.; Cranford, P.J.; Lee, K. (Eds). pp. 587-614. Battelle Press, Columbus, Ohio, USA.

Burkhardt, E. and Lanfredi, C. 2012. Fall feeding aggregations of fin whales off Elephant Island (Antarctica). Paper SC/64/SH9 presented to the IWC Scientific Committee (unpublished).

Burkhardt-Holm, P. and N'Guyen, A. 2019. Ingestion of microplastics by fish and other prey organisms of cetaceans, exemplified for two large baleen whale species. *Marine Pollution Bulletin*. 144: 224-234.

Bustos, C.A., Balbontín, F. and Landaeta, M. 2007. Spawning of the southern hake *Merluccius australis* (Pisces: Merlucciidae) in Chilean fjords. *Fisheries Research*. 83: 23-32.

Butler, R.G., Harfenist, A., Leighton, F.A. and Peakall, D.B. 1988. Impact of sublethal oil and emulsion exposure on the reproductive success of Leach's Storm-Petrels: short and long- term effects. *Journal of Applied Ecology*. 25: 125–143.

CAA. 2013. CAP 437, Standards for offshore helicopter landing areas. Civil Aviation Authority. https://www.caa.co.uk/our-work/publications/documents/content/cap-437/.

CABI. 2013. Biological control of the European earwig (*Forficula auricularia*) – a severe threat to horticulture and health and safety on the Falkland Islands. Centre for Agriculture and Bioscience International (CABI) report to Falkland Islands Government.

CABI. 2014. Invasive Species Compendium, Datasheet - *Carcinus meanus*. https://ckan.cabi.org/data/dataset/invasive-species-compendium.

Caldeira, K. and Wickett, M.E. 2003. Anthropogenic carbon and ocean pH. *Nature*. 425: 365.

Camphuysen, C.J. 1989. Beached bird surveys in the Netherlands 1915-1988: seabird mortality in the southern North Sea since the early days of oil pollution. Werkgroep Noordzee, Amsterdam.

Camphuysen, C.J. 2005. North Sea Pilot Project on Ecological Quality Objectives, Issue 4. Seabirds, EcoQO element (f): Oiled-guillemot-EcoQO. Final version, January 2005. CSR Consultancy, Oosterend, Texel.

Camphuysen C.J., Chardine, J., Frederiksen, M. and Nunes, M. 2005. Review of the impacts of recent major oil spills on seabirds. In: Report of the Working Group on Seabird Ecology, Texel, 29 March to 1 April 2005 (Eds: Anonymous). Oceanography Committee, ICES CM 2005/C:05, Ref. ACME+E, International Council for the Exploration of the Sea, Copenhagen, Denmark.

Cárdenas-Alayza, S., Oliveira, L. and Crespo, E. 2016. *Arctocephalus australis*. The IUCN Red List of Threatened Species 2016: e.T2055A45223529.

Carlmark J.W. 1971. Penetration of free-falling objects into deep-sea sediments. United States Naval Postgraduate School. http://calhoun.nps.edu/bitstream/handle/10945/15850/penetrationoffre00carl.pdf?sequence=1.

Carreto, J.I., Lutz, V.A., Carignan, M.O., Cucchi Colleoni, A.D. and De Marco, S.G. 1995. Hydrography and chlorophyll a in a transect from the coast to the shelf-break in the Argentine Sea. *Continental Shelf Research*. 15: 315-336.

Carroll, M., Pearson, T., Dragsund, E. and Gabrielsen, K.L. 2000. Environmental Status of the Norwegian Offshore Sector Based on the Petroleum Regional Monitoring Programme, 1996-1998. Prepared for the Norwegian Oil industry Association (OLF).

Catry, P., Campos, A., Segurado, P., Silva, M. and Strange, I. 2003. Population census and nesting habitat selection of thin-billed prion *Pachyptila belcheri* on New Island, Falkland Islands. *Polar Biology*. 26: 202-207.

Catry, P., Lemos, R., Brickle, P., Phillips, R.A., Matias, R. and Granadeiro, J.P. 2013. Predicting the distribution of a threatened albatross: the importance of competition, fisheries and annual variability. *Progress in Oceanography*. 110: 1-10.

Cave, E.J. and Kajiura, S.M. 2018. Effect of Deepwater Horizon crude oil water accommodated fraction on olfactory function in the Atlantic stingray, *Hypanus sabinus*. *Scientific Reports*. 8(1): p.15786.

CCAMLR. 2010. Twenty-ninth Meeting of the Commission. Ocean acidification and the Southern Ocean. CCAMLR-XXIX/BG/24.

CDP. 2022. CDP Technical Note: Guidance methodology for estimation of Scope 3 category 11 emissions for oil and gas companies, v2.0. https://cdn.cdp.net/cdp-production/cms/guidance_docs/pdfs/000/000/469/original/CDP-Scope-3-Category11-Guidance-Oil-Gas.pdf?1479754082.

CEDRE (Centre de documentation, de recherche et d'experimentations sur les pollutions accidentelles des eaux). 2017. Premier Oil: Study of the Weathering, Behaviour and Potential Impacts of a Crude Oil at the Laboratory and Pilot Scale in Simulated Local Weather Conditions. R.17.50.C/5227

CEFAS. 2001. Contaminant Status of the North Sea, DTI Strategic Environmental Assessment Technical Report TR_004.

Celi., M Filiciotto. F., Mirella, V., Vincenzo, A., Maccarrone, V., Ceraulo, M., Mazzola, S., and Buscaino, G. 2015. Shipping noise affecting immune responses of European spiny lobster (*Palinurus elephas*). *Canadian Journal of Zoology*. 93: 113-121.

Cerchio, S. and Weir, C. R. 2022. Mid-frequency song and low-frequency calls of sei whales in the Falkland Islands. *Royal Society Open Science*. 9: 220738.

CFL. 2023. Country-Specific electricity grid greenhouse gas emissions factors. – 2023. https://www.carbonfootprint.com/docs/2023_07_international_factors_release_11.xlsx.

Chamber of Shipping. 2009. Danish Shipowners' Association, Netherlands Oil and Gas Exploration and Production Association, Norwegian Oil Industry Association (OLF), Norwegian Shipowners' Association and Oil and Gas UK: NWEA Guidelines for the Safe Management of Offshore Supply and Rig Moving Operations Version 2.

Chemshirova, I., Arkhipkin, A., Shaw, P. W. and McKeown, N. J. 2023. Integrated statolith and genomic analysis reveals high connectivity in the nektonic squid *Illex* argentinus: implications for management of an International cephalopod fishery. *ICES Journal of Marine Science*. 80: 1976-1990.

Cherel, Y., Pütz, K. and Hobson, K. 2002. Summer diet of king penguins (*Aptenodytes patagonicus*) at the Falkland Islands, southern Atlantic Ocean. *Polar Biology*. 25: 898-906.

Cholewiak, D., DeAngelis, A. I., Palka, D., Corkeron, P. J., van Parijs, S. M. 2017. Beaked whales demonstrate a marked acoustic response to the use of shipboard echosounders. Royal Society of Open Science. 4(12):170940.

CIE. 2003. International Commission on Illumination. Report 150: Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations.

Claireaux, G., Queau, P., Marras, S., Le Floch, S., Farrell, A.P., Nicolas-Kopec, A., Lemaire, P., Domenici, P., 2018. Avoidance threshold to oil water-soluble fraction by a juvenile marine teleost fish. *Environmental Toxicology and Chemistry*. 37: 854–859.

Clarke, M.R. 1980. Cephalopoda in the diet of sperm whales of the southern hemisphere and their bearing on sperm whale biology. *Discovery Reports*. 37: 1-324.

Clarke, T.J., Matthiopoulos, T., Bonnet-Lebrun, A-S., Campioni, L., Catry, P., Marengo, I. and Poncet, S. 2019. Integrating habitat and partial survey data to estimate the regional population of a globally declining seabird species, the sooty shearwater. *Global Ecology and Conservation*. 17: e00554.

Clausen, A.P. and Pütz, K. 2003. Winter diet and foraging range of gentoo penguins (*Pygoscelis papua*) from Kidney Cove, Falkland Islands. *Polar Biology*. 26: 32-40.

Clausen, A.P., Arkhipkin, A.I., Laptikhovsky, V. and Huin, N. 2005. What is out there: diversity in feeding of gentoo penguins (*Pygoscelis papua*) around the Falkland Islands (South-west Atlantic). *Polar Biology*. 28: 653-662.

Clay, T. A., Manica, A., Ryan, P. G., Silk, J. R. D, Croxall, J. P., Ireland, L. and Phillips, R. A. 2016. Proximate drivers of spatial segregation in non-breeding albatrosses. *Scientific Reports*. 6: 29932.

Clyne, H. and Leaper, R. 1999. Modelling collisions between whales and ships. Assessing the potential for vessels to take avoiding action in response to sightings of whales. SC/56/BC6.

C-NOPB. 2002. (Canada–Newfoundland Offshore Petroleum Board), Offshore waste treatment guidelines. St. John's, NL: National Energy Board, Canada–Newfoundland Offshore Petroleum Board and Canada – Nova Scotia Offshore Petroleum Board. 21 pp.

Cohen, D.M., Inada, T., Iwamoto, T. and Scialabba, N. 1990. FAO species catalogue. Vol. 10. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers and other gadiform fishes known to date. FAO Fisheries Synopsis, v. 10. FAO, Rome.

Cole, S., Codling, I.D., Parr, W. and Zabel, T. 1999. Guidelines for managing water quality impacts with European marine sites. Report prepared for the UK Marine SACs project. Swindon WRC.

Coleman, J., Hollyman, P.R., Black, A. and Collins, M.A. 2022. Blinded by the light: Seabird collision events in South Georgia. *Polar Biology*. 45: 1151-1156.

Collette, B., Amorim, A.F., Boustany, A., Carpenter, K.E., de Oliveira Leite Jr., N., Di Natale, A., Fox, W., Fredou, F.L., Graves, J., Viera Hazin, F.H., Juan Jorda, M., Minte Vera, C., Miyabe, N., Nelson, R., Oxenford, H., Sun, C., Teixeira Lessa, R.P., Pires Ferreira Travassos, P.E. and Uozumi, Y. 2011. Allothunnus fallai. The IUCN Red List of Threatened Species 2011: e.T170349A6761139.

Collins, M, D. 1993. A split-step Padé solution for the parabolic equation method. *Journal of the Acoustical Society of America*. 93: 1736–1742.

Collins, M. A., Brickle, P., Brown, J., Belchier, M. 2010. The Patagonian toothfish: Biology, ecology and fishery. *Advances in Marine Biology*. 58: 227 – 300.

Committee on oil in the sea. 2003. Committee on oil in the sea: inputs, fates and effects. National Research Council of the National Academies. Washington, D.C.: The National Academies Press.

Conn, P. B., and G. K. Silber. 2013. Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. *Ecosphere* 4: 1-16.

Cooke, J.G. and Zerbini, A.N. 2018. *Eubalaena australis*. The IUCN Red List of Threatened Species 2018: e.T8153A50354147.

Coolen, J. W. P., Lindeboom, H., Cuperus J., van der Wiede, B. and van der Stap, T. 2015. Benthic communities on old gas platforms as predictors for new offshore wind farms. Conference on Wind energy and Wildlife impacts 2015, Berlin. https://www.researchgate.net/publication/279202168_Benthic_communities_on_old_gas_platforms_as_predictors_for_new_offshore_wind_farms.

Cooper, J. 1982. Methods of reducing mortality of seabirds caused by underwater blasting. *Cormorant*. 10: 109-114.

Cooper, J., Avenant, N.L. and Lafite, P.W. 1994. Airdrops and penguins: a potential conservation problem at sub-Antarctic Marion Island. *Polar Record*. 30: 277-282.

Costa D.P., Robinson P.W., Arnould J.P.Y., Harrison A-L, Simmons SE, Hassrick J.L., Hoskins, A.J., Kirkman, S.P., Oosthuizen, H., Villegas-Amtmann, S. and Crocker, D.E. 2010. Accuracy of ARGOS Locations of Pinnipeds at-Sea Estimated Using Fastloc GPS. *PLoS ONE* 5(1): e8677.

Costa, M. and Garcia, M. 2017. DOKE Field Work Report Aerial Survey. South Atlantic Environmental Research Institute. pp13.

Costa, M. and Cazzola, M. 2018. Dolphins of the kelp: Data priorities for Falkland's inshore cetaceans. Darwin Plus: Final Report. Pp. 74.

Cranford, P.J. and Gordon, D.C. 1992. The Influence of Dilute Clay Suspensions on Sea Scallop (*Placopecten magellanicus*) Feeding Activity and Tissue Growth. *Netherlands Journal of Sea Research*. 30: 107-200.

Cranford, P., Querbach, K., Maillet, G., Lee, K., Grant, J. and Taggart, C. 1998a. Sensitivity of Larvae to Drilling Wastes (Part A): Effects of water-based drilling mud on early life stages of haddock, lobster and sea scallop. Report to the Georges Bank Review Panel, Halifax, NS.

Cranford, P.J., Emerson, C.W., Hargrave, B.T. and. Milligan, T.G. 1998b. *In situ* feeding and absorption responses of sea scallops *Placopecten magellanicus* (Gmelin) to storm-induced changes in the quantity and composition of the seston. *Journal of Experimental Marine Biology and Ecology.* 219: 45-70.

Cranford, P.J., Gordon, K.L., Jr, Lee, K., Armsworthy, S.L. and Tremblay, G.H. 1999. Chronic Toxicity and Physical Disturbance Effects of Water and Oil-based Drilling Fluids and Some Major Constituents of Adult Sea Scallops (*Placopecten magellanicus*). *Marine Environmental Research*. 48: 225-256.

Crespo, E.A., Pedraza, N., Dans, S.L., Svendsen, G.M., Degrati, M. and Coscarella, M.A. 2019. The south-western Atlantic southern right whale, *Eubalaena australis*, population is growing but at a decelerated rate. *Marine Mammal Science*. 35: 93-107.

Crofts, S. 2014. Action Plan for the southern rockhopper penguin *Eudyptes chrysocome chrysocome* at the Falkland Islands: Review of potential threats, progress of work and prioritised action for 2014 – 2020. A report to Falklands Islands Government. Falklands Conservation, Stanley.

Crofts, S. and Stanworth, A. 2017. Falkland Islands Seabird Monitoring Programme Annual Report 2016/2017 (SMP24), Falklands Conservation, Stanley.

Crofts, S. and Stanworth, A. 2018. Falkland Islands Seabird Monitoring Programme Annual Report 2017/2018 (SMP25). Falklands Conservation, Stanley.

Crofts, S. and Stanworth, A. 2019. Falkland Islands Seabird Monitoring Programme - Annual Report 2018/2019 (SMP26). Falklands Conservation, Stanley.

Crofts, S. 2020. Notes on population census of Black-browed Albatrosses in the Falkland Islands in 2017. Funded by the Falkland Islands Government Environmental Study Budget.

Croxall, J.P., McInnes, S.J. and Prince, P.A. 1984. The status and conservation of seabirds at the Falkland Islands. In: Status and Conservation of the Worlds Seabirds. Croxall, J.P, Evans, P.G.H, and Schreiber, R.W. (Eds). pp 271-293. ICBP Publication No 2 Cambridge.

Croxall, J.P., Black, A.D. and Woods, A.G. 1999. Age, sex and status of wandering albatrosses *Diomedea exulans* in Falkland Island waters. *Antarctic Science*. 11: 150-156.

Croxall, J.P. and Woods, A.G. 2002. The importance of the Patagonian Shelf for top predator species breeding at South Georgia. *Aquatic Conservation: Marine and Freshwater Ecosystems*. 12: 101-118.

Croxall, J.P., Butchart, S.H.M., Lascelles, B., Stattersfield, A.J., Sullivan, B., Symes, A. and Taylor, P. 2012. Seabird conservation status, threats and priority actions: a global assessment. *Bird Conservation International*. 22: 1-34.

Crum, L. and Mao, Y. 1996. Acoustically enhanced bubble growth at low frequencies and its implications for human diver and marine mammal safety. *Journal of the Acoustical Society of America*. 99: 2898-2908.

Culik, B., Adelung, D. and Woakes, A.J. 1990. The effect of disturbance on the heart rate and behaviour of Adelie Penguins (*Pygoscelis adeliae*) during the breeding season. In: Antarctic ecosystems: ecological change and conservation. Kerry KR, Hempel G. (Eds). pp 177–182.Springer, Berlin.

Cunningham, A.P., Howe, J.A. and Barker, P.F. 2002. Contourite sedimentation in the Falkland Trough, western South Atlantic Ocean. In: Deep-water contourite systems: modern drifts and ancient series, seismic and sedimentary characteristics. (Stow, D.A.V., Pudsey, C.J., Howe, J.A., Fauge`res, J.- C., and Viana, A.R., eds), pp 337-352. Geological Society of London Memoir. 22.

Cuthbert, R.N., Pattison, Z., Taylor, N.G., Verbrugge, L., Diagne, C., Ahmed, D.A., Leroy, B., Angulo, E., Briski, E., Capinha, C., Catford, J.A., Dalu, T., Essl, F., Gozlan, R.E., Haubrock, P.J, Kourantidou, M., Kramer, A.M., Renault, D., Wasserman, R.J. and Courchamp, F. 2021. Global economic costs of aquatic invasive alien species. *Science of the Total Environment*. 775: 145238.

Danish Ministry for the Environment 2010. Noise from ships in ports. Possibilities for noise reduction. Lloyd's Register ODS Environmental Project No. 1330 2010.

Danilewicz, D., Ignacio, M., Maurício, T., Federico, S. 2016. Southern right whales (*Eubalaena australis*) off Torres, Brazil: Group characteristics, movements, and insights into the role of the Brazilian-Uruguayan wintering ground. Mammalia. 81.

Dauvin, J.C. and Gentil, F. 1990. Conditions of the peracarid populations of subtidal communities in Northern Brittany ten years after the Amoco Cadiz oil spill. *Marine Pollution Bulletin*. 21: 123– 130.

Davidson, D. 2016. Inshore Fisheries Research Project Berkeley Sound – West (Port Louis) Trip Report.

Davies, J.M. and Topping, G. (editors.) 1997. The impact of an oil spill in turbulent waters: The Braer. Proceedings of a symposium held at the Royal Society of Edinburgh, 7-8 September 1995.

Davies, T.W., Duffy, J.P., Bennie, J. and Gaston, K.J. 2014. The nature, extent and ecological implications of marine light pollution. *Frontiers in Ecology and the Environment*. 12: 347-355.

Dawson, W., Peyton, J. M., Pescott, O. L., Adriaens, T., Cottier-Cook, E. J., Frohlich, D. S., Key, G., Malumphy, C., Martinou, A. F., Minchin, D., Moore, N., Rabitsch, W., Rorke, S. L., Tricarico, E., Turvey,

K. M. A., Winfield, I. J., Barnes, D. K. A., Baum, D., Bensusan, K., Roy, H. E. 2022. Horizon scanning for potential invasive non-native species across the United Kingdom Overseas Territories. *Conservation Letters.* 16(1): Article e12928.

de Susanne, P., Morris, P. and Hopper, A. 2015. Web-GIS Based Waste Calculator for Oil Spill Preparedness and Response. Presented at the 2015 Interspill Conference.

DECC. 2008. Department of Energy and Climate Change, EEMS-Atmospheric Emissions Calculations (Issue 1.810a).

DECC. 2014. UK Greenhouse Gas Inventory, 1990 to 2012.

DEFRA. 2010. Noise Policy Statement for England (NPSE). DEFRA: London.

DEFRA. 2015. Guidance: Artificial Light Nuisances, How Councils Deal with Complaints. https://www.gov.uk/guidance/artificial-light-nuisances-how-councils-deal-with-complaints.

DEFRA. 2021. UK Plan for Shipments of Waste.

DEFRA. 2023. Official UK Statistics on Waste - website release 28 June 2023.

Derose-Wilson, A., Fraser, J.D., Karpanty, S.M., and Hillman, M.D. 2015. Effects of overflights on incubating Wilson's plover behavior and heart rate*. Journal of Wildlife Management*. 79: 1246–1254.

Derraik, J.G.B. 2002. The pollution of the marine environment by plastic debris: a review. *Marine Pollution Bulletin*. 44: 842-852.

DESNZ. 2023a. UK Greenhouse Gas Inventory, 1990 to 2021.

DESNZ. 2023b. Final UK greenhouse gas emissions national statistics 1990-2021 (spreadsheet).

DESNZ. 2023c. Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting.

Dewar, M., Blackford, J., Espie, T., Wilford, S. and Bouffin. N. 2022. Impact potential of hypersaline brines released into the marine environment for CCS reservoir pressure management, *International Journal of Greenhouse Gas Control*. 114: 103559. ISSN 1750-5836.

DeWitt, H.H., Heemstra, P.C. and Gon, O. 1990. Nototheniidae. In: Fishes of the Southern Ocean. Gon O. and Heemstra P. C. (Eds): 279–331. Grahamstown: J. L. B. Smith Institute of Ichthyology.

Dick, M.H. and Donaldson, W. 1978. Fishing vessel endangered by Crested Auklet landings. *Condor*. 80: 235-236.

DNR. 2019. Falkland Islands Department of Natural Resources Vessel Movements Database.

DNV. 2010 Technical Data Report: Marine shipping quantitative risk analysis, Enbridge Northern Gateway Project, Det Norske Veritas Oslo, Norway.

Doney, S.C., Fabry, V.J, Feely, R.A., and Kleypas, J.A. 2009. Ocean Acidification: The Other CO_2 Problem. *Annual Review of Marine Science*. 1: 169-192.

Doney, S.C., Mahowald, N., Lima, I., Feely, R.A., Mackenzie, F.T., Lamarque, J.F., Rasch, P.J. 2007. Impact of anthropogenic atmospheric nitrogen and sulfur deposition on ocean acidification and the inorganic carbon system. *Proceedings of the National Academy of Sciences*. 104: 14580-14585

Drewery, H. and Wolfaardt, A. 2017. Output of a review of ingestion pathways for oil with particular regard for the size range of solid particles. A report to Premier Oil (not published).

Durban, J.W. and Pitman, R.L. 2012. Antarctic killer whales make rapid, round-trip movements to subtropical waters: Evidence for physiological maintenance migrations? *Biology Letters*. 8: 274-277.

EA. 2023. Spreadsheet of remaining landfill capacity in 2022. https://www.data.gov.uk/dataset/237825cb-dc10-4c53-8446-1bcd35614c12/remaining-landfill-capacity.

EAC. 2014. Environmental Audit Committee - Tenth Report. Sustainability in the UK Overseas Territories.

Eastman, J.T. 1993. Antarctic Fish Biology: Evolution in a Unique Environment. London: Academic Press Limited.

EC. 2003. Technical Guidance Document on Risk Assessment in support of Commission Directive 93/67/EEC on Risk Assessment for new notified substances Commission Regulation (EC) No 1488/94 on Risk Assessment for existing substances Directive 98/8/EC of the European Parliament and of the Council concerning the placing of biocidal products on the market. European Commission Joint Research Centre. EUR 20418 EN/2.

Edmonds N.J., Firmin C.J., Goldsmith D., Faulkner R.C., Wood D.T. 2016. A review of crustacean sensitivity to high amplitude underwater noise: Data needs for effective risk assessment in relation to UK commercial species. *Marine Pollution Bulletin.* 108: 5–11.

EEP. 2019. Energy and Emissions Projections 2019.

Eglinton, G., Gonzalez, A.G., Hamilton, R.J. and Raphael, R.A. 1962. Hydrocarbon constituents of the wax coatings of plant leaves; a taxonomic survey. *Phytochemistry*. 1: 89-102.

Ekau, W. 1982. Biological investigations on *Notothenia ramsayi* Regan 1913 (Pisces, Notothenioidei, Nototheniidae). *Archiv für Fischereiwissenschaft*. 33: 43-68.

Ellenberg, U., Mattern, T., Seddon, P.J. and Jorquera, G.L. 2006. Physiological and reproductive consequences of human disturbance in Humboldt penguins: The need for species specific visitor management. *Biological Conservation*. 133: 95-106.

Ellenberg, U., Setiawan, A.N., Cree, A., Houston, D.M. and Seddon, P.J. 2007. Elevated hormonal stress response and reduced reproductive output in yellow-eyed penguins exposed to unregulated tourism. *General and Comparative Endocrinology*. 152: 54-63.

Energy Institute. 2016a. Guidance on the management of subsea hydraulic fluids.

Energy Institute. 2016b. Guidelines for the bunding of temporarily stored liquids offshore.

Engen. 2005. The Value of Airborne Sensors In Oil Spill Recovery Operations-Á Case Study From An Offshore Oil Spill In The Norwegian Sea. Norwegian Clean Seas Association for Operating Companies (NOFO).

EnvSys. 2016. Terrestrial and marine habitat mapping from satellite imagery of Berkeley Sound, Falkland Islands. Environment Systems unpublished report to Premier Oil.

Erbe, C. 2002. Hearing Abilities of Baleen Whales. (Contractor Report #DRDC Atlantic CR 2002-065). Dartmouth, NS: Defence R&D Canada – Atlantic. 30 pp.

Erbe, C., McCauley, R., McPherson, C. and Gavrilov, A. 2013. Underwater noise from offshore oil production vessels. *The Journal of the Acoustical Society of America*. 133: 65-70.

Eriksen, D.Ø., Sidhu, R., StrÃ¥lberg, E., Iden, K. I., Hylland, K., Ruus, A., RÃ¸yset, O., Berntssen, M. H. G., Rye, H. 2006. Radionuclides in produced water from Norwegian oil and gas installations — concentrations and bioavailability. *Czechoslovak Journal of Physics.* 56(4): D43–D48.

Erin Consulting Ltd. and OCL Services Ltd. 2003. Sheens associated with produced water effluents—review of causes and mitigation options. Report No.142. Calgary: Environmental Studies Research Funds. 46 pp.

Etkin, D.S., Nedwed, T.J. 2021. Effectiveness of mechanical recovery for large offshore oil spills. *Marine Pollution Bulletin*. 163: 111848.

Faerber, M.M. and Baird, R.W. (2010), Does a lack of observed beaked whale strandings in military exercise areas mean no impacts have occurred? A comparison of stranding and detection probabilities in the Canary and main Hawaiian Islands. *Marine Mammal Science*. 26: 602-613.

Falchi, F., Cinzano, P., Elvidge, C.D., Keith, D.M. and Haim, A. 2011. Limiting the Impact of Light Pollution on Human Health, Environmental and Stellar Visibility. *Journal of Environmental Management*. 92: 2714-2722.

Falcone, E.A., Schorr, G.S., Douglas, A.B., Calambokidis, J., Henderson, E., McKenna, M.F., Hildebrand, J., Moretti, D. 2009. Sighting characteristics and photo-identification of Cuvier's beaked whales (*Ziphius cavirostris*) near San Clemente Island, California: a key area for beaked whales and the military? *Marine Biology*. 156: 2631-2640.

Falklands Conservation. 2006. Important bird areas of the Falkland Islands.

Falklands Conservation. 2015. Welcome to Falklands Conservation.

Falklands Conservation. 2020. Cetacean code of conduct for the Falkland Islands. pp 6.

FAO. 2014. Fishing Techniques. Industrial squid jigging. Technology Fact Sheets. In: Food and Agriculture Organisation of the United Nations, FAO Fisheries and Aquaculture Department.

Farrington, J.W. and Tripp, B.W. 1977. Hydrocarbons in western North Atlantic surface sediments. *Geochiica et Cosmochimica Acta*. 41: 1627-1641.

Feyrer, L.J., Stanistreet, J.E., Moors-Murphy, H.B. 2024. Navigating the unknown: assessing anthropogenic threats to beaked whales, family Ziphiidae. *Royal Society of Open Science*. 11(4): 240058.

FICoC. 2023. Falkland Islands Chamber of Commerce. https://www.commerce.co.fk/.

FIFCA. 2023. Falkland Islands Fishing Companies Association (FIFCA) - http://www.fifca.co.fk/.

FIG. 2008a. Falkland Islands Government, Environmental Planning Department; Falkland Islands State of the Environment Report 2008. Falkland Islands Government and Falklands Conservation, Stanley. Otley, H., Munro, G., Clausen, A. and Ingham, B.

FIG. 2008b. Falkland Islands Species Action Plan for Cetaceans 2008-2018. The Environmental Planning Department, Stanley, Falkland Islands.

FIG. 2008c. Falkland Islands Species Action Plan for Cobb's wren 2008-2018. The Environmental Planning Department, Stanley, Falkland Islands.

FIG. 2008d. Falkland Islands Species Action Plan for Seals and Sea Lions 2008-2018. The Environmental Planning Department, Stanley, Falkland Islands.

FIG. 2011. UK Overseas Territories - Falkland Islands Biodiversity Snapshot. N. Rendell editor.

FIG. 2012a. Falkland Islands Government, Department of Public Works; Priorities for roads maintenance, increased funding for grading, capping and for surfacing the MPA road. ExCo paper 39/12, April 2012.

FIG. 2013a. Draft Stanley Tussac Islands Management Plan 2013-2018, Kidney Island, Cochon Island, Top Island and Bottom Island. Environmental Planning Department, Falkland Islands Government.

FIG. 2013b. Guidance note on approvals for offshore operations. Department of Mineral Resources, Falkland Islands Government.

FIG. 2013c. Falkland Islands Government, Fisheries Department Fisheries Statistics, Volume 17, 2012.

FIG. 2014a. Falkland Islands Government, Fisheries Department Fisheries Statistics, Volume 18, 2013.

FIG. 2014b. Waste Management Action Plan (2015-2017).

FIG. 2015a. An assessment of seabird by-catch in Falkland Islands trawl fisheries, July 2013 to June 2014. Quintin, M.J. Falkland Islands Government, Fisheries Department.

FIG. 2015b. Falkland Islands Fisheries Department Vessel Movements Database.

FIG. 2015c. Falkland Islands Government, Department of Agriculture. 'Falkland Islands biosecurity: protecting our home, environment and economy. A guide to importing goods'

FIG. 2015d. Falkland Islands Government, Environmental Planning Department. Falkland Islands Town Plan.

FIG. 2016a. Falkland Islands Biodiversity Framework 2016-2030. Falkland Islands Government, Environmental Planning Department.

FIG. 2016b. An assessment of seabird by-catch in Falkland Islands trawl fisheries, July 2014 to June 2015. Kuepfer, A. Falkland Islands Government, Fisheries Department.

FIG. 2016c. Fisheries Department Fisheries Statistics, Volume 20, 2006-2015.

FIG. 2016d. Executive Council Paper: Developing Offsetting Guidance for the Falklands Islands. Paper No: 124/16, 29th June 2016, Director of Mineral Resources.

FIG. 2016e. Falkland Islands Government, Environmental Planning Department. Environmental Impact Assessment guidance notes.

FIG. 2017a. Falkland Islands Government Policy Unit, Falkland Islands census 2016, Statistics and Data Tables. Falkland Islands Government., Policy Unit.

FIG. 2017b. An assessment of seabird by-catch in the Falkland Islands trawl fishery July 2016 – June 2017. Falkland Islands Fisheries Department report. https://www.falklands.gov.fk/fisheries/.

FIG. 2018a. FIG ExCo paper 30-18 Waste Management Strategy, 2018.

FIG. 2018b. FIG Code of Practice for Procurement by Oil and Gas Companies and their Subcontractors Operating in the Falkland Islands. July 2018.

FIG. 2019a. Fisheries Department Fisheries Statistics, Volume 23, 2009-2018: 102pp.

FIG. 2019b. ExCo 99-19 'Investment in Improved Waste Management', 2019.

FIG. 2020. Falkland Islands Government Fishery Statistics 2019 Volume 24 (2010 –2019).

FIG. 2021a. Falkland Islands Environment Strategy 2021-2040. Stanley, Falkland Islands. 52 pages. Available from: website: https://www.fig.gov.fk/policy/environment/environment-strategy.

FIG. 2021b. Falkland Islands Government Fishery Statistics 2020 Volume 24 (2010 –2020).

FIG. 2021c. Housing for our Future: Falkland Islands Housing Strategy. https://www.falklands.gov.fk/policy/images/jdownloads/Housing_for_our_Future_-_Falkland_Islands_Housing_Strategy.pdf.

FIG. 2022a. Falkland Islands Government Fishery Statistics 2021 Volume 25 (2010 –2021).

FIG. 2022b. National Oil Spill Contingency Plan, Volumes 1 and 2.

FIG. 2023a. FIG Self-governance. https://www.falklands.gov.fk/2-uncategorised/109-self-governance.

FIG. 2023b. FIG The Environmental Charter. https://www.ukotcf.org.uk/env-charter/.

FIG. 2023c. FIG The Constitution. https://www.fiassociation.com/about-us/falkland-islands-constitution/.

FIG. 2023d. FIG Fisheries Department. https://www.falklands.gov.fk/fisheries/.

FIG. 2023e. FIG Department of Mineral Resources. https://falklands.gov.fk/mineralresources/.

FIG. 2023f. FIG Directorate of Policy, Economy & Corporate Services. Policy Department. https://falklands.gov.fk/policy/.

FIG. 2023g. FIG Agriculture Department. https://www.falklands.gov.fk/agriculture/17-home.

FIG. 2023h. Falkland Islands Tourism Board. https://www.falklandislands.com/.

FIG. 2023i. Falkland Islands Civil Aviation Department; https://www.falklands.gov.fk/civilaviation/.

FIG. 2023j. Falkland Islands Energy Strategy. Cooper, R.; Copping, L. and Barlow, D. Falkland Islands Government, Stanley, Falkland Islands. 51 pp.

FIG. 2023k. FIG Energy Strategy Implementation Plan. Environment Department. December 2023.

FIG. 2023l. Census 2021 - Preliminary Data Tables. Falkland Islands Government: Policy and Economic Development Unit. Available online: https://www.falklands.gov.fk/policy/2021-census/census.

FIG. 2023m. Falkland Islands Data Portal. Available online: http://dataportal.saeri.org.

FIG. 2023n. Falkland Islands Government Fishery Statistics 2022 Volume 27 (2013 –2022). Falkland Islands government. 94pp.

FIG. 2023o. Falkland Islands Pollution Prevention and Waste Management Policy.

FIG. 2024a. Falkland Islands ports and harbours information 2017, 23rd edition. www.falklandislands.com/shopimages/2017 Harbour Info Booklet.pdf.

FIG. 2024b. Fishery Statistics Bulletin volume 28 (2014-2023) 98pp.

Filatova, O.A., Fedutin, I.D., Meschersky, I.G., Mamaev, E.G., and Hoyt, E. 2024. Unusual use of shallow habitats may be evidence of a cultural tradition in Baird's beaked whales. *Animal Behaviour*. 209: 121-128.

FILFH. 2024. Falkland Islands Low Flying Handbook.

Filkin and Co. 2017. Premier Oil Waste Strategy. Document Reference FK-SL-PMO-EV-0003.

FIMA. 2023. Falkland Islands Maritime Authority Vessel Movements Database.

FIMA. 2024. Falkland Islands Maritime Authority Vessel Movements Database.

Fisk, A.T., Stern, G.A., Hobson, K.A., Strachan, W.J., Loewen, M.D., and Norstrom, R.J. 2001. Persistent Organic Pollutants (POPs) in a Small, Herbivorous, Arctic Marine Zooplankton (*Calanus hyperboreus*): Trends from April to July and the Influence of Lipids and Trophic Transfer. *Marine Pollution Bulletin*. 43: 93-101.

FITB. 2016. Falkland Islands Tourism Development Strategy 2016-2023, 2016.

FITB. 2022. Falkland Islands Tourism Statistics Report 2022. https://www.falklandislands.com/trade/statistics.

Fjogstad, A., Saasen, A., Hagen, R., Tanche-Larsen, P.B., Ree, R., Melgren, H., Rostad, E. and Hoset, H. 2000. Field Trial of Alternative Weight Material with Improved Occupational Hygiene and Environmental Performance: SPE61042.

Folk, R.L. 1954. The distinction between grain size and mineral composition in sedimentary rock nomenclature. *Journal of Geology*. 62: 344-359.

Fordham, S., Fowler, S.L., Coelho, R.P., Goldman, K. and Francis, M.P. 2016. *Squalus acanthias*. The IUCN Red List of Threatened Species 2016: e.T91209505A2898271.

Fortreath, G.N.R., Picken, G.B., Ralph. R., and Williams, J. 1982. Marine Growth Studies on the North Sea Oil Platform Monstrose Alpha. *Marine Ecology Progress Series*. 8: 61-68.

Foster, M. S. and Willan, R. C. 1979. Marine algae of an offshore oil platform. *Marine Biology*. 52: 291-301.

Fowler, C.W. 1987. Marine debris and northern fur seals: a case study. *Marine Pollution Bulletin*. 18: 326-335.

Franchini, F., Smout, S., Blight, C., Boehme, L., Munro, G., Costa, M. and Heinrich, S. 2020. Habitat Partitioning in Sympatric Delphinids Around the Falkland Islands: Predicting Distributions Based on a Limited Data Set. *Frontiers in Marine Science*. 7:277.

Franco, B.C., Piola, A.R., Rivas, A.L., Baldoni A. and Pisoni, J.P. 2008. Multiple thermal fronts near the Patagonian Shelf break. *Geophysical Research Letters*. 35: 1-6.

Frans, V.F. and Augé, A.A. 2016. Use of local ecological knowledge to investigate endangered baleen whale recovery in the Falkland Islands. *Biological Conservation*: 202, 127-137.

Frankish, C.K., Manica, A. and Phillips, R.A. 2020a. Effects of age on foraging behavior in two closely related albatross species. *Movement Ecology*. 8(7).

Frankish, C.K., Phillips, R.A., Clay, T.A., Somveille, M. and Manica, A. 2020b. Environmental drivers of movement in a threatened seabird: insights from a mechanistic model and implications for conservation. *Divers Distribution*. 26: 1315–1329.

Fraser, G.S., Russell, J. and von Zharen, W.M. 2006. Produced water from offshore oil and gas installations on the Grand Banks, Newfoundland and Labrador: are the potential effects to seabirds sufficiently known? *Marine Ornithology*. 34: 147–156.

Frasier, K.E. 2020. Evaluating Impacts of Deep Oil Spills on Oceanic Marine Mammals. In: Murawski, S., *et al.,* Scenarios and Responses to Future Deep Oil Spills. Springer, Cham.

French, S.S., González-Suárez, M., Young, J.K., Durham, S. and Gerber, L.R. 2011. Human Disturbance Influences Reproductive Success and Growth Rate in California Sea Lions (*Zalophus californianus*). *PLoS ONE*. 6: e17686.

Frisch-Jordán, A. and López-Arzate, C. D. 2024. Large whale entanglements in Mexico, a 25-year review from 1996 to 2021. *Marine Mammal Science*. 40: e13106.

FUGRO. 1999. North Falklands Metocean Survey Final Report - Volume 1 19. June-97 to 30-Sep-98. C10317/1762.

Furness, B. and Wade, H. 2012. 'Vulnerability of Scottish seabirds to offshore wind turbines.' MacArthur Green Ltd.

Galimberti, F. and Sanvito, S. 2012. Tracking at sea the elephant seals of Sea Lion Island, 2011 report. Ensenada, BC, Mexico, 28/01/2012.

García-Borboroglu, P., Boersma, D., Ruoppolo, V., Pinho-da-Silva-Filho, R., Corrado-Adornes, A., Conte-Sena, D. and Velozo, R. 2010. Magellanic penguin mortality in 2008 along the SW Atlantic coast. *Marine Pollution Bulletin*. 60: 1652-1657.

García-Borboroglu, P., Boersma, P.D., Reyes, L. and Skewgar, E. 2008. Petroleum Pollution and Penguins: Marine Conservation Tools to Reduce the Problem. In: Marine Pollution: New Research (Ed: Hofer, T.N.), pp. 339-356. Nova Science Publishers Inc., New York, USA.

García-Borboroglu, P., Boersma, P.D., Ruoppolo, V., Reyes, L., Rebstock, G.A., Griot, K., Heredia, S.R., Adornes, A.C. and da Silva, R.P. 2006. Chronic oil pollution harms Magellanic Penguins in the South-west Atlantic. *Marine Pollution Bulletin*. 52: 193-198.

Gardline. 1998a. Benthic Environmental Baseline Survey of the Sediments around the exploration "Little Blue-A" Well (February 1998). Gardline Surveys Limited.

Gardline. 1998b. Benthic Environmental Baseline Survey of the Sediments around the exploration "B1" Well (February 1998). Gardline Surveys Limited.

Gardline. 1998c. Benthic Environmental Baseline Survey of the Sediments around the exploration "14/14- A" Well, 1998d. Gardline Surveys Limited.

Gardline. 1998d. Benthic Environmental Baseline Survey of the Sediments around the exploration " Well 14/23-A (February 1998). Gardline Surveys Limited.

Gardline. 1998e. Benthic Environmental Baseline Survey of the Sediments around the exploration "FI 14/19-A" Well (March 1998). Gardline Surveys Limited.

Gardline. 1998f. Benthic Environmental Baseline Survey of the Sediments around the exploration FI 14/24 "Braela" Well (March 1998). Gardline Surveys Limited.

Gardline. 1998g. Benthic Environmental Baseline Survey of the Sediments around the exploration "Minke" 14/13-B Well (June 1998). Gardline Surveys Limited.

Gardline. 1998h. Post-Drill Environmental Survey of the Sediments around the Exploration Well "Little Blue- A" - Final report October 1998. Gardline Surveys Limited.

Gardline. 2012. Sea Lion Field Development. North Falklands Licence Areas. PL032, PL033 and PL04. March and April 2012. Environmental Baseline Survey Report. Prepared for Rockhopper Exploration Plc. Reference: 9030.1.

Gardline. 2013a. Sea Lion Field Development North Falkland Licence Areas PL032, PL033 AND PL04, March and April 2012 Environmental Baseline Survey Report. Ref. 9030.1.

Gardline. 2013b. Sea Lion Post Drill Environmental Survey North Falkland Licence Areas PL032, PL033 and PL04, March and April 2012 Environmental Report. Ref. 9030.2.

Gass, S.E. and Roberts, J.M. 2006. The occurrence of the cold-water coral *Lophelia pertusa* (Scleractinia) on oil and gas platforms in the North Sea: Colony growth, recruitment and environmental controls on distribution. *Marine Pollution Bulletin*. 52: 549-59.

Genesis. 2013. Premier Oil UK Limited – Sea Lion Pre-FEED concept engineering study. File name: J20230B-Y-TN-24004 B1 Environmental Road Map, Genesis June 2013.

Genesis. 2014. J20490B-Y-RT-24002 B03 - Sea Lion ESIA Scoping Report rev 7.8.2014. unpublished.

Genesis. 2015a. Sea Lion drill cuttings modelling. Document Number: J73700A-Y-TN-24001/B1. Prepared for Premier Oil.

Genesis. 2015b. Sea Lion Produced Water and Cooling Water modelling. Document Number J73700A-Y-TN-24003/B1. Prepared for Premier Oil.

Genesis. 2017. Review of Seabird Data at Sea Lion. Document Number: J74462B-A-RT-00001/A1. Prepared for Premier.

Genesis. 2024a. J-UK-00200-218436-Y-TN001-Sea Lion Project-Underwater Noise-Offshore-Report 0.

Genesis. 2024b. J-UK-00200-218436-Y-TN002-Sea Lion Project-Underwater Noise-Inshore-Report 0.

Geomotive and MRAG. 2011. Marine Mammal and Sea Birds Observation and Passive Acoustic Monitoring During the 3D Survey in the North Falkland Basin 11-Jan-11 to 02-May-11. Report for Rockhopper Exploration.

Gerrard, S., Grant, A., March, R. and London, C., 1999. Drill Cuttings Piles in the North Sea. Management options during Platform Decommissioning. Centre for Environmental Risk Report No 31. University of East Anglia.

GESAMP. 2007. Estimates of oil entering the marine environment from sea-based activities. GESAMP (IMO/FAO/UNESCO-IOC/UNIDO/WMO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection)– Rep. Stud. GESAMP No. 75.

Gillon, K.W., White, R.W. and Black, A.D. 2001 Grey-backed storm-petrels *Garrodia nereis* and other seabirds associating with free-floating kelp. *Atlantic Seabirds*. 3: 75-84.

Girling, A.E., 1989. Acute and chronic toxicity of produced water from a north-sea oil production platform to the calanoid copepod *Acartia tonsa*. *Bulletin of Environmental Contamination and Toxicology*. 43: 280–286.

Glass, J.P. and Ryan, P.G. 2013. Reduced seabird night strikes and mortality in the Tristan rock lobster fishery. *African Journal of Marine Science*. 35: 589-592.

Glasson, J., Therivel, R. and Chadwick, A. 2013. Introduction to Environmental Impact Assessment, 4th Ed. Natural and Built Environment Series. Routledge.

Glegg, G.A. and Rowland, S.J. 1996. The Braer oil spill - hydrocarbon concentrations in intertidal organisms. *Marine Pollution Bulletin*. 32: 486-492.

Glemarec, M. and Hussenot, E. 1982. A three-year ecological survey in Benoit and Wrac'h Abers following the Amoco Cadiz oil spill. *Netherlands Journal of Sea Research*. 16: 483-490.

Godard-Codding, C.A. and Collier, T.K. 2018. The effects of oil exposure on cetaceans. In: *Marine Mammal Ecotoxicology* (pp.75-93). Academic Press.

Golding, N., Black, B. 2020. Final Report from the DPLUS065 Mapping Falklands and South Georgia coastal margins for spatial planning project. SAERI.

Goldsworthy, S.D., Giese, M., Gales, R.P., Brothers, N., and Hamill, J. 2000. Effects of the Iron Baron oil spill on little penguins (*Eudyptula minor*). II. Post-release survival of rehabilitated oiled birds. *Wildlife Research*. 27: 573-582.

Gollasch, S., Lenz, J., Dammer, M. and Andres, H-G. 2000. Survival of tropical ballast water organisms during a cruise from the Indian Ocean to the North Sea. *Journal of Plankton Research*. 22: 923–937.

Gomes, F., Oliveira, M., Ramalhosa, M.J., Delerue-Matos, C. and Morais, S. 2013. Polycyclic aromatic hydrocarbons in commercial squids from different geographical origins: Levels and risks for human consumption. *Food and Chemical Toxicology*. 59: 46-54.

GOMO. 2013. Guidelines for Offshore Marine Operations.

Gonçalves-Araujo, R., de Souza, M.S., Borges Mendes, C.R., Maria Tavano, V. and Garcia, C.A.E. 2016. Seasonal change of phytoplankton (spring *vs.* summer) in the southern Patagonian shelf. *Continental Shelf Research*. 124: 142–152.

González-Solís, J., Croxall, J.P. and Wood, A.G. 2000. Sexual dimorphism and sexual segregation in foraging strategies of Northern Giant Petrels, *Macronectes halli*, during incubation. *Oikos.* 90: 390–398.

Goodwin, C., Jones, J., Neely, K. and Brickle, P. 2011. Sponge biodiversity of the Jason Islands and Stanley, Falkland Islands with descriptions of twelve new species. *Journal of the Marine Biological Association of the United Kingdom*. 91: 275-301.

Goodwin, C., Jones, J., Neely, K., and Brickle, P. 2016. Sponge biodiversity of Beauchêne and the Sea Lion Islands and south-east East Falkland, Falkland Islands, with a description of nine new species. *Journal of the Marine Biological Association of the United Kingdom*. 96: 263-290.

Gordon, J., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R. and Thompson, D. 2004. A review of the effects of seismic surveys on marine mammals. *Marine Technology Society Journal*. 37: 16-34.

Gowans, S., Whitehead, H., Arch, J.K., Hooker, S.K. 2000. Population size and residency patterns of northern bottlenose whales (Hyperoodon ampullatus) using the Gully, Nova Scotia. *Journal of Cetacean Research and Management*. 2(3): 201-210.

Granadeiro, J.P., Phillips R.A., Brickle, P. and Catry, P. 2011. Albatrosses following fishing vessels. How badly hooked are they on an easy meal? *PLoS ONE*. 6: e17467.

Greene, C.R. Jr. 1987. Characteristics of oil industry dredge and drilling sounds in the Beaufort Sea. *Journal of Acoustical Society of America*. 82:1315–1324.

Gregory, M.R. 2009. Environmental implications of plastic debris in marine settings - entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions. *Philosophical Transactions of the Royal Society B.* 364: 2013-2025.

Grob, C. and Pollet, B.G. 2016. Regrowth in ship's ballast water tanks: Think again! *Marine Pollution Bulletin*, 109: 46–48.

Grosell, M. and Pasparakis, C. 2021. Physiological responses of fish to oil spills. *Annual review of marine science*. 13: 137-160.

GSGSSI. 2009. Government of South Georgia Low Flight Avoidance Map.

GSGSSI. 2016. Government of South Georgia and the South Sandwich Islands Conservation Action Plan for Black-browed Albatrosses at South Georgia (2016-2020). Government House, Stanley, Falkland Islands.

Gubbay, S. and Earll, R. 2000. Proposed guidelines for dealing with cetaceans in the event of an oil spill in the Moray Firth. Report to Talisman Energy (UK) Limited and Scottish Natural Heritage.

Guerrero, R.A., Baldoni, A. and Benavides, H. 1999. Oceanographic Conditions at the Southern End of the Argentine Continental Slope. *INIDEP Documento Cientifico*. 5: 7-22.

Gunlach, E.R. and Hayes, M.O. 1978. Vulnerability of Coastal Environments to Oil Spill Impacts. *Marine Technology Society Journal*. 12: 18-27.

Gwynn, J., Fievet, B., Stackhouse, A., Robinson, C., Aquilonius, K., Arends, P., Baglan, N., Caplin, H., Cardoso, G., Chartier, M., Claes, J., Dewar, A., Hagg, A., Löhle, J., Luque, S., McGinnity, P., Nilsen, M., Nyffenegger, C., Pynn, A., Reynal, N., Ryan, R., Siegfried, M., Tanzi, C.P., Telleria, D., Trinidad, J.A. 2022. Fifth periodic evaluation of progress towards the objective of the OSPAR Radioactive Substances Strategy. In: OSPAR, 2023: The 2023 Quality Status Report for the Northeast Atlantic. OSPAR Commission, London.

Hamilton, J.E. 1939. The leopard seal, *Hydrurga leptonyx* (de Blainville). *Discovery Reports*. 18: 239-264.

Hamilton, L.D., Meinhold, A.F., Nagy, J. 1991. Produced water radionuclide hazard/risk assessment — phase 1. Prepared for the American Petroleum Institute. Brookhaven National Laboratory. BNL 47403.

Hanchet, M.S., Tracey, D., Dunn, A., Horn, P. and Smith, N. 2012. Mercury concentrations of two toothfish and three of its prey species from the Pacific sector of the Antarctic. *Antarctic Science.* 24: 34–42.

Handley, J. M., Harte, E., Stanworth, A., Poncet, S., Catry, P., Cleminson, S., Crofts, S. and Dias, M. 2023. Progressing delineations of key biodiversity areas for seabirds, and their application to management of coastal seas. *Diversity and Distributions*. 29: 123–142.

Hansen, J., Nazarenko, L., Ruedy, R., Sato, M., Willis, J., Del Genio, A., Koch, D., Lacis, A., Lo, K., Menon, S. and Novakov, T., 2005. Earth's energy imbalance: Confirmation and implications. Science, 308:1431-1435.

Harding, S. and Cousins N. 2022. Review of the Impacts of Anthropogenic Underwater Noise on Marine Biodiversity and Approaches to Manage and Mitigate them. Technical Series No. 99. Secretariat of the Convention on Biological Diversity, Montreal, 145 pp.

Harnois, V., Smith H. C. M., Benjamins, S. and Johanning, L. 2015. Assessment of entanglement risk to marine megafauna due to offshore renewable energy mooring systems. International Journal of Marine Energy. 11: 27-49.

Harrison-Matthews, L. 1932. Lobster krill: *Anomuran crustacea* that are the food of whales. *Discovery Reports*. 5: 467-484.

Hart, T.J. 1946. Report on trawling surveys on the Patagonian continental shelf. *Discovery Reports*. 23: 223-408.

Hartung, R. 1967. Energy Metabolism in Oil-Covered Ducks. *The Journal of Wildlife Management*. 31: 798-804.

Hassel, A., T. Knutsen, J. Dalen, K. Skaar, S. Løkkeborg, O. Misund, Ø. Østensen, M. Fonn, and Haugland, E. K. 2004. Influence of seismic shooting on the lesser sandeel (Ammodytes marinus). *Journal of Marine Science*. 61: 1165-1173.

Hastings, M.C. and Popper, A.N. 2005. Effects of sound on fish. Report to Jones and Stokes for California Department of Transportation, 2005.

Hatanaka, H. 1986. Growth and life span of short-finned squid *Illex argentinus* in the waters off Argentina. *Bulletin of the Japanese Society for the Science of Fish*. 52: 11-17.

Hatch, L., Clark, C., Merrick, R., Van Parijs, S., Ponirakis, D., Schwehr, K., Thompson, M., and Wiley, D. 2008. Characterising the relative contributions of large vessels to total ocean noise fields: A case study

using the Gerry E. Studds Stellwagen Bank National Marine Sanctuary. *Environmental Management*. 42: 735-752.

Hawkins, A.D. and Popper, A.N. 2014. Assessing the impact of underwater sounds on fishes and other forms of marine life. *Acoustics Today*. 10: 30-41.

Hawkins, A.D., Pembroke, A.E. and Popper, A.N. 2015. Information gaps in understanding the effects of noise on fishes and invertebrates. *Reviews in Fish Biology and Fisheries*. 25: 39-64.

Hawkins, A. D., and Popper, A. N. 2017. A sound approach to assessing the impact of underwater noise on marine fishes and invertebrates. – *ICES Journal of Marine Science*. 74: 635–651.

Hayes, S. and Galley, L. 2012. Modelling the Options for Managing Drill Cuttings Piles on Decommissioning. Presented at the European HSE Conference and Exhibition, London, United Kingdom, April 2013. Paper Number: SPE-164983-MS.

Hedd, A., Montevecchi, W.A., Phillips, R.A. and, Fifield, D.A. 2014. Seasonal sexual segregation by monomorphic sooty shearwaters *Puffinus griseus* reflects different reproductive roles during the pre-laying period. *PLoS ONE*. 9(1): e85572.

Henry, A. G., Garron, M., Morin, D., Reid, A., Ledwell, W., and Cole, T. V. N. 2020. Serious injury and mortality determinations for baleen whale stocks along the Gulf of Mexico, United States east coast, and Atlantic Canadian provinces, 2013–2017. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Herr, H., Viquerat, S., Devas, F., Lees, A., Wells, L., Gregory, B., Giffords, T., Beecham, D. and Meyer, B. 2022. Return of large fin whale feeding aggregations to historical whaling grounds in the Southern Ocean. *Scientific Reports*. 12: 9458.

Hilliard, R. 2004. Best practice for the management of introduced marine pests: A review. GISP: the Global Invasive Species Program, GISP Secretariat.

Hjermann, D., Melsom, A., Dingsør, G.E., Durant, J.M., Eikeset, A.M., Røed, L.P., Ottersen, G., Storvik, G. and Stenseth, N.C. 2007. Fish and oil in the Lofoten–Barents Sea system: synoptic review of the effect of oil spills on fish populations. *Marine Ecology Progress Series*. 339:283-299.

Hipsey, S.J., Delarue, J., Martin, B., Burns, R.D.J. and Lumsden, E. 2013. Static Acoustic Monitoring Programme for the Sea Lion Development Area. JASCO Document 00591, Version 1.0. Technical report by JASCO Applied Sciences for Premier Oil Plc, Falkland Islands Business Unit.

Hiscock, K., Sharrock, S., Highfield, J. and Snelling, D. 2010. Colonisation of an artificial reef in south-west England – ex-HMS 'Scylla'. *Journal of the Marine Biological Association of the United Kingdom*. 90: 69–94.

Holdway, D.A. 2002. The acute and chronic effects of wastes associated with offshore oil and gas production on temperate and tropical marine ecological processes. *Marine Pollution Bulletin*. 44: 185-203.

Hölker, F., Wolter, C., Perkin, E.K. and Tockner, K. 2010. Light pollution as a biodiversity threat. *Trends in Ecology and Evolution*. 25: 681-682.

Holmes, N. Atkin, D., Mahdi, S. and Ayress, M.A. 2015. Integrated biostratigraphy and chemical stratigraphy in the development of a reservoir-scale stratigraphic framework for the Sea Lion Field area, North Falkland Basin. *Petroleum Geoscience*. 21: 171-182.

Holst., S. and Jarms, G. 2007. Substrate choice and settlement preferences of planula larvae of five Scyphozoa (Cnidaria) from German Bight, North Sea. *Marine Biology*. 151: 863-871.

Holth, T.F., Beylich, B.A., Skarphedinsdottir, H., Liewenborg, B., Grung, M., Hylland, K., 2009. Genotoxicity of environmentally relevant concentrations of water-soluble oil components in cod (*Gadus morhua*). *Environmental Science Technology*. 43: 3329–3334.

Hope-Jones, P. 1980. The effect on birds of a North Sea gas flare. *British Birds.* 73: 547-555.

Horvath, C. 2013. Confidence, Uncertainty, and Risk in Environmental Assessment. IAIA13 Conference Proceedings. Impact Assessment the Next Generation 33rd Annual Meeting of the International Association for Impact Assessment 13–16 May 2013.

Hosseini, A., Brown, J.E., Gwynn, J.P., Dowdall, M. 2012. Review of research on impacts to biota of discharges of naturally occurring radionuclides in produced water to the marine environment. *Science of the Total Environment*. 438: 325-333. ISSN 0048-9697.

House of Commons Library. 2023. International treaties and the Overseas Territories. Research Briefing. 26 January 2023. Number 9707.

HSE. 2008. Safety zones around oil and gas installations in waters around the UK.

Hu, M. Y., Yan, H. Y., Chung, W-S., Shiao, J-C. and Hwang, P-P. 2009. Acoustically evoked potentials in two cephalopods inferred using the auditory brainstem response (ABR) approach. *Comparative Biochemistry and Physiology*, Part A. 153: 278-283.

Huang, L-F., Xu, X-M., Yang, L-L., Huang, S-Q., Zhang, X-H. and Zhou, Y-L. 2022. Underwater noise characteristics of offshore exploratory drilling and its impact on marine mammals. Ocean Observation, *Journal Frontiers in Marine Science*. 10.

Hughes, K.A., Waluda, C.M., Stone, R.E., Ridout, M.S. and Shears, J.R. 2008. Short-term responses of king penguins *Aptenodytes patagonicus* to helicopter disturbance at South Georgia. *Polar Biology*. 31: 521-1530.

Huhta, H-K., Rytkönen, J. and Sassi, J. 2007. Estimated nutrient load from waste waters originating from ships in the Baltic Sea area. Espoo 2007. VTT Tiedotteita. *Research Notes*. 2370.

Huin, N., and Croxall, J.P. 1996. Fishing gear, oil and marine debris associated with seabirds at Bird Island, South Georgia, during 1993/1994. *Marine Ornithology*. 24: 19– 22.

Huin, N. 2002. Foraging distribution of the black-browed albatross *Thalassarche melanophrys*, breeding in the Falkland Islands. *Aquatic Conservation*. 12: 89-99.

Hunt, G.L. 1987. Offshore oil development and seabirds: the present status of knowledge and long-term research needs. In: Long-term environmental effects of offshore oil and gas development. Boesch, D.F. and Rabalais, N.N. (Eds). pp. 539–586. London: Elsevier Applied Science.

IAIA. 2013 Conference Proceedings. Impact Assessment the Next Generation 33rd Annual Meeting of the International Association for Impact Assessment 13–16 May 2013.

IAQM. 2011. Institute of Air Quality Management: Guidance on the Assessment of the Impacts of Construction on Air Quality and the Determination of their Significance. https://iaqm.co.uk/text/guidance/construction_guidance_2011.pdf.

IEA. 2023. Oil Market Report - December 2023. https://www.iea.org/reports/oil-market-report-december-2023.

IEA. 2024. Oil Market Report - November 2024. https://www.iea.org/reports/oil-market-report-november-2024.

IEEM. 2010. Institute of Ecology and Environmental Management: Guidelines for Ecological Impact Assessment in Britain and Ireland.

IEMA. 2008. Institute of Environmental Management and Assessment: Practitioner: Environmental Management Plans. Best Practice Series. Volume 12.

IFAW. 2013. Whales: avoiding collisions prevents damage to ships and injuries to passengers, crew and whales. International Fund for Animal Welfare.

IFC. 2007a. Environmental, Health and Safety (EHS) Guidelines: Noise Management. The International Finance Corporation.

IFC. 2007b. Environmental Health and Safety Guidelines. Wastewater and Ambient Water. International Finance Corporation.

ILP. 2021. Institute of Lighting Professionals Guidance Notes. https://www.theilp.org.uk/documents/obtrusive-light/.

Imber, M.J. 1975. Behaviour of petrels in relation to the moon and artificial lights. *Notornis*. 22: 302-306.

IMO. 2001. International conference on the control of harmful anti-fouling systems on ships, adoption of the final act of the conference and any instruments, recommendations and resolutions resulting from the work of the conference, 18 October 2001. International Maritime Organisation Headquarters, London, UK.

IMO. 2005. Marine Environment Protection Committee Resolution 127 (53).

IMO. 2014. Guidelines for the reduction of underwater noise from commercial shipping to address adverse impacts on marine life. MEPC. 1/Circ.8, 33, 7 April 2014.

IMO. 2016. The Ship Energy Efficiency Management Plan.

IMO. 2023. MEPC.1/Circ.906 Revised Guidelines for the Reduction of Underwater Radiated Noise from Shipping to Address Adverse Impacts on Marine Life.

Incardona, J.P., Gardner, L.D., Linbo, T.L., Brown, T.L., Esbaugh, A.J., Mager, E.M., Stieglitz, J.D., French, B.L., Labenia, J.S., Laetz, C.A., Tagal, M., Sloan, C.A., Elizur, A., Benetti, D.D., Grosell, M., Block, B.A. and Scholz, N.L. 2014. . *Proceedings of the National Academy of Science of the United States of America*. 111: E1510-E1518.

Iñíguez, M., Masello, J.F., Gribaudo, C., Arcucci, B., Krohling, F. and Belgrano, J. 2010. On the occurrence of sei whales, *Balaenoptera borealis*, in the south-western Atlantic. *Marine Biodiversity Record*. 3: 1-6.

Invenio. 2013. Safety Review and Statistical Analysis Stanley – Darwin (MPC) Road. Data derived from FIG.

IPCC. 2007. Intergovernmental Panel on Climate Change Fourth Assessment Report (AR4): Climate Change 2007.

IPCC. 2013. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Stocker, T.F., D. Qin, G.-K., Plattner, M., Tignor, S.K., Allen, J., Boschung, A., Nauels, Y., Xia, V., Bex and P.M. Midgley (Eds.). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

IPCC. 2014. AR5 Synthesis Report: Climate Change 2014. Summary for Policy Makers Report https://www.ipcc.ch/report/ar5/syr/.

IPCC. 2018. Special Report: Global Warming of 1.5 ºC.

IPIECA. 1995. Biological Impacts of Oil Pollution on Rocky Shores. IPIECA Report Series Volume 7.

IPIECA. 2011. Sensitivity mapping for oil spill response. OGP Report No 000 IPIECA/IMO/OGP 2011.

IPIECA. 2016. Sensitivity mapping for oil spill response. Good practice guidelines for incident management and emergency response personnel. Sensitivity mapping for oil spill response.

Irwin, R.J., Mouwerik, M.V., Stevens, S., Seese, M.D. and Basham W. 1997. Environmental contaminants encyclopedia—PAHs entry. National Parks Service Report, Water Resources Division.

ITOPF. 2018. Country profiles Falkland Islands: A summary of oil spill response arrangements and resources worldwide. https://www.itopf.org/fileadmin/uploads/itopf/data/Documents/Country_Profiles/falkland.pdf.

IUCN ISSG. 2024. IUCN Invasive Species Specialist Group. Global Invasive Species Database: 100 of the World's Worst Invasive Alien Species. Available online: https://www.iucngisd.org/gisd/100_worst.php.

IUCN. 2012. IUCN Red List categories and criteria, version 3.1. IUCN-RL-2001-001, 2nd ed.

IUCN. 2016. A Global Standard for the Identification of Key Biodiversity Areas, Version 1.0. First edition. Gland, Switzerland.

IUCN. 2020. The IUCN Red List of Threatened Species. Version 2020-1. https://www.iucnredlist.org. Downloaded on 19 March 2020.

IWC. 2011. Agreement of the Conservation of Cetaceans in the Black Sea Mediterranean Sea (ACCOBAMS). Report of the Joint IWC-ACCOBAMS Workshop on Reducing Risk of Collisions between Vessels and Cetaceans. https://www.cms.int/en/legalinstrument/accobams.

IWC. 2014a. Report of the second workshop on mortality of southern right whales (*Eubalaena australis*) at Peninsula Valdes, Argentina 5-6 August 2014, SC/66a/Rep/8.

IWC. 2014b. The International Whaling Commission global database on ship strikes. https://portal.iwc.int/.

IWC-CMP. 2023. Report of the Workshop on the Conservation Management Plan for the Southern Right Whale Southwest Atlantic Population, 1-2 June 2022, Curitiba, Brazil. SC/69A/REP/05.

Jackson, G.D. 1993. Growth zones within the statolith microstructure of the deep-water squid *Moroteuthis ingens* (Cephalopoda: Onychoteuthidae): evidence for a habitat shift? *Canadian Journal of Fisheries and Aquatic Sciences*. 50: 2365-2374.

Jackson, G.D., George, M.J.A. and Buxton, N. 1998. Distribution and abundance of the squid *Moroteuthis ingens* (Cephalopoda: Onychoteuthidae) in the Falkland Islands region of the South Atlantic. *Polar Biology*. 20: 161-169.

Jee. 2013. Sea Lion Fishing Trawling Risk Study. FK-SL-SE-SU-001. Report for Premier Oil.

Jenssen, B.M. and Ekker, M., 1989. Rehabilitation of oiled birds – a physiological evaluation of 4 cleaning agents. *Marine Pollution Bulletin*. 20: 509–512.

Jenssen, B.M. 1996. An overview of exposure to, and effects of, petroleum oil and organochlorine pollution in Grey seals (*Halichoerus grypus*). *Science of the Total Environment*. 186: 109-118.

Jiménez, S., Domingo, A., Braxeiro, A., Defeo, O., Wood, A.G., Froy, H., Xavier, J.C. and Phillips, R.A. 2016. Sex-related variation in the vulnerability of wandering albatrosses to pelagic longline fleets. Laboratorio de Recursos Pelágicos, Dirección Nacional de Recursos Acuáticos. Constituyente 1497.

11200 Montevideo, Uruguay

JNCC. 2010. The protection of marine European Protected Species from injury and disturbance. Guidance for the marine area in England and Wales and the UK offshore marine area. Joint Nature Conservation Committee, Draft June 2010.

JNCC. 2012. Environmental mainstreaming in the Falkland Islands; Workshop report, summary document. Joint Nature Conservation Committee, May, 2012.

JNCC. 2016. UK BAP priority species and habitats. http://jncc.defra.gov.uk/page-5705.

Jødestøl, K., and Furuholt, E. 2010. Will drill cuttings and drill mud harm cold water corals. In Paper SPE 126486 presented at the SPE International Conference on Health, Safety and Environment in Oil and Gas Exploration and Production, Rio de Janeiro, Brazil (pp. 12-14).

Johansen, O., Rye, H., Melbye, A.G., Jensen, H.V., Serigstad, B. and Knutsen, T. 2001. Deep Spill JIP Experimental Discharges of Gas and Oil at Helland Hansen. SINTEF Technical Report No: STF66 F01082.

Jones, J.B., Pierce, G.J., Saborido-Rey, F., Brickle, P., Kuepper, F.C., Shcherbich, Z.N. and Arkhipkin, A.I. 2019. Size-dependent change in body shape and its possible ecological role in the Patagonian squid (*Doryteuthis gahi*) in the Southwest Atlantic. *Marine Biology*. 166: 1-17.

Jones, I.T., Peyla, J.F., Clark, H., Song, Z., Stanley, J.A. and Mooney, T.A. 2021. Changes in feeding behavior of longfin squid (*Doryteuthis pealeii*) during laboratory exposure to pile driving noise. *Marine Environmental Research*. 165: 105250. ISSN 0141-1136.

Joyce, T.W., Durban, J.W., Claridge, D.E., Dunn, C.A., Hickmott, L.S., Fearnbach, H., Dolan, K., Moretti, D. 2020. Behavioral responses of satellite tracked Blainville's beaked whales (*Mesoplodon densirostris*) to mid-frequency active sonar. Marine Mammal Science. 36: 29–46.

Keith, D.A., Rodríguez, J.P., Rodríguez-Clark, K.M., Nicholson, E., and Aapala, K. 2013. Scientific Foundations for an IUCN Red List of Ecosystems. *PLoS ONE*. 8(5): e62111.

Kelley, D.E., Vlasic, J.P. and Brillant, S.W. 2020. Assessing the lethality of ship strikes on whales using simple biophysical models. *Marine Mammal Science*. 37: 251-267.

Khalaf, F., Literathy, V. and Anderlini, V. 1982. Vanadium as a tracer of oil pollution in the sediments of Kuwait. *Hydrobiologica*. 91:147-154.

Kim, E., C. H., Park, G. J. and Lee J. H. 2024. Satellite tagging confirms long distance movement and fast dispersal of Patagonian toothfish (*Dissostichus eleginoides*) in the Southwest Atlantic. Frontiers of Marine Science. 11:1334339.

King, J.G and Sanger, G.A., 1979. Oil vulnerability index for marine oriented birds. In: Conservation of Marine Birds of Northern North America, (Bartonek, J.C., Nettleship, D.N. (Eds.)). pp. 227–239.

King, M.D., Elliot, J.E. and Williams, T. D. 2021. Effects of petroleum exposure on birds: A review. *Science of the Total Environment*. 755: Part 1.

Kingston, P.F. 2002. Long-term environmental impact of oil spills. *Spill Science and Technology Bulletin*. 7: 53-61.

Kjeilen-Eilertsen, G., Trannum, H., Jak, R., Smit, M., Neff, J. and Durell, G. 2004. Literature report on burial: derivation of PNEC as component in the MEMW model tool. Akvamiljø Report no. AM-2004/024. https://www.sintef.no/project/ERMS/Reports/ERMS%20Report%20no%209B_Burial_RF-AM.pdf.

Klinger, D.H., Dale, J.J., Machado, B.E., Incardona, J.P., Farwell, C.J. and Block, B.A. 2015. Exposure to Deepwater Horizon weathered crude oil increases routine metabolic demand in chub mackerel, *Scomber japonicas*. *Marine Pollution Bulletin*. 98: 259-266.

Knipe, A. and Pendolay, K. 2019. Lighting Design Environmental Impact Study: Sea Lion Phase 1 FPSO. Prepared by Pendoley Environmental Pty Ltd for R. STAHL PTE LTD and BW Offshore. Report No. J68001.

Koons, C.B., McAuliffe, C.D., Weiss, F.T. 1977. Environmental aspects of produced waters from oil and gas extraction operations in offshore and coastal waters. *Journal of Petroleum Technology*. 263: 723–729.

Kropp, R. K. 2013. Biological and Existing Data Analysis to Inform Risk of Collision and Entanglement Hypotheses. Environmental Effects of Marine and Hydrokinetic Energy. Pacific Northwest National Laboratory, Richland, Washington 99352.

Kuepfer, A. and Stanworth, A. 2023. Falkland Islands Seabird Monitoring Programme – Annual Report 2022/2023 (SMP30). Falklands Conservation, Stanley.

Kuepfer, A., Lee B., Stanworth A. 2024. Burrowing Seabird Survey 2023/2024: Population estimates of sooty shearwaters and white-chinned petrels on Kidney Island and Top Island, Falkland Islands. Report to Falkland Islands Government. Falklands Conservation, Stanley.

Kyhn, L.A., Tougaard, J., Jensen, F., Wahlberg, M., Stone, G., Yoshinaga, A., Beedholm, K. and Madsen, P.T. 2009. Feeding at a high pitch: Source parameters of narrow band, high-frequency clicks from echolocating off-shore hourglass dolphins and coastal Hector's dolphins. *Journal of the Acoustical Society of America*. 125: 1783-1791.

Kyne, P.M., Lamilla, J., Licandeo, R.R., Jimena San Martín, M., Stehmann, M.F.W. and McCormack, C. 2007. *Zearaja chilensis*. The IUCN Red List of Threatened Species 2007: e.T63147A12623314.

Laflamme, R.E. and Hites, R. A. 1978. The global distribution of polycyclic aromatic hydrocarbons in recent sediments. *Geochimica et Cosmochimica Acta*. 42: 289-303.

Laist, D. 1987 Overview of the biological effects of lost and discarded plastic debris in the marine environment. *Marine Pollution Bulletin*. 18: 319-326.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S. and Podesta, M. 2001. Collisions between ships and great whales. *Marine Mammal Science*. 17: 35-75.

Lambert, G., Peakall, D.B., Philogene, B.J.R. and Engelhardt, F.R. 1982. Effect of oil and oil dispersant mixtures on the basal metabolic-rate of ducks. *Bulletin of Environmental Contamination and Toxicology*. 29: 520–524.

Langford, T.E. 1990. Ecological Effects of Thermal Discharges. Elsevier Applied Science.

Laptikhovsky, V. and Arkhipkin, A.I. 2003. An impact of seasonal squid migrations and fishing on the feeding spectra of sub-Antarctic notothenioids *Patagonotothen ramsayi* and *Cottoperca gobio* around the Falkland Islands. *Journal of Applied Ichthyology*. 19: 35-39.

Laptikhovsky, V. 2004. A comparative study of diet in three sympatric populations of *Patagonotothen* species (Pisces: Nototheniidae). *Polar Biology*. 63: 428-441.

Laptikhovsky, V., Arkhipkin, A.I. and Brickle, P. 2006. Distribution and reproduction of the Patagonian toothfish *Dissostichus eleginoides* (Smitt) around the Falkland Islands. *Journal of Fish Biology*. 68: 849-861.

Laptikhovsky, V. 2008. New data on spawning and bathymetric distribution of the Patagonian squid, *Loligo gahi*. JMBA2 – Biodiversity Records. 1:e50. Published on-line: https://www.cambridge.org/core/journals/marine-biodiversity-records/article/abs/new-data-on-

spawning-and-bathymetric-distribution-of-the-patagonian-squid-loligo-gahi/6FC75BF4CAC9C727AC00E7E7A76FD97E.

Laptikhovsky, V., Arkhipkin, A.I. and Brickle, P. 2013. From small by-catch to main commercial species: Explosion of stocks of rock cod *Patagonotothen ramsayi* (Regan) in the South-west Atlantic. Fisheries Research. 147: 399-403.

Lardicci, C., Rossi, F. and Maltagliati, F. 1989. Detection of Thermal Pollution: Variability of Benthic Communities at Two Different Spatial Scales in an Area Influenced by a Coastal Power Station. *Marine Pollution Bulletin*. 38: 296-303.

Law, R.J. and Moffat, C.F. 2011. The Braer Oil Spill, 1993. In: Oil Spill Science and Technology, Chapter 36, pp 1119–1126.

