Noble Energy Falklands Limited

# Environmental Impact Statement (EIS) for Exploration Drilling Offshore the Falkland Islands

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noble energy

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# Non-Technical Summary

## The Project

Noble Energy Falklands Limited, a subsidiary of Noble Energy, Inc. (hereafter referred to as 'Noble') is proposing to conduct exploration drilling activities offshore the Falkland Islands within its Production License (PL) areas. Currently, the planned drilling programme consists of two exploration wells and one optional exploration/appraisal well (a potential total of three wells). To date, four potential well locations have been identified. The exploration drilling activities are planned to commence early to mid-2015. It is currently estimated that it will take between 75 and 90 days to drill and construct each well.

The exploration drilling campaign will use the *Eirik Raude* drilling rig. The drilling rig will be supported by three Offshore Supply Vessels (OSVs). One of these OSVs will remain within the vicinity of the drilling unit at all times and assume the role of Safety Stand-by Vessel (SSV).

The onshore support location for the exploration drilling activities will be in Stanley. The OSVs will travel to/from the drilling rig from the planned Noble Temporary Dock Facility (TDF) under installation in Stanley Harbour (which is the subject of a former planning submission). The vessels will transport the materials and supplies needed for the drilling operations to/from the drilling unit on an ongoing basis. Noble will also have a shore base located on Boxer Bridge Road which will be used to store drilling equipment, associated tools and chemicals. These items will be transferred between the shore base and TDF by road.

## The Environment

The Noble License areas lie to the north-east, east and south-east of East Falkland Island. There are three areas of potential drilling interest to Noble.

The Falkland Islands Southern Phase A area (referred to as 'FISA12') is located approximately 100 kilometres from the nearest landfall at Cape Pembroke on the East Falkland mainland. FISA12 was subject to 3D seismic survey between December 2012 and May 2013.

The Falkland Islands Southern Tilted Fault Block area (referred to as 'FIST13') is located approximately 62 kilometres from the nearest landfall at Beauchêne Island and approximately 125 kilometres from the East Falkland mainland at Bull Point. FIST13 was subject to 3D seismic survey between May and June 2013.

The Falkland Islands Northern Area (referred to as 'FINA13') is located approximately 206 kilometres from the nearest landfall at Mengeary Point on the East Falkland mainland. FINA13 covers an area of 5,380km$^2$ and was subject to seismic survey between November 2013 and February 2014.

Currently, exploration drilling activities are proposed to occur in FISA12 and FIST13. Although less likely, drilling in FINA13 is also a possibility. For all confirmed well locations, EIS addenda will be prepared. The addenda will include all relevant well-specific details and will be submitted for approval (in agreement with Falkland Islands Government [FIG]) prior to drilling commencing.

### Bathymetry

In the southernmost of the Noble licenses, bathymetry ranges from approximately 700 metres in the far south near the Burdwood Bank, to approximately 1,900 metres further to the north near the Falklands Trough. Across the more central and northern license areas, bathymetry ranges from approximately 1,000 to 1,600 metres.

### Seabed Sediments

Towards the southernmost of the Noble licenses, sediments are expected to comprise sand and gravels of varying density, clay and silty gravelly sand. The dominant sediment type found across the FISA12 survey area was representative of slightly gravelly muddy sand. Stretching northwards, fine to coarse sand and gravels are expected to dominate.

### Plankton

Plankton numbers offshore rise sharply during austral spring and summer months, peaking in January and February.

### Benthos

Environmental surveys have taken place over the FISA12, FIST13 and FINA13 areas. The results of the FISA12 survey are available and have been presented within the EIS document; the results of the FIST13 and FINA13 surveys are not currently available and will be reported in EIS addenda prior to drilling operations commencing. References have been made to existing environmental surveys conducted by previous operators in the vicinity of the Noble licenses.