Lazar, L., Gomoiu, M-T., Boicenco, L. and Vasiliu, D. 2012. Total Organic Carbon (TOC) of the surface layer sediments covering the seafloor of the Romanian Black Sea coast. *Geo-Eco-Marina*. 18: 121-132.

Lee, R.F., Köster, M. and Paffenhöfer, G.A. 2012. Ingestion and defecation of dispersed oil droplets by pelagic tunicates. *Journal of Plankton Research*. 34: 1058-1063.

Lee, B., Skeljo, F., Randhawa, H. S. and Arkhipkin, A. 2022. Deep-sea movement patterns of the Patagonian toothfish *Dissostichus eleginoides* Smitt in the Southwest Atlantic. *Marine and Freshwater Research*. 73: 833-845.

Leighton, F.A. 1991. The toxicity of petroleum oils to seabirds: an overview. In: The effects of oil on wildlife. (Ed: White, J.), p 43-57. Sheridan Press, Hanover, PA.

Levy, E.M., 1980. Oil pollution and seabirds - Atlantic Canada 1976-77 and some implications for northern environments. *Marine Pollution Bulletin*. 11: 51-56.

Lewis, J.A. and Coutts, A.D.M. 2010. Biofouling invasions. In: Biofouling. (Durr, S. and Thomason, J. C., (Eds.)). pp 348-358. Oxford: Blackwell Publishing.

Linssen, H., Van De Pol, M., Allen, A.M., Jans, M., Ens, B.J., Krijgsveld, K.L., Frauendorf, M. and Van Der Kolk, H.J. 2019. Disturbance increases high tide travel distance of a roosting shorebird but only marginally affects daily energy expenditure. *Avian Research*. 10:1-11.

Long, E.R., MacDonald, D.D., Smith, S.L., and Calder, F.D. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. *Environmental Management*. 19: 81–97.

Lowe, S., Browne, M., Boudjelas, S. and De Poorter, M. 2004. 100 of the World's Worst Invasive Alien Species A selection from the Global Invasive Species Database. Published by The Invasive Species Specialist Group (ISSG) a specialist group of the Species Survival Commission (SSC) of the World Conservation Union (IUCN), 12pp. First published as special lift-out in Aliens 12, December 2000. Updated and reprinted version: November 2004.

Liu, Y., Liu, Y., Li, N., Lou, Y. & Zhao, X. 2019. Effect of oil spill stress on fatty acid stable carbon isotope composition of *Ulva pertusa*. *Science of the Total Environment*. 649: 1443-1451.

MacGillivray A. and de Jong C. 2021. A Reference Spectrum Model for Estimating Source Levels of Marine Shipping Based on Automated Identification System Data. *Journal of Marine Science and Engineering*. 9: 369.

MacLeod, C.D., Zuur, A.F. 2005. Habitat utilization by Blainville's beaked whales off Great Abaco, northern Bahamas, in relation to seabed topography. *Marine Biology*. 147: 1-11.

MacLeod, C.D. and Mitchell, G. 2023. Key areas for beaked whales worldwide. *Journal of Cetacean Research and Management*. 7(3): 309-322.

Mandiola, M.A., Giardino, G., Bastida, J., Morón, S., Rodríguez, D.H., Bastida, R. 2020. Half a century of sightings data of southern right whales in Mar del Plata (Buenos Aires, Argentina). *Journal of the Marine Biological Association of the United Kingdom*. 100(1): 165-171.

Maplecroft. 2019. Sea Lion Socio-economic Impact Assessment Prepared for Premier Oil plc, Final Report, 25th May 2019. PMO Doc Ref: FK-SL-PMO-EV-STU-0002 B01.

Marangoni, L. F. B., Davies, T., Smyth, T., Rodríguez, A., Hamann, M., Duarte, C., Pendoley, K., Berge, J., Maggi, E., and Levy, O. 2022. Impacts of artificial light at night in marine ecosystems—A review. *Global Change Biology*. 28: 5346–5367.

Marengo, I. 2014a. GIS-based assessment of coastal vulnerability to oil spill of the north-east coastline of the Falkland Islands. Technical report #1. Report by SAERI to Premier Oil.

Marengo, I. 2014b. GIS-based analysis of the coastal habitats and the shallow water marine habitats identified in three areas of East Falklands. Technical report #2. Report by SAERI to Premier Oil.

Marquenie, J.M. 2007. Green light to birds: Investigation into the effect of bird-friendly lighting. NAM LOCATIE L15-FA-1.

Marques, T.A., Thomas, L., Booth, C. G., Garrison, L. P., Rosel, P.E., Takeshita, R., Mullin, K. D. and Shwacke, L. 2023. Population consequences of the Deepwater Horizon oil spill on pelagic cetaceans. *Marine Ecology Progress Series*. 714: 1-14.

Martin, A. R., Poncet, S., Barbraud, C., Foster, E., Fretwell, P. and Rothery, R. 2009. The White-chinned Petrel (*Procellaria aequinoctialis*) on South Georgia: population size, distribution and global significance. *Polar Biology*. 32: 655-661.

Martin, S.B., Kowarski, K. and Delarue, J. 2023. Impact of Mobile Offshore Drilling Units on Odontocetes. In: Popper, A.N., Sisneros, J., Hawkins, A.D. and Thomsen, F. (eds). The Effects of Noise on Aquatic Life. Springer, Cham.

Martos, P. and Piccolo, M.C. 1988. Hydrography of the Argentine continental shelf between 38° and 42°S. *Continental Shelf Research*. 8: 1043–1056.

Maruyama, A., Maeda, M. and Simidu, U. 1989. Microbial production of auxin indole-3-acetic acid in marine sediments. *Marine Ecology Progress Series*. 58: 69-75.

Masello, J.F., Mundry, R., Poisbleau, M., Demongin, L., Voigt, C.C., Wikelski, M. and Quillfeldt P. 2010. Diving seabirds share foraging space and time within and among species. *Ecosphere*. 1: 1-28.

Massie, P. P., McIntyre, T., Ryan, P. G., Bester, M. N., Bornemann, H., Ansorge, I. J. 2015. The role of eddies in the diving behaviour of female southern elephant seals. https://epic.awi.de/id/eprint/38653/1/Massie-etal_2015.pdf.

Matkin, C.O., Saulitis, E.L., Ellis, G.M., P. Olesiuk, P. and Rice, S.D. 2008. Ongoing population-level impacts on killer whales *Orcinus orca* following the 'Exxon Valdez' oil spill in Prince William Sound, Alaska. *Marine Ecology Progress Series*. 356: 269-281.

MCA. 2012. Marine and Coastguard Agency Ship-to-Ship Transfer Regulations (MSN 1829).

McCauley R. 1998. Radiated underwater noise measured from the drilling rig Ocean General,rig tenders Pacific Ariki and Pacific Frontier, fishing vessel Reef Venture and natural sources in the Timor Sea, Northern Australia. (Prepared for: Shell Australia, Shell House Melbourne), Project CMST, Report C98-20, Centre for Marine Science and Technology, Western Australia 6102.

McCauley, R. D. 2001. Biological sea noise in northern Australia: Patterns of fish calling. PhD. Thesis. James Cook University of North Queensland, Australia, 282 pp.

McCauley, R., Day, R.D., Swadling, K.M., Fitzgibbon, Q.P., Watson, R.A., and Semmens, J.M. 2017. Widely used marine seismic survey air gun operations negatively impact zooplankton. *Nature Ecology and Evolution*. 1: 1-8.

McEwan, E.H. and Koelink, A.F.C., 1973. Heat production of oiled mallards and scaup*. Canadian Journal of Zoology*. 51: 27–31.

McFarlin, K., Brakstad, O.G., Br¨onner, U., 2018. EXT4-T3-D1 - Biodegradation of Naturally Occurring Substances in Produced Water: Revision of Data for the DREAM Model. SINTEF, Trondheim, Norway, p. 28.

McIntyre, T., de Bruyn, P.J.N., Ansorge, I.J., Bester, M.N., Bornemann, H., Plötz, J. and Tosh, C.A. 2010. A lifetime at depth: vertical distribution of southern elephant seals in the water column. *Polar Biology*. 33: 1037-1048.

McMahon, C.R., Burton, H.R. and Bester, M.N. 2000. Weaning mass and the future survival of juvenile southern elephant seals, *Mirounga leonina*, at Macquarie Island. *Antarctic Science*. 12: 149-153.

McSweeney, D.J., Baird, R.W., Mahaffy, S.D. 2007. Site fidelity, associations and movements of Cuvier's (Zhipius cavirostris) and Blainville's (Mesoplodon densirostris) beaked whales off the islands of Hawai'i. *Marine Mammal Science*. 23(3): 666-687.

Meador, J.P. 2003. Bioaccumulation of PAHs in marine invertebrates. In: Douben, P. E.T. (Ed.), PAHs: An Ecological Perspective. John Wiley and Sons, IncHoboken, NJ. 147-172.

Meier, S., Morton, H.C., Nyhammer, G., Grøsvik, B.E., Makhotin, V., Geffen, A., Boitsov, S., Kvestad, K.A., Bohne-Kjersem, A., Goksøyr, A., Folkvord, A., Klungsøyr, J., Svardal, A. 2010. Development of Atlantic cod (Gadus morhua) exposed to produced water during early life stages. Effects on embryos, larvae, and juvenile fish. *Marine Environmental Research.* 70: 383-394.

Meinhold, A.F., Holtzman, S., DePhillips, M.P. 1996. Risk assessment for produced water discharges to open bays in Lousiana. In: Reed M, Johnsen S, editors. Produced water 2: environmental issues and mitigation technologies. New York: Plenum Press; 1996.

MEPC. 2008a. Marine Environment Protection Agency: Guidelines for approval of ballast water management systems (G8). 174(58).

MEPC. 2008b. Procedure for approval of ballast water management systems that make use of active substances (G9). The Marine Environment Protection Agency. 169(57).

MEPC. 2011. Guidelines for the control and management of ships' biofouling to minimise the transfer of invasive aquatic species. MEPC 62/24/Add.1 Annex 26.

Merkel, F.R. 2010. Light-induced bird strikes on vessels in South-west Greenland. Technical Report No. 84, Pinngortitaleriffik, Greenland Institute of Natural Resources.

Merkel, F.R. and Johansen, K.L. 2011. Light-induced bird strikes on vessels in south-west Greenland. *Marine Pollution Bulletin*. 62: 2330-2336.

MG3. Ltd. 2014. Premier Oil; Sea Lion Development Environmental and Geochemical Programme. Isobel/Elaine Habitat Assessment Report.

Michalik, A., van Noordwijk, H., Brickle, P., Eggers, T. and Quillfeldt, P. 2010. The diet of the Imperial Shag *Palacrocorax articeps* at a colony on New Island, Falkland Islands using three different sampling techniques. *Polar Biology*. 33: 1537-1546.

Middleditch, B.S. 1984. Ecological effects of produced water effluents from offshore oil and gas production platforms. *Ocean Management*. 9: 191–316.

Miller, C.R. & Rice, A.N. 2023. A synthesis of the risks of marine light pollution across organismal and ecological scales. *Aquatic Conservation: Marine and Freshwater Ecosystems.* 33(12): 1590–1602.

Minchin, D. and Gollasch, S. 2003. Fouling and Ships' Hulls: How Changing Circumstances and Spawning Events may Result in the Spread of Exotic Species. *Biofouling*. 19: 111-122.

Mitson, R.B. (ed). 1995. Underwater Noise of Research Vessels: Review and Recommendations. Cooperative Research Report, No. 209. International Council for the Exploration of the Sea, Copenhagen, Denmark.

MMS. 2010. Literature review, synthesis and design of monitoring of ambient artificial light intensity on the OCS regarding potential effects on resident marine fauna. U.S. Department of the Interior, Minerals Management Service, Anchorage, Alaska. OCS Study MMS 2007-055. http://www.boem.gov/Alaska-Reports-2007/.

MoD. 2014. Ministry of Defence Falkland Islands Range and Avoidance Areas. Series: GSGS 5563, Edition 5.

Montevecchi, W.A. 2006. Influences of artificial light on marine birds. In: Ecological consequences of artificial night lighting. (Rich, C. and Longcore, T., (Eds.)). pp. 94-113. Island Press, Washington, USA.

Montgomery, J.C., Jeffs, A., Simpson, S.D., Meekan, M.G. and Tindle, C. 2006. Sound as an orientation clue for the pelagic larvae of reef fish and crustaceans. *Advances in Marine Biology*. 51: 143-196.

Mooney, A.T., Hanlon, R.T., Christensen-Dalsgaard, J., Madsen, P.T., Ketten, D.R. and Nachtigall, P.E. 2010. Sound detection by the longfin squid (*Loligo pealeii*) studied with auditory evoked potentials: sensitivity to low-frequency particle motion and not pressure. *Journal of Experimental Biology*. 213: 3748-3759.

Moore, S.F. and Dwyer, R.L. 1974. Effects of oil on marine organisms: a critical assessment of published data. *Water Research*. 8: 819-827.

Moore, M.J., Berrow, S.D., Jensen, B.A., Carr, P., Sears, R., Rowntree, V.J., Payne, R. and Hamilton, P.K. 1999. Relative abundance of large whales around South Georgia (1979-1998). *Marine Mammal Science*. 15: 1287-1302.

Morais, S., Gomes, F., Ramalhosa, M.J. and Oliveira, M. 2013. Occurrence of polycyclic aromatic hydrocarbons in cephalopods. In: Occurrence of Polycyclic Aromatic Hydrocarbons in Cephalopods (Bandeira, G.C., Meneses, H.E. (Eds.)). Nova Science Publishers.

Morris, P. and Therivel, R. (Eds.). 2009. Methods of Environmental Impact Assessment. 3rd Edition. Natural and Built Environment Series. Routledge.

Mouat, B., Collins, M.A., and Pompert, J. 2001. Patterns in the diet of *Illex argentinus* (Cephalopoda: Ommastrephidae) from the Falkland Islands jigging fishery. *Fisheries Research*. 52: 41-49.

Munday, P.L., Dixson, D.L., Welch, M.J., Chivers, D.P., Domenici, P., Grosell, M., Heuer, R.M., Jones, G.P., McCormick, M.I., Meekan, M. and Nilsson, G.E., 2020. Methods matter in repeating ocean acidification studies. *Nature*, 586(7830), pp.E20-E24.

Munro, G. 2011. Seabird and marine mammal observations during well test flaring of Sea Lion 14/10-5 in the North Falkland Basin. Unpublished report to Rockhopper Exploration PLC.

Murphy, R.C. 1936. Oceanic birds of South America. Macmillan, New York, USA.

Muschenheim, D. K., and Lee, K. 2002. Removal of oil from the sea surface through particulate interactions: review and prospectus. *Spill Science and Technology Bulletin*. 8: 9-18.

Mystikou, A. 2015. Seaweed biodiversity around the Antarctic Convergence in the South Atlantic. PhD Thesis, University of Aberdeen.

NAEI. 2014. National Atmospheric Emissions Inventory. International Aviation – Aircraft between UK and other OTs (excl. Gib.)

Nakamura, I., Inada, T., Takeda, M. and Hatanaka, H. 1986. Important Fishes Trawled off Patagonia. Tokyo: Japan Marine Fishery Resource Research Centre.

NAM. 2007 Green light to birds: Investigation into the effect of bird-friendly lighting. NAM LOCATIE L15-FA-1, December 2007, ING. F.J.T. Van de Laar.

Nedelec, S.L., Simpson, S.D., Morley, E.L., Nedelec, B., and Radford, A.N. (2015). Impacts of regular and random noise on the behaviour, growth and development of larval Atlantic cod (*Gadus morhua*). *Proceedings of the Royal Society B*. 282(1817): 20151943.

Nedwell, J.R. and Edwards, B. 2004. A Review of Measurements of Underwater Man-made Noise Carried out by Subacoustech Ltd, 1993 – 2003, Subacoustech Report to the DTI, Ref: 534R0109, 29th September 2004.

Neely, K. 2010. Summary report of the Falkland Islands Shallow Marine Programme 2008-2010. Shallow marine Survey Group.

Neely, K., Brickle, P., and Laptikhovsky, V. 2010a. Biotopes of the Falkland Islands Shallow Marine Environment. Report to FIG. Shallow Marine Surveys Group.

Neely, K., Brickle, P., and Laptikhovsky, V. 2010b. Marine Resources of the Falklands' Shallow marine Environment, A Review of species, distributions and sustainability. Report to FIG. Shallow Marine Surveys Group.

Neely, K. and Brickle, P. 2013. Marine life of the Falkland Islands. Shallow Marine Survey Group: Stanley.

Neff, J.N., Hillman, R.E. and Waugh J.J. 1988a. Bioaccumulation of trace metals from drilling mud barite by benthic marine animals pp. 461- 479. In: Drilling Wastes, Engelhardt, FR, Ray JP and Gillam, AH (Eds) Elsevier Applied Science.

Neff, J.M., Breteler, R.J. and Carr, R.S. 1988b. Bioaccumulation, Food Chain Transfer, and Biological Effects of Barium and Chromium from Drilling Muds by Flounder, Pseudopleuronectes americanus, and Lobster, Homarus Americanus. In: Drilling Wastes (Engelhardt, F.R., Ray J.P. and Gillam, A.H. (Eds.)) pp. 439-459. Elsevier Applied Science.

Neff, J.M., Sauer, T.C., Maciolek, N. 1992. Composition, Fate and Effects of Produced Water Discharges to Nearshore Marine Waters. In: Ray, J.P., Engelhardt, F.R. (Eds) Produced Water. *Environmental Science Research*. 46. Springer, Boston, MA.

Neff, J.M. 2002. Bioaccumulation in marine organisms, effect of contaminants from oil well produced water. Elsevier press, Oxford, UK.

Neff, J.M. 2005. Composition, environmental fates, and biological effects of water-based drilling muds and cuttings discharged to the marine environment: a synthesis and annotated biography. Prepared for the Petroleum Environmental Research Forum (PERF) and the American Petroleum Institute. American Petroleum Institute. Washington, DC.

Neff, J.M., 2010. Fate and Effects of Water-based Drilling Muds and Cuttings in Cold Water Environments. A Scientific Review prepared for Shell Exploration and Production Company.

NEFL. 2013. Nobel Energy Falklands Ltd. ESHIA for Temporary Dock Facility Stanley Harbour, Falkland Islands. Noble Energy Falklands Limited ESIA, prepared by RPS Energy.

NEFL. 2015a. Nobel Energy Falklands Ltd. Rhea-1 Exploration Well Environmental Impact Statement. (024-15-EHSR-EIS-PA-T4).

NEFL. 2015b. Nobel Energy Falklands Ltd. Biosecurity Management Plan. Noble Energy Falklands Limited: Document 021-15-EHSR-BSP-PA-T4.

Nichols, D.G., Robertson, C.J.R., Prince, P.A., Murray, M.D., Walker, K.J. and Elliott, G.P. 2002. Foraging niches of three *Diomedea* albatrosses. *Marine Ecology-Progress Series*. 231: 269-277.

Nicholls, P.E., Hewitt, J.E. and Halliday, J.M. 2003. Effects of suspended sediment concentrations on suspension and deposit feeding marine macrofauna. Auckland Regional Council.

Nicholls, D.G., Robertson, C.J.R. and Naef-Daenzer, B. 2005. Evaluating distribution modelling using kernel functions for northern royal albatrosses (*Diomedea sanfordi*) at sea off South America. *Notornis*. 52: 223–235.

Niu, H., Lee, K., Robinson, B., Coban, S. and Li, P. 2016. Monitoring and modeling the dispersion of produced water on the Scotian Shelf. *Environmental Systems research.* 5: 19

NMFS. 2005. National Marine Fisheries Service: Recovery Plan for the North Atlantic Right Whale (*Eubalaena glacialis*). National Marine Fisheries Service, Silver Spring, MD.

NMFS. 2018. 2018 Revision to Technical Guidance for Assessing Effects of Anthropogenic Sound on Marine Mammal Hearing | NOAA Fisheries.

NOAA and API. 1994. National Oceanic and Atmospheric Administration and American Petroleum Institute. Inland oil spills: Options for minimizing environmental impacts of freshwater spill response. *American Petroleum Institute Publication*. 4558: 130.

NOAA. 2004. Final Report of the National Oceanic and Atmospheric Administration (NOAA) International Symposium: Shipping Noise and Marine Mammals. A Forum for Science, Management, and Technology 18-19 May 2004, Arlington, Virginia, U.S.A.

NOAA. 2009. A Prudent Mariner's Guide to Right Whale Protection CD-ROM Version 1.1. https://www.greateratlantic.fisheries.noaa.gov/public/public/web/NEROINET/OLDshipstrike/doc/mtrOLD1.html.

NOAA. 2018. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Providing thresholds for onset of permanent threshold shift (PTS) and temporary threshold shifts (TTS) in marine mammal hearing for all underwater sound sources. National Oceanic and Atmospheric Administration, USA. https://www.fisheries.noaa.gov/resource/document/technical-guidance-assessing-effects-anthropogenic-sound-marine-mammal-hearing.

NoiseNet. 2008. Noise Terms – Energy Averaging. http://www.noisenet.org/Noise_Terms_Leq.htm.

NoMEPorts. 2008. Noise Management in European Ports Good Practice Guide on Port Area Noise Mapping and Management. Amsterdam.

Norman, J.R. 1937. Coast fishes. Part II. The Patagonian region. *Discovery Reports*. 16: 1-150.

Norske Olje and Gass. 2014. Norwegian Oil and Gas Guideline 114: Recommended Guidelines for Handling Noise.

NRC. 1983. National Research Council: Risk assessment in the federal government. Managing the process. National Academy Press, Washington, DC.

NRC. 1985. National Research Council: Oil in the sea: inputs, fates and effects. The National Academies Press, Washington, DC.

NRC. 2003. Oil in the Sea III: Inputs, Fates, and Effects. The National Academies Press, Washington, DC.

NRC. 2005. Marine mammal populations and ocean noise: Determining when noise causes biologically significant effect. The National Academies Press, Washington DC.

NSTA. 2024. Emissions Monitoring Report. https://www.nstauthority.co.uk/media/bicn5tva/nsta-emissions-monitoring-report-2023-final-accessible.pdf.

NSTF. 1993. North Sea Quality Status Report 1993. North Sea Task Force. Oslo and Paris Commissions, London.

O'Hara, P.D. and Morandin, L.A. 2010. Effects of Sheens Associated with Offshore Oil and Gas Development on the Feather Microstructure of Pelagic Seabirds. *Marine Pollution Bulletin*. 60: 672-678.

OECD. 2013. Sulphur oxides (SO_x) and nitrogen oxides (NO_x) emissions. Environment at a Glance. 2013. Organisation for Economic Co-operation Development Indicators. OECD Publishing, Paris.

OEUK. 2014. Tandem Offloading Guidelines, Issue 3, November 2014. Available online: https://oeuk.org.uk/product/tandem-loading-guidelines-issue-3/.

OEUK. 2023a. Emissions Report 2023. The emissions performance of the UK offshore oil and gas industry.

OEUK. 2023b. Health, Safety & Environment (HS&E) Report 2022. https://oeuk.org.uk/wp-content/uploads/2022/12/HSE-report-2022-Offshore-Energies-UK-OEUK.pdf.

Ognedal, T.A. 2012. The noise project of Norwegian oil industry. Presentation to BNAM 2012, Joint Baltic-Nordic Acoustics Meeting, June 18th – 20th June 2012, Odense, Denmark. www.olf.no/Stoy.

OGP. 1994. Methods for estimating atmospheric emissions from EandP operations. International Association of Oil and Gas Producers publication 197.

OGP. 2005. Fate and naturally occurring substances in produced water on the marine environment. Report No. 364. Available for download at:

OGP. 2010a. International Association of Oil and Gas Producers: Risk Assessment Data Directory. Report No. 434 – 17 March 2010.

OGP. 2010b. International Association of Oil and Gas Producers: Mechanical Lifting Failures. Report No. 434 – 08 March 2010.

OGP. 2019. Analyse frequencies of blowouts and well control incidents. IOGP Report 434-02, V3.

OGP/IPIECA. 2010. Alien invasive species and the oil and gas industry: Guidance for prevention and management.

OGUK. 2011. Management of marine growth during decommissioning. Prepared by BMT Cordah. Report No. A.CON.093.

Olsgard, F and Gray, J.S. 1995. A comprehensive analysis of the effects of offshore oil and gas exploration and production on the benthic communities of the Norwegian continental shelf. *Marine Ecology Progress Series*. 122: 277-306.

Olsvik, P.A., Berntssen, M.H.G., Hylland, K., Eriksen, D.Ø., Holen, E. 2012. Low impact of exposure to environmentally relevant doses of 226Ra in Atlantic cod (Gadus morhua) embryonic cells. *Journal of Environmental Radioactivity*. 109:84–93.

Open University Course Team. 2004. Ocean Circulation. Ed. Gerry Bearman. Elsevier Science and Technology (UK). 288pgs.

Orensanz, J.M., Schwindt, E., Pastorino, G., Bortolus, A., Casas, G., Darrigran, G., Elias, R., Lopez Gappa, J.J., Obenat, S., Pascual, M.M., Penchaszadeh, P., Piriz, M.L., Scarabino, F., Spivak, E.D. and Vallarino, E.A. 2002. No longer the pristine confines of the world ocean: A survey of exotic marine species in the south-western Atlantic. *Biological Invasions*. 4: 115-143.

Orr, J.C., Fabry, V.J., Aumont, O., Bopp, L., Doney, S.C., Feely, R. A., Gnanadesikan, A., Gruber, N., Ishida, A., Joos, F., Key, R.M., Lindsay, K., Maier-Reimer, E., Matear, R., Monfray, P., Mouchet, A., Najjar, R.G., Plattner, G.-K., Rodgers, K.B., Sabine, C.L., Sarmiento, J.L., Schlitzer, R., Slater, R.D., Totterdell, I.J., Weirig, M.-F., Yamanaka, Y. and Yool, A. 2005. Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms. *Nature*. 437: 681-686.

Ortego, B. 1978. Blue-faced boobies at an oil production platform. *Auk*. 95: 762-763.

OSPAR. 1998. OSPAR Decision 98/3 on the Disposal of Disused Offshore Installations.

OSPAR. 2000. Quality Status Report, Chapter 4 -Chemistry.

OSPAR. 2004-12. OSPAR List of Chemicals for Priority Action.

OSPAR. 2008. Descriptions of habitats on the OSPAR list of threatened and/or declining species and habitats.

OSPAR. 2009a. Assessment of the impacts of offshore oil and gas activities in the north-east Atlantic. Offshore Industry Series. Publication No. 453/2009. ISBN 978-1-906840-93-8.

OSPAR. 2009b. Overview of Impact of anthropogenic underwater sound in the marine environment. Biodiversity Series , OSPAR Commission, 2009.

OSPAR. 2012. Report of the OSPAR Workshop on research into possible effects of regular platform lighting on specific bird populations. OSPAR Commission 2012.

OSPAR. 2015-08. Guidelines to reduce the impact of offshore installations lighting on birds in the OSPAR maritime area.

OSPAR. 2023a. OSPAR Inventory of Offshore Installations - 2021.

OSPAR. 2023b. OSPAR List of Chemicals for Priority Action. https://www.ospar.org/work-areas/hasec/hazardous-substances/priority-action.

Otley, H.M., Clausen, A.P., Christie, D.J. and Pütz, K. 2005. Aspects of the breeding biology of the Gentoo Penguin *Pygoscelis papua* at Volunteer Beach, Falkland Islands, 2001/02. *Marine Ornithology*. 33: 167-171.

Otley, H., Reid, T., Phillips, R., Wood, A., Phalan, B. and Forster, I. 2007. Origin, age, sex and breeding status of wandering albatrosses (*Diomedea exulans*), northern (*Macronectes halli*) and southern giant petrels (*Macronectes giganteus*) attending demersal longliners in Falkland Islands and Scotia Ridge waters, 2001-2005. *Polar Biology*. 30: 359-368.

Otley, H., Smith, J., Dalebout, M.L. 2011. Beaked whale strandings on the Falkland Islands and South Georgia, South Atlantic Ocean, between 1866 and 2008. *Journal of the Marine Biological Association of the United Kingdom*. 92(8):1851-1864.

Otley, H. 2012. The composition of the cetacean community in the Falkland (Malvinas) Islands, south-west South Atlantic Ocean. *Revista de Biologia Marina y Oceanografia*. 47: 537-551.

Padovani, L.N., Viñas, M.D, Sánchez, F. and Mianzan, H. 2012. Amphipod-supported food web: *Themisto gaudichaudii*, a key food resource for fishes in the southern Patagonian Shelf. *Journal of Sea Research*. 67: 85-90.

Padula, A. D., Machado, R., Milmann, L., de Leon, M. C., Gana, J. C. M., Wickert, J. C., Argañaraz, M. E., Bastida, R. O., Rodríguez, D. H., Denuncio, P.E. 2023. Marine debris ingestion by odontocete species from the Southwest Atlantic Ocean: Absence also matter. *Marine Pollution Bulletin*. 186. 114486.

Page, B., McKenzie, J., McIntosh, R., Baylis, A., Morrissey, A., Calvert, N., Haase, T., Berris, M., Dowie, D., Shaughnessy, P.D. and Goldsworthy, S.D. 2004. Entanglement of Australian sea lions and New Zealand fur seals in lost fishing gear and other marine debris before and after Government and industry attempts to reduce the problem. *Marine Pollution Bulletin*. 49: 33-42.

Pakhomov, E., and Perissinotto, R. 1996grient. Trophodynamics of the hyperiid amphipod *Themisto gaudichaudii* in the South Georgia region during late austral summer. *Marine Ecology Progress Series*. 134: 91-100.

Pale Maiden Consultancy. 2013. Summary Report: Fishing Activity over the Sea Lion Development Area. Report for Premier Oil.

Pampanin, D.M., Brooks, S.J., Grøsvik, B.E., Le Goff, J., Meier, S., Sydnes, M.O., 2017. DNA adducts in marine fish as biological marker of genotoxicity in environmental monitoring: the way forward. *Marine Environmental Research*. 125: 49–62.

Pang, K. and Martindale, M.Q. 2008. Ctenophores. *Current Biology*. 18: 1119-1120.

Parker, G., Brickle, P., Crofts, S., Pompert, J. and Wolfaardt, A. 2013. Research into undetected seabird mortality in a demersal trawl fishery. Fifth Meeting of the Seabird Bycatch Working Group, La Rochelle, France, 1-3 May 2013. SBWG5 Doc 07.

Passchier-Vermeer, W. and Passchier, W.F. 2000. Noise Exposure and Public Health. *Environmental Health Perspectives*. 108: 123-131.

Patin, S. 2004. Environmental Impact of Crude Oil Spills. Encyclopaedia of Energy, Volume 1.

Payá, I. and Ehrhardt, N.M. 2005. Comparative sustainability mechanisms of two hake (*Merluccius gayi gayi* and *Merluccius australis*) populations subjected to exploitation in Chile. *Bulletin of Marine Science*. 76: 261-286.

Payá, I. 2009. Grenadier (*Macrourus carinatus*) Stock Assessment and Total Allowable Catch 2009. Falkland Islands Government Fisheries Department Scientific Report. pp 34.

Peckol, P., Levings, S.C. and Garritty, S.D. 1990. Kelp response following the World Prodigy oil spill. *Marine Pollution Bulletin.* 21: 473-476.

Perez, C., Munilla, I., Lopez-Alonso, M., and Velando, A. 2009. Sublethal effects on seabirds after the Prestige oil-spill are mirrored in sexual signals. *Biology Letters*. 6: 33-35.

Perez-Barros, P., D'Amato, M.E., Guzman, N.V. and Lovrich, G.A. 2008. Taxonomic status of two South American sympatric squat lobsters, *Munida gregaria* and *Munida subrugosa* (Crustacea: Decapoda: Galatheidae), challenged by DNA sequence information. *Biological Journal of the Linnean Society*. 94: 421-434.

Perkol-Finkel, S. and Benayahu, Y. 2007. Differential recruitment of benthic communities on neighbouring artificial and natural reefs. *Journal of Experimental Marine Biology and Ecology*. 340: 25-39.

Peterson, R.G. and Whitworth, T.III. 1989. The Sub-Antarctic and Polar fronts in relation to deep water masses through the South-western Atlantic. *Journal of Geophysical Research*. 94: 10817-10838.

Phillips, R.A., Silk, J.R.D., Croxall, J.P. and Afanasyev, V. 2006. Year-round distribution of white-chinned petrels from South Georgia: Relationships with oceanography and fisheries. *Biological Conservation*. 129: 336-347.

Phillips, R.A. and Waluda, C.M. 2020. Albatrosses and petrels at South Georgia as sentinels of marine debris input from vessels in the southwest Atlantic. *Environment International*. 136: 10544.

Phillips *et al.* 2023. *Global political responsibility for the conservation of ACAP Priority Populations*. Joint 11th Meeting of the Seabird Bycatch Working Group and 7th Meeting of the Population and Conservation Status Working Group Edinburgh, United Kingdom, 18 May 2023.

Pichegru, L., Nyengera R., McInnes, A.M. and Pistorius, P. 2017. Avoidance of seismic survey activities by penguins. *Scientific Reports*. 7:16305

Pierce, G.J., Valavanis, V.D., Guerra, A., Jereb, P., Orsi-Relini, L., Jose M. Bellido, J.M., Katara, I., Piatkowski, U., Pereira, J., Balguerias, E., Sobrino, I., Lefkaditou, E., Wang, J., Santurtun, M., Boyle, P.R. Hastie, L.C. MacLeod, C.D., Smith, J.M., Viana, M., González, A.F. and Zuur, A.F. 2008. A review of cephalopod–environment interactions in European Seas. *Hydrobiologia*. 612: 49–70.

Pike, S., Medcalf, K. and Cameron, I. 2014. Seabed and land cover maps to support comparative assessment of sites for inshore transfer of oil. A report produced for Premier Oil on behalf of the South Atlantic Environmental Research Institute by Environment Systems Ltd.

Piontek, R., Jaspers, C., Boersma, M. and Arkhipkin, A. 2023. Temporal and spatial variability in the mesozooplankton community off the Falkland Islands (Southwest Atlantic). Regional Studies and *Marine Science*. 66: 103147.

Piot, E., Picard, B., Badaut, J., Gilbert, C. and Guinet, C. 2023. Diving behaviour of southern elephant seals: new models of behavioural and ecophysiological adjustments of oxygen store management. *Journal of Experimental Biology.* 226. jeb245157.

Pistorius, P.A., Baylis, A., Crofts, S. and Pütz, K. 2012. Population development and historical occurrence of king penguins at the Falkland Islands. *Antarctic Science*. 24: 435-440.

Platt, N.H. and Phillip, P.R. 1995. Structure of the southern Falkland Islands continental shelf: initial results from new seismic data. *Marine and Petroleum Geology*. 12: 759-771.

Plexus Energy. 2012. Socio-economic Impact Study of the Sea Lion Oil Development Project (Falkland Islands). Report for Rockhopper Exploration Plc.

Polarcus. 2011. Marine Mammal and Seabird observations during 3D seismic survey in the North Falkland Basin (Nov-10 to May-11). Report for Desire Petroleum Plc and Rockhopper Exploration.

Pompert, J.W. 2011. On the biology of two skate species *Bathyraja macloviana* (Norman, 1937) and *Bathyraja cousseauae* (Díaz de Astarloa and Mabragaña, 2004) around the Falkland Islands. MSc Thesis, University of Aberdeen.

Poncet, S. 2014. Report on a baseline survey of coastal birds, mammals and wildlife habitats of Stanley Harbour, Navy Point and Cape Pembroke. Beaver Island LandCare.

Poncet, S., Robertson, G., Phillips, R. A., Lawton, K., Phalan, B., Trathan, P. N. and Croxhall, J. P. 2006. Status and distribution of wandering, black-browed and grey-headed albatross breeding at South Georgia. *Polar Biology*: 29: 772-781.

Poncet, S., Wolfaardt, A.C., Black, A., Browning, S., Lawton, K., Lee, J., Passfield, K., Strange, G. and Phillips, R.A. 2017. Recent trends in numbers of wandering (*Diomedea exulans*), black-browed (*Thalassarche melanophris*) and grey-headed (*T. chrysostoma*) albatrosses breeding at South Georgia. *Polar Biology*. 40: 1347-1358.

Poncet, S. 2021. Report on a survey of coastal birds and mammals of Stanley Harbour and Cape Pembroke for December 2020 and June 2021. Island LandCare.

Ponti, M., Abbiati, M. and Ceccherelli, V.U. 2015. Biotic and abiotic factors influencing the development and persistence of fouling assemblages on offshore gas platforms. *Continental Shelf Research*. 95: 55 64.

Poot, H., Ens, B.J., de Vries, H., Donners, M.A.H., Wernand, M.R. and Marquenie, J.M. 2008. Green light for nocturnally migrating birds. *Ecology and Society*. 13: 47.

Popper, A.N. and Hastings, M.C. 2009. The effects of anthropogenic sources of sound on fishes. *Journal of Fish Biology*. 75: 455-498.

Popper, A.N. Hawkins, A.D., Fay, R.F., Mann, D.A., Bartol, S., Carlson, T.J., Coombs, S., Ellison, W. T., Gentry, R.L., Halvorsen, M B., Løkkeborg, S., Rogers, P.H., Southall, B.L., Zeddies, D.G. and Tavolga, W.N. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI. ASA S3/SC1.4 TR-2014.

Popper, A.N. and Hawkins, A.D. 2019. An overview of fish bioacoustics and the impacts of anthropogenic sounds on fishes. *Journal of Fish Biology*. 94: 692-713.

Porter, M. B. and Liu, Y-C. 1994. Finite-Element Ray Tracing. In *Theoretical and Computational Acoustics*. 2. World Scientific Publishing Co.

Prado, J. H. F., Secchi, E. R., Kinas, P. G. 2013. Mark-recapture of the endangered franciscana dolphin (*Pontoporia blainvillei*) killed in gillnets fisheries to estimate past bycatch from time series of stranded carcasses in southern Brazil. *Ecological Indicators.* 32: 35-41.

Premier. 2014a. North Falklands Coastline Environmental Sensitivity for Oil Spill Response. September 2014. pp 154.

Premier. 2014b. Temporary Dock Facility: Oil spill response plan. Premier Oil Exploration and Production Limited, Falkland Islands Business Unit. November 2014.

Premier. 2014c. Drilling EIS Addendum Isobel Deep. Premier Oil Exploration and Production Limited, FK-BU-PMO-EV-REP-0004 REV 1.0.

Premier. 2014d. Premier Oil. '2015 Exploration Campaign Environmental Impact Statement' (CP-BA-PMO-HS-SE-ST-0001).

Premier. 2015a. Basis of Design Document Rev 4. Premier Oil Exploration and Production Limited, Document number: FK-SL-PMO-PM-BOD-0004.

Premier. 2015b. Bird Strike Management Standard FK-BU-PMO-SE-PLN-0008.

Premier. 2015c. Environmental assessment of potential inshore transfer sites. Premier Oil Exploration and Production Limited, Falkland Islands Business Unit.

Premier. 2015d. Premier Oil Bird strike report. Premier Oil Exploration and Production Limited.

Premier. 2015e. Sea Lion Development; Iceberg Management Strategy (Doc: FK-SL-PMO-NA-STY-0001).

Premier. 2016. Fate and Behaviour Tests for 'Dead' Sea Lion Crude Oil Inshore Transfer Operations Berkeley Sound. Research conducted by SpillConsult for Premier Oil Exploration and Production Limited, Document No. FK-SL-PMO-EV-TTR-0001, April 2016.

Premier. 2017a. Sea Lion Development Onshore Storage Facilities – Major Accident Hazard Assessment. Assessment conducted by Risktec for Premier Oil Exploration and Production Limited, Document No. FK-SL-PMO-HS-REP-0004, June 2017.

Premier. 2017b. Sea Lion Phase 1 Design Notification. Premier Oil Document No. FK-SL-PMO-HS-REP-0003, May 2017.

Premier. 2017c. Sea Lion Phase 1 Environmental Modelling Report. Premier Oil Document No. FK-SL-PMO-EV-REP-0100.

Premier. 2017d. Sea Lion Inshore Oil Spill Strategy. Premier Oil Document No. FK-SL-PMO-EV-STY-0003.

Premier. 2017e. Sea Lion Development Oil Spill on Paper Workshop – Report. Document No. FK-SL-PMO-EV-REP-0012.

Premier. 2019a. Invasive species monitoring: Stanley Harbour and Port William Report- Final Report. Prepared by Shallow Marine Surveys Group. 15 July 2019.

Premier. 2019b. Sea Lion Offshore Oil Spill Strategy. Premier Oil Document No. FK-SL-PMO-EV-STY-0002.

Premier. 2020. Sea Lion Field Development Phase 1 Environmental Impact Statement. Document No. FK-SL-PMO-EV-REP-0008, Revision B05.

Procter, D. and Fleming, L.V. (Edited). 1999. Biodiversity: the UK Overseas Territories, ISBN 1 86107 502 2.

PTTEP. 2016. Montara Operations Oil Pollution Emergency Plan MV-HSE-D30-811606.

Pütz, K., Ingham, R.J. and Smith, J.G. 2000. Satellite tracking of the winter migration of Magellanic Penguins *Spheniscus magellanicus* breeding in the Falkland Islands. *Ibis*. 142: 614-622.

Pütz, K. 2002. Spatial and temporal variability in the foraging areas of breeding king penguins. *Condor*. 104: 528-538.

Pütz, K., Ingham, R.J. and Smith, J.G. 2002a. Foraging movements of Magellanic Penguins *Spheniscus magellanicus* during the breeding season in the Falkland Islands. *Aquatic Conservation*. 12: 75-87.

Pütz, K., Smith, J.G., Ingham, R.J. and Lüthi B.H. 2002b. Winter dispersal of Rockhopper Penguins *Eudyptes chrysocome* from the Falkland Islands and its implications for conservation. *Marine Ecology Progress Series*. 240: 273-284.

Pütz, K., Smith, J.G., Ingham, R.J. and Luthi, B.H. 2003. Satellite tracking of male rockhopper penguins *Eudyptes chrysocome* during the incubation period at the Falkland Islands. *Journal of Avian Biology*. 34: 139-144.

Pütz, K. and Cherel, Y. 2005. The diving behaviour of brooding king penguins (*Aptenodytes patagonicus*) from the Falkland Islands: variation in dive profiles and synchronous underwater swimming provide new insights into their foraging strategies. *Marine Biology*. 147: 281-290.

Quillfeldt, P., Masello, J.F., Brickle, P. and Martin-Creuzburg, D. 2011. Fatty acid signatures reflect inter- and intra-annual changes in diet of a small pelagic seabird, the Thin-billed prion *Pachyptila belcheri*. *Marine Biology*. 158: 1805-1813.

Raimi, D., Zhu, Y., Newell, R. G., Prest, B. C., and Bergman, A. 2023. Global Energy Outlook 2023: Sowing the Seeds of an Energy Transition. Report 23-02, Resources for the Future. https://media.rff.org/documents/Report_23-02_NPKKYws.pdf.

Ratcliffe, N., Crofts, S., Brown, R., Baylis, A.M.M., Adlard, S., Horswill, C., Venables, H., Taylor, P., Trathan, P.N. and Staniland, I.J. 2014. Love thy neighbour or opposites attract? Patterns of spatial segregation and association among crested penguin populations during winter. *Journal of Biogeography*. 41: 1183-1192.

Raymond, B., Lea, M.A., Patterson, T., Andrews-Goff, V., Sharples, R., Charrassin, J.B., Cottin, M., Emmerson, L., Gales, N., Gales, R., Goldsworthy, S.D., Harcourt, R., Kato, A., Kirkwood, R., Lawton, K., Ropert-Coudert, Y., Southwell, C., van den Hoff, J., Wienecke, B., Woehler, E.J., Wotherspoon, S. and Hindell, M.A. 2015. Important marine habitat off east Antarctica revealed by two decades of multi-species predator tracking. *Ecography*. 38: 121-129.

Reed, M., French, D., Rines, H., and Rye, H. 1995. A three dimensional oil and chemical spill model for environmental impact assessment. In: Proceedings of the 1995 International Oil Spill Conference, pp. 61-66.

Reed, M., Aamo, M. and Downing, K. 1996. Calibration and testing of IKU's oil spill contingency and response (OSCAR) model system. *In: Proceedings of the 1996 Arctic and Marine Oil Spill Program (AMOP) Technical Seminar*. 689-726 pp.

Regan, C.T. 1913. The Antarctic fishes of the Scottish National Antarctic Expedition. Transcriptions of the *Royal Society of Edinburgh*. 49: 229-292.

Regel, J. and Pütz, K. 1997. Effect of human disturbance on body temperature and energy expenditure in penguins. *Polar Biology*. 18: 246-253.

Regeneris. 2013. Socio-economic Study of Oil and Gas Development in the Falklands. Report by Regeneris Consulting Ltd for the Falkland Islands Government.

Regeneris. 2015. Social Economic Monitoring Programme. Report by Regeneris Consulting Ltd for the Falkland Islands Government.

Reid, T.A. and Huin, N. 2005. Census of the Southern Giant-Petrel Population of the Falkland Islands 2004/2005. Falklands Conservation Report to OTEP and FIG. https://falklandsconservation.com/wp-content/uploads/2020/07/Census-of-the-Southern-Giant-Petrel-population-of-the-Falkland-Islands-2004-and-2005.pdf.

Reid, T.A., Sullivan, B.J., Pompert, J., Endicott, J.W. and Black, A.D. 2004. Seabird mortality associated with Patagonian toothfish (*Dissostichus eleginoides*) longliners in Falkland Islands waters. *Emu*. 104: 317-325.

Reid, T.A., Lecoq, M. and Catry, P. 2007. The white-chinned petrel *Procellaria aequinoctialis* population of the Falkland Islands. *Marine Ornithology*. 35: 57-60.

Reilly, S.B., Bannister, J.L., Best, P.B., Brown, M., Brownell Jr., R.L., Butterworth, D.S., Clapham, P.J., Cooke, J., Donovan, G.P., Urbán, J. and Zerbini, A.N. 2013. *Eubalaena australis*. The IUCN Red List of Threatened Species. Version 2014.2. www.iucnredlist.org [Accessed September 2014].

Renault-Braga, E., Groch, K., Simões-Lopes, P. 2022. Predicting the breeding hotspots of the southern right whale, *Eubalaena australis* (Cetartiodactyla: Mysticeti), along the southern Brazilian coastline. *Scientia Marina*. 86.

Renzi, M.A. 1986. Aspectos biologico-pesqueros del abadejo (*Genypterus blacodes*). *Revista de Investigaciones y Desarrollo Pesquero*. 6: 5-19.

Riaz, J., Orben, R.A., Gamble, A., Catry, P., Granadeiro, J.P., Campioni, L., Tierney, M. and Baylis, A.M.M. 2024. Coastal connectivity of marine predators over the Patagonian Shelf during the highly pathogenic avian influenza outbreak. *Ecography*. e07415.

Richards, P.C. and Hillier, B.V. 2000. Post Drilling Analysis of the North Falkland Basin – Part 1: Tectono-Stratigraphic Framework. *Journal of Petroleum Geology*. 23: 273-292.

Richardson, W.J., Greene, C.R., Malme, C.I. and Thompson, D.H. 1995. Marine mammals and noise. Academic Press Inc., San Diego.

Ridoux, V., Lafontaine, L., Bustamante, P., Caurant, F., Dabin, W., Delcroix, C. and Hassani, S. 2004. The impact of the 'Erika' oil spill on pelagic and coastal marine mammals: Combining demographic, ecological, trace metals and biomarker evidences. *Aquatic Living Resources*. 17: 379-387.

Riedman, M. 1990. The pinnipeds: seals, sea lions, and walruses (Vol. 12). Univ of California Press.

Ríos, C., Arntz, W.E., Gerdes, D., Mutschke, E. and Montiel, A. 2007. Spatial and temporal variability of the benthic assemblages associated to the holdfasts of the kelp *Macrocystis pyrifera* in the Straits of Magellan, Chile. *Polar Biology*. 31: 89-100.

Risch, D., Castellote, M., Clark, C. W., Davis, G. E., Dugan, P. J., Hodge, L. E. W., Kumar, A., Lucke, K., Mellinger, D., Nieukirk, S. L., Popescu, C. M., Ramp, C., Read, A. J., Rice, A. N., Silva, M. A., Siebert, S. L., Stafford, K. M., Verdaat, H and Van Parijs, S. M. 2014a. Seasonal migrations of North Atlantic minke whales: novel insights from large-scale passive acoustic monitoring networks. *Movement Ecology*. 2:24.

Risch, D., Gales, N.J., Gedamke, J., Kindermann, L., Nowacek, D.P., Read, A.J., Siebert, U., Opzeeland, I.C., Van Parijs, S.M. and Van Friedlaender, A.S. 2014b. Mysterious bio-duck sound attributed to the Antarctic minke whale (*Balaenoptera bonaerensis*). *Biological Letters*. 10: 20140175.

Roberts, J.M. 2002. The Occurrence of the Coral *Lophelia pertusa* and Other Conspicuous Epifauna around an Oil Platform in the North Sea. *Journal of the Society for Underwater Technology*. 25: 83-91.

Roberts, D.A., Johnston, E.L. and Knott, A. 2010. Impacts of desalination plant discharges on the marine environment: A critical review of published studies. *Water Research*. 44: 5117-5128.

Rocke, T.E. 1999. Field Manual of Wildlife Diseases, General Field Procedures and Diseases of Birds, Biological Resources Division, Information and Technology Report 1999–001. U.S. Geological Survey. Chapter 42.

Rodhouse, P.G., Symon, C. and Hatfield, E.M.C. 1992. Early life cycle of cephalopods in relation to the major oceanographic features of the south-west Atlantic Ocean. *Marine Ecology Progress Series*. 89: 183-195.

Rodhouse, P.G., Elvidge, C.D. and Trathan, P.N. 2001. Remote sensing of the global light-fishing fleet: an analysis of interactions with oceanography, other fisheries and predators. *Advances in Marine Biology*. 39: 261-303.

Rodolfo-Metalpa, R., Houlbrèque, F., Tambutté, É., Boisson, F., Baggini, C., Patti, F.P., Jeffree, R., Fine, M., Foggo, A., Gattuso, J.P. and Hall-Spencer, J.M. 2011. Coral and mollusc resistance to ocean acidification adversely affected by warming. *Nature Climate Change*. 1(6): 308-312.

Rodríguez, D., Bastida, R., Moron, S., Rodríguez, S. and Luoreiro, J. 2003. Occurrence of leopard seals in Northern Argentina. *Latin American Journal of Aquatic Mammals*. 2: 51-54.

Rodríguez, A., Burgan, G., Dann, P., Jessop, R., Negro, J. J. and Chiaradia, A. 2014. Fatal attraction of short-tailed shearwaters to artificial lights. *PLoS One*. 9(10): e110114.

Rodríguez, A., García, D., Rodríguez, B. Cardona, E., Parpal, L. and Pons, P. 2015a. Artificial lights and seabirds: is light pollution a threat for the threatened Balearic petrels? *Journal of Ornithology*. 156: 893-902.

Rodríguez, A. and Rodríguez, B. and Negro, J.J. 2015b. GPS tracking for mapping seabird mortality induced by light pollution. *Nature Scientific Reports*. 5: 10670.

Rodríguez, A., Holmes, N.D., Ryan, P.G., Wilson, K.-J., Faulquier, L., Murillo, Y., Raine, A.F., Penniman, J.F., Neves, V., Rodríguez, B., Negro, J.J., Chiaradia, A., Dann, P., Anderson, T., Metzger, B., Shirai, M., Deppe, L., Wheeler, J., Hodum, P., Gouveia, C., Carmo, V., Carreira, G.P., Delgado-Alburqueque, L., Guerra-Correa, C., Couzi, F.-X., Travers, M. and Corre, M.L. 2017. Seabird mortality induced by land-based artificial lights. *Conservation Biology*. 31: 986-1001.

Rolland R.M., Parks, S.E., Hunt, K.E., Castellote, M., Corkeron, P.J., Nowacek, D.P., Wasser, S.K. and Kraus, S.D. 2012. Evidence that ship noise increases stress in right whales. *Proceedings of the Royal Society B*. 279: 2363-2368.

Romero, S.I., Piola, A.R., Charo, M. and Eiras Garcia, C.A. 2006. Chlorophyll-a variability off Patagonia based on SeaWiFS data. *Journal of Geophysical Research*. 111: C05021.

Ronconi, R.A., Allard, K.A. and Taylor, P.D. 2015. Bird interactions with offshore oil and gas platforms: Review of impacts and monitoring techniques. *Journal of Environmental Management*. 147: 34-45.

Ross, D. (1976). Mechanics of underwater noise. Pergamon, New York. 375 pp.

Rounsevell, D. and Binns, D. 1991. Mass deaths of king penguins (*Aptenodytes patagonica*) at Lusitania Bay, Macquarie Island. *Aurora*. 10: 8-10.

Royal Haskoning. 2021. Unpublished data. EIS document PB7829-RHD-ZZ-ZZ-RP-YE-0005.P01.01.

Royal Navy. 2019. HMS Protector (A173). https://www.royalnavy.mod.uk/organisation/units-and-squadrons/survey/hms-protector.

Royal Society. 2021. The carbon cycle: Better understanding carbon-climate feedbacks and reducing future risks. *Climate Change: Science and Solutions*. Briefing 7.

RPS Energy. 2009. Environmental Impact Statement for Offshore Drilling Licences PL032 and PL033 in the Falkland Islands. Report for Rockhopper Exploration.

Runciman, D. 2001. Investigation of the toxicokinetics of water-based mud cuttings. ERT Ltd. Phase II, Task 2a. UKOOA Drill Cuttings Initiative 2001.

Russell, J.C., Meyer, J-Y., Holmes, N. D. and Pagad, S. 2017. Invasive alien species on islands: impacts, distribution, interactions and management. *Environmental Conservation. Thematic Section: Humans and Island Environments*: 359-370.

Ryan, P.G. 1991. The impact of the commercial lobster fishery on seabirds at the Tristan da Cunha islands, South Atlantic. *Biological Conservation*. 57: 339-350.

Ryan, P.G., De Bruyn, P.N. & Bester, M.N. 2016. Regional differences in plastic ingestion among Southern Ocean fur seals and albatrosses. *Marine Pollution Bulletin*. 104: 207-210.

Rye, H. 2010. Calculation of stresses (depositions and water column concentrations) at the sea floor caused by drilling discharges. Presentation at the 2010 OLF cold-water coral workshop, held at IRIS, Stavanger, 31 May – 1 June 2010.

SAERI and SMSG. 2016. Berkeley Sound Environmental Baseline Survey: Qualitative subtidal habitat assessment. Prepared for Premier Oil Exploration and Production Limited, July 2016.

SAERI. 2015. South Atlantic Environmental Research Institute. https://www.south-atlantic-research.org/.

SAERI. 2016. Berkeley Sound coastal bird survey report conducted for Premier Oil. May 2016. Doc. No. FK-BU-FIG-EV-REP-0011.

SAERI. 2017. Berkeley Sound Coastal Bird Survey Report. Prepared for Premier Oil Exploration and Production Ltd, July 2017 (with assistance from Austral Biodiversity).

SAERI. 2018. Berkeley Sound coastal bird survey report – October 2018. In collaboration with Austral Biodiversity Ltd. pp 23.

SAERI. 2019. Berkeley Sound coastal bird survey report – May 2019. In collaboration with Austral Biodiversity Ltd. pp 24.

SAERI. 2023. Vulnerable Marine Ecosystems Project: Technical Document. Report prepared for Consolidated Fishing Ltd. July 2023.

Saha, S., Moorthi, S., Pan H-L., Wu, X., Wang, J., Nadiga, S., Tripp, P., Kistler, R., Woollen, J., Behringer, D., Liu, H., Stokes, D., Grumbine, R., Gayno, G., Wang, J., Hou, Y-T., Chuang, H-Y., Juang, H-M H., Sela, J., Iredell, M., Treadon, R., Kleist, D., Van Delst, P., Keyser, D., Derber, J., Ek M., Meng, J., Wei, H., Yang, R., Lord, S., Van Den Dool, H., Kumar, A., Wang, W., Long, C., Chelliah, M., Xue, Y., Huang, B., Schemm, J-K., Ebisuzaki, W., Lin, R., Xie, P., Chen, M., Zhou, S., Higgins, W., Zou, C-Z., Liu, Q., Chen, Y., Han, Y., Cucurull, L., Reynolds, R.W., Rutledge, G. and Goldberg, M. 2010. The NCEP Climate Forecast System Reanalysis. *Bulletin of American Meteorological Society*. 91: 1015–1057.

Salazar, S. 2003. Impacts of the Jessica oil spill on sea lion (*Zalophus wollebaeki*) populations. *Marine Pollution Bulletin*. 47: 313-318.

Sanvito, S. and Galimberti, F. 2018. Killer whales of Sea Lion Island (Falkland Islands) Photo-identification catalogue 2017-2018. http://eleseal.org/pdf_vari/KW_SLI_cat_2023.pdf.

Schaanning, M., Ruus, A., Bakke, T., Hylland, K. and Olsgard, F. 2002. Bioavailability of heavy metals in drilling muds.

Schiel, D.R., Steinbeck, J.R. & Foster, M.S. 2004. Ten years of induced ocean warming causes comprehensive changes in marine benthic communities. *Ecology*. *85*: 1833-1839.

Schoeman, R. P., Patterson-Abrolat, C. and Plön, S. 2020. A Global Review of Vessel Collisions with Marine Animals. *Frontiers in Marine Science*. 7: 292.

Schwacke, L.H., Smith, C.R., Townsend, F.I., Wells, R.S., Hart, L.B., Balmer, B.C., Collier, T.K., De Guise, S., Fry, M.M, Guillette, Jr., L.J., Lamb, S.V., Lane, S.M., McFee, W.E., Place, N.J., Tumlin, M.C., Ylitalo, G.M., Zolman, E.S. and Rowles, T.K. 2014. Health of Common Bottlenose Dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, Following the Deepwater Horizon Oil Spill. *Environmental Science and Technology*. 48: 93-103.

Schorr, G.S., Falcone, E.A., Moretti, D.J., Andrews, R.D. 2014. First long-term behavioural records from Cuvier's beaked whales (*Ziphius cavirostris*) reveal record-breaking dives. *PLoS ONE*. 9(3): e92633.

Schwacke, L.H., Smith, C.R., Townsend, F.I., Wells, R.S., Hart, L.B., Balmer, B.C., Collier, T.K., De Guise, S., Fry, M.M, Guillette, Jr., L.J., Lamb, S.V., Lane, S.M., McFee, W.E., Place, N.J., Tumlin, M.C., Ylitalo, G.M., Zolman, E.S. and Rowles, T.K. 2014. Health of Common Bottlenose Dolphins (*Tursiops truncatus*) in Barataria Bay, Louisiana, Following the Deepwater Horizon Oil Spill. *Environmental Science and Technology*. 48: 93-103.

Schwacke, L. H., Marques, T. A., Thomas, L., Booth, C. G., Balmer, B. C., Barratclough, A., Colegrove, K., De Guise, S., Garrison, L. P., Gomez, F. M., Morey, J. S., Mullin, K. D., Quigley, B. M., Rosel, P. E., Rowles, T. K., Takeshita, R., Townsend, F. I., Speakman, T. R., Wells, R. S., Zolman, E.S. and Smith, C. R. 2022. Modeling population effects of the Deepwater Horizon oil spill on a long-lived species. *Conservation Biology.* 36(4): e13878.

Scottish Executive. 2007. Guidance Note: Controlling Light Pollution and Reducing Light Energy Consumption. Edinburgh: Scottish Executive.

Sea Watch Foundation. 2012. Species information sheet: Sei whale in UK waters. http://seawatchfoundation.org.uk/wp-content/uploads/2012/07/Sei_Whale1.pdf.

Sei Whale CMP. 2024. Conservation Management Plan for the sei whale (*Balaenoptera borealis*) in the Falkland Islands. Falklands Conservation, Stanley, Falkland Islands. September 2024.

Segre, P.S., Weir, C.R., Stanworth, A., Cartwright, S., Friedlaender, A.S. and Goldbogen, J. A. 2021. Biomechanically distinct filter-feeding behaviors distinguish sei whales as a functional intermediate and ecologically flexible species. *Journal of Experimental Biology*. 224: jeb238873.

SEPA. 2023a. Waste Data for Scotland data tool: Waste from all sources: waste data table 2021. https://www.sepa.org.uk/environment/waste/waste-data/waste-data-reporting/waste-data-for-scotland/.

SEPA. 2024. Waste Site Capacity Informatics website, accessed - https://informatics.sepa.org.uk/WasteSiteCapacity/ [Accessed 10.02.24]

SFL. 2022a. Falkland Islands New Port Facility: Shag Rock Scuttling Site Benthic Baseline Survey Report. Report prepared by SAERI (Falklands) Ltd. for Royal HaskoningDHV, May 2022.

SFL. 2022b. FIPASS mussel identification - DNA barcoding. Report for the Falkland Islands Government. April 2022.

Sharp, T. and Dobrijevic, D. 2023. Earth's atmosphere: Facts about our planet's protective blanket - https://www.space.com/17683-earth-atmosphere.html.

Shirihai, H. 2006. Whales, dolphins and seals: A field guide to marine mammals of the world. A and C Black Publishers Ltd.

Silber, G.K., Bettridge, S. and Cottingham, D. 2009. Report of a workshop to identify and assess technologies to reduce ship strikes of large whales, 8-10 July, 2008, Providence, Rhode Island. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-OPR-42. 55 p.

Simsovic, D. and Ranghetti, D. 2019. Socio-economic impacts of oil and gas development in the Falkland Islands: Employment and population growth, a wider perspective. Falklands Islands Government: Policy and Economic Development Directorate. Available online: https://www.falklands.gov.fk/policy/downloads?task=download.send&id=60:soc-econ-impacts-og&catid=15.

Singh, A. and Agrawal, M. 2008. Acid rain and its ecological consequences. *Journal of Environmental Biology*. 29: 15-24.

SINTEF. 2008. Background noise levels in Europe. Truls Gjestland, SINTEF A6631. https://www.easa.europa.eu/system/files/dfu/Background_noise_report.pdf.

Širović, A., Hildebrand, J.A., Wiggins, S.M. and Thiele, D. 2009. Blue and fin whale acoustic presence around Antarctica during 2003 and 2004. *Marine Mammal Science*. 25: 125-136.

Skamarock, W.C., Klemp, J.B., Dudhia, J., Gill, D.O., Barker, D.M., Duda, M.G., Huang, X-Y., Wang, W. and Powers, J.G. 2008. A Description of the Advanced Research WRF Version 3, Tech. rep., UCAR.

Skottsberg, C. 1921. Botanische Ergebnise der schwedischen Expedition nach Patagonien und dem Feurlande 1907-1909. Marine algae I. Phaeophyceae. K.Sv.Vet. Akad.Handl 61, 1-56.

Sladen, W.J.L., Boyd, J.C. and Pedersen, J.M. 1966. Biotelemetry studies on penguin body temperatures. *Antarctic Journal of the United States*. 1: 142-143.

Smethurst Consultancy. 2013. Towards an Infrastructure Delivery Plan. Report commissioned by the Director of Central Services, Falkland Islands Government.

Smit, M.G.D., Tamis, J.E., Jak, R.G., Karman, G., Kjeilen-Eilertsen, G., Trannum, H. and Neff, J. 2006. Threshold levels and risk functions for non-toxic sediment stressors: burial, grain size changes and hypoxia. Summary. TNO Report no. 2006-DH-0046/A.

Smit, M.G.D., Frost, T.K. and Johnsen, S. 2011. Achievements of Risk-based produced water management on the Norwegian Continental Shelf (2002-2008). *Integrated Environmental Assessment and Management.* 7: 668-677.

SMSG. 2008. Benthic survey of the Jason Islands, Falkland Islands. Shallow Marine Survey Group.

SMSG. 2009a. Benthic survey of Berkeley Sound, Shallow Marine Survey Group.

SMSG. 2009b. Benthic survey of Beauchêne and Sea Lion Islands, Falkland Islands. Shallow Marine Survey Group.

SMSG. 2009c. Benthic survey of Adventure Sound, Falkland Islands. Shallow Marine Survey Group: Stanley.

SMSG. 2011. Shallow Marine Surveys Group: Survey report: Invasive species, March 2011. Unpublished Shallow Marine Surveys Group report.

SMSG. 2012. Shallow Marine Surveys Group: Kidney Island National Nature Reserve. Survey of the Marine Environment. Shallow Marine Survey Group.

SMSG. 2013. Shallow Marine Surveys Group: Stanley Harbour Environmental Baseline Survey (EBS). Qualitative Subtidal and Intertidal Habitat Assessment. Contract Number FI-2013-C-029. Prepared for Premier Oil and Production Limited.

SMSG. 2016. Shallow Marine Surveys Group. https://www.smsg-falklands.org/.

Snelgrove, P.V.R. and Butman, C.A. 1994. Animal–sediment relationships revisited: cause versus effect. *Oceanography and Marine Biology: An Annual Review.* 32: 111-177.

Solan, M., Hauton, C., Godbold, J. A., Wood, C. L., Leighton, T. G., and White, P. 2016. Anthropogenic sources of underwater sound can modify how sediment-dwelling invertebrates mediate ecosystem properties. *Scientific Reports*. 6: 20540.

Somerville, H.J., Bennett, D., Davenport, J.N., Holt, M.S., Lynes, A., Mahieu, A., McCourt, B., Parker, J.G., Stephenson, R.R., Watkinson, R.J., Wilkinson, T.G., 1987. Environmental effect of produced water from North Sea oil operations. *Marine Pollution Bulletin*. 18: 549–558.

Sørensen K., Neumann C., Dähne M., Hansen K. A. and Wahlberg M. 2020. Gentoo penguins (Pygoscelis papua) react to underwater sounds. *Royal Society of Open Science*. 7191988.

Southall, B.L. 2005. Shipping noise and marine mammals: A forum for science, management, and technology. In Final Report of the National Oceanic and Atmospheric Administration (NOAA) International Symposium.

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene, C.R. Jr., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A. and Tyack, P. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. *Aquatic Mammals*. 33: 411-521.

Southall, B.L., Finneran, J.J., Reichmuth, C., Ketten, D.R., Bowles, A.E., Ellison, Nowacek , D.P. and Tyack, P. 2019. Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects. *Aquatic Mammals.* 45: 125-232.

Southall, B. L., Nowacek, D.P., Bowles, A.E., Senigaglia, V., Bejder, L. and Tyack, P.L. 2021. Marine mammal noise exposure criteria : Assessing the severity of marine mammal behavioural responses to human noise. *Aquatic Mammals*. 47(5).

Southwell, C. 2005. Response behaviour of seals and penguins to helicopter surveys over the pack ice off East Antarctica. *Antarctic Science*. 17: 328-334.

Spencer, N. 2019a. Review of impact assessment methodologies. Report prepared as part of the GAP Project (Phase II) for the Falkland Islands Offshore Hydrocarbons Environmental Forum (FIOHEF). South Atlantic Environmental Research Institute, Falkland Islands.

Spencer, N. 2019b. Best-practise guidelines for hydrocarbon related environmental impact and risk assessment methodology. Report prepared as part of the GAP Project (Phase II) for the Falkland Islands Offshore Hydrocarbons Environmental Forum (FIOHEF). South Atlantic Environmental Research Institute (SAERI), Falkland Islands.

Stafford, K.M., Mellinger, D.K., Moore, S.E. and Fox, C.G. 2007. Seasonal variability and detection range modelling of baleen whale calls in the Gulf of Alaska, 1999–2002. *Journal of Acoustical Society of America*. 122: 3378-3390.

Stagg, R.M. and McIntosh, A. 1996. The effects of drill cuttings on the Dab (*Limanda limanda*). EandP Forum Report. The Physical and Biological Effects of Processed Oily Drill Cuttings.

Staniland, J., Robinson, S.L., Silk, J.R.D., Warren, N. and Trathan, P.N. 2012. Winter distribution and haul-out behaviour of female Antarctic fur seals from South Georgia. *Marine Biology*. 159: 291-301.

Stankovic, A., Spalik, K., Kamler, E., Borsuk, P. and Weglenski, P. 2002. Recent origin of sub-Antarctic notothenioids. *Polar Biology*. 25: 203–205.

Stanworth, A. 2014 Falkland Islands Seabird Monitoring Programme Annual Report 2013/2014 (SMP21). Unpublished Falklands Conservation (FC) report.

Stanworth, A. and Crofts, S. 2017. Population status and trends of southern giant petrels (*Macronectes giganteus*) in the Falkland Islands. Falklands Conservation.

Stark, J.S., Snape, I. and Riddle, M.J. 2003. The effects of petroleum hydrocarbon and heavy metal contamination of marine sediments on recruitment of Antarctic soft-sediment assemblages: a field experimental investigation. *Journal of Experimental Marine Biology and Ecology*. 283: 21– 50.

Stephenson, M.T., 1992. Components of produced water - a compilation of industry studies. *Journal of Petroleum Technology*. 44: 548-550 and 602-603.

Strange, I.J. 1992. A field guide to the wildlife of the Falkland Islands and South Georgia. Harper and Collins, London.

Suez. 2017. Mind the Gap: UK Residual Waste Infrastructure Capacity Requirements.

Sullivan, B.J., Reid, T.A. and Bugoni, L. 2003. Seabird mortality on factory trawlers in the Falkland Islands and beyond. *Biological Conservation*. 131: 495-504.

Sundt, R., Ruus, A., Jonsson, H., Skarph´ eðinsd´ottir, H., Meier, S., Grung, M., Beyer, J., Pampanin, D., 2012. Biomarker responses in Atlantic cod (Gadus morhua) exposed to produced water from a North Sea oil field: laboratory and field assessments. *Marine Pollution Bulletin*. 64: 144–152.

Tabak, M.A., Poncet, S., Passfield, K., Goheen, J.R. and Martinez del Rio, C. 2015. Rat eradication and the resistance and resilience of passerine bird assemblages in the Falkland Islands. *Journal of Animal Ecology*. 84: 755-764.

Tabak, M.A., Anderson, O.R., Robb, G., Poncet, S., Passfield, K., Martinez, M. and Martinez del Rio, C. 2016. Comparative isotopic natural history of two native passerines (*Troglodytes cobbi* and *Cinclodes antarcticus*) and the invasive rats (*Rattus norvegicus*) that extirpate them. *Austral Ecology*. 41: 622-632.

Tarling, G. A., Ward, P., Shaeder, M., Williams, J. A. and Symon, C. 1995. Distribution patterns of macrozooplankton assemblages in the south-west Atlantic. *Marine Ecology Progress Series*. 120: 29-40.

Tasker, M.L., Hope-Jones, P., Blake, B.F., Dixon, T. and Wallis, A.W. 1986. Seabirds associated with oil production platforms in the North Sea. *Ringing and Migration*. 7: 7-14.

Tasker, M.L. and Pienkowski, M.W. 1987. Vulnerable Concentrations of Birds in the North Sea. Nature Conservation Council.

Taylor, B., Barlow, J., Pitman, R., Ballance, L., Klinger, T., DeMaster, D., Hildebrand, J., Urban, J., Palacios, D. and Mead, J. 2000. A call for research to assess risk of acoustic impact on beaked whale populations. International Whaling Commission paper. https://www.cetus.ucsd.edu/docs/reports/TaylorIWC-2004.pdf.

Thiebault, A., Charrier, I., Aubin, T., Green, D.B., Pistorius, P.A. 2019. First evidence of underwater vocalisations in hunting penguins. *PeerJ*. 7: e8240.

Thompson, K.R. 1992 Quantitative analysis of the use of discards from squid trawlers by black-browed albatrosses *Diomedea melanophris* in the vicinity of the Falkland Islands. *Ibis*. 134: 11-21.

Thompson, K.R. 1993. Falkland Islands Seabird Monitoring Programme Summary of Results. Falklands Conservation Report SMP/3, Falkland Islands.

Thompson, K.R. and Riddy, M. 1995. Utilisation of offal discards from 'finfish' trawlers around the Falkland Islands by the black-browed albatross *Diomedea melanophris* in the vicinity of the Falkland Islands. *Ibis*. 137: 198-206.

Thompson, D., Moss, S. and Lovell, P. 2003. Foraging behaviour of South American fur seals (*Arctocephalus australis*): extracting fine scale foraging behaviour from satellite tracks. *Marine Ecology Progress Series*. 260: 285-296.

Thompson, D, Strange, I, Riddy, M, and Duck, C. 2005. The size and status of the population of southern sea lions *Otaria flavescens* in the Falkland Islands. *Biological Conservation*. 121: 357-367.

Thomson, R.B. 1977. Effects of human disturbance on an Adelie Penguin rookery and measures of control. In: Adaptations within Antarctic ecosystems. (Llano, G.A. (Ed.)). pp 1177–1180. Smithsonian Institute, Washington, DC.

Thomson, I. and Munro, G. 2014. Results from the pilot line transect survey for inshore cetaceans in the Falkland Islands and designing a full Falkland Islands line transect survey for inshore cetaceans. Unpublished report to the Darwin Initiative.

Tingley, G., Saunders, G., Harries, D. and King, J. 1996. The first shallow marine survey around the Falkland Islands. IC Consultants Ltd. and Brown and Root Environmental, UK.

Todd, V. L. G., Williamson, L. D., Jiang, J., Cox, S. E., Todd, I. B. and Ruffert, M. 2020. Proximate underwater soundscape of a North Sea offshore petroleum exploration jack-up drilling rig in the Dogger Bank. Journal of Acoustic Society of America. 148: 3971–3979.

Towers, J.R., Tixier, P., Ross, K.A., Bennett, J., Arnould, J.P.Y., Pitman, R.L., Durban, J. 2019. Movements and dive behaviour of a toothfish-depredating killer and sperm whale. *ICES Journal of Marine Science.* 76(1): 298-311.

Trannum, H.C. 2004. Calculation of the PNEC for changed grain size based on data from MOD. Akvaplan Niva report APN-411.3088.1 ERMS report 9A.

Trannum, H.C., Nilsson, H.C., Schaanning, M.T.and Øxnevad, S. 2010. Effects of sedimentation from water-based drill cuttings and natural sediment on benthic macrofaunal community structure and ecosystem processes. *Journal of Experimental Marine Biology and Ecology*. 383: 111-121.

Trathan, P.N., Warwick-Evans, V., Hinke, J.T., Young, E.F., Murphy, E.J., Carneiro, A.P.B., Dias, M.P., Kovacs, K.M., Lowther, A.D., Godø, O.R., Kokubun, N., Kim, J.H., Takahashi, A., and Santos, M. 2018. Managing fishery development in sensitive ecosystems: identifying penguin habitat use to direct management in Antarctica. *Ecosphere*. 9: e02392.

Trimborn, S., Brenneis, T., Hoppe, C.J.M., Laglera, L., Norman, L., Santos-Echeandía, J., Volkner, C., Wolf-Gladrow, D. and Hassler, C.S. 2017. Iron sources alter the response of Southern Ocean phytoplankton to ocean acidification. *Marine Ecology Progress Series.* 578: 35–50.

Troccoli, G. H., Anguilla, E., Martinez, P. A. and Belleggia, M. 2020. The diet of the Patagonian toothfish *Dissostichus eleginoides*, a deep-sea top predator off Southwest Atlantic Ocean. *Polar Biology*. 43: 1595-1604.

Troy, J.R., Holmes, N.D. and Green, M.C. 2011. Modeling artificial light viewed by fledgling seabirds. *Ecosphere*. 2: 1-13.

Tyack, P.L., Johnson, M., Aguilar Soto, N., Sturlese, A., Madsen, P.T. 2006. Extreme diving of beaked whales. *The Journal of Experimental Biology*. 209: 4238-4253.

Tyack, P.L. 2008. Implications for marine mammals of large-scale changes in the marine acoustic environment. *Journal of Mammalogy*. 89: 549-558.

Tyler Grange. 2016. Transfer Mooring Buoy, Berkeley Sound, Falkland Islands: Landscape and Visual Impact Assessment (Report No: 10102_R01a_JJ_AR).

UK Government. 2015. British Forces Overseas: Falkland Islands and Ascension Island. https://www.gov.uk/guidance/british-forces-overseas-falkland-islands-and-ascension-island.

UK Hydrographic Office. 2023. Falkland Islands Wreck Chart, *via* Wrecksite. http://www.wrecksite.eu/chartDetails.aspx?511.

UKOOA. 1999. Activity 2.1. Faunal Colonisation Of Drill Cuttings Pile Based On Literature Review. United Kingdom Offshore Operators Association (UKOOA) Drill Cuttings Initiative, Research and Development Programme. Report by Dames and Moore; and NIOZ.

UKOOA. 2001. United Kingdom Offshore Operators Association: An analysis of UK offshore oil and gas environmental surveys 1975-95. Heriot-Watt University.

UKOTCF. 2025. Falkland Islands. Online resource: https://www.ukotcf.org.uk/southern-oceans/falkland-islands/.

UKRI. 2022. INSITE Influence of man-made structures in the ecosystem. http://www.insitenorthsea.org.

UKSAC. 2015. http://www.ukmarinesac.org.uk/activities/water-quality/wq9_8.htm#a1.

UNCLOS. 1982. United Nations Convention on the Law of the Sea (UNCLOS) Contiguous zone. "SECTION 4. CONTIGUOUS ZONE, Article 33". UNCLOS PART II – TERRITORIAL SEA AND CONTIGUOUS ZONE. United Nations. Retrieved 2012-01-19 in Wikipedia (2015c)

UNDP. 2006. Human Development Report 2006: Beyond scarcity: Power, poverty and the global water crisis. United Nations Development Program. https://www.undp.org/libya/publications/human-development-report-2006-beyond-scarcity-power-poverty-and-global-water-crisis.

University of California. 1971. Santa Barbara oil spill: Short-term analysis of macroplankton and fish. A report for the Office of Water Quality Research, Environmental Protection Agency.

Upson, R. 2012. Important Plant Areas of the Falkland Islands. Unpublished Report, Falklands Conservation. 80pp.

Upson, R. and Clubbe, C. and Mcadam, J. 2014. TEFRA: Terrestrial Ecosystems of the Falklands - a Climate Change Risk Assessment - Seminar and Prioritisation Workshop Report. 10.13140/RG.2.2.23210.41922. https://www.researchgate.net/publication/308416364_TEFRA_Terrestrial_Ecosystems_of_the_Falklands_-_a_Climate_Change_Risk_Assessment_-_Seminar_and_Prioritisation_Workshop_Report.

Upson, R. and Lewis, R. 2014. Updated atlas and checklist of Falkland Islands plants. Report to Falklands Conservation.

Upson, R., McAdam, J. and Clubbe, C. 2016. Climate Change Risk Assessment for Plants and Soils of the Falkland Islands and the Services they provide.

USEPA. 1975. Tamano Oil Spill in Casco Bay: Environmental Effects and Cleanup Operations. United States Environmental Protection Agency.

USEPA. 1981. Some effects of petroleum on nearshore Alaskan marine organisms.

USEPA. 1991. EPA/505/2-90-001 PB91-127415 EPA Technical Support Document for Water Quality-based Toxics Control March 1991.

Vaes, T. and Druon, J-N. 2013. Mapping of potential risk of ship strike with fin whales in the Western Mediterranean Sea: A scientific and technical review using the potential habitat of fin whales and effective vessel density. Report by the Joint Research Centre of the European Commission. ISBN: 978-92-79-28851-7.

van der Grient, J., Morley, S., Arkhipkin, A., Bates, J., Baylis, A., Brewin, P., Harte, M., White, J. W. and Brickle, P. 2023. The Falkland Islands marine ecosystem: A review of the seasonal dynamics and trophic interactions across the food web. *Advances in Marine Biology*. 94: 1-68.

van der Hoop, J., Corkeron, P. and Moore, M. 2016. Entanglement is a costly life-history stage in large whales. *Ecology and Evolution*. 7: 92–106.

van der Kolk, H.J, Allen, A.M., Ens, B.J., Oosterbeek, K., Jongejans, E., van de Pol, M. 2020. Spatiotemporal variation in disturbance impacts derived from simultaneous tracking of aircraft and shorebirds. *Journal of Applied Ecology*. 57: 2406–2418.

van Tussenbroek, B.I. 1989. Seasonal growth and composition of fronds of *Macrocystis pyrifera* in the Falkland Islands. *Marine Biology*. 100: 419-430.

van Waerebeek, K., Baker, A. N., Felix, F., Gedamke, J., Inguez, M., Sanino, G. P., Secchi, E., Sutaria, D., van Helden, A. and Wang, Y. 2007. Vessels collisions with small cetaceans worldwide and with large whales in the Southern Hemisphere, and initial assessment. *Latin American Journal of Aquatic Mammals*. 6: 43-69.

Vanderlaan, A.S.M. and Taggart, C.T. 2007. Vessel collisions with whales: The probability of lethal injury based on vessel speed. *Marine Mammal Science*. 23: 144-156.

Vazzana M., Ceraulo M., Mauro M., Papale E., Dioguardi M., Mazzola S., Arizza, V., Chiaramonte, M. and Buscaino, G. 2020. Effects of acoustic stimulation on biochemical parameters in the digestive gland of Mediterranean mussel *Mytilus galloprovincialis* (Lamarck 1819). *Journal of the Acoustical Society of America*. 147: 2414–2422.

Veil, J.A., Puder, M.G., Elcock, D. and Redweik, R.J. Jr., 2004. A white paper describing produced water from production of crude oil, natural gas, and coal bed methane. Pittsburgh: US Department of Energy, National Energy Technology Laboratory. 79 pp.

venn-Watson, S., Garrison, L., Litz, J., Fougeres, E., Mase, B., Rappucci, G.,Stratton, E., Carmichael, R., Odell, D., Shannon, D., Shippee, S., Smith, S., Staggs, L., Tumlin, M., Whitehead, H. and Rowles, T. 2015. Demographic Clusters Identified within the Northern Gulf of Mexico Common Bottlenose Dolphin (*Tursiops truncatus*) Unusual Mortality Event: January 2010 - June 2013. *PLoS ONE*. 10: e0117248.

Wakefield, E.D., Clark, T.J., Matthiopoulos, J., Bonnet-Lebrun, A.S., Campioni, L. and Catry, P. 2017 The population size and fine-scale foraging distribution of Kidney Islands sooty shearwaters – a baseline study, Report to the Falkland Islands Government, 30th September, 2017, University of Glasgow, UK, 40p.

Wale, M.A, Briers, R.A, Bryson, D., Hartl, M.G.J. and Diele, K. 2016. The Effects of Anthropogenic Noise Playbacks on the Blue Mussel *Mytilus edulis*. MASTS: Annual Science Meeting, 16-21 October 2016.

Wales, S. C. and Heitmeyer, R. M. 2002. An ensemble source spectra model for merchant ship-radiated noise. *Journal of the Acoustical Society of America*. 111: 1211-1231.

Walker, T.R., Boyd, I.L., McCafferty, D.J., Huin, N., Taylor, R.I. and Reid, K. 1998. Seasonal occurrence and diet of leopard seals (*Hydrurga leptonyx*) at Bird Island, South Georgia. *Antarctic Science*. 10: 75-81.

Walsh, G.E. 1978. Toxic effects of pollutants on Plankton. Principles of Ecotoxicology. John Wiley and Sons, Inc., New York, 257-274.

Waluda, C.M., Griffiths, H.J. and Rodhouse, P.G. 2008. Remotely sensed spatial dynamics of the *Illex argentinus* fishery, South-west Atlantic. *Fisheries Research*. 91: 196-202.

Waluda, C.M., and Staniland, I.J. 2013. Entanglement of Antarctic fur seals at Bird Island, South Georgia. *Marine Pollution Bulletin*. 74: 244-252.

Wang, X.C. and Zhao, H.M. 2007. Uptake and Biodegradation of Polycyclic Aromatic Hydrocarbons by Marine Seaweed. *Journal of Coastal Research.* 50: 1056 – 1061.

Wanless, R.M., Scott, S., Sauer, W.H.H., Andrew, T.G., Glass, J.P., Godfrey, B., Griffiths, C. and Yeld, E. 2010. Semi-submersible rigs: A vector transporting entire marine communities around the world. *Biological Invasions*. 12: 2573-2583.

Wardle, C. S., Carter, T. J., Urquhart, G. G., Johnstone, A. D. F., Ziolkowski, A. M., Hampson, G. and Mackie, D. 2001. Effects of seismic air guns on marine fish. *Continental Shelf Research.* 21: 1005-1027.

Wartzok, D., Popper, A.N., Gordon, J. and Merrill, J. 2004. Factors affecting the responses of marine mammals to acoustic disturbance. *Marine Technology Society Journal*. 37: 6-15.

Warwick-Evans, V., Ratcliffe, N., Lowther, A.D., Manco, F., Ireland, L., Clewlow, H.L., and Trathan, P.N. 2018. Using habitat models for chinstrap penguins *Pygoscelis antarctica* to advise krill fisheries management during the penguin breeding season. *Diversity and Distribution.* 24: 1756-1771.

Watkins, W.A. 1981. Activities and underwater sounds of fin whales*. Scientific Reports of the Whales Research Institute*. 33: 83-117.

WBG. 1998a. World Bank Group: Pollution Prevention and Abatement Handbook. Nitrogen Oxides.

WBG. 1998b. World Bank Group: Pollution Prevention and Abatement Handbook. Sulphur Oxides.

WDCS. 2006. Vessel collisions and cetaceans: What happens when they don't miss the boat? A Whale and Dolphin Conservation Society (WDCS) Report by Dolman, S., Williams-Grey, V., Asmutis-Silvia, R. and Isaac, S.

Weatherspark. 2023. Weather statistics from MPA, Falkland Islands. https://weatherspark.com/y/147511/Average-Weather-at-Mount-Pleasant-Airport-Falkland-Islands-Year-Round.

Weilgart, L. 2013. A review of the impacts of seismic airgun surveys on marine life. Submitted to the CBD Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity, 25-27 February 2014, London, UK.

Weilgart, L. 2018. The impact of ocean noise pollution on fish and invertebrates. Report for OceanCare, Switzerland. PhD Thesis. Oceancare and Dalhousie University.

Weir, C.R. 2017. Developing a site-based conservation approach for sei whales *Balaenoptera borealis* at Berkeley Sound, Falkland Islands. Falklands Conservation report. 114 pp.

Weir, C.R. 2018. A preliminary assessment of endangered sei whales (*Balaenoptera borealis*) in two candidate Key Biodiversity Areas in West Falkland. Falklands Conservation report. Version 1.2, 3 September 2018. 128 pp.

Weir, C.R. and Black, A. 2018. Records of the dusky dolphin (*Lagenorhynchus obscurus*) in the Falkland Islands, including associations with Peale's dolphin (*L. australis*). *Marine Biodiversity Records*. 11:18.

Weir, C.R., Taylor, M., Jelbes, P A.Q. and Stanworth, A. 2018. Cue rates and surfacing characteristics of sei whales (*Balaenoptera borealis*) in the Falkland Islands. *Journal of Cetacean Research and Management*. 19: 43-55.

Weir, C. R., Oms, G., Baracho-Neto, C. G., Wedekin, L. L., Daura-Jorge, F. G. 2019. Migratory movement of a sei whale (*Balaenoptera borealis*) between Brazil and the Falkland Islands (Malvinas). Marine Mammal Science. 36: 1050–1057.

Weir, C.R. 2020. Supporting evidence for the proposal of Falkland Islands Inner Shelf Waters as a KBA for endangered sei whales (*Balaenoptera borealis*). Falklands Conservation, Stanley, Falkland Islands.

Weir, C.R. and Stanworth, A. 2020. The Falkland Islands (Malvinas) as sub-Antarctic foraging, migratory and wintering habitat for southern right whales. *Journal of the Marine Biological Association of the United Kingdom*. 100: 153–163.

Weir, C.R. 2021. Supporting evidence for the proposal of Falkland Islands Inner Shelf Waters as a KBA for endangered sei whales (*Balaenoptera borealis*). Falklands Conservation, Stanley, Falkland Islands. 36 pp.

Weir, C.R., Taylor, M., Jelbes, P.A., Stanworth, A, and Hammond P.S. 2021 Distribution and abundance of sei whales off the west coast of the Falkland Islands. *Marine Mammal Science*. 37: 919-933.

Weir, C.R. (Ed.). 2022. Conserving Falklands' whale populations: addressing data deficiencies for informed management. Technical Report for DPLUS082. Falklands Conservation, Stanley, Falkland Islands. Version 1, 31 Jan 2022. 210 pp.

Weir, C. R. and Prieto, R. 2024. Sei Whale *Balaenoptera borealis* Lesson, 1828 in S. Siciliano (Ed.), Mammals of Middle and South America: Cetacea and Sirenia, Handbook of the Mammals of Middle and South America, Springer Nature Switzerland AG 2024.

Weir, C. R., Fernandez, S., Jackson, J. A., Miller, A., Sucunza, F., Slesser, H. W. and Zerbini. 2024. Movements and behaviour of southern right whales satellite-tracked in and beyond a subantarctic archipelago wintering ground. *Endangered Species Research*. 55: 229-245.

Wells, E. 2010. Intertidal and subtidal benthic marine algae of the Falkland Islands. Unpublished survey report, Wells Marine.

Wernberg, T., Thomsen, M.S., Baum, J.K., Bishop, M.J., Bruno, J.F., Coleman, M.A., Filbee-Dexter, K., Gagnon, K., He, Q., Murdiyarso, D., Rogers, K., Silliman, B.R., Smale, D.A., Starko, S. and Vanderklift, M.A. 2024. Impacts of Climate Change on Marine Foundation Species. *Annual Review of Marine Science*. 16: 247-282.

Werth, J., Blakeney, S. M. and Cothren, A. I. 2019. Oil adsorption does not structurally or functionally alter whale baleen. Royal Society of Open Science. 6182194.

White, R.W., Gillon, K.W., Black, A.D. and Reid, J.B. 2001. Vulnerable concentrations of seabirds in Falkland Islands waters. JNCC, Peterborough.

White, R.W., Gillon, K.W., Black, A.D. and Reid J.B. 2002. The distribution of seabirds and marine mammals in Falkland Islands waters. Joint Nature Conservation Committee, Peterborough, UK. pp. 107.

Whitehead, H. 2003. Sperm whales: Social evolution in the ocean. The University of Chicago Press.

WHO. 1999. World Health Organisation: Guidelines for Community Noise. Geneva: WHO.

WHO. 2009. World Health Organisation: Night Noise Guidelines for Europe. Geneva: WHO.

Wiese, F.K., Montevecchi, W.A., Davoren, G.K., Huettmann, F., Diamond, A.W. and Linke, J. 2001. Seabirds at risk around offshore oil platforms in the north-west Atlantic. *Marine Pollution Bulletin*. 42: 1285-1290.

Williams, T.D., Kato, A., Croxall, J.P., Naito, Y., Briggs, D.R., Rodwell, S. and Barton, T.R. 1992. Diving pattern and performance in nonbreeding Gentoo penguins (*Pygoscelis papua*) during winter. *The Auk*. 109: 223-234.

Williams, J.M., Tasker, M.L., Carter, I.C. and Webb, A. 1994. A method of assessing seabird vulnerability to surface pollutants. *Ibis*. 137: S147-S152.

Williams, R. and O'Hara, P. 2010. Modelling ship strike risk to fin, humpback and killer whales in British Columbia, Canada. *Journal of Cetacean Research and Management*. 11: 1-8.

Williams, R., Gero, S., Bejder, L., Calambokidis, J., Kraus, S. D., Lusseau, D., Read, A. J., and Robbins, J. 2011. Underestimating the damage: interpreting cetacean carcass recoveries in the context of the Deepwater Horizon/BP incident. *Conservation Letters*. 4(3): 228-233.

Wills, J. 1999. A Survey of Offshore Oilfield Drilling Wastes and Disposal Techniques to Reduce the Ecological Impact of Sea Dumping: Environmental Effects of Drilling Waste Discharges. In: Environmental Impact of the Offshore Oil and Gas Industry (Patin, S. (Ed.)).

Wills, J.D. 2000. Muddied waters: a survey of offshore oilfield drilling wastes and disposal techniques to reduce the ecological impacts of sea dumping. The effects of discharges of produced water [Web resource]. East Northport, NY.

Wilson, K.J., Taylor, R.H. and Barton, K.J. 1990. The impact of man on Adelie penguins at Cape Hallett, Antarctica. In: Antarctic ecosystems: ecological change and conservation. (Kerry, K.R. and Hempel, G. (Eds.)) Springer, Berlin, pp 183–190.

Wolfaardt, A.C., Underhill, L.G., Altwegg, R., Visagie. J. 2008. Restoration of oiled African Penguins *Spheniscus demersus* a decade after the Apollo Sea spill. *African Journal of Marine Science*. 30: 421-436.

Wolfaardt, A.C., Williams, A.J., Underhill, L.G., Crawford, R.J.M. and Whittington, P.A. 2009. Review of the rescue, rehabilitation and restoration of oiled seabirds in South Africa, especially African Penguins *Spheniscus demersus* and Cape Gannets *Morus capensis*, 1983-2005. *African Journal of Marine Science*. 31: 31-54.

Wolfaardt, A.C., Rendell, N. and Brickle, P. 2010. Falkland Islands implementation plan for the Agreement on the Conservation of Albatrosses and Petrels (ACAP): review of current work and a prioritised work programme for the future. Falkland Islands Government. Stanley, Falkland Islands.

Wolfaardt, A.C. 2012. An assessment of the population trends and conservation status of Black-browed Albatrosses in the Falkland Islands. Joint Nature Conservation Committee, Stanley Falkland Islands.

Woods, R.W. 1970. Great shearwater *Puffinus gravis* breeding in the Falkland Islands. *Ibis*: 112, 259-260.

Woods, R.W. 1988. Guide to birds of the Falkland Islands. Anthony Nelson, Shropshire.

Woods, R.W. and Woods, A. 1997. Atlas of breeding birds of the Falkland Islands. Anthony Nelson, Oswestry.

Woods, R.W. and Woods A. 2006. Birds and Mammals of the Falkland Islands. WILD Guides, UK.

Wursig, B. 1988. Cetaceans and Oil: Ecologic Perspectives. Synthesis of Effects of Oil on Marine Mammals. Report.

Yang, M. and Tulloch, S. 2002. Oil-in-water monitoring - where are we heading? Presentation at the Oil-in-Water Workshop, 23 May.

Yates, O. and P. Brickle. 2007. On the relative abundance and distribution of sperm whales (*Physeter macrocephalus*) and killer whales (*Orcinus orca*) in the Falkland Islands longline fishery. *Journal of Cetacean Research and Management*. 9: 65-71.

Yebra, D.M., Kiil, S. and Dam-Johansen, K. 2004. Antifouling technology—past, present and future steps towards efficient and environmentally friendly antifouling coatings. *Progress in Organic Coatings*. 50: 75-104.

Youngblood, W.W. and Blumer, M. 1975. Polycyclic aromatic hydrocarbons in the environment: homologues series in soils and recent marine sediments. *Geochimica Cosmochimica Acta*. 39: 1303-1314.

Zerbini, A.N., Andriolo, A., Heide-Jørgensen, M.P., Pizzorno, J.L., Maia, Y.G., VanBaricom, G.R., DeMasters, D.P., Simões-Lopes, P.C., Moreira, S. and Bethlam, C. 2006. Satellite-monitored movements of humpback whales *Megaptera novaeangliae* in the South-west Atlantic Ocean. *Marine Ecology Progress Series*. 313: 295-304.

Zerbini, A.N., Adams, G., Best, J., Clapham, P.J., Jackson, J.A. and Punt, A.E. 2019. Assessing the recovery of an Antarctic predator from historical exploitation. *Royal Society Open Science*. 6: 190368.

Zhou, Z., Li, X., Chen, L., Li, B., Wang, C., Guo, J., Shi, P., Yang, L., Liu, B and Song, B. 2019. Effects of diesel oil spill on macrobenthic assemblages at the intertidal zone: A mesocosm experiment *in situ*. *Marine Environmental Research*. 152: 104823.

Zimmer, W.M.X., Harwood, J., Tyack, P.L., Johnson, M.P. and Madsen, P.T. 2008. Passive acoustic detection of deep-diving beaked whales. *Journal of the Acoustical Society of America*. 124: 2823-2832.

Zyrjanov, V.N. and Severov, D.N. 1979. Water circulation in the Falkland Patagonian region and its seasonal variability. *Okeanologiya*. 29: 782-790.

APPENDIX 1 INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE (IUCN) THREAT CATEGORIES

The IUCN (2024) Red List Categories and Criteria are a widely understood system for classifying species at risk of global extinction. The criteria can be applied to any taxonomic unit at or below the species level (known as a 'taxon'). A listing in a higher extinction risk category (see Figure 1) implies a higher expectation of extinction, and over the time-frames specified more taxa listed in a higher category are expected to go extinct than those in a lower one.

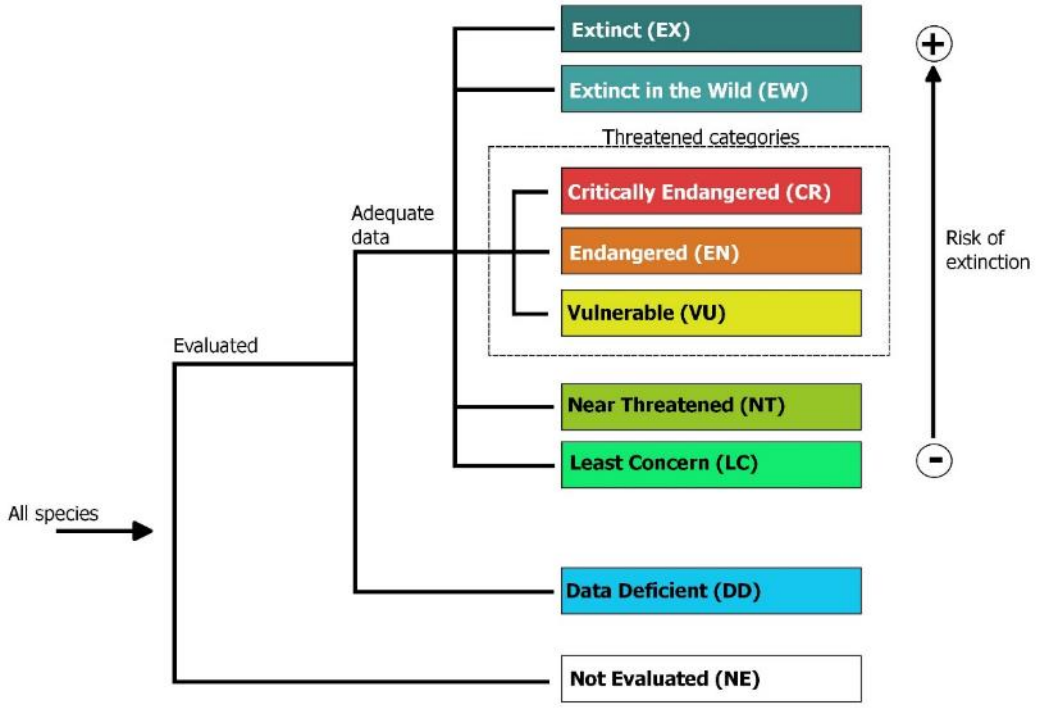


Figure 1: The relationship between the IUCN Red List Categories

A1.1 IUCN Categories

A1.1.1 Extinct (EX)

A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times, throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

A1.1.2 Extinct in the Wild (EW)

A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalised population well outside the historic range.

A1.1.3 Critically Endangered (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (Section 1.2), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

A1.1.4 Endangered (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (Section 1.2), and it is therefore considered to be facing a very high risk of extinction in the wild.

A1.1.5 Vulnerable (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (Section 1.2), and it is therefore considered to be facing a high risk of extinction in the wild.

A1.1.6 Near Threatened (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

A1.1.7 Least Concern (LC)

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

A1.1.8 Data Deficient (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.

A1.1.9 Not Evaluated (NE)

A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

A1.2 IUCN threat criteria for Critically Endangered, Endangered and Vulnerable taxa

A taxon is assigned to a particular threat category if it meets one or more of the criteria associated with that category. The criteria for each threat category are based on the following:

- Reduction in population size over a set time period or three generations,
- Geographical range,
- Overall population size, and
- Quantitative analysis of the probability of extinction in the wild.

Further details concerning the criteria and how they relate to each of the threatened categories can be found on the IUCN website (https://www.iucnredlist.org/resources/summary-sheet).

A1.3 Falkland Islands species and their IUCN status

The species of bird and marine mammal mentioned in the Environmental Impact Statement (EIS) are listed in Tables A1.1 and A1.2 respectively. The species codes refer to those used in Chapter 7 of the EIS. The IUCN status for each species was correct as of October 2024.

Table A1-1: Bird species mentioned in the ES text with current IUCN status

Species code	Common name	Scientific name	IUCN status October 2024
AF	Antarctic fulmar	*Fulmarus glacialoides*	LC
AS	Antarctic skua	*Catharacta antarctica*	LC
AtP	Atlantic petrel	*Pterodroma incerta*	EN
BBSP	Black-bellied storm-petrel	*Fregetta tropica*	LC
BBA	Black-browed albatross	*Thalassarche melanophris*	LC
	Black-chinned siskin	*Spinus barbatus*	LC
	Blackish oystercatcher	*Haematopus ater*	LC
	Black-throated finch	*Melanodera melanodera*	LC
BP	Blue petrel	*Halobaena caerulea*	LC
BHG	Brown-hooded gull	*Larus maculipennis*	LC
CP	Cape petrel	*Daption capense*	LC
	Chiloe wigeon	*Mareca sibilatrix*	LC
CW	Cobb's wren	*Troglodytes cobbi*	LC
	Crested caracara	*Caracara plancus*	LC
	Dark-crowned night heron	*Nycticorax nycticorax*	LC
	Dark-faced ground-tyrant	*Muscisaxicola maclovianus*	LC
Dio Alb	Diomedea albatross species	*Diomedea* spp.	EN
DP	Diving-petrel species	*Pelecanoides* spp.	LC
DG	Dolphin gull	*Larus scoresbii*	LC
	Falkland pipit	*Anthus correndera*	LC
FSD	Falkland steamer duck	*Tachyeres brachypterus*	LC
	Falklands thrush	*Turdus falcklandii*	LC
GP	Gentoo penguin	*Pygoscelis papua*	LC
GPsp	Giant petrel species	*Macronectes* spp.	LC
	Grass wren	*Cistothorus platensis*	LC
GS	Great shearwater	*Ardenna gravis*	LC
GrP	Grey petrel	*Procellaria cinerea*	NT
GBSP	Grey-backed storm-petrel	*Garrodia nereis*	LC
GHA	Grey-headed albatross	*Thalassarche chrysostoma*	EN
	House sparrow	*Passer domesticus*	LC
IS	Imperial shag	*Leucocarbo atriceps*	LC
Kgo	Kelp goose	*Chloephaga hybrida*	LC
KG	Kelp gull	*Larus dominicanus*	LC
KeP	Kerguelen petrel	*Aphrodroma brevirostris*	LC
KP	King penguin	*Aptenodytes patagonicus*	LC
	Least seed snipe	*Thinocorus rumicivorus*	LC
LMSA	Light-mantled sooty albatross	*Phoebetria palpebrata*	NT
LS	Little shearwater	*Puffinus assimilis*	LC
	Long-tailed meadow lark	*Sturnella loyca*	LC

Species code	Common name	Scientific name	IUCN status October 2024
LTS	Long-tailed skua	*Stercorarius longicaudus*	LC
MDP	Magellan diving-petrel	*Pelecanoides magellani*	LC
	Magellanic oystercatcher	*Haematopus leucopodus*	LC
MP	Magellanic penguin	*Spheniscus magellanicus*	LC
	Magellanic snipe	*Gallinago magellanica*	LC
NGP	Northern giant petrel	*Macronectes halli*	LC
NRA	Northern royal albatross	*Diomedea sanfordi*	EN
PCD	Patagonian crested duck	*Lophonetta specularioides*	LC
	Peregrine falcon	*Falco peregrinus*	LC
Pr	Prion species	*Pachyptila* spp.	LC
	Red-backed hawk	*Buteo polyosoma*	LC
RS	Rock shag	*Leucocarbo magellanicus*	LC
R/M	Rockhopper / macaroni penguin	*Eudyptes* spp.	VU
RP	Rockhopper penguin	*Eudyptes chrysocome*	VU
	Ruddy-headed goose	*Chloephaga rubidiceps*	LC
	Rufous-chested dotterel	*Charadrius modestus*	LC
	Sanderling	*Calidris alba*	LC
	Sheathbill	*Chionis albus*	LC
	Silver teal	*Anas versicolor*	LC
SPP	Soft-plumaged petrel	*Pterodroma mollis*	LC
SS	Sooty shearwater	*Ardenna grisea*	NT
SAT	South American tern	*Sterna hirundinacea*	LC
SGP	Southern giant petrel	*Macronectes giganteus*	LC
SRA	Southern royal albatross	*Diomedea epomophora*	VU
	Speckled teal	*Anas flavirostris*	LC
	Turkey vulture	*Cathartes aura*	LC
TB	Tussac bird (blackish cinclodes)	*Cinclodes antarcticus*	NT
	Two-banded plover	*Charadrius falklandicus*	LC
	Upland goose	*Chloephaga picta*	LC
WA	Wandering albatross	*Diomedea exulans*	VU
WCP	White-chinned petrel	*Procellaria aequinoctialis*	VU
	White-rumped sandpiper	*Calidris fuscicollis*	LC
	White-tufted grebe	*Rollandia rolland*	LC
WP	Wilson's storm-petrel	*Oceanites oceanicus*	LC
	Yellow-billed pintail	*Anas georgica*	LC

Table A1-2: Marine mammal species mentioned in the ES text with current IUCN status

Common name	Scientific name	IUCN status October 2024
Cetaceans		
Antarctic minke whale	*Balaenoptera bonaerensis*	NT
Blue whale	*Balaenoptera musculus*	EN
Commerson's dolphin	*Cephalorhynchus commersonii*	LC
Dusky dolphin	*Lagenorhynchus obscurus*	LC
Fin whale	*Balaenoptera physalus*	VU
Hourglass dolphin	*Lagenorhynchus cruciger*	LC
Humpback whale	*Megaptera novaeangliae*	LC

Common name	Scientific name	IUCN status October 2024
Killer whale	*Orcinus orca*	DD
Long-finned pilot whale	*Globicephala melas*	LC
Peale's dolphin	*Lagenorhynchus australis*	LC
Sei whale	*Balaenoptera borealis*	EN
Southern bottlenose whale	*Hyperoodon planifrons*	LC
Southern right whale	*Eubalaena australis*	LC
Southern right whale dolphin	*Lissodelphis peronii*	LC
Sperm whale	*Physeter macrocephalus*	VU
Pinnipeds		
Southern elephant seal	*Mirounga leonina*	LC
Leopard seal	*Hydrurga leptonyx*	LC
Ross seal	*Ommatophoca rossii*	LC
South American fur seal	*Arctocephalus australis*	LC
Antarctic fur seal	*Arctocephalus gazella*	LC
South American sea lion	*Otaria flavescens*	LC

APPENDIX 2 COMPLIANCE EVALUATION AGAINST SCHEDULE 4

Table A2-1 cross references the Requirements of the Offshore Minerals (Amendment) Ordinance 2011 Schedule 4 with the Offshore component of The Sea Lion Field Northern Area Development, Phase 1 & 2.

Table A2-1: Schedule 4 requirements and the Phase 1 & 2 Development

Offshore Minerals (Amendment) Ordinance 2011		Notes	Location of information within the EIS
Schedule 4			
Sub-Para	Requirement		Chapter / Section[101]
Paragraph 2: Project Description			
1	Description of the project to which the EIS relates	An overview of the project is provided in the NTS (Chapter 1) and in the main EIS Introduction (Chapter 2). A similar summary of the project, followed by full details are provided in the Development Description (Chapter 5). Further presentation of project details is provided in each Impact and Risk assessment Chapter where it is considered necessary for quantification.	Chapter 1 Chapter 2 Chapter 5
2	Detail on location, design and size	• Detail on the location of the Sea Lion Drill Centres (DCs) is provided in Section 5.4.1 and Section 5.8 of the Development Description and detail on the number of wells and drilling design is in Sections 5.4.4 and 5.4.5 respectively. • The location of the FPSO is in Section 5.5.4 and the design of the unit is described in Section 5.8.2 to Section 5.8.6. • Detail on the location and scale of inshore operations is provided in Section 5.5. Detail on the crude oil export facilities and process is provided in Section 5.10. • Detail on the onshore base facilities is provided in Section 5.11.1.	Section 5.4.1 Section 5.4.4 Section 5.4.5 Section 5.5.4 Section 5.8.2 Section 5.8.3 Section 5.8.4 Section 5.8.5 Section 5.8.6 Section 5.5 Section 5.10 Section 5.11.1
4a	Land and seabed use requirements during the operational phase	**Detail on the equipment on the seabed is provided in:** • MODU anchors – Section 5.4.3.1. • FPSO anchors – Section 5.5.2. • Subsea production systems – Section 5.5.3. • Inshore anchorage – Section 5.5.1. • The location of the existing Temporary Dock Facility (TDF) is provided in Section 5.11.1.1.1.	Section 5.4.3.1 Section 5.5.2 Section 5.5.3 Section 5.5.1 Section 5.11.1.1.1 Section 5.11.1.1.2 Section 5.11.4.1.1

[101] Please note that the 'X's are intended as wildcards where numerous sections within the document are being referred to e.g., 10.1.4, and 10.5.4 etc.

Offshore Minerals (Amendment) Ordinance 2011 Schedule 4		Notes	Location of information within the EIS
Sub-Para	Requirement		Chapter / Section[101]
		• The land use requirements with regard to the proposed and anticipated dimensions of the onshore supply base are described in Section 5.11.1.2. • The potential for development of temporary accommodation units is described in Section 5.11.4.1.1. Land use with regard to the forecasted use of roads is estimated in Section 11.7.4.4. • The area of seabed likely to be used offshore for the DCs, all flowlines, and the MODU/FPSO moorings, as well as the seabed used in Berkeley Sound for the LTV anchorage is quantified in the Disturbance to the Seabed Chapter 10.3.4.3. • The area of seabed that may be 'used' by discharged drill cuttings is quantified in Section 10.6.4.3.4.1. The fact that land may be used around the coast in the event of an oil spill necessitating the development of lined storage space for oil spill wastes, is described in Section 10.10.2.2.3. **Acknowledged uncertainties:** • The area (and location) of the temporary accommodation units is as yet unknown. It is not possible to credibly estimate the area of land that may be required for the temporary storage of oil spill waste.	Section 11.7.4.4 Section 10.3.4.3 Section 10.6.4.3.4.1 Section 10.10.2.2.3
4b	The nature and quantity of materials used	**Detail on the chemicals that may be required for the:** • Drilling mud are provided in Section 5.4.5.3. • Cement is provided in Section 5.4.6.2. • Drilling chemical use and discharge in Section 5.4.6. • Production operations are provided in Section 5.9.1. • Detail on the potential for the use of explosives is described in Section 5.4.7. • Detail on the need for diesel is provided in Sections 5.8.2.3 (fuel combustion equipment) and 5.8.3.3. • Detail on the volumes of associated gas that may be used as fuel gas is provided in Section 5.8.4.3. • Detail on the assumption made with regard to fuel use are provided in Section 10.9.4.4.1 • Detail on the diesel and fuel gas consumption rates is provided in Section 10.9.4.4.2. **Use of 'materials' in terms of finite local resources:** **Detail on the need for the use of finite 'materials' is provided in the Development Description Chapter as follows:**	Section 5.4.5.3 Section 5.4.6.2 Section 5.4.6 Section 5.9.1 Section 5.4.7 Sections 5.8.2.3 Section 5.8.3.3 Section 5.8.4.3 Section 10.9.4.4.1 Section 10.9.4.4.2

Offshore Minerals (Amendment) Ordinance 2011 Schedule 4		Notes	Location of information within the EIS
Sub-Para	Requirement		Chapter / Section[101]
		• Accommodation: Section 5.11.4.1. • Water: Section 5.11.4.2. • Electricity: Section 5.11.4.3. • Potential for use of commercial flights: Section 5.11.3.1.1 **Quantification of the use of finite materials in provided in the following Impact and Risk Assessment Chapters:** • Accommodation: Section 11.3.4.2 (in terms of whether existing accommodation is sufficient to meet Navitas requirements). • Water: Section 11.4.4.2.3. • Electricity: Section 11.5.4.2. • Use of airlinks: Section 11.6.4.1. • Use of roads: Section 11.7.4.4. **Acknowledged uncertainties:** • It is acknowledged that the current baseline of water and power availability in the Falklands may change depending upon future developments. • Potential for use of commercial flights: Section 5.11.3.1.1.	Section 5.11.4.1 Section 5.11.4.2 Section 5.11.4.3 Section 5.11.3.1 Section 11.3.4.2 Section 5.11.3.1.1 Section 11.4.4.2.3 Section 11.5.4.2 Section 11.6.4.1 Section 11.7.4.4
4c	Estimation of the type and quantity of residues and emissions resulting from the operation of the project:	• The type and quantity of residues / emissions and other outputs is quantified within the 'Characterisation and Quantification of the Nature of the Impact / Risk' section in each Impact / Risk Chapter. However, they are also summarised in Section 5.14 of the Development Description. **Acknowledged uncertainties / data gaps:** • When forecasting the outputs from the project that may impact upon the environmental and social receptors, it is acknowledged that these are predictions and a precautionary approach is taken throughout the assessment to ensure that the maximum credible residue or emission is assumed. The use of a precautionary approach is described, as necessary, in each chapter, and a final confidence rating is assigned within Section X.X.10 of each Impact / Risk Assessment Chapter.	Sections X.X.4[1] in Chapters 10, 11 and 12 Section 5.15 Sections X.X.10 in Chapters 10, 11 and 12

Offshore Minerals (Amendment) Ordinance 2011 Schedule 4		Notes	Location of information within the EIS
Sub-Para	Requirement		Chapter / Section[101]
4c	Water quality	**The residues that may impact upon water quality are detailed within the characterisation and quantification sections of the:** • Drilling muds and cuttings Chapter, Section 10.6.4.1.3 (mud composition) and Section 10.6.4.3 (dispersion modelling). • Operational Discharges Chapter, Section 10.7.4.1 (regarding composition of discharges) and Section 10.7.4.5 (dispersion modelling). • Thermal discharges Chapter, Section 10.8.4.3.3. • Atmospheric Emissions Chapter, Section 10.9.4.2 (with regard to Impacts of CO_2 on ocean acidification and acid deposition). **The residues to water that may result from oil spills are estimated in the Characterisation and Quantification sections of the:** • Oil spill offshore Chapter, Section 12.1.4.3 (oil spill modelling regarding spill volumes and trajectories). • Oil spill inshore Chapter, Section 12.2.4.3 (oil spill modelling regarding spill volumes and trajectories). • Oil spill at-shore Chapter, Section 12.3.4.1 (regarding the types of fluids that may be spilled).	Section 10.6.4.1.3 Section 10.6.4.3 Section 10.7.4.1 Section 10.7.4.5 Section 10.8.4.3.3 Section 10.9.4.2 Section 12.1.4.3 Section 12.2.4.3 Section 12.3.4.1
	Air quality	**The emissions that may Impact upon the global climate are detailed within the Characterisation and Quantification sections of the:** • Atmospheric emissions Chapter, Section 10.9.4.4 (regarding forecast emissions).	Section 10.9.4.4
	Soil quality	**The residues and emissions that may impact upon soil quality and the global climate are detailed within the Characterisation and Quantification sections of the:** • Atmospheric emissions Chapter, Section 10.9.4.5 (with regard to acid deposition).	Section 10.9.4.4.6
	Noise	**The noise emissions are detailed within the Characterisation and Quantification sections of the:** • Disturbance to wildlife from helicopter noise Chapter, Section 10.2.4.2 (regarding estimated helicopter noise exposure). • Underwater noise offshore Chapter, Section 10.4.4.4 (noise modelling). • Under water noise inshore Chapter, Section 10.5.4.4 (noise modelling).	Section 10.2.4.2 Section 10.4.4.5 Section 10.5.4.4 Section 11.9.4.3 Section 11.9.4.4

Offshore Minerals (Amendment) Ordinance 2011 Schedule 4		Notes	Location of information within the EIS
Sub-Para	**Requirement**		**Chapter / Section[101]**
		• Disturbance to human population from helicopters and noise Chapter, Section 11.9.4.3 (regarding estimated helicopter noise exposure) and Section 11.9.4.4 (regarding exposure to other noise sources).	
	Light	**The emissions of artificial light are detailed within the Characterisation and Quantification sections of the:** • Artificial light Chapter, Section 10.1.4.1 (regarding light levels). Disturbance to human population from light Chapter, Section 11.8.4.2 (regarding light levels).	Section 10.1.4.1 Section 11.8.4.2
	Waste	• **The residues and emissions associated with waste are detailed within the Characterisation and Quantification sections of the:** Waste Chapter, Section 10.10.4.4 (regarding waste estimates).	Section 10.10.4.4
Paragraph 2: Measures to protect the environment			
(2a,b,c)	Information on mitigation measures to eliminate or reduce, remedy or offset environmental Impacts to/from:	Information on the mitigation hierarchy and the types of mitigations that are applied within the EIA are described in Section 8.7 of the EIA methodology Chapter. The mitigations that are built-in to the basis of the project design (i.e., the base-case mitigations) in order to minimise or eliminate residue or emission outputs (thus reducing impacts) are described throughout the Development Description and summarised in Section 5.13. **Note:** where it was deemed appropriate, the base-case mitigations are re-iterated in the relevant Chapter as they reduce the forecasted residue / emission / output. The industry-standard mitigations, and the project-specific mitigations (which are applied where necessary), are itemised within each Impact / Risk Assessment Chapter, as itemised below. With regard to offsetting measures specifically, these are described in Section 8.11 and noted throughout the assessment chapters in Sections X.X.11.	Section 8.7 Section 5.13 Section 8.11 Section X.X.11 in Chapters 10, 11 and 12
	Water quality	**The industry-standard and project-specific mitigations that apply to Impacts on water quality are described in the following:** • Drilling muds and cuttings Chapter, Section 10.6.5 & Section 10.6.7. • Operational Discharges Chapter, Section 10.7.5 & Section 10.7.7. • Thermal discharges Chapter, Section 10.8.5 & Section 10.8.7.	Sections 10.6.5 & 10.6.7 Sections 10.7.5 & 10.7.7 Sections 10.8.5 & 10.8.7 Sections 10.9.5 & 10.9.7 Sections 12.1.5 & 12.2.7

Offshore Minerals (Amendment) Ordinance 2011 Schedule 4		Notes	Location of information within the EIS
Sub-Para	Requirement		Chapter / Section[101]
		• Atmospheric Emissions Chapter, Section 10.9.5 & Section 10.9.7 (with regard to reducing emissions to lessen the impacts on ocean acidification). • Oil spill offshore Chapter, Section 12.1.5 & Section 12.1.7. • Oil spill inshore Chapter, Section 12.2.5 & Section 12.2.7. • Oil spill at-shore Chapter, Section 12.3.5 & Section 12.3.7.	Sections 12.2.5 & 12.2.7 Sections 12.3.5 & 12.3.7
	Air quality	**The industry-standard and project-specific mitigations that apply to Impacts on air quality and global emissions are described in the following:** • Atmospheric Emissions Chapter, Section 10.9.5 & Section 10.9.7.	Sections 10.9.5 & 10.9.7
	Soil quality	**The industry-standard and project-specific mitigations that apply to Impacts on soil / sediment (including seabed) quality are described in the following:** • Drilling Mud and Cuttings Chapter, Section 10.6.5 & Section 10.6.7. • Atmospheric emissions Chapter, Section 10.9.5 & Section 10.9.7 (with regard to reducing emissions to lessen the impacts of acid deposition).	Sections 10.6.5 & 10.6.7 Sections 10.9.5 & 10.9.7
	Noise	**The industry-standard and project-specific mitigations that apply to noise generation are described in the following:** • Disturbance to wildlife from helicopter noise Chapter, Section 10.2.5 & Section 10.2.7. • Underwater noise offshore Chapter, Section 10.4.5 & Section 10.4.7. • Under water noise inshore Chapter, Section 10.5.5 & Section 10.5.7. • Disturbance to human population from helicopters and noise Chapter, Section 11.9.5 & Section 11.9.7.	Sections 10.2.5 & 10.2.7 Sections 10.4.5 & 10.4.7 Sections 0 & 10.5.7 Sections 11.9.5 & 11.9.7
	Light	**The industry-standard and project-specific mitigations that apply to light generation are described in the following:** • Artificial light Chapter, Section 10.1.5 & Section 10.1.7. • Disturbance to human population from light Chapter, Section 11.8.5 & Section 11.8.7.	Sections 10.1.5 & 10.1.7 Sections 11.8.5 & 11.8.7
	Waste	**The industry-standard and project-specific mitigations that apply to waste generation are described in the following:** • Waste Chapter, Section 10.10.5 & Section 10.10.7.	Sections 10.10.5 & 10.10.7
Paragraph 3: Requirement for data			

Offshore Minerals (Amendment) Ordinance 2011 Schedule 4		Notes	Location of information within the EIS
Sub-Para	Requirement		Chapter / Section[101]
		As explained in Section 2.5.1, (Table 8) each Impact / Risk Assessment Chapter draws on (and references) data from the: • Development Description (Chapter 5) to enable quantification / estimation of residues, emissions and other outputs associated with the project activities. • Subject-matter literature reviews used to ensure understanding of the nature of the impact. Environmental Baseline Chapter (Chapter 7) to enable understanding of the nature of the impact when assessing the 'sensitivity of the receptor' and the 'severity of effect' in the Falklands Islands specifically. **Acknowledged uncertainties / Data Gaps:** • Known uncertainties in the project design are listed in Section 2.2.4 and where these exist, the credible worst-case is always assumed to ensure that impact assessments are of the highest level of residue / emission / other outputs. • Uncertainties within the project design are expounded upon further in the Development Description (Chapter 5). • Uncertainties within the literature are discussed within the Characterising and Quantification Sections of each Impact / Risk Assessment Chapter. • Known data gaps within the Environmental Baseline are identified in Section 7.2.4. • A precautionary approach is taken throughout each Impact / Risk Assessment and the overall Confidence in the data used for each assessment is assigned a score in Section X.X.10 of each Impact / Risk Chapter.	Sections 2.5.1 Chapter 5 Chapter 7 Section 2.2.4 Section 7.2.42.2.4 Section X.X.10 in Chapters 10, 11 and 12
	Water	**The data and background information required to identify and assess the impacts on water quality is provided in:** • Drilling muds and cuttings Chapter, Section 10.6.4. • Operational Discharges Chapter, Section 10.7.4. • Thermal discharges Chapter, Section 10.8.4. • Atmospheric Emissions Chapter, Section 10.9.4 (with regard to Impacts on ocean acidification). • Oil spill offshore Chapter, Section 12.1.4. • Oil spill inshore Chapter, Section 12.2.4. • Oil spill at-shore Chapter, Section 12.3.4.	Section 10.6.4 Section 10.7.4 Section □ Section 10.9.4 Section 12.1.4 Section 12.2.4 Section 12.3.4

Offshore Minerals (Amendment) Ordinance 2011 Schedule 4		Notes	Location of information within the EIS
Sub-Para	Requirement		Chapter / Section[101]
	Air quality	**The data and background information required to identify and assess the impacts on air quality and global emissions is provided in:** • Atmospheric emissions Chapter, Section 10.9.4.	Section 10.9.4
	Soil quality	**The data and background information required to identify and assess the impacts on soil / sediment (including seabed) quality is provided in:** • Drilling Mud and Cuttings Chapter, Section 10.6.4. • Atmospheric Emissions Chapter, Section 10.9.4 (with regard to quantifying acid deposition).	Section 10.6.4 Section 10.9.4
	Noise	**The data and background information required to identify and assess the impacts of noise generation is provided in:** • Disturbance to wildlife from helicopter noise Chapter, Section 10.2.4. • Underwater noise offshore Chapter, Section 10.4.4. • Under water noise inshore Chapter, Section 10.5.4. • Disturbance to human population from helicopters and noise Chapter, Section 11.9.4.	Section 10.2.4 Section 10.4.4 Section 10.5.4 Section 11.9.4
	Light	**The data and background information required to identify and assess the impacts of light generation is provided in**: • Artificial Light Chapter, Section 10.1.4. • Disturbance to human population from light Chapter, Section 11.8.4.	Section 10.1.4 Section 11.8.4
	Waste	**The data and background information required to identify and assess the impacts of waste generation is provided in:** • Waste Chapter, Section 10.10.4.	Section 10.10.4
Paragraph 4 :Environmental effects			
2	Description of the specific aspects of the environment likely to be significantly	**The following chapters demonstrate how the environment effects were identified and estimated:** • The EIA Methodology Chapter 8. • The Identification of Environmental Aspect and Impact Identification' and Screening which provides the outputs of the ENVIID workshop in Chapter 9. • The Environmental Baseline (Chapter 7) which describes the environmental and social aspects of the environment which may be affected.	Chapter 8 Chapter 9 Chapter 7 Section X.X.6 in Chapters 10, 11 and 12

Offshore Minerals (Amendment) Ordinance 2011 Schedule 4		Notes	Location of information within the EIS
Sub-Para	Requirement		Chapter / Section[101]
	affected by the project	• The impact and risk assessments of each activity are described in Section X.X.6 of each assessment. **Acknowledged data gaps:** • It is recognised that data gaps still exist with regard to the baseline. These are acknowledged in Section 7.2.4, throughout the Impact / Risk Assessment Chapters in the Characterising and Quantifying sections (X.X.4) and in the Confidence section (X.X.10).	Section 7.2.4 Section X.X.4 in Chapters 10, 11 and 12 Section X.X.10 in Chapters 10, 11 and 12
2a	Human population	The social baseline is described in Section 7.7 of the Environmental baseline with the human population described specifically in Section 7.7.2.	Section 7.6.4 Section 7.7.2
2b	Flora	• Phytoplankton are described in Section 7.4.1.2 of the Environmental Baseline Chapter. • Marine and intertidal vegetation are described in Section 7.4.2. • Flora are also covered in the description of 'Threatened Terrestrial Habitats' in Section 7.5.3. • Protected terrestrial plant species are described in Section 7.5.1.5. • Important Plants Areas are described in Section 7.5.2.3.2. • Terrestrial Habitats surrounding Berkeley Sound in Section 7.5.2.4.	Section 7.4.1.2 Section 7.4.2 Section 7.5.3 Section 7.5.1.5 Section 7.5.2.4 Section 7.5.2.3.5
2c	Fauna	**Fauna are described in:** • Section 7.4.3 Benthic Environmental. • Section 7.4.4 Fish and Invertebrate Ecology. • Section 7.4.5 Seabirds and Seabird vulnerability. • Section 7.4.6 Marine mammals. **The conservation status of fauna is described in:** • Section 7.5.1.1 Benthic species. • Section 7.5.1.2 Fish species. • Section 7.5.1.3 Seabird species. • Section 7.5.1.4 Marine mammal species.	Section 7.4.3 Section 7.4.4 Section 7.4.5 Section 7.4.6 Section 7.5.1.1 Section 7.5.1.2 Section 7.5.1.3 Section 7.5.1.4
2d	Soil (including seabed and its subsoil)	Seabed sediments are described in Section 7.3.7 of the Environmental Baseline.	Section 7.3.7

Offshore Minerals (Amendment) Ordinance 2011		Notes	Location of information within the EIS
Schedule 4			
Sub-Para	Requirement		Chapter / Section[101]
2e	Water (including the sea)	• Water movements are described in Section 7.3.3 of the Environmental Baseline. • Details on background salinity is described in Section 10.7.4.1.5.	Section 7.3.3 Section 10.7.4.1.5
2f	Air	The global atmosphere is described in Section 7.3.1 of the Environmental Baseline. General detail on the meteorology of the area (wind speed, air temperature etc.) is provided in Section 7.3.2 of the Environmental Baseline.	Section 7.3.1 Section 7.3.2
(2g)	Climatic factors	The global atmosphere is described in Section 7.3.1 of the Environmental Baseline.	Section 7.3.1
(2h)	Landscape and seascape	Scenery, wildlife and tourism are described in Section 7.7.4.6 of the Environmental Baseline.	Section 7.7.4.6
(2i)	Tangible property	Tangible property is described in Section 7.7.4 of the Environmental Baseline.	Section 7.7.4
(2j)	Architectural and archaeological heritage	Architectural and archaeological heritage is described in Section 7.7.6 of the Environmental Baseline.	Section 7.7.6
(2k)	Interactions between these factors in any combination	• While impact interactions are touched upon in the relevant Impact / Risk Assessment Chapters, Chapter 13. provides a summary of all the varying interactions that may occur. • Cumulative impacts are described within each assessment chapter in X.X.9 of each assessment chapter.	Chapter 13 X.X.9 in Chapters 10, 11 and 12
3	Description of the likely significant effects on the environment arising from:	**As explained in Section 2.4.1, (Table 8) each Impact / Risk Assessment Chapter has a specific section which draws upon all the data provided in the Chapter thus far to:** • Assess the initial Impact and / or the Risk which is in Section X.X.6. • Assess the residual Impact and / or the Risk which is in Section X.X.8. • Assess the cumulative Impacts in Section X.X.9.	X.X.6, X.X.8 and X.X.9 in Chapters 10, 11 and 12
(3a)	The existence of the project	The NTS (Chapter 1) provides a user-friendly overview of the project and the associated impacts and risks There is not a single Chapter which impact assesses the existence of the project as the entire EIS aims to do this. However, Chapter 14 provides an overall summary of the EIS findings and details the significance of the Impacts / Risks and the confidence in the assessment.	Chapter 1 Chapter 14
(3b)	The use of natural resources	**The need for resource use is described in the Development Description as follows:** • Detail on the combustion equipment on the FPSO is provided in Section 5.8.2.3.	Section 5.8.2.3

Offshore Minerals (Amendment) Ordinance 2011 Schedule 4		Notes	Location of information within the EIS
Sub-Para	Requirement		Chapter / Section[101]
		• Detail on the need for diesel is provided in Section 5.8.3.3. • Detail on the need for freshwater (and seawater) is provided in Section 5.8.3.5. Detail on the use of seawater is provided in Section 5.8.4.2 on heating and cooling systems and Section 5.8.5.8 on Water reinjection facilities. • Detail on the expected consumption of fuels is provided in the Atmospheric Emissions Chapter, Section 10.9.4.4.2 which estimates the planned emissions. • Detail on the expected freshwater use is provided in Section 11.4.4.2.3 which forecasts Phase 1 & 2 water usage.	Section 5.8.3.3 Section 5.8.3.5 Section 5.8.4.2 Section 5.8.5.8 Section 5.8.4.2 Section 11.4.4.2.3
(3c)	The emission of pollutants	**The emission of pollutants to air are described in:** • Atmospheric emissions Chapter, Section 10.9.6, Section 10.9.8 and Section 10.9.9.	Section 10.9
(3d)	The creation of nuisances by the project	**The Impacts upon the human population from nuisance factors are described in:** • Chapter 11.8 on Disturbance to the human population from light, Section 11.8.6 & Section 11.8.8 & Section 11.8.9. • Chapter 11.9 on Disturbance to the human population from helicopters and noise Section 11.9.6, Section 11.9.8 & Section 11.9.9.	Section 11.8 Section 11.9
(3e)	The elimination of waste	The Impacts of waste management in accordance with the waste hierarchy is described in: Chapter 10.10 on Waste Management, Section 10.10.6 & Section 10.10.8 & Section 10.10.9.	Sections 10.10.6, 10.10.8 & 10.10.9
Paragraph 5: Forecasting methods			
2	Details of the forecasting methods used to assess the effects of the project on the environment	**In order to carry out any Impact / Risk assessment, it is necessary to understand what the 'outputs' of the project may be e.g., how much CO_2, how much waste, noise etc. It is therefore necessary to forecast the data. Using data from the Development Description, and taking account of the base-case mitigations that are intended to reduce outputs, detail on the data quantification is provide in:** • Underwater noise offshore Chapter, Section 10.4.4.4. • Underwater noise inshore Chapter, Section 10.5.4.4. • Drill cuttings and mud Chapter, Section 10.6.4.3. • Discharges to Sea Chapter, Section 10.7.4.5.	Section 10.4.4.5 Section 10.5.4.4 Section 10.6.4.3 Section 10.7.4.5 Section 10.8.4.3.2 Section 10.9.4.4 Section 10.10.4.4 Section 10.11.4.4

Offshore Minerals (Amendment) Ordinance 2011		Notes	Location of information within the EIS
Schedule 4			
Sub-Para	Requirement		Chapter / Section[101]
		• Thermal discharges to sea Chapter, Section 10.8.4.3.2. • Atmospheric Emissions Chapter, Section 10.9.4.4. • Waste Management Chapter, Section 10.10.4.4. • Marine mammals collisions Chapter, Section 10.11.4.4 (with regard to forecasted vessel behaviour). • Terrestrial invasive species Chapter, Section 10.13.4.2 (with regard to forecasted cargo delivery routes). • Disturbance to other users offshore Chapter, Section 11.1.4, and onshore Chapter, Section 11.2.4 (with regard to forecasting vessel behaviour and modelling of collision Risks).	Section 10.13.4.2 Section 11.1.4 Section 11.2.4
2	Details of the forecasting methods used to assess the effects of the project on the environment	• **Resource competition:** Accommodation Chapter, Section 11.3.4.2.1 (with regard to forecasted accommodation requirement and provision). • Resource competition: Fresh potable water Chapter, Section 11.4.4.2.3 (with regard to forecasted local water supply usage). • **Resource competition:** Use of Electricity Chapter, Section 11.5.4.2.2 (with regard to forecasted energy use). • **Resource competition:** Air-links Chapter, Section 11.6.4.1 (with regard to forecasted Phase 1 & 2 transportation requirements). • **Resource competition:** Use of Roads Chapter, Section 11.7.4.5 (with regard to forecasted Phase 1 & 2 road usage). • Disturbance to the human population from Light Chapter, Section 11.8.4.2.2 (with regard to forecasted location, number of light sources etc.). • Disturbance to the human population from helicopters and noise Chapter, Section 11.9.4.3 and Section 11.9.4.4 (with regard to forecasting noise levels). • Oil Spill offshore Chapter, Section 12.1.4.3 (oil spill modelling). • Oil Spill inshore Chapter, Section 12.2.4.4 (oil spill modelling). • Oil Spill at-shore Chapter, Section 12.3.4.1 (with regard to forecasting spill scenarios). **Acknowledged uncertainties:**	Section 11.3.4.2.1 Section 11.4.4.2.3 Section 11.5.4.2.2 Section 11.6.4.1 Section 11.7.4.5 Section 11.8.4.2.2 Section 11.9.4.3 Section 11.9.4.4 Section 12.1.4.3 Section 12.2.4.4 Section 12.3.4.1

Offshore Minerals (Amendment) Ordinance 2011 Schedule 4		Notes	Location of information within the EIS
Sub-Para	Requirement		Chapter / Section[101]
		• Where there was uncertainty regarding the project basis of design (e.g., the number of wells or duration of an activity), the worst-case forecast was used. Where different options had different impacts , both options were factored into the assessment.	
Paragraph 6: Remediation:			
	Description of the measures envisaged upon termination of the project to eliminate or reduce, remedy or offset environmental Impacts	The decommissioning of the project will be covered by a separate EIA, as described in Section 5.12. The need for remediation efforts will be determined based on the outcomes of monitoring. The detailed Navitas monitoring strategy was established during the Environmental Monitoring and Management Plan (EMMP) workshop. All monitoring requirements agreed by Navitas and FIG will be recorded and managed *via* the project-specific Phase 1 & 2 EMMP, an outline of which is included within the EIS in Chapter 15. Details on monitoring are also included within each assessment chapter in Section X.X.10.1.	Section 5.12 Chapter 15 Section X.X.10.1 in Chapters 10, 11 and 12
Paragraph 7: Alternatives			
	An outline of the main alternatives (if any) that were studied by the applicant and the reasons for their rejection / selection	A summary of the consideration of alternatives is provided in the NTS. Detail on the Consideration of Alternatives is provided in Chapter 4.	Chapter 1 Chapter 4
(7a)	An outline of any alternatives that were considered	An outline of alternatives that were considered is provided in Section 4.3.	Section 4.3

Offshore Minerals (Amendment) Ordinance 2011 Schedule 4		Notes	Location of information within the EIS
Sub-Para	Requirement		Chapter / Section[101]
(7b)	Indication of the main reason for the selected project design (taking into account the environmental effects)	**Indication for the main reasons that the proposed project design was selected is provided in:** • Section 4.3.2.1 for oil production. • Section 4.3.2.2 for oil export. • Please note the above describe the processes carried out by the previous operator and carried over by Navitas. • Further detail on the project optimisation by Navitas is provided in Section 4.4.	Section 4.3.2.1 Section 4.3.2.2 Section 4.4
8	Non-Technical Summary	The Non-Technical Summary is located in Chapter 1 and will also be available as a separate document.	Chapter 1
Paragraph 9: Difficulties encountered			
2	An indication of any difficulties (including technical difficulties and lack of know-how) encountered when compiling the required information	**The only difficulty encountered has related to data gaps in the environmental baseline and uncertainties with regard to the final project design:** • Wherever data gaps were encountered, efforts were made to address the gap. • Where this was not possible, a very precautionary approach was taken during the Impact / Risk Assessment and the worst-case was assumed with regard to the project-design. • The presence of data gaps is reflected in the overall confidence rating assigned to each assessment in Section X.X.10. Because a precautionary approach was taken throughout, and worst-case assumptions about emissions, residues and other outputs were used, it is possible that where the confidence is 'probable' or 'uncertain', the Impact / Risk may be lower than is estimated in this EIS. • As stated above, all monitoring requirements intended to validate the EIS, and fill existing data gaps, will be reported in the EMMP in Chapter 15.	Section 2.2.4 Section 7.2.4 Section X.X.10 in Chapters 10, 11 and 12 Chapter 15

APPENDIX 3 STATUTORY CONSULTATION REPRESENTATIONS AND RESPONSES

The FIG Offshore Minerals Ordinance (Section 3.1.7.3.1) requires that, following a compliance review against Schedule 4 of the Ordinance, every EIS undergoes a statutory 42-day consultation process. A record of the representations made during the consultation must be included within the final EIS, alongside responses from the Operator.

Two historical statutory consultations were carried out on various revisions of this EIS (under POEPL) and details on these are included within this Appendix for the sake of completeness.

Table A3-1 provides a summary of the representations made during the 2018 formal statutory and public consultation process on the EIS (Rev B03) which included inshore ship-to-ship transfer as the proposed oil export method (Chapter 4).

Table A3-2 provides a summary of the representations made during the 2020 formal statutory and public consultation process on the EIS (Rev B04) which was required following change of the oil export method from inshore transfer to direct offtake at the Sea Lion location (Chapter 4).

Note: for the sake of preserving the integrity of the comments, the chapter, section and page references in the tables below refer to those within the original documents to which they were responding (i.e., submissions B03 and B04 under POEPL). These may no longer match the chapter, section and page numbers in the current document.

Table A3-1: Summary of the representations made during the 2018 statutory consultation process on the POEPL EIS submission, Rev B03

Consultee	Representation	POEPL response	Amendments/further detail
OPRED Offshore Petroleum Regulator for Environment & Decommissioning			
OPRED 1	1. Areas of uncertainty Although there are number of uncertainties regarding the proposals at the EIS stage, OPRED do not believe they are material to the conclusions drawn for the offshore development proposals.	POEPL acknowledges and welcome the comments, which support the findings of the EIS. POEPL are happy that OPRED agree that uncertainties are not material and do not affect the validity of the assessment undertaken.	==
OPRED 2	2. Oil export options OPRED recognise that the base-case for oil export is the inshore transfer option, however the EIS also details the option of direct offload from the FPSO. Although OPRED would not object to either option, we would advise that the viability for the direct offload option should be explored further if this is considered in the future.	Direct offloading to the Purchaser's Conventional Trading Tanker (CTT) is the usual means to undertake export from an FPSO on a worldwide basis - this is the simplest and lowest cost option. The workability of this option however depends on the regularity of metocean conditions being below the operating limits associated with conventional trading tankers to reliably allow cargos to be offloaded. In harsh locations, higher operating metocean limits are necessary to achieve acceptable availability and this is achieved by using specialist Dynamically Positioned (DP) offshore loading tankers as is the case in the North Sea / UKCS. The remote nature of the Sea Lion location and the lack of operating experience in the prevailing met-ocean conditions mean that to guarantee a reliable offtake solution and enable sanction of the project, the base case for oil export needs to be on the basis of the use of DP specialist offshore loading tankers. Accurate knowledge of the met-ocean conditions is key to enabling direct offloading to a CTT and after over 2 years of met ocean data recording at Sea Lion, there is greater confidence that direct offloading to CTT may be viable. The FPSO offloading equipment will be specified to accommodate either of 2 types of offloading hose strings; approx. 120m for offloading to a bow loading tanker and approx. 320m floating hose for a conventional trading tanker. This capability will enable direct offload trials to be undertaken once operations have commenced. These sea trials will be conducted very early in	==

Consultee	Representation	POEPL response	Amendments/further detail
		field life once the FPSO is commissioned and if successful would result in POEPL seeking to amend the Base Case to direct offloading to a CTT. Further description of the process of developing Direct Offloading as an option is given in 'Additional Information' OPRED2.	
OPRED 3	3. Drilling operations OPRED note that POEPL propose to use Water-based Mud (WBM) for the drilling of the top-hole sections and Oil Based Muds (OBM) for the lower sections, which is standard UK practice. The batch sequencing of the sections will minimise the mud wastes as this method reduces the need for changes in the mud system. It is also noted that OBM contaminated cuttings will be processed through a thermo-mechanical cuttings cleaner and will be discharged with <1% dry weight on cuttings, which adheres to requirements of OSPAR Decision 2000/3. If the unit cannot be used, cuttings will be shipped to shore. The tophole sections of the proposed wells will be drilled using water-based mud and a suite of chemicals that are predominantly classed by OSPAR as PLONOR (Pose Little Or No Risk), and the overall impact on benthic fauna from the cumulative discharge of the drill cuttings is considered, as a precautionary conclusion, to be moderate.	POEPL acknowledges the comments which support the findings of the EIS.	==

Consultee	Representation	POEPL response	Amendments/further detail
	However, modelling indicates a comparatively small area of impact which will reduce significantly over a 5-year period and recolonisation is expected after 1-2 years (and the sensitivity of the receptor is considered to be low). OPRED would agree that the EIS assessment is precautionary.		
OPRED 4	4. Well testing As a base-case, no well tests are planned. However, there may be a necessity to undertake a maximum of 3 well tests at the MODU to confirm reservoir productivity. Well test volumes would exceed 5,000 tonnes of oil for each well and therefore would constitute an Extended Well Test under UK requirements. OPRED would consider this level to be excessive and would recommend that FIG should seek clarification of the quantity and proposed duration for each well test. We would further point out that, on the UKCS, it would be necessary to provide a detailed justification for any well test designed to flow in excess of 2,000 tonnes of oil or for any well test scheduled to continue for more than 96 hours. If any proposed well test exceeds those thresholds, it would therefore be appropriate to request a justification	Well test volumes have been re-evaluated by the POEPL subsurface team and it is now considered that flaring a total of 1,024 tonnes of hydrocarbons per well in a well test will satisfy the project requirements, with scope to perform such a test on two wells. A recalculation of the volumes is given in 'Well test'. The relevant EIS Section 5.4.9 would be re-worded as follows. 5.4.9 Initial well testing Well testing, to measure individual well flow rates, will be carried out throughout the life of the field as part of day to day operations (Section 5.8.5.7). A short flowback of two production wells to the MODU is being included in this assessment. In the base-case field development plan no flowbacks are planned, however provision is being requested, in case it is required nearer the time, to satisfy development criteria that may be requested by stakeholders. The flowbacks could be used to demonstrate repeatability of the original 14/10_5 well test, confirm well productivity and to prove the completion integrity. In the event that initial flow back to MODU on wells is deemed necessary then both gas and oil will be produced from the well to the temporary testing equipment on the MODU. There will be the need to flare both gas and oil due to the volumes that will be received for the test.	Text amended.

Consultee	Representation	POEPL response	Amendments/further detail
	and a more detailed emissions assessment to put the well test into some sort of environmental context, as it seems likely that the total emissions from the Islands are likely to be comparatively small. It would also have been beneficial if the EIS had provided some indication of any proposed best practice measures to minimise the impacts of the well tests.		
OPRED 5	5. Produced water OPRED notes that the monthly average of Oil in Water concentrations from produced water discharge will be below 30mg/l, which aligns with UK Regulations. It is also noted that the expected concentrations are 10-15mg/l, which is in line with current industry expectations.	POEPL acknowledges the comments which support the findings of the EIS.	==
OPRED 6	6. Operational chemicals As the chemicals will be compliant with the UK Offshore Chemical Notification Scheme (OCNS), OPRED can assume that the risk to the marine environment are unlikely to be significant. However, as the specific chemicals and dosages are yet to be confirmed, OPRED would advise that chemical risk assessments be undertaken prior to chemical usage.	POEPL acknowledges the comments which support the findings of the EIS. An assessment of risks from the discharge of the specific chemicals offshore would be undertaken prior to the relevant operations including drilling, installation and production. Chemicals would be selected from those on the UK Approved List that had undergone standard CEFAS testing for toxicity, biodegradation and persistence and chemicals with higher risks would be substituted with lower-risk chemicals with the required properties, as they became available.	==

Consultee	Representation	POEPL response	Amendments/further detail
OPRED 7	7. Decommissioning OPRED note that the development has been designed to enable full well abandonment and decommissioning, including subsea infrastructure unless a comparative assessment indicates a wholly or partially in-situ option is the best practicable option.	POEPL acknowledges the comments which support the findings of the EIS and note that while the design of the facilities has taken into account the ability to remove infrastructure at decommissioning, the detailed assessment of decommissioning impacts is outside the scope of the EIS in line with POEPL's discussions with FIG.	==
OPRED 8	8. Environmental baseline Overall, the EIS provided a comprehensive description of the environment and covered all of the salient issues. The level of environmental survey work undertaken provided an informed and contextual description of the development area which was very beneficial. It is also reassuring to note that through the Gap Analysis Programme further work will be undertaken to address data gaps at a regional level to aid the understanding of the Falkland Islands marine environment.	POEPL acknowledges the comments which support the findings of the EIS. Outputs from the Gap Analysis Programme will continue to be fed into the knowledge base that underpins the EIS and will feature in EMMP discussions as work proceeds.	==
OPRED 9	9. Noise assessment Whilst OPRED would agree with the conclusions of the assessment of underwater noise impacts (Section 10.4), OPRED found it difficult to correlate between the many sub-sections. Although there was mention of drilling noise as a non-pulsed source,	Underwater noise from the drilling rig was scoped out of the assessment as it is a relatively low level source of noise and noise levels are dominated by the piling and vessels that are included in the predictions and assessment. This is mentioned in the report referred to in the EIS (Genesis, 2015) and is corroborated by other documents e.g., measurements of a semi-submersible drilling rig (similar to that proposed for Sea Lion) by McCauley (1998) of 115 dB (rms) re 1µPa at 405m distance and the review published by BEIS "Genesis (2011) Review and Assessment of Underwater Sound Produced from Oil and Gas Sound Activities and Potential Reporting Requirements	==

Consultee	Representation	POEPL response	Amendments/further detail
	OPRED would question why a detailed assessment of vessel noise was undertaken but there wasn't a similar assessment for the drilling operations? In addition, although the EIS commits to undertaking operations with the use of the JNCC noise mitigation measures, we would advise that a further explanation of the mitigation measures should be provided and the precautionary principle followed given the species and number of cetaceans within the vicinity of the proposed development area. Within the EIS it is also stated that given the diving capability of marine mammals "…the JNCC advised soft-start and ADD devices may be a more effective mitigation than MMO's or PAM" (Section 10.4.6.1.3.1), and POEPL should therefore be asked to confirm the mitigation measures proposed for relevant noise producing operations.	under the Marine Strategy Framework Directive. Genesis Ref: J71656 Document No. J71656-Final Report –G2." The mitigation measures included in the JNCC Guideline referred to are summarised as follows: - A pre-start watches of up to 60 minutes to detect marine mammals surfacing within 500m (60 minutes is allowed for deeper diving species); - A delay of 20 minutes after the last sighting of a marine mammal within 500m; - A soft start to the piling that lasts 20 minutes; - A repeat of the pre-start watch and soft start when piling is stopped for a period greater than 10 minutes; - Reporting of activities and observations using the JNCC format. - Should piling be required to start in dark or foggy conditions such that visibility within the 500m zone is compromised, additional measures such as PAM will be deployed. The protocol, including whether ADDs are recommended in the light of the most recent data, will be agreed with FIG in consultation with its nature conservation advisors. This will be re-iterated in the update to the underwater noise predictions to be completed following submission of these responses.	
OPRED 10	10. Accidental pollution events OPRED is satisfied with the information provided within the EIS. Since the start of the EIS consultation period, POEPL has presented further information regarding the oil	POEPL acknowledges the comments which support the findings of the EIS.	==

Consultee	Representation	POEPL response	Amendments/further detail
	characteristics and the potential for a spill event to occur. The information provided concludes that the oil is heavy and has a significant wax content related to a high pour point and subsequently the reservoir requires additional pressure for flow to surface. A significant uncontrolled reservoir flow is therefore unlikely. Due to its characteristics, in the marine environment it would solidify almost immediately and no emulsification would occur. It has also been concluded that dispersants would be inefficient, but OPRED notes that POEPL are investigating other offshore clean-up solutions.		
Scottish Association for Marine Science (SAMS)			
SAMS1	Benthos 'B' 4.1.2 The B rating given above reflects the relative lack of information on benthic communities in the Sea Lion drilling area offshore. Less information is available for deep-water habitats in the Sea Lion drilling area, but this is to be expected given the remoteness of the location. This is reflected in the scoring of the Berkeley Sound area being an 'A', whilst the Sea Lion area is a 'B'.	POEPL acknowledges the comments which support the findings of the EIS. A significant survey effort was entered into prior to the most recent Exploration Wells campaign in order to set up a widespread baseline of the benthos that could be relied on for a long-term production project. 90 benthic stations were conducted over the licence block, far more than would normally be expected for an exploration well campaign. The benthic samples were processed by the Natural History Museum with many new taxa identified which have been given species codes and retained as voucher specimens for further work. On the basis of this survey, the GAP work developed online taxonomic tools for future surveys to ensure QA and QC controls. It has led to the identification of a large number of new species and is a step change in survey effort compared to previous campaigns.	Minor text changes.