Across the FISA12 area (southern area licenses), infaunal communities were dominated by small polychaetes, closely followed by crustaceans which were also well represented; this finding is in line with other regional surveys. The survey found a rich epifaunal assemblage. Key faunal groups were the sponges, class Hexactinellida, Calcarea and Demospongia; many of the genera were typical for deeper water. The Cnidaria were represented by nine genera of thecate and athecate Hydrozoa and two genera of Stylasteridae. The live solitary coral belonging to the species *Flabellum curvatum* (a potential CITES Appendix II coral species) was also recorded. Several Octocorallia were found, including the sea pens Pennatulidae (generally too small to identify) and two species of Gorgonacea. Bryozoa were also a very common constituent on pebbles and stones, with many species endemic to the South Atlantic region. Echinoderms were represented, with ophiuroids, crinodea, asteroids and holothurians present. Where drop-stones were present, encrusting sponges were common along with anthozoans. Often rooted into soft sediments bryozoans and hydroids were observed as sparse tufts. There were also numerous burrows likely to be associated with crustacean and holothurian activity. Free-swimming megafauna included the demersal teleosts: moridae, grenadier, hake and batoids.

Across the FIST13 area (southernmost license area), evidence from previous site surveys has shown that polycheate species dominate the infaunal taxa. Epifauna observed previously has included Cnidaria and Crustacea. Evidence of bioturbation in the form of burrows has also been observed. Comparable benthic results are expected from the Noble environmental survey results in FIST13 at similar depths and with similar sediments. A degree of variation between sampling sites is expected due to the marked variety of depths and sediments across the area. Even in light of the variable depths and sediments, the macrofaunal analysis is expected to comprise mainly of polychaete species, as previous results have shown that the variation in sediments in this area had only a small effect on the apparent distribution and abundance of macrofaunal species.

Across the FINA13 area (northern license area), previous surveys have shown that the most abundant colonial epifauna encountered were Cnidaria, which included at least two species of gorgonian (soft corals) and at least one species of scleractinian (hard or stony coral). Given the similarity of results observed between the existing surveys in the FINA13 region so far, similar epifaunal and macrofaunal observations are expected at similar depths and sediments.

### Fish

Fish species known to spawn in the vicinity of the Noble license areas include Patagonian toothfish (*Dissostichus eleginoides*) (peaks in occurrence in May and July through to August), and grenadier (peaks in occurrence during March-April) in more northerly areas. Other species occurring regularly across the Noble license areas include skates and rays (*Rajidae*).

### Marine Mammals

The results of the marine mammal observations that occurred during the seismic surveys conducted in FISA12 and FIST13 (*RPS, 2013*) correlate well with the Joint Nature Conservation Committee (JNCC) survey results (*White et al., 2002*). Both data sets suggest that the species most frequently encountered across the Noble license areas include: sei whale (*Balaenoptera borealis*), fin whale (*Balaenoptera physalus*), Antarctic minke whale (*Balaenoptera bonaerensis*), sperm whale (*Physeter macrocephalus*), southern bottlenose whale (*Hyperoodon planifrons*), long finned pilot whale (*Globicephala melas*), southern right whale (*Eubalaena australis*), killer whale (*Orcinus orca*), Commerson's dolphin (*Cephalorhynchus* *commersonii*), Peale's dolphin (*Lagenorhynchus australis*) and hourglass dolphin (*Lagenorhynchus cruciger*).

### Pinnipeds

Pinnipeds of the wider Falkland Islands region include the South American sea lion (*Otaria flavescens*), southern elephant seal (*Mirounga leonina*), South American fur seal (*Arctocephalus australis*) and the leopard seal (*Hydrurga leptonyx*). With the exception of the leopard seal, which is an occasional visitor to the Falkland Islands, these species spend some time during the summer months ashore on the Falkland Islands to breed. Of these, the South American fur seal has been sighted within the vicinity of the Noble license areas. Sightings of other species are unlikely, but may be possible in the event of long foraging trips that the animals sometimes make.