Consultee	Representation	POEPL response	Amendments/further detail
SAMS2	Biosecurity 'A' Therefore, it is recommended that scrapes of biofouling present on artificial structures closely associated with the POEPL Sea Lion Development (e.g., Inshore Transfer Mooring Buoy) be included in the monitoring activities. Likewise a combination of panels deployed for short periods (6-12 weeks) and longer periods (annual inspection) will ensure that late succession species are included in the overall species list whilst ensuring sufficient frequency of monitoring.	POEPL acknowledges the comments which support the findings of the EIS. Monitoring of invasive species will continue *via* the EMMP building on the settlement plate work started by POEPL during the Exploration Wells campaign and suggestions for locations and methods can be discussed at the EMMP workshop in collaboration with FIFD and the wider management of Stanley Harbour, Port William and Berkeley Sound.	==
SAMS3	Fisheries, Fish and Plankton 'B' Although the report details the impacts of oil toxicity on fish/squid eggs, it is strongly recommended to look at a pathway to exposure for fish larvae and small squid as well. Fish eggs are likely to be more resistant to pollutants except for very small molecular chemicals. It is a dangerous assumption to take toxicity test results from eggs, and assume the results will be the same once the eggs have hatched. All the life stages need to be looked at, especially the early life stages.	POEPL acknowledges the comments which support the findings of the EIS.	==
SAMS4	Global Atmosphere 'A' No comments	POEPL acknowledges the comments which support the findings of the EIS.	==

Consultee	Representation	POEPL response	Amendments/further detail
SAMS5	Marine Flora 'A' Fig 73 (pg. 307) could be clearer, as it is difficult to tell between Macrocystis and open water due to the colours used to represent each.	POEPL acknowledges the comments. The map can be reproduced if required.	Open water and kelp are clearly different colours, however, there is very little Macrocystis in this image (small areas in the north east corner of the Cove). The image is in the document to illustrate the process of combining satellite images with on the ground surveys to produce the final habitat map. Magellan Cove was selected as an example and has little bearing on the overall assessment, in its own right. Therefore, we do not think there is any need to change the figure.
SAMS6	Marine Mammals 'D/C' Section 7.4.6. Marine mammals 4.6.7 There is reference to acoustic monitoring results summarized by Hipsey *et al.* (2013), but the specifics of data analysis (i.e., which call types, duty cycles, frequency range etc.), important information on ambient noise levels, and results for some species are either phrased very vaguely or missing from this section."	The JASCO report (Hipsey *et al.,* 2013) is available for review for further details. Some of the key points are given in 'Additional Information' SAMS6.	==
SAMS7	4.6.8 There are also some contradictions in this section. For example, while it is recognized that some species such as Antarctic minke whales were only described acoustically after Hipsey *et al.* (2013) was published, the report states that	The number of unidentified sounds was relatively small and an expert validation process was used by JASCO to ensure reasonable skill and care was applied. Other acoustic traits of Antarctic minke whale than their calls were	Text was amended to clarify the lack of sei and minke whales in the acoustic record.

Consultee	Representation	POEPL response	Amendments/further detail
	they were not detected. How could they have been detected if their calls were not known? It should rather be stated that the absence or presence of minke whales could not be established at the time of Hipsey *et al.*'s report was published. Similarly, with sei whales, they were not detected, but this could be due to a true absence or equally due to a lack of knowledge of call types. The language of the report could be more precise here.	used to identify their presence/absence so we believe the narrative is fair, but could be expanded to give more detail. For sei whales, JASCO (Hipsey *et al.,* (2013) reports: "The recordings did not contain any confirmed sei whale calls. Due to the potential overlap in calls from both species (e.g., Watkins 1981; Baumgartner *et al.,* 2008) and due to the absence of sei whale call description for the southern Atlantic, one cannot completely exclude that the Fin whale detection record included a few sei whale calls" Nevertheless, besides two sightings north of the Falkland Islands, all sei whale sightings during the JNCC surveys (White, *et al.,* 2002) occurred close to and south/west of the islands, which is consistent with the lack of sei whale detections in the study area. There is an inherent uncertainty with such studies whereby animals can be present but may not vocalise in range of the instruments, and the EIS attempts to draw together other data sources to reach a reasonable conclusion.	
SAMS8	Section 10.4.1.1 Relevant legislation 4.6.9 The EIS should mention noise regulation provisions under the EU Marine Strategy Framework Directive (2008/56/EC) as well as OSPAR (OSPAR 2014-08)	We acknowledge the noise regulation provisions noted by SAMS. EU Marine Strategy Framework Directive Task Group 11 has examined underwater noise and other forms of energy and its recommendations currently are not binding. POEPL hopes to involve the Chair of this Group (Mark Tasker) in forthcoming EMMP discussions for this project. OSPAR Agreement 2014/08 is not legislation but is relevant: Monitoring Guidance for Underwater Noise in European Seas.	Chapter 15 of the EIS (EMMP) includes a commitment to examine this issue further.
SAMS9	10.4.4.3.1 Invertebrates 4.6.10 Although little is known about the impact of noise on invertebrates, there have been several papers published recently on this research topic and these could be cited here, e.g., Morley *et al.* (2014).	This is acknowledged, although we do not believe addition of these references changes the outcome of the assessment.	==
SAMS10	10.4.4.3.2 Fish 4.6.11 Similarly to the review of noise impacts on invertebrates, newer	This is acknowledged, although we do not believe addition of these references changes the outcome of the assessment.	==

Consultee	Representation	POEPL response	Amendments/further detail
	assessments of noise impacts on fish are available and include Hawkins & Popper (2017), Simpson *et al.* (2016) or Nedelec *et al.* (2016). It should also be made clearer that for fish, particle motion might be more important than sound pressure level when examining noise impacts.		
SAMS11	10.4.4.3.3. Seabirds 4.6.12 The EIA misses some key recent literature on seabird hearing in this assessment, e.g., Maxwell *et al.* (2017) and Johansen *et al.* (2016).	This is acknowledged, although we do not believe addition of these references changes the outcome of the assessment.	==
SAMS12	10.4.4.3.4.1 Marine mammal hearing thresholds 4.6.13 It is not clear how the loudness of the sound an animal produces relates to its hearing range; while this may be true for the frequency range of species-specific vocalizations, the sound intensity seems of lesser importance in this context.	POEPL believe the EIS commentary is valid and provides context. POEPL agrees that there may not be a direct relationship between the intensity of an animal's vocalisation and hearing sensitivity. However, given the lack of extensive data regarding hearing sensitivity in many marine mammal species, the known range of vocalisations was included to give some context. These values are not used in the assessment, which relies on the best available thresholds for injury and disturbance.	==
SAMS13	10.4.4.3.4.4 Marine mammal injury thresholds 4.6.14 The injury thresholds cited here have recently been extensively reviewed and updated, which resulted in the new NOAA guidelines for 'Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing' (NMFS, 2016). These updated and adjusted guidelines and injury thresholds	Advice from JNCC on this project and in the UK more generally is that assessments already conducted may remain with the Southall *et al.* (2007) thresholds, while future assessments should adopt the NOAA (2016) thresholds, and predictions should be revisited before operations commence to confirm the relevance of mitigation zones. The underwater noise assessments for the Sea Lion EIS were completed prior to the NOAA Guidelines being published. The NOAA thresholds apply a slightly different method for species hearing weighting along with different thresholds such	The assessment has been repeated to include the updated thresholds in the NOAA guidelines (2016). There are some differences in the results of the assessment and proposed mitigation, and HF cetaceans in particular have a large mitigation zone. The chapters covering underwater noise have been updated to reflect this.

Consultee	Representation	POEPL response	Amendments/further detail
	include a lot of the more recent literature, and should replace the thresholds defined by Southall *et al.* (2007) and used in this report for noise impact modelling.	that we do not expect the outcome of the assessment to be significantly different. POEPL agrees to update the underwater noise assessments using the new thresholds by the end of May 2018 and will submit the revised assessment to FIG.	
SAMS14	10.4.4.4.3.3 SEL results and injury from vessel noise 4.6.15 It is not clear which functional cetacean hearing group was modelled in the scenario presented.	This will be updated with the predictions & thresholds relevant to NOAA Guidelines (see SAMS13).	Relevant text updated.
SAMS15	10.4.5 Industry-standard mitigation 4.6.16 The JNCC guidelines for minimising risk of injury to marine mammals from geophysical surveys have recently been reviewed and updated. There have been several critical reviews that have pointed out weaknesses of these guidelines, especially with regards to problems with using visual observers, using a 500 m radius from the centre of the seismic array for monitoring etc. (e.g., Nowacek *et al.,* 2013; Leaper *et al.,* 2015; Wright & Cosentino, 2015). The EIA would benefit from taking onboard some of these valid criticisms and suggest more proactive monitoring and mitigation approaches which in time will hopefully to an update of currently insufficient guidelines.	The EIS does not reference the JNCC guidelines for minimising risk of injury to marine mammals from geophysical surveys as seismic surveys are not in the scope of the EIS and would be subject to independent EIA process if they were proposed. The JNCC protocol for minimising the risk of injury to marine mammals from piling noise is referenced, and is under review by JNCC, meanwhile it is still the extant guidance from UK Government and is followed in the UK. POEPL has no doubt that JNCC will in due course make a balanced scientific assessment of recent evidence, including the papers noted that are critical of the seismic guidelines, and which may reflect on piling as another form of impulsive noise. As and when JNCC revise their protocol for piling noise we will be happy to discuss the implications within the EMMP group set up for the project. Following a reassessment of the impact of underwater noise, greater emphasis is now placed on PAM, along with MMOs to monitor for the presence of marine mammals within the scope of influence of project activities.	==

Consultee	Representation	POEPL response	Amendments/further detail
SAMS16	10.4.6.1 Impact assessment pile driving 4.6.17 For seabirds, the justification for 'low' impact based only on the application of JNCC guidelines and 'soft starts' is very weak, and difficult to follow (i.e., is there any research showing seabirds moving out of an area after application of soft start procedures?). The Reviewer considered the impacts to be at least 'moderate'. Similar to the situation with impacts on fish, it should be clearly stated that there is a knowledge gap which complicates this assessment.	The assessment recognises the potential for impact on seabirds, fish and invertebrates and attempts to assess the scale of the impact using the best available information. In the case of seabirds, there is not a recognised method of assessment and very little data regarding thresholds for impact. More is known about invertebrates and fish but it is recognised that this is an area that is poorly understood, especially in regard to the assessment of the impact of particle motion. Confidence in the assessment is 'Uncertain' due to these, and other, knowledge gaps.	==
SAMS17	4.6.18 For impacts of cetaceans (both disturbance and injury), a general conclusion of 'low' impact based on the application of current JNCC guidelines is not justified by scientific evidence. At the very least, risk reduction for impacted marine mammal species based on JNCC guidelines should be simulated by species and circumstance before these conclusions are drawn (see Leaper *et al.,* 2015).	JNCC provides guidance on measures to minimise the risk of injury to marine mammals. JNCC is led by the Joint Committee, which brings together members from the nature conservation bodies for England, Scotland, Wales and Northern Ireland and independent members appointed by the Secretary of State for the Environment, Food and Rural Affairs under an independent Chair. The assessment considers extant JNCC guidance in light of considerable scientific evidence and has used experienced and independent advisors in reaching conclusions on impact and risk. POEPL recognise that some authors are sceptical about the effectiveness of published precautions, but we cannot disregard the implications of extant government guidance that represents a substantial body of scientific opinion, by assuming that impacts were moderate after applying the recommended mitigations. The JNCC guidelines clearly state they have been developed to reduce to negligible levels the potential risk of injury or death to marine mammals in close proximity to piling operations.	==
SAMS18	4.6.19 With respect to the potential for disturbance, what scientific	The assumption that animals will move away from a source of noise is valid (see NOAA guidelines, 2016), although the response of an individual is likely	==

Consultee	Representation	POEPL response	Amendments/further detail
	evidence was used to validate the assumption that all animals will vacate the area after start of piling? To assign a 'slight' impact from disturbance from pile driving does not appear justified, nor is it supported by scientific evidence. Several scientific papers have pointed out the limitations of the current JNCC guidelines as mitigation measure (see above); for example, suggestions such as mandatory shutdowns should marine mammals be detected within the mitigation zone are still not required. Given these limitations of current guidelines, it is hard to follow the conclusion of the EIS of 'slight' impact.	to relate to a number of variables (such as; feeding activity, previous exposure). This is also inherent in the behavioural responses to noise described in the chapter (Table 145). The categories of disturbance are based on observations and are described in Southall *et al.* (2007). Should JNCC advise at a future point that shutdowns are a measure that should be adopted, then POEPL will consider this carefully and discuss it in the context of the EMMP.	
SAMS19	4.6.20 There is a gap in knowledge on impacts on fish, especially in the longer-term. Also several recent papers have suggested reduced communication space and masking (Clark *et al.,* 2009; Stanley *et al.,* 2017) as a possible severe impact for both marine mammals and fish. This should be acknowledged in the EIS.	Potential impacts on fish are listed in Section 10.4.4.3.2.2 and significant gaps in knowledge are acknowledged throughout the EIS. It is accepted that this section could be expanded to include impacts on communication space. but we do not believe this would alter the assessment, as each chapter contains a 'Confidence' section, which highlights these limitations. Greater emphasis is placed on marine mammals throughout as these are regarded to be the receptors of greatest conservation concern.	==
SAMS20	10.4.7. Project-specific mitigation measures 4.6.21 As pointed out above, due to the limitations of current JNCC guidelines, additional stronger	POEPL believes it is appropriate to follow the advice issued by the UK Government's scientific advisors (JNCC) and has committed to MMOs on vessels as a valid way to understand uncertainties in potential impacts, which will then be managed through the EMMP process. Controls on vessel speed offshore have not been identified as a necessary mitigation in the	Text updated accordingly.

Consultee	Representation	POEPL response	Amendments/further detail
	measures such as shutdowns upon animal detections, improvement of Marine Mammal Observer (MMO) and/or Passive Acoustic Monitoring (PAM) personnel knowledge and working requirements, biologically relevant safety zones etc. (see Wright & Cosentino, 2015) should be suggested in order to reduce risks to all receptors. With regard to vessel noise, a reduction of speed should still be recommended in order to reduce noise for ships with fixed pitch propellers and to reduce general collision risk with marine mammals	assessment and we have committed to monitoring underwater noise in operations which will provide a basis for ongoing review *via* the EMMP. Following reassessment, greater emphasis is now placed on PAM, which will improve detection of marine mammals. There is not a simple relationship between noise on vessel speed and the type of propulsion is more relevant (e.g., fixed pitch vs variable pitch propellers). Applying a speed limit may not influence the sound intensity, and the significance of the impact is not at a level that demands mitigation.	
SAMS21	10.4.8. Residual impacts 4.6.22 Based on their knowledge, the Reviewer considers the impact of pile driving in particular more severe than 'low' and therefore suggests that this section should be rewritten, taking into account the actual impacts and risks of both pile driving and prolonged vessel noise exposure for marine mammals.	POEPL believe that the rating assigned to the single event of a short term piling operation, as proposed, is reasonable. The JNCC guidelines clearly state they have been developed to reduce to negligible levels the potential risk of injury or death to marine mammals in close proximity to piling operations. Such operations and precautions are routine in many parts of the world with populations of similar animals. Cetaceans have strict protection under the Habitats Directive in European waters for example, and the extant guidelines and their application *via* mandatory consents supervised by independent MMOs are designed to allow developers to undertake operations with negligible risk of an offence.	==
SAMS22	10.5.4.4.1 Identification of source sound levels 4.6.23 It is stated that vessel noise will have greater impact on seals and baleen whales, due to most vessel acoustic energy being concentrated in the lower frequencies. This statement disregards several	POEPL recognise that high frequency components can give rise to impacts and a wide range of frequencies has been considered in the numerical analysis and described in the narrative on sensitivities. The main energy levels in vessel noise are in lower frequencies as described in the EIS which propagate farthest. The assessment incorporating the NOAA guidelines confirms that low-frequency cetaceans are most at risk of injury. The disturbance thresholds from Southall *et al.* (2007) for nonpulses such as vessel noise are derived from "relatively extensive behavioural observation"	==

Consultee	Representation	POEPL response	Amendments/further detail
	published studies showing the impact of higher frequency vessel noise (e.g., Hermannsen *et al.,* 2014; Aguilar Soto *et al.,* 2006; Jensen *et al.,* 2009; Dyndo *et al.,* 2015).	for LF cetaceans, observations of "A relatively large number of mid-frequency cetaceans" and "Numerous controlled studies" of HF cetaceans. These indicate that LF cetaceans tend to respond at lower received noise levels than MF or HF cetaceans. We note that Hermannsen *et al.* (2014) emphasises high-frequency noise from high speed jet ferries travelling at around 38 knots that are not representative of the Sea Lion Phase 1 Development vessels.	
SAMS23	10.5.4.4.3 Comparison of model results with injury thresholds 4.6.24 The updated NOAA guidelines (NMFS 2016) rather than Southall *et al.* (2007) should be used to assess potential for injury and behavioural response. With regards to fish and invertebrates, more recent scientific literature and suggested impacts should be considered.	The chapter has been updated in respect of the NOAA guidelines. POEPL acknowledges more recent references for fish and invertebrates and we believe that the assessment remains valid in light of these sources. We recognise that this is a developing area of science and the 5-yearly validity of the EIS along with the EMMP process is a responsible way of managing any future issues that might emerge.	==
SAMS24	10.11.8.1 Risk of collision during drilling, installation and production 4.6.25 Speed restrictions should be mandatory in order to reduce the impact to 'minor'; if restrictions are voluntary it is difficult to see how the overall impact significance can be confidently lowered.	The use of the word 'voluntary' is merely intended to denote that they are beyond legal requirements. The mitigation is a commitment that POEPL makes for the movement of tankers and is mandatory in terms of POEPL's requirements for the operation of those vessels. The risks of collision are greatest with the largest vessels due to their mass, restricted field of view and lower manoeuvrability. Therefore, restrictions on the speed of tankers inshore is a key mitigation measure that lowers the risk and it is a commitment along with all other mitigation measures. POEPL has committed to limit the speed of tankers in Berkeley Sound to 8 knots, which is lower than the USA National Marine Fisheries Service "Final Rule to reduce the likelihood of deaths and serious injuries to endangered North Atlantic right whales that result from collisions with ships" which is 10 knots. For other vessels that are of the same size range as existing vessels using Berkeley Sound, the advice of the Harbour Master will be observed. Further, MMO observations provided by POEPL-operated vessels will contribute to	==

Consultee	Representation	POEPL response	Amendments/further detail
		our knowledge of collision risks and will inform the best way to manage them.	
SAMS25	Regional Air Quality 'F' 4.7.3 There is not a huge amount of detail provided on regional air quality apart from combustion. It is suggested that further action on regional air quality is required. Accidental/unplanned emissions from each spill scenario should identify the regional atmosphere/humans as a receptor. Exposure modelling, following the procedures used in the water quality sections, should be followed for releases to atmosphere from hydrocarbon spills for each of the activities identified. The risk assessments should be revised to include the impacts to the regional atmosphere from e.g., oil spills of varying sizes, both offshore and inshore, diesel bunkering spills inshore and offshore, etc. These assessments should detail the loss to atmosphere of volatile hydrocarbons and other pollutants from each activity.	POEPL disagree that air quality impacts from oil spills are on an equivalent level of concern or scale as water quality impacts and this is not a routine expectation in the UK or other countries where POEPL operates worldwide. POEPL has, however, quantified the issue for the spill scenarios included in the EIS, undertaken screening modelling, compared this with established exposure thresholds and provided insight from a well-documented incident to support this position. This is given in 'Additional Information'. The loss of VOCs offshore and inshore is controlled to a minimum by having these design features: • No venting from the FPSO during normal production; • Use of Vapour Recovery Package during normal operations; • Back-up inert gas generator for use as cargo tank 'gas blanket' in the event that the Vapour Recovery Package malfunctions to prevent venting of hydrocarbon gas; • Use of a vapour balancing system to pass 'blanket gases' from the CTT cargo tanks to the OLST cargo tanks during transfer of oil from the OLST to the CTT. The effect of this is that emissions of VOCs offshore are negligible when compared to combustion emissions. VOCs and odour from tank vents during loading inshore was highlighted as a potential issue given the low thresholds for detection for some odourous compounds, and this is mitigated by using vapour transfer whenever possible, and the residual impacts are fully assessed using dispersion modelling with local topography and meteorological data in EIS Section 11.10.	==
SAMS26	The scenario modelling efforts present in the water quality sections should be utilised for regional air quality, e.g., Offshore spills: subsea well blow-out; loss of the FPSO crude oil inventory, plus two Offshore	See SAMS25	==

Consultee	Representation	POEPL response	Amendments/further detail
	Loading Shuttle Tanker (OLST) tanks; crude oil transfer spill; loss of the MODU diesel inventory and diesel bunkering spill. Inshore spill scenarios should also be modelled: e.g., between tanker collisions; 300 tonne crude oil spill; 3,000 tonne crude oil spill; 50,000 tonne spill; 300 tonne fuel spill. There seems to be a fundamental assumption that spills of volatile hydrocarbons will not have any impacts on regional air quality. This assumption is unsatisfactory.		
SAMS27	Seabed Sediment & Geology 'A' 4.8.7 No gaps were discernible with respect to geology, seabed sediment and bathymetry, although the description of the sub-surface geology could be improved (see Section 5).	POEPL acknowledges the comments which support the findings of the EIS.	==
SAMS28	Seabirds 'B' Presentation of seabird distribution data has some shortcomings. Table 63 (pg. 342) attempts to categorise seasonal distribution. However, much of this characterisation is based upon the White et. al. (2002) study, where survey effort was not uniform. Similarly, seabird vulnerability maps in Figures 95-98 (pgs. 380-383) are also of questionable value, given non-uniformity of source data. Section 7.4.5.3 Birdlife of Berkeley Sound	POEPL clearly highlight the limitations of the seabird distribution data in various places in the text, and are not suggesting that the maps and tables represent a quantification of seabird distribution and vulnerability, but rather a characterisation of these aspects to be used in the risk assessment. Non-uniformity of source data in seabird studies is an inherent problem in almost all offshore locations and the representation of data cartographically is valid and aids interpretation given that the limitations are highlighted. An independent report (Genesis, 2017) has examined the validity of the data. The offshore distribution data relies on a number of sources but White, *et al.,* 2002 is the most comprehensive. The coastal bird survey follows a set methodology as stated in the text, the maps are scaled and clearly not 'presence only'.	==

Consultee	Representation	POEPL response	Amendments/further detail
	(inshore) includes a series of Figures that details the seabird distribution in the coastal area of Berkeley Sound. It is unclear whether this data is presence only, or collected using appropriate transect mythologies, so the data can be accurately scaled.		
SAMS29	Social 'B' There are weaknesses in Chapter 11 in relation to the less technical aspects of some of the social impacts, especially in relation to fishing livelihoods and resource competition for accommodation where it is unclear whether these have been covered by the SIA or not. [comments relating to topics in the SIA are repeated]	Social impacts relevant to an EIS under the Minerals Ordinance are clearly described in FIG Guidance Paper 187-15 and POEPL has followed this guidance in examining air quality, noise and resource competition aspects in discussion with FIG on the scope of the EIS. Considerable work has been on assessing wider social impacts in the Falkland Islands society and economy including studies by Regeneris and Plexus e.g., referred to in 11.3.1. POEPL is currently reviewing and updating this work as required to ensure it aligns with the most recently available census data and project forecasts. Once completed, any additional reports will be made available.	==
SAMS30	However, within Chapter 11, there were frequent references to 'in comparison to other places in the world'. This seems to undermine evidence that POEPL is aware of the social context of the Falkland Islands, and the differences in social impact that might occur given that there are few places in the world with which it can be compared. As such, it would have been more beneficial had comparisons been drawn with locations that might have similar social contexts – e.g., the Shetland Islands. This would have been	The EIS uses 'world' comparison in relation to operation of harbours which must meet common worldwide standards under IMO rules and expectations and therefore has a legitimate basis for comparison. We disagree that there are frequent such references and where possible we have used objective standards such as for noise and air quality that apply to diverse communities across the UK and Europe. The Regeneris and Plexus studies contain more information on social impacts beyond the scope of the EIS (see also SAMS29).	==

Consultee	Representation	POEPL response	Amendments/further detail
	particularly nice to see for accommodation resource competition (Sub-Chapter 11.3, pg. 905).		
SAMS31	4.10.12 In Section 11.1.4.3 (pg. 864) there is a note which states; 'Importantly, it is out with the scope of this EIA to assess the safety implications with regard to the injury or loss of life on fishing vessels and this EIA explores only the potential environmental and social impacts with regard to the loss of tangible property.' Despite the legal ramifications for fishing vessels which do ignore the exclusion zone lying with the fishing vessels, the social impact of loss of life poses a real and tangible risk to POEPL's operations (not to mention local communities in the Falkland Islands). This note should perhaps refer to the SIA being conducted by POEPL and preferably cite the section which covers this assessment.	POEPL agrees that the wording is unfortunate and could better reflect the importance attached to the safety of other sea users, and the lengths to which POEPL goes in managing a wide range of risk controls to avoid incidents and minimise risk. The intent of the words is rather to point out that there are other POEPL processes, other legislation and other industry good practices that address these issues while the EIS is focussed on the environmental impacts and risks.	The note has been edited to indicate that safety is addressed elsewhere.
SAMS32	4.10.13 In Section 11.1.6.2.1 (pg. 871), loss of gear under normal fishing circumstances was considered in this EIS to cause 'moderate' impact. Loss of gear plus the legal ramifications of fishing in an exclusion zone due to POEPL's subsea infrastructure was also considered	POEPL believe the loss of fishing gear is addressed adequately. POEPL expect there to be little if any interaction between fishing gear and the development, and any such unintentional interaction would be dealt with *via* a fair and transparent claims process such as exists in the UK between the relevant industry bodies.	==

Consultee	Representation	POEPL response	Amendments/further detail
	'moderate'. Legal consequences will likely add to the impact on the livelihoods of fishers from the 'moderate' impact of fishing gear loss under normal circumstances. This is not clearly differentiated or considered within the text.		
SAMS33	4.10.14 Assumptions on fishing effort are based on data from five years ago (2013). No monitoring is suggested for fishing effort, but there is for shipping (both offshore). Impact was considered not to be higher than 'low' in both cases. It is unclear from the text why one will be monitored and the other not (Section 11.1.6.2, pg. 871).	Ongoing fisheries data is available but was not felt to be a variable to which the assessment is particularly sensitive, and interaction is quite limited in scale given the design standards in use for subsea infrastructure. Shipping data relates to the potential for a collision and a significant acute incident, which explains the difference in monitoring. POEPL will maintain contact with FIFD and review updated fishing effort days every five years as part of EIS update process.	==
SAMS34	4.10.15 The EIS states in Section 11.2.5.2 (pg. 896) that disruption to other vessels in Stanley Harbour will occur, but is likely to be 'minimal'. However, it is then stated that stakeholders (fishing and shipping) are 'resistant to a change on this scale'. It then assumes that occasional use of Falklands Interim Port And Storage System (FIPASS) will be acceptable to 'the majority of stakeholders'; fishing and shipping are large stakeholders, so this does not seem logical. The text then concludes that the sensitivity of the receptor is 'low'. In the following	POEPL agrees that the wording could be clearer, and it is intended to reflect that a long-term increase in POEPL-operated vessels using FIPASS could cause significant stakeholder concerns and consequently POEPL is planning that the TDF be the primary berthing and refuelling facility for all POEPL-operated vessels. This has resulted in POEPL proposing to build a diesel loading line into the TDF to avoid project vessels bunkering at FIPASS. This TDF upgrade would be subject to separate FIG approvals.	'Resistant to change on this scale' should read 'tolerant to change on this scale', the text has been amended. This should be regarded as a typo and this section reads more clearly with this wording. The wording used elsewhere in this section conforms with the definitions given in the methodology chapter.

Consultee	Representation	POEPL response	Amendments/further detail
	paragraph it then goes on to say that waiting for a berth to become available might be 'unacceptable to a minority of stakeholders' – concluding that the severity of the effect is 'minor'. Both of these conclusions are contradictory to the wording of the second sentence in the first paragraph of Section 11.2.6.1.1 (pg. 896), with the latter being based on assumption of stakeholder opinion rather than a direct reference to information garnered in the scoping consultations. This descriptive quantification of impact could be made clearer given that extensive stakeholder consultation was conducted in the scoping stage of the EIS.		
SAMS35	4.10.16 No consultation has been done with stakeholders on changes to the project since 2016 (pg. 218). This includes exclusion zone changes in Berkeley Sound. Therefore, the assumption in Section 11.2.6.1.2 (pg. 897) that 'inconvenience cause is expected to be relatively short-term and minor, although this may be unacceptable to some stakeholders' is not based on the real opinions of stakeholders. However, the document does state that these	The plans for Inshore Transfer have been widely advertised and discussed through the development of the EIS during 2016-2018. This includes the 500m permanent exclusion zone and the temporary exclusion zones during the Inshore Transfer operation itself. We believe the EIS statements are a reasonable, precautionary reflection of actual stakeholder views expressed to POEPL.	==

Consultee	Representation	POEPL response	Amendments/further detail
	changes will be highlighted during the public consultation phase.		
SAMS36	4.10.17 Section 11.11.1.1 might benefit from mentioning that the basis for conducting an L/SVIA is within EIA legislation.	POEPL accepts this point.	Text added to capture this.
SAMS37	Water Quality 'A' No comments	POEPL acknowledges the comments which support the findings of the EIS.	==
SAMS38	1.1.1 Section 1.2, pg.32. The location of the Sea Lion field is stated as '…the Sea Lion Field is an oil field which is trapped in underground sandstone rocks approximately 2.5km below sea level… '; this should read approximately 2.5 km below sea bed.	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions.	Relevant has been text modified.
SAMS39	1.1.2 Section 7.3.4.1 pg. 256. 'The Patagonian continental shelf is one the largest and flattest continental shelves in the world' – a reference is needed to support this statement.	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions.	Citation added to the relevant text.
SAMS40	1.1.3 Section 7.3.6.1, pg. 271. The geological description of Northern Rift Basin ('….Cretaceous turbidite sandstone that form from a series of deep-water…. ') needs an age control. This extends to the rest of the section. Are the '…younger fans… ' tertiary in age? Also the referencing of (Casper, Casper South	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions. POEPL has tried to make these sections readable for all audiences. For the more technical reader there are references for further reading.	==

Consultee	Representation	POEPL response	Amendments/further detail
	and Beverly) are presumably locations, but this needs clarifying. The authors would be better re-writing this section with formation, age depositional environment and reference to borehole occurrence.		
SAMS41	1.1.4 Section 7.3.6.2, pg. 271. The text states '…principally sandstone and mudstone with overlying Quaternary sediments.' Again age is missing so presumably these formations are Cretaceous or Early Tertiary in age?	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions. – see comment above in response to SAMS40	==
SAMS42	1.1.5 Section 7.3.6.2, pg. 271. Reference is made to '…solifluction process'; soil creep is a terrestrial process, so the implication is the Quaternary deposits are terrestrial sub-aerial, and now submarine due to the post-glacial rise in sea level. It would be worth including a sentence clarifying this, supported by a reference, as this has implications for the nature of the seabed sediments in Berkeley Sound.	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions. – see comment above in response to SAMS40, SAMS41	==
SAMS43	1.1.6 Section 7.3.6.2, pg. 271. No age has been provided for the rock outcrops from the Fox Bay, Philomena, Port Stanley and Port Stephens formations.	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions. – see comment above.	==
SAMS44	1.1.7 Section 7.3.7.1.1, pg. 272. The statement on grain-size directly affecting the composition of benthic	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions. If the more technical minded reader wants further	==

Consultee	Representation	POEPL response	Amendments/further detail
	communities needs a supporting reference. When discussion grain size, it might be worth including the Folk or Wentworth scale to illustrate the size classes."	information they can read Gardline, 1998a. POEPL has made a concerted effort to make this ES readable to a wide audience.	
SAMS45	1.1.8 Section 7.3.7.2.2.1, pg.281. Typographical error in last sentence before Figure 64; 'iflux ' should be influx	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions.	Relevant has been text modified.
SAMS46	1.1.9 Table 7 (Chapter 1, pg. 63) has the "Impact / Risk" Definition part after the matrix of activity, receptors and residual Impact / Risk. It is suggested that the definition is placed before the matrix part of the table, as it is otherwise potentially confusing - at first read the "Impact / Risk" seemed to imply some combination of Impact with Risk, which doesn't make sense in relation to the methodology.	POEPL accepts this point on drafting of the document and this could be added. Each species is nevertheless given a substantive description and we note that the readership would assume a conservative viewpoint as it stands, and the EIS conclusions would not be affected.	==
SAMS47	1.1.10 Section 6.2, pgs. 221-224. Scoping is described in reasonably detail e.g., Falkland Islands Fishing Company Association (FIFCA) and Fisheries Department (FIFD) seem to have been consulted during scoping. Table 49 summarises concerns (weighted by the number of raises) and links to the EIS Chapters where the issue is addressed. Do the Chapters fully address Stakeholder concerns, or do some residual gaps	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions.	==

Consultee	Representation	POEPL response	Amendments/further detail
	remain? It would definitely be useful to have a final Table which lists the concerns raised about inadequate knowledge against the information uncovered during the EIS, with an assessment of whether the knowledge gap still remains.		
SAMS48	1.1.11 Section 7.2.4.1, pg. 247. 'Impact of sea lion crude on fur' should read 'Sea Lion' not 'sea lion'.	POEPL accept this point on drafting of the document. It does not materially alter the EIS conclusions.	Relevant text amended.
SAMS49	1.1.12 The Falkland Islands GAP project seems an excellent initiative, and developer participation in the scheme is strongly encouraged. For example, under the EMMP the data that will be generated anyway, which would be of value to GAP, should be identified, as well as any additional useful things which could be monitored.	POEPL accept this point on drafting of the document. It does not materially alter the EIS conclusions.	==
SAMS50	1.1.13 Section 7.4.1.1, pg. 286. The last sentence implies zooplankton are also primary producers – they are not, sentence needs re-drafting.	We accept this point on drafting of the document. It does not materially alter the EIS conclusions.	Relevant text amended.
SAMS51	1.1.14 Section 7.4.1.2, pg. 286. Phytoplankton – this is quite a general section, is there no more up-to-date data for the phytoplankton around the Falkland Islands?	There are few scientifically robust sources of such data on planktonic blooms, although it would be possible to show the seasonal variation near the sea surface. The information displayed is representative of the phenomenon which is described and assessed in the text.	==
SAMS52	1.1.15 Section 7.4.1.3, pg. 288. Zooplankton – could do with a few sentences on seasonality to link	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions.	Text amended to include a description of seasonality, Table 105 also amended to reflect

Consultee	Representation	POEPL response	Amendments/further detail
	better to Table 105 (pg. 475) and Table 106 (pg. 476) , and thus explain the patterns illustrated.		periods of peak zooplankton abundance.
SAMS53	1.1.16 Section 7.4.1.3.2.1, pg. 288. 'This is a very abundant species…' refers to two species of Munida; it should be corrected to 'These very abundant species …"	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions.	Relevant text amended.
SAMS54	1.1.17 Section 7.4.4, pg. 317. The use of the Northern Slope (NS) zone in relation to fish abundance was felt to be unhelpful – apparently the NS zone includes different areas, some of which are important for fish and fishing and some not. Throughout this section there is some confusion between the overall NS situation and the situation around the Sea Lion Development site. This arises at several points in the report where it is sometimes stated that the NS zone is very important for fish, which may be present at high abundance, but then it is argued that there are few fish around the proposed drill site.	POEPL accepts that some further clarity could result from distinguishing between large scale characteristics and small scale inferences at the development location, although it would not materially change the document. The NS is considered as an eco-region based on oceanography and environmental conditions. See Arkhipkin, A., Brickle, P., Laptikhovsky, V. V., Pompert, J. & Winter, A. (2012). Skate assemblage on the eastern Patagonian shelf and slope: structure, diversity and abundance. Journal of Fish Biology 80, 1704–1726.	Relevant text amended to make this clearer.
SAMS55	1.1.18 The text states that the NE part of the NS is rough with rocks and corals. Unfortunately, Figure 76 (pg. 318) does not indicate where this zone begins – it is therefore not very clear what the actual habitat around the Phase I site actually is. The Reviewer's feeling is that the NS zone	POEPL agrees there is heterogeneity in these regions and this could be clarified.	Relevant text amended.

Consultee	Representation	POEPL response	Amendments/further detail
	is actually too large to be useful for descriptive purposes, and seems to include a range of habitats and depths with varying importance for fisheries. It would be better to include a map that splits the NS into sub-zones by habitat or substrate (if that information is available), which will result in the text being less confusing.		
SAMS56	1.1.19 Section 7.4.4.2.3.2, pg. 323. The International Union for the Conservation of Nature (IUCN) status mentioned for yellownose skate and spurdog, but it would be helpful to indicate the IUCN criteria for all the species mentioned. Otherwise, it is left to the reader to infer that if an IUCN status is not mentioned then there is least cause for concern; stating the criteria would add some reassurance.	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions.	Relevant text amended and citations added to the reference list.
SAMS57	1.1.20 Section 7.4.4.3, pg. 325. It is a little unclear as to what is meant by coastal and inshore fishing zones. The Reviewers understanding is that there is no commercial fishing permitted within 3 nm of the coast, but since “coastal” does not have a specific distance based definition, at least in common usage, it would be better to use a term like “3 mile	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions. Note that these terms are understood locally.	Text amended through the document to make this clear.

Consultee	Representation	POEPL response	Amendments/further detail
	inshore no-commercial take zone" or similar appropriate wording."		
SAMS58	1.1.21 Section 7.4.4.3.1.1, pg325. Is the Bargelloni reference (Bargelloni *et al.,* 2000) really that relevant? It is probably very interesting, but the importance for an EIA is unclear.	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions. The reference adds context to local nearshore fish fauna in the Falkland Islands.	==
SAMS59	1.1.22 Section 7.4.4.3.1.2, pg. 326. The wording "as high as…" implies a large value, but the landing is only 15 t. It might be better just to say "up to 15 t"."	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions.	Relevant text amended.
SAMS60	1.1.23 Section 7.4.4.3.1.3, pg. 326. Beach seine catches are mentioned, but there was no commercial fishing within 3 nm of the coast, which implies that these were research fishing beach seine samples? If so, this should be stated clearly.	Small scale beach seine catches were recorded near the coast, but commercial fishing in this context refers to large scale fisheries with potentially damaging gear, whereas small scale fisheries are permitted.	==
SAMS61	1.1.24 Section 7.4.4.3.2.1, pg. 326. 3rd paragraph, end of third line - "out crops " should be "outcrops".	POEPL accept this point on drafting of the document. It does not materially alter the EIS conclusions.	Relevant text amended.
SAMS62	1.1.25 Section 7.4.4.3.2.1, pg. 326. The description of Loligo spawning behaviour in Argentine waters is a bit confusing – the Reviewer assumed that this was results of an experiment putting artificial substrates in the sea for the squid to lay eggs on? This part could do with re-wording for clarity.	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions. The aim was to demonstrate that loligo lay on other structures other than kelp species so can use this to back up our belief that the spawning grounds are not just restricted to kelp and they are likely to be extending into deep waters on rock outcrops.	==

Consultee	Representation	POEPL response	Amendments/further detail
SAMS63	1.1.26 Section 7.5.1.2, pg. 422. There needs to be some more consistent in use of the terms 'coastal' and 'inshore' in relation to fishing activity – these seem to be used interchangeably, but seem to refer to different fishing zones in other parts of the text (see 4.3.19 also.).	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions.	The terms 'coastal' and 'inshore waters' have been defined in section 7.1. Also see SAMS57
SAMS64	1.1.27 Section 7.7.3.1.1, pg. 442. This section describes low fishing activity due to depth and rough ground, but this is in contrast with an earlier statement (7.4.4.2.1.1) that the ground in the NS is flat sandy mud, which is heavily trawled throughout the year. Table 57 (pg. 316) also says the Phase I site is uniform mud, gravel and sand with no erratics. In the Reviewers opinion, the lack of trawling activity around the Phase I site seems more related to depth, or some other factor, rather than bottom type.	Bottom type is stated by fishermen as a reason for not fishing the area, however, this may be due to experience in areas away from the Sea Lion Field. We agree the reported benthic analysis appears to disagree with this viewpoint. See SAMS55	==
SAMS65	1.1.28 Figure 126, pg. 445. Adding location of the Phase I drill site to the map would be advantageous.	We accept this point on drafting of the document. It does not materially alter the EIS conclusions.	==
SAMS66	1.1.29 Table 105, pg. 475. It is unclear how May-Jul has been identified as peak months for fish. Comparison with Table 58 (pg. 320) suggests that Jan-Mar is more likely the peak (based on adding up the	These sensitivity summaries distil a wide range of data to assist the public to come to high-level views, while the text and visualisations in the main body contain more detailed information for those seeking a more detailed viewpoint. The peak months reflect the seasonal presence of *Illex* in the region. By weight of catch, *Illex* is by far the largest fishery in Falklands waters.	The peak months reflect the seasonal presence of *Illex* in the region. However, the reviewer is correct to point out that the shaded areas did not reflect the seasonal abundance of fish and

Consultee	Representation	POEPL response	Amendments/further detail
	high abundance in NS boxes) – also that would make more sense in relation to the plankton production seasonality shown.		shellfish. The table has been amended.
SAMS67	1.1.30 Section 10.1.4.2.1, pg. 547. The section acknowledges impacts of artificial light on fish, but uses fisheries data to argue the area is not very important for fish. Some caution is recommended with this argument – although lack of commercial fishing is suggestive that the area is not that important for fish, there could be other reasons why trawling is not pursued here. Also the commercial data does not say anything about abundance of non-commercial species.	POEPL agrees this wording could be rephrased to be more specific to commercial fishing, although commercial fishing is often a proxy for other non-commercial species that are linked in the same food web.	Text amended to reflect the likely presence of unexploited species such as Myctophids.
SAMS68	1.1.31 Table 39, pg. 616. The Reviewer is unaware of any fish eggs that have gas filled spaces; these can develop in some fish larvae, and even at quite an early stage, as the swim bladder is inflated.	POEPL agrees. Current concern over the effects of sound upon eggs, and especially for larvae containing gas bubbles, is focused on barotrauma rather than hearing.	Chapters 10.4 and 10.5 (Underwater noise) have been revised to incorporate these points.
SAMS69	1.1.32 There is a Hawkins 2015 review on impacts of sound of fish which is more recent - Hawkins, A. D., A. E. Pembroke, *et al.,* (2015). "Information gaps in understanding the effects of noise on fishes and invertebrates." Reviews in Fish Biology and Fisheries 25(1): 39-64."	POEPL appreciate the contribution and it can be included in the updated assessment of underwater noise (see SAMS13).	Chapters 10.4 and 10.5 (Underwater noise) have been revised to incorporate these points.

Consultee	Representation	POEPL response	Amendments/further detail
SAMS70	1.1.33 Section 10.4.6.1.1, pgs. 633-634. If soft start procedures are always in operation, then it can be argued they will also mitigate noise impacts on fish as well. Exactly how the mitigation will be applied could do with clarifying.	Accepted - however the impact of the project's piling noise on fish is assessed as minor and mitigation is therefore not required.	==
SAMS71	1.1.34 Table 152, pg. 640. There is no evaluation of noise on fish behaviour; this does need including as a separate line from 'Injury to invertebrates and fish'.	Agreed, this could be added.	The influence of noise on fish is described i.e., the assessment already considers disturbance as well as injury, and Table 152 is updated to reflect this.
SAMS72	1.1.35 Section 10.6.4.2.5.1, pg. 670. Again, here it is repeated that the NS is important for feeding fish, which is slightly at odds with statements about the un-importance of the Phase I drill site for fish. It just leaves some confusion in the mind of the reader and a bit of doubt that you have really evaluated the site with regard to fish properly.	This again is a matter of the large scale of the NS versus the footprint of the development and heterogeneity within the area and could be more clearly worded. The development location is not a known fishing area, which is different to it hosting fish populations.	See earlier comments in reference to the NS SAMS55 and others
SAMS73	1.1.36 Section 10.6.4.2.6, pg. 672. The need to look at metal accumulation in toothfish and get more baseline data is raised, but it does not appear to be re-iterated in the EMMP. This may be an oversight, but if a deliberate decision needs to be explained.	The section describes how studies over many years have failed to show a meaningful connection between drilling discharges and metal accumulation in fish. The topic is not one that is of ongoing concern in the OSPAR area for example relating to far more intensive oil and gas operations. The question was raised by a fishing stakeholder during scoping exercises and we believe the discussion presented addresses the concern. Benthic sampling including metals has taken place offshore and will continue under the EMMP. Establishing a baseline for fish is not considered justified in terms of managing a non-significant impact but we are happy to discuss further with FIFD the ongoing monitoring of fish quality and how we can address any concerns they have.	==

Consultee	Representation	POEPL response	Amendments/further detail
SAMS74	1.1.37 Section 10.6.6.2, pg. 684. The first sentence needs redrafting as it is at odds with earlier description of phytoplankton being mainly in the upper part of the water column. "Distributed though the water column" implies they are fairly evenly spread with depth – which is not true. Also for zooplankton some mention of vertical migration should be made because it can transport material (including contaminants) from depth to near surface, and vice versa.	POEPL accept this point on drafting of the document. It does not materially alter the EIS conclusions.	==
SAMS75	1.1.38 Section 10.7.6.1.1 pg. 721. An assumption is made that (larger) organisms will move away from biocides, but this will only occur if they are able to detect them. What evidence is there for this? If none, then this must be stated as an assumption you are making.	The statement in the EIS is intended to reflect the point that motile organisms are less likely to stay within a discharge plume when that would involve some intelligence and expense of energy, and therefore is it relevant to assess plankton which could diffuse along with the plume.	==
SAMS76	1.1.39 Section 10.9.4.2.2, pg. 751. Some mention should be made of the role sea temperature plays in modifying the impacts of ocean acidification – it is quite an important factor in relation to colder waters.	We accept this point on drafting of the document. It does not materially alter the EIS conclusions.	==
SAMS77	1.1.40 Section 11.1.6.2.1, pg. 871. The 4th paragraph mentions trawling in area in the past – does this refer to the trawling described as "exploratory" in other sections?	POEPL's understanding is that trawling is no longer permitted in this area hence the form of the narrative used, which could be clarified.	Relevant text amended

Consultee	Representation	POEPL response	Amendments/further detail
	Using consistent terminology will help keep reader clear about what you are saying.		
SAMS78	1.1.41 Section 12.1.4.2.1, pg. 1082. Thermisto gaudich feeding patterns are referred, although it is unclear what relevance of this is to the impact being discussed?	POEPL agrees that the statement regarding this species providing an important ecological link between small zooplankton and top consumers is relevant, but its feeding habits are less so.	==
SAMS79	1.1.42 Section 12.1.4.2.1, pg. 1082. The Reviewer believes that eggs will not ingest oil droplets. Only very small molecules would cross the egg chorion – this is why larvae are often more vulnerable to pollutants compared with the eggs.	POEPL agrees that larvae are more vulnerable to pollutants compared with eggs, but the two studies cited in the EIS (Lee *et al.,* 2012; Almeda *et al.,* 2014c) support the statements in the EIS.	==
SAMS80	1.1.43 Section 12.1.4.2.1, pg.1082. The Ultra Violet Radiation (UVR) effect mentioned in the last sentence of this section needs some references to support the statement.	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions.	Two references were added to the relevant text and in the reference list
SAMS81	1.1.44 Section 12.1.4.2.3.1, pg. 1083. The sentence "Cephalopods are sensitive to environmental conditions, which can affect their abundance and distribution widely" reads a bit oddly and could do with re-drafting. In addition, the statement on squid as a potential bioindicator species lacks any supporting references – have they been used in this manner elsewhere? Given that squid are quite mobile (at least in the Reviewer's opinion), does	POEPL agrees that the first sentence of the paragraph on Cephalopods could be re-drafted to clarify this point. Squid are identified as having potential to act as bioindicator species in environmental monitoring studies due to their rapid growth rates, short life-spans, such that the accumulation of pollutants in their tissues reflect the bioavailability in the immediate environment over a relatively short period of time. However, it would be useful to note the reviewer's comment that their mobile nature may limit their potential as bioindicators.	Text amended

Consultee	Representation	POEPL response	Amendments/further detail
	this not present some problem with using them as biomonitors?		
SAMS82	1.1.45 Section 12.1.4.2.3.2, pg. 1083. Toxicology tests on zebra fish eggs are mentioned several times but as indicated in other comment, tests are required on larvae as well. Fish eggs are likely to be more resistant to pollutants except for very small molecular chemicals. It is a dangerous assumption to take the results from eggs, and assume the results will be the same once the eggs have hatched. Similarly, for proposed work on squid – all the life stages need to be looked at, especially the early life stages. The section on impacts on adult and larval fish is rather muddled – it jumps about and needs re-ordering in logical sequence: eggs, larvae, juveniles, adults. Overall, this section was not as well written as other parts of the report the Reviewer looked at."	POEPL acknowledges that larvae could well be more sensitive than eggs. Zebrafish are standard laboratory animals and give us standardised results in the same way as the algae, plankton and crustacean tests that have been undertaken on the crude oil. This enables us to assess the toxicity versus other substances, and it is normal practice in chemical risk assessment to use results from standard organisms to extrapolate onto the wider ecosystem by taking into account assessment factors that reflect the uncertainties in doing so. The results are consistent in that the crude oil is very low toxicity with a very low fraction of soluble components that are most harmful to aquatic organisms. The physical characteristics strongly point to the oil remaining floating and away from the seabed and main water column where most eggs would be found, and the toxicity results on fish eggs showed little or no effect using water accommodated fractions derived from very high concentrations of oil. We have committed to looking at toxicity towards squid eggs (15.6.1.2). As it stands, there is a very large body of literature on the impacts of oil on the life stages of animals and the level of oil testing undertaken for Sea Lion crude goes far beyond other projects worldwide. We believe that the uncertainties are far larger in terms of where fish eggs occur and it would be more fruitful to identify spawning and juvenile sites as part of fisheries management. We note that identification of squid spawning is an EMMP topic and a GAP Phase II topic.	==
SAMS83	1.1.46 Section 12.1.4.2.4.2, pg. 1085. The last sentence in the 1st paragraph on this page is unclear ("Even if tainting…"). Although the Reviewer understood the intended point (the public perception that fish are tainted may damage markets even if there is no detectable	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions.	Public added to perception. The reviewer has understood the intended message and therefore it seems unnecessary to change the text.

Consultee	Representation	POEPL response	Amendments/further detail
	taint), but the sentence could do with redrafting to make it easier to understand.		
SAMS84	1.1.47 Section 12.2.4.2.3, pg. 1192. The relevance of the Braer data to the present EIS is not clear – in other parts of the report it is stated that the characteristics of oils at Sea Lion are different to other incidents, so is that the case with Braer? If they are different then how useful is the information given for evaluating Sea Lion risks? However, if it is comparable then you need to make that clear. The writing of this section is also a bit muddled and could do with re- organising.	The intention of this section is to illustrate some of the oil spill impacts on benthic communities that have been documented following spills. It is acknowledged up front that the type of oil will influence the nature and extent of impacts, and the purpose is to illustrate the potential impacts of oil contamination of benthic communities. Further, it is noted that even within the Sea Lion context, there are different types of oils that could be accidentally released (crude, MGO or IGO). Nevertheless, the basic components of all oils are very similar, as they contain aliphatics, aromatics, polycyclic aromatics and naphthalenes, and comparison between case studies is valid provided the differences are understood, as here, and impacts are interpreted at the relevant level.	==
SAMS85	1.1.48 In some later tables, (e.g., Tables 309-312 in Section 2.2.6.1), the mix of 'Sensitivity of Receptor and Severity of Effect (Impact)' together with text in one column, followed by Impact and Likelihood subsequent columns was a bit confusing to follow. It may have been better to have all these evaluations in column format, thus enabling the reader to quickly scan across to see how the final (unmitigated) risks were arrived at (as per Table 295 in Section 12.1.12).	The format in Table 309 etc. was chosen in order to condense the results of a lengthy chapter into a single table and the overall layout needs to be consistent within the document. It may be possible to split 'sensitivity' and 'severity' into separate columns but we are unsure if this would make it clearer.	==
SAMS86	1.1.49 Section 15.6.1.2, pg. 1349. It is strongly recommended to look at	As noted above, substantial specific test data has been generated for Sea Lion crude oil and is supported by worldwide experience in oil spills in order	==

Consultee	Representation	POEPL response	Amendments/further detail
	a pathway to exposure for fish larvae and small squid, as well as fish/squid eggs for reasons stated above.	to draw conclusions in the EIS, and we note the low solubility of the oil, the low aromatic content and the low ecotoxicity in the standard species tests. Nevertheless, we agree that ingestion pathways are unusual for this oil type given its highly waxy and persistent nature and this would be a relevant topic for EMMP discussion. Indicator species to be discussed at EMMP.	
SAMS87	1.1.50 There were some typographical/formatting errors in the sections on regional air quality; for example, on pg. 760 there is a cross reference to a section (0) that doesn't exist.	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions.	Formatting errors have been corrected
SAMS88	There are some typographical/formatting errors in the document; it is very difficult to produce a document this large (1432 pp) without errors of this nature. For example, on pg. 138 there is a duplicated sentence, and on pg. 499 a repeated paragraph.	POEPL accepts this point on drafting of the document. It does not materially alter the EIS conclusions.	Formatting errors have been corrected
Joint Nature Conservation Committee (JNCC)			
JNCC1	Noise modelling has been undertaken to estimate the risks posed to marine mammals from piling operations. Injury ranges have been estimated based on thresholds proposed by Southall *et al.,* 2007. We highlight that new injury thresholds were published in 2016 by the National Oceanic and Atmospheric Administration1. This technical guidance includes revised frequencies for hearing groups and updated injury	POEPL accepts this comment. POEPL's understanding of current UK practice is that assessments already conducted may remain with the Southall *et al.* (2007) thresholds, while future assessment should adopt the NMFS (2016) thresholds (NOAA Guidelines), and predictions should be revisited before operations commence to confirm the relevance of mitigation zones. The underwater noise assessments for the Sea Lion EIS were completed prior to the NOAA Guidelines being published. The NMFS thresholds apply a slightly different method for species hearing weighting according to the type of animal, along with different thresholds for injury and disturbance, such that	The underwater noise assessment has been updated in line with the NOAA guidance resulting in increased mitigation zones for HF cetaceans in particular and additional mitigation measures.

Consultee	Representation	POEPL response	Amendments/further detail
	thresholds which takes account of additional research undertaken since the publication of Southall *et al.,* 2007. It is likely we will be formally endorsing these new thresholds/ hearing functions in 2018 and therefore we are recommending operators use them in future assessments. We believe the NOAA thresholds may result in larger predicted injury ranges for some marine mammals. Subsequently, we recommend the Phase 1 noise modelling (which includes piling) for marine mammals is repeated prior to work commencing to ensure predicted injury ranges are within mitigation zones.	we do not expect the outcome of the assessment to be significantly different. POEPL agrees to update the underwater noise assessments using the new thresholds by the end of May 2018 and will submit the revised assessment to FIG.	
JNCC2	Planning and operational controls (including mitigation) can typically cover the risk of auditory injury that could result from noise exposure, however the risk of disturbance, particularly the cumulative effects of several disturbances, is considerably more difficult to assess and mitigate. Disturbance could have implications to survival and fitness, particularly if animals are disturbed from a preferred foraging area. In terms of estimating disturbance ranges, the level of sound received by an animal does not seem to be the sole	POEPL understand the point being made about the importance of empirical evidence in combination with, numerical thresholds. OSPAR recognises "Some studies (e.g., DeRuiter *et al.,* 2013; Pirotta *et al.,* 2015b) have shown that sound level can be a poor predictor of behavioural responses, and that other parameters (such as distance to source) may be more relevant. " The use of threshold and their specific values, are nevertheless are based on a consensus of a group of recognised world experts in light of extensive scientific information. Cumulative disturbances are a concern for example in areas of the North Sea where multiple wind farms are being constructed with large diameter, continuous piling over several years, whereas the piling proposed for Sea Lion Phase 1 is a single short term event, and vessel noise is a widespread phenomenon across various industries present in Falkland Islands waters. If further projects are proposed, cumulative impacts will certainly be more relevant.	==

Consultee	Representation	POEPL response	Amendments/further detail
	important aspect in determining a response and its significance. Therefore, it is preferable to examine empirical evidence from comparable circumstances when considering displacement, rather than numerical criteria for the onset of disturbance as used in noise modelling. It can also be helpful to consider the occurrence of past activities within an area to help determine a baseline and provide context. SNCB guidance on disturbance to European Protected Species (JNCC, 2010 2) considers that disturbance in terms of UK regulations is unlikely to result from single, short-term operations, e.g., a seismic vessel operating in an area for 4-6 weeks, or the driving of a dozen small diameter piles. Such activities would most likely result in temporary sporadic disturbance, which on its own would not be likely to impair the ability of an animal to survive, reproduce, etc, nor result in significant effects on the local abundance or distribution.		
JNCC3	We commend POEPL on their intention to follow JNCC mitigation guidelines for use during piling operations. Given that the activities will be carried out in deep waters and the possibility of deep diving species	POEPL accepts this comment and is commited to including the 60-minute pre-watch into the EMMP outputs where it will be carried forward into operations. MMO reports will be submitted to FIG after the end of the relevant operations.	==

Consultee	Representation	POEPL response	Amendments/further detail
	being present, we advise the use of a 60-minute pre-watch period. Adequate implementation of the guidelines, customised to mitigate for predicted injury ranges should reduce the risks of injury to marine mammals to negligible levels. We recommend use of the guidelines are included as a condition of any consent issued and Marine Mammal Observer (MMO) reports are provided at the end of the project to licensing authority.		
JNCC4	We also commend POEPL on their intention to introduce measures to reduce collision risk to marine mammals in inshore waters. We agree with the approaches proposed and again recommend using these measures are included as a condition of any consent issued.	POEPL accepts this comment. It is expected that this will be included in the EMMP outcomes and suggest that a specific condition may not be necessary if compliance with an EMMP is an overarching condition.	==
JNCC5	We note that specific details as to how either of these mitigation plans will be implemented is sparse within the EIA, as is information on proposed monitoring plans. FIG may wish to consider including a requirement in any consent issued, for a marine mammal mitigation and monitoring plan to be produced and approved (by the regulator and/or a nature conservation advisor) prior to works commencing. JNCC are	POEPL will develop an Environmental Management and Monitoring Plan which will draw on the outline in the EIS and output of the EMMP workshop that includes all such activities. Currently, the EIS structures the draft EMMP into types of work and marine mammals are included in 15.5.1.3, 15.5.2.5 and 15.6.3.2. POEPL would be very happy to discuss optimal structuring of the EMMP to make it most useful to stakeholders and we suggest this can be done immediately post EIS-approval when an EMMP workshop will be held.	==

Consultee	Representation	POEPL response	Amendments/further detail
	available to offer advice on such a plan should you require it.		
JNCC6	The document states that "However, none of the species found are rare or protected under any Falkland Islands legislation". Although this statement may be true, this does not mean that areas of conservation interest may not still be present in the area (noting that work is ongoing in the Falkland's to identify marine areas that support important aggregations of seabirds and other fauna) and therefore a cautious approach should be taken.	POEPL understand the important areas of conservation interest and agree that a better wording would be e.g., "Although none of the species found is rare or protected under any Falkland Islands legislation. Work is ongoing to identify important marine areas, and as such work develops, new designations can be incorporated in the ongoing management of the project *via* the EMMP and the 5-yearly review of the EIS."	Text amended.
JNCC7	The bullet points at the top of the page state that only six species were recorded in mud habitat and five species were recorded in fine sand habitat. JNCC considers that these numbers seem extremely low for the area and would ask POEPL to clarify if these are correct, and if so, explain why this might be the case? Were the surveys undertaken only considering epifauna, rather than the addition of infauna?	The SMSG surveys are visual census surveys based on Reef Life Survey (RLS) methods which were used to estimate densities of invertebrates and macroalgae, as described in Edgar and Stuart-Smith (2014). Therefore, only a record of epifauna / flora on the surface of hard and soft sediments is presented. The surveys are repeatable and comparable in this context.	==
JNCC8	JNCC would request that in future applications POEPL use the Latin genus and species name, where possible, to aid identification and prevent confusion between common names of species.	Accepted, and we will also consider adding an Appendix to list all the species referred to.	Throughout the document, we have endeavoured to provide scientific names where a species is first mentioned in the text.

Consultee	Representation	POEPL response	Amendments/further detail
JNCC9	JNCC would request that if any species of conservation importance e.g., sponges or deepwater corals are found during future surveys, that they be recoded and avoided by operations where practically possible.	POEPL agrees and we expect to have a common understanding of what such species are in advance of any guidelines specific to the Falkland Islands. At the FPSO anchor locations, Drilling Rig anchor locations, well locations and flow line routes we will undertake site surveys (normally sidescan sonar) prior to mobilising to the site that will identify features with unusual reflectivity which will then be targeted with ROV survey. We will take all reasonable measures to avoid direct impacts to any significant features in full consultation with FIG and its advisors including JNCC.	==
JNCC10	JNCC would request that 'Large dropped objects' be included in further assessments, as we believe that until further surveys are conducted, the impacts of large dropped objects on the seabed cannot be fully considered and understood.	Agreed, and the table already states that further assessment is required with regard to large dropped objects.	==
JNCC11	JNCC would request that 'Discharges of hot water from cooling systems' be included in further assessments, as we believe that the impacts of water, heated above ambient temperature, on surrounding benthos, particularly in waters influenced by cold water currents, is still not fully understood and would need further consideration.	Agreed, and the table already states that further assessment is required with regard to thermal discharges.	==
JNCC12	JNCC would request that 'Presence of oil spill infrastructure' be included in further assessments, as we believe that until further surveys are conducted and the final decision is made on what infrastructure will be installed, the extent and severity of	Agreed, and the table already states that further assessment is required with regard to the presence of oil spill infrastructure.	==

Consultee	Representation	POEPL response	Amendments/further detail
	the impact cannot be fully understood.		
JNCC13	JNCC would ask POEPL to justify the inclusion of 'Fuel combustion for power generation by all vessels during all activities' in further assessment regarding its impact on benthos. We would expect this operation would have limited or no impact on the areas benthos.	Agreed, but we note that this is not currently included anyway.	==
JNCC14	Page 303, Table 55, Line 2; States 'Sand cobbles and pebbles medium depth'. JNCC request that POEPL clarify what is meant by 'medium depth'?	The descriptor 'medium depth' is linked to the terminology of the SMSG depth strata classification and in the sense in which they are used in the EIS, 'medium depth' can be ignored.	==
JNCC15	JNCC would request that POEPL increase the image size of habitat video/ stills taken in the areas of interest to help facilitate better understanding of the habitats present, more accurate classification and aid in providing appropriate conservation advice.	These were graphics prepared by Benthic Solutions and we are unable to modify them. We suggest it would be preferable to provide the original reports to JNCC which we are happy to do.	==
JNCC16	JNCC would request that POEPL provide evidence as to why the mussel beds recorded at stations 11 and 17 do not constitute 'mussel bed' habitat?	Our interpretation is that the mussel beds at stations 11 and 17 are biogenic reefs but the small aggregations of mussels found at four other stations are not considered to be biogenic reefs. We note OSPAR policy in respect of Lophelia pertusa and Sabellaria spinulosa habitats, that aggregations less than 25m2 are considered of lesser conservation importance.	==
JNCC17	JNCC would like to highlight to POEPL that the OSPAR List of threatened habitats includes intertidal Mytilus	PMO would say there are some questions over their taxonomy here. They are abundant in the Falkland Islands and are unlikely to represent a threatened habitat here.	==

Consultee	Representation	POEPL response	Amendments/further detail
	edulis beds, as well as those stated in this section.		
JNCC18	JNCC commends POEPLs commitment to carry out further seabed surveys to inform baseline information, validate the EIA and assess any future remediation needs, as well the creation of a POEPL monitoring strategy during the Environmental Monitoring and Management Plan (EMMP) workshop. JNCC are available to offer advice on such a plan should you require it.	POEPL appreciates the kind offer and look forward to receiving JNCC's advice.	==
JNCC19	There is evidence that suggests marine benthos can in some instances react to impacts from noise, JNCC request that POEPL show their reasoning behind the scoping out of noise impacts on marine benthos.	POEPL are aware of a small number of studies, e.g., linking mussel feeding behaviour to the noise from passing ships, although we are not aware it is a matter of significant concern. We will reference this topic when updating the underwater noise assessment to explain why it is not in scope for more detailed evaluation.	The underwater chapter has been revised and this was scoped out.
JNCC20	There is also evidence that suggests marine benthos can be impacted by artificial light, particularly in areas of shallow water. JNCC request that POEPL show their reasoning behind the scoping out of light impacts on marine benthos.	POEPL are aware of a small number of papers on this topic and will continue to review the literature on this topic. Given the depth of water offshore (>400m), it is not anticipated that any light would reach the benthos, and underwater lights are restricted to the use of ROVs which have a very localised spatial extent and used intermittently, hence the issue has been scoped out. Inshore, ships' lighting is already a feature to which the benthos is routinely exposed (see existing satellite images of light in Figures 145 and 146) and the additional impact of POEPL's activities is not considered of concern.	==
JNCC21	The last bullet point mentions several small Southern Giant Petrel colonies in the north of East Falkland, at Black	POEPL confirms that the giant petrel colonies referred to are included within the 'Very sensitive areas' on Figure 147 in 10.2.4.2.3. Our exploration well campaign provider Bristows were contacted regarding their observance of	==

Consultee	Representation	POEPL response	Amendments/further detail
	Point and Rincon Grande. Giant Petrels are extremely susceptible to disturbance from their nest sites and abandon nests and eggs at a very low disturbance threshold (R. Phillips, pers comm.). It is not clear from Figure 147 exactly where the Southern Giant Petrel colonies are located and if they coincide with the flight path from Stanley Airport to the Sea Lion Field. These colonies, being located some distance from Stanley or MPN airports are not likely to have become habituated to disturbance from helicopter noise. It may be advisable to ascertain whether the FILFH avoidance maps indicate avoidance of these colony areas or stipulate a minimum flight height of 3,000 ft.	the low flying handbook, and in response they confirmed the strict induction process that takes place, they provided POEPL with the maps used as the basis for avoiding areas sensitive for wildlife and they also noted that all flight paths are recorded and retained on their GIS system for later enquiry. In examining the flights for POEPL during the Exploration Wells campaign, the vast majority of logs are at 4000' or 5000', well above a height that should cause an issue for wildlife. A small number of points were identified that were lower than 3000' over the areas with higher potential for bird strikes, but these appeared to be either low-level SAR flights or that the altitude had to be reduced for operational reasons and hence remained in line with the local policy. An example of the GIS system screen is shown in 'Additional Information'. POEPL believe the issue has been accurately assessed but we are very happy to facilitate a conversation with Bristows for a more exhaustive look at the historic data.	
JNCC22	Whilst JNCC would accept the 'Risk Significance' to be 'Low', given the presence and projected application of the Falkland Islands Low Flying Handbook (FILFH 2015), however we would query the assessment of 'Disturbance to Wildlife' in terms of 'Sensitivity' as 'Low'? This is given the previous extensive section in 10.2.4.1.1 detailing the nature of potential impacts to seabirds, such as penguins, where a mass mortality incident of 7,000 King Penguins was	The scale of the incident described in Rounsevell and Binns 1991 and Cooper *et al.,* 1994 was linked to the local geomorphology and is not typical of interactions between helicopters and penguins observed elsewhere (e.g., Hughes *et al.,* 2008). The assessment states that; by following the FILFH guidelines the exposure of sensitive receptors will be greatly reduced hence the sensitivity of the receptor is also reduced and is considered to be Low (as defined in the methodology).	==

Consultee	Representation	POEPL response	Amendments/further detail
	attributable to over-flight by a helicopter (Rounsevell and Binns, 1991; Cooper *et al.,* 1994).		
JNCC23	JNCC note the High numbers of Sooty Shearwater in Berkeley Sound during the periods Summer, Autumn and Spring. Also noting that this species is given a Near Threatened (NT) status under IUCN.	Response included in JNCC25	==
JNCC24	Also noting, from Table 123, the High numbers of Prion species present in North Falkland Basin area during winter, when the potential for collision is significantly increased due to more frequent occurrence of poor weather and longer nights. Although we recognise these species are given an IUCN status of Least Concern (LC).	Response included in JNCC25	==
JNCC25	We would query the assessment of impact being 'Possible' for likelihood of multiple bird strike for both areas. We note the evidence presented in Table 124 on bird strikes reported during the 2015 POEPL Exploration Drilling Campaign, which does indicate a level of both bird strikes and mortality associated with it. However, these incidents are all single individual strikes, and would seem to give no supporting indication as to the likelihood (or otherwise) of multiple bird strike incidents. From a precautionary standpoint, it would	The assessment draws on experience of bird strikes around the Falklands. There are many vessels operating both offshore and within Berkeley Sound; although small scale bird strikes frequently occur, large events such as that described in Black 2005 have not been reported. However, the likelihood of 'Possible' acknowledges that these events are likely to occur within the life of the Sea Lion Field, which is appropriate in our opinion. During the recent Exploration Wells campaign, no bird strikes were reported offshore and the two strikes reported were at the TDF where the facilities were not obviously any different to many other commercial facilities on the shoreside.	==

Consultee	Representation	POEPL response	Amendments/further detail
	seem reasonable to allow for the possibility of there being at least one incident of multiple bird-strike events in a year. Adequate monitoring and reporting of such incidences as development continues will provide important contextual information as to the likelihood or not of such multiple bird-strike events happening on an annual (or less frequent) basis. Moreover, on the provision of monitoring data regarding such incidences, a more informed examination of the likelihood of impact on particular species can be made. We would note that if multiple bird-strikes were observed to occur, then the likelihood or not of potential impact at a population level, is entirely dependent on the scale of the incident (and therefore further data is required before anything conclusive can be stated). A previous incident of vessel lighting induced mortality of Southern Ocean seabirds, reported 900 birds impacted on a single night (Black 2005).		
JNCC26	JNCC welcome the plans to continue the Bird Strike Monitoring Programme (BSMP), initiated during the 2015 exploration drilling campaign. However, we would note	Response below - JNCC27.	==

Consultee	Representation	POEPL response	Amendments/further detail
	that information on how any bird strikes that do occur will be preserved and identifications made could not be found within the EIA It will be important to ensure that those monitoring the bird strikes have sufficient identification skills to accurately record the species subject to bird strikes, particularly if birds are being released alive (as opposed to dead birds being kept and later identified).		
JNCC27	JNCC would be interested in further details of the BSMP, in particular, how, when and who will record any incidents of bird collisions and to what body these will be reported to? JNCC also requests clarification on the following points: • What would the response be to a large incident of bird strike i.e., with many individuals injured or killed in one day or one short period? • Would all these individual birds be thoroughly recorded and species identified? • Is there a critical threshold number of birds where operations that may be attracting birds, such as flaring if this took place, or adverse weather conditions, would be halted?	The EMMP includes setting up an initial seabird and MMO observer network using available vessels and establishing a monitoring and reporting format. A Bird Strike Management Plan is a commitment within the EMMP and we will consult on the best methods to deliver this plan. We would begin by ensuring the design and operation of the facilities followed OSPAR Agreement 2015-08 to minimise risks. Bird strike will be established as a specific operational metric. POEPL anticipate that trained crew members on the installations would be responsible for recording and reporting bird strikes, and the means of ensuring robust results will be discussed *via* the EMMP and informed by the initial seabird and MMO network. References such as Ronconi *et al.* (2015) provide a basis for such monitoring. HSE incidents such as this are routinely reported on installations *via* the daily operational meeting ('morning call') in the first instance and included in the Daily Report for the installation so that it is flagged to managers who are then responsible for investigation and closeout. This would include reporting to the regulator in a reasonable timescale (e.g., within 48 hours in the UK for non-compliances, or forthwith if there are ongoing issues requiring regulator input). The 'bird monitor' would be familiar with the issue of bird attraction *via* his induction (as would the Offshore Installation Manager) and they would immediately investigate sources of light, food, weather patterns, bright	==

Consultee	Representation	POEPL response	Amendments/further detail
		objects, odours etc. that might be contributing. The OIM is experienced in making real time decisions about emerging HSE issues in terms of when and how to modify operations and will also contact his managers quickly to discuss the appropriate reaction or precautions. This would involve minimising the perceived attractant immediately as far as safely possible. The bird monitor would count all birds and photograph separate species or significantly different individuals for later identification. As well as collecting any dead birds for identification, any live birds found on deck would be cared for until it was deemed safe to release them.	
JNCC28	JNCC note that 'Large scale bird collisions offshore' merits a 'severity' rating of 'Moderate' and yet 'Large scale bird collisions inshore' merits a 'severity' rating of 'Minor'. What is the reason for this disparity in 'severity' assessment?	As stated in the ES; inshore, POEPL's activity adds to an already existing significant source of light pollution. However, offshore the Development represents a new, 'permanent' light source particularly in the winter. As such there is a greater deviation from the current baseline offshore.	==
JNCC29	As highlighted through the EIA, there are a number of threatened, vulnerable and endangered seabird species that frequent the waters around the Sea Lion field. A major accidental oil spill event has the potential to impact upon and kill significant numbers of protected seabirds through oiling and ingestion of oil.	Response is below (JNCC30).	==
JNCC30	Figures 95-98 on pages 380 to 383 clearly demonstrate the vulnerability of various seabird species throughout the year in the form of the Seabird Vulnerability Maps. However, POEPL should be made aware that these maps are based on data collected	POEPL is happy that JNCC recognise the clear demonstration of seabird vulnerability provided by Figures 95-98. It is acknowledged in the EIS that the age of the Seabirds-at-Sea dataset, and inherent limitations of the survey method, mean that there are some questions regarding how representative the data are of present day populations. See Section 7.4.5.2.1.1. The EIS does acknowledge data gaps and the methodology explicitly incorporates uncertainty. An independent	

Consultee	Representation	POEPL response	Amendments/further detail
	some 20 years ago as part of the SAST surveys.	review of the data (Genesis, 2017) concluded that while there were gaps, the seabird data was adequate for EIS purposes and equivalent to frontier areas of the UK with oil and gas activity. Given these uncertainties, a precautionary approach has been applied to the assessment of risks to seabirds e.g., in the oil spill assessments they have been considered as high sensitivity and impacts assessed as moderate, serious or major depending on the size of the spill. It is also acknowledged that a combination of satellite tracking and at-sea observations is likely to provide the best overview of seabird distribution within the waters of the Falkland Islands. The Sea Lion Development EIA process has been guided by local experts *via* the Hydrocarbons Forum and Gap Analysis Projects. POEPL and partners have funded the Gap Analysis Project to identify and help complement project-based knowledge and reduce uncertainty, and available results have been included in the EIS, including using seabird tracking data to complement the 3-year regional seabird programme published in 2002. Satellite tracking of higher predators has been ongoing and the results have recently been amalgamated with data collected throughout the Falkland Islands. The findings of this work will be applied to further colonies in a predictive form to better determine the distribution patterns of seabirds and seals. However, the results of this latest work were not available at the time of writing.	
JNCC31	Page 1107, Figure 237; shows that the whole of the north coast of East Falkland would have exposure to oil, covering King Penguin colony at Volunteer Point, all other penguin species and Southern Giant Petrel colonies on north coast of East Falkland. Therefore, it would be helpful in this section to have a summary of oil spill response procedures for the treatment of oiled	Figure 237 indicates that there is a low probability of oil reaching the shore following a worst-case blowout i.e., there is zero shoreline oil in many outcomes. The worst case volumes are still a very small fraction of the release and would barely be detectable spread over such large areas. By the time oil reaches the coast (minimum of 80 days), it will have weathered and pose little risk of oiling seabirds. Oil Spill Strategies have been prepared as agreed with FIG. These include Offshore and Inshore Oil Spill Strategies, both of which have been submitted to FIG. These detail all the main items of equipment and response methods including wildlife response and shoreline response to minimise further exposure to which POEPL is committed as part of their response and which provide a clear basis for the Oil Spill Contingency	==

Consultee	Representation	POEPL response	Amendments/further detail
	seabirds, in the event of a serious accidental oil spill incident in the Sea Lion Field, as well as measures to be taken to minimise the further exposure of birds to further oiling after the event.	Plans which will require FIG approval before operations can commence. POEPL's use of detailed hydrodynamic and spill models allow the response to be targeted and proportionate.	
JNCC32	We are concerned with the limited options and constraints presented for oil spill response and believe that a large scale pollution incident from this development could potentially have significant impacts on the environment around the Falklands.	POEPL acknowledges this statement of concern. It is inevitable that large-scale pollution incidents can have significant impact wherever they occur in the world, and this is reflected in the assessment. The nature of Sea Lion Crude is, however, less hazardous than most crudes from which experience is drawn from historic incidents - it is less adhesive to birds' feathers, less adhesive to shorelines, less likely to contaminate sediments and less soluble with a lower PAH content making it less toxic in the marine environment. It is far more important to prevent releases than to attempt to control oil once it is in the environment, particularly offshore where weather conditions limit recovery and given that dispersant is not effective. Spills are prevented offshore by a variety of means including the application of Safety and Environmentally Critical Elements processes which were strengthened after the Deepwater Horizon incident *via* a European Directive and a significant revision of the Safety Case Regulations. These require systems that control Major Environmental Incidents to be managed in a formal way that brings those risks to a tolerable (low) level, by ensuring that systems are in place to manage critical equipment (design, reliability and maintenance), operational procedures and personnel competence, brought together as the management of Safety and Environmentally Critical Elements.	==
JNCC33	National Oil Spill Contingency Plan The documents states that "Oil spill response equipment is stored at the Falklands Interim Port And Storage System (FIPASS) to counter this risk. Offshore, the NOSCP relies on the use of dispersants providing that the oil	POEPL has designed its oil spill management around its own risks and does not rely on the NOSCP alone. In addition to pre-positioned equipment, POEPL has access to the international inventory of equipment managed by Oil Spill Response Limited and Wild Well Control. The EIS does include an evaluation of a sustained response to a 77- day blowout and predicts that 12% of oil on average could be recovered offshore, and recovery would be much higher inshore where weather conditions are more favourable.	==

Consultee	Representation	POEPL response	Amendments/further detail
	and environmental conditions are suitable". However, we note that dispersant chemicals are not considered as a viable option as they are not effective on Sealion Crude. With this in mind JNCC would like POEPL to clarify whether this pre-positioned equipment would be able to sustain a significant spill clean-up? Can POEPL provide information on how much sealion oil the pre-located equipment could contain/ recover and how long this response could continue for if being used in an ongoing response? We note from experiences of spill incidents and exercises around the UK that oil containment equipment can only recover a relatively small proportion of a slick.	Dispersant use is not effective on Sea Lion crude and is not planned and in any case, dispersant merely moves oil from the sea surface into the water column and reduces mechanical recovery. The reliance on dispersant use in UK-based responses is a key reason why recovery during historic incidents is often poor. Recovery proportions in Norwegian-based responses where mechanical recovery is favoured are much higher. The response plans for Sea Lion crude focus on mechanical recovery. A response will continue for as long as necessary, to a point where the incident commander decides that the actions are no longer productive. POEPL routinely makes financial provision for a response that includes the 77-day period to arrest a blowout and a 172-day period to drill a relief well if necessary. This also includes the cleanup that is simultaneous to this and the cleanup that takes place after the source has been controlled. The Inshore Oil Spill Strategy for example shows activities continuing for 6 months in a Tier 3 scenario.	
JNCC34	Inshore Oil Transfer JNCC accept that the occurrence of an accidental release of oil is unlikely. However, due to the oils properties: thick, persistent, unlikely to break up naturally for some time, as well as not being amenable to dispersants, there are still major concerns to the marine environment; particularly for seabirds and marine mammals, especially within Berkeley Sound. We would suggest keeping higher risk activities offshore where possible and	POEPL is committed to continuing to pursue the feasibility of Direct Offtake of oil from the FPSO to conventional trading tankers. If this is proved viable, it would remove the need for the routine Inshore Transfer of crude oil - please see the document referenced under 'Additional Information - JNCC34' for a fuller description of this issue. Currently, Inshore Transfer is a necessary part of the development and the use of Berkeley Sound is primarily to take advantage of the calmer weather conditions and straightforward navigation that reduce safety and environmental risks. Our quantitative risk assessment study, undertaken by DNV-GL and referenced in the EIS, has also enabled us to identify the operational measures necessary to minimise risk such as the use of a	==

Consultee	Representation	POEPL response	Amendments/further detail
	ask if POEPL has considered the precautionary setting up of booms around the bunkering operations an option, or using technology such as smart buoys (this technology is used in Arctic shipping lane routes to detect traces of hydrocarbons in the water and helps to facilitate a rapid response).	mooring buoy, a qualified Pilot, a vessel traffic management system, and many other measures. For bunkering of fuel in Berkeley Sound we will have in place a dedicated oil spill response vessel and a Multi-Role Support Vessel with oil spill response capability and bunkering would be undertaken to international standards including the OGUK Guidelines for Offshore Marine Operations. The risks are not of the same scale as transferring a crude oil cargo, and are managed appropriately without defensive booming. We note that Berkeley Sound has been chosen as a sheltered water used historically as an anchorage and fuel/cargo transfer location where the risk of accidents due to weather is minimised. POEPL has employed several international experts in oil spill response to design the response strategies and equipment. The risks from our operations are present at discrete locations at the FPSO and mooring buoy in Berkeley Sound where there is a high level of surveillance from the vessels present, and the use of smart buoys has not been recommended. POEPL appreciate this advice and will confirm with our advisors the suitability of such devices and continue to monitor the recommended equipment and emerging technologies as we draft the Oil Spill Contingency Plans for approval prior to operations. We can see the potential of such devices as an early warning system for unidentified sources of oil and it may be a solution to help detect existing sources of oil pollution that give rise to underlying levels of bird contamination in the Falkland Islands."	
JNCC35	Dedicated Oil Spill Response Vessels JNCC would like to query why a dedicated oil spill response vessel is not required during certain parts of the proposed operations? Given worst-case scenario well blow-out rates and the assumption that in ideal weather conditions, 30 tonnes of oil an hour could be recovered, POEPL predict that 12% of spilled oil could	The dedicated oil spill response vessel is required in Berkeley Sound prior to any tankers entering, and will remain there in a state of readiness until all tankers have left. Our hydrodynamic simulations of Berkeley Sound and our monitoring using a wave buoy have confirmed that conditions are such that mechanical recovery of oil in Berkeley Sound is feasible in the vast majority of conditions. Offshore, however, sea states are much higher, and this makes the catamaran design of the dedicated oil spill response vessels inefficient and their overall size and seaworthiness is also unsuited to serious duties offshore. Although containment technology in the form of booms is	==

Consultee	Representation	POEPL response	Amendments/further detail
	be recovered. We query why more containment equipment is not on standby and what is the likelihood that mechanical recovery would be possible given the Falklands offshore weather conditions? It would also be good to understand further why in-situ burning was not considered as a viable option (i.e., the document mentions the need for FIG consent (Page 121), but this isn't explained in any detail and seems to have been scoped out of response planning without much explanation).	available in a range of duties and designs, sea states in excess of 2.5m are very problematic in achieving significant rates of oil recovery worldwide. POEPL has included oil spill recovery equipment on the Multi-Role Support Vessel that will be in attendance offshore, which can be deployed in 30 minutes in the event of a spill, equipped with two skimmers capable of 60 tonnes per hour recovery combined. 12% is the expected recovery fraction for a prolonged subsea blowout where dispersed oil is emerging onto large areas of sea surface, and where it is conservatively assumed that ongoing safety issues prevent recovery for the first 24 hours; for smaller spills, recovery can be more targeted and more rapid and a much higher recovery would be expected in favourable conditions. The prevention of oil release is of primary importance and this is controlled by the management of Safety and Environmentally Critical Elements. Burning of the Sea Lion crude has not been recommended due to a combination of the difficulty of booming oil for long enough offshore in the expected sea states and, more importantly, due to its low content of volatile (flammable) components making it very unlikely to burn. This possibility was discounted at an early stage by our oil specialists.	
JNCC36	Oil Spill Contingency Plan The document states that "POEPL has developed an Offshore Oil Spill Strategy for the Sea Lion Development which identifies the essential components of spill response for this operation. It will shape an Oil Spill Contingency Plan (OSCP) that will later (closer to the start of operations) be submitted as a separate document which contains specific operational information, such	The Oil Spill Strategies (for Offshore, Inshore and Stanley Harbour) were available during the consultation period. We attach the relevant section on wildlife response ('Additional Information') which has been developed by a group of international experts including Aiuka in Brazil who are recognised for their skills in responding to oil spills affecting South Atlantic wildlife. The remote location and the current scarcity of manpower and equipment were significant considerations when the strategies were developed and is reflected, for example, in using POEPL staff and offshore crews as part of the staffing of oil spill response, whereby the FPSO would be down manned in the event of a serious incident. POEPL also has access to personnel and equipment resources *via* Oil Spill Resource Limited for Tier 3 response.	==

Consultee	Representation	POEPL response	Amendments/further detail
	as detailed action lists and contact details for personnel". It would be helpful to have an understanding of what these plans are in relation to seabird and marine mammal oiling, given the remote location of the Falkland Islands and the difficulty of obtaining man-power and equipment in the short time frame necessary to affect a rapid response to a large-scale wildlife oiling event. Are there facilities on land/ plans in place for this?		
JNCC37	Considering the oil type/ predicted behaviour and general offshore weather conditions likely to be encountered in this area, we ask that the OSCP details how tracking and monitoring of an oil spill/ actual slick would be carried out, as the response options presented seem to be fairly limited for this development. We assume this document will also detail waste management plans. JNCC would welcome being consulted on the production of the OSCP and available to offer advice on such a plan should you require it.	Surveillance is a key part of spill response and is documented in the Oil Spill Strategies. The surveillance would be carried out by trained personnel and specialised equipment. - Helicopter surveillance: Crew change helicopters will be utilised to conduct aerial surveillance. For this to be effective several POEPL personnel will be trained in aerial surveillance. Infrared cameras will be available for helicopter deployment. - Tracking Buoy: A tracking buoy will be stored in the warehouse onshore and transported to the source of the spill when required. The tracking buoy will accurately track a surface oil spill dependent on prevailing Metocean conditions. - Satellite: POEPL has access to satellite surveillance through membership with OSRL. - Aerostat surveillance system: Helium aerostat (balloon) fitted with optical and infrared sensors to monitor oil trajectory and location day and night. Data link back to command centre. This system was chosen over a remote controlled aerial droid surveillance due to the reduced training requirement and robustness of the system being able to withstand 50 knot winds. Computer modelling of the spill would be started immediately using the forecast mode of the detailed hydrodynamic model generated by POEPL	==

Consultee	Representation	POEPL response	Amendments/further detail
		along with the oil weathering properties determined by laboratory analysis in order to focus surveillance and response actions. The modelling would be updated with visual observations as the response progressed. We have specifically tested detection of the oil masses at the laboratories in CEDRE and confirmed that IR detection is viable. We would be very happy to discuss the preparation of the OSCP with JNCC post-sanction of the project.	
JNCC38	Sufficiency of survey evidence JNCC is of the opinion that insufficient survey evidence was presented in the application to allow the best provision of accurate and meaningful advice. While we recognise that it is unlikely that survey-based data can be expanded upon for this application, we provide the following to help FIG and POEPL understand what we consider necessary in an application. • Survey data should at least include the area of proposed operations, unless justification is provided as to why wider area surveys are sufficiently representative of conditions at the site of proposed operations. • Survey data should provide adequate evidence that habitats and species of nature conservation concern are or are not present. • It is good practice to include a diagram indicating the surveyed area in the context of the proposed	Sufficiency of survey evidence JNCC is of the opinion that insufficient survey evidence was presented in the application to allow the best provision of accurate and meaningful advice. While we recognise that it is unlikely that survey-based data can be expanded upon for this application, we provide the following to help FIG and POEPL understand what we consider necessary in an application. • Survey data should at least include the area of proposed operations, unless justification is provided as to why wider area surveys are sufficiently representative of conditions at the site of proposed operations. • Survey data should provide adequate evidence that habitats and species of nature conservation concern are or are not present. • It is good practice to include a diagram indicating the surveyed area in the context of the proposed activity and to identify any sample points or the location of photographic evidence. Data provided should also include high resolution acoustic data, video and /or still images. However, JNCC accept that POEPL has stated that they are committed to carrying out further seabed habitat surveys as part of their Sealion field development Environmental Monitoring and Management Plan (EMMP). JNCC are available to offer further advice on such a plan.	==

Consultee	Representation	POEPL response	Amendments/further detail
	activity and to identify any sample points or the location of photographic evidence. Data provided should also include high resolution acoustic data, video and /or still images. However, JNCC accept that POEPL has stated that they are committed to carrying out further seabed habitat surveys as part of their Sealion field development Environmental Monitoring and Management Plan (EMMP). JNCC are available to offer further advice on such a plan.		
JNCC39	Stabilisation material The application involves the potential introduction of hard substrate into a mainly sedimentary environment. Although the changes are not necessarily considered as having a significant impact in this instance, we still encourage POEPL to continue working to minimise the amount of hard substrate material used. We note that the long-term effect of the introduction of substratum into naturally sandy or muddy sea beds is not fully understood at present and should be carefully considered by the regulators. We would welcome further detailed commentary on stabilisation/ protection operations to allow	Currently POEPL do not envisage rock placement being necessary for stablisation or impact protection in the project and so there is no further information to provide on this topic. In terms of pipeline protection, there is little fishing activity predicted in or near the immediate footprint of the facilities, a standby vessel will be present at all times and surface laid lines will be designed for anticipated loading from bottom gear as a precaution. Should a potential deployment of rock arise at a later stage in the project we are certainly aware of JNCC's concerns and appreciate the expectations around it being brought to our attention.	==

Consultee	Representation	POEPL response	Amendments/further detail
	further understanding of their actual potential nature conservation impact. This would include: • Location of dump sites • Size / grade of rock to be used • Tonnage / volume to be used • Contingency tonnage / volume to be used • Method of delivery to the seabed • Footprint of rock • Assessment of the impact • Expected fate of deposit after end of production, i.e., will it be left *in situ* or recovered?		
JNCC40	Cumulative Impacts JNCC wish to clarify why fisheries within the Sealion field have not been considered as a factor that could influence cumulative impacts of the project?	Fishing intensity in the vicinity of the field is so low that cumulative impacts are not considered a realistic prospect.	==
JNCC41	Gap Analysis Programme JNCC ask whether POEPL expect to have additional survey data and outputs prior to the commencement of the drilling campaign?"	Prior to commencement of the drilling campaign we expect additional outputs to be available from the GAP Phase II work scope including work on identifying squid spawning grounds and also outputs from the out workings of the Phase I work scope e.g., applying tracking data findings in a predictive mode for other colonies. POEPL will commission SAERI to undertake a further inshore seabird survey and begin work on integrating this into seabird colony population estimates. POEPL will set up a seabird carcass survey protocol by selecting representative beaches for survey, with the aim of being able to distinguish	==

Consultee	Representation	POEPL response	Amendments/further detail
		the added impacts of oil spills on background oiling and mortality at reference locations. Site survey data will be collected at the development location prior to the arrival of the drilling rig and FPSO to identify any local seabed features of interest.	
JNCC42	Invasive species The introduction of non-native species to the marine environment around the Falkland Islands could pose a major threat to native biological diversity. JNCC commends POEPL's commitment to follow IMO guidelines on exchanging ballast water and managing biofouling organisms. JNCC also commends POEPLs commitment to taking samples of ballast water for analysis from all vessels coming inshore and arriving 'in-ballast', as well as the review of sampling results being drawn into the EMMP.	POEPL appreciate the feedback on managing invasive species.	==
JNCC43	JNCC ask POEPL to confirm if the weather conditions considered 'acceptable' i.e., Mean 10-min wind speed <30knots, Significant wave height <3m and Visibility >1,000m are realistic for the Sealion Field and whether these 'acceptable' criteria are based on modelled date or historical data from the area?	POEPL confirm that these criteria are satisfied for the majority of the time at the Sea Lion Field location and the full spread of metocean conditions are included in our design, operational and safety assessments which are in turn reflected in the project economics. A large amount of metocean analysis and measurement has been done to accurately determine the sea and weather conditions which feed into a wide variety of decisions. A detailed hydronamic model has been constructed by BMT in collaboration with Oceanwise using the TUFLOW model drawing on international datasets for metocean forcing and where results have been calibrated using measured data from oil and gas operations in the basin over many years. Data gathered by POEPL during exploration wells in the vicinity of Sea Lion has also been used as input to the model. The model has produced 20 years of	==

Consultee	Representation	POEPL response	Amendments/further detail
		outputs at a high resolution that are used e.g., for predicting the proportion of weather conditions suitable for offloading using different vessels. POEPL can supply the metocean modelling report to JNCC.	
JNCC44	Decommissioning JNCC consider it best practice for decommissioning plans to be outlined in as much detail as practically possible, as early as possible in the planning stages of a fields development. Although the EIA states that all subsea infrastructure and pipelines will be removed during the decommissioning of the Sealion field, we would request that POEPL take a pragmatic approach and consider if this 'clear seabed' approach is achievable in its entirety, and if not, to begin discussions about what might be left *in situ* as a worst-case scenario. Should FIG require a full decommissioning plan for this project then JNCC are available to offer advice on such a plan.	The EIS notes that the concept allows for the simplest means of decommissioning. It is true that some items such as small flow lines can be problematic to recover in later field life if they have become weakened or buried etc. and there may be a discussion around such items closer to decommissioning to be included in a Decommissioning Programme for approval. Nevertheless, we expect to follow UK practice in that the main infrastructure items will all be removed and a debris survey will be undertaken resulting in a clearance certificate.	==
JNCC45	Survey Reports JNCC request that POEPL provide any environmental survey reports relating to the Sea lion field development to us when available.	See response JNCC38; large amounts of data are stored in the South Atlantic Database hosted by SAERI http://www.south-atlantic-research.org/metadata-catalogue. The original datasets can be requested from the data owners, and a significant amount of data is publicly available *via* the webGIS service associated with this site.	==
JNCC46	Corrections The paragraph references Chapter 0, 11.0 and 0, however it appears this reference doesn't exist in the document. We request that	Noted, this should be Chapters 10, 11 and 12.	All links to Chapters, Sections, Figures and Tables have been checked in the final document.

Consultee	Representation	POEPL response	Amendments/further detail
	this reference is amended for the next version of this publication.		
Falkland Islands Government, Department of Mineral Resources (DMR)			
DMR1	General: Page: : Proposed date for EMMP workshop?	POEPL would aim to undertake an EMMP workshop Post-EIS approval and in the run-up to a Sanction decision at a mutually convenient time.	==
DMR2	General: Page: : The FIG Wildlife Response Plan 2015 is not mentioned and should be as a separate document to the NOSCP	Agreed, this could be made clearer.	FIG's Wildlife Response Plan 2018 was published after submission and will be included in the Oil Spill Response Plans that are required for the project closer to operations.
DMR3	General: Page: : The Offshore Oil Spill Strategy and Stanley Harbour Spill Strategy should both be in the list of references and accessible by members of the public on request.	These can be added to the references and we have advertised their availability at all public consultations sessions.	References updated
DMR4	2.1.2: Page: 72: Has the FDP document FK-SL-PMO-PM-PLN-0004 (referenced in this para) been requested by the public as part of the consultation, and has it been made available if so?	The FDP was not requested by the public during the consultation - however POEPL would be willing to release FDP related information if required to address a comment but with any commercially sensitive information redacted.	==
DMR5	2.4.1: Page: 80: Spurious chapter ref to "Chapters 0, 11.0 and 0" – clarify.	The references are incorrect and should read Chapters 10.0, 11.0 , 12.0.	All links to Chapters, Sections, Figures and Tables have been checked in the final document is compiled.
DMR6	3.1.6.3.1: Page: 89: It would be preferable to refer to the Offshore Minerals Ordinance 1994 as ""The Ordinance"" rather than ""The	POEPL agrees the re-wording would be clearer.	Relevant text amended

Consultee	Representation	POEPL response	Amendments/further detail
	Regulations"" in future documents, to avoid confusion with the subsidiary legislation (Offshore Petroleum (Licensing) Regulations 1995 & 2000).		
DMR7	3.2.17: Page: 104: Does POEPL view the change of a significant project contractor as a 'material change' for the purposes of the EIS?	Contractors will be required to deliver to POEPL's Design Philosophies and the additional detail provided in the Basis of Design and Functional Design Spec which have already been agreed for the project. The EIS does not refer to specific contract providers and a change of contractor is not seen as a material change unless it is accompanied by a significant design change which for the key environmental aspects would change. We would discuss the implications of a change of contractor in detail with FIG.	==
DMR8	4.3.2.2.2: Page: 114: Has the Design Notification document (referenced in this para) been requested by the public as part of the consultation, and has it been made available if so?	The Design Notification was not requested by the public during the consultation - however POEPL would be willing to release information related to the Design Notification if required to address a comment but with any commercially sensitive information redacted.	==
DMR9	Table 19: Page: 120: General comment: this table is not very clearly written. There is a mixture of: - Items that have been clearly ruled out with a clear explanation as to why - Items that are implied as being ruled out but are still 'being investigated'. Clarity on these is required e.g., a pilot- free flare design, which would have a significant impact on emissions, is still being investigated. If it is being investigated when will clarity on its use become available? This example	Operational flaring in the EIS accounts for 5% of the GHG emissions from the FPSO, about 3% of the overall total. We have minimised volumes of flaring by choosing a design with flare gas recovery and having the ability to reinject gas if necessary. Pilot-free flare has been rejected as a base-case choice for the project because we do not have enough evidence on its reliability in offshore operations in a similar setting, and hence whether it meets the required levels of safety performance as safety-critical equipment that safely burns gas in the event of a rapid depressurisation of the plant. We are noting our commitment to investigate it further but cannot make any further commitments until more design work is completed. We will seek agreement with the Harbour Master that a foghorn is superfluous in light of the range of other anti-collision measures, and we expect this to be undertaken prior to operations e.g., alongside planning consultations for the mooring buoy. It is relevant to note that our Country Manager received an email from Byron Marine on 11th January 2018 as part	==

Consultee	Representation	POEPL response	Amendments/further detail
	would have a measureable effect on reducing emissions. - Items that are not clearly worded e.g., "Noise from the foghorn will be discussed with the Harbour Master if it is considered a nuisance and other warning devices are considered suitable". Does this mean that a foghorn being proposed, or not being proposed, or is it subject to further consultation, or is POEPL waiting to see if anybody complains about it after installation? This example has been flagged previously as a potential concern.	of our early consultations stating that they did not see a need for a foghorn at the Mooring Buoy.	
DMR10	Table 19: Page: 120: 10.3 contradicts what is said on page 142 on cuttings disposal in the event of a TCC malfunction (see comment below on 5.4.5.3.2)	This is a high-level statement around overall management of cuttings i.e., that thermal treatment and discharge under permit is our chosen solution for cuttings. In 5.4.5.3.2. we expand on the unlikely contingency of a failure of the equipment resulting in a need to temporarily return cuttings to shore. This is a very unusual circumstance and the cuttings treatment is planned and executed as a highly reliable system that is built into the choice of the drilling rig and its deck layout. It has a certain amount of buffer capacity and critical spares are stored either on the rig or at the supply base. There will be an ongoing stream of materials being moved to and from the rig and the supply base, but if storage of cuttings at the supply base was unacceptable for some reason, the operation would be suspended until it was resolved.	==

Consultee	Representation	POEPL response	Amendments/further detail
DMR11	5.4.5.3.2: Page: 142: Strategy in the event of TCC malfunction is quoted as skip-and-ship, initially on the rig, then to shore, and with possible international export. This is listed as a discounted measure in Table 19, page 120. Which is correct? Would suggest a clear commitment is added that in no circumstances will untreated OBM cuttings be discharged, and if necessary operations would cease pending reinstatement of TCC capability. In the event of ship to shore transfer and storage of oiled cuttings, further consideration would be needed on the logistics and safeguards for unloading, storage and reloading, given challenging metocean conditions, and an assessment would be required of how an accidental cuttings discharge to sea would be dealt with both during transfer offshore and at the TDF in Stanley Harbour.	Discharge of untreated OBM cuttings is not stated as it is illegal. In 5.4.5.3.2 we state that either cuttings will temporarily be shipped to shore, or operations will cease as described further above, and this point could be made more clearly. Unloading cuttings in skips at the TDF would be within the normal envelope of operations. The loss of OBM offshore is assessed and the impacts also reflect the potential loss of OBM cuttings, in the unlikely event of the need to offload cuttings coupled with a failure of lifting gear or containment. POEPL also carries out a rig containment audit prior to hiring the rig, and as an example for the ENSCO100 rig used recently for the Catcher Development in the UK, POEPL required Ensco to improve the layout of the cuttings handling area and install additional bunding, covers and walkways to ensure the cuttings handling had a high level of containment (pictures are available). Any spills at the TDF will be covered by the Stanley Harbour Oil Spill Contingency Plan. The Stanley Harbour Oil Spill Strategy includes chemicals handling such as oil based mud in section 2.1.3. Practically, the oil in OBM is bound into the mud matrix and while it may give rise to a sheen, most of the oil would sink straight to the seabed with the dense cohesive mud.	Text amended to clarify the options in event of a TCC malfunction
DMR12	10.5.2.3: Page: 644: Does not consider additional noise contribution from maintaining station when OLST is bunkering in vicinity of mooring buoy - this will take place every two months, even once number of transfers has decreased, the need to refuel the OLST will	POEPL agrees that 'in the vicinity of the mooring buoy' is unclear and should read 'at anchor in the vicinity of the mooring buoy'. The proposal to bunker at anchor is noted in sections 10.3.2, 10.3.4 and Table 136. Practically, there is also the option of connecting to the mooring buoy for bunkering which avoids the impact of anchoring but which increases the duration of thruster	==

Consultee	Representation	POEPL response	Amendments/further detail
	remain and so the noise of thrusters and from bunkering vessel will need to be included.	noise. We will consider the impacts of any additional manoeuvring on DP in the updated noise modelling report. More information on bunkering of the OLST is given in 'Additional Information' DMR12-13.	
DMR13	12.2.4.3.2: Page: 1196: 2016 QRA for accident frequencies didn't account for additional operations inshore such as OLST bunkering. This should be incorporated.	It is agreed that the QRA did not cover this specific task, but the risks are very similar to those included in the assessment from the MRSV and ISV working in close proximity to the tankers. Bunkering would add a very small number of vessel hours to the total, from well managed activities, where the OLST is empty of crude oil and with little fuel cargo. This would not change the ranking of the assessment. See 'Additional Information' DMR12-13.	Subsea construction vessel noise is typical of general vessel traffic mentioned in 10.4.2.3. A greater degree of analysis has been undertaken for the more significant sources of noise such as piling and tanker thrusters. There is data on pipelay vessels and other installation vessels available that could be added to the narrative. Data on typical underwater equipment is more difficult to find, but recent measurements of underwater cutting for example found it to be difficult to discern above background noise [Underwater sound measurement data during diamond wire cutting: First description of radiated noise. Proc. Mtgs. Acoust. 27, 040012 (2016); https://doi.org/10.1121/2.0000322 Tanja Pangerc, Stephen Robinson, Peter Theobald, and Liz Galley]. Underwater noise from subsea well severance has recently been measured in the Southern North Sea but this is not yet published (*pers. comm.* BMT Cordah).

Consultee	Representation	POEPL response	Amendments/further detail
DMR14	15.3.2: Page: 1327: Should changes to the EMMP scope be possible with agreement of the majority of stakeholders rather than "all"	Groups like SOTEAG work by agreeing a consensus and we will involve SOTEAG experience in setting up the EMMP. The statement is one of intent and the governance of the EMMP would be drawn up in more detail. A majority voting system, when different parties have different responsibilities, could be very problematic.	==
DMR15	Table 329: Page: 1334: Oil spills - project-specific "regular oil spill response exercises to be conducted" -this is a legislative requirement	Agreed, these requirements will be built into our Oil Spill Contingency Plans. We expect these to include regular exercises where lines of communication and reporting are tested and more detailed 5-yearly exercises of a major incident.	==
DMR16	Table 332: Page: 1338: Offshore seabirds and benthic sediments are not aligned with monitoring, is there a particular reason for this (benthic fq explained in text but not the disparity b/w the two)? Regarding seabirds in particular, given the commitment to monitoring seabirds through observers should this not be occurring more regularly than every 5 years, as is the case for marine mammals and appears to be detailed in 15.5.1.1?	Correct, more frequent monitoring for seabirds will occur at the start of the project when support vessels will be equipped with seabird/marine mammal observers. As observations and experience builds up, monitoring frequency is expected to diminish. Table 332 has been updated - 'Additional Information' DMR16-20."	Updated table (Additional Information DMR16-20) inserted into text
DMR17	Table 332: Page: 1338: There is no baseline in the table for inshore benthic sediments, should this be added for clarity in the pre-sanction phase to cover the BS/SH baseline survey completed to date?	There is a pre-existing baseline for inshore benthos described in the EIS Chapter 7 and Table 332 has been updated to reflect where substantive baseline data already exists.	Updated table (Additional Information DMR16-20) inserted into text
DMR18	Table 332: Page: 1338: Footnote explaining that the Loligo ongiong monitoring may occur dependent on collaboration with FIFD and results from baseline?"	POEPL acknowledges the point, investigating squid spawning grounds is included in EMMP and a collaborative project currently under discussion *via* GAP II programme.	==

Consultee	Representation	POEPL response	Amendments/further detail
DMR19	Table 332: Page: 1338: Why is there a gap between marine mammal baseline and monitoring during the development drilling phase?	POEPL recognise the discrepancy and we have updated the EMMP Table 332 as attached 'Additional Information' DMR16-20.	Updated table (Additional Information DMR16-20) inserted into text
DMR20	Table 332: Page: 1338: Onshore Air quality and Offshore emissions also have monitoring with no apparent baseline - please can this be explained in the text?	Inshore air quality will need a baseline for VOC and odour and should be added - see update to Table 332. Offshore emissions are to do with efficient operation of the combustion plant reflected by NOx, SOx and other gases, and are relative to the global atmosphere baseline hence no site-specific baseline.	Updated table (Additional Information DMR16-20) inserted into text
DMR21	15.6.3.4: Page: 1352: Should this scope of work include timing of spill exercises and/or equipment testing/maintenance or is that beyond EMMP?	This is normal operational practice and included in the OSCP and operational management processes rather than EMMP activities we would suggest. Nevertheless, it would be beneficial to ensure the EMMP steering group was aware of these activities and POEPL would be happy to facilitate their understanding and receive questions and feedback.	==
Falkland Islands Government, Environmental Planning Department (EPD)			
EPD1	Although seabirds and marine mammals are addressed separately, conservation sites are less sensitive during the winter months (May to August). This only is listed for sensitivities at Sea Lion. Site sensitivity for conservation sites is the same (High) year-round. To resolve this either give a clear explanation on why there is a monthly variation in site sensitivity and why or change this to highly sensitive year-round. This was not reflected on in the corresponding text.	POEPL understand the point being made and clearly the sensitivity of important features within the sites could be lower during the winter months, when one considers for example the islands/protected areas that host important seabird breeding colonies. However, when one considers the conservation sites collectively, including the habitat attributes and terrestrial components (IPAs), then they could be considered sensitive year round, and damage to the habitat itself could have consequences that span across seasons.	These tables are summaries of summaries and are necessarily at a very high level. It is not possible to condense all the information presented into a single High, Medium or Low category that will be relevant to all receptors.

Consultee	Representation	POEPL response	Amendments/further detail
EPD2	Decommissioning on the table is noted by a footnote "f" which is not referred to anywhere else.	'f' = not relevant to this document as it is in the decommissioning scope.	==
EPD3	Underwater noise is not an identified environmental aspect for "subsea works". Although pile-driving is included in the EIS, further work should be done to assess sources of underwater noise during all subsea work.	Subsea construction vessel noise is typical of general vessel traffic mentioned in 10.4.2.3. A greater degree of analysis has been undertaken for the more significant sources of noise such as piling and tanker thrusters. There is data on pipelay vessels and other installation vessels available that could be added to the narrative.	POEPL agrees that 'in the vicinity of the mooring buoy' is unclear and should read 'at anchor in the vicinity of the mooring buoy'. The proposal to bunker at anchor is noted in sections 10.3.2, 10.3.4 and Table 136. Practically, there is also the option of connecting to the mooring buoy for bunkering which avoids the impact of anchoring but which increases the duration of thruster noise. We will consider the impacts of any additional manoeuvring on DP in the updated noise modelling report. More information on bunkering of the OLST is given in 'Additional Information' DMR12-13."
EPD4	Why were cetacean collisions not a matter of stake-holder concern?	Figure 4 is not intended to imply that marine mammals are not a matter of stakeholder concern, which they clearly are. Marine mammal collisions are recorded as an issue in both parts of the table and relate to vessels which is intended to reflect any of the stages of marine operations.	==
EPD5	No reference is made to sensitivities of human well-being assessed in the SEMP report. This ideally should be addressed here and the impact assessed in the document in more detail.	Well-being as such is not listed in the EIS Guidance, but we have included human health in relation to disturbance due to noise and health thresholds for air quality impacts.	==

Consultee	Representation	POEPL response	Amendments/further detail
EPD6	Why is there no assessment of the impact of an inshore spill on surrounding archaeology? Due to the long-lasting effects of an accidental spill and the importance of archaeological artefacts in cultural history, very little mention is made of the effect of a spill.	POEPL don't remember this issue being raised by stakeholders and it was not identified in the ENVID. Wrecks in Berkeley Sound and in marine waters are fully covered by water and unlikely to be affected by Sea Lion crude oil.	==
EPD7	The phrase "meaningful" is mentioned throughout the document. There is no definition given for the term and leaves room for potential inappropriate interpretation. In each instance there should be an appropriate definition provided or a clearer restructuring of the wording to provide clear interpretation of the document.	These are either: from FIG Guidance; or can be removed; or changed to 'significant' or 'accurately'. 1.7.3 quotes FIG Guidance 3.1.6.2 remove 5.12.3 change to possible 7.4.5.2.1.3 significant 8.9.1 quotes FIG Guidance 10.8.4.2 change to significant 10.9.4.5.3.2 remove 10.9.9 change to relevant 10.11.4.3.2 remove 11.12.4.4.1.5 remove 11.12.9 change to accurately 12.1.4.3.3.1 change to significant, and relevant 12.2.4 remove 12.2.4.4.4 change to relevant 13.1 remove	Quotation marks added where relevant, all other changes applied.
EPD8	Only one mention of remediation is made in the document and this is not expanded on, nor a mention of POEPL's obligations under any spill scenario.	EIS Appendix A states that "The need for remediation efforts will be determined based on the outcomes of monitoring. The detailed POEPL monitoring strategy will be established during the Environmental Monitoring and Management Plan (EMMP) workshop." Within topics such as seabed disturbance and drill cuttings deposition we discuss recovery of the seabed, and the facilities are designed to be removable. Remediation related to oil spills is one example and POEPL would work within the NOSCP. This includes a net environmental benefit analysis to identify the most environmentally beneficial remediation options which are	==

Consultee	Representation	POEPL response	Amendments/further detail
		decided after an assessment of the specific conditions of the spill in question and its relation to sensitivities, time of year, ongoing risks etc. Provision for financial liabilities relating to oil spills is covered separately to the EIS as described in FIG EIS Guidance 187/15. Substantial sums are provided for in insurances and compensation schemes. Correspondence on the level of financial provision is provided under 'Additional Information' EPD8.	
Falkland Islands Government, Directorate of Natural Resources, Fisheries Department (FIFD)			
FIFD1	On page 60 of the EIS, it mentions that "An Oil Spill Contingency Plan (OSCP) that covers the offshore operations will be submitted to FIG before operations commence". Why is this contingency plan not available now? It seems like it should be part of the EIS on which POEPL will be evaluated as to whether they can properly respond to an oil spill. They should not be cleared to move on with this project without an approved contingency plan in place.	Oil Spill Strategies have been prepared as agreed with FIG including Offshore, Inshore and Stanley Harbour Oil Spill Strategies which have been submitted to FIG. These strategies detail all the main items of equipment and response methods. These provide a clear basis for the development of Oil Spill Contingency Plans which will require FIG approval before operations can commence.	==
FIFD2	On page 442 of the EIS and page 27 of the NTS, offsetting of impacts through a "meaningful" contribution into an Environmental fund is mentioned, but it seems important at the offset to establish a definition for "meaningful" and to define a process on how this level will be determined. We assume that this will discussed with FIG representatives, but more clarity seems necessary in the EIS. However, we do recognise that any	This wording is from FIG paper 124-16P and the offsetting approach has been discussed with FIG. POEPL has prepared an Environment Fund Briefing Note that has been submitted to FIG describing the basis of the contribution which has been accepted.	==

Consultee	Representation	POEPL response	Amendments/further detail
	offsetting for impacts on Fisheries related issues will need to be negotiated or discussed with FIG or the Committee administering the Environmental fund and not POEPL directly.		
FIFD3	In the oil tests summary table (page 1075) it mentions first that the crude is solid and resists physical breakup into smaller particles, but then says that it will remain in the environment as solid components (for at least seven days) until eventually breaking up and biodegrading. Seven days is not very long for an oil spill response, especially if there's bad weather, and therefore it seems like there's a chance that some large percentage of the oil will break up and not be recovered from the environment.	POEPL agrees that there is a risk of oil dispersing into the environment, and natural dispersion is often quoted as a deliberate strategy in oil spill response generally; nevertheless, POEPL has invested in optimising methods for recovering oil relating to potential inshore releases of crude oil, and expects this to be have moderate to high effectiveness for small spills based on modelling and case studies for locations with a similar state or preparedness. The oil remained in solid lumps fo 10 days in the CEDRE Polludrome under moderate and high energy conditions. The OSCAR modelling predicts that a fraction of the oil is not recovered, dependent on weather and light, and does migrate into the wider environment, and this is acknowledged in the impact assessment. Offshore, mechanical recovery has very limited efficiency due to sea state and an average recovery rate of no more than 12% is expected for a prolonged blowout for example. Prevention of releases is of prime importance.	==
FIFD4	Although obviously difficult to do, but testing on the effect of oil on eggs of local fish species would be much better than using zebra fish. There are facilities on the islands that may allow research to take place here on the effect of oil on toothfish, rock cod or even squid eggs. Furthermore, it seems like the biodegradation of the crude oil here is possible after a week or two. In that case, it is important to test the toxicity of the crude in both on fish eggs after degradation as well	Zebrafish are standard laboratory animals and give us standardised results in the same way as the algae, plankton and crustacean tests that have been undertaken. This enables POEPL to assess the toxicity versus other substances, and the results are consistent in that the crude oil is very low toxicity with a very low fraction of soluble components that are most harmful to aquatic organisms. The physical characteristics strongly point to the oil remaining floating and away from the seabed and main water column where most eggs would be found. POEPL has committed to looking at toxicity towards squid eggs (15.6.1.2). The zebrafish test is a standard laboratory test for ecotoxicity and is comparable to the testing and assessment of chemicals offshore that uses three standard aquatic species plus a sediment reworker to draw conclusions on wider risks to the environment - which we have also performed on the	==

Consultee	Representation	POEPL response	Amendments/further detail
	as while it is still solid. If this has been done and we've missed this, disregard this comment, but fisheries being so important here it is very crucial that we make sure we are not unduly endangering the resources.	crude oil at CEDRE. The uncertainties across species and ecosystems are normally incorporated in an 'assessment factor' which is used to deduce a no-effect concentration from LC50 or EC50 results, which could be 100 or 1000 times lower than the LC50 or EC50. The approach to assessing wider ecosystem risk is documented in the European Technical Guidance Document on the Risk Assessment of Chemicals (EU-TGD, https://echa.europa.eu/documents/10162/16960216/tgdpart2_2ed_en.pdf). However, in the laboratory tests, it was impossible to reach an LC50/EC50 level in some cases even with the use of extremely high concentrations of oil in water (percent levels) to generate water-accommodated fractions. This low level of toxicity, combined with a precautionary approach to impacts and examining concentrations of oil down to 25 ppb in POEPL's predictions are believed to give precautionary and defensible conclusions on aquatic toxicity. POEPL are also completing testing on juvenile turbot at CEDRE (Scophthalmus maximus). OSPAR recommends the test species Scophthalmus maximus (juveniles); or Cyprinodon variegatus (juveniles) for testing of offshore chemicals, and it is a standard species for obtaining generalised toxicity data as above. The recommended test protocol is the PARCOM Protocol 1995 part B (https://www.cefas.co.uk/cefas-data-hub/offshore-chemical-notification-scheme/ocns-ecotoxicology-testing/). This testing was delayed due to additional European controls and permits required for testing on higher animals and will be completed in April 2018 but POEPL do not expect the results to alter the overall conclusions.	
FIFD5	It does not seem clear how prioritisation of activities in Berkeley Sound will be determined. For instance, if Berkeley Sound is required for a number of fishing vessels and POEPL has arranged a transfer, how will prioritisation be determined? Who will have a say?	POEPL would defer to the Harbour Master who has responsibility to approve each STS transfer taking into account other users. POEPL's assessment of existing vessel movements and anchorage is that the 500m permanent exclusion zone, and the temporary 1500m zone plus 2000m approach channel will not present a significant impact.	==

Consultee	Representation	POEPL response	Amendments/further detail
FIFD6	Regarding charter flights, there seems to be an opportunity for POEPL to work closely with the fishing industry as many companies transfer crew *via* Europe and could make use of additional seats on charter flights if these were available. Perhaps this can be followed up with FIFCA.	POEPL appreciate this suggestion and we seek to build on the arrangements during the exploration wells campaign when charter flights were used for mutual benefit. Very happy to follow up with FIFCA as work proceeds.	==
Shallow Marine Surveys Group (SMSG)			
SMSG1	There is a need for a better description of the audit process of mitigation plans. It's fine to describe what if any, mitigation will be in place, but how will these be monitored/audited? Internally? Externally? This plan may not be fully developed, and in that case, it should be more clearly explained what the 'next steps' are and POEPL's expectations for auditing mitigations.	POEPL agrees that an important function of the EMMP is to review the efficacy of the mitigation measures. 15.1.2 of the EIS states "Where the proposed EMMP programme indicates that the mitigations proposed have not been appropriate or do not deliver the level or value expected in the impact / risk assessment, or are unnecessary, the EMMP Steering Group may assess whether a revised mitigation or measure is needed or a particular measure is no longer required." Performance and monitoring data will be reviewed regularly and mitigations may be removed, added or amended dependent on the results obtained by monitoring and/or on receipt of relevant scientific information. The way in which the EMMP process will operate is outlined in Chapter 15 of the EIS and will be discussed in more detail at the EMMP workshop and will include reference to other such groups around the world. POEPL are conscious that the EIS has a 5-yearly period of validity under the Offshore Minerals Ordinance and would undergo a thorough review at such intervals, informed heavily by the ongoing working of the EMMP group and the results of monitoring of mitigations. POEPL's operations are certified to ISO14001 which includes internal and external audit of its environmental processes and significant impacts and monitoring."	
SMSG2	Similarly, the ALARP concept needs more detailed explanation. POEPL's risk management appears to be	ALARP is a well-defined concept under UK and international HSE regulation and is a central part of POEPL's HSES Risk Management Standard for all its operations, where ALARP is defined as "As Low As Reasonably Practicable,	==

	heavily dependent on the ALARP concept and as such, it's important for the reader to assess this in more detail and understand its practical implications. for example, is this internally or externally reviewed? By who? How often? A short definition including practical implications in the Falklands case would be very helpful.	which means that after reviewing all possible alternatives, further risk reduction would involve disproportionate cost or use of resources for the risk reduction that could be achieved". In the context of the EIS it is summarised in Section 8.2 "Ultimately, the aim of all mitigation is to reduce the overall impact or risk associated with an activity to a level that is 'As Low As is Reasonably Practicable' (ALARP), irrespective of whether this is achieved by prevention, reduction and / or remediation. Very importantly however, 'ALARP' is not synonymous with 'Low' and the concept takes into account the balance between the costs and benefits of a mitigation measure. Here it is recognised that while it may be possible to reduce an impact or risk further, the process of doing so may require excessive time and resource such that it is not considered 'reasonably practicable' in light of the benefits that can be gained." Further elaboration of ALARP can be found in (e.g.) Health and Safety Executive documents 'Reducing Risk Protecting People (2001)' and 'ALARP at a Glance' and 'Policy and guidance on reducing risks as low as reasonably practicable in design'. POEPL are conscious that the EIS requires a 5-yearly period of validity and would undergo a thorough review at such intervals, and re-approval would require oversight by FIG and its scientific advisors who would externally review the level of risk management. As a project-specific example: Project vessels entering inshore waters pose a risk to biosecurity. It is clearly reasonably practicable to follow international protocols for ballast water and biofouling that are designed to manage such risks. For vessels that are to be present inshore for some time presenting a higher degree of exposure e.g., the Large Transit Vessels in Berkeley Sound, it is considered reasonable also to undertake a hull inspection prior to its journey to the Falklands as part of the vessel audit process. For Conventional Trading Tankers, they are present for a much shorter time, and the costs of going beyond the international standards would be disproportionately high in relation to the risks, and hull inspections are not considered ALARP, but audit of their control systems prior to entry is considered reasonably practicable, as is taking samples of ballast water to monitor the efficiency of their ballast water systems, which are both above international standards.	

Consultee	Representation	POEPL response	Amendments/further detail
SMSG3	The significance of kelp forests is significantly under-represented. in some cases, baseline evidence presented here is not fully utilised. as such, risk analyses based on marine flora are likely to be underestimated.	The significance of kelp is highlighted in Chapter 7 (environmental baseline), both in terms of its role as a primary producer, and also as a keystone species providing habitat for other species. It is assessed as MEDIUM sensitivity in its Berkeley Sound component. We highlight that the distribution of kelp is an important consideration in respect of possible oil spill scenarios, but indicate that compared with the East Falkland coastline as a whole, Berkeley Sound has relatively low kelp coverage, and impacts on kelp from oil spills in the literature are relatively modest.	==
SMSG4	The impact of off-shore spills on the planktonic assemblage is understated. the only testing done (zebrafish eggs) is not A robust test necessarily, and as such knowledge of this impact is A significant knowledge gap. the risks associated with impact on the planktonic assemblage is likely to be underestimated.	The test on zebrafish is to an internationally recognised standard for industrial effluents, and is used as an indicator more generally for relative risk to early life cycle stages of fish. POEPL understand that larvae are more sensitive than eggs. POEPL use a threshold of 25 parts per billion to report and assess oil concentrations in the water column, whereas the applied dose in the zebrafish egg test of 8.8 parts per thousand (a factor of 350,000 higher than the assessment threshold) produced no observable effect in the hatching success of zebrafish eggs, and 97% of the larvae were healthy. POEPL therefore believe the testing and assessment give us a very precautionary position and we do not believe that further oil testing would alter the assessment.	==
SMSG5	Although the EIS identified interaction effects of impacts as being A knowledge gap, this lack of knowledge does not appear to have been included in the defined “precautionary approach” to risk identification and management. this suggests that the impact/risk matrix scores across and number of receptors may be underestimated.	See responses to SMSG35 and SMSG36.	==
SMSG6	Layout could be more user-friendly. The size of the document in its present form is quite unwieldy and difficult to use, particularly with the	POEPL need to be conscious that some recipients rely ultimately on a paper format for the EIS but recognise that adding electronic bookmarks could help the document to be more user-friendly.	The electronic version of the EIS has bookmarks, to aid navigation.

Consultee	Representation	POEPL response	Amendments/further detail
	large amount of cross-referencing and the need to compare methods (e.g., assessment methods) to results (e.g., final assessment scoring) in each section. The nature of the document would necessarily mean that some effort will be required by the user. However, ease of use would be significantly improved by using modern PDF facilities such as Tabs or Bookmarks. I do note that many figures and tables have hyperlinks, which was helpful.		
SMSG7	Can a DATE be included on the cover or a publisher page? Date of Public release? Date of end of 42 day consultation?"	POEPL agrees - it would be sensible to mark the submission and approval dates on the EIS and any further information that supports it as an output from the ExCo approval process.	==
SMSG8	Has there been internal/external review of the document prior to release of this version?	There have been multiple reviews of the document internally by POEPL and its advisors SAERI as part of their respective QA and technical review processes. FIG have also undertaken a compliance review of the document and a scientific review of the document using their appointed technical reviewer SAMS.	==
SMSG9	Tables 31 – 38 are miss-numbered. Should be 300 and something.	POEPL Agrees, the contents should be numbered Table 326-333.	Corrected.
SMSG10	Table 12, Element 9 and 10 indicate that there will be processes developed for monitoring, audit and review. It seems this is internally driven; is there an external, independent element to auditing of monitoring processes?	POEPL has internal processes for monitoring, audit and review to which this table on its HSES Management System refers. POEPL's operations are certified to ISO14001 which includes internal and external audit of its environmental processes and significant impacts and monitoring. Via the EMMP there will be external review of monitoring relevant to the scope of the EMMP. FIG will exercise it normal legal duties regarding review and inspection of POEPL's plans and operations *via* its regulatory functions.	==

Consultee	Representation	POEPL response	Amendments/further detail
SMSG11	Is there external review of the ALARP? This also seems internally driven. The whole EIS (assessment, mitigation and monitoring processes) seems to depend heavily on the ALARP concept. The EIS explains that ALARP decisions are guided by the FK-BU-PMO-HS-STD-0006. This document provides a definition, but does not provide details of the mechanism of its assessment. This is particularly important for assessing the risk to environmental receptors that cannot be easily measured in a cost/benefit way. For example, assessment of risk to environmental features or processes should necessarily be inclusive of the cascading effects of impacts that may have long-term impacts a number of receptors. Weighing up costs against such impacts would not may not necessarily be captured under the current application of ALARP it seems. Additionally, the ALARP concept would not work for ecological risks where there is a declared lack of information – in other words, how is ALARP applied in a precautionary way in the absence of supporting information?	The EIA is driven by its methodology that includes the ALARP concept. Uncertainties in data are inherent in all forms of risk assessment and are routinely managed quantitatively and qualitatively. Some uncertainties in ecological risks are simply a feature of the receptor and are part of normal assessment process e.g., large natural variabilities in population size, and risks and mitigations take this into account. Other uncertainties are around a lack of knowledge and these have been methodically documented in the assessment chapters and logically reviewed in terms of screening topics for inclusion in the EMMP process. The assessments include cumulative and long-term impacts where appropriate.	==
SMSG12	6. 5.8.5.4.1. In the event of discharge to the sea, is FIG informed of this	Planned discharges to sea are done under a specific permit and reported against according to the requirements of the permit, which could include	

Consultee	Representation	POEPL response	Amendments/further detail
	prior to discharge? Or a report post-discharge?	daily analysis of produced water that are reported to FIG on a monthly basis for example. Drilling discharges under permit are normally reported at the end of the well. Unplanned discharges must be reported without delay, which is normally interpreted to be within 6 hours. Any discharges that have a permit, but which do not comply with the permit, are reported promptly (normally within 48 hours) unless they pose a significant immediate risk in which case they are reported within 6 hours. Such reports are made using standard reporting forms and are followed by a more detailed investigation report into the incident that concludes the exact details of the unplanned or non-compliant discharge along with root causes and actions to prevent recurrence.	
SMSG13	The role and importance of kelp forests in the Falklands is understated. Ecological importance (biodiversity, fisheries) of kelp forests are presented well. However, lacking is the importance of kelps (primarily Macrocystis) in their role as a mechanical buffer to the effects of waves and storms on coastal geomorphologic structure and habitats the coast supports. Loss of giant kelp forests could result in irreversible changes to shoreline geomorphology, which in turn could have dramatic irreversible effects to shore-based bird, mammal, and plant assemblages. In addition, kelp forests are likely to be significant carbon sinks in the Falklands, implying much broader-scale and long-term importance of kelp forests. Finally,	This point is similar to SMSG3 and our response applies. The significance of kelp is highlighted in Chapter 7 (environmental baseline), both in terms of its role as a primary producer, and also as a keystone species providing habitat for other species. POEPL acknowledges that these additional attributes (buffering shoreline from wave action, carbon sinks, and commercial potential) are useful additional commentary that would inform the relevant sections of the Environmental Baseline chapter.	==

Consultee	Representation	POEPL response	Amendments/further detail
	there is consistent interest in kelps for commercial exploitation in the Falklands; although not currently exploited it is important to consider this as an important economic feature of kelp forests. These should be highlighted as being additional critically important features of Falkland kelp forests. See "Smale *et al.,* 2013, Threats and knowledge gaps for ecosystem services provided by kelp forests: a northeast Atlantic perspective", and "D.T.I Bayley, I. Marengo and T. Pelembe, 2017. Giant kelp 'Blue carbon' storage and sequestration value in the Falkland Islands. SAERI". (both attached)		
SMSG14	The Environmental Sensitivity Index (ESI) assessment is based on physical attributes of the shoreline, as indicated in Table 85. However, it should be made more clear that biological/ecological attributes are NOT used in the sensitivity test. It is somewhat confusing that despite Table 85, bulleted points on pg 433 say that "General biological productivity and sensitivity" should be integrated into the ESI.	POEPL acknowledges the issues around the use of this classification system and its use of the word 'sensitivity' which has differences in meaning between the EIS methodology and the specific meaning within the ESI classification system. It is in some respects a very broad descriptor but which is nevertheless widely used in the world especially in the context of response to oil spill incidents. It relates physical characteristics to ecological vulnerability or robustness and recognises that by correlating these aspects it is possible to make a rapid initial step in prioritising oil spill response. 7.6.2 and 7.6.3 acknowledge that the system requires further information e.g., "In addition, it is important to understand and map the location of internationally recognised sites and nationally designated sites of environmental importance to identify sensitive ecosystems, critical habitats and endangered species. Therefore, to highlight environmentally sensitive areas within the coastal zones adjacent to Berkeley Sound, the occurrence of nationally protected areas and the known locations of key faunal and floral species have been mapped throughout this baseline chapter.	'General biological productivity and sensitivity' removed from the list of bullet points on pg 433

Consultee	Representation	POEPL response	Amendments/further detail
SMSG15	Environmental sensitivity. It is then described how bird colonies overlap with the ESI. However, it goes on to say that "Additional species and taxa were not considered either due to a lack of quantitative data that could be extrapolated to un-surveyed coastlines or to a widespread distribution across the coastal habitat types." This does not seem to be true in the case of kelp forests, where it was presented above that kelp forests are important coastal features and have been mapped across the target areas. Coverage of this data seems adequate to include in the ESI assessment, as shown in "Figure 67: Kelp coverage around the East Falkland coastline". A discussion on the overlap of ESI and kelp forests should be included.	The sensitivities of kelp have been included in the assessment and we must also recognise that kelp has characteristics that may also be dissimilar to aspects included in the ESI for neighbouring coastline. Going forward, the mapping of ecological features for the detailed oil spill contingency plans will be required, along with coastal inspections to site potential booming points, and incorporation of more detailed mapping of kelp (taking into account its temporal variability) would certainly be relevant at that point both in terms of protecting more sensitive components but also in managing the physical response most effectively.	==
SMSG16	Sensitivity of Berkeley Sound coast to inshore oil spills – there is a great deal of quantitative biological/ecological data that could be included in the interpretation and/or application of the ESI for Berkley Sound, as presented in earlier sections of this report describing shoreline floral and faunal surveys. Can there be some more detailed commentary on the ESI and	POEPL believe that while the inter-tidal information in the EIS is adequate for the assessment, further inter-tidal work is necessary to establish a monitoring baseline post- approval and such work would support more detailed coastal sensitivity plans. Such inter-tidal work is an important commitment in the EMMP (Section 15.5.2.3). We note that additional mapping of coastal bird sensitivity was included in the Inshore Oil Spill Strategy and complements the ESI data and we attach a page from this strategy in 'Additional Information'. POEPL has been given access to the oil spill contingency plan mapping for Sullom Voe Oil Terminal and while permission is required from its owners, we hope to be able to use this (and other such information) to help build the	==

Consultee	Representation	POEPL response	Amendments/further detail
	relationship with surveyed biological data from Berkeley Sound.	detailed maps required for the Inshore Oil Spill Contingency Plan post-Sanction.	
SMSG17	It may be that those biological/ecological data are not discussed because the resolution was still not adequate for ESI assessment. If this is the case, how has this lack of information affected the final use of the ESI assessment method? It should be stated more clearly what the limitations are of the current ESI based on available data.	Sensitivity mapping is a method used to identify the most sensitive sites or receptors to oil spill events, thus providing a basis for the definition of priorities for protection and clean-up, and information to plan the best-suited response strategy. Essentially, a sensitivity map will overlay the distribution of receptors and habitat types to summarise the information presented in the baseline. It is not a question of assessment. As above, two further sensitivity maps are relevant. More detail on sensitivity mapping for oil spill response can be found here, which is referenced in the EIS: http://www.oilspillresponseproject.org/wp-content/uploads/2016/02/GPG-Sensitivity-Mapping.pdf	==
SMSG18	The second column is headed with “planned events” – presumably this is meant to be “unplanned events”? Is this a typo?	No, this is correct. The EIS distinguishes between risks and potential impacts associated with planned events (e.g., noise), versus accidental (unplanned) events (such as oil spills). The latter incorporates an assessment of the Likelihood of the Unplanned Event occurring.	==
SMSG19	In the 2nd paragraph of this section, the strategy for planned events and unplanned events is broadly outlined, but there is seemingly no strategy for accidental events. Although the identification and assessment of accidental events is bundled with unplanned events in the previous section, is the same strategy for reducing risk and increasing mitigation the also the same for accidental events?	In Section 8.7, it is indicated that for planned events (i.e., those that will occur), mitigation measures should be aimed firstly at avoiding and reducing the impacts before considering options to remedy the impact once it occurs. In contrast, for unplanned (or accidental) events the priority is to minimise the likelihood of occurrence, followed by actions/mitigation measures to minimise the consequences of an event should it occur. These principles have been incorporated into the assessment process and identifying options for reducing risk.	==
SMSG20	Agree that this is sensible to improve mitigation if ongoing monitoring suggests that it’s necessary. Indeed equally, it could be that mitigation can be relaxed in those areas where	We agree with the comment and the approach taken.	==

Consultee	Representation	POEPL response	Amendments/further detail
	monitoring suggests that risks were over- estimated in the EIA.		
SMSG21	Regarding the observed increase in jellyfish in the Falklands, although true, it is somewhat misleading to relate this to increased marine debris as described in the first part of the paragraph. As its written now, it suggests a highly spurious connection and should be deleted – the increase in jellyfish in the Falklands could be for all manner of reasons and least of all marine debris.	We agree that increased jellyfish abundance in the Falklands does not appear related to marine debris. The ES references a study that did find a connection between hard substrate and debris and jellyfish but this is not linked directly to the Falklands. The wording could be clearer in this respect.	Relevant text reworded to reflect the comment.
SMSG22	This section needs more detail. The statement "Fish eggs and larvae are considered to be more susceptible to the toxic effects of oil than adults, due to their reduced ability to avoid contaminated water." is perhaps true per se, but it understates the critical issues. Eggs, larvae, and juvenile organisms occupy a variety of depths in the water column – some will naturally be in the path of oil contaminants, while others will avoid contamination due to their natural vertical distribution. Much more critical to the notion of vulnerability of eggs, larvae, and juveniles is the fact that they are very small, with high surface:volume ratios due their shape and appendages, and that their membranes are particularly thin with	Noted. Because POEPL has already acknowledged the increased susceptibility of fish eggs and larvae to the toxic effects of oil contamination compared to adults, this will not change the outcomes of the assessment process. POEPL agrees that additional wording around stock recruitment would be beneficial to interpretation.	Some relevant text is added to clarify this.

Consultee	Representation	POEPL response	Amendments/further detail
	high rates of passive and/or active diffusion across the membrane. Moreover, even very small concentrations of contaminants could be potentially lethal or sub-lethal and causing malformations during development. Such impacts may lead to significantly lowered stock recruitment in that year, having direct and indirect effects on commercial species and species supporting commercial stocks.		
SMSG23	Given the fact that testing was only done on one species – Zebrafish – a freshwater fish –would suggest that any risk assessment of Falklands marine eggs, larvae, or juveniles based on this single test has a very high degree of uncertainty. This weakness in the evidence should be described more clearly.	As noted previously, this test is a standard laboratory test for ecotoxicity and is comparable to the testing and assessment of chemicals offshore that uses three standard aquatic species plus a sediment reworker to draw conclusions on wider risks to the environment - which we have also performed on the crude oil at CEDRE. The uncertainties across species and ecosystems are normally incorporated in an 'assessment factor' which is used to deduce a no-effect concentration from LC50 or EC50 results, which could be 100 or 1000 times lower than the LC50 or EC50. The approach to assessing wider ecosystem risk is documented in the European Technical Guidance Document on the Risk Assessment of Chemicals (EU-TGD, https://echa.europa.eu/documents/10162/16960216/tgdpart2_2ed_en.pdf). However in the laboratory tests, it was impossible to reach an LC50/EC50 level in some cases even with the use of extremely high concentrations of oil in water (percent levels) to generate water-accommodated fractions. This low level of toxicity, combined with a precautionary approach to impacts and examining concentrations of oil down to 25 ppb in our predictions, give, we believe precautionary and defensible conclusions on aquatic toxicity. POEPL are also completing testing on juvenile turbot at CEDRE (Scophthalmus maximus). OSPAR recommends the test species Scophthalmus maximus (juveniles); or Cyprinodon variegatus (juveniles) for testing of offshore chemicals, and it is a standard species for obtaining	==

Consultee	Representation	POEPL response	Amendments/further detail
		generalised toxicity data as above. The recommended test protocol is the PARCOM Protocol 1995 part B (https://www.cefas.co.uk/cefas-data-hub/offshore-chemical-notification-scheme/ocns-ecotoxicology-testing/). This testing was delayed due to additional European controls and permits required for testing on higher animals and will be completed in April 2018 but we do not expect the results to alter the overall conclusions. POEPL are committed to further investigating the toxicity of the oil with respect to local squid eggs.	
SMSG24	Combining the above two observations, the sensitivity of the Plankton (phytoplankton, zooplankton, eggs, larvae, juveniles) receptor under any of the spill scenarios is likely to be underestimated in the assessment, or in the least not well assessed based on highly uncertain and incomplete data. This component of the assessment should be re-evaluated.	We believe that by examining concentrations of oil down to 25 ppb using recognised models, by having ecotoxicity testing carried out to recognised international standards and by using local and international expertise in evaluating of the potential exposures against the known sensitivities, we have a robust and precautionary assessment. The exposure of such communities to oil given the solid and buoyant nature of Sea Lion crude is likely to be small and it lacks significant fractions of soluble or PAH components. Uncertainties such as the location of squid spawning are acknowledged and taken forward in the EMMP.	==
SMSG25	In this sense, this risk should be included in Table 293 as the fate and impact as it relates to the planktonic assemblage is largely unknown.	Plankton is assessed as having a low sensitivity reflecting that it is a receptor of very high abundance and rapid reproduction. The ecotoxicity testing undertaken is in line with OSPAR testing for offshore chemicals which refers to the European Technical Guidance Note for Risk Assessment of Chemicals and which is used internationally for assessing risk to aquatic ecosystems as a whole through the testing of different trophic levels. The oil has been tested on algae and copepods and LC50 result of 20.7 g/l (20,700 ppm) was determined for Acartia tonsa and 39.7 g.l (39,700 ppm) for Skeletonema costatum. Risks to plankton can be considered well defined and low.	==
SMSG26	Better understanding of all types of spills on the planktonic assemblage should also be included in "12.1.10.1 Monitoring required", where there should be more ongoing real-world	POEPL do not agree that this is warranted given the extensive laboratory testing already undertaken and the nature of the receptor.	==

Consultee	Representation	POEPL response	Amendments/further detail
	testing of oil on the Falklands planktonic assemblage.		
SMSG27	Why are kelp forests not considered as significant receptors in this section on off-shore spills? Compare to data presented in Figure 67. Kelp forests should be included as receptors as they are likely to be significantly related to other ecological processes, including barriers to the shoreline from oil spills.	The EIS includes 'COASTAL' as an environmental receptor for offshore oil spills. For the two spill scenarios in which oil reaches the coast, the sensitivity is assessed as HIGH and the severity of impact MODERATE. The Coastal receptor does not explicitly include kelp, but is a more general ranking of sensitivity including kelp and the presence of IBAs, important colonies etc. The overall assessment has assessed potential impacts on the coastline habitat. We have undertaken oil testing on three different species of kelp and found zero adhesion of Sea Lion crude oil in the immersed state. POEPL acknowledges the respondent's concerns that EIS could more clearly present the importance of kelp as a valuable ecosystem component, and we fully agree that kelp forest represents a very important habitat in the Falkland Islands ecosystem. We do believe, however, that kelp has been assessed appropriately in the EIS with a proportionate level of scientific investigation. As per comments SMSG15, SMSG16 and SMSG17, the way kelp is included in detailed oil spill contingency plans will ensure it is represented and managed appropriately in the unlikely event that oil is released and moves into areas of kelp.	==
SMSG28	Table 284 – Are there guidelines for operations during storms? I may have missed them. Importantly, should operational parameters/limits for storms be included as mitigation? Are they specific to Falklands? There is knowledge of storm events in the region; has this knowledge been translated into mitigation?	Inshore operations will not be undertaken outwith the following weather criteria (EIS Section 12.2.5): - Mooring 25 knot wind - Suspending Cargo Transfer 30 knot wind, 2.0m significant wave height - Disconnection of Cargo Hoses (prepare for departure of both vessels from the Buoy Mooring) 35 knot wind - Vacate Buoy Mooring 40 knot wind The FPSO is designed for safe operations in all predicted weather conditions offshore, and the envelope of weather is well understood from predictive models, from measurements taken in-field and from the history of exploration drilling over the previous two decades. Certain operations will also be restricted by weather including lifting, transfer of bulk cargoes and the close approach of vessels. These will be	==

Consultee	Representation	POEPL response	Amendments/further detail
		included in the project's operational requirements and include criteria such as those listed in Appendix 12A of the OGUK Guidelines for Offshore Marine Operations and within the requirements of the Safety Case for the FPSO and Drilling Rig. Seafastening procedures will be in place on the FPSO and Drilling Rig to prevent windblown debris or movement of portable items during adverse weather.	
SMSG29	Pg 1226, 12.2.4.9.2 Oil fate predictions. The second bullet point suggesting that there is little likelihood of oil spills in Berkeley Sound reaching Cape Pembroke is clearly not true. See Figs 298, 292, 293, 294, 295, 296.	The second bullet point indicates that there is a low likelihood of oil spills in Berkeley Sound reaching the shore south of Cape Pembroke. There is a likelihood of oil reaching this shore (for the 3,000 and 50,000 tonne spill scenarios), but this likelihood is very low.	==
SMSG30	The shore line and subtidal habitats and species in the area of Cape Pembroke and the Tussac Islands are under some scenarios significant receptors of unplanned/accidental impacts that need to be addressed specifically. These areas represent unique habitats and species not seen in other nearby areas, particularly with regard to subtidal areas (e.g., Phragmatopoma virgini, reef building tube worms.)	The shoreline and terrestrial coastal habitats (including of the Tussac islands) are considered in the Coastal Habitats receptor. The Benthic Communities receptor includes habitats such as biogenic reefs. The Phragmatopoma reefs are generally >5m below low tide and given the properties of the oil (buoyant) and indeed when coupled the low probabilities and densities indicated by the modelling would mean that the impacts would be non-existent to very low.	==
SMSG31	Moreover, these areas are very important public recreation areas and have historic significance, and as such should be explicitly considered in the impact/risk assessment.	We accept the importance of such areas. This is dealt with broadly through the Human Population (tourism) receptor.	==

Consultee	Representation	POEPL response	Amendments/further detail
SMSG32	It may be that areas in Pt William were not identified as receptors in initial scoping exercises. If that was the case, then Pt William and specifically the Tussac Islands and Cape Pembroke should be included in EMMP monitoring plans. This need should be highlighted in this EIS.	The locations of representative baseline monitoring points can be discussed in the EMMP workshop and we welcome input from local experts into that process.	==
SMSG33	Table 308. The severity of oil spills on the marine flora, specifically kelp forests, in Berkeley Sound is likely to be underestimated in this assessment. As highlighted above, this EIS has not considered the full range of significance that kelp forests have on the ecology and structure of the shore and near shore. As such, the overall risk significance is likely to be underestimated. Improving our knowledge of the effects of oil spills on the regions illustrated in the inshore spill modelling should be of key priority in the EMMP.	The assessment does account for the importance (and sensitivity) of marine flora, which is assessed as being of Moderate sensitivity. Due to a low probability of oil reaching large areas of kelp forest following a 300 tonne spill, the severity of the effect of a 300 tonne spill has been assessed as Minor. Following the larger (3,000 and 50,000 tonne spill scenarios) the severity is increased to Moderate. We note preceding responses discussing the ecological properties of kelp, adhesion testing on kelp and ecotoxicity testing at different trophic levels that support the assessment in the EIS.	==
SMSG34	Given the underestimates of the risk to Pt William (Tussac Islands, Cape Pembroke), and the related potential impacts to kelp forests and other ecological aspect not considered in this by inshore modelling, a re-evaluation of related impacts should be done throughout Section 12.2.6 – Risk Assessment. Better acknowledgement of knowledge gaps	Referring to the combination of POEPL's responses to SMSG representations, it is believed the assessment of inshore oil spills is sound and backed by a proportionate level of scientific investigation and impact analysis. POEPL acknowledges the importance of coastal habitats including kelp forests and have incorporated their characteristics when determining assessment outcomes. There are elements of the assessment of oil spills with respect to coastal environment that will evolve in EMMP activities, and further mapping of sensitivities and response actions will be an important part of developing the detailed Oil Spill Contingency Plans.	==

Consultee	Representation	POEPL response	Amendments/further detail
	and how those impact on the assessment scoring should be presented.		
SMSG35	POEPL should be commended for recognising that there are likely to be interaction effects between identified impacts. Indeed, it is accepted that such interactions are difficult to assess. However, the decision to not incorporate this unknown element into the impact and risk assessment seems at odds with the "precautionary approach" adopted for assessment of impacts and risks. The precautionary approach was explicitly expressed in Sections; 1.6.1.1.3 "While a precautionary approach was taken during all the impact and risk assessments, it is important to note that the presence of data gaps was pivotal in determining the level of confidence in the assessment, as is described in the EIA Methodology (Chapter 8.0 of the EIS). "1.7.4.2 (Bullet 2)" The use of a precautionary approach during the assessment due to data gaps." According to this methodology, the interaction effects albeit difficult to quantify, should have been considered additional source of unknowns, and incorporated in a precautionary way into the impact	POEPL interpret this as being supportive of the approach to impact interactions in the EIS, and point out that reasonably foreseeable impacts, and interactions have been included in the EIS (e.g., multiple stresses in the event of a large oil spill by way of examining case studies). With respect to interactions being a new source of uncertainty: Chapter 13 reflects the role of the EMMP process in monitoring performance and taking steps to steer the environmental management of the project, to which POEPL is committed.	==

Consultee	Representation	POEPL response	Amendments/further detail
	and risk assessment matrix. In other words, the assessed impacts, risks, mitigation, and residuals should necessarily include ALL the identified unknowns, including interaction unknowns, in line with the precautionary principle.		
SMSG36	In fact, Table 324 does somewhat quantify those unknown interactions. This table identifies areas of interaction and provides an overall score of "Total number of ways receptor could be impacted" by interaction effects. For example, there are 10 ways in which receptors of Marine Mammals impact can interact. How does this affect the impact and risk assessment for Marine Mammals? The impact and risk measure is likely to be underestimated given there are 10 sources of potential interaction effects.	As per comment SMSG35, much of the assessment includes data from case studies and from experienced personnel whereby the overall impact on receptors from multiple impact interactions is included in the judgement of impacts.	==
SMSG37	Table 324 – why were inshore marine flora and fauna not included as receptors?	The row titles used are headings that flow through the EIS and include marine flora and fauna in respective compartments. We recognise that taken collectively, the coastal or inter-tidal environment is a very important and productive part of the ecosystem and the table is not intended to imply that it has been excluded, rather it is simply a function of how the receptors have been classified in order to make the EIS systematic.	==
SMSG38	Given that there are some likely underestimated impacts/risk assessments relating to kelp forests,	Please see preceding comments, POEPL believe the EMMP logically reflects the significant uncertainties and significant impacts and risks for the receptors described.	==

Consultee	Representation	POEPL response	Amendments/further detail
	plankton, impacts to habitats in Pt William, there are likely additional EMMP actions required in this table.		
SMSG39	Also identified as a significant knowledge gap are the interaction effects of impacts (Section 13). Filling this gap should also be included in the EMMP in some form.	The stated aim of the Interaction chapter is to provide an indication of the potential for impact interactions with a view to informing the EMMP process. Many of the interactions noted are already included in the assessment process, reasonably foreseeable impacts are assessed and the precautionary principle requires a plausible scientific basis for taking further precautions.	==
SMSG40	I understand that there is a planned EMMP workshop, but for now this list should include those areas identified in this EIS, including continued mapping of coastal habitats with particular reference to kelp forests, continued toxicity testing on marine eggs, larvae, and juvenile fish and invertebrates, and continued updates of all oceanographic spill model parameters and running of scenarios including continued collection of metocean data.	Mapping of coastal habitats for oil spill response will take place as an inevitable outcome of the oil spill contingency plan process and we welcome input from local experts. We have undertaken a wide suite of toxicity testing using international standardised organisms which consistently show very low levels of toxicity. Additional testing relating to squid eggs is a commitment in the EMMP (15.6.1.2). Updating the oceanographic and spill models is a commitment in the EMMP (15.6.3.4).	==
SMSG41	Proposed monitoring of Benthic Sediments (15.5.1.2) should include identification and monitoring of indicator species. It is somewhat surprising that indicator species have not been identified as yet?	Choosing indicator species will be an output from the EMMP process. The EIS discusses amphipods and squid as candidates for monitoring in respect of oil spills.	==
SMSG42	Loligo (15.5.2.6) ongoing monitoring should include toxicity tests on eggs and the close association of egg laying grounds in the vicinity of kelp forests.	Via the EMMP POEPL commit to further investigation of oil toxicity with respect to squid eggs and cooperating in investigating squid spawning areas.	==

Consultee	Representation	POEPL response	Amendments/further detail
SMSG43	I see under Oil Spills (15.6.1.2) it is suggested further research on interaction with Kelp and Egg Toxicity. Excellent. These should also be monitored consistently for chronic low-dosage effects to detect shifting baselines.	The frequency of monitoring needs to be in proportion to the risks, to take account of the scale of change triggered by the impact and the scale at which effects would be significant. It would also be important to ensure that monitoring for other economic and environmental purposes was coordinated.	==
Royal Society for the Protection of Birds (RSPB)			
RSPB1	The RSPB feels that the EIS consultation has a significant flaw due to lack of inclusion of a number of significant reports (set out in the annex below) that are key to understanding the conclusions made in the EIS, but which are not summarised in a meaningful way in that document and which have not been made publically available. Provision of supporting reports is standard practice in EIA consultation. This omission limits consultees' understanding of key issues and their ability to provide a full response to issues raised in the EIS and the licence application.	The Oil Spill Strategies (for Offshore, Inshore and Stanley Harbour) were available during the consultation period and advertised at the public meetings and in the Data Room and include the strategy for wildlife response. They were provided to parties on request during the consultation period. The EIS necessarily has to summarise and present data from a large number of technical sources in a way that is accessible to stakeholders who may have interests in specific and diverse topics. POEPL has no reservation in sharing these documents with RSPB as listed (note that the first, and last three documents in the list have been shared with Falklands Conservation) POEPL shared information for example on oil testing in relation to seabirds. Copies of these are attached to this correspondence. • Genesis. 2017. Review of Seabird Data at Sea Lion • Marengo, I. 2014b. GIS-based assessment of coastal vulnerability to oil spill of the north-east coastline of the Falkland Islands • POEPL. 2015c. Environmental assessment of potential inshore transfer sites. • Offshore Oil Spill Strategy • Inshore Oil Spill Strategy • Wildlife Response Strategy"	==
RSPB2	Baseline data We are disappointed that no effort has been made between the exploration and extraction licence	POEPL and partners have made significant investments in the collection of baseline data, offshore, inshore and onshore in support of the EIS. For example, the Sea Lion benthic survey covering 92 stations and the 12-month long PAM surveys conducted prior to the last exploration round were	==

Consultee	Representation	POEPL response	Amendments/further detail
	applications to gather more offshore baseline ecological data on birds and cetaceans. There are also significant gaps in the baseline data of receptors that may be impacted by the inshore transfer operations in Berkeley Sound, and it is hard to understand why these gaps could not have been filled in the time available. We agree that the proponent has taken a suitably precautionary approach in their risk assessments. However, these data gaps mean that there is unnecessary uncertainty regarding both the significance of impact on receptors, but also regarding the efficacy of any mitigation measures that are proposed. We believe that FIG needs to ensure these baseline gaps are filled through appropriate consent conditions prior to any operations commencing. Nevertheless, we believe that it is poor practice that this information is not available to decision makers when taking a consent decision on a major infrastructure project.	conducted at a scale that would support a development EIS, and were considerably in excess of what would be expected for exploration drilling. Given the precautionary approach adopted in the EIS we believe there is ample baseline data on which to draw robust conclusions. The EMMP takes forward further data gathering and monitoring to address remaining gaps and uncertainties. The EIS does acknowledge the data gaps and deficiencies and the methodology explicitly incorporates uncertainty. The Sea Lion Development EIA process has been guided by local experts *via* the Hydrocarbons Forum and Gap Analysis Projects. POEPL and partners have funded the Gap Analysis Project to identify and help complement project-based knowledge and reduce uncertainty, and available results have been included in the EIS, including using seabird tracking data to complement the 3-year regional seabird programme published in 2002. Satellite tracking of higher predators has been ongoing and the results have recently been amalgamated with data collected throughout the Falkland Islands. The findings of this work will be applied to further colonies in a predictive form to better determine the distribution patterns of seabirds and seals. However, the results of this latest work were not available at the time of writing. The initial results of the EU Best sei whale project are included in the ES. A number of projects to improve the environmental baseline have been ongoing concurrently with the writing of the ES such as Falklands Conservation's sei whale project, and we have striven to include such data up to the last drafting deadlines. We note the FIG EIS Guidance 3.13: "the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they address the gaps in the RA. Therefore, the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained. When carrying out the risk assessment data gaps can be taken into account." And 3.18 "where there are data gaps a risk may be increased to reflect the higher degree of uncertainty (and work on a worst-case scenario/precautionary approach)."	