### Sea Birds

Of the penguin species recorded offshore the Falkland Islands, king penguin (*Aptenodytes patagonicus*), rockhopper penguin (*Eudyptes chrysocome*), magellanic penguin (*Spheniscus magellanicus*), macaroni penguin (*Eudyptes chrysolophus*) and chinstrap penguin (*Pygoscelis antarctica*) may be present across the Noble license areas. Penguins can forage far offshore, but predominantly stay closer to the shore.

The following species of albatross are likely to be present in the vicinity of Noble licenses throughout the year: black-browed albatross (*Thalassarche melanophris*), grey-headed albatross (*Thalassarche chrysostoma*), northern and southern royal albatross (*Diomedea sanfordi* and *Diomedea epomophora*), yellow-nosed albatross *(Thalassarche chlororhynchos),* light -mantled sooty albatross (*Phoebetricia palpebrata*), wandering albatross (*Diomedea exulans*) and sooty albatross (*Phoebetria fusca*).

Petrels known to be present in the vicinity of the Noble license areas include: southern giant petrel (*Macronectes giganteus*), northern giant petrel (*Macronectes halli*), Antarctic petrel (*Thalassoica antarctica*), cape petrel (*Daption capense*), blue petrel (*Halobaena caerulea*), Kerguelen petrel (*Pterodroma brevirostris*), soft-plumaged petrel (*Pterodroma mollis*), Atlantic petrel (*Pterodroma incerta*), grey petrel (*Procellaria cinerea*), white-chinned petrel (*Procellaria aequinoctialis*), Wilson's storm petrel (*Oceanites oceanicus*), grey-backed storm petrel (*Garrodia nereis*), black and white bellied storm petrel (*Fregetta tropica* and *F. grallaria*) , magellanic diving petrel (*Pelecanoides magellani*), common diving petrel (*Pelecanoides urinatrix*), great shearwater (*Puffinus gravis*) and sooty shearwater (*Puffinus griseus*). The great shearwater and cape petrel were the most frequently observed species during recent Noble commissioned seismic surveys.

Other seabird species that may be present across the Noble license areas include: various prion species; skua species including *Catharacta* skuas, long-tailed skua (*Stercorarius longicaudus*); gull species including kelp gull (*Larus dominicanus*); and tern species including Arctic tern (*Sterna paradisea*).

### Protected Areas

Numerous sensitive areas exist on the Falkland Islands coastline related to seabirds and seal colonies. The closest of these to the Noble license areas are Beauchêne Island (approximately 62 kilometres from the FIST13 area), Cape Pembroke (approximately 100 kilometres from the FISA12 area), Sea Lion Islands group (approximately 110 kilometres from the FIST13 area) and Bull Point on the East Falkland mainland (approximately 125 kilometres from the FIST13 area).

To date, there are no offshore protected or designated marine areas in the Falkland Islands, although there are a number of draft Important Bird Areas (IBAs) in the water around the Falkland Islands, including two which cover the FIST13 and FINA13 licence blocks (Atlantic, Southwest 4 – Marine and Atlantic, Southwest 3 – marine, respectively). There are however several protected areas in shallow waters around the Falkland Islands coastline and a number of coastal IBAs.

## Human Environment

The Gross Domestic Product (GDP) of the Falkland Islands is approximately £100 million a year. The total population of the Falkland Islands was calculated to be 2,931, as recorded during the most recent 2012 Census (*FIG, 2013*). Stanley is the main town and capital in the Falkland Islands., with a population of 2,120 (*FIG, 2013*).

The economy of the Falkland Islands is limited by its small population and remote location. Since the conflict with Argentina ended in 1982 the economy has grown rapidly, initially as a result of UK aid but more recently from the development of the fishing industry.

A workforce of over 2,000 exists in the Falkland Islands, with FIG being the largest employer (employing around 600 people). The three largest industries are commercial fisheries, agriculture and tourism, while the construction and retail industry are currently experiencing periods of growth.

### Waste Management Facilities

Waste disposal options on the Falkland Islands are extremely limited. There is no capability for the disposal of hazardous waste.

### Commercial Fisheries

Commercial fisheries are currently the largest source of income for the Falkland Islands. All fishing within 200 nautical miles of the Falkland Islands is subject to licensing by FIG. Fisheries typically generate £15 to £20 million per annum in license fees, roughly half of the government annual revenue.