Consultee	Representation	POEPL response	Amendments/further detail
RSPB3	Alternatives for inshore transfer of oil We continue to be concerned with risks associated with inshore transfer of oil and believe its avoidance would be desirable. With regards to the alternative of offshore transfer, we note the issues with the safety case, but also that the Proponent will undertake trials to prove its viability or otherwise once vessels are in the water. Having not been able to review the inshore transfer location environmental assessment comparison report, we are obliged to take on face value that Berkeley Sound is the least damaging option. Due to the relative risks to the environment posed by inshore transfer we encourage FIG to ensure that any eventual consent is conditioned to ensure this work reports and a decision taken as soon as possible after operations commence, ideally with a fixed timetable.	POEPL recognises the importance of this issue to the environmental risks and performance of the project and also to its safety and commercial aspects and has done considerable work to understand the issues correctly and adopt the optimal approach. The choice of inshore transfer as the base case and the choice of Berkeley Sound as the optimal site is described over eight pages at Section 4.3.2. A more detailed justification for the choice of Berkeley Sound is referenced in this section - POEPL report "Environmental assessment of potential inshore transfer sites". This report is available for review. A summary of the decision process around Inshore Transfer versus Direct Offloading is contained in 'Additional Information'."	==
RSPB4	Bird-strike The EIS concludes that bird strike has a moderate residual significance risk to seabirds. In a worst-case this could have significant impacts on endangered seabird populations. We are concerned that there is little detail presented or apparent	We commit to applying OSPAR Agreement 2015-08 on minimising risks to birds from artificial light, which involves examining available techniques and balancing safety and operational requirements. Inevitably the detail of lighting design, fittings, shielding, lamp types, lighting philosophy for safe operations etc. must take place post-EIS approval when detailed design and rig selection is being undertaken. We have committed to investigating non-pilot flares but we note that they must be extremely reliable to be	==

Consultee	Representation	POEPL response	Amendments/further detail
	commitment to identify mitigation measures to reduce this potential, which are not dependent on a reaction to in-situ monitoring once vessels are in place and impacts already occurring. Again, as a condition of consent the Proponent should be required to outline in detail measures they will take to reduce artificial light pollution on its operating vessels, platform and FPSO. This should include a requirement to investigate and report in a timely way (before production) on the potential for use of non-pilot flares and green spectrum lighting. This information should form part of a precautionary state-of-the-art bird strike mitigation plan agreed before project implementation. This is particularly important as adaptive management and retrofitting of vessels once in the field is likely to be difficult, expensive and potentially impractical.	accepted as Safety Critical pieces of equipment and this includes a track record of successful deployment in similar operations in offshore settings. The EIS notes that a Bird Strike Management Plan is required prior to operations commencing and this is also included in the EMMP, and a BSMP was in place for previous exploration well operations.	
RSPB5	Oil spill response We note that the offshore oil spill scenarios in the EIS factor in oil spill response into their final risk significance values, but that the document then states that due to the weather conditions in the North Falklands Basin, oil spill response is unlikely to be a feasible mitigation	The EIS recognises that 'at sea recovery may not always be feasible in the Falkland Islands due to prevailing sea conditions'. The prevention of releases is always the primary risk reduction measure. It has been demonstrated that Sea Lion crude oil is solid at sea temperatures. Laboratory tests using feathers of nine species of seabird from the Falkland Islands showed that at low concentrations no oil was adsorbed by the feathers, and no structural damage was observed. At high concentrations, which would be limited in spatial extent, feathers became stained, and a	==

Consultee	Representation	POEPL response	Amendments/further detail
	option. FIG decision makers need to be cognisant that, although unlikely, should a major spill event occur offshore, there will be very little that can be done whilst impacts occur to globally important seabird populations for which they are responsible.	small amount of oil was adsorbed by the feathers of two of the species tested. The sensitivity of the local bird populations including their global importance has been taken into account in the assessment.	
RSPB6	Inshore there is little information in the EIS to show how the proposed oil spill response mitigation has taken into account the most sensitive colonies and habitats in Berkeley Sound –such as the large colony of near-threatened Sooty Shearwaters– or detail as to why the mitigation strategy chosen was picked over those which would result in better response outcomes. No attempt has been made to try to quantify the potential extent of impact on individual protected areas and their interest features within the Sound. As above, FIG decision makers should be aware that a major oil spill event in Berkeley sound, even with oil spill response, will have adverse impacts on nationally important seabird and cetacean populations for which they are responsible.	A large number of different response options and different equipment types were analysed in arriving at the preferred strategy, described in 12.2.7.1.1 in the EIS and given in more detail in the Inshore Oil Spill Strategy where a sensitivity analysis on the number of spill response units was also undertaken. The oil spill response mitigation utilised expertise from multiple international spill response experts (Morlich Consulting, SpillConsult, Franklin Marine, Braemar, Aiuka) and involved respected ecological experts with specific experience of the Falkland Islands in undertaking the EIS. An unprecedented amount of analysis has been undertaken on the crude oil to understand its behaviour and risks in the local environment including testing on sooty shearwater feathers amongst others. The spill response includes equipment specifically chosen for the crude oil type and includes a system of shoreline booms to limit migration of oil along coastlines towards the more sensitive areas. It is recognised that a major oil spill event in Berkeley Sound could have significant impacts on seabirds and cetaceans at certain times of year and the risks are assessed in the EIS according to a transparent assessment protocol (12.2.6.1.3). Such risks are inherent with the use of inshore waters for commercial activity and POEPL's proposals include numerous risk management measures such as vessel traffic management, the use of a mooring buoy, a local pilot and tug escorts amongst others.	==
RSPB7	Agreed Inshore and Offshore Oil Spill Response Plans and a Wildlife	The legislative regime in the Falkland Islands is such that operations could not commence without these approved plans being in place and therefore POEPL believes a specific condition would not be required.	==

Consultee	Representation	POEPL response	Amendments/further detail
	Response Plan should be a condition of consent.		
RSPB8	Environmental Monitoring and Management Plan Due to the uncertainties surrounding identified impacts to receptors in the EIS, it is vital that the EMMP is a robust, long term and iterative process that builds in adaptive management mechanisms to amend project activities and mitigation measures as needed. As such, we have a number of issues (set out in the Annex to this letter) which we believe the EMMP must address, and which are not adequately covered in the EIS. In addition, due to the vital importance of the EMMP in monitoring and addressing project impacts we believe that FIG need to carefully condition the set up, and implementation of the EMMP so that they retain a close regulatory and enforcement role, as would come into effect under the draft Environmental Case legislation.	POEPL agrees that development of an EMMP is an important step post-EIS approval. POEPL agrees with RSPB's points that the representation on the EMMP should include experts from the Proponent, FIG and relevant sector stakeholders (e.g.: fisheries/nature conservation). POEPL agrees that reviews should take place at intervals of no more than 5 years and agree it would make more sense to have short review periods at the start of operations, gradually increasing as time progresses, and so as certainty over impacts increases e.g., 1, 3, 6, 10, 15 years. POEPL supports FIG's recent consultation on the implementation of an Environmental Case model for future regulation subject to further discussion on comments submitted.	==
RSPB9	Offsetting The EIS sets out that all residual moderate impacts will be dealt with through 'offsetting' contributions to the Environment Fund. Although we understand that it is difficult for the Proponent to undertake direct or	Where POEPL has identified potentially significant impacts, POEPL has responded with alternative proposals during project development and/or we have applied mitigation to control the impacts and risks. FIG paper 124-16 is around developing a policy on further addressing significant impacts *via* offsetting, giving applicants a choice between managing their own projects that are considered offsetting or contributing to an Environment Fund managed by FIG. POEPL has chosen to adopt the Environment Fund	==

Consultee	Representation	POEPL response	Amendments/further detail
	indirect offsetting themselves, it is very important that these contributions are ring-fenced for conservation projects that benefit the conservation status of species and habitats that are impacted by the project, rather than being part of any wider pot of money. In particular, projects to enhance baseline data provision are not offsetting and should not be considered for funding from this source.	approach and is reliant on FIG to deliver the offsetting. The application of this principle has involved considerable discussion and an agreement was reached on a meaningful level of contribution which involved reference to other similar projects and activities around the world within an Environment Fund Briefing Note supplied to FIG. This approach is intended to deliver both offsetting and environmental legacy *via* the environment fund option which was expressed as FIG's policy preference in the ExCo paper 124-16.	
RSPB10	We note that the Proponent is including offshore and inshore oil spill residual impacts in its offsetting contributions to the Environment Fund. In reality, it is not possible to offset for impacts that would only occur in the event of an accident, and this would in no way absolve the Proponent of their remediation obligations in such an instance. We are therefore taking it that this is part of a 'net gain' contribution by the Proponent to the environment of the Falklands, and as such it should be considered a separate contribution.	POEPL agrees that offsetting unplanned events is problematic and the most likely outcome predicted for inshore transfer is zero spills over field life. In the event of a spill, there are mechanisms for response, compensation and remediation that are backed by insurances and which will take place irrespective of offsetting. POEPL believe that offsetting is not an applicable mechanism for unplanned events that may not occur and this interpretation is intended in the EIS text "It has not been possible to develop a practicable direct offset due to the uncertain impact, particularly as it may not occur during the life of field".	==
RSPB11	Decommissioning We note the commitment in the EIS to decommission the project to UK standards. Whilst acknowledging that at this stage it is not practical to have a detailed decommissioning plan, we	The EIS notes that the concept allows for the simplest means of decommissioning. POEPL would carry out a debris survey before relinquishing the licence resulting in a clearance certificate. It is a standard clause in petroleum production licences that operators must have financial provision to cover decommissioning costs and it is normal for them to demonstrate this periodically to the regulator, and we expect this to	==

Consultee	Representation	POEPL response	Amendments/further detail
	believe this needs to be an integral part of the project and a condition of the consent. In addition, we believe there should be a requirement to ensure that funds will always be available for the full decommissioning of the project, especially in the event that the operator went bust, or the operation was sold to a different company. Not doing so would risk unacceptable liabilities to Falklands and potentially UK taxpayers.	be covered in the Field Development Plan approval process. This obligation would transfer to any new owner with the licence.	
RSPB12	Remediation Liabilities The Deep Water Horizon blowout illustrated the potential enormous scale of environmental liabilities in the event of a catastrophic event. FIG and the UK government therefore need to have certainty that the Proponent has adequate resources and insurance to fully cover a worst-case scenario event. This information should be publicly available for reasons of clear public interest. Not to do so would risk unacceptable consequences for the globally important environment of the Falklands, Falkland Islanders and potentially UK taxpayers.	Provision for financial liabilities relating to oil spills is covered separately to the EIS and is linked to subsequent approvals such that EIS conditions are not necessary. Substantial sums are provided for in insurances and compensation schemes that fully cover the costs of worst-case releases, however unlikely. Information on the typical levels of financial provision is provided under 'Additional Information'.	==
RSPB13	Legislation For the reasons set out above and in the annex below, the RSPB does not believe that the EIS as it currently	POEPL believe the EIS is compliant and contains sufficient information for a determination. POEPL also note that many matters raised by RSPB are	==

Consultee	Representation	POEPL response	Amendments/further detail
	stands allows FIG decision makers to make a fully informed decision on licence application. However, if a decision is taken to consent the project we strongly recommend that robust conditions address these issues prior to operations commencing.	managed within the EMMP and subsequent approvals prior to operations commencing.	
RSPB14	Documents The following reports form the basis of important conclusions outlined in the EIS, which were not available to consultees, and which detail specific issues relating to the ecological impacts to birds, cetaceans and coastal habitats which are important in reviewing the EIS and the adequacy of its assessments and conclusions: · Genesis. 2017. Review of Seabird Data at Sea Lion · Marengo, I. 2014b. GIS-based assessment of coastal vulnerability to oil spill of the north-east coastline of the Falkland Islands · POEPL. 2015c. Environmental assessment of potential inshore transfer sites. · Offshore Oil Spill Strategy · Inshore Oil Spill Strategy · Wildlife Response Strategy"	See response to RSPB1.	
RSPB15	Env Basline We have not been able to review the Genesis report to be able to review	It is acknowledged in the EIS that the age of the Seabirds-at-Sea dataset, and inherent limitations of the survey method, mean that there are some questions regarding how representative the data are of present day	==

Consultee	Representation	POEPL response	Amendments/further detail
	their assessment and arguments. The coverage of the data (although in a much smaller time series) may or may not be equivalent to that used in frontier areas in the UK. This does not imply that the data used in these new UK fields is adequate and the environment offshore in the UK is not as environmentally sensitive as that of the North Falklands Basin (NFB), which we feel should imply a need for a higher level of effort.	populations. See Section 7.4.5.2.1.1. An independent review of the data (Genesis, 2017) concluded that while there were gaps, the seabird data was adequate for EIS purposes and equivalent to frontier areas of the UK with oil and gas activity where the UK Government and its nature conservation agencies permit development in light of this data. Given these uncertainties, a precautionary approach has been applied to the assessment of risks to seabirds e.g., in the oil spill assessments they have been considered as high sensitivity and impacts assessed as moderate, serious or major depending on the size of the spill. It is also acknowledged that a combination of satellite tracking and at-sea observations is likely to provide the best overview of seabird distribution within the waters of the Falkland Islands. The Sea Lion Development EIA process has been guided by local experts *via* the Hydrocarbons Forum and Gap Analysis Projects. POEPL and partners have funded the Gap Analysis Project to identify and help complement project-based knowledge and reduce uncertainty, and available results have been included in the EIS, including using seabird tracking data to complement the 3-year regional seabird programme published in 2002. Satellite tracking of higher predators has been ongoing and the results have recently been amalgamated with data collected throughout the Falkland Islands.	
RSPB16	Env Baseline The fact that much of the NFB east of the drill site has no SAST data in sensitive months (see Fig's 95-98, pp 380-383) clearly indicates a significant data gap, particularly when considering impacts from spill events. There is little indication that the available GAP seabird tracking data has filled this. Indeed, the report states (p.333) that penguin tracking data has not yet been	See response to RSPB03.	==

Consultee	Representation	POEPL response	Amendments/further detail
	compiled and analysed to enable its use.		
RSPB17	Env Baseline The EIS suggests that the SAST data is still relevant, as available Rockhopper penguin tracking summer tracking data corresponds well with the surveys of 2000. Even a brief glance at Fig.77 shows this is not the case, and that most penguin tracks are either in squares where SAST recorded no birds, or in squares which were not covered by SAST at all.	See response to RSPB03.	SAST surveys were not the sole source of seabird distribution data. The assessment does not rely solely on any one source of data. Although the recent GAP tracking data was not available at the time of writing, tracking data collected prior to writing was.
RSPB18	Spill Impacts The RSPB acknowledges the precautionary nature of the oil spill assessments made in the EIS, and that in relation to bird strike risk, baseline data without vessels in the water may not provide a reasonable basis of assessment (due to birds being attracted to the vessels). However, this does not overcome the fact that the Proponent has not undertaken any systematic, repeatable offshore seabird surveys in the offshore zone of influence, leading to their risk significance assessments for oil pollution events being highly uncertain. We do not believe this is a reasonable outcome for the EIS of a large	See response to RSPB15.	==

Consultee	Representation	POEPL response	Amendments/further detail
	extractive project in a globally sensitive environment.		
RSPB19	Env Baseline Volunteer lagoon is a key seabird site in the vicinity of Berkeley Sound, and yet no baseline surveys were undertaken to ascertain population numbers of seabirds, their significance nationally and their temporal use of the site.	The most recent (winter) coastal seabird survey has covered this area and it will be repeated in future surveys. Volunteer Lagoon is not considered especially significant for coastal seabirds. There is a very low probability of oil predicted to enter the narrow mouth of the lagoon and the booming plans in the Oil Spill Strategy include a booming location across the mouth of the lagoon to prevent oil ingress.	==
ESPB030	Env Baseline Excluding penguin populations, no attempt has been made to quantify the significance of seabird populations at Berkeley Sound colonies in relation to national or biogeographic scales, making it difficult to assess risk significance for these populations.	POEPL do not believe that quantifying the populations would add materially to the impact assessment given uncertainties in the impacts, and the assessment of populations of conservation importance is a strategic matter that is the subject of historic and ongoing studies and research. The impact assessment in the EIS accords a high sensitivity to seabirds in Berkeley Sound recognising large and important populations in the assessment with moderate, serious and major impacts on seabirds recorded for different sizes of oil spills inshore.	==
RSPB031	Env Baseline We are concerned that significant effort has not been put in to survey the numbers and behaviour of the sooty shearwater population in and around the sound, as these are a potential key species which could be affected by an oil spill event and key feature of Kidney and Cochon island Important Bird Area (IBA).	The impact assessment in the EIS accords a high sensitivity to sooty shearwater recognising a large and important population in the assessment with moderate, serious and major impacts on seabirds recorded for different sizes of oil spills inshore. Emerging data on population estimates e.g., on Kidney Island and Bird Island by Ewan Wakefield *et al.,* continues to contribute knowledge to this area. It is inevitable that new data will emerge and this will be incorporated in the EMMP and is noted in Section 15.5.2.1 of the EIS.	==
RSPB032	Spill Impacts The baseline data for birds in and around Berkeley Sound is patchy	See response to RSPB15.	==

Consultee	Representation	POEPL response	Amendments/further detail
	and excludes important data. The RSPB believes that these holes in the baseline need to be completed, and risk assessments re-appraised in advance of any operations occurring in the Sound.		
RSPB033	Env Baseline There is no explanation of why the oil vulnerability was not calculated using the newer SOSI method, rather than OVI.	The implementation of SOSI is a matter of national policy and has not been attempted in the Falkland Islands, it requires careful application as both methods introduce different levels of bias e.g., towards those species whose carcasses are more readily found on shorelines. As and when there is a policy change to the use of SOSI in the Falkland Islands, we would be happy to review the findings *via* the EMMP forum.	The range of data required to apply the SOSI method is not available for the Falklands. Any update on OVI methodology would rely on the same data and this was considered to be of limited value.
RSPB034	Env Baseline As above these figures illustrate the lack of baseline data, and so OVI values for much of the area east of the project area that would be impacted by spill events.	Gaps in the survey data are an intrinsic issue and the data is interpreted in the same way as equivalent datasets in the UK. The GAP higher predator work was initiated by the Offshore Hydrocarbons Environment Forum including POEPL and partners *via* FIPLA specifically to address issues such as this and to begin to fill the gaps, and the tracking studies have contributed to improving the confidence in the sum of the datasets that have been used in this assessment. The project will generate monitoring data *via* seabird and marine mammal observers that will be used to review the findings and reduce the uncertainties that have been acknowledged and included in the assessment.	==
RSPB035	Env Baseline The project area, which has implications regarding the certainty of assessment for risk significance from spill events for marine mammals.	The baseline data for marine mammals incorporates a number of data sources, in particular the 12-month JASCO acoustic survey data (Hipsey*et al.,* (2013)). Other data sources are used to corroborate the findings and understand the uncertainties which are acknowledged.	==
RSPB036	Env Baseline No specific field surveys were undertaken by the Proponent to assess marine mammal populations in Berkeley Sound and surrounding	The EIS has used the best available data at the time of writing in a body of water that is relatively well understood locally and has been used for decades for commercial activity. Receptors in Berkeley Sound such as marine mammals and seabirds have been accorded 'high' sensitivity in the assessment process. There is emerging data through research and	

Consultee	Representation	POEPL response	Amendments/further detail
	area, despite the fact that the existing patchy data shows it holds significant seal and cetacean populations. In our opinion this is a significant failing in the EIS, and makes it very difficult to assess the significance of marine mammal populations present, the risk significance of impacts affecting them, and the efficacy of any mitigation measures proposed to address these issues (e.g.: inshore oil spill response, disturbance and collision).	monitoring being undertaken by Falklands Conservation on sei whales and SAERI on dolphins & other cetaceans. As new data emerges, the EMMP process is designed to allow that to be brought to the table and to understand if management practices need to be adapted and will work in conjunction with the 5-year review process for the EIS.	
RSPB037	Env Baseline No indication of the relative significance of sealion colonies and haul out populations within a national or biogeographic context, whereas this information is provided for fur seals.	Fur seal census data is currently being worked up by SAERI. As new data emerges, the EMMP process is designed to allow that to be brought to the table and to understand if management practices need to be adapted and will work in conjunction with the 5-year review process for the EIS.	An indication of the proportion of the breeding population within Berkeley Sound has been added to the text. It is harder to determine the proportion of animals that use the area as a haul-out but several haul-out sites are highlighted in the text.
RSPB038	Env Baseline The RSPB does not think that the baseline information provided in the EIS, particularly inshore, is fit for purpose. As such, if consent were granted we strongly recommend that this information is required before operations commence in the Sound, and that risk assessments and mitigation strategies are re-appraised at this time.	The uncertainties in data have been acknowledged and communicated into the EMMP. Delivery of the EMM Plan will continue to strengthen the conclusions and there is no doubt that the deliverables of the oil spill contingency plans, the bird strike management plan and other documents will incorporate the latest and best available evidence.	==

Consultee	Representation	POEPL response	Amendments/further detail
RSPB039	Env Baseline Having not been able to review the Marengo report, we are not able to comment on this assessment and its conclusions. There is no explanation in the EIS of how its results have been taken into account in the Inshore Oil Spill Strategy.	The report on coastline sensitivity index assessment is attached. Coastline type has been incorporated in the oil spill modelling by mapping the ESI coastline designations into different coastline properties which is a function available in the OSCAR model, which reflects in the amount of oil that is predicted to adhere to coastlines, and the rate at which it is re-mobilised due to waves and currents.	==
RSPB30	Scoping We have already made our views clear on the scoping process of the EIS (our letter 17/10/17). In the explanation of the internal ENVIID scoping process, there is no mention of how the external consultation influenced the eventual scope of the assessment.	The scope of consultations and their outputs are described in some detail in Chapter 6 of the EIS.	==
RSPB31	Artificial Light We are concerned that only limited mitigation measures to reduce light pollution, and so the potential for seabird attraction and wrecks, have been outlined in the EIS, and that investigation of pilot-free flares and green deck lighting has been put back to post-sanction.	The main mitigation measure is to follow the guidelines of the OSPAR Convention whose purpose is to minimise pollution of the northeast Atlantic and North Sea including light pollution. This in turn requires a series of options to be investigated and balanced with safety and operational imperatives. This investigation will take place during detailed design and the outcomes cannot yet be determined, although a number of possibilities have been noted.	==
RSPB32	Artificial Light Due to the uncertainty surrounding bird strike both offshore and inshore, particularly as seabird usage in the areas surrounding project vessels may be influenced by attraction, we	POEPL recognise the uncertainty and agree that monitoring will be an important part of the mitigation and is included in the EMMP plans.	==

Consultee	Representation	POEPL response	Amendments/further detail
	agree that further comprehensive monitoring is undertaken, as part of a Bird Strike Management Plan and integrated into the EMMP.		
RSPB33	Artificial Light The RSPB strongly recommends that an agreed Bird Strike Management plan is a condition of consent, and that all reasonable mitigation measures RE: the design of project vessels are implemented before operations commence, as retrofitting vessels in the field may be prohibitively expensive or impractical. Saying this, bird strike monitoring should be an integrated part of the EMMP as outlined below, and an adaptive management approach adopted such that if significant impacts occur, further mitigation measures are put in place address them.	A bird strike management plan is a commitment in the EMMP and was previously prepared for the exploration wells campaign. POEPL believe that a condition is not necessary and would not change our commitment to this matter. The EMMP is a vehicle that will enable active management of issues in response to the data being collected. We look forward to developing the BSMP nearer to operations commencing and following discussion with our respected colleagues at the EMMP workshop.	==
RSPB34	Airborne Noise Although we acknowledge that with the mitigation measures outlined in the EIS, significant impacts are unlikely to occur to sensitive species populations, we do however feel that monitoring of the implementation/enforcement of FILFH protocols is included in the EMMP, to ensure that this is the case during operations.	During development of the EIS, exploration campaign helicopter provider Bristows were contacted regarding their observance of the low flying handbook. In response they confirmed the strict induction process that takes place, they provided POEPL with the maps used as the basis for avoiding areas sensitive for wildlife and they also noted that all flight paths are recorded and retained on their GIS system for later enquiry. In examining the flights for POEPL during the Exploration Wells campaign, the vast majority of logs are at 4000' or 5000', well above a height that should cause an issue for wildlife. A small number of points were identified that were lower than 3000' over the areas with higher potential for bird strikes, but these appeared to be either low-level SAR flights or that the altitude had	==

Consultee	Representation	POEPL response	Amendments/further detail
		to be reduced for operational reasons and hence remained in line with the local policy. An example of the GIS system screen is shown in 'Additional Information'. The level of flight data automatically recorded allows compliance to be audited, and periodic audits of compliance may be a valid way to monitor this. Currently the issue is not included in the EMMP following the criteria applied in relation to significance, sensitivity and uncertainty.	
RSPB35	Mammal collision The EMMP needs to include collision monitoring and monitoring of the implementation of mitigation measures (e.g.: ship speeds).	EIS section 15.6.3.2 includes marine mammal collisions in the scope of the EMMP.	==
RSPB36	Documents We have not had the opportunity to review the offshore oil spill strategy which should have been appended to the EIS as a key mitigation strategy.	See response to RSPB1.	==
RSPB37	Spill Prevention/Response Although it is discussed, no summary is given in the EIS of FPSO collision risk or iceberg collision risk.	Iceberg collision is not plausible due to the design of the facilities enabling disconnect and sail away and the approach speed of icebergs. 15.6.3.3 includes a commitment to review shipping patterns for collision risk and this will be used to update safety risk models that are routinely produced and which would be made available closer to operations commencing.	==
RSPB38	Spill Prevention/Response It is unclear from the EIS where anchor-handling vessels offload captured oil – is this to other vessels in the vicinity, or to onshore facilities?	12.1.4.4.5 states "The AHV unit would store 200 tonnes of oil and take 48 hours to offload, as it is assumed that no offshore storage would be available." This is intended to indicate that the AHV would return to Stanley where it would offload to an expanding oil bladder designed for such purposes which would be stored at the TDF/supply base. As part of its international oil spill response agreements, POEPL will also be able to mobilise vessels to the field to enable offload of oil from the anchor handling vessels in a matter of days if there is a major incident.	==

Consultee	Representation	POEPL response	Amendments/further detail
RSPB39	Spill Prevention/Response Although the scenario assessments for FPSO and well blow-out included offshore oil spill response as a mitigation measure, reducing residual impacts, this concluding section states that offshore oil spill response is unlikely to be a viable option. It would therefore have been clearer not to include it in the individual scenario assessments.	The text is intended to communicate that offshore recovery has not indeed been included in the scenario assessment rankings for a prolonged blowout at the maximum reservoir rates. It would of course still be attempted and it does make a difference in the outcomes, and in calmer weather, recovery might be appreciable, but such periods are not 'visible' in the stochastic outputs for such a very prolonged blowout. The efficiency for smaller incidents will be higher and it is a valuable tool in such situations.	==
RSPB40	Spill Prevention/Response Although in the baseline section above, the seabird data is deemed adequate, this section acknowledges that species distribution is a data gap. In our opinion, this gap should have been filled within this EIS process, and it is not an appropriate response to leave it to the GAP project at some point in the future.	Such gaps are intrinsic to offshore seabird data worldwide and the data is considered adequate for the purposes of the assessment. The GAP project was deliberately initiated and supported by POEPL and partners and has been active since 2014 in helping to improve this dataset. In that time it has successfully tracked over 200 animals and the available outputs have been incorporated in the EIS.	==
RSPB41	Spill Prevention/Response We have not had the opportunity to review the inshore oil spill strategy which should have been appended to the EIS as a key mitigation strategy.	See response to RSPB1.	==
RSPB42	Spill Prevention/Response Without explanation, this table and associated section is not legible to a non-specialist audience.	We agree that additional notes would assist interpretation, but it is inevitably a difficult topic. The rest of the text in 12.2.4.3.2 does explain the figures in more simplified language.	Table amended to aid interpretation

Consultee	Representation	POEPL response	Amendments/further detail
RSPB43	Spill Prevention/Response This talks about recovered oil storage capacity, but as offshore, it is unclear what this is referring too.	Section 12.2.(etc.) is for inshore spills, not offshore, and recovered oil storage is explained in the earlier sections.	==
RSPB44	Spill Prevention/Response It is unclear why response option 5 has been chosen over other options that would achieve better response results (e.g.: options 2,12 and 13).	The associated text states "The comparative assessment showed that three response vessels (e.g., DOSRV, MRSV and ISV after releasing CTT static towline - Option 5 in Figure 299) are able to start recovering oil within 15-30 minutes and in doing so will reduce the amount of oil reaching the shore substantially more than when using two vessels (Option 8). Thereafter, the extent of the gain from different combinations declines." This reflects that supplying more equipment, especially additional vessels, dramatically increases the cost without increasing the benefit in proportion. The test of disproportionate cost is a key test in the ALARP process. This is expanded in more detail in the Inshore Oil Spill Strategy. Although it is not explicit, the chosen set of resources illustrated in Table 313 corresponds to Option 5 plus additional storage plus shoreline booming locations, i.e., performs better than Option 5 alone, whereas Figure 299 is shown simply to illustrate one stage in the process of identifying and comparing and options.	==
RSPB45	Spill Prevention/Response From the information presented in the EIS, it is unclear how the inshore oil spill mitigation has taken into account the coastal sensitivities, and key seabird and marine mammal sites in Berkeley Sound and its surrounding area. Oil spill marker species monitoring should be included in the EMMP, as should spill modelling before each inshore transfer operation (to also take into account ecological sensitivities dependent on time of year).	The inshore spills assessment chapter runs to 88 pages and includes a methodical description of the sensitivities, the potential impacts without mitigation, the preventative measures that were identified and the development of oil spill response plans that mitigate the impacts. It draws on the baseline and sensitivity information in Chapter 7. We believe this is an appropriate level of commentary for a public EIS and various other documents are referred to that are available for review for stakeholders with a more detailed interest. Section 12.2.10.3 identifies the need to identify marker species for oil pollution and this is repeated in EMMP Section 15.5.2.3 and 15.5.2.4.	==

Consultee	Representation	POEPL response	Amendments/further detail
RSPB46	EMMP A clear distinction needs to be made between inadequacies in the spatial and temporal coverage of baseline data in the EIS, which needs to be closely conditioned and completed before operations commence, and operational monitoring and management of impacts, which should be managed by the EMMP process.	POEPL believe that the level of baseline data in the EIS is adequate and the EIS is compliant in that respect. There is a clear process for identifying matters to be included in the EMMP by virtue of their significance, uncertainty and sensitivity. In this context, we do not believe additional conditions are necessary.	==
RSPB47	EMMP The RSPB recommends that the EMMP steering group includes relevant experts/representative from the Proponent, FIG and relevant sector stakeholders (e.g.: fisheries/nature conservation).	See Response to RSPB8.	==
RSPB48	EMMP Instead of 5-year review periods, it would make more sense to have short review periods at the start of operations, gradually increasing as time progresses, and so as certainty over impacts increases. This might look something like 1, 3, 6, 10, 15 years etc.	See response to RSPB8.	==
RSPB49	EMMP Although the EIS provides a bare-bones outline of the EMMP scope, this needs to be discussed and agreed by a representative steering	POEPL agrees that an EMMP workshop should be held as soon as possible after EIS approval including respected colleagues in nature conservation along with other parties and membership of the EMMP steering group is the first bullet point of Section 15.2 regarding the EMMP.	==

Consultee	Representation	POEPL response	Amendments/further detail
	committee once sanction has been given.		
Falklands Conservation (FC)			
FC1	Legislation Legislation and policy: A good EIA will consider its compliance with legislation and policy and identify where its actions can contribute to policy objectives – the current EIS needs to consistently address legal and policy compliance and demonstrate a clear aspiration to meeting good practice policy objectives such as the 'net gain' principle.	POEPL understand the issues raised and the EIS addresses relevant legislation and policy which is summarised in each assessment chapter. We question whether 'net gain' is a stated objective of Falkland Islands policy for development in general, or for environment or for hydrocarbons or how such gain would be measured within the large economic benefits of an oil development. The Minerals Ordinance is clear in the obligations to manage significant adverse impacts and we believe these have been addressed within the EIS.	==
FC2	Env Baseline Data: The EIS acknowledges wide ranging data deficiencies yet disappointingly little relevant survey work has been conducted and included in the EIS for a development of this scale. The survey information provided needs to be more robust (e.g., more survey visits or more recent) and/or improve its coverage to include missing key locations or species. Key data that are available, such as for non-statutory designated sites for nature conservation, are not used appropriately/consistently, or at all, and need to be incorporated.	POEPL and partners have made significant investments in the collection of baseline data, offshore, inshore and onshore in support of the EIS. For example, the Sea Lion benthic survey covering 92 stations and the 12-month long PAM surveys conducted prior to the last exploration round were conducted at a scale that would support a development EIS, and were considerably in excess of what would be expected for exploration drilling. Given the precautionary approach adopted in the EIS we believe there is ample baseline data on which to draw robust conclusions and be able approve the EIS. The EMMP takes forward further data gathering and monitoring to address remaining gaps and uncertainties. The EIS does acknowledge the data gaps and deficiencies and the methodology explicitly incorporates uncertainty. POEPL and partners have also funded the Gap Analysis Project in parallel to identify and help complement project-based knowledge and reduce uncertainty and available results have been included in the EIS, including using seabird tracking data to complement the 3-year regional seabird programme published in 2001. Satellite tracking of higher predators has been ongoing and has been applied to further wildlife colonies in a predictive form. However, the results of this	==

Consultee	Representation	POEPL response	Amendments/further detail
		latest work were not available at the time of writing. The initial results of the EU Best sei whale project are included in the ES. The designation of conservation sites in the Falklands and their conservation objectives and management is not as developed as some other parts of the world. The ES has aimed to assess the sensitivities consistently, which in many cases is believed to result in a precautionary assessment. We note FIG EIS Guidance 3.13: "the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they address the gaps in the RA. Therefore, the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained. When carrying out the risk assessment data gaps can be taken into account." And 3.18 "where there are data gaps a risk may be increased to reflect the higher degree of uncertainty (and work on a worst-case scenario/precautionary approach)."	
FC3	Liabilities Oil Spill response: The EIS identifies that oil spill responses would not be possible under worst-case weather conditions, and combined with insufficient details on financial arrangements for spill response and remediation programmes (which may be over multiple years), further conditions need to be applied to provide confidence.	It is far more important to prevent releases than to attempt to control oil once it is in the environment, particularly offshore where weather conditions limit recovery and given that dispersant is not effective. Spills are prevented offshore by a variety of means including the application of Safety and Environmentally Critical Elements processes which were strengthened after the Deepwater Horizon incident *via* a European Directive and a significant revision of the Safety Case Regulations. These require systems that control Major Environmental Incidents to be managed in a formal way that brings those risks to a tolerable (low) level, by ensuring that systems are in place to manage critical equipment (design, reliability and maintenance), operational procedures and personnel competence, brought together as the management of Safety and Environmentally Critical Elements. Provision for financial liabilities relating to oil spills is covered separately to the EIS and is linked to subsequent approvals such that EIS conditions are not necessary. Substantial sums are provided for in insurances and compensation schemes that fully cover the costs of worst-case releases, however unlikely. Information on the typical levels of financial provision is provided under 'Additional Information'.	==

Consultee	Representation	POEPL response	Amendments/further detail
FC4	Offsetting Offsetting: There has been little apparent effort to consider offsetting options for biodiversity and carbon. Payment for offsetting is not considered good practice. Consequently, the EIS needs to provide stronger justification for payment as an option and a monetary value to assess its suitability, along with a guaranteed mechanism to ensure any financial contribution is used appropriately. The scale of the figure suggested in the recent ExCo paper (124/16) is very low (c£3m over 17 years).	Where potentially significant impacts have been identified, POEPL has responded with alternative proposals during project development and/or have applied mitigation to control the impacts and risks. FIG requires POEPL to include offsetting within the EIS for impacts that are significant and paper 124-16 is around developing a policy on this topic, giving applicants a choice between managing their own projects that are considered offsetting or contributing to an Environment Fund managed by FIG. POEPL has chosen to adopt the Environment Fund approach and is reliant on FIG to deliver the offsetting. The application of this principle has involved considerable discussion and an agreement was reached on a meaningful level of contribution which involved reference to other similar projects and activities around the world within an Environment Fund Briefing Note supplied to FIG. This approach is intended to deliver both offsetting and environmental legacy *via* the environment fund approach which was expressed as FIG's policy preference in the ExCo paper 124-16.	==
FC5	EMMP Environmental Monitor and Management Plan (EMMP): The EMMP is poorly aligned with its intended purpose and inappropriate in scope. It is heavily weighted towards monitoring and provides few management solutions. The EMMP should not deliver baseline data which should have been included within the EIS, but focus on monitoring the less certain risks/mitigation and identify real action that can be undertaken should those risks worsen or mitigation fail.	The purpose of the EMMP is to define the management actions and resources required, respond to the priority data gaps/areas of uncertainty identified in the assessment, and importantly to assess and monitor the effectiveness of the mitigation measures during all stages of the proposed operation, and based on this monitoring to help underpin an adaptive approach to the management of the operation to prevent or reduce risks to the environment.	==

Consultee	Representation	POEPL response	Amendments/further detail
FC6	Oil Export Inshore transfer - Alternatives: There is very little evidence included within the EIS to support the choice of inshore transfer rather than offshore transfer as well as the current choice of location for inshore transfer. FC consider that inshore transfer poses the greatest risk to the environment and therefore believe every effort would need to be shown to keep transfer away from Berkeley Sound or similar sites. The EIS needs to include a more comprehensive and justifiable assessment.	POEPL recognises the importance of this issue to the environmental risks and performance of the project and also to its safety and commercial aspects and has done considerable work to understand the issues correctly and adopt the optimal approach. The choice of inshore transfer as the base case and the choice of Berkeley Sound as the optimal site is described over eight pages at Section 4.3.2. A more detailed justification for the choice of Berkeley Sound is referenced in this section - POEPL report "Environmental assessment of potential inshore transfer sites". This report is available for review. A summary of the decision process around Inshore Transfer versus Direct Offloading is contained in 'Additional Information'.	==
FC7	Significance of impacts The ZoI is rarely defined and other area reference terms are sometimes used which are not associated/conflicting with the ZoI such as 'North Falkland Basin' (pg. 409 and others). The baseline data is significantly overloaded with information that seems to fall outside the likely ZoI (which is usually undefined) for the impacts/risks identified e.g., coastal sensitivity indexes for areas beyond the extent of worse case spill models (pg. 435), terrestrial habitats that are included where highly unlikely to be impacted by marine pollution (pg. 417), Seabirds at Sea Data beyond oil	POEPL understand the point being made but this would involve a significant reorganisation of the document and it would not result in any differences in the outcomes. Therefore, POEPL do not believe it would be a good use of resources when stakeholders are now familiar with the approach taken. Composite diagrams have been produced illustrating areas of potential impact for different stressors e.g., the maximum footprint of drill cuttings deposition leading to a risk of >5% on a combined PEC/PNEC basis, but it is extremely difficult to make such diagrams accessible without applying significant degree of explanation e.g., where the significance levels are complex, or seasonally variable, or the impact has a statistical footprint. The assessment of the affected zone is also iterative in applying assessment methods that are specific to the receptor e.g., coastline types or cetacean species so it is rarely as cause-and-effect as the ZOI approach might suggest. We do not propose to include such diagrams but we would be happy to have a dialogue on good practice for future projects.	==

Consultee	Representation	POEPL response	Amendments/further detail
	spill models, NNR listings etc. It also includes features within a ZoI that are not defined (e.g., the very sensitive area on Fig. 147) or addressed i.e., designated sites (see below). It is repeatedly unclear which environmental receptors (ecological features) are considered appropriate to consider for each of the potential/known impacts. Resolution The Zone of Influence for potential impacts should be clearly and repeatedly identified. This should be done before summarising relevant receptors (ecological features that may be impacted) and baseline data as a necessary prerequisite to provide robust and clear assessment.		
FC8	Oil Export The statements imply there is now evidence to support feasible offshore transfer. Given the hugely significant reduction in impacts and risk on/to the environment that this would bring, it does not appear that inshore transfer would be a satisfactory alternative unless this potentially feasible offshore transfer option is ruled out (pg. 113 and 114). 1 CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial,	As per response to comment FC6, a note has been prepared summarising the decision process around the export options, and a detailed assessment of inshore transfer sites is available to review.	==

	Freshwater and Coastal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester. (Section 2.19) It is not clear if the option to undertake inshore transfer has been selected because FIG and HSE have stated they will not support a safety case, or because PMO do not consider that they would. It appears to be the latter (pg. 113 and 114). Whilst perhaps environmental risk from spill is implicit in statements about safety of operations; the ordinance requires the indications of the main reasons for the applicant's choice to take into account environmental effects. There seems to be no direct consideration of environmental impacts for the various options included in the EIS. There seems to be a shortage of information to support statements, as well as references to studies which are not included in the EIS as part of the consultation (pg. 113 and 114). Resolutions The EIS should include an overview of the impacts and risks from each proposal (offshore transfer vs inshore transfer) to be able to balance environmental considerations with operating safety and economic viability. The EIS should include		

Consultee	Representation	POEPL response	Amendments/further detail
	further information to support statements of operating safety and economic viability as reasons not to pursue offshore transfer. The applicant needs to confirm whether FIG and HSE would, or would not, support the Safety Case in order to substantiate what satisfactory alternatives exist. This confirmation from the developer needs to be an agreed within a specific timeline with an accompanying review period. As minimum, FC believes this should be a condition of any consent.		
FC9	Env Baseline Whilst the Falklands marine environment is acknowledged as being data deficient or poorly understood few surveys were conducted for the EIS. Those documented within it were: 'mapping the shallow marine, intertidal and terrestrial habitats found within Berkeley Sound. a dedicated coastal bird survey of Berkeley Sound.' Surveys of Berkeley Sound (within a presumed Zone of Influence of an oil spill) did not include the globally endangered sei whale for which the	As per response to comment FC2, baseline data gathering has been building over many years towards the consenting of production operations in Falkland Islands waters and surveys for recent Exploration Wells campaigns were designed to be large in scale to support the assessment of production proposals. The Sea Lion Development EIA process has been guided by local experts *via* the Hydrocarbons Forum and GAP analysis. Satellite tracking has been ongoing throughout the exploration and project development phase. However, at the results of this work were not available at the time of writing. The initial results of the EU Best sei whale project are included in the ES. Although the sooty shearwater colony on Kidney Island was not surveyed, the importance of this colony, and Kidney Island, is well known, acknowledged and accounted for in the assessment. The EIS states that a large proportion of the Falklands population of sooty shearwaters and white-chinned petrels breed on Kidney Island and that an oil spill in Berkeley Sound during their breeding season could impact a significant proportion of the	==

Consultee	Representation	POEPL response	Amendments/further detail
	Sound is a candidate Key Biodiversity Area Surveys of Berkeley Sound did not include the 'Near Threatened' sooty shearwater, one of the key features of Kidney and Cochon Important Bird Area, to assess what impacts a spill could have on the internationally recognised site. Many thousands raft daily on the water in this area during breeding. No direct assessment of the habitats in the known Zone of Influence of the mooring buoy were made in Berkeley Sound.	regional populations, especially as sooty shearwaters form vast rafts close inshore before returning to their nest burrows. The structure of the EIS has been to examine groups of species, which includes an assessment of impacts on their habitats. We are conscious that the EIS has a 5-yearly period of validity under the Offshore Minerals Ordinance and would undergo a thorough review at such intervals, informed heavily by the ongoing working of the EMMP group and the results of monitoring of mitigations.	
FC10	Env Baseline The EIS does not contain tracking data from the GAP project (pg. 333). Is this information therefore not 'required to identify and assess the main effects' on the environment as per the OMO? The EIS acknowledges the requirement for further information (pg. 247). This section (repeated below) highlights areas where data should and could have been gathered ahead of an EIS submission (points 1,4,6,7,8,10 in list below) even with	Tracking data from GAP was not available in a form that was useable at the time of writing. However, initial results indicate that the distribution patterns used in the assessment are consistent with evidence from tracking and this supports the conclusions reached in the EIS. Much of the GAP higher predator tracking work is being rolled out onto other taxa - specifically flying seabirds from data collected by tracking programmes conducted by other scientific programmes in the Falkland Islands. This can be fed into the EMMP process along with other emerging scientific outputs that are inevitable as time passes. We believe these points are addressed in the assessments with sound data and with a clear method for addressing uncertainties recognising the FIG EIS	==

	opportunities and timescales available General 1. Impact of sea lion crude on fur; 2. Predicting the likelihood of introducing invasive species; 3. Auditory sensitivity of penguins and marine mammals; 4. Quantifying the impact of bird strikes; 5. Impact of long-term noise and actual noise outputs from the operations; Offshore environment (North Falklands Basin and Sea Lion Field): 6. Inter-annual distribution and abundance of marine mammals in the North Falklands Basin; 7. Benthic habitats and fauna at the Sea Lion drill centre and flowline locations specifically; Inshore environment (Berkeley Sound): 8. Benthic habitats and fauna at the Mooring Buoy location specifically; 9. Location(s) of loligo spawning grounds; 10. Inter-annual distribution and abundance of marine mammals. Points 2, 3, and 5 may provide some risk refinement but are unlikely to be clearly linked to oil industry activities and deliver management options (see EMMP below). Resolution	Guidance and with relevant points transferred to the EMMP *via* a logical process to ensure the correct level of management. 1. This is a commitment that affects detailed wildlife response and will be included in Oil Spill Contingency Plans. 2. POEPL has already funded an invasive species monitoring programme at the TDF and initial results are included in the EIS. 3. Auditory sensitivity of receptors is described in the EIS and has a substantial body of knowledge associated. 4. Bird strike cannot be baselined at this stage other than by reference to Exploration Wells activities where no birds were recorded in incidents involving the drilling rig, and a very small number were involved with vessels or inshore. 5. The JASCO monitoring provides a 12-month baseline of noise levels. 6. There are numerous datasets used relating to marine mammals spanning many years: tracking data of marine mammals funded through the GAP project in addition; the JASCO acoustic survey; the White, *et al.,* 3-year survey; and emerging datasets from other monitoring activities *via* the oil industry and conservation/research projects. These provide a wide spectrum of data on marine mammals at different times of year sufficient to draw conclusions for the EIS. 7. The 92-station benthic survey and scientific analysis characterise the area in detail. A site survey will be undertaken prior to locating the drilling rig and FPSO to clarify any specific local features. 8. The Benthic Solutions survey of Berkeley Sound was comprehensive and a site survey will be undertaken prior to locating the mooring buoy. 9. The oil properties show that toxic effects to squid eggs of any exposure to Sea Lion Crude are likely to be very limited, and the buoyant and relatively insoluble nature of the oil mean that interaction is limited. 10. There are many existing sources of data and local knowledge regarding marine mammals in Berkeley Sound and these are summarised in the EIS and a suitable for assessment purposes. POEPL are committed to gathering further marine mammal data offshore and inshore as part of EMMP efforts following project sanction.	

Consultee	Representation	POEPL response	Amendments/further detail
	The EIS should contain relevant data detailed above. It would be bad practice to make collection of these basic data a condition of a licence as once a licence is granted it can be potentially costly and difficult to alter the consented operations. It should certainly not be delivered as part of an EMMP as this is information that should be collected immediately to inform the EIS and before deployment of any infrastructure."		
FC11	Protected Areas There is lack of: -assessment of impacts against sites specifically and legal implications, -inclusion of important (international) site designations candidate Key Biodiversity Areas (KBA), KBAs and Priority KBAs, candidate Important Bird Areas, -understanding of the significance of particular designations. (pg. 424 '4 levels'; pg. 1236 Kidney is stated as 'nationally' significant whereas IBA designation is international). The FIG National Nature Reserve network is flawed in not having any key features identified and not having management objectives in place, therefore it is difficult to make good assessments of value and risk. However, international non-statutory	Designation of sites of conservation value in the Falklands is a developing topic, nevertheless the EIS has tried to use the available information to assess the impact on 'sites' in a consistent manner (as outlined in the methodology). It is noted that the scientific designations (such as IBA IPA, and IUCN status), while not necessarily affording legal protection represent outcomes of a systematic process. We have used all of these designations in the assessment, and so if an area is not formally protected, but is listed as an IBA for example, we have afforded it a level of importance. Key Biodiversity Areas (KBAs) are a relatively new concept for the Falkland Islands. The sensitivities associated with these protected areas are assessed in the EIS. The phrasing 'four levels' is perhaps unfortunate ('categories' might have been a better word) and was not meant to imply that there is a relationship between the listed designations, which are sub-divided into three rather than four categories (typo). The example on Page 1236 deals with the impact from oil spills in Berkeley Sound. In this instance, the impact on coastal habitats (terrestrial) is assessed and it was deemed that the greatest impact would be on species that rely on these habitats as foraging grounds (i.e., Cobb's wren in this case) rather than the seabird species breeding at a site that contribute to the IBA status of that site It is important to note that seabirds such as rockhoppers and sooty shearwaters, which breed on the	Changed 'four levels' to 'three categories'

Consultee	Representation	POEPL response	Amendments/further detail
	designations (IPA, IBA and KBA), provide criteria by which 'internationally important' sites, and key features are identified. Resolution Site assessments of all relevant designations within identified Zones of Influence should be included within the EIS."	Kidney island group, and King Penguins which breed at Volunteer Point (both IPAs), for example, are assessed separately as part of the 'seabirds' receptor. For the largest potential release of 50,000 tonnes, it cannot be ruled out that if these happened at specific times of year and with specific trajectories of oil, the features of some protected sites could be affected to the point where favourable conservation status is lost for a time. In the absence of a clear legal framework there is some legal precedent around the Habitats Directive which includes the concept of 'likely' significant adverse effects on site integrity. While 'likely' is given a very wide interpretation in the courts, it has been determined that 'extremely remote' outcomes are not in scope when considering whether a project should be consented, whereas reasonably foreseeable outcomes are in scope.	
FC12	Legislation Legislation and policy are the framework against which Environmental Impact Assessments (EIAs) are judged. They provide instruction or guidance to developers about what is acceptable with regards to development proposals or ongoing activities. A good EIA will consider its compliance with it and identify where its actions can contribute to policy objectives4 Issue/s - Falkland Islands policy, legislation and guidelines are not integrated into the EIS - Whilst there is some listing of policy and legislation this is incomplete: - No mention of the Development Plan which describes important policy	Schedule 4 of the Minerals Ordinance details the contents required within an Environmental Impact Statement (EIS) and we believe that the submitted EIS conforms with these requirements as summarised in Appendix A of the EIS. Each Chapter includes a summary of relevant legislation and related material which is then assimilated into the assessment. The Falkland Islands Development Plan is mentioned and has significant application to onshore development and infrastructure. Any onshore development will have to go through a separate planning process during which the Falkland Islands Development Plan will be of greater relevance. The Biodiversity Framework came into being part way through the production of the EIS. It is acknowledged that the Biodiversity Framework is the correct reference and the statements in the EIS containing Biodiversity Strategy should be read as Biodiversity Framework. It is acknowledged that the Conservation of Wildlife and Nature Ordinance does state that it is an offence to disturb nesting birds or any animals within a National Nature Reserve, however, it is not clear what constitutes disturbance. This is relevant to the section highlighted on page 570 but does not affect the outcome of the assessment. Targets 14 and 16 within the cetacean action plan refer to acoustic and physical disturbance to cetaceans and these issues are assessed. The Marine Mammal Ordinance provides a basis for the action plan as a management tool for Government. We note	Biodiversity strategy is cited in Chapter 10.4, amended to Biodiversity Framework

	on development and the environment, - The Biodiversity Framework is the primary national policy document for biodiversity in the Islands and superseded the old Biodiversity Strategy. The EIS repeatedly makes reference to species and habitats listed within the Biodiversity Strategy, - The EIS states no relevant legislation for 'disturbance' (pg. 570). Whilst the main piece of wildlife legislation the Conservation of Wildlife and Nature ordinance 1997, contains plenty of legal relevance to this, - Species Action Plans recognise the agreed approach to particular species within the Islands e.g., targets 14, and 16 in the Cetaceans SAP are of relevance, but are not included. The Falkland Islands wildlife legislation is dated and inappropriate for the globally significant wildlife supported by the Islands and includes little guidance for dealing with breaches. As the EIS correctly points out (pg. 608) there are no equivalent 'Disturbance licences', so it is difficult for developers to know what the next steps are to be compliant with legislation and policy; however, as a minimum the Development Plan lays out the reason to consider legally protected species within the EIS:	that the term 'disturbance' is also used in the UK *via* the Habitats Directive and is defined as "... to be likely significantly to affect (i) the ability of any significant group of animals of that species to survive, breed, or rear or nurture their young; or (ii) the local distribution or abundance of that species." In practice virtually no licences have ever been required or issued for deliberate disturbance for oil and gas projects. While further reference to plans and policies could be included, we believe impacts are adequately assessed in the EIS. Again, reference to the Falkland Islands Development Plan in the context of this EIS is relates mainly to development onshore and within the Territorial Sea. It is acknowledged that any such development associated with the Sea Lion Field will have to go through the planning process, which is likely to include a separate assessment of impacts where the guidance in the FI Development Plan is most relevant.	

Consultee	Representation	POEPL response	Amendments/further detail
	Policy SP5 'D. To protect the natural environment proposals must: 1. not have any significant adverse impact upon species protected by law (including their habitat)' Resolution The EIS should accurately assess compliance and identify actions that contribute to policy objectives to provide confidence that the EIS is written with an understanding of relevant Falkland Islands policy and legislation.		
FC13	Methodology The concept of As Low As Reasonably Practicable (ALARP) is widely used in the EIS. However, it is subjective - what is 'reasonable' to PMO may be 'unreasonable' for FIG or stakeholders for example. This is important when considering the adequacy of mitigation, particularly for ecological receptors. In the EIS, what is 'reasonable', is dictated to decision makers and stakeholder by the applicant, as well as what further action should be taken (pg.54 Table 6, Table pg. 65 as examples). - The significance of risk is dictated by the applicant, as again are the	The current Ordinance and EIS Guidance operates on conditions of mitigation being triggered by a significant impact, in common with much worldwide EIA legislation. POEPL has followed this method and also gone further where possible by using ALARP *in situ*ations where the impact is non-significant. POEPL do not agree that significance is dictated by the applicant; for each category of impact there is reference to international protocols and standards for assessing risk and impact as appropriate and these have been evolved through previous experience in the Falklands as well as POEPL experience worldwide and the experience of our specialist advisors locally and worldwide. POEPL welcome feedback on any topics where respondents believe alternative significance levels could be used.	==

Consultee	Representation	POEPL response	Amendments/further detail
	subsequent actions, such as offsetting (Table pg. 65). - Risk categories should be more clearly explained in order to allow decision makers to make informed judgements i.e., for 'moderate risk' a nationally important site could be 'temporarily' impacted (timescale unknown), or a site of less importance could be destroyed. - The EIS does not deliver 'no net loss' and has little evident aspiration for environmental 'net gain' Resolutions The proposed development should clearly deliver 'no net loss' as minimum. The risk assessment is 'leading', it should not conclude decisions/actions on behalf of decision makers.		
FC14	Offsetting Whilst PMO may not have permanent in-house expertise on offsetting (pg. 52), consultants are there to fill this expertise gap. It is disappointing that little thought seems to have been put into offsetting projects proposed within the EIS. For example, impacts on petrel populations from bird strike could be offset by rat or mouse removal at small petrel sites that would reduce pressure on colonies, or low spill lighting in town could	As per response to comment FC4, POEPL has been given a choice to self-manage offsetting or give responsibility for choosing offsetting projects to FIG *via* an Environment Fund. Agreement has been reached on the latter option.	==

	reduce sooty shearwater collisions; disturbance at penguin colonies could be offset by wardens or improved fencing/markers at sites already under disturbance pressures. - The lack of offsetting projects also seems to be argued on the absence of exact quantitative information. In this situation the decision is made by the developer as to whether to do nothing i.e., leave an impact, or propose something that is relevant and shows desire towards 'net gain', if not 'no net loss' as minimum, and could result in beneficial impacts overall. - Carbon: the development proposal will generate over 9.5 million tonnes CO2 in its Field Life (pg. 770), increasing the Falkland Islands production by around 340 % in that period. Again PMO have made no proposals for offsetting projects and instead propose payments to an offsetting fund. - Proposals for contributions to a fund provide no values, so it is not possible to determine whether the payments to a fund would cover projects that would offset identified impacts i.e., reasonably proportional to the calculated emissions projections. Carbon credit/trading schemes start around $1 at the		

Consultee	Representation	POEPL response	Amendments/further detail
	bottom but up to $20 per tonne. The EU Emissions Trading Scheme is currently c€10 per tonne. - The offsetting fund has not been set up, so there is currently no legal mechanism to ensure that money being provided by the developer for offsetting will be used appropriately. Resolutions The offsetting proposals need to provide better justification for not exploring indirect offsetting project proposals. The offsetting proposals for contributing to a fund need to state a value that can be judged to be commensurate with delivering offsetting to provide 'no net loss', and for carbon for comparability with carbon credit values.		
FC15	EMMP EMMP is being used to gather baseline data that should have been done for the EIS - EMMP is not being focussed on uncertainty of impact categories or mitigation - EMMP is being used to gather data that cannot be attributable to oil activities and therefore cannot guarantee positive management. Examples of EMMP actions - Marine Mammal Observers to check for cetacean collisions/ near miss	POEPL disagree with statements around baseline data. POEPL believe the EIS has sufficient baseline data to comply with the legal requirements and in some cases far more than would be found in equivalent applications in other regions. POEPL believe the EMMP subject matter has been determined in a logical way connected to significance, sensitivity and uncertainty. Seabird/MMOs will be employed on vessels to monitor for presence and behaviour of seabirds and marine mammals who will advise on direct actions e.g., to avoid collisions or alter speed if high densities of mammals are encountered. POEPL will certainly discuss the results of monitoring e.g., for bird strike *via* the EMMP forum and directly with regulator and determine the best course of action, and it is possible that this could involve trigger	==

	whilst vessels are operating – if above acceptable threshold change vessel activity Code of Conduct to more precautionary, - Seabird Observers to check for bird strike, set acceptable limits - if above acceptable limit change lighting type/timing/spill etc., - Data needs collecting on actual anchorage area Zone of Influence before consent. If habitats prove to be valuable, but impacts are argued against, then monitor anchorage Zone of Influence and change location if impacts are large. - If dynamically positioned tankers have significantly different noise outputs to other vessels using the Sound, monitor occurrence of cetaceans, change location/engines/timing, - If utilising higher risk areas than existing fishing, or bunkering vessels - monitor ballast water and hulls for species that could survive, improve hull cleaning and ballast water treatment. Resolutions EMMP proposals are not acceptable and should be revised to meet the generally accepted requirements of EMMPs. Contributions to broadly relevant, but non-EIA essential wider	levels of impact. We have committed that the DP shuttle tanker in Berkeley Sound will employ an SMMO to monitor and record specific reactions. POEPL confirm that offshore, site-specific seabed surveys will be undertaken prior to laying anchors or installing infrastructure. Similarly, inshore surveys will be undertaken at the mooring buoy anchor locations which will allow any fine tuning to avoid specific features. POEPL are committed to monitoring measures for ballast water and invasive species and to hull inspection for construction vessels to be anchored in Berkeley Sound.	

Consultee	Representation	POEPL response	Amendments/further detail
	environmental monitoring, where management actions cannot be undertaken, should be delivered outside of the EIA process. Once appropriate, EMMP commitments should be part of strict licence conditions."		
FC16	Spill Prevention/ Response Oil response strategies (including for oiled wildlife) were not included within this EIS, neither was it clear during the consultation that three response strategies (Offshore, Inshore and Stanley Harbour) were available, which is disappointing. - Metocean data is available for both the offshore and inshore operational sites, and thus the inclusion of models to inform on the ability of the operator to carry out effective and sustained spill responses and subsequent remediation needs to be included - critical for decision makers to fully understand the consequences of not being able to carry out a response to an oil spill. - The operational Oil Spill Contingency Plan (OSCP) and Oiled Wildlife Response Plan (OWRP) are proposed to be submitted at a later date before operations commence. According to the PMO Oil Spill Strategy for Inshore Crude Oil	The Oil Spill Strategies (for Offshore, Inshore and Stanley Harbour) were available during the consultation period and advertised at the public meetings and in the Data Room. They were provided to FC in request during the consultation period. Metocean data and modelling services will indeed be available to the ongoing operations including metocean and spill fate and the development of this work has been presented at numerous forums over the last few years. POEPL is obliged to ensure its plans interface with the NOSCP and Falkland Islands Oiled Wildlife Plan, although its response is not reliant on those resources. We look forward to discussing the development of the operational OSCPs with FIG and FC in their respective capacities as described in the NOSCP after the project has been sanctioned. POEPL is committed to understanding the adhesion of oil to pelts to include in our wildlife cleanup procedures. POEPL recognise that two of the main impact mechanisms (feather oiling and water-soluble toxicity) are less significant with this oil type than typical crude oils, given its solid and relatively non-adhesive nature and its low proportion of soluble and aromatic components. After many oil spills, birds die due to ingesting the oil that they preen off their feathers, and we can expect much less Sea Lion crude to be present on feathers than with most crude oil types. This leaves the pathway of ingestion of water borne wax. The ingestion of oil is a major pathway for all oil spills as it becomes biodegraded, and POEPL has specifically included the expertise of Dr Anton Wolfhaardt in the EIS team, who has direct experience of oil ingestion in penguins amongst other animals, to provide robust scientific advice. POEPL recognise that the high wax content, low solubility and particulate nature of the residual oil is	==

	Transfer Operations these plans will interface with theFalkland Islands National Oil Spill Contingency Plan (NOSCP) and the Falkland Islands Oiled Wildlife Plan, therefore placing a potential resource and financial commitment on FIG and other stakeholders (e.g., FC). Conditions should be set by FIG which include realistic time-frames to inform stakeholders, investigate, develop and disseminate plans for approval and well in advance of operations commencing. - Further investigations of oil behaviour on wildlife is required. There are still many unknowns regarding the interaction of Sea Lion waxy oil with wildlife. A recent study suggests ocean-borne plastic has a smell that marine animals find appealing Proceedings of the Royal Society B, DOI: 10.1098/rspb.2017.1000. Further studies are essential that investigate whether in an oil spill incident Sea Lion oil as solid wax balls are attractive to marine wildlife and incidentally consumed, as well as the continued testing of the oil on marine wildlife pelts. - Further investigations are required to trial and test logistical capabilities of oil spill plans in advance of	unusual and we will continue to investigate this topic post-sanction of the project. POEPL is committed to undertaking *in situ* spill response exercises prior to operations commencing and regular exercises will be undertaken to internal and legal requirements. Financing of oil spill liabilities is a requirement for all POEPL operations worldwide and further information on the levels of insurance cover routinely provided are given under Additional Information.	

Consultee	Representation	POEPL response	Amendments/further detail
	submitting these to FIG. For example investigating seasonal weather conditions and resource limitations. As examples, tents used as temporary animal shelters may not be suitable in a windy climate. There needs to be consideration of rehabilitation in a cold climate - use of outdoor pools will not be suitable. There is no mention of sourcing food supplies for the duration of rehabilitating wildlife. Resolutions More data should be provided on oil behaviour with wildlife and trials carried out to test feasibility of the logistics of response plans.		
FC17	Legislation The EIS appears not to be compliant with the OMO in not providing details on decommissioning. - There is no mention in the EIS of finance for decommissioning (pg. 211). Resolution To be compliant with the OMO the EIS should include the decommissioning phase of the proposed development. There needs to be a clear commitment to be able to decommission even if the developer is in financial difficulty.	It was agreed with FIG that in this EIS POEPL would provide a high level description of measures taken in design to facilitate decommissioning, but that a full plan and assessment of the impact of decommissioning will be undertaken near the end of the field life. It is considered that this approach is consistent with OMO (Amendment) 2011 – Section 6. Remediation. This is also the current approach on the UKCS (BEIS EIA Guideline, Feb 2018), "There is no requirement to provide detailed information in relation to how removal will be achieved at the time of abandonment or decommissioning, or to provide a demonstration of the likely significant effects of the activities." Decommissioning was discussed with EPD and DMR in November 2015 and it was agreed: - In summary, a high level description will be given with a base-case of complete removal of all structures. However, due to uncertainty as to how that will be achieved and potential for technological developments, it is not meaningful to assess the impact of the removal process at this time. A full	==

Consultee	Representation	POEPL response	Amendments/further detail
		plan and assessment of the impact of decommissioning will be undertaken near the end of the Field life. This is the approach taken in the UK. - It was agreed in principle by all that this was reasonable and would comply with the current ordinance. It is a standard clause in petroleum production licences that operators must have financial provision to cover decommissioning costs and it is normal for them to demonstrate this periodically to the regulator, and we expect this to be covered in the Field Development Plan. This obligation would transfer to any new owner with the licence.	
FC18	Env Baseline Why would only globally threatened species be included? There is a Falkland Islands Red List for nationally threatened plant species – this shows poor understanding of conservation status indicators.	This section of the EIS reviews information contained in the Important Plant Area directory and nationally important plant communities are covered on page 432.	As a marine-based project, plants are largely irrelevant and therefore the EIS only contains a very brief description of the flora of the Falklands. Any on-shore development will have to undertake a separate EIA and it is here that more detail on plants is required.
FC19	Env Baseline Why are only seabirds considered and then narrowed to penguins when all nesting birds are protected under the CoWNO? Further, why are seals included when they are not protected and are Least Concern? This shows poor understanding of legislative and conservation relevance.	The focus of this chapter is disturbance to colonial seabirds and marine mammals as these are the receptors that are known to be vulnerable to disturbance from aircraft. These were identified as the main receptors in the ENVIID workshop. Much of the research on impacts of helicopter noise on seabirds has focussed on penguins, and so the literature review and distillation of the main findings reflects this. However, the EIS does identify (small) Southern Giant Petrel colonies in the north of East Falkland as being susceptible to the impacts of helicopter noise.	==
FC20	Env Baseline King Penguins are increasing in numbers and are 'Least Concern' globally, Volunteer point holds less than a percentage of the world population. Southern Rockhopper are	Although we accept King penguins are classified as 'Least Concern' by the IUCN, and their population in the Falkland Islands is arguably insignificant in global terms, it is almost entirely concentrated at the colony at Volunteer Point, which is also a significant tourist attraction. Furthermore, King Penguins are known to be especially susceptible to disturbance from low flying aircraft (Cooper *et al.,* 1994, Hughes *et al.,* 2008, Giese and Gales	==

Consultee	Representation	POEPL response	Amendments/further detail
	decreasing in numbers globally and are' Vulnerable'. Why would the king penguin colony be valued higher than the southern Rockhopper colonies - this shows poor understanding of conservation value.	2009). The text does not indicate that king penguins are valued higher than rockhoppers on the grounds of conservation status or global population trends. The fact that king penguins are present year-round and virtually the entire Falklands population breed at a single site are more relevant, however, the sensitivity of king and rockhopper penguins is regarded to be the same in this assessment.	
FC21	Env Baseline States there are no population estimates for cetaceans, but the current SAERI Dolphins of the Kelp project has provided population estimates are for Peale's and Commerson's dolphins and the FC sei whale project provided a minimum individual count for Berkeley Sound which is reported in the EIS but not used further. Shows lack of up- to-date information.	At the time of writing, the results of SAERI's 'dolphins in the kelp' project were not available.	==
FC22	Env Baseline Reasonable to assume with species that are 'threatened' due to declining populations, such as Southern Rockhopper, that temporal or low level impacts can be treated as 'within the natural variation of the population' (pg. 657 and pg. 737) as the population is considered outside of this natural variation. This is acknowledged on pg792 so should be consistently applied throughout.	Unfortunately, we cannot find precise wording quoted in the EIS. With regard to rockhopper penguins, page 657 says 'such that the level of disturbance would be barely detectable above background variability'. This reflects the background level of disturbance already experienced that is compatible with their existing conservation status. It is not intended to suggest that noise impacts will cause population changes or that significant impacts are being dismissed.	==
FC23	Env Baseline The IUCN Red list category for Black-browed Albatross is actually Least	The status of black-browed albatross has changed several times in recent years (from Endangered in 2013 to Least Concern now) and the current status which changed late in 2017 after finalisation of the EIS. Additionally,	==

Consultee	Representation	POEPL response	Amendments/further detail
	Concern. Shows lack of up-to-date information.	tussock birds are now regarded as endemic to the Falkland Islands which is not reflected in the ES but which does not change the assessment.	
FC24	Env Baseline Whale numbers are considered increasing in the Islands and the presence of Southern Right Whale in numbers in 2017 which are more prone to ship strike will increase the risk of ship strike from that considered in the 2008 cetaceans Species Action Plan. The EIS has a lack of up-to-date information on cetacean ship-strike as last year there was one observed near miss with the Concordia Bay and one reported strike with a launch.	Unfortunately POEPL and the EIA team have not received this information and we are unclear how it is published.	==
FC25	Significance of impacts Why is the North Falkland Basin inferred as a Zone of Influence for exposure of cetaceans to an oil spill when there is a spill model? Demonstrates poor understanding of EIA process?	The North Falkland Basin is used throughout the EIS to refer to the broad zone around the offshore Development area. It is not implied that any potential impacts are restricted to this area or occupy the whole area, but it is considered useful to characterise the receptors, such as cetaceans, within this area. The oil spill modelling predicts specific areas within which oil might be expected, the likelihood, character and length of time present all of which are presented in the EIS and supporting strategies.	==
New Island Conservation Trust (NICT)			
NICT1	Artificial Light There does not appear or be any real attempt to deal with lighting and bird-strike. In a neighbouring territory (South Georgia) new illumination standards have been introduced to mitigate bird strike. Might lessons be learned from that	POEPL welcome feedback on developments in this emerging area and we will make enquiries. POEPL has committed to applying OSPAR Agreement 2015-08 on minimising risks to birds from artificial light, which involves examining available techniques and balancing safety and operational requirements and this can include reviewing the standards and lessons from South Georgia. Inevitably the detail of lighting design, fittings, shielding, lamp types, lighting philosophy for safe operations etc. must take place post-EIS approval when detailed design and rig selection is being undertaken."	N.B. There are not any new illumination standards on South Georgia to mitigate bird strike.