Commercial fisheries are active across all of the Noble license areas, with the key species being Patagonian toothfish. Catches of rock cod, grenadiers, skates, rays and other by-catch species are also made across the license areas.

### Commercial Shipping

The commercial shipping traffic within the Noble license areas is closely aligned with the commercial fishing activities. There are some commercial shipping routes that traverse the Noble license areas; however, shipping activity in general is very low.

### Cultural Heritage

The best known location of two shipwrecks, designated as ‘war graves’, are positioned within the FISA12 area; *SMS Scharnhorst* and *SMS Gneisenau*. These two wrecks are uncharted and there is a degree of uncertainty about their exact location on the seabed, due to the way in which the vessels sank. Attempts were made during the environmental baseline surveys to positively locate these wrecks; however, they were not identified with the survey equipment. It is thought that an anomaly seen during the bathymetry survey is highly likely to be the wreck of the *Atlantic Conveyor* in FINA13, but the survey was unable to obtain seabed photographs so a positive identification was not possible. An additional charted wreck, the wreck of the *RFA Sir Galahad*, is located within license PL011 approximately 12 kilometres from the FISA12 area.

### Tourism

Over the last 5 years, the tourism industry has grown rapidly, with large numbers of passengers arriving in Stanley each year from cruise ships during the main tourist season (from October to early April). The main attractions are the Falkland Islands’ unique environment and wildlife. Up to 2,500 passengers can arrive on a single cruise ship.

### Military

After the 1982 conflict in the Falkland Islands, the UK established a garrison consisting of naval, land and air elements. It is based at the Mount Pleasant Airport (MPA) Complex, which is based approximately 35 miles from Stanley. UK military assets are drawn from all three services and include infantry and specialist troops, air defence assets, a maritime patrol capability and RAF Typhoon aircraft. The British Forces South Atlantic Islands (BFSAI) is based at MPA; it consists of approximately 1,300 service personnel plus around 50 MOD civil servants.

## The Environmental Impact Statement

Noble has prepared an Environmental Impact Statement (EIS) meeting the requirements of the *Offshore Minerals Ordinance 1994 (as amended),* including the *Offshore Minerals (Amendment) Ordinance 2011.*

The EIS document will be submitted to the FIG Department of Mineral Resources (DMR) for review and approval.

The EIA process presented in this EIS document has systematically identified and assessed all potential environmental impacts associated with the project. The main aspects and their residual impacts, following the implementation of mitigation measures, are shown in Table A and Table B below. Table A presents a summary of the potential impacts for routine hazards and Table B presents a summary of the hazards, effects and mitigation measures for non-routine hazards.

*Table A: Summary of hazards, effects and mitigation measures for routine hazards (scores given represent the worst case for each impact)*

| POTENTIAL NEGATIVE ROUTINE IMPACT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| **Physical Presence** | **Removal of small area of seabed for well construction**<br>The impacts include the permanent removal of a small area of seabed, sediment and any macrofauna associated with that sediment. There is also the potential for disturbance of sensitive species that may be present. | Certain | Negligible | Low | • As this impact is an inevitable consequence of well construction, there are no mitigation measures that can be used to reduce the impact. However, the mitigation measures described below under 'Discharges to Sea' in relation to pre-drilling, during drilling and post-drilling environmental surveys will allow close monitoring of the impacts in situ.<br>• During pre-drilling monitoring of the wellhead location the presence of habitats of conservation importance will be established. Should any important habitats be observed prior to commencement of drilling, the wellhead will be re-located in order to avoid these habitats. | Certain | Negligible | Low |
| | **Navigation risk**<br>The physical presence of the drilling rig represents a physical obstruction in the sea and an associated increased risk of collision with a third-party vessel.<br>There is also a small risk of collision from icebergs that may be in the area, although this risk is very low. | Possible | Major | High | • A 500 metre radial safety zone will be implemented around the drilling unit whilst on location which will be applicable to all third-party vessels, to reduce the potential for a collision with the drilling unit to occur. The 500 metre safety zone will be patrolled and enforced by the a Safety Stand-by Vessel (SSV), which will be in attendance in the vicinity of the drilling unit at all times.<br>• Up to 3 OSVs will be used throughout the drilling programme. At all times, the role of SSV will be undertaken by one of these OSVs to patrol the safety zone and warn of the presence of the drilling unit and vessel safety zone. All OSVs will be equipped with modern radar and radio equipment. A set of procedures will be established so that vessel masters, who need to deviate from their planned route based on their current sea passage trajectory, will be asked by the SSV via VHF radio to confirm that they intend to follow the requirements of the drilling rig Automatic Identification System (AIS) | Remote | Moderate | Low |