Consultee	Representation	POEPL response	Amendments/further detail
	territory and adopted offshore the Falkland Islands?		
NICT2	Spill Prevention/ Response There appears to be a lack of wildlife response plan: there are indications that it will follow. Any EIS should be include sufficient detail to form the basis of realistic mitigation. New Island birds, in theory, could be impacted, given their migratory pathways.	The strategy for wildlife response is included in the Offshore and Inshore Oil Spill Strategies that were available during the public consultation. See Additional Information for an extract that describes the wildlife response. Birds relevant to New Island populations are included in the EIS baseline and impacts including petrel, prions, albatross, shag and penguins. Research conducted at New Island has been a valuable source of information for the project.	==
NICT3	EMMP The Environmental Monitor and Manage Plan looks more like just a monitoring plan (few management proposals), with lots of money potentially spent on monitoring, but no options/solutions for actually managing, should impacts be detected.	The purpose of the EMMP is to define the management actions and resources required, respond to the priority data gaps/areas of uncertainty identified in the assessment, and importantly to assess and monitor the effectiveness of the mitigation measures during all stages of the proposed operation, and based on this monitoring to help underpin an adaptive approach to the management of the operation to prevent or reduce risks to the environment. Since the assessments have been precautionary in general, uncertainties tend to manifest as monitoring to observe whether the 'potential' impact materialises. If it does not, the management solution is to agree a more realistic impact rating and reduce or remove the monitoring.	==
Member of Public A (MP)			
MP(A)1	Legislation The Harbours and Ports Bill 2017 and the Maritime Bill 2017 were published in the Falkland Islands Gazette Supplement No 9 and 10 dated 16 June 2017 and were passed into legislation by the Legislative Assembly at their meeting in September 2017. These Bills were published in the Falkland Islands	POEPL recognise these changes which we were not able to include in the EIS drafting cycle. We accept the wording can be expressed more accurately and we are grateful for the summary provided.	==

Consultee	Representation	POEPL response	Amendments/further detail
	Gazette Supplement No 2 & No 3 dated 31 January 2018 as the Maritime Ordinance 2017 and the Harbours and Ports Ordinance 2017. The Maritime Ordinance in particular contains a raft of legislation relating to offshore oil pollution. The comment that the legislation is being updated is inaccurate as the primary legislation is in place.		
MP(A)2	Oil export An export route by directly offloading the crude from the FPSO remains the preferred route for Islanders in order to reduce risk from accidental spills into to the environment from inshore transfer, particularly on inshore coastlines. It is helpful to see that POEPL make reference to a direct offloading route but the EIS is very scant in detail about how this will be taken forward, if at all, once the route through Berkeley Sound is established as the base line. It would be more convincing and informative to have details about what would be involved to achieve offshore transfer: i.e., access to dynamically positioned tankers and other technology under development. There needs to be a guarantee that POEPL will report on their findings regarding an offshore	POEPL recognises the importance of this issue to the environmental risks and performance of the project and also to its safety and commercial aspects and has done considerable work to understand the issues correctly and adopt the optimal approach. The choice of inshore transfer as the base case and the choice of Berkeley Sound as the optimal site is described over eight pages at Section 4.3.2. A more detailed justification for the choice of Berkeley Sound is referenced in this section - POEPL report "Environmental assessment of potential inshore transfer sites". This report is available for review. A summary of the decision process around Inshore Transfer versus Direct Offloading is contained in 'Additional Information'.	==

Consultee	Representation	POEPL response	Amendments/further detail
	route every two years or such timescale to be agreed with the Regulator. These evaluations, feasible or not, should be made public. It is important to keep the issue live as it is assumed that the success of Phase 1 will lead to proposals to move to Phase 2 with more activity in Falklands' inshore waters, possibly beyond the capacity of Berkeley Sound, if no offshore transfer model is developed.		
MP(A)3	Artificial Light It is encouraging to read that POEPL intends to check the practicalities of adopting a green lighting strategy during FEED and to review pilot- free flare designs using an automated ignition system to prevent or reduce bird strikes. However, POEPL does not confirm commitment to these strategies if feasible. Nor does the company commit to a no flaring policy during the hours of darkness without express approval from the Regulator in justified circumstances. These matters need further consideration and commitment in the EIS. It is acknowledged that a Bird Strike Management Plan will be developed but policy assurances need to be stated in the EIS.	POEPL acknowledges the concerns around artificial light. POEPL are committed to applying OSPAR Agreement 2015-08 on minimising risks to birds from artificial light, which involves examining available techniques and balancing safety and operational requirements. Inevitably the detail of lighting design, fittings, shielding, lamp types, lighting philosophy for safe operations etc. must take place post-EIS approval when detailed design and rig selection is being undertaken. POEPL has committed to investigating non-pilot flares but we note that they must be extremely reliable to be accepted as Safety Critical pieces of equipment and this includes a track record of successful deployment in similar operations in an offshore setting. The EIS notes that a Bird Strike Management Plan is required prior to operations commencing and this is also included in the EMMP, and a BSMP was in place for previous exploration well operations. No bird strikes were recorded on the drilling rig in previous operations, which included flaring. POEPL has no objection to consulting with FIG on operations involving high amounts of flaring, and we will prioritise the scheduling of planned flaring for daylight hours e.g., prior to shutdowns. There are, however, also situations where immediate depressurisation is required for safety reasons that cannot be delayed.	==

Consultee	Representation	POEPL response	Amendments/further detail
MP(A)4	Waste The cumulative effect of 20 years of waste generation on the Falkland Islands is a concern. The EIS states that it is planned that some hazardous wastes, ash from incineration etc. and recyclable items will be taken to the UK (Scotland) for disposal. It is acknowledged that POEPL will prepare a Waste Management Plan for FIG approval before development can proceed, but it would be reassuring to have confirmation that procedures and approvals are readily in place for shipping waste to the UK from the Falkland Islands. Many of us are aware of the increasing issues related to shipping and receiving waste around the world and there needs to be assurances in the EIS that the UK will accept waste of the types described in the EIS that are generated here. Shared facilities developed with FIG and MOD over time may reduce this requirement but not remove it entirely.	Clearly POEPL's preference, and international good practice, is to adopt the proximity principle and manage waste as closely as possible to the source. We strongly welcome recent developments by EPD and PWD to improve the understanding of waste needs, to engage relevant parties on-island and to look forward to waste handling, treatment and disposal methods. POEPL has experience of returning wastes to the UK gained during previous campaigns so we know that this route is available, and there is no obvious legal impediment provided it is demonstrated that there is no viable outlet in the Islands. Waste export/import policies are summarised in POEPL's Waste Management Strategy which we are happy to supply. POEPL are certainly willing to approach the UK waste regulators to obtain their reassurances on such issues, although it may raise wider questions about the existing facilities and forward plans for waste from the Falkland Islands in general beyond the needs purely of the Sea Lion project that would require governmental input. It is important to note the two most important positive messages, which is firstly that by embedding thermal treatment into the choice and design of drilling rig, we will be able to treat the majority of the wastes (oily drill cuttings) offshore to a high standard without recourse to onshore treatment. Secondly our investigations into portable incinerators show that they are feasible and efficient and will deal with the majority of the remainder of the wastes, such that the residual items are a far smaller problem to manage.	==
MP(A)5	Waste People are questioning the use of plastics particularly during offshore activities and the need to ensure nil discard into the sea. The South Atlantic is relatively plastic free	POEPL's offshore operations anywhere in the world forbid the overboard release of waste and it would be contrary to IMO international rules. POEPL include measures in waste management offshore such as compactors and containers to prevent waste from becoming wind-blown and to ensure that loose items are sea fastened during adverse weather. POEPL completely support the minimisation of waste through our ISO14001 Environmental	==

Consultee	Representation	POEPL response	Amendments/further detail
	compared to other oceans but not entirely so. More detail about initiatives to reduce the use of plastics in the first place, and procedures for control and disposal of those used would be welcome in the EIS, in addition to the references to education and training of the work force in management of plastic and other waste.	Management System that is externally certificated and we use biodegradable plastics where possible in our onshore facilities. On all POEPL facilities the offshore crews undergo an induction that is specific to the operations. At Sea Lion this would inevitable include basic training in wildlife response, reporting of bird strike, the importance of minimising artificial light and the specific issues around litter prevention and waste disposal. When POEPL appoint service companies, the importance of environmental performance in this region will be impressed on them and reflected in their Key Performance Indicators.	

Table A3-2: Summary of the representations made during the 2020 statutory consultation process on EIS Rev B04

Consultee	Representation	POEPL response	Details in
Offshore Petroleum Regulator for Environment & Decommissioning (OPRED)			
OPRED1	1. Areas of uncertainty Although there are number of uncertainties regarding the proposals at the EIS stage, OPRED do not believe they are material to the conclusions drawn for the offshore development proposals.	POEPL acknowledges and welcomes the comment, which supports the findings of the EIS.	
OPRED2	2. Oil export options Since OPRED's previous review in March 2018, POEPL have taken the decision to select a Direct Offtake from the FPSO in field. OPRED recognise this as the best environmental option.	POEPL acknowledges and welcomes the comment, which supports the findings of the EIS.	
OPRED3	3. Drilling operations OPRED note that POEPL propose to use Water-based Mud (WBM) for the drilling of the top-hole sections and Non-Aqueous Drilling Fluid (NADF)(Oil Based Muds (OBM)) for the lower sections, which is standard UK practice. The batch sequencing of the sections will minimise the mud wastes as this method reduces the need for changes in the mud system. It is also noted that OBM contaminated cuttings will be processed through a thermo-mechanical cuttings cleaner and will be discharged with <1% dry weight on cuttings, which adheres to requirements of OSPAR Decision 2000/3. If the unit cannot be used, cuttings will be shipped to shore. The tophole sections of the proposed wells will be drilled using water-based mud and a suite of chemicals that are predominantly classed by OSPAR as PLONOR (Pose Little Or No Risk), and the overall impact on benthic fauna from the cumulative discharge of the drill cuttings is considered, as a precautionary conclusion, to be moderate. However, modelling indicates a comparatively small area of impact which will reduce significantly over a 5 year period and recolonisation is expected after 1-2 years (and the sensitivity of the receptor is considered to be low). OPRED would agree that the EIS assessment is precautionary.	POEPL acknowledges and welcomes the comment, which supports the findings of the EIS.	

Consultee	Representation	POEPL response	Details in
OPRED4	Produced water POEPL intend to use Produced Water Re-Injection (PWRI) and therefore there will be zero discharge of produced water. However, in the event produced water discharge is unavailable either during commissioning or operationally the monthly average of Oil in Water concentrations from produced water discharge will be below 30mg/l, which aligns with UK Regulations. It is also noted that the expected concentrations are 10-15mg/l, which is in line with current industry expectations. If the oil in water concentrations are higher than this there is provision for the fluids to be diverted to an off-spec tank.OPRED also note that there is the intention to apply a Risk Based Approach to identify any potential issues.	POEPL acknowledges and welcomes the comment, which supports the findings of the EIS.	
OPRED5	Operational chemicals As the chemicals will be compliant with the UK Offshore Chemical Notification Scheme (OCNS), OPRED can assume that the risk to the marine environment are unlikely to be significant. In addition, POEPL have committed to only using chemcials with a HQ band Gold, with no product or substitution warnings. However, as the specific chemicals and dosages are yet to be confirmed and OPRED would suggest that given UKCS experience this could be a challenging commitment. OPRED would advise that relevant chemical risk assessments be undertaken prior to chemical usage.	POEPL has committed to select 'Gold' or 'E' rated chemicals where possible and any exceptions to this will be fully justified. POEPL acknowledges the comment that specific risk assessments of chemicals should be done prior to chemical usage as has been done in the past, for example, prior to the exploration well campaigns. Through this process, risks will be minimised and good practice in chemical selection will be undertaken.	
OPRED6	6 Environmental baseline Overall, the EIS provided an comprehensive description of the environment and covered all of the salient issues. The level of environmental survey work undertaken provided an informed and contextual description of the development area which was very beneficial. It is also reassuring to note that through the Gap Analysis Programme further work will be undertaken to address data gaps at a regional level to aid the understanding of the Falkland Islands marine environment.	POEPL acknowledges and welcomes the comment, which supports the findings of the EIS.	
OPRED7	7 Noise assessment Whilst OPRED would agree with the conclusions of the assessment	Notes and a reference have been added to the EIS Section 10.4.4.4.1 on noise from mobile	Notes and a reference have

Consultee	Representation	POEPL response	Details in
	of underwater noise impacts (Section 10.4), OPRED found it difficult to correlate between the many sub-sections. Although there was mention of drilling noise as a non-pulsed source, OPRED would question why a detailed assessment of vessel noise was undertaken but there wasn't a similar assessment for the drilling operations?	drilling units. When operating, anchored drilling rigs have a low noise output, typically some 30 dB lower than the other sources present (vessels on dynamic positioning or using propulsion frequently), so were scoped out of the predictions. Reference: DECC (now BEIS) (2011) 'Review and Assessment of Underwater Sound Produced from Oil and Gas Sound Activities and Potential Reporting Requirements under the Marine Strategy Framework Directive'.	been added to the EIS Section 10.4.4.4.1 on noise from mobile drilling units
OPRED8	8 Accidental pollution events OPRED is satisfied with the information provided within the EIS. Since the start of the EIS consultation period, POEPL have presented further information regarding the oil characteristics and the potential for a spill event to occur. The information provided concludes that the oil is heavy and has a significant wax content related to a high pour point and subsequently the reservoir requires additional pressure for flow to surface. A significant uncontrolled reservoir flow is therefore unlikely. Due to its characteristics, in the marine environment it would solidify almost immediately and no emulsification would occur.	POEPL acknowledges and welcomes the comment, which supports the findings of the EIS.	
OPRED9	Our overall conclusion is that the information provided in the EIS indicates that the proposed Sea Lion development is unlikely to have a significant impact on the local South Atlantic Ocean environment, and we would be grateful if you could forward our comments to FIG.	POEPL acknowledges and welcomes the comment.	
Scottish Association for Marine Science (SAMS)			
SAMS1	Benthos 'B' An extremely detailed technical document that presents the available data on benthic habitats and communities in a clear and accessible manner. The report displays a familiarity with the relevant peer-reviewed literature (e.g., relating to major oil spills in	POEPL welcomes the 'B' rating. In response to a perceived lack of benthic information offshore, POEPL believes it has approached this topic in a positive way. The existing taxonomic literature for the region is outdated and many	Text updated to make this clear.

Consultee	Representation	POEPL response	Details in
	temperate marine environments) and information from previous EIAs. It displays an appropriate level of understanding of the sourced literature, and where appropriate applies the findings to the study areas. The B rating given for the Topic Assessment Score reflects the relative lack of information on benthic communities in the Sea Lion drilling area offshore. With respect to inshore locations in Berkeley Sound, an A rating could be assigned.	species in existing literature are likely misidentifications. Many species retreived from the benthic surveys were identified with the help of the Natural History Musuem and this work continues. 25,000 polychaete (Annelida) specimens, representing at least 233 morphological species were processed at the Natural History Museum. Taxonomic assessment led to recognition of many polychaete species that are new to science. Initially, an online taxonomic guide was created (http://falklands.myspecies.info), to provide a single taxonomic source for 220 polychaete species to standardize identification across different environmental contractors. This is described in a paper submited to ZooKeys that also formally describes 6 new species to science. Work on crustacea is ongoing in a similar way.	
SAMS2	Biosecurity 'A' Well presented, researched and consistent with international guidance and Best Practice measures used to minimise the likelihood of new introductions of Non-Native Species. The risk scores were justified and additional mitigation measures including monitoring established. The limitations were acknowledged and measures put in place (EMMP) to minimise risk and address uncertainties. Overall, a very concise a detailed risk assessment made for Biosecurity.	POEPL welcomes the 'A' rating.	
SAMS3	Fisheries, Fish and Plankton 'B' Overall, the assessments of impact of the project on plankton, fish and fisheries were reasonably well justified. A couple of the fish sections were not as well written or structured as other parts, and could do with a bit more work (see Section 5 for details). There also	POEPL welcomes the 'B' rating. These points raised have been addressed with changes to the relevant narratives in the EIS, which are of a minor nature. There was some misunderstanding around the 'zones' in terms	Section 7.4.4.2.1.1 Figure 7.46

Consultee	Representation	POEPL response	Details in
	appears to be a few instances where assumptions have been made and not supported with appropriate references to scientific studies. This needs to be remedied, or it needs to be made clear that these are assumptions for which there is no strong evidence.	of fish communities and the definitions and use in terms of 'sub-zones' have been tightened. The Falkland Islands Conservation and Management Zones (FICZ and FOCZ) delineate the extent of the Falkland Islands EEZ, and six main habitat zones have been identified within this area characterised by a combination bottom topography, bathymetry, water structure and hydrodynamics. These zones are explained in detail by Arkhipkin, *et al.* (2012a). It is very clear that they are environments that represent temperate or sub-Antarctic fauna. Some of zones are quite wide. However as noted in the EIS the shallow-water area of the NS (250-350 m) is heavily fished for finfish and skates throughout the year. The remainder of the NS (>350 m) is not important to the fishery at all. The text has been amended to take account of this and amended Figure 7.46 with respect to the habitat zones.	
SAMS4	Global Atmosphere 'A' The Sea Lion Development - Phase 1 Environmental Impact Statement was assessed on its treatment of impacts to global atmosphere. The various stages of the development from the Mobile Offshore Drilling Unit (MODU) to transfer of oil were covered, by activity. Planned global atmosphere impacts to unplanned such as maritime accidents were covered. Activities offshore were examined as well as inshore. Numerous scenarios at different contamination levels and from different sources were covered. The literature was adequate and relevant. The sections on global atmosphere impacts are what one would expect to see in an EIA prepared for the UK oil and gas sector.	POEPL welcomes the 'A' rating.	

Consultee	Representation	POEPL response	Details in
SAMS5	Regional Air Quality 'B' Additional information has been provided concerning an assessment of the potential impact of volatile organic compounds (VOCs) resulting from an unplanned oil spill on regional air quality. The modelling undertaken, combined with the presentation of a case study from the MV Braer event, shows that likely impacts would be minimal. It is suggested that the additional document might be annexed into the EIS to add evidence as to why such potential pathways of impact have been screened out of the assessment.	POEPL welcomes the 'B' rating. POEPL believes the comment refers to work done previously in modelling VOC concentrations from a very large crude oil release in Berkeley Sound, which is no longer a scenario under consideration. The EIS Section 12.2.4.2.5 discusses the evidence from the Braer incident and 12.2.6.4 notes that the potential incidents in Berkeley Sound are far smaller. POEPL believes the material presented provides a proportionate amount of analysis and justification.	
SAMS6	Marine Flora 'A' The EIS has identified kelp beds as particularly important as primary producers in relation to the inshore site at Berkeley Sound with the giant kelp Macrocystis pyriferia the dominant species. Overall the report coverage of kelp beds, their importance to the Falkland Islands and the potential impacts of an oil spill plus mitigation steps has been well presented, and are appropriate, with no major issues noted for this review area.	POEPL welcomes the 'A' rating.	
SAMS7	Marine Mammals 'C' The revised chapters concerning the impacts of underwater noise on marine mammals have been improved by the adoption of the NMFS thresholds as part of the assessments made. It was still felt that the severity levels have still been understated, and that they should be elevated from Slight to Minor, resulting in an overall impact significance level of Moderate. However, the project-specific mitigation measures proposed by POEPL are already above and beyond what would be considered routine; essentially they are already aligned towards managing impacts as though they were assessed at the Moderate level rather than Minor. So although such a change is recommended to be documented within the EIS, it is not anticipated that this would result in more work beyond what POEPL has indicated they will be undertaking. There are a number of other	POEPL acknowledges a difference of opinion in terms of classifying the severity of effect, while noting that there is no disagreement over the sensitivities, the quantification of impacts or the mitigation measures that are committed to. POEPL is committed to following the UK Government's official protocol, that has been developed to reduce to negligible levels the potential risk of injury or death to marine mammals in close proximity to piling operations.	

Consultee	Representation	POEPL response	Details in
	recommendations that should be noted, particularly concerning understanding the limitations of types of monitoring devices to be deployed (e.g., PAM). It is likely that this will become more important as discussions on the EMMP progress.		
SAMS8	Seabed sediment & geology 'A' The EIS sections pertaining to geology, seabed sediments and bathymetry were extremely comprehensive, with no major issues noted. Overall this is a robust and highly detailed examination of the impacts and risks associated with hydrocarbon extraction onshore and offshore of the Northern Falkland Islands.	POEPL welcomes the 'A' rating.	
SAMS9	Seabirds 'B' The EIS is a highly detailed technical document that comprehensively covers aspects of seabird biology and ecology of species occurring in Falkland Islands waters. It has widely sourced relevant peer reviewed and grey literature, and in general has displayed an appropriate level of understanding of the sourced literature, and where appropriate applied the findings suitably. The risk assessment section uses appropriate, internationally recognised methodologies for detailing its findings. Some assumptions with regard to seabird distribution around the proposed drilling site are not supported by the data, and are displayed in a somewhat misleading fashion. However, the report is clear on stating these shortcomings where appropriate, and has indicated where the data will be reviewed after ongoing studies are concluded, and where further studies will be undertaken to improve data gaps. Despite the issues with the presentation of the distribution information, the application of seabird distribution information to the risk assessment framework has been appropriate.	POEPL welcomes the 'B' rating. POEPL disagrees that the data are presented in a misleading manner. The Environmental Description Section 7.4.5.2 reviews the available data on seabirds, and other taxa, in sufficient detail to support the assessment sections of the document. In the past, some reviewers commented that the EIS contained too much detail in the Environmental Description and, therefore, efforts were made to pare back this section to provide only the information that was considered to be directly relevant to the assessment. This was intended to make the analysis clearer. References throughout the document direct the reader to the original sources where further detail can be found. POEPL undertook an independent review of these data which is described and referenced in Section 7.4.5.2.1.1.	
SAMS10	Social 'B' The overall assessment and modelling of the technical aspects of the scoping and social impact chapters is strong and the mitigation measures that are suggested are appropriate to the data presented.	POEPL welcomes the 'B' rating.	

Consultee	Representation	POEPL response	Details in
	However, the less technical aspects of social impact chapter are not as strong – the disturbance to other users (onshore) and the resource competition (accommodation) sections, in particular. The use of literature where models or quantifiable data was not available is very limited. It is unclear whether these topics will be covered in the social impact assessment (SIA). Chapters 6 and 11 of the POEPL's Sea Lion Field Development EIS are technically robust, methodologically sound, present the data in a logical fashion, and reach conclusions that are generally evidence-based. There are weaknesses in Chapter 11 in relation to the less technical aspects of some of the social impacts, especially in relation to fishing livelihoods and resource competition for accommodation where it is unclear whether these have been covered by the SIA or not.		
SAMS11	Water quality 'A' The Sea Lion Development - Phase 1 Environmental Impact Statement was assessed on its treatment of impacts to water quality. The various stages of the development from MODU to transfer of oil were covered, by activity. Planned water quality impacts such as suspended particulates from drilling muds to unplanned such as maritime accidents were covered. Activities offshore were examined as well as inshore. Numerous scenarios at different contamination levels and from different sources were covered. The literature was adequate and relevant. The sections on water quality impacts are what one would expect to see in an EIA prepared for the UK oil and gas sector.	POEPL welcomes the 'A' rating.	
SAMS12	Other 'B' The EIS is an extremely comprehensive document, and contains all the sections necessary to allow for a full evaluation of the proposed Sea Lion development. The Project Description is clear, the methodology and approach for the impact assessments is appropriate and uses recognised methods. Some minor alterations to how the assessed 'Severity', 'Sensitivity' and 'Impact' evaluations	POEPL welcomes the 'B' rating.	

Consultee	Representation	POEPL response	Details in
	are written would add some clarity to how the methodology has been applied. The organisation of the document is logical, and Chapter layout is consistent. There are some minor typographical and formatting errors, which is unsurprising considering the size of the whole document.		
SAMS13	4.1.2 Table 3.1 provides a clear summary of the environmental monitoring commitments that POEPL intend to undertake during the lifetime of the Sea Lion Phase 1 development. The planned monitoring to adhere to legislative and corporate requirements (Tables 3.2 and 3.3) are realistic and achievable commitments, based on POEPL's existing environmental monitoring programmes established at other developments. The scope of these proposed monitoring programmes also appears to be appropriate for the proposed development.	POEPL acknowledges the comment.	
SAMS14	4.1.3 With respect to the seven impacts highlighted after the EIA process for monitoring due to either uncertainty of impacts or sensitivity of receptor, the proposed monitoring programmes appear to be appropriate and realistic. Where the EMMP is currently lacking is in defining 'expected' or 'predicted' results, against which the adaptive management thresholds can be applied. As an example, Table 3.5.1.2 Benthic Sediments, has adaptive management thresholds that read 'Resample – a significant fraction of the samples are outwith 1 SD of expected results'; 'React – Impacted areas are >100% greater than expected'. Whilst these thresholds appear to be appropriate, no information is given within the EMMP as to what 'expected results' are. It is expected that such detail will be forthcoming at a later date as the development progress towards the sanction stage.	POEPL agrees that the determinands and thresholds that will be implemented in the EMMP will be developed in further detail, while the details already provided are those that were the outputs of multi-stakeholder discussions at the EMMP workshop in April 2019.	
SAMS15	4.1.4 Within the EMMP, there are several references to 'periodic reviews' (i.e., 'periodic reviews on whether or not impacts of waste remains ALARP'; '… all impact and risk assessments will be periodically reviewed to ensure controls remain in place…'). In these cases, there is no indication as to the timeframe that maybe covered	The EIS (Section 15.3.2) commits to a formal review of the EMMP at least every 5 years. More details of expected EMMP review timescales and governance are included in the	

Consultee	Representation	POEPL response	Details in
	by the term 'periodic', which may vary considerably depending on the item in question. In Section 3.2 'periodic' is defined as 'At least every five years', which seems sensible for review of the EMMP document. However, this timescale seems too long for waste management review. It is suggested that some caveats are included alongside the use of 'periodic' for clarity.	EMMP document which was made available during the consultation period.	
SAMS16	4.1.5 There is an intention to investigate Loligo squid spawning grounds to fill a data gap. In Section 3.5 it is stated that POEPL will co-operate 'with surveys relating to Loligo spawning grounds within Berkeley Sound environs prior to operations'; this is reflected in Table 3.6 with a planned baseline survey at the sanction stage. Whilst it is recognised that the EMMP will be adjusted as data becomes available from all monitoring programmes, it is felt that a more explicit reference to possible ongoing monitoring pending the results of the baseline surveys could be included for this particular receptor.	This topic has been progressed with support from POEPL including initial test deployments of an ROV. It is too early to report any results but the EIS has been updated to more clearly state the aim of undertaking spatial / bathymetric surveys and habitat characterisation of squid (loligo) spawning grounds.	Section 7.2.4.1 and 15.5 updated.
SAMS17	4.1.6 With regards to the monitoring proposed in Section 3.5.1.3 for potential impacts of underwater noise on marine mammals, the recommendations made in Wittich *et al.* (2018) should be taken into account with regards to the design of monitoring arrays. As stated within that report, the use of PAM is an appropriate tool, but there must be awareness shown of the limitations of the system so that ultimately the effectiveness of the intended monitoring can be judged. It is accepted that detailed monitoring plans are not included within the EMMP at this stage, and that this work may be ongoing.	POEPL agrees with this comment and will incorporate this recent information on monitoring design, and an acknowledgement of the limitations of PAM, in the EMMP.	
SAMS18	4.2.1 All recommendations made here acknowledge that the EMMP will not yet be fully detailed until the project gets closer to the sanction phase, and that the new environmental legislation proposed by the FIG is not yet in force. However, there are some pertinent points to be noted. The following sections examine each point of the 'Content of Environment Plans', and whether the	POEPL acknowledges the comment.	

Consultee	Representation	POEPL response	Details in
	current EMMP demonstrates compliance. A summary of the sections below is included in Table 2.		
SAMS19	4.2.2 Under point (a) of the 'Content of Environment Plans' proposed by the FIG, an Environmental Plan (EP) must 'set environmental performance standards'. This point stands out as the hardest for a developer to adhere to when drafting an EP, as it requires some metric or threshold for impacts to be defined. Whilst the Sea Lion EMMP states that it '…will also identify the thresholds…' (Section 3.1, pg. 12) and details that defining and agreeing 'intervention thresholds' was a key aim of the EMMP workshop held in 2019, there appears to be no definite statement of these thresholds within the EMMP document. A specific example is outlined in Section 4.1.3 above. It is acknowledged that this omission is likely due to such metrics not yet being defined. A requirement for baseline data to define pre-development conditions would be necessary to set such thresholds, and the EMMP shows that such surveys are not planned to be completed until the post-sanction phase of the project.	POEPL welcomes this input on the potential interface between existing processes for EIA under the Offshore Minerals Ordinance and future legislation and looks forward to commenting on draft future legislation when this is published, along with refining the EMMP.	
SAMS20	4.2.3 Considering the above, the timing of baseline data acquisition in Table 3.6 seems to be phased slightly late for benthic sediments, seabirds –light and –oil spill, marine mammals –collision and –noise. The Reviewer would have expected such activities to commence on sanction/FIG approval, rather than at FPSO Construction etc., as activities undertaken during this phase may alter the results of baseline data acquisition.	For almost all topics in the EMMP, there is sufficient baseline data to commence the monitoring phase. For some, additional baseline data is required and will be fed in. This includes data on the actual noise outputs of offshore and inshore sources, and on the deposition of drill cuttings, which can only take place once operations are ongoing. This can be clarified in the EMMP document.	
SAMS21	4.2.4 As the EMMP does not adhere to point (a) of the 'Content of Environmental Plans', there is a knock-on effect on whether there is sufficient information to address points (b), (e) and (h) – without set environmental performance standards, it is not possible to fully define outcomes against which performance can be measured, expected performance levels in respect of each performance	As above, POEPL is operating within the current Offshore Minerals Ordinance process and guidelines. POEPL will review the alignment of the EMMP with a proposed 'Environmental Plan' when it has sight of the legislative proposals. POEPL appreciates this feedback,	

Consultee	Representation	POEPL response	Details in
	standard, and thus report compliance to those standards. However, within Table 3.3 the EMMP details legislative and corporate environmental monitoring requirements, which does state limits on what is an acceptable level for some impacts, along with the monitoring programme designed to measure these levels. Adaptive management thresholds defined in Section 3.5 show that actions will be taken if monitoring results fall outside a defined criteria, although the thresholds for action require an acceptable base level to be set. These areas show that POEPL have taken steps to define performance levels and outcomes, but they may need to be amended once environmental performance standards have been set.	which no doubt will be considered fully in the future.	
SAMS22	4.2.5 Table 3.2 demonstrates that POEPL have a comprehensive monitoring plan for environmental KPIs, detailing the areas monitored, the frequency and units of measurement. However, there are no metrics provided within this table as to what are regarded as acceptable levels for these KPIs. It may be that such values cannot be established or be stated with any certainty at the current stage of the development. Together with Table 3.3, and the information provided in the Tables within Section 3.5, the EMMP shows that there are arrangements for the monitoring and recording of performance (including pollution discharges), which meets the criteria for points (h) and (i). As detailed in Section 4.2.4 above, without set performance standards, reporting compliance as required in point (h) is not possible, but should be easily achieved within the framework of reporting outlined in the EMMP once thresholds are defined.	POEPL is operating within the current Offshore Minerals Ordinance process and guidelines. POEPL will review the alignment of the EMMP with a proposed 'Environmental Plan' when it has sight of the legislative proposals, and POEPL appreciates this feedback which no doubt will be considered fully in the future.	
SAMS23	4.2.6 Sections 3.2, 3.3 and 3.4 define the systems, policies and procedures that that will be employed to monitor for any potential environmental impacts arising from the development, and how that information will be used to inform changes to reduce impacts or maintain them at ALARP levels. The EMMP adheres to points (c) and	POEPL appreciates this feedback on the EMMP.	

Consultee	Representation	POEPL response	Details in
	(d) of the 'Content of Environment Plans' as far as is practically possible at this stage of the development.		
SAMS24	4.2.7 Section 3.4 describes POEPL's Corporate Health, Safety, Environment and Security Policy Management System (HSES-MS), and how the Sea Lion development fits within that structure. It defines the chain of command and roles and responsibilities and project-specific management plans. Section 3.4.3 defines how the Sea Lion Development will be audited to check compliance, whilst Section 3.4.4 describes contractor management, and Section 3.4.5 details management of change for the project. These sections cover the points (f) and (g) of the 'Content of Environmental Plans'. There could perhaps be additional detail in defining specific named roles and responsibilities for the management of the development, including a more detailed organogram, and it is noted on page 2 that once the project has been sanctioned, the EMMP will become a live document with these details included.	The EMMP will indeed be populated with more organisational data as this becomes known post-Sanction.	
SAMS25	4.2.8 Point (j) requires that an EP must 'include arrangements for third-party verification of the responsible person's compliance with performance standards'. Although an overview of auditing is provided in Section 3.4.3, there are no explicit details of how the monitoring records will be verified by independent parties. The EMMP does state that the results of monitoring relating to the seven impacts where uncertainty remains and ongoing research studies will be reported to the FIG (Sections 3.5.1.1 to 3.6.3.4). It is felt that the EMMP could benefit from an additional section where a description of how independent checks on the commitments made within the EMMP will be carried out. This also applies to the content of point (l); whilst the EMMP states that regular reports on environmental performance will be made to the FIG, the arrangements for doing so (including frequency) are not explicitly defined.	POEPL envisages that the EMMP governance will provide a robust level of checking and challenge and will include participants who regard themselves as independent. POEPL submits that the governance panel may consider itself an appropriate body to decide whether further review is needed by external parties.	
SAMS26	4.2.9 There is no explicit list on the types of events that would constitute reportable events, as required by point (k). It is clear that	POEPL appreciates this feedback on how governance may be effective.	

Consultee	Representation	POEPL response	Details in
	performance against environmental KPIs will be reported, and results of monitoring programmes provided, but no details are included to describe how those areas outwith acceptable thresholds will be highlighted. Introducing an explicit mechanism on reporting by exception may offer a sensible way to flag these events. Whilst management actions and adaptive management thresholds are provided (Tables within Section 3.5), there is no reference to how they will be reported.		
SAMS27	4.2.10 The 'Content of Environmental Plans' is a document that is being drafted as part of new environmental legislation by the FIG. To demonstrate compliance against this document, it may be advisable that the content of the EMMP be re-arranged to more explicitly show that the points have been adhered to. In particular, diagrams showing (more detailed) organisational structure, roles, responsibilities and reporting mechanisms will add a level of clarity that is currently absent, and it appears that POEPL intend to include such content once the project is sanctioned. As it currently stands, the main deficiency of the EMMP is the lack of defined environmental performance standards, which undoubtedly reflects the current stage of the development, and is thus understandable. There is an opportunity to define a reporting by exception system, which would aid POEPL in showing compliance to many of points required under the new legislation.	As above, POEPL is operating within the current Offshore Minerals Ordinance process and guidelines. POEPL will review the alignment of the EMMP with a proposed 'Environmental Plan' when the proposals are published, and appreciates this feedback which will be considered fully in the future.	
SAMS28	TABLE OF COMPLIANCE OF EMMP WITH PROPOSED ENVIRONMENTAL PLAN	POEPL acknowledges this as summarising the preceding points and for future reference.	
SAMS29	5.1.1 In lieu of a complete Oil Pollution Emergency Plans (OPEP) for the Sea Lion Development, FIG provided three documents for SRSL to review: • Oil Spill Response Strategy for Inshore Operations FK-SL-PMO-EV-STY-003 -B01 • Oil Spill Strategy for Offshore Operations FK-SL-PMO-EV-STY-0007 - B01 • Oil Spill Strategy for Stanley Harbour FK-SL-PMO-EV-STY-0008 -	POEPL acknowledges the comment.	

Consultee	Representation	POEPL response	Details in
	B01 5.1.2 The information contained within the three documents mirrors that included within the version B04 of the EIS, principally Chapter 12: Accidental & Chronic Oil Pollution. 5.1.3 The oil spill strategies outlined within the documents appear to be reasonable and appropriate, with management plans and oil spill response strategies that tally with the commitments made within the EIS.		
SAMS30	5.2.1 As with the EMMP, all recommendations made here acknowledge that a final OPEP will not be submitted until more detail is available, which will be once the Safety Case has been accepted, and that the new environmental legislation proposed by the FIG is not yet in force. Each of the three documents under review explicitly state that it is not an OPEP, but an overall strategy, which is an important consideration when identifying areas where information is lacking. The following sections examine each point of the 'Requirements for Oil Pollution Emergency Plans' proposed by the FIG, and whether the current oil spill strategy documents demonstrate compliance. A summary of compliance to the new legislation is included in Table 3 below.	POEPL acknowledges the comment.	
SAMS31	5.2.2 Point (1) of the 'Requirements for Oil Pollution Emergency Plans' states that 'An OPEP must take into account any risk assessment undertaken during the preparation of the safety case'. The Reviewer has not had sight of the safety case, but is aware that it is has yet to be accepted. It is not possible to know whether the risk assessments made have been incorporated into the oil spill strategy documents, and considering the current point of progress with the safety case, explicit references within the oil spill strategy documents to the risk assessments are unlikely to be included anyway.	POEPL has not had sight of proposed requirements for OPEPs under the expected Environmental Case Regulations. POEPL's oil spill response plans have been developed in line with UK requirements and prevailing Falkland Islands guidance for exploration wells. The OPEP must reflect the outcomes of the Safety Case where oil spill response is identified as being within the envelope of safety and environmental critical elements. Work on safety in design, and the Safety Case Design Notification, has proceeded in parallel with the EIS and the Oil Spill Strategies. Draft OPEPs are	

Consultee	Representation	POEPL response	Details in
		in preparation and POEPL looks forward to developing its plans in discussion with the authorities.	
SAMS32	5.2.3 Section 8 within the offshore operations and Section 9 within the inshore operations document defines the POEPL incident command structure for the Sea Lion development. It is stated that 'A detailed management structure with roles and responsibilities will be defined in an OPEP/OSCP to be prepared closer to operations'. The lack of this information means that points (2a) and (2b) within the FIG proposed requirements are currently not met, although there is every indication that they will be in the future. The oil spill strategy document for Stanley Harbour has Incident Management covered in Section 10, again with the caveat that a detailed management structure is to follow closer to the commencement of operations.	POEPL would note that it is not in possession of proposed requirements for OPEPs under the expected Environmental Case Regulations. More detailed arrangements will be included in operational OPEPs closer to operations.	
SAMS33	5.2.4 Section 12 Training and Exercises within the Stanley Harbour document details the training requirements for all personnel (both POEPL and contractor) involved with bunkering operations that would be required to act in event of a spill, in addition to summarising the training exercises undertaken to keep skills up to date. Similar details are provided within Section 8.2 of the offshore operations document, and Section 9.2 of the inshore operations. The tables provided within these sections adhere to the requirements under point (2c), although no reference is made to co-ordinating the training with the Falkland Islands Contingency plan, which is specifically detailed as a requirement.	As above	
SAMS34	5.2.5 Each of the oil spill strategy documents have defined specific scenarios in order to assess potential worse case release of oil to the sea. For the inshore operations, three scenarios are defined in Section 3.1: • A 10 tonne Marine Gas Oil (MGO) spill resulting from a bunkering incident • A spill of 3,400 tonnes of MGO due to installation vessel collision	POEPL acknowledges this point; the likelihood of simultaneous worst-case events is extremely small, and it is not an expectation in the UK (or other countries to our knowledge) that such scenarios are specifically documented or planned for.	

Consultee	Representation	POEPL response	Details in
	with a third-party • A spill of 1,500 tonnes of Intermediate Fuel Oil (IFO) due to drift grounding Sections 3.2 and 3.3, detail the modelling methodology used to assess the scenarios, and assumptions overlying the discharge analysis. The results of modelling the consequences of each scenario are included within Section 3.4. The offshore strategy document follows a similar structure, with two scenarios detailed and modelled in Sections 3.1 – 3.4: • A subsea well blowout during the drilling stage • Full inventory loss from the FPSO, and two CTT tanks. The Stanley Harbour document follows a slightly different structure, with likely spill scenarios defined in Section 2. A description of the likely fate resulting from such spills is included within Section 3. The Reviewer believes sufficient information is contained within the three documents to adhere to point (2d), although it is noted that there is no current attempt at assessing the consequence if scenarios from each document were to happen concurrently.		
SAMS35	5.2.6 Point (2e) requires that the OPEP contains arrangements for limiting risk to the environment, including descriptions of equipment and how warnings are to be given and action taken. The inshore operations and offshore operations have a section entitled 'Response Options' (Sections 5 and 4 respectively) that details the process of choosing an optimum response strategy. These sections include descriptions of how to contain, recover or disperse a spill in order to limit risks to the environment in the event of an accident occurring. Both documents also have an 'Oil Spill Response Equipment' section (Section 7 for inshore, Section 6 for offshore), which describes the equipment to be used in event of a spill. Preventative measures are included in Appendix 2 and 4 of the inshore and offshore documents respectively. Appendix 7 in the offshore and Appendix 5 in the inshore operation document contains a flow chart detailing the response strategy. The flowchart	Operational details and specific reporting structures will be included in the operational OPEPs in due course.	

Consultee	Representation	POEPL response	Details in
	shows a clear decision tree as to what steps should be initiated in response to an oil spill event, but does not define who is responsible for initiating the emergency procedures or for making the decisions at each stage gate. It is assumed that when the management structure is defined, these flow charts will be updated (as discussed in Section 5.2.3 above). The Stanley Harbour document includes Section 5: Prevention, Section 6: Response Options and Section 9: Tactical Response Plans, with equipment listed within Section 11. One item that does not appear to be explicitly stated within any document is 'how warnings are to be given', which is a specifically detailed requirement in the FIG document.		
SAMS36	5.2.7 Point (2f) requires more specific information on equipment and resources available to respond to an event. As described above, descriptions of equipment are included in each document. For the Stanley Harbour strategy document Table 11.1 is the sole source of information. Appendix 8 of the offshore document includes a detailed inventory of oil spill response assets, with a similar account within Appendix 6 of the inshore operations document. Point (2f ii) requires that storage locations for equipment are provided, along with details of ownership, and the arrangements for transport and mode of deployment at an incident site. Whilst storage locations are included in all documents, the other required items are not explicitly detailed.	Details of storage arrangements and ownership will be included in the operational OPEPs in due course. POEPL would note that oil spill response resources have previously been located and operated in the Falkland Islands during exploration well campaigns.	
SAMS37	5.2.8 Within the three oil spill strategy documents, there no explicit details provided on measures that will ensure response equipment and procedures are maintained in an operable condition, as required by point (2g). However, the scheduled training exercises (see Section 5.2.4 above) would likely test the oil spill response procedures on a regular basis.	Specific operational details will be included in the operational OPEPs in due course.	
SAMS38	5.2.9 Point (2h) requires that an OPEP must include an estimate of the oil spill response effectiveness, taking into account various environmental factors. The inshore and offshore strategy documents both use the Oil Spill Contingency and Response (OSCAR)	POEPL infers that the details provided in the EIS and supporting strategies are therefore acceptable, with a residual question around spill response effectiveness in Stanley Harbour.	

Consultee	Representation	POEPL response	Details in
	model to examine the effectiveness of the proposed response. The modelling is detailed in the section 'Effectiveness Assessment', and is supported by a short appendix describing the OSCAR model. Within the inshore document, these are Section 10 and Appendix 1, whilst they can be found in Section 9 and Appendix 3 of the offshore document. The OSCAR model takes into account the environmental variables detailed as a requirement, although the content relating explicitly to this is found within the main EIS document, and not within the strategy plans themselves. The inshore document does also include notes on additional environmental information pertaining to Metocean conditions in Appendix 3. The Stanley Harbour document does not include any assessment of effectiveness to the proposed oil spill response measures.	This has been described in a different way to the offshore and inshore scenarios due to the scale of the likely releases. Section 12.3.7 discusses the effectiveness of at-shore response options and recognises that prevention is the main tool.	
SAMS39	5.2.10 Point (2h) requires that evidence of prior assessment of any chemical dispersants have been carried out. Each document discusses the possible use of dispersants, and conclude that dispersant use is not a primary response option. Within the Stanley Harbour document, Section 6.6 states 'dispersant application for oil spills in Stanley Harbour is not considered a viable response strategy', whilst Sections 4.2.4 and 5.3.1 from the offshore and inshore documents state '… POEPL will not store any dispersants in the Falklands and will rely on access to dispersants *via* Tier 3 oil spill response provider OSRL in the unlikely event that an IFO oil spill occurs…'. It seems reasonable that no further information has been provided considering POEPL's intent not to use chemical dispersants.	POEPL acknowledges the comment.	
SAMS40	5.2.11 Point (2j) requires that an OPEP has information on the potential effects resulting from a spill, and how these may be mitigated. This appears to be outwith the scope of the strategy documents, as this information is included within the main EIS document. However, the documents do contain an Oiled Wildlife Response Strategy (Section 8 & Appendix 7 inshore, Section 7 & Appendix 9 offshore and Port Stanley), which includes information	POEPL believes the information provided is appropriate for the purposes of the EIS. Further details of wildlife response and waste management will be included in the operational OPEPs in due course.	

Consultee	Representation	POEPL response	Details in
	how impacts to wildlife receptors would be handled and monitored. Each document also has a section on Waste Management (Section 6 inshore, Section 5 offshore and Section 8 Port Stanley), which details how waste generated from a spill will be dealt with. Shoreline Response information is also provided (Appendix 4 inshore, Appendix 6 offshore), detailing how Shoreline Clean-up Assessment Technique (SCAT) teams will be deployed in event of a spill. Whilst these Sections do not cover the entire required content of point (2j), they demonstrate some of the required information.		
SAMS41	5.2.12 No information within any of the strategy documents could be found pertaining to the arrangements for providing an early warning of a major environmental incident, as per point (2k) and sub-points therein. It is likely that such information will be included in the final OPEP closer to the commencement of operations.	This requirement is not one POEPL is currently aware of. There are many measures in place for early warning, and POEPL would expect to include these in operational OPEPs, and in line with any new requirements in the future.	
SAMS42	5.2.13 Taken as a representative of what the OPEP for the Sea Lion Development may contain, the three oil spill strategy documents generally showed a great deal of compliance with the proposed 'Requirements for Oil Pollution Emergency Plans' as drafted by the FIG. Where gaps exist, this information is likely lacking due to the current phase of the development, and will likely be provided in due course. Point (2j) appears to require that the OPEP includes information that is undertaken principally as part of the EIS for the development; the Reviewer wonders whether this should be a stated requirement of OPEPs, or whether reference to the EIS would be sufficient.	POEPL welcomes the comment regarding the content of the Oil Spill Strategies. POEPL would prefer any future approaches to documentation to minimise duplication while keeping necessary data accessible in an emergency.	
SAMS43	5.2.14 As mentioned for the EMMP, to demonstrate compliance against the new legislation being proposed by the FIG, it may advisable that the content of the OPEP be re-arranged to more explicitly show that the points have been adhered to.	As above.	
SAMS44	TABLE OF COMPLIANCE WITH PROPOSED OPEP GUIDANCE	POEPL acknowledges this as summarising the preceding points and for future reference.	

Consultee	Representation	POEPL response	Details in
Joint Nature Conservation Committee (JNCC)			
JNCC1	We note previous advice regarding marine mammal injury thresholds has been followed and the marine mammal noise assessment has been updated to take account of updates to the thresholds. Page 708, Section 10.4.4.3.4.4; The EIS states disturbance thresholds in Southall 2007 are unchanged by NMFS 2016. While strictly true, we highlight that NMFS 2016 only discusses injury and parameters to assess disturbance, these are currently under review by NMFS. We also highlight that contributors to NMFS 2016 have published the same injury thresholds in a peer-reviewed journal (Southall *et al.,* 2019). While the thresholds/functions presented in each document are identical, the terminology used to identify the hearing function groups does differ between the two documents: e.g., high frequency in NMSF 2016 is very high frequency in Southall *et al.,* 2019. When undertaking future noise assessment, applicants should be clear with regard to which reference they are using.	POEPL acknowledges these points and will take these into account for any future work.	
JNCC2	The noise assessment appears to have used the Sound Pressure Level (SPL) metric for predicting injury and cumulative Sound Exposure Levels (SELcum) for predicting behaviour. We highlight that both metrics are recommended when assessing potential injury from impulsive noise. For disturbance, we favour the use of a fixed deterrent range based on empirical evidence as opposed to disturbance ranges estimated from noise modelling. The latter carries considerable uncertainty. In particular: there are no agreed quantitative thresholds for disturbance as there are for auditory injury; depending on the choice of numerical models to estimate sound source and propagation, one can end up with several orders of magnitude different predictions for disturbance ranges; received sound levels are not the single most influencing factor in triggering disturbance, other characteristics of sound and how they propagate with distance will influence how an animal perceives the noise; and behavioural context, individual animal motivation and previous	POEPL understands the concerns and points out that the use of a disturbance threshold is referenced and there is no published guidance to use a fixed deterrent range. POEPL acknowledge the uncertainty in assessing the impacts of underwater noise in the uncertainties section in Section 10.4 (graded 'Uncertain'), which forms part of the precautionary assessment. Nevertheless, POEPL appreciates the input and a precautionary deterrent range has been included in the text of EIS. It is noted that the disturbance ranges calculated for Scenarios 1 and 2 in Section 10.3 are 17.5 km and 21.5 km respectively, which is a similar scale to the ranges quoted by JNCC for activities similar to	Section 10.4.4.4.4.3 of the EIS updated.

Consultee	Representation	POEPL response	Details in
	exposure will also all play a role in determining response. For pin piling (smaller diameter piles that secure jacket structures), one study found a 50% probability of porpoise response within 7.4 km, in the 12 hours after the piling had ended (the deterrence distance during piling was not reported). The study also showed a 25% probability of response within approximately 18 km. Potential habituation was also recorded, with response distances decreasing over the duration of the piling operations (Graham *et al.,* 2019). For this type of piling we recommend a precautionary 15km deterrence range to be used in assessments. Conductor piles used in oil and gas well surface holes have also much smaller diameters (<1m) therefore requiring lower hammer energy than for monopiles and generating noise of a lower amplitude (Jiang *et al.,* 2015, MacGillivray 2018). We recommend a precautionary 15km effective deterrent range (EDR).	Scenario 1. Since Scenario 1 is a shorter duration activity than Scenarios 2 and 3, POEPL is confident that the overall assessment rating of offshore underwater noise is not increased by taking this approach.	
JNCC3	The noise modelling report states a range of swimming speeds has been modelled (page 22), however, page 32 states a swim speed of 5m/s has been used as 'typical' of cetacean swimming speed and conservative, as escape speeds would be higher. We believe, in reality, this is likely to be slower. For example, Mate & Stafford 1994 (white-sided dolphins), Bloch *et al.,* 2003 (pilot whales), Goldbogen *et al.,* 2006 (fin whales) all recorded slower average speeds from tagged animals. In addition, there is no evidence animals would sprint away from a noise source. Subsequently the injury ranges may be larger than predicted and therefore a precautionary approach is advised when considering mitigations zones.	POEPL acknowledges this point and would note that the 5 m/s swim speed was a common (and referenced) assumption at the time the original assessment was undertaken. Actual swim speeds are very variable, especially if the animal is considered to be 'fleeing'. It is acknowledged that swim speeds of around 2-3 m/s are quoted in literature, with several recent papers contributing to this knowledge. A re-analysis of the predicted sound exposure levels during the conductor piling operations has been undertaken using a swim speed of 2 m/s, which acts to increase predicted levels. At the same time however, the application of a 'soft start' to the operation has been incorporated into the analysis, whereby hammer energy is increased gradually over a period of 20 minutes. This acts to decrease	Section 10.4.5.1 updated.

Consultee	Representation	POEPL response	Details in
		predicted levels. The results of these updates together mean that the sound exposure levels are no greater than those quoted in the EIS. On balance therefore, the assessment conclusions are unchanged.	
JNCC4	Piling We commend POEPL on their intention to follow JNCC mitigation guidelines for use during piling should it be required. However, we note that the revised modelling predicts injury to high frequency cetaceans could occur at 850m from the source. We subsequently recommend that the mitigation zone is increased from the standard 500m to 1km. We repeat our previous advice that the pre-piling search is undertaken for 60 minutes to allow for the possibility of deep-diving species in the area. We recommend use of the guidelines are included as a condition of any consent issued and note a commitment by the applicant to provide FIG the Marine Mammal Observer (MMO) reports once piling is complete. This report will provide evidence of compliance and may provide additional insight into marine mammal presence in the area.	The EIS has been updated to reflect a recalculated mitigation zone of 700 m taking into account a revised swim speed assumption of 2 m/s and the inclusion of a soft-start top the piling operation. The EIS also commits to a 60 minute pre-piling search as recommended by JNCC. Under ideal conditions, it should be possible to visually detect hourglass dolphins (the most numerous high frequency cetacean in the area) at this range. However, detectability will be lower with increased sea state or reduced visibility at increasing distance from the observer. POEPL has already committed to using PAM to help in the detection of HF cetaceans as an additional precaution.	Section 10.4.5.1 updated.
JNCC5	Explosive use We note that explosives will be used to perforate the well once drilled. As this will occur between 1.8 and 2.2km below the seabed, marine mammal mitigation will not be required before this operation.	POEPL acknowledges these points and will take these into account for any future work.	
JNCC6	Monitoring Page 1446, Section 15; We appreciate that monitoring plans included within the EIS are drafts and specific protocols are still to be developed, however the information presented felt confused. The purpose of the monitoring proposed is not clear (i.e., what questions are to be answered), and there appears to be overlap between mitigation and monitoring. For example, Section 15.6.1.3, Post-sanction, pre First-Oil, reads more like mitigation than	The EIS has been amended to clarify that the intended mitigation measures during piling, of having marine mammal observers and PAM, will also contribute to baseline information. Having observers who are SMMOs is established practice and we acknowledge that the specific protocols that they will be expected to follow will be discussed with JNCC in further	Section 15.6.1.3 amended.

Consultee	Representation	POEPL response	Details in
	baseline/ongoing monitoring, further compounded by the task to determine if JNCC piling guidelines need to be adapted. The two procedures need to be considered separately and all mitigation requirements should be detailed in a separate document. It is not clear whether PAM will be used for mitigation, monitoring or both. We also question the intention to have seabird observers contributing to marine mammal data. Again, it is unclear if this is to be part of mitigation searches or monitoring, and the purpose will influence the relevance/appropriateness of such data. We are available to review future drafts and protocols should it be required.	development of the EMMP, and we welcome the opportunity to liaise with JNCC on this.	
JNCC7	Page 46, Table 1.3 and Page 552, Table 7.57; The document states that "However, none of the species found are rare or protected under any Falkland Islands legislation". Although this statement may be true, this does not mean that areas of conservation interest may not still be present in the area (noting that work is ongoing in the Falklands to identify marine areas that support important aggregations of seabirds and other fauna) and therefore a precautionary approach should be taken.	POEPL believes a precautionary approach has been taken with the EIS and the statement is a matter of fact. The EIS provides a lot of data on the existing habitat types from many sources and these have been taken into account in the impact assessment.	
JNCC8	Page 321, Section 7.4.3.3.1; The bullet points at the top of the page state that only six species were recorded in mud habitat and five species were recorded in fine sand habitat. JNCC considers that these numbers seem extremely low for the area and would ask POEPL to clarify if these are correct within the text by explaining why this might be the case. Were the surveys undertaken only considering epifauna, rather than the addition of infauna? Further information should be included in this section to make this clear.	These were SCUBA surveys and represent epifauna only. POEPL has amended the text to make this clear. The surveys comprise a 20 m belt transect and 0.25 m2 quadrats which were photographed every metre and therefore represent the surface only. The text has been amended to make this clear	Amendment to Section 7.4.3.3.1.
JNCC9	Page 329, Table 7.5; JNCC would like to reiterate that in future applications POEPL use the Latin genus and species name, where possible, to aid identification and prevent confusion between common names of species.	Latin names are mentioned at the first occurrence, and then common names have been used to make the content more accessible to a broad spectrum of readers	
JNCC10	Page 330, Table 7.6; It would be beneficial to include a definition of what is classified as open water within the Berkeley Sound. Is there a depth criterion to this classification? It is unlikely that the benthic	The text in the table has been amended to make this clearer. Open water is defined as the area of water outside of the 'kelp line'.	

Consultee	Representation	POEPL response	Details in
	habitats within the open water are the same throughout the Berkeley Sound, particularly when reviewed against Figures 7.26, 7.28, 7.29, 7.30, 7.43 and 7.44, which show the differences in sand, fines and gravel percentages during the BSL 2015 survey and the habitats mapped in the area. It would be more valuable in future applications to characterise the habitat types based on the benthic habitats present.		
JNCC11	Preliminary Impact Assessment and Screening Page 590, Table 9.2; There are several previous suggestions from JNCC on activities in the offshore ENVID assessment (such as large dropped objects, etc) where we believe some receptors should be assessed in further detail, particularly the benthos or seabed and soil. These have not been updated in this version: we would like to reiterate that we believe these should be included.	POEPL notes that in 2018, JNCC commented that in future assessments, consideration should be given to large dropped objects, cooling water discharges and the presence of oil spill infrastructure. Cooling water has now been included in the assessment (Section 10.7.2.3), and oil spill infrastructure is described in Sections 12.1 and 12.2. During the ENVIID, it was agreed that smaller dropped objects could be scoped out of the EIA, noting that these would be retrieved if possible at the time of the occurrence or shortly thereafter. Certainly any remaining debris will be retrieved at the time of decommissioning. However, at the time of the ENVIID it was also agreed that the risk of impacts from large dropped objects required further investigation and so they were scoped in (Table 9.2, pg. 590). Chapter 10.3 on the 'Disturbance to the seabed / placement and removal of objects' describes the nature of the impacts of placing objects on the seabed and the potential for crushing benthos, and smothering through seabed disturbance. The potential impact of marine growth and the creation of artificial reefs is also	

Consultee	Representation	POEPL response	Details in
		discussed. The impacts of the above are described for the offshore and the inshore locations. These data are then drawn upon for the risk assessment of large dropped objects. While the area-wide surveys indicate homogeneity in the benthic communities, the absence of site-specific offshore benthic surveys and detail on the diversity and abundance of benthic fauna around the offshore locations is acknowledged and factored into the confidence assessment. The impact on soil quality from any leaks is discussed in the spill chapters.	
JNCC12	Habitat Classification Page 333, Table 7.7; The last fieldwork class states 'Sand cobbles and pebbles medium depth'. It is still not clear within the document what is meant by 'medium depth' therefore this should be clarified. Page 341, Section 7.4.3.3.4.2; The application states 'Mussel beds were identified at two stations: 11 and 17, with patchy aggregations observed at four further stations although these are not thought to constitute the dense aggregations that define this habitat type'. JNCC would request that POEPL provide evidence as to why the mussel beds recorded at stations 11 and 17 do not constitute 'mussel bed' habitat? Is this due to densities of the habitat in the area?	The reference to medium depth has been clarified to refer to the subtidal zone. Brachidontes blakeanus were found amongst the Aulacomya atra reefs and were not sound in dense aggregations in the overall structure.	Table 7.6 amended.
JNCC13	Drill cuttings modelling Page 777, Table 10.40; The total seabed footprint of drill cuttings from the main drill centre is included in the drill cuttings modelling section. However, it would be beneficial to include the total seabed footprint of all wells to show the worst-case impact area.	The EIS includes deposition thickness predictions for all the drill centres and concluded that "The depositional thickness at the end of drilling the wells was found to exceed 6.5 mm over an area of up to 0.15 km2". There is an additional analysis of the main drill centre that provides a more sophisticated picture of risk factors and area at	

Consultee	Representation	POEPL response	Details in
		risk, which is associated with a high degree of modelling. Since the main drill centre represents the majority of the area of this risk, the analysis was confined to that area, and it provides conclusions on the importance of oil content in cuttings versus deposition thickness, etc. that are applicable to the other drill centres. POEPL submits that the assessment has sufficient data and are willing to incorporate this as a request for any future assessments.	
JNCC14	General Page 356, Section 7.4.3.3.3; The legend of Figures 7.43 and 7.44 are blurry which makes it difficult to determine which habitats are present in each figure. Also, the size of habitat video/ stills within the map are too small to determine the habitats present, therefore it would be beneficial to include larger versions of these below the map to make them clearer. We recommend that these changes are made during the next update.	The figures in question have now been updated in the EIS and are clearer.	Figures 7.43 and 7.44 updated.
JNCC15	Pages 363-366, Section 7.4.5.2.1.1; This section outlines that the EIS has used the JNCC Seabirds at Sea Team (SAST) surveys as the baseline for information on the spatial and temporal distribution of seabirds in the North Falklands Basis (NFB) – i.e., the development area. It acknowledges that there are limitations to the database (age of data, temporal windows, species covered, methodology used), but still considers it the most comprehensive survey data available. Where possible, information has been supplemented by more recent references/data on a species-by-species basis. In response to earlier queries as to how representative the dataset is, given the type of limitations listed above, POEPL commissioned Genesis to undertake a review of the data to assess its adequacy for the purposes of impact assessment. The Genesis review (2017)	An appendix has been added listing the names (and codes) of the species of bird and marine mammal mentioned in the ES	Appendix 1 added.

Consultee	Representation	POEPL response	Details in
	concluded that the survey methods, the coverage and age of the data were comparable with existing datasets used to inform similar impact assessments undertaken in the UK. The SAST was re-examined to highlight the species recorded in the vicinity of the Sea Lion area so that relative abundance of species could be calculated on a seasonal basis – summary data presented in Table 7.12 (page 364). A suggestion for Table 7.12 would be to include an explanation of the species codes in either the table caption or table footer – it is cumbersome to try and find them in the text; also, would suggest repeating heading rows when a table is split over more than one page. In the previous EIS, JNCC commented on the age of the data and whether it is still representative. We are pleased to see that a review and re-examination of relevant data has been conducted, and are more content now that there is evidence that the SAST is satisfactory for such an impact assessment – although the limitations to this dataset identified in the EIS (p365-366) do need to be taken into consideration when considering the outcomes of the impact assessments. We would also encourage POEPL and/or FIG to continue to update data where/when possible and/or consider repeat or regular surveys of seabirds at sea to enhance monitoring and response to impacts/activities. It is noted that some of the data limitations will be addressed by the GAP project (p366); however, it is believed that this programme has now been completed. Text may need to be amended to a more general statement of how these gaps may be addressed.		
JNCC16	Page 366, Section 7.4.5.2.1.2; It appears that data collected from seabird surveys on seismic vessels have not been incorporated into existing seabird distribution data (SAST) and represented within the OVI context. See our comments to Section 7.4.5.6.1: The seismic survey data should be used, alongside other available seabird distribution data that has been collected since the OVI was developed, as a visual assessment of how representative the OVI	Additional references to the seismic surveys have been added to the EIS.	Section 7.4.5.2.1.1 amended.

Consultee	Representation	POEPL response	Details in
	maps might be if it were to be updated with newer data (and methods).		
JNCC17	Page 367, Table 7.13; The text referencing this table (p366-367) says it should show the IUCN Red Data List threat status, but this information appears to be missing from the table itself.	Reference to IUCN status in Table 7.13 has been removed from the text as it was not thought to be relevant to the data presented in the Table. IUCN status for all species of bird mentioned in the text can now be found in Appendix 1.	Appendix 1 added.
JNCC18	Page 368, Section 7.4.5.2.1.3; The reference Baylis, *et al.,* 2019 (cited elsewhere in document) could be inserted in the last sentence of the first paragraph as an example of ongoing work that has now been published.	POEPL acknowledges this point. The reference to Baylis, *et al.* (2019) has now been inserted.	Section 7.4.5.2.1.3 amended.
JNCC19	Page 394, Section 7.4.5.3; A more recent reference for census work of southern giant petrels on the Falklands is available from the census conducted by Falklands Conservation in 2015-16: Stanworth, A. and Crofts, S. (2017). Population status and trends of Southern Giant Petrels (Macronectes giganteus) in the Falkland Islands. Falklands Conservation.	POEPL acknowledges this point and the text has been amended to incorporate the latest census data. Stanworth and Crofts 2017 has been cited here and the data incorporated where relevant.	Section 7.4.5.3 amended.
JNCC20	Page 394, Section 7.4.5.3.1.1; We welcome the inclusion of the data from the additional Berkeley Sound coastal bird surveys that have been conducted since submission of the previous EIS. Even if only a 'snapshot', this seasonal information is very valuable for baseline information.	POEPL acknowledges this point.	
JNCC21	Page 394, Section 7.4.5.3.1.1; 'Summer 2016' could be deleted from the Section heading.	The text has been amended.	Section 7.4.5.3.1.1 amended.
JNCC22	Page 396, Figures 7.56 and 7.57; What is the difference between the four panels in each figure? This should be included in the description to clarify which survey is in each image and when they were conducted.	Each panel has now been labelled with the season in which the data were collected. The figures with the corresponding season have been amended.	Figures 7.56 and 7.57 amended.
JNCC23	Page 398, Table 7.17; It should be made clear that the numbers in the Spring/Summer/Autumn/Winter/Total columns are the number of birds counted in each of the surveys.	POEPL acknowledges this point and the EIS has been amended to make this clear.	Table 7.17 amended.

Consultee	Representation	POEPL response	Details in
JNCC24	Page 399, Table 7.18; It would be helpful to have the list of species codes explained with the table.	POEPL has included these data. Appendix 1 has been added listing the codes used.	Appendix 1 added.
JNCC25	Page 368, Section 7.4.5.2.1.4; We are pleased to see the incorporation of the GAP project data which has now been more comprehensively analysed since the previous version of the EIS. Detail and methods are satisfactory for inclusion and consideration of distribution of the species included in the study, and for use in subsequent impact and risk assessments – caveats highlighted in relation to limitations notwithstanding. While the information on GAP project data and the tracking work undertaken as part of it is clear, what is less clear is how this distribution data is used (quantitatively or qualitatively) in the assessment of risk, particularly in respect of accidental or chronic oil spills. We recommend that, at the very least, tracking data (e.g., Figure 7.48-7.49) is overlaid with the Seabird Vulnerability Maps presented in Figures 7.69-7.72. Ideally, tracking data alongside the new seabirds at sea data from seabird surveys on seismic vessels are integrated quantitatively in an update to the Falkland Islands OVI to bring it into line with comparable Seabird Oil Sensitivity Index (SOSI) analysis from the UK (see comments on later Section 7.4.5.6.1).	The risk assessment in each section has been fully reviewed by specialists at SAERI in combination with POEPL in the light of both the project updates and the recent environmental data presented. Very few changes were deemed necessary, including the assessment of oil spill risks. Similar to the response to comment JNCC16 (seismic survey seabird data), there are significant difficulties in comparing tracking data with SAST data. Thus far, the tracking data shows presence or absence on a 'summer' or 'winter' basis. Further analysis of the tracking data is required to show the density distribution of birds on a monthly basis, if this is to be used to assess OVI. POEPL anticipates that this sort of analysis will be further investigated going forward. POEPL believes the EIS contains sufficient information for its purposes and takes account of data uncertainties.	
JNCC26	Page 368, Section 7.4.5.2.1.4; As well as referencing Baylis, *et al.* (2019), it would also be useful to reference the related GAP II reports which this data and the Baylis *et al.* (2019) paper is based on. These reports contain more detailed information about the data sources and accessibility, as well as the scripts used for the analyses. Citations would be: 1) Baylis, A.M.M. and Tierney, M. (2018). Analytical methods for establishing marine higher predator movements in Falkland Island waters. Report prepared as part of the GAP Project (Phase II) for the Falkland Islands Offshore	POEPL has updated and amended these references which were instrumental in preparation of the Baylis, *et al.,* 2019 paper.	Section 7.4.5.2.1.4 amended.

Consultee	Representation	POEPL response	Details in
	Hydrocarbons Environmental Forum (FIOHEF). South Atlantic Environmental Research Institute, Falkland Islands; 2) Baylis, A.M.M., Tierney, M. and Brickle, P. (2019). Marine higher predator modelling: predicting habitat use for colonies not tracked and identifying areas of high species diversity. Report prepared as part of the GAP Project (Phase II) for the Falkland Islands Offshore Hydrocarbons Environmental Forum (FIOHEF). South Atlantic Environmental Research Institute, Falkland Islands.		
JNCC27	Species specific distribution and abundance IUCN threat categories are referred to throughout the EIA, these should include a date (year) as threat categories are reassessed and might change over time. Where IUCN threat categories have been included (Page 427, Table 7.24), it would also be useful to explain the threat category abbreviations for clarity and completeness.	The status of some species changed during the preparation of the EIS. The document has been reviewed to ensure that all references to IUCN status are correct on the date of issuing of this document. IUCN status of all species checked and updated where necessary and included in Appendix 1.	Various amendments, Appendix 1 added.
JNCC28	Page 377, Section 7.4.5.2.2; It would be useful to include an explanation of how POEPL decided which were the most 'noteworthy' species to be included in Table 7.16.	The species included in Table 7.16 are listed according to their abundance as recorded within the North Falkland Basin by the Seabirds at Sea Team (SAST).	
JNCC29	Page 377, Section 7.4.5.2.2; While the limitations of at-sea distributions of seabird species have been highlighted in the EIS, there is no such consideration to quoted population numbers for the majority of species (breeding on the Falklands) described in this section. Many of the Falklands breeding populations have not been censused in many years, nor are subject to regular surveys, and so figures may be considerably out of date. Good population data is required to accurately assess impacts, and so the lack of updated or verification of the accuracy of existing data should be noted as a limitation in the EIS, and possibly noted as a data gap to be filled.	POEPL acknowledges this point. Text has been added to highlight the lack of population census data and population trends as a data gap.	Section 7.4.5.2.2 amended.
JNCC30	Page 377, black-browed albatross (BBA); Although the EIS quotes the last published figures for the size of the Falklands BBA population (Wolfaardt, 2010), a new figure should be released soon from the island-wise census conducted in 2017. If POEPL wanted to	POEPL appreciates the advice and will monitor this.	

Consultee	Representation	POEPL response	Details in
	include reference to this updated figure, they could approach Falklands Conservation who are conducted the analyses on behalf of FIG. Early indications are that the population is at least stable or possibly increasing.		
JNCC31	Page 379, sooty shearwaters (SSW); The recent, unpublished report by Wakefield *et al.* (2017) contains an updated estimate of the number of breeding pairs of SSW on Kidney Island, plus new tracking data (which was incorporated into the analysis by Baylis, *et al.,* 2019). The new population figure puts the number of breeding pairs at 139,000. The report can be requested from the FIG Policy and Environment Unit. Report reference is: Wakefield, E.D., Clark, T.J., Matthiopoulos, J., Bonnet-Lebrun, A.S., 4, Campioni, L., Catry, P. The population size and fine-scale foraging distribution of Kidney Islands sooty shearwaters – a baseline study, Report to the Falkland Islands Government, 30th September, 2017, University of Glasgow, UK, 40p.	POEPL has added this population estimate and reference to the EIS where appropriate.	Section 7.4.5.2.2 and Table 7.16 amended.
JNCC32	Page 381, southern giant petrels (SGP); a more recent reference for the population size of SGPs on the Falklands is from the census conducted by Falklands Conservation in 2015-16, i.e., Stanworth, A. and Crofts, S. (2017). Population status and trends of southern giant petrels (Macronectes giganteus) in the Falkland Islands. Falklands Conservation. For the South Georgia population, the most recent publication is: Poncet *et al.* (2020). The distribution, abundance, status and global importance of giant petrels breeding at South Georgia. Polar Biology 43(1): 17-34.	POEPL acknowledges this update and has updated the population estimates and references in the EIS where necessary.	Section 7.4.5.2.2 and Table 7.16 amended.
JNCC33	Page 381, Magellanic Penguins; Blockley and Tierney (2017) also provide additional data to that referred to in this section for overwintering movements of Magellanic penguins. Blockley and Tierney (2017) data concurs with that in the EIS but could also be cited to further support the evidence base. This reference is cited elsewhere in the document.	POEPL has re-examined the Blockley and Tierney 2017 reference and has amended the text appropriately in the EIS.	Section 7.4.5.2.2 amended.
JNCC34	Page 383, wandering albatross; There has been some more recent publications on the size of the South Georgia wandering albatross population, than the one currently cited in the EIS. See Poncet *et al.*	POEPL acknowledges this and has updated the population estimates and references in the EIS.	Section 7.4.5.2.2 and Table 7.16 amended.

Consultee	Representation	POEPL response	Details in
	(2017). Recent trends in number of wandering, black-browed and grey-headed albatrosses breeding at South Georgia. Polar Biology 40(7): 1347-1358.		
JNCC35	Page 385, northern giant petrels; There has been some more recent publications on the size of the South Georgia giant petrel populations, than the one currently cited in the EIS: Poncet *et al.* (2020). The distribution, abundance, status and global importance of giant petrels breeding at South Georgia. Polar Biology 43(1): 17-34.	POEPL acknowledges this and has updated the population estimates and references in the EIS.	Section 7.4.5.2.2 and Table 7.16 amended.
JNCC36	Page 384, rockhopper and macaroni Penguins; Blockley and Tierney (2017) also provide additional data to that referred to in this section for overwintering movements of rockhopper penguins, and in particular shows them moving through the Sea Lion field in September/October as they return to the Falklands from their overwintering grounds for the summer breeding season.	POEPL has re-examined the Blockley and Tierney 2017 reference and has amended the text appropriately in the EIS. The reference has been incorporated.	Section 7.4.5.2.2 amended.
JNCC37	Page 386, gentoo penguins; The report Baylis, *et al.* (2019) modelled habitat use for gentoo penguins – why has this not been included in the text and as a figure? This has been included for the other species included in the Baylis, *et al.* (2019) analysis and should therefore be included for the gentoo penguin. Tracking data does show them travelling further offshore than the SAST surveys but concurs that most were in shelf waters of <200m.	The omission of the gentoo penguin map was an oversight. POEPL has added the figure showing the gentoo locations, as well as supporting text, to the EIS.	Section 7.4.5.2.2 amended and Figure 7.57 added.
JNCC38	Page 424, Section 7.4.5.5; A more recent publication on the population numbers of South Georgia black-browed albatross is available and should be included in the last sentence of paragraph one. The reference is: Recent trends in number of wandering, black-browed and grey-headed albatrosses breeding at South Georgia. Polar Biology 40(7): 1347-1358.	POEPL acknowledges this update and has updated the population estimates and references in the EIS.	Section 7.4.5.2.2 and Table 7.16 amended.
JNCC39	Page 405, Section 7.4.5.3.2; • Rockhopper penguin: A reference should be provided for the GAP work referred to in the last paragraph – Blockley and Tierney (2017). In Figure 7.60, it would be beneficial to include in the caption that no rockhoppers were observed in autumn and winter, therefore no	The text does state that few rockhopper penguins were recorded in the autumn and none in the winter. POEPL agrees with the points raised by JNCC and the EIS has been updated accordingly. The issues raised	Section 7.4.5.3.2, Figures 7.61-7.66 amended and Appendix 1 added.

Consultee	Representation	POEPL response	Details in
	maps of this are included. • Rock shags: A reference to the rock shag tracking that is referred to should be provided. In Figure 7.61 the caption is incorrect for this figure; also, not all panels in the figure are correctly referred to. • Imperial shags: In Figure 7.62, the caption is incorrect for this figure; also, not all panels in the figure are correctly referred to. • Magellanic Penguins: In Figure 7.64, the source for this figure should be referenced. • Black-browed albatross: In Figure 7.65, the source for this figure should be referenced. • White-chinned petrels: IUCN threat category should be referenced with a date/year. • Sooty shearwaters: In Figure 7.66, is the source of this data from SAST (as stated in the figure caption), or the GAP programme, as stated in the last paragraph of text on p415? This should be updated to reflect the correct source.	regarding IUCN status have been addressed by the addition of Appendix 1. References for the sources of population data are provided in the footnote. Note that 'FI priority species' are a priority according to FIG and management plans have been proposed for these species.	
JNCC40	Page 388, Table 7.16 and Page 419, Table 7.22; These are very useful summary tables. However, some suggested edits to improve them and/or queries are: • The reference date should be provided for the IUCN threat categories provided; • Provide a reference for where the information for the global population numbers and trends came from; • Breeding cycle – information presented here is not consistent for all species. This would be beneficial if this was consistent across the species; • What is meant by 'FI priority species' – who has decided it is a priority? If discussed previously, refer reader back to relevant section; • Provide a footnote (or include in figure caption) as to what the IUCN threat category abbreviations mean; • Move the key to the relative abundance colour codes to the top of the table.	The tables have been amended accordingly within the EIS.	Table 7.16 and Table 7.22 amended.

Consultee	Representation	POEPL response	Details in
JNCC41	Agreement for the Conservation of Albatrosses and Petrels (ACAP) Page 426, Section 7.4.5.5.2; The number of ACAP listed species needs to be corrected from 30 species to 31.	The text has been amended.	Section 7.4.5.5.2 amended.
JNCC42	Page 426, Section 7.4.5.5.2; It would be beneficial to include that, in addition to the breeding populations of the ACAP listed species of southern giant petrels and white chinned petrels that breed near Berkeley Sound, the Falklands also has 70% of the breeding population of the ACAP-listed black-browed albatrosses, and 40% of southern giant petrels.	The proportion of each species breeding in the Falklands IS stated in EIS Table 7.16 and is supported in the text. However, note that throughout the document, the aim is to avoid repetition. Population estimates have been updated with the latest published numbers.	Section 7.4.5.2.2 amended.
JNCC43	Page 428, Section 7.4.5.6.1; To assess the relative risk of seabirds to oil spill, the analysis done by the SAST in 2001 using the JNCC-developed OVI has been used. The report acknowledges that JNCC has updated this method, which is now called the Seabird Oil Sensitivity Index (SOSI). The Falklands SAST data has not been reanalysed with the SOSI methods – we would question as to why this has not been done.	As per above response to comment JNCC16, and below response to comment JNCC44. POEPL does not feel that SOSI as defioned in the UK is necessarily appropriate in the Falkland Islands, and believes this is a matter for JNCC to lead on.	
JNCC44	Page 428, Section 7.4.5.6.1; It appears that recent seabird distribution data, collected in the Sea Lion region from seismic vessels, have not be incorporated into distribution maps and the OVI method applied. Given the age of the Falklands SAST data and the availability of a more up-to-date OVI method (SOSI) we recommend that an entirely new analysis is conducted to create new seabird density layers and update the Falklands OVI, making use of the latest distribution data available (i.e., incorporating SAST, seismic survey seabird data, and tracking data), although we recognise that methods for incorporating these disparate types of dataset are difficult and time consuming. SOSI differs from OVI in both the methods used to calculate vulnerability scores and the species sensitivity scores themselves. A review of these elements, along with creation of new seabird density layers is a complex process, requiring detailed expertise in Falkland Island seabird species and spatial modelling skills. We recommend that this exercise be undertaken but recognise that this may be beyond the scope of this	POEPL agrees a full OVI/SOSI review and update would be disproportionate in terms of this EIS and would recommend that this is a matter for government/ JNCC to lead on. There are difficulties comparing or combining different datasets, such as those from seismic surveys and tracking data in a way that could be used with the OVI/SOSI methodology, which requires the density of each species (number of birds per km2), in specific areas, in each month of the year. POEPL notes that future EMMP plans include gathering SMMO data from vessels of opportunity. POEPL expects that the methodologies for collecting this data will be finalised in light of discussion on how these	

Consultee	Representation	POEPL response	Details in
	EIS. We propose that as part of this EIS, recent SAST, seismic survey seabird data, and tracking data are presented alongside the OVI maps with a visual (qualitative) assessment, by month, of potential changes to spatial oil spill vulnerability in light of more recent distribution data. And we recommend that the Falkland Islands government seeks to produce an updated seabird oil sensitivity or vulnerability tool making use of recent data and improved methods such as those presented in the JNCC's Seabird Oil Sensitivity Index (SOSI). If it is felt that there is a likelihood of more oil and gas developments being proposed/developed in the region, JNCC can assist in either understanding the requirements, and/or undertaking such work.	different datasets can be synthesised or, at least, presented in a way that is complementary and helpful in decision-making in terms of EIA, monitoring and oil spill planning/response. For now, POEPL believes the EIS contains sufficient data for its purposes.	
JNCC45	Page 622, Section 10.1.1; Useful remarks made in the EIA regarding artificial light and how it might be considered when assessing impact are: • Numerous vessels and offshore installations will be used throughout the three Stages of the Phase 1 Development, each of which requires the use of artificial light, and flaring may be required to clean-up four wells from the Mobile Offshore Drilling Unit (MODU). • Artificial light and flares can affect the natural behaviour of animals in several ways such as disturbance to activity patterns and hormone-regulated processes dictated by the internal clock. A more obvious effect, however, is the attraction of seabirds to man-made light sources and their subsequent disorientation. • There is a growing awareness of the impact that anthropogenic sources of light are having on seabirds (Montevecchi, 2006), although quantitative studies are few in number. • Outside the EIA process for major projects, no legislation is in place in the Falkland Islands to govern the environmental impact of artificial light, although offshore industry guidelines are in place. • It is important to understand during this assessment that mitigation measures will be limited by the need to ensure the use of	POEPL acknowledges this point and understand JNCC's emphasis.	

Consultee	Representation	POEPL response	Details in
	sufficient lighting for safety reasons. Specifically, offshore installations are required to be lit in line with various international and national (Falklands) legislation.		
JNCC46	Page 627, Section 10.1.4.1.3; It is noted in the text that the specific lighting specifications of the MODU and vessels that will be used is not known yet; therefore, assessment of light intensity is based on representative comparisons from operations elsewhere. This should be kept in mind when assessing potential impacts.	POEPL acknowledges this point and the EIS commits to reducing light pollution by design and auditing across all vessels.	
JNCC47	Page 633, Table 10.3; The text and table should reference the date/year of the IUCN Red List threat category that has been used, as assessments are updated (relatively) regularly and categories change. Explanation of the threat category abbreviations used should also be given in the table caption and/or footnote.	POEPL has added Appendix 1 to the EIS to clarify IUCN classifications current at the time of preparation.	Appendix 1 added.
JNCC48	Page 639, Section 10.1.6.2; JNCC queried the assessment of impact being 'Possible' for likelihood of multiple bird strikes for both the Sealion and Berkeley Sound areas. We note that the same ranking has been assigned in the revised EIS, and our query remains – i.e., we note the evidence presented in Table 10.4 (Page 636) on bird strikes reported during the 2015 POEPL Exploration Drilling Campaign, which does indicate a level of both bird strikes and mortality associated with it. However, these incidents are all single individual strikes, and would seem to give no supporting indication as to the likelihood (or otherwise) of multiple bird strike incidents. From a precautionary standpoint, it would seem reasonable to allow for the possibility of there being at least one incident of multiple bird-strike events in a year. Adequate monitoring and reporting (of which we note, and welcome, is planned *via* the EMMP) of such incidences as development continues will provide important contextual information as to the likelihood or not of such multiple bird-strike events happening on an annual (or less frequent) basis. Moreover, on the provision of monitoring data regarding such incidences, a more informed examination of the likelihood of impact on particular species can be made. We would note that if multiple	It is impossible to prove that annual multiple bird strike events will not occur. Nevertheless, POEPL does not have any evidence that this is likely on an ongoing basis, and there are other light-emitting marine activities in the area that provide opportunity. Hence the risks are recognised, but it is considered over-precautionary to rate it higher than 'possible'. Section 10.1 states that there are a number of variables that influence the likelihood of bird strikes. The most significant of these is location, and the presence of seabird assemblages close to a source of light. The incident described in Black (2005) occurred off the south coast of South Georgia, which has many differences compared to the North Falkland Basin. From what is known about bird strikes in the South Atlantic, POEPL believes a likelihood of	

Consultee	Representation	POEPL response	Details in
	bird-strikes were observed to occur, then the likelihood or not of potential impact at a population level is entirely dependent on the scale of the incident (and therefore further data is required before anything conclusive can be stated). A previous incident of vessel lighting-induced mortality of Southern Ocean seabirds reported 900 birds impacted on a single night (Black 2005). We welcome the acknowledgment made that, due to the number of variables that influence the potential for bird-strikes, it can be challenging to assess the risk of bird strikes due to artificial lights, and the recognition that there is a need to identify opportunities for improvement through mitigation and controls, and to consult with project stakeholders further on this topic.	'Possible' for multiple bird strikes is appropriate.	
JNCC49	Page 642, Section 10.1.7; Recognising that ensuring a safe working environment and the need to adhere to international and national legislations limits any additional project-specific mitigation measures that can be put in place to reduce impacts by artificial lights on seabirds, those outlined in 10.1.7 appear satisfactory. It is welcomed that monitoring of light-related impacts forms a part of the EMMP and further mitigation will be discussed should adverse impacts be identified.	POEPL appreciates the point made.	
JNCC50	Page 649, Section 10.1.10; JNCC welcome the acknowledgement that data gaps exist on the knowledge of the true potential impact of artificial lights on seabirds and that it is not yet possible to assess these in quantitative terms. We welcome the intention of POEPL to: i) develop and implement a Bird Strike Monitoring Programme (BSMP), including awareness training for rig workers and ship crews, and reporting of incidents to FIG; ii) use independent Seabird and Marine Mammal Observers (SMMOs) on support vessels, with reporting to FIG; iii) investigate working with FIG Fisheries Department to establish a seabird distribution monitoring programme; and iv) investigate the practicalities of adopting OSPAR green lighting	POEPL appreciates the point made.	

Consultee	Representation	POEPL response	Details in
	strategy during the project engineering phases, as well as a pilot-free flare design using an automated ignition system.		
JNCC51	JNCC can provide assistance to develop seabird survey, monitoring and assessment programmes. We also welcome the inclusion of monitoring requirements in the EMMP and would be interested in seeing further details as this develops.	POEPL welcomes this offer of assistance and looks forward to engaging with JNCC on this when developing the EMMP further.	
JNCC52	Page 654, Section 10.2.1; The potential for aircraft noise to impact seabird species is not limited to colonies of penguins (see previous comments on the potential impacts to giant petrels).	EIS Section 10.2.4.2.3 does highlight that giant petrels are susceptible to disturbance from helicopter noise. However, POEPL considered that the potential for impacts on penguins were more likely due to the location of colonies and the likely flight-path. Therefore the section focusses on penguins.	
JNCC53	Page 661, Section 10.2.4.2.3; This section focuses on the distribution of helicopter sensitive receptors and details king penguin colonies at Volunteer Point (National Nature Reserve (NNR), IBA) and various species of penguins at Seal Bay (IBA). Meanwhile, Figure 10.7 shows flights to the Sea Lion Field as passing directly over Seal Bay (when departing from Stanley) as well as bordering the 'Very Sensitive Area' at Volunteer Point. It is indicated that for both of these areas, no flights would occur below 3,000 feet as per the Falkland Islands Low Flying Handbook (FILFH) avoidance maps. However, evidence is not detailed demonstrating why this is an acceptable flight height from the point of view of disturbance and given the mass king penguin mortality event reported from South Georgia (Rounsevell and Binns, 1991; Cooper *et al.,* 1994), there is demonstrable cause for concern. Evidence should be included illustrating why this is an acceptable flight height above colonies.	Small aircraft are frequently used to transport people around the Falkland Islands. FIG and MoD have identified sensitive sites and issued guidelines regarding minimum flight heights to avoid disturbing sensitive wildlife. The EIS indicates that these guidelines will be adhered to. The incident concerning king penguin mortality occurred on Macquarie Island, not South Georgia, and was related to the topography of the land surrounding the colony. The flight path shown in EIS Figure 10.7 is 5.5 km from the colony of king penguins at Volunteer Point and there is no reason to believe there will be any impact on this colony. Ideally, helicopters should avoid overflying seabird and seal colonies where practical. There is potential to pass closer to colonies in the Seal Bay area, however aircraft will be above the minimum height stated in the regulations. Studies of king penguins on a	

Consultee	Representation	POEPL response	Details in
		number of sub-Antarctic islands recommend a minimum height that is far lower than the 3,000 ft recommended here (500 ft in many cases).	
JNCC54	In addition, consideration should be given as to whether flight paths above NNRs/IBAs (such as that at Seal Bay and Volunteer Point) can be completely avoided. This is the case primarily for flights from Stanley Airport to the Sea Lion Field. If such flights are unavoidable then monitoring may be required at key onshore seabird sites which are subject to regular over-flights, to demonstrate no significant impacts are occurring.	The flight path shown in EIS Figure 10.7 shows the straight-line route between the heliport and the Sea lion field. As such it represents the most likely (and worst-case) flight path. Therefore, it is anticipated that even the worst-case flight path does not pass over Volunteer Point. As stated in EIS Section 10.2.5, a project-specific flight plan will be developed and approved by FIG.	-
JNCC55	Page 661, Figure 10.7; This figure would benefit from marking Mount Pleasant, Stanley and key sensitive areas by name on the map.	The map has been annotated to provide the place names mentioned in the text in the EIS.	Figure 10.7 amended.
JNCC56	Page 662, Section 10.2.5; The source data for the 'avoid areas' is unknown. Therefore, it is possible that the 'Very Sensitive Area' boundaries may not be sufficiently precautionary. We recommend that the 'full review' mentioned of possible sources is undertaken as soon as possible to ensure that the potential for errors in the assessment of onshore disturbance to wildlife from helicopter use is minimised.	The note beneath EIS Figure 10.7 references the source of the areas marked on the map. This information has been used to manage aircraft movements around the Falklands for many years. The assessment presented is considered to be very precautionary.	-
JNCC57	Page 664, Section 10.2.6.1; This section mentions that traffic will pass *c.* 5.5 km away from the Volunteer Point IBA, but the distance to penguin breeding sites appears much closer than this according to Figure 10.7. This should be clarified.	The stated distance from the king penguin colony is correct (c. 5.5 km).	-
JNCC58	Page 664, Section 10.2.6.1; The text concludes that 'Nonetheless, as the FILFH compliant flight plan will prevent such chronic exposure, the severity of effect of helicopter over-flights is considered to be 'Minor'.' However, we would refer to our previous comments on overlap of flight paths with a number of NNR and IBAs (albeit at considerable height). We recommend inclusion of further evidence demonstrating	The assessment concludes that the severity of effect is 'Minor' which is not the same as negligible. Studies elsewhere on king penguins support the recommendations in the Falkland Islands Low Flying Handbook (FILFH); in fact the minimum flight height is greater than that recommended on many sub-Antarctic islands.	-

Consultee	Representation	POEPL response	Details in
	flight heights at this altitude have negligible effects on seabird colonies before concluding that the severity of effect is 'Minor'.		
JNCC59	Page 666, Section 10.2.12; With respect to Table 10.11, we would query the ranking of 'Low' sensitivity for 'disturbance to wildlife', given the proximity of helicopter use to the main breeding colony of the Falkland Island's king penguin population (at Volunteer Point).	As response to JNCC53, the helicopters will not pass within 5 km of the king penguin colony at Volunteer Point.	
JNCC60	Page 1220, Section 12.1.4.2.5.3; In relation to comments regarding vessel association and albatrosses and petrels, we feel it is unlikely that these species will be as attracted to vessels associated with the Sea Lion development compared with fishing vessels (as they are not discarding fish waste). While they may be attracted to vessel presence initially, they are unlikely to land on the surface of the water (behaviour which is associated with feeding) near these vessels and so may be less likely to suffer from chronic oil pollution associated with vessel traffic. Penguins, however, are a risk from such pollution due to their behaviour and occurrence in the Sea Lion development area, particularly at critical times of year (January and February). As noted, species that spend a large portion of their time on the sea surface or under it (e.g., penguins and shags) are highly vulnerable to oil pollution, both chronic and accidental. Moreover, given the remote location of the Falkland Islands and the difficulty of obtaining manpower and equipment in the short time frame necessary to affect a rapid response to a large-scale seabird oiling event, extreme care must be taken to prevent oiling of birds.	The EIS draws on first-hand observations of seabird association with vessels in the North Falkland Basin, including albatrosses and petrels. These observations come from many years of experience working at-sea around the Falklands, and observations from supply vessels alongside drilling rigs. This section provides an overview of the species that are likely to occur in the NFB and their vulnerability to oil spill and it states that penguins are vulnerable to contamination by oil.	
JNCC61	Page 1224, Section 12.1.4.4.4; Figure 12.13 clearly demonstrates the worst-case scenario for a subsea well blow-out, and potential impact to important bird breeding sites on the north-east coast of East Falkland (e.g., Seal Bay and Volunteer Point). These colonies have the potential to be significantly affected if such an event were to occur during the breeding period. We recognise the unlikely nature of such an event occurring. However, it is worth noting that risky activities should be avoided during critical periods of seabird species annual cycles. Austral summer and winter can be vulnerable times for birds at	Any oil reaching the shore will have been at-sea for several weeks (minimum of 56 days). It is predicted that the oil will be highly dispersed in small masses (waxy particles) and that it will not form a slick. However, uncertainty concerning the long-term impact of these waxy particles has been incorporated into the risk assessment and is reflected in the confidence rating.	

Consultee	Representation	POEPL response	Details in
	sea in the region around the Sea Lion development area (due to their relatively high/very high occurrence in the region).		
JNCC62	Page 1245, Section 12.1.4.4.5; We note the following text: "In the case of a blow-out, it is assumed that any vessels present would support rescue or source control activities for the first 24 hours, and there would be no recovery." And that: "the assumed response has a very modest effect and recovers 9% (2,419 tonnes) of the oil on average". The recovery rate predicted, as a result of a significant accidental oil spill, is extremely low. Hence, the potential for long-term and significant impacts on local seabird populations is high. We also note the limited capacity of the Falkland Islands to undertake a large-scale de-oiling programme for injured/affected birds.	POEPL agrees that the sea states and periods of darkness significantly limit recovery operations, as is experienced in many parts of the world. The assessment takes this into account. In an incident, it will be possible to direct spill response more accurately than the model assumptions, and to areas that pose more risk to seabirds in light of surveillance.	
JNCC63	Dedicated Oil Spill Response Vessels It is still not clear why in-situ burning was not considered as a viable option (i.e., the document mentions the need for FIG consent (Page 133), but this isn't explained in any further detail and seems to have been scoped out of response planning without any explanation). We advise that POEPL provide clarification in Table 4.5 on the scoping out of in-situ burning.	Burning of the Sea Lion crude has not been recommended due to a combination of the difficulty of booming oil for long enough offshore in the expected sea states and, more importantly, due to its low content of volatile (flammable) components making it very unlikely to burn. The possibility of in-situ burning was discounted at an early stage by POEPL's oil specialists due to the very high flash point (> 70 Celsius), low environmental temperatures and non-flowing nature of the oil after release.	
JNCC64	Environmental Monitoring & Management Plan Page 1461, Section 15.5; We welcome POEPL's intention to develop a number of key surveys and data collection programmes related to the key phases of the project to address uncertainties in the EIS that have arisen from lack of baseline data, and which relate to seabirds, including: Seabird monitoring - species distribution prior to operations and throughout field life; offshore and coastal birds around Berkeley Sound, although further work is required to specify more clearly the extent and detail such monitoring will take. Seabirds will benefit from some of the other surveys proposed, including: baseline	POEPL acknowledges the points made on proposed EMMP scope.	

Consultee	Representation	POEPL response	Details in
	measurements of underwater noise in Berkeley Sound, measurements of underwater noise during construction operations at Sea Lion; underwater noise monitoring during LTV and OCV operations in Berkeley Sound.		
JNCC65	Page 1462, Section 15.6; A diagram/framework depicting the governance structure would be useful.	POEPL agrees that governance is very important and expect to define this in more detail with the development of the EMMP document.	
JNCC66	Page 1464, Section 15.6.1.1; Proposed actions for monitoring/managing potential impacts on seabirds resulting from artificial light appear satisfactory. We would be interested in seeing further details as they develop and would be willing to assist where we can. Some questions do remain, however. It would be beneficial to clarify what the response to a large multi-bird strike would be, with many individuals killed in one day or short period. Is there a critical threshold number of birds where operations that may be attracting birds, such as flaring or adverse conditions, would be halted?	The asset will be managed by an experienced Offshore Installation Manager supported by technical expertise including an Environmental Advisor within an HSE team. The issue of potential bird strike is mandated in the operational plans for the FPSO *via* the EMMP and contract documents. In the event of even a single bird strike, the matter will be reported to the HSE team immediately and management steps will be initiated. Many factors will have to be taken into account, but it is highly likely, for example, that if a high flaring rate is associated with bird strikes then, as quickly as safe operations allow, the activities will be suspended pending further information.	
JNCC67	For all bird strikes, will individual birds be identified to species level (i.e., will crew have training in this, or will there be a process for e.g., taking detailed photographs which can be used to identify to species level, if no SMMO on-board at the time of strike)?	The Bird Strike Management Plan will include basic training for key offshore personnel but will rely on photograhic identification and plumage sent to shore for confirmation.	
JNCC68	Sufficiency of survey evidence JNCC acknowledges the existence of several environmental surveys in the vicinity of the Sea Lion field. Given their relevance to the Phase 1 drill centre, it is suggested that more of the results from this survey should be included. As a minimum: • the locations of the 2013 environmental survey stations should be reproduced in greater detail that that shown in Figures 7.4 and 7.5. It	POEPL has amended the figures in the EIS to provide greater clarity. Section 7.2.2. (containing Figures 7.4 and 7.5) introduces the reader to the data sources available. The results of the surveys are cited and discussed in subsequent sections. The EIS summarises the available data throughout and directs the reader to the original	

Consultee	Representation	POEPL response	Details in
	is good practice to include a diagram indicating the surveyed area in the context of the proposed activity and to identify any sample points or the location of photographic evidence. Data provided should also include high resolution acoustic data, video and /or still images • Survey data should provide adequate evidence that habitats and species of nature conservation concern are or are not present.	source should further detail or clarification be required, in line with FIG guidelines. The volume of information available means that it is not possible to reproduce everything in this document and efforts have been made at all opportunities to ensure that the data presented are those which remain key to the actual impact and risk assessments. POEPL has cooperated with the 'South Atlantic Metadata Catalogue' project adminstered by SAERI that publicises available survey data and provides a straightforward means of requesting access.	
JNCC69	JNCC commend POEPL's commitment to carrying out further seabed habitat surveys pre and post drilling as part of their Sealion field development EMMP. JNCC are available to offer further advice on such a plan.	POEPL welcomes this offer of assistance and looks forward to engaging JNCC on this.	
JNCC70	Page 685, Section 10.3.9.1, Paragraph 1; Fisheries within the Sealion field have not been considered as a factor that could influence cumulative impacts on seabed disturbance of the project. It is noted that impacts to fisheries from these activities is included in the disturbance to other users of the sea offshore in Section 11.1. This should be highlighted in Section 10.3.9.1 that impacts to fisheries is considered in Section 11.1.4.2.	Fisheries are very limited in the licence area, however POEPL has made reference to this in the EIS. Specifically it is noted that that fisheries within the Sealion field have not been considered as a factor that could influence cumulative impacts on seabed disturbance of the project. The impacts to fisheries are considered in 11.1.4.2.	
JNCC71	JNCC request that POEPL provide any environmental survey reports relating to the Sealion field development to us when available.	POEPL is happy to share any and all survey data with JNCC, as it has done with FIG, and the majority of the data is also available on the South Atlantic Metadata Catalogue hosted by SAERI and available online. POEPL would be happy to discuss further with JNCC the specific reports that can be supplied.	

Consultee	Representation	POEPL response	Details in
JNCC72	Page 261, Figure 7.5; The scale description is misleading: 1nm equals 1.85km, not 111.12km (which does equate to 60nm). Page 366, Section 7.4.5.2.1.2; In line 2 of this Section, the licence block number referred to in this sentence is missing. Page 372, Table 7.15; Footnote 'c' is missing from the table Page 373, Figure 7.47; The end of the first sentence in the caption is missing (i.e., it just ends with 'tracking data presented in…' and should be included. Page 373, Figure 7.47; This map should include in the legend the time period the tracking represents (i.e., months and breeding periods). Page 374, Figures 7.48 - 7.50; It would be useful to include in the captions that the telemetry data is the blue line, and that the black line is the 200m bathymetric contour that marks the edge of the Patagonian Shelf, as well as the Burdwood Bank. Page 683, Section 10.3.6; The sensitivity, severity and significance are not included for any of the receptors of seabed disturbance in this Section, each paragraph ends with 'is estimated/considered to be.' This is missing from the end of eleven sentence. POEPL should update this Section to include what the sensitivity, severity and significance to each receptor is, as currently this cannot be determined. Page 686, Section 10.3.10; The overall confidence in the seabed disturbance and marine growth assessments is missing from the text. This should be updated to include the confidence level.	POEPL has amended the text and figures in the EIS. Specifically: - The scale in Figure 7.5 has been rectified. - Figure 7.1 has been amended to show the licence block names - A footnote has been added to Table 7.15 - The title in Figure 7.47 has been corrected. - Sections 10.3.6 and 10.3.10 appear to be complete.	Figure 7.1, Figure 7.5, Figure 7.47 and Table 7.15 amended.
Falkland Islands Government Fisheries Department (FIFD)			
FIFD1	It is clear that POEPL took under consideration comments made by the Fisheries Dept during the public consultation when the last EIS was submitted. Generally, we are pleased with the progress made on these points since the last submission and have no further comments to make at this time.	POEPL welcomes this comment and thanks the Fisheries Department for its cooperation.	
Royal Society for the Protection of Birds (RSPB)			
RSPB1	The incorporation of new pinniped and avian data is welcome. This helps narrow risk and current uncertainty on impacts upon vulnerable seabird and marine mammal populations. Nevertheless, we remain	POEPL and partners have made significant investments in the collection of baseline data, offshore, inshore and onshore, in support of the	

Consultee	Representation	POEPL response	Details in
	disappointed that inadequate effort has been made between the exploration and extraction licence applications to gather more offshore baseline ecological data on birds and cetaceans. It remains hard to understand why these gaps could not have been filled by the proponent in the time available.	EIS. For example, the Sea Lion benthic survey covering 92 stations, and the 12-month long PAM surveys conducted prior to the last exploration round were conducted purposefully at a scale that would support a development EIS, and were considerably in excess of what would be expected for exploration drilling. Given the precautionary approach adopted in the EIS, POEPL believes there is ample baseline data on which to draw robust conclusions. The EMMP takes forward further data gathering and monitoring. The EIS does acknowledge data gaps and deficiencies where applicable and the methodology explicitly incorporates uncertainty. The Sea Lion Development EIA process has been guided by local experts *via* the Hydrocarbons Forum and Gap Analysis Projects. POEPL and partners have funded the Gap Analysis Project to identify and help complement project-based knowledge and reduce uncertainty, and available results have been included in the EIS, including using seabird tracking data to complement the 3-year regional seabird programme published in 2002. Satellite tracking of higher predators has been ongoing and the results have recently been amalgamated with data collected throughout the Falkland Islands. The findings of this work have been applied to further colonies in a predictive form to better determine the distribution patterns of seabirds and seals. The initial results of the EU Best sei whale project are included in the ES. Conclusions from a number of recent	

Consultee	Representation	POEPL response	Details in
		projects have been added to the EIS such as Falklands Conservation's sei whale project, and POEPL has striven to include such data up to the last drafting deadlines. POEPL notes the FIG EIS Guidance 3.13: "the applicant should not be accountable for data gaps that could not reasonably have been filled, but more for the way in which they address the gaps in the RA. Therefore the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained. When carrying out the risk assessment data gaps can be taken into account." And 3.18 "where there are data gaps a risk may be increased to reflect the higher degree of uncertainty (and work on a worst-case scenario/precautionary approach)."	
RSPB2	The RSPB considers much of the utilised data too old given the importance of this development and given possible changes in the ecology of the EEZ; for example mooted variation in distribution of keystone species such as Rock Cod and other prey species. Distribution modelling can be useful, but if based on inadequate data, risks giving false impressions upon which decisions are then made. In addition the fact that much of the NFB east of the drill site has no SAST data in sensitive months clearly indicates a significant data gap, particularly when considering impacts from spill events.	Response as above response to comment RSPB 1. Additionally, POEPL would note that Rock Cod is not actually available to seabirds naturally, only when it is exposed as bycatch, and does not qualify as a keystone species. POEPL believes the relevant data is included in the EIS. Seabird data comes from SAST sources, from seismic survey observations and from tracking studies amongst other sources. POEPL acknowledges deficiencies in each dataset and take account of these in the assessment and uncertainties. POEPL believes that the level of data is sufficient for the purposes of the EIS.	

Consultee	Representation	POEPL response	Details in
RSPB3	We agree that the proponent has taken a suitably precautionary approach in their risk assessments. However, these data gaps mean that there is unnecessary uncertainty regarding both the significance of impact on receptors, but also regarding the efficacy of any mitigation measures that are proposed. We believe that FIG needs to ensure these baseline gaps are filled through appropriate consent conditions prior to any operations commencing. These will need to be kept separate from the EMMP. Nevertheless, we believe that it is poor practice that this information is not available to decision makers when taking a consent decision on a major infrastructure project.	POEPL welcomes the acknowledgement that the assessment is precautionary. Our forward programme of work includes seabird and marine mammal observations from vessels, beginning well before First-Oil and during the drilling and subsea installation phases. POEPL expects the EMMP, which includes these commitments, to form part of the overall project approval and would suggest it would be unusual and unnecessary to add specific conditions such as this.	
RSPB4	We welcome the withdrawal of the proposed transfer of crude oil in Berkeley Sound. We view this as a significant de-risking of the proposed inshore operational logistics for the Kidney Island Group Important Bird Area, candidate Key Biodiversity Area for Sei Whales and other sensitive coastal environments. Such internationally designated sites are at the heart of FIG's planning guidance policy for biodiversity.	POEPL acknowledges the comment.	
RSPB5	Bird Strike The RSPB continues to be concerned that there is little detail presented to identify mitigation measures to reduce this potential, which are not dependent on a reaction to in-situ monitoring once vessels are in place and impacts already occurring. We welcome personal presentation from the proponent of a Lighting Design Environmental Impact Study for the FPSO. However, it is not currently clear to us if it forms part of the EIS. While we welcome the study, it remains a preliminary assessment, proposing further study to identify impacts and how to design the FPSO to minimise bird-strike. We look forward to seeing rapid presentation of greater detail, particularly the quantification of impacts and consequent response, in order to offer confidence in a state-of-the-art plan that does not simply use the unambitious and unreliable 'concept of reasonableness' built in to ALARP.	The Lighting Design study is a result of the commitment in the EIS to employ good practice in the lighting design for the FPSO. This is an outcome of the EIS which POEPL has pursued before project Sanction. POEPL is working to build the recommendations into the lighting 'functional design specification' with the FPSO owner and working with our drilling rig and vessel contractors to understand how they can also implement good practices, bearing in mind they are smaller and are present for less time than the FPSO. Another outcome of the previous revision of the EIS was to investigate the feasibility of zero pilot flare, which POEPL has now done in some detail and are close to concluding with the FPSO	

Consultee	Representation	POEPL response	Details in
	As a condition of consent the Proponent should be required to outline in detail measures they will take to reduce artificial light pollution on its operating vessels, platform and FPSO up to state-of-the-art standards. This should include a requirement to investigate and report in a timely way (before production) on the potential for use of non-pilot flares and measures sketched out in the above-mentioned report such as appropriate spectrum lighting, agreed before project implementation.	operator. POEPL believes that the conclusions of the EIS are sound and POEPL has already begun implementing the recommendations. This work will continue after Sanction. This matter is referenced in ExCo Paper 180-18, Appendix A, Section 4.5.3.	
RSPB6	Oil spill response The RSPB welcomes the increase in detail being presented for response to oil spill scenarios and the precautionary nature of the oil spill assessments made in the EIS. The use of Aiuka as a chosen partner is positive. However, we retain some concern that the level of detail for wildlife response does not offer sufficient assurance that response will fulfil the needs of a potentially serious situation with state-of-the-art standards. We are concerned that some proposed aspects risk being seen as 'make-do'. We believe that a condition of consent should be that greater clarity be given regarding the interaction between the proponent's Oil Spill Response Plan and the National Oil Spill Contingency Plan including financing mechanisms and amounts.	POEPL believes the oil spill strategies adequately detail the wildlife response for this stage of the project. Further detail on wildlife response will be developed in the operational OPEPs. POEPL is conscious that RSPB may not be aware of work done on financial liability assessment, and such work contains commercially sensitive information. A Financial Liability Assessment Report has been prepared that is in line with the accepted UK approach to calculating liabilities *via* guidance issued by Oil and Gas UK (OGUK) pursuant to guidance from the Department of Business, Energy and Industrial Strategy (BEIS), which includes the costs of source control, spill response, cleanup and pollution-related damages. This assessment has been submitted to the Department of Mineral Resources (DMR) for consideration. On financial liability, POEPL submits that FIG will decide if adequate provision has been demonstrated at this stage, and FIG will decide what information, if any, to communicate to stakeholders on this topic, such as *via* published	

Consultee	Representation	POEPL response	Details in
		reports to ExCo. This matter is referenced in ExCo Paper 180-18, Appendix A, Section 4.3.14. Detailed work has been done pre-Sanction to make sure POEPL's spill response plans dovetail with the NOSCP including discussions and workshops with the relevant FIG departments.	
RSPB7	As in our previous EIS consultation response, we note that the offshore oil spill scenarios in the EIS factor in oil spill response into their final risk significance values, but that the document then states that due to the weather conditions in the North Falklands Basin, oil spill response is unlikely to be a feasible mitigation option. FIG decision makers need to be cognisant that, although unlikely, should a major spill event occur offshore, there will be very little that can be done whilst impacts occur to globally important seabird populations for which they are responsible.	A major oil spill is an extremely unlikely event and there are many layers of protection built into the design and operations of both the drilling rig and FPSO that control such risks to an extremely low level. As stated in the EIS and Oil Spill Strategies, a major incident will trigger a substantial response that includes many different resources of source control, surveillance, sampling, containment, recovery, wildlife response and organisation. Oil containment and recovery will be engaged and the effectiveness has been predicted in the EIS taking into account real weather conditions. This will mitigate the impact, but a major incident will inevitably have a significant environmental impact, and prevention is key. POEPL believes the risks are clearly stated and assessed, and prevention and mitigation measures are world class. These include Safety Case requirements for the drilling rig and FPSO, Blowout Preventors, independently examined well designs, support vessels equipped with containment and response equipment and an array of onshore equipment for surveillance and wildlife response. In addition, POEPL has access to multiple well capping devices and international oil spill response providers.	

Consultee	Representation	POEPL response	Details in
RSPB8	The RSPB welcomes the presentation of ambition to create a mechanism to offset biodiversity impacts, as required under the Offshore Minerals Ordinance. Furthermore, we understand that it is difficult for the proponent to undertake direct or indirect offsetting themselves. It is very important that these contributions are ring-fenced for conservation projects that benefit the conservation status of species and habitats that are impacted by the project, rather than being part of any wider pot of money.	POEPL agrees with the points raised and the need to link any Environmental Fund contribution to project-related impacts or risks.	
RSPB9	However, it is disappointing that a clear statement is not given to demonstrate either a 'no net loss' or 'net gain' target for biodiversity. This would be in accordance with guidance under the International Financing Corporation Performance Standard number 6. It would be appropriate to outline the scale of financing proposed in order to allow a judgement by decision makers of the potential scale of efficacy of the proponent's scheme.	POEPL would note that the purpose of the EIS is to comply with the Offshore Minerals Ordinance and guidance, which is based on the identification and mitigation of significant impacts. FIG ExCo paper 124-16 addresses developing a policy on further addressing significant impacts *via* offsetting, implying the process is ongoing and linked to reducing significant impacts, which is a different objective to 'net gain'. The paper discussed giving applicants a choice between managing their own projects that are considered offsetting or contributing to an Environment Fund managed by FIG. POEPL has chosen to adopt the Environment Fund approach and is reliant on FIG to deliver the offsetting. The application of this principle has involved considerable discussion. This approach is intended to deliver both offsetting and environmental legacy *via* the environment fund option, which was expressed as FIG's policy preference in the ExCo paper 124-16.	
RSPB10	Likewise it is disappointing that the proponent offers little ambition to deal with average emissions of 440,000 Tonnes/year CO2 equivalent in the Falkland Islands. Recent reports from the IPCC indicate a greater understanding of the two-way link between greenhouse gas emissions	POEPL is committed to protecting and enhancing the environment of the Falkland Islands. POEPL has put considerable effort into minimising greenhouse gas emissions and has prepared Best	

Consultee	Representation	POEPL response	Details in
	and the state of biodiversity. At least several receptors are suspected of being vulnerable to climate change impacts. Given this, there is an increasing recognition of 'nature based solutions' to greenhouse gas mitigation, for which the Falklands may be well suited. There is a possible strong link to species impacted and at risk from the proposed development. We believe a clear commitment to a 'net gain' biodiversity target should be a condition for consent alongside a mechanism for carbon emission mitigation either by the developer or by FIG, or jointly.	Available Technique assessments on its gas turbines, flare system and low pressure ('flash gas') gas compression systems to select low emissions solutions. To avoid flaring we have designed-in reinjection of excess gas, recovery of low pressure flare gas and recovery of tank vapours on the FPSO, and we are investigating the elimination of a pilot flame on the flare system. POEPL recently considered greenhouse gas emissions across the entire portfolio and confirmed in early March 2020 that the company will aim to achieve carbon neutrality in relation to Scope 1 and 2 emissions, per the GHG Protocol, on all new projects. A significant component of efforts to achieve carbon neutrality on Sea Lion will be secured through verifiable carbon offsetting. ExCo paper 124/16 Section 5.11 acknowledges that carbon offsetting is unlikely to be fully achieved within the Falkland Islands, and that supplementary international schemes are likely to be required. POEPL's research to date confirms that this is the case however, POEPL will prioritise locally based projects against international schemes where they are practicable and effective. POEPL acknowledges the reference in ExCo paper 124-16 to undertaking both biodiversity offsetting and carbon offsetting and will facilitate Falkland Island nature based biodiversity and carbon offsetting schemes through the	

Consultee	Representation	POEPL response	Details in
		environmental fund. It is intended that in pursuit of carbon neutrality offsetting of residual volumes of carbon will be administered internationally by POEPL using verifiable, where possible, Gold Standard schemes from a central, POEPL group wide, 'net zero' fund. POEPL will encourage applications to the group net zero fund for additional Falkland Islands nature and infrastructure based offsetting projects, and will work with proposers to achieve the required levels of assurance and certification for such schemes. This approach is consistent with ExCo paper 124/16 which confirms that adopting the environment fund approach does not prevent an operator from seeking alternative 'more hands on' offsetting.	
RSPB11	As outlined in our previous consultation response, for the reasons set out above, the RSPB does not believe that the EIS as it currently stands allows FIG decision makers to make a fully informed decision on a licence application. However, if a decision is taken to consent the project we strongly recommend that robust conditions address these issues prior to operations commencing.	POEPL would note that the EIS embeds a wide range of commitments into the project and submits that specific conditions should be kept to a minimum lest they imply that some commitments are are more important than others.	
Falklands Conservation (FC)			
FC1	Non-Technical Summary (NTS) as a decision making tool: The NTS needs to clearly include the pertinent points of the risk assessment, including the key components required relevant to legislation and policy, such as impacts on globally important sites, cumulative impacts, and satisfactory alternatives.	The NTS reproduces the risk assessment summary and references marine and terrestrial conservation sites. The contents of the NTS are specified in the Offshore Minerals Ordinance Schedule 4 Article 2, and POEPL believes that the Sea Lion NTS complies with that requirement.	
FC2	Legislation and policy: In order to present a good assessment in a way that decision-makers can assess compliance against FIG policy, the impacts need consideration in the context of relevant biodiversity legislation and wider policy.	The EIS lists applicable legislation in some detail in Section 3.1, including policy in Sections 3.1.5.1 and 3.1.5.2. POEPL would refer to the Legislative Compliance	

Consultee	Representation	POEPL response	Details in
		Review undertaken for DMR by SAMS as evidence that the EIS is compliant with the legal requirements.	
FC3	Data: Data presented needs to be made relevant, important data gaps need to be filled before sanction (seabirds and cetaceans) and existing relevant data needs to be included, such as Key Biodiversity Areas and other designations for biodiversity and nature conservation.	The EIS does acknowledge data gaps and deficiencies where applicable and the methodology explicitly incorporates uncertainty by taking a precautionary approach in each assessment, and by applying a confidence rating. The Sea Lion Development EIA process has been guided by local experts *via* the Hydrocarbons Forum and Gap Analysis Projects. POEPL and partners have funded the Gap Analysis Project to identify and help complement project-based knowledge and reduce uncertainty, and available results have been included in the EIS, including using seabird tracking data to complement the 3-year regional seabird programme published in 2002. Satellite tracking of higher predators has been ongoing and the results have recently been amalgamated with data collected throughout the Falkland Islands. The findings of this work have been applied to further colonies in a predictive form to better determine the distribution patterns of seabirds and seals. The initial results of the EU Best sei whale project have been included in the EIS. Conclusions from a number of recent projects have also been added to the EIS, such as Falklands Conservation's sei whale behavioural study. POEPL sought to include such data up to the last drafting deadlines. We note the FIG EIS Guidance 3.13: "the applicant should not be accountable for data gaps	

Consultee	Representation	POEPL response	Details in
		that could not reasonably have been filled, but more for the way in which they address the gaps in the RA. Therefore the presence of justifiable data gaps does not make an EIS unfit-for-purpose, as long as these are acknowledged and explained. When carrying out the risk assessment data gaps can be taken into account." And 3.18 "where there are data gaps a risk may be increased to reflect the higher degree of uncertainty (and work on a worst-case scenario/precautionary approach)."	
FC4	Oil Spill Response Planning (OSRP): The OSRP should be assured as deliverable prior to sanction and the interface between PMO's OSRP and the NOSCP, if there is one, should be clear. Provision of finer details could be conditioned at sanction though should not be part of an EMMP. PMO need to guarantee resource and funding for an appropriate response. This needs to include costs of remediation, and holding birds until remediation is sufficiently complete and retaining sufficient resource and equipment to initiate a response, not rely on volunteers.	Operational details and specific reporting structures will be included in the operational OPEPs in due course. POEPL is conscious that FC may not be aware of work done on financial liability assessment, and such work contains commercially sensitive information. A Financial Liability Assessment Report has been prepared that is in line with the accepted UK approach to calculating liabilities *via* guidance issued by Oil and Gas UK (OGUK) pursuant to guidance from the Department of Business, Energy and Industrial Strategy (BEIS), which includes the costs of source control, spill response, cleanup and pollution-related damages, has been submitted to DMR for consideration. POEPL submits that FIG will decide if adequate provision has been demonstrated on financial liability at this stage, and FIG will decide what information, if any, to communicate to	

Consultee	Representation	POEPL response	Details in
		stakeholders on this topic, such as *via* published reports to ExCo. This matter is referenced in ExCo Paper 180-18, Appendix A, Section 4.3.14.	
FC5	Environmental Monitoring and Management Plan (EMMP): Work that should have been done pre-sanction, should not be put into the EMMP document which will be live during the whole length of the campaign.	POEPL believes that sufficient information is included in the EIS for a competent decision to be made on approval of the project. Considerable amounts of baseline data have been added to pre-oil datasets and specific gaps have been identified, and priority gaps filled, *via* the 'Gap' Project and through surveys conducted specifically for the Sea Lion project. The EIS incorporates all this data and has been updated in respect of many recent studies that were not available to the previous revision. POEPL believes the scopes of work identified for the establishment and continuation of the EMMP are separate to this, and that a competent timetable has been put forward for them.	
FC6	Offsetting: The EIS needs to make a clear commitment to offsetting, which if delivered by payments, needs to be determined by biodiversity impacts, not other factors. The EIS needs to lay out how net gain for biodiversity will be achieved.	The EIS discusses offsetting clearly in Section 8.9. We believe the EIS is compliant with the Offshore Minerals Ordinance which is based on the identification and mitigation of significant adverse effects, and which requires offsetting for those significant adverse effects to be considered after applying other layers of reduction and mitigation. The Environment Fund contribution provides the means by which a biodiversity offset can be achieved *via* projects identified by FIG/the Environment Trust that are relevant to the Sea Lion project significant impacts and risks.	
FC7	Decommissioning: Remediation plans should be included within the EIS.	It was agreed with FIG that in this EIS POEPL would provide a high level description of measures taken in design to facilitate	

Consultee	Representation	POEPL response	Details in
		decommissioning, but that a full plan and assessment of the impact of decommissioning will be undertaken near the end of the field life. It is considered that this approach is consistent with Offshore Minerals Ordinance (Amendment) 2011 – Section 6. Remediation. This is also the current approach on the UKCS (BEIS EIA Guideline, Feb 2018), "There is no requirement to provide detailed information in relation to how removal will be achieved at the time of abandonment or decommissioning, or to provide a demonstration of the likely significant effects of the activities." At an early stage it was agreed with FIG Environmental Planning Department (EPD) and DMR that: • In summary, a high level description will be given with a base-case of complete removal of all structures. However, due to uncertainty as to how that will be achieved and potential for technological developments, it is not meaningful to assess the impact of the removal process at this time. A full plan and assessment of the impact of decommissioning will be undertaken near the end of the Field life. This is the approach taken in the UK. • It was agreed in principle by all that this was reasonable and would comply with the current ordinance. It is typically required that operators must have financial provision to cover decommissioning	

Consultee	Representation	POEPL response	Details in
		costs and it is normal for them to demonstrate this periodically to the regulator, and we expect this to be covered in the Field Development Plan. This obligation would transfer to any new owner along with the licence. This matter is referenced in ExCo Paper 180-18, Appendix A, Section 4.12.	
FC8	The document layout weakens the assessment quality by complicating the process and access to pertinent data. This would be aided by grouping relevant information within specific Sections, rather than striping through multiple Sections and appending supporting data rather than including in main body.	POEPL believes the EIS is clearly and consistently laid out and the NTS provides simpler summary information. The EIS is inevitably a large document covering many issues in detail. The document deliberately does not have any appended supporting data, as POEPL felt that this demotes important information and reduces transparency. By grouping the baseline data into a single chapter, readers can see a consistent account of the environment in one place, without duplication.	
FC9	NTS as a decision making tool: The NTS provides a summary of the key components/requirements of an EIS that is accessible to non-technical readers. By admission even key stakeholders do not have capacity to read beyond the NTS to make assessment of the current EIS – the EIS being too technical or too large. This is of significant concern. The NTS in itself highlights some of the issues with the EIS, and FC have concerns that due to capacity and/or the complexity of the main document, that this Section will be used in faith to make significant decisions. If that is the case, decisions based on the NTS should be looking to see whether it demonstrates a desire to achieve no net loss or net gain, or comply with good practice or broader policy. FC believe these elements are missing. For example: · The NTS does not include key elements of the EIA as laid out in the OMO and standard practice namely cumulative impacts, satisfactory	Inevitably for the First-Oil production in the region, the EIS is a large document describing much data and analysis. This befits the importance of the issues and the need to be transparent about the basis for the assessment. POEPL has made public presentations of the EIS and made itself available for discussion and questions voluntarily during the consultation period. When requested, POEPL provided FC with a list of significant changes between this version and the previous version of the EIS to assist their review. See FC1 for other comments.	

Consultee	Representation	POEPL response	Details in
	alternatives · The NTS states the EIS only aims to comply with EIS guidance and POEPL HSE policy. Why not other relevant policy? · Key risks are not identified. The NTS only partially identifies relevant globally important sites for biodiversity, missing candidate IBAs offshore and candidate KBAs inshore. It does not summarise an assessment of the specific risks to such sites. · NTS states the use of industry standard practice not leading practice. · NTS fails to commit to offsetting that will achieve 'net gain', or even 'no net loss' for biodiversity or carbon neutrality.		
FC10	A good EIS will consider its compliance with legislation and wider policy (there seems to be some confusion between regulation, legislation and wider policy within the document) and identify where its actions need to comply with, or can positively contribute to, policy objectives. There is some consideration, mostly for polluting legislation, but little for biodiversity. For example the development proposal may run contrary to FIG Development Plan Policy SP5 in having impacts on key species and sites. The EIS does not appear to address requirements under SP5 Sections D1 and D2, so at present it does not make a case for being compliant with FIG policy.	See response to comment FC2. The purpose of the EIS is to identify and address potential significant impacts and risks such that they are minimised. POEPL believes the EIS is compliant with the Offshore Minerals Ordinance and that there is no conflict between complying with the Offshore Minerals Ordinance and complying with Development Plan Policy SP5. In response to SP5, we believe the EIS demonstrates a minimisation of impacts on the environment (A), includes impacts on species and sites protected by law (D1), and demonstrates that alternatives have been considered (D2).	
FC11	Identification of key data requirements and collection of data has been poorly approached and/or prioritised. Key data (such as the seabird data) that are being used, are too old for the risk assessment to be considered in accordance with good practice. Some recent data are also not robust in terms of effort (coastal bird surveys). Key data that are available are not being used, such as for globally significant sites for biodiversity. Significant data gaps still exist.	See response to comment FC3.	
FC12	The data on seabirds is too old, it is difficult to see how models using near 20 year old data can be argued as up-to-date (a good practice requirement). It is the baseline data on which an assessment of the	See response to comment FC3. Seabird data is described in detail in Section 7.4.5 of the EIS. The main source of offshore seabird	

Consultee	Representation	POEPL response	Details in
	value/sensitivity of the bird assemblage that falls within any Zone-of-influence (ZoI) is based. It is critical to understand what birds are currently using the area, even if this only covered the core spill area initially, this should have been collected before sanction (to accord even with standard practice). Spill models for some impacts extend way beyond the Falklands EEZ, but no data for this part of the ZoI have been provided. Whilst penguins may be more readily exposed to oil, prevailing spill coverage will certainly cover areas used by species with higher threat categories (IUCN Red List) such as Atlantic petrel (Endangered), Tristan albatross (Critically Endangered), etc. and these species certainly influence the significance of impacts and the types of offsetting proposed.	data has been independently reviewed, described in EIS Section 7.4.5.2.1.1.	
FC13	Designated sites are one of, if not the most important, risk assessment tools and considerations. They are the most obvious representation of areas that are of international, national or local significance for biodiversity. They are widely identified in national legislation and policy as requiring special considerations of impacts, often avoidance, as any significant impacts are globally significant. The OMO schedule 5 states that 'sites or areas that have an international designation, need to be taken into account in deciding whether projects might have a significant effect on the environment' (sec 2 cl 8). Good practice (CIEEM guidance) is to consider candidate sites as fully designated sites – this is actually a legal requirement in UK and EU. The EIS still fails to properly account for such sites, nor does it acknowledge Key Biodiversity Areas (terrestrial or candidate marine) and candidate marine Important Bird Areas (IBAs). There is no specific risk assessment of such sites even where mentioned i.e., Kidney IBA. This is surprising given that, instead of subjective interpretation of heat maps of distribution data, the internationally accepted criteria mean that important areas are delineated based on key features making impacts easier to assess. Also, that specific mention of possible marine management areas is included, which is less progressed than designated or candidate globally important sites for biodiversity.	See response to comment FC3. These candidate marine protected areas have not yet achieved an official status. Nevertheless POEPL has recorded and taken account of the conservation status of relevant flora and fauna affected by the project e.g., EIS Section 7.4.5.5, and identified features that are merely of conservation interest e.g., Section 7.4.3.3.4. Impacts to the species involved have been predicted and included in the impact and risk assessments. POEPL will of course comply with any future requirements that may arise from the protected area designation process, but given that the EIS already considers the entire flora and fauna and the project's interaction with them, we do not envisage that this would significantly affect the EIS conclusions. POEPL is engaged in local fora such as the OHEF and Gap Project and participates in consultations on conservation issues and legal developments.	

Consultee	Representation	POEPL response	Details in
FC14	Data presentation – using an overall baseline Section is not helpful. Data presentation should be focussed by defined Zones-of-Influence for impacts (such as Oil Spill Modelling, or vessels operating areas), rather than geographical areas such as the North Falkland Basin, and therefore sensitivities of receptors are not always evaluated appropriately by the presented data i.e., a summary table across all areas and taxa for sensitivity.	See response to comment FC3. This is a logical and established structure which gives a complete picture of the environment.	
FC15	Data gaps have been long-evident in key areas, yet investment in information gathering that has taken place in this time has not achieved filling such key data gaps for an EIA, which could and should have been achieved prior to any sanction. Data gap priorities are not necessarily being driven by key receptors or indeed data collection by its suitability for EIA improvement, such as globally significant sites or threatened or vulnerable species or habitats. Baseline data, such as the presence or absence of key species within a ZoI, are a basic requirement to make any risk assessment, whereas risk refinement data (how much oil may adhere to fur for example) are significant principally to the developer in demonstrating a reduced risk.	See response to comment FC3. The EIS contains a great deal of data and the whole development process has included significant original data gathering on benthic populations, marine mammal presence and behaviours, underwater noise and mammal vocalisations, offshore seabirds, inshore bird distributions, inshore seabed surveys, non-native species monitoring, and onshore noise. POEPL acknowledges the viewpoint that the EIA could be structured or presented differently in terms of 'zones of influence'. However, we have chosen not to use this approach in efforts to prevent repetition and to contain all assessments of the sensitivity of receptors within the relevant zone of influence to the specific impact/risk assessment chapters. POEPL believes that the EIS presents a clear and coherent assessment of impacts and risks. For each impact or risk topic, the assessment Section discusses the relevant affected receptors with reference back to the baseline data Section. Testing the adherence of Sea Lion crude oil to fur remains a commitment of the EIS.	
FC16	Oil Spill Response Planning: It is welcome that the EIA still acknowledges that 'remoteness, poor transport and abundant wildlife	See response to comment FC4. A major oil spill is an extremely unlikely event and	

Consultee	Representation	POEPL response	Details in
	in the Falklands pose unique and significant challenges in responding to major oil pollution incident, and that in the worst-case scenario weather conditions will be such that effective recovery of oil spills would not be possible. Under this scenario, impacts would be significantly detrimental to the Falklands' environment and wildlife, as well as the economies driven by it (e.g., international wildlife tourism)'. It is important to recognise that whilst very unlikely, a major oil spill in the Islands may well represent a more damaging prospect than in other locations with regard to spill response.	there are many layers of protection built into the design and operations of both the drilling rig and FPSO that control such risks to an extremely low level. As stated in the EIS and Oil Spill Strategies, a major incident will trigger a substantial response that includes many different resources of source control, surveillance, sampling, containment, recovery, wildlife response and organisation. Oil containment and recovery will be engaged and the effectiveness has been predicted in the EIS, taking into account real weather conditions. This will mitigate the impact, but a major incident will inevitably have a significant environmental impact, and prevention is key. POEPL believes the risks are clearly stated and assessed, and prevention and mitigation measures are world class. These include Safety Case requirements for the drilling rig and FPSO, Blowout Preventers, independently examined well designs, support vessels equipped with containment and response equipment and an array of onshore equipment for surveillance and wildlife response. In addition, POEPL has access to multiple well capping devices and international oil spill response providers. Via a separate process, POEPL is required to demonstrate its ability to fund a spill response and compensate for damages for worst-case incidents.	
FC17	The announcement of Aiuká as PMO's wildlife responders is very welcome, providing many years of very relevant expertise in the field. It is also positive that spill plans follow IPIECA guidelines, though it	See response to comment FC4. The Stanley Harbour Oil Spill Strategy relates to marine diesel only, which is very difficult to	

Consultee	Representation	POEPL response	Details in
	would be improved if Stanley Harbour plan was approached in a consistent fashion with similar details to Offshore and Inshore ones.	contain or recover, versus larger scale risks in Berkeley Sound or offshore. The Stanley Harbour Strategy is therefore scaled to those activities.	
FC18	FC are concerned that elements of this work have been pushed back into the EMMP. Whilst further details of Oil Spill Response Planning could be conditioned to occur ahead of any oil, this should be separate from EMMP. For good practice it is still vital that plans contain sufficient real commitment to deliver a response prior to sanction; however, some non-critical detail could be conditioned. Recognition of the issues that can occur with lack of early detail on OSRP are borne out by FIG guidance in that the Hydrocarbons Environmental Impact Assessment Guidance Note states that 'A key risk is oil spill.', and that 'the approval of the EIS without understanding the broad approach to how a spill event would be responded to [] has previously led to considerable delays in the approval of EIS'.	See response to comment FC4. POEPL would note that the EIS embeds a wide range of commitments into the project and does not see the need for further specific conditions. POEPL believes the EIS does indeed give understanding of "the broad approach to how a spill event would be responded to".	
FC19	In the absence of information on adherence of oil on fur or likelihood of ingestion, response plans should assume and be resourced and ready to deal with worse-case oiling to wildlife	See response to comment FC4. Testing of the adherence of Sea lion crude oil to fur remains a commitment, which will remove a small uncertainty in terms of the potential impact and ability to respond; meanwhile a precautionary assessment has been made. Ingestion of oil is discussed several times e.g., Section 12.1.4.2.5.2 for seabirds. Laboratory testing of the oil has indicated generally low toxicity for the oil due to its low PAH content and low soluble oil content e.g., Table 12.1. Adherence to feathers has been tested and is relatively low.	
FC20	There needs to be guarantee that an oil spill response and remediation programme can be financed by the developer. This will need to provide details of specific cover – e.g., clean-up *vs.* remediation which is potentially more expensive– and financial details rather than a simple assurance. The length of any remediation	See response to comment FC4.	

Consultee	Representation	POEPL response	Details in
	programme will influence the ability to release cleaned birds from the rehabilitation facility and this potential for prolonged holding of birds needs to be able to be accommodated and financed.		
FC21	Successful delivery of the Plans will be very dependent upon the nature of any 'interface' with NOSCP. In this regard, the exact nature of delivery needs to be determined in terms of which resource will be drawn upon by who and when. The NOSCP may not in fact deliver a level of response suited to an industry spill of the potential scale possible. There is no question that any effective response would need a minimum of resource, facility and people, and that using volunteers who may or may not be available or committed at any time, is not a reliable approach. Whilst there are likely to be full-time paid first-aiders to deal with Health and Safety issues there appear to be no full-time paid responders. An oiled wildlife response workshop should have been held ahead of plan formulation, and should certainly not fall under EMMP.	See response to comment FC4. This is more an organisational matter rather than a matter for environmental impact assessment, nevertheless it is very important to ensure the mitigation of an oil spill, and POEPL has had ongoing discussions with the relevant authorities and a number of meetings and workshops to present and test its plans in open dialogue with FIG DMR. We have put forward relatively detailed Oil Spill Strategies that set out the relationship between the POEPL plans and the NOSCP and which describe the resourcing for wildlife response including maintaining a core competency on-island as well as access to emergency responders from Brazil (Aiuka) in addition to other international responders.	
FC22	EMMP: It is welcome that it is identified that many of the responsibilities likely required for the EMMP, such as observers, need to be independent. Unfortunately, the EMMP is being used as a vehicle to deliver work elements that should have been achieved pre-sanction or as separate conditions post-sanction. A number of work elements include 'baseline' – these should clearly have been done as part of the EIS if directly attributable impacts could occur through the proposed development.	See response to comment FC5. The establishment of a monitoring programme requires a slightly different dataset to the baseline required for an EIA. POEPL believes the EIS has competent baseline data that includes some extensive original data gathering and analysis, enabling the significance of impacts to be predicted and mitigation measures to be evaluated. Monitoring moves onto some very specific determinands and locations to identify potentially subtle changes in amongst potentially high natural variability. It is natural that some baselining for monitoring purposes is conducted,	

Consultee	Representation	POEPL response	Details in
		which is not necessary for the impact assessment.	
FC23	Decommissioning: It is understood that this would be dealt with by another EIA. However in the OMO, it states that the EIS must address remediation of the project.	See response to comment FC7.	
FC24	It is positive that a mechanism for offsetting exists in an Environment Fund. Unfortunately, as the principle document setting out the impacts of the proposed industry there is little consideration of offsetting in the EIS. It is understood that it is difficult for PMO to undertake offsetting themselves directly, however, the NTS summarises that POEPL do not have the inclination to do offsetting, despite this being the key mechanism by which to achieve 'no net loss' if residual impacts are predicted for either biodiversity or carbon emissions. For biodiversity impacts, offsetting by financial contribution without scheme proposals is not seen to be good practice. There is no guarantee within the EIS that offsetting will occur to achieve 'no net-loss'. Rather the EIS states that the level of financial contribution will be made in relation to a whole range of factors, not one of which is the impacts on biodiversity or the carbon produced, for which offsetting is required. At the moment the EIS does not set out a development proposal that does anything other than deliver environmental impacts and makes no commitment to 'no net loss' let alone net-gain (which is now increasingly as standard). Whilst this may not be the ultimate intention of PMO there is no evidence to ensure otherwise at this point.	See response to comment FC6. POEPL has chosen to fulfil its offsetting obligations using the Environment Fund option, which is one of the recommended means given in FIG ExCo paper 124-16, and which was expressed as FIG's policy preference. POEPL understands, and firmly expects, that this fund will deliver offsetting *via* projects that are clearly linked to significant impacts or risks of the Sea Lion project. The EIS process under the Offshore Minerals Ordinance is founded on the identification and mitigation of significant adverse effects, and it requires offsetting for those significant adverse effects to be considered after applying other layers of reduction and mitigation. The Environment Fund contribution provides the means by which a biodiversity offset can be achieved *via* projects identified by FIG/the Environment Trust that are relevant to the Sea Lion project significant impacts and risks.	
Peter Carey (PC)			
PC1	One of the worst-case scenarios considered is of a well blow-out lasting 29 days. A duration of only 29 days seems very short to qualify as a "worst-case scenario", given that there are examples of oil wells that have continued to spew oil into the marine environment for many months (e.g., Ixtoc 1, in 1979), and for many years (Taylor Well, 2004-present). It therefore seems the modelling presented for this kind of	The historic wells mentioned did not have the design prevention, operational controls or contingency planning that is present on this project. Since the Macondo incident in 2010, worldwide capability in major blowout prevention and response has increased very substantially. POEPL employs all North Sea	

Consultee	Representation	POEPL response	Details in
	environmental threat is a gross underestimate of the worst that could happen if there is a blow-out at a Sea Lion project well.	standard prevention approaches such as a blowout preventer and has access to multiple capping devices that can be flown into the basin and installed rapidly. More details on oil spill response planning for major incidents are given in the Offshore Oil Spill Strategy. POEPL has investigated the logistics necessary for mobilising and transporting this equipment to the Sea Lion field and estimates that a capping device could be installed in 14 days, with an upper estimate of 29 days, which has been used as a worst-case in the current revision of the EIS. This is in line with UK requirements for oil spill planning published by the Department of Business, Energy and Industrial Strategy (BEIS).	
PC2	In addition, has any consideration been given to how environmental damage could be minimised if the drilling platform and/or FPSO were attacked as a result of war or armed conflict?	The risks of environmental damage from drilling and FPSO operations are mitigated through a comprehensive programme of prevention and emergency response that meets good oil field practice and North Sea standards. The wells are protected by blowout preventers which are designed to prevent the release of hydrocarbons to the environment from the reservoir. The drilling rig and the FPSO are both floating facilities and can be removed from the field quickly if necessary. POEPL considers that the risk of armed conflict is very low and the facilities have no special features to address this eventuality. Nevertheless, standard oil field mitigations will be in place for Sea Lion, which provide many layers of control for acute events. POEPL will continue to engage with relevant authorities to ensure that security considerations	

Consultee	Representation	POEPL response	Details in
		in relation to Sea Lion operations are monitored, that appropriate mitigation and response plans are in place and regularly exercised.	
PC3	p. 119 – "Consideration of Alternatives" – Has there been consideration for the alternative of not extracting oil from this basin? I recognise that for an oil company like POEPL this is not attractive, but it is a real alternative. For FIG, the "no extraction" option should be one of the alternatives considered.	FIG Policy is to support hydrocarbons development, and POEPL responds to many different drivers in selecting prospects to explore, develop and invest in. This aspect of the 'consideration of alternatives' process is above the level of the EIA process, which is designed to examine specific project proposals.	

APPENDIX 4 INVENTORY OF BASELINE DATA COLLECTION

Baseline Data Collection				
Title	**Author**	**Year**	**Topic**	
Marine Mammal and Seabird Observations During 3d Seismic Survey in the North Falkland Basin. June 2011	Austral Biodiversity	2011	MMO	FK-SL-RKH-EV-REP-0001
Marine Mammal and Sea Birds Observation and Passive Acoustic Monitoring During The 3d Survey In The North Falkland Basin 11th Jan 2011 – 2nd May 2011	Polarcus/Argos	2011	MMO	FK-SL-RKH-EV-REP-0002
Survey Report Invasive Species March 2011	SMSG	2011	Marine fouling	FK-BU-FIG-EV-REP-0009
Benthic Environmental Baseline Survey of the Sediments Around the Exploration Well	Gardline	2012	Sediments Survey	FK-SL-GAR-NA-REP-0003 Rep B01
North Falkland Licence Areas PL032, PL033 and PL004 - March and April 2012 - Environmental Baseline Survey Report	Gardline	2012	Baseline Survey	FK-SL-GAR-EV-REP-0002 Rev B0
Sea Lion Post Drill Environmental Survey - North Falkland Licence Areas PL032, PL033 and PL004 March and April 2012	Gardline	2012	Environmental Report	FK-SL-GAR-EV-REP-0001 Rev B01
Acoustic Monitoring Programme for the Sea Lion Development Area 14/23-A February 1998	JASCO	2013	Acoustic Monitoring	FK-SL-JAS-EV-REP-0001 Rev B01Static
TDF Environmental Report. March 2013	Royal Haskoning DHV	2013	Environmental Report to support an outline planning application TDF	FK-BU-FIG-EV-REP-0012
Investigation of the Location, Frequency and Composition of Algal Blooms for the Sea Lion Field, South Atlantic. July 2014	British Antarctic Survey	2014	Algal Blooms	FK-SL-BAS-EV-STU-0002
Sea Lion Marine Growth Study Investigation of Probable Marine Growth Types, Thickness, Mass, Density, Roughness and Drag on The Sea Lion Field Development, South Atlantic	British Antarctic Survey	2014	Marine Growth	FK-SL-BAS-EV-STU-0001
Sea Lion Development Environmental and Geochemical Program April – May 2014 Isobel/Elaine Habitat Assessment Report	MG3 (Survey)	2014	EBS	FK-SL-MG3-SU-REP-0003
Sea Lion Development Environmental Program April – May 2014 Isobel/Elaine Environmental Baseline Survey Report. Nov 2014	MG3 (Survey)	2014	EBS	FK-SL-MG3-EV-REP-0001

Baseline Data Collection				
Title	**Author**	**Year**	**Topic**	
Seabed and Land cover maps to cover support comparative assessment of sites for inshore transfer of oil. October 2014	Environmental Systems	2014	Terrestrial Ecology	SAERI
Berkeley Sound, 1506 Volume 4 – Habitat Assessment Report	Benthic Solutions	2015	Geophysical and Environmental Programme	FK-SL-BSL-EV-REP-0003 Rev B01
Serpent Survey Exploration Programme - Isobel Deep ROV Survey. November 2015	Global Marine Research	2015	Benthic	FK-SL-GMR-EV-REP-0001
Sea Lion Nearshore Oil Spill Modelling	Genesis	2015	Oil Spill	J73700-A-Y-TN-24001
Sea Lion Drill Cuttings Modelling	Genesis	2015	Drill Cuttings	J73700-A-Y-TN-24001
Sea Lion Produced Water and Cooling Water Modelling Report	Genesis	2015	Produced Water and Cooling Water	J73700-A-Y-TN-24003
Sea Lion Offshore Oil Spill Modelling	Genesis	2015	Oil Spill	J73700-A-Y-TN-24004
Sea Lion Development - Underwater Noise Modelling	Genesis	2015	Underwater Noise	J73700-A-Y-TN-24005
Sea Lion Development - Atmospheric Emissions Modelling	Genesis	2015	Atmospheric Emissions	J73700-A-Y-TN-24006
Sea Lion Nearshore Oil Spill Modelling	Genesis	2015	Oil Spill	J73700-A-Y-TN-24001
Sea Lion Development - Underwater Noise Modelling. Nov 2015	Genesis	2015	Underwater Noise	J73700A-Y-TN-24005/B3
Eirik Raude Waste Management Plan	OCEAN RIG	2015	Waste Management	FK-BU-FIG-EV-PLN-0006
Environmental Assessment of Inshore Transfer Sites	PMO	2015	Environmental Assessment	FK-SL-PMO-EV-REP-0007
Terrestrial and marine habitat mapping from satellite imagery of Berkeley Sound, Falkland Islands. April 2016	Environmental Systems	2016	Terrestrial Ecology	FK-SL-FIG-EV-REP-0008
Stanley Harbour Environmental Baseline Survey (EBS), 2016	Benthic Solutions	2016	Qualitative Sub-tidal and Intertidal	FK-SL-EBS-EV-REP-0001 Rev B01

Baseline Data Collection				
Title	**Author**	**Year**	**Topic**	
			Habitat Assessment	
Geophysical and Environmental Programme Berkeley Sound 1506 Non-Technical Summary April 2016	Benthic Solutions	2016	Non-Technical Summary	FK-SL-BSL-EV-REP-0005 Rev B01
Sub-tidal habitat assessment report - Berkeley Sound Environmental Baseline Survey (EBS). July 2016	SAERI/SMSG	2016	Sub-tidal habitat	SAERI
Proposed Inshore Transfer Mooring Buoy, Berkeley Sound, Falkland Islands Landscape and Visual Impact Assessment. July 2016	Tyler Grange	2016	Landscape	FK-SL-TGR-EV-REP-0001
Long-term marine invasive species monitoring: Stanley Harbour and Pt William Progress Report 05 April, 2016	SMSG	2016	Marine fouling	FK-BU-FIG-EV-REP-0010
Berkeley Sound coastal bird survey report. May 2016	SAERI	2016	Coastal bird survey	FK-BU-FIG-EV-REP-0011
Cetacean Research study 2016/2017	SAERI, St. Andrews University, Oregon State University, Falklands Conservation, Shallow Marine Survey Group and Austral Biodiversity	2016	Marine mammals	SAERI
Sea Lion Development - Underwater Noise Modelling. Oct 2016	Genesis	2016	Underwater Noise	J73700A-Y-TN-24005/B4
Inshore Environmental Modelling Report. Aug 2016	PMO	2016	Environmental modelling	FK-SL-PMO-EV-REP-0010
Gap Project Phase I: Addressing priority gaps in understanding ecosystem functioning for the developing Falkland Islands offshore hydrocarbon industry – the 'Gap Project'. Phase I Final Report. September 2016.	Blockley, D. and Tierney, M. (2017).	2017	Seabirds, marine mammals, benthic habitats and fisheries	http://dataportal.saeri.org/dataset/gap-project-reports

Baseline Data Collection				
Title	**Author**	**Year**	**Topic**	
Gap Project Phase II: Addressing priority gaps in understanding ecosystem functioning for the developing Falkland Islands offshore hydrocarbon industry – the 'GAP Project'. Phase II Final Report, 2020	Blockley, D., Tierney, M. and Brickle, P. (2020).	2020	Seabirds, marine mammals, benthic habitats and fisheries	http://dataportal.saeri.org/dataset/gap-project-reports
Sea Lion Project-Underwater Noise-Offshore	Genesis	2024	Underwater Noise	J-UK-00200-218436-Y-TN001
Sea Lion Project-Underwater Noise-Offshore	Genesis	2024	Underwater Noise	J-UK-00200-218436-Y-TN002
Sea Lion Development Fishing and Trawling Risk Study. May 2013	JEE	2013	Fishing	FK-SL-PMO-SE-STU-0001
Sea Lion Field Environmental Baseline Description	SAERI	2014	Environmental baseline	FK-SL-PMO-EV-REP-0001 Rev B01
Premier Oil Sea Lion Algal Bloom Investigation Report	BAS	2014	Algal Bloom	FK-SL-BAS-EV-STU-0002 Rev B01
Premier Oil Sea Lion Report	BAS	2014	Marine Growth	FK-SL-BAS-EV-STU-0001 Rev B01
Iceberg Management Study. Aug 2015	PMO	2015	Icebergs	FK-SL-PMO-NA-STY-0001
FIBU Environmental Assessment of Potential Inshore Transfer Sites	PMO	2015	Environmental Assessment	FK-SL-PMO-EV-REP-0007 Rev B02
North Falklands Coastline Environmental Sensitivity for Oil Spill Response	SAERI	2016	Environmental Sensitivity	FK-BU-PMO-EV-REP-0002 Rev B01
2015 Falkland Islands Exploration Campaign Post-Consultation Environmental Impact Statement	PMO	2015	Environmental Impact Statement	FK-BU-PMO-EV-REP-0003 Rev B04
Sea Lion ESIA Scoping Report	PMO	2015	Scoping	FK-SL-GEN-EV-REP-0003 Rev B02
Exploration Drilling ESIA Scoping Report	PMO	2015	ESIA Scoping	FK-BU-PMO-EV-REP-0001 Rev A01
Sea Lion Offshore Development Phase 1a EIA Scoping Workshop Report Nov 2015	PMO	2015		

Baseline Data Collection				
Title	**Author**	**Year**	**Topic**	
Geotechnical Survey EIA	PMO	2015	EIA	FK-SL-PMO-EV-REP-0003 Rev B02
Wildlife Procedure for Premier Oil in case of an oil spill in the Falkland Islands. March 2015	PMO	2015		
CEDRE report: Study of the weathering, behaviour and potential impacts of the sea lion crude oil at the laboratory and pilot scale in simulated local weather conditions. 18th May 2017	CEDRE	2017	Behaviour and impacts of crude oil	R.17.50.C/5227
Socio-economic impact Study of The Sea Lion Oil Development Project (Falkland Islands). December 2012	Plexus Energy	2012	Socio-economic	FK-SL-RKH-PM-STU-0002
Socio-Economic Study of Oil and Gas Development in the Falklands May 2013	Regeneris Consulting	2013	Social Impact	FK-SL-RKH-PM-STU-0001
Social Effects Monitoring Programme for Oil and Gas Development in the Falklands. November 2015	Regeneris Consulting	2015	Social Impact	FI Exco Paper 212/15
Application for a Ship-to-Ship Oil Transfer Licence 10th December 2015	Cromarty Firth Port Authority	2015	STS Analogue	FK-BU-FIG-EV-REP-0007



Navitas Petroleum Development and Production Ltd.

www.navitaspet.com