| POTENTIAL NEGATIVE ROUTINE IMPACT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Area of Concern | Aspects | Likelihood | Severity | Potential Impact | Mitigation measures | Likelihood | Severity | Residual Impact |
| | | | | | warnings. The SSV will maintain close contact with the third-party vessel until they have changed their course away from entering the safety zone.<br>• Due regard will also be given by the officers on watch on board the OSVs to fellow sea users at all times, in line with the International Regulations for Preventing Collisions at Sea (COLREGs). Any fishing vessel encountered by the OSVs in transit to/from the drilling unit shall be given a wide berth in full cooperation with any flags, symbols or other instructions that the fishing vessel may be displaying or may issue via VHF.<br>• The emergency response plans and procedures of the drilling unit and OSVs will be verified by Noble for adequacy to respond to a potential collision threat. This shall include the threat of collision from icebergs.<br>• The Falkland Islands Fishing Companies Association (FIFCA), Consolidated Fisheries Limited (CFL) and Falkland Islands Government (FIG) will be notified, in writing, a minimum of 30 calendar days before the start of drilling activities, so that fishing vessels can plot the drilling location on marine charts, avoid the safety zone and plan their sea passage to/from any favoured fishing grounds accordingly.<br>• Noble will liaise with the Fisheries Department and CFL with regard to the issue of navigation warnings advertising the presence of the drilling rig through the existing Fisheries Department Daily Shipping Forecast system. The information provided will include details on the current position of the drilling rig, presence of the OSVs, description of the 500 metre radial safety zone and the need for vessels to stay outside of this zone at all times.<br>• A message will be attached to the drilling unit's | | | |

| POTENTIAL NEGATIVE ROUTINE IMPACT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | | | | | AIS to provide an identical set of information to the Daily Shipping Forecast as described above.<br>• The drilling rig will be fitted with navigational lighting and a radar transponder to show its position to third-party vessels visually, and also through the use of radar equipment.<br>• Standard Marking Schedule provisions or International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) recommendations and guidelines will be adhered to during operations and transit to and from Stanley Harbour and the rig location by OSVs.<br>• Any complaints associated with the temporary loss of access to the sea will be recorded and monitored, in accordance with the Noble Energy Community Feedback Mechanism.<br>• Details of the as-built well locations will be provided to FIG and to hydrographic organisations to enable the location of the wells to be plotted onto navigational charts. | | | |
| | **Interference with other users**<br>During the drilling programme, a safety exclusion zone will be in place to prevent third-party vessels from travelling in close proximity to the drilling rig, which could potentially be a threat to both the safety of the drilling unit and the safety of passing vessels. The safety exclusion zone will comprise a radial area of 500 metres around the perimeter of the drilling unit.<br>This temporary restriction of access to the sea to third-parties has the potential to disrupt regional marine activities such as commercial | **Moderate** | **Possible** | **Medium** | • Up to 3 OSVs will be used throughout the drilling programme. At all times, the role of SSV will be undertaken by one of these OSVs to patrol the safety zone and warn other users of the sea about the presence of the drilling unit and safety zone. All OSVs will be equipped with modern radar and radio equipment. A set of procedures will be established so that vessel masters, who need to deviate from their planned route based on their current sea passage trajectory, will be asked by the SSV via VHF radio to confirm that they intend to follow the requirements of the drilling rig AIS warnings. The SSV will maintain close contact with the third-party vessel until they have changed their course away from entering the safety zone. | **Moderate** | **Remote** | **Low** |

| POTENTIAL NEGATIVE ROUTINE IMPACT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | shipping and fishing, from the restriction in access to the sea and the financial cost from the extra time (and fuel) required to deviate around the exclusion zone. | | | | • FIFCA, CFL and FIG will be notified, in writing, a minimum of 30 calendar days before the start of drilling activities, so that fishing vessels can plot the drilling location on marine charts, avoid the safety zone and plan their sea passage to/from any favoured fishing grounds and their fishing activities accordingly.<br>• Noble will liaise with the Fisheries Department and CFL with regard to the issue of navigation warnings advertising the presence of the drilling rig through the existing Fisheries Department Daily Shipping Forecast system. The information provided will include details on the current position of the drilling rig, presence of the OSVs, description of the 500 metre radial safety zone and the need for vessels to stay outside of this zone at all times.<br>• A message will be attached to the drilling unit's AIS to provide an identical set of information to the Daily Shipping Forecast described above.<br>• The drilling rig will be fitted with navigational lighting and a radar transponder to show its position to third-party vessels visually, and also through the use of radar equipment.<br>• Any complaints associated with the temporary loss of access to the sea will be recorded and monitored, in accordance with the Noble Energy Community Feedback Mechanism.<br>• Details of the as-built well locations will be provided to FIG and to hydrographic organisations to enable the location of the wells to be plotted onto navigational charts.<br>• Noble will comply with FIG regulatory requirements on the removal of the wellhead and near seabed casing to three metres below the seabed. | | | |

| POTENTIAL NEGATIVE ROUTINE IMPACT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | **Collision risk with marine mammals**<br>The physical presence of vessels transiting has the potential to present a collision risk to marine mammals. | **Possible** | **Minor** | **Medium** | • Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species that may be present within the vicinity of these islands. This will also reduce any potential collision risk (however small) with marine mammals within shallower areas.<br>• Whilst transiting near coastal areas (i.e., within the vicinity of the approaches to Port William, and whilst within Port William and Stanley Harbour), vessel speed will be reduced in order to minimise the chance of vessel strike with any species that may be present. All other applicable vessel speed limits shall also be observed when within the approaches to Port William and whilst within Port William and Stanley Harbour. | **Unlikely** | **Minor** | **Low** |
| | **Interference with wrecks and archaeological remains**<br>The drilling of an exploration well in close proximity to a wreck has the potential to disturb it, either by direct contact with the wreck itself by drilling equipment, or by discharges associated with the drilling project, such as the discharge of drill cuttings. | **Possible** | **Moderate** | **Medium** | • Well locations will be chosen so that existing and reported wreck locations are avoided.<br>• Any subsequent changes to top-hole well locations will also actively avoid areas of existing wreck sites. Changes to the top-hole locations will be reported within subsequent addenda to this EIS (as required), and the impacts with respect to existing wrecks will be reassessed if necessary.<br>• No accurate positions of the shipwrecks within FISA12 are known. It is likely that the positions reported by Wrecksite.eu are inaccurate. The environmental survey of the FISA12 area put considerable effort into attempting to positively identify the un-charted wrecks during the survey; however, the wrecks were not identified. Noble will therefore avoid drilling within the immediate vicinity of the reported wreck locations by placing a 10 kilometre safety zone around the current reported Wrecksite.eu locations. | **Remote** | **Moderate** | **Low** |

| POTENTIAL NEGATIVE ROUTINE IMPACT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | | | | | • The absence of wrecks in the vicinity of the well locations will also be confirmed through the pre-drilling site specific environmental seabed surveys with a remotely operated vehicle (ROV). Should the wreck sites be identified during the pre-drilling survey their location will be noted and reported to FIG and the well location relocated to avoid the wreck sites.<br>• A reporting protocol will be instigated for the accidental discovery of archaeological material during drilling activity and all appropriate notifications will be completed. | | | |
| | **Potential for conflict between workers requiring temporary accommodation in Stanley and local residents**<br>There is a risk that incoming workers could cause conflict with local residents in Stanley from anti-social behaviour, problems arising from alcohol abuse, or public disorder/violence incidents. | **Possible** | **Minor** | **Medium** | • Noble will use the locally available work force where possible. This will minimise the need for contractors to bring in workers from outside the Falkland Islands into Stanley.<br>• All Noble contractors, including the drilling contractor, will monitor individuals that are part of their work force and ensure they are made fully aware of the standards of behaviour expected, examples as to what constitutes a breach of their own Behavioural Code of Conduct, a description of the disciplinary and appeal processes and procedures to be followed for alleged misconduct. Contractors will ensure that these aspects are clearly outlined in the workers' contracts so that any termination of employment due to a breach is legally enforceable. In addition, the contractors and Noble will limit the amount of time offshore employees spend in Stanley during crew change periods.<br>• All complaints associated with the behaviour of workers will be recorded and monitored, in accordance with the Noble Energy Community Feedback Mechanism. | **Unlikely** | **Minor** | **Low** |

| POTENTIAL NEGATIVE ROUTINE IMPACT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| **Atmospheric Emissions and Air Quality** | **Atmospheric emissions from power generation by rig, OSVs/SSV and helicopter(s)**<br><br>Atmospheric emissions have the potential to contribute to the pool of greenhouse gasses in the atmosphere ($CH_4$, $CO_2$) and increase the risk of acid effects (SOx, NOx) potentially causing a short term localised impact on air quality. | **Certain** | **Minor** | **Medium** | • Noble will undertake extensive pre-project planning in order to ensure that the project operations are conducted efficiently, to minimise the duration of project activities as far as possible. This will also assist in optimising the number of trips for OSVs and helicopters between the rig and onshore.<br>• Emissions generated from the proposed drilling programme will be controlled through the use of modern and well maintained power generation equipment. The equipment shall be maintained in accordance with the written procedures based on manufacturer's guidelines, applicable industry code, or engineering standard to ensure efficient and reliable operation.<br>• Contracted vessels will be required to control fuel use, efficiently manage energy and to plan voyages efficiently. | **Certain** | **Negligible** | **Low** |
| | **Fugitive emissions (e.g. volatile organic compounds - VOCs) associated with (for example), leaks, vents and fuel bunkering**<br><br>Atmospheric emissions have the potential to contribute to the pool of greenhouse gasses in the atmosphere ($CH_4$, $CO_2$) and increase the risk of acid effects (SOx, NOx) potentially causing a short term localised impact on air quality. | **Possible** | **Minor** | **Medium** | • To control fugitive emissions, operational and maintenance procedures will be implemented, which include all environmentally critical valves, flanges, fittings and seals in use on the drilling rig, to eliminate or reduce as far as possible the capacity for gas leaks and fugitive emissions.<br>• A gas/leak detection system and repair program will be in operation on the rig (requirement of rig Safety Case). | **Unlikely** | **Minor** | **Low** |
| **Discharges to Sea** | **Discharge of drilling mud and associated chemicals**<br><br>Discharges of drilling mud have the potential to cause smothering of the seabed in the vicinity of the well, increased localised turbidity, potential depletion of oxygen in | **Likely** | **Moderate** | **Medium** | • It is proposed that water based mud (WBM) is used for drilling all sections of the exploration wells. The design of the drilling programme, to include the use of dedicated water based mud systems, negates the use of oil based mud (OBM), which, even after the required thermal cuttings cleaning treatment to FIG PON10 standards, would have a higher toxicity upon | **Remote** | **Moderate** | **Low** |

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| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | surface sediments and potential loss of seafloor habitat. There is also the potential for cumulative impacts with other wells drilled in the area. | | | | discharge to the marine environment than WBM.<br>• All drilling mud components will be selected on the basis of environmental performance, as much as possible, within the mud programme, so as to reduce any potential environmental impacts upon the release of the drilling mud.<br>• A Discharge Management Programme (DMPO) will be in place for the drilling operations. The purpose of the DMPO will be to provide a consistent set of discharge requirements for the exploration drilling programme. The prohibitions, limitations and monitoring requirements in the document will be based on recognized standards and regulations that have been developed to protect the environment. The DMPO will include provisions for the discharge of drilling mud.<br>• Chemical use and discharge will be closely monitored throughout the drilling program through the rig chemicals tracking system and minimised by the drill crew and mud engineers where practicable, without compromising well safety. All chemical use and discharge will be controlled through the DMPO through the detailing of the reporting procedures for chemical use and discharge. The DMPO will provide a consistent set of discharge requirements for the exploration drilling programme.<br>• Batch discharges of drilling mud will be minimised, as far as possible. All drilling mud will be recycled and used on other well sections, as much as possible, without compromising well safety.<br>• The DMPO will be in place for the drilling operations, as described above in Section 6.3.1, and will include provisions for the discharge of drilling mud. | | | |

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| Area of Concern | Aspects | Likelihood | Severity | Potential Impact | Mitigation measures | Likelihood | Severity | Residual Impact |
| | | | | | • Seabed features and habitats at the well sites will be confirmed through site specific environmental seabed surveys, which will include pre-drilling, during drilling and post-drilling elements as follows:<br>○ The pre-drilling survey will include a 100 metre radius (centred on the well location) remotely operated vehicle (ROV) inspection of the seabed, using an environmental specialist to interpret for habitats and species. Additional features showing important species (e.g. rocks with epifaunal communities or the presence of corals) will be marked and re-visited after drilling is completed. Seabed sampling will be carried out upstream and downstream of the prevailing currents at 50, 100 and 200 metre offset locations, using a specialist environmental ROV corer (89mm outside diameter). At each station, 2 x physico-chemical samples will be taken from the top 10 cm of sediment, and 5 x biological samples will be taken from the top 20 cm of sediment, and processed through a 500 µm mesh sieve.<br>○ During drilling, specially designed sediment traps will be deployed at each of the above environmental stations for the purposes of logging the settlement of any cuttings material deposited on the seabed.<br>○ The post-drilling survey will repeat the survey undertaken pre-drilling. Any additional features showing important species marked during the pre-drilling survey will be re-visited. | | | |



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| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | | | | | In addition, a 1.5 metre ROV corer will be used to assess the vertical profile of the sediments in the thickest part of the cuttings pile, expected to be approximately 10 metres from the wellhead. This will record the settlement regime of discharged material over the duration of the drilling, with discrete layers identified, measured and analysed for their physico-chemical properties. | | | |
| | **Discharge of drill cuttings**<br><br>Discharges of drill cuttings have the potential to cause smothering of the seabed in the vicinity of the well by drill cuttings, increased localised turbidity, potential depletion of oxygen in surface sediments and potential loss of seafloor habitat. There is also the potential for cumulative impacts with other wells drilled in the area. | **Likely** | **Moderate** | **Medium** | • All mitigation measures as described above for the release of drilling mud.<br>• Should any habitats of conservation importance be identified during pre-drilling surveys, Noble will look to relocate the well location to avoid these habitats.<br>• Should either the SMS Scharnhorst or SMS Gneisenau be identified during the pre-drilling surveys, Noble will look to relocate the well location to avoid these wrecks<br>• The results of the post drilling surveys will be used to verify the accuracy of the cuttings dispersion modelling.<br>• The DMPO will be in place for the drilling operations, as described above, and will include provisions for the discharge of drilling cuttings. | **Remote** | **Moderate** | **Low** |
| | **Potential discharge of cement and associated chemicals (including potentially large volumes of cement in the unlikely event of mixing and/or mechanical problems)**<br><br>The discharge of cement has the potential to cause smothering of the seabed in the vicinity of the well, increased localised turbidity, | **Likely** | **Moderate** | **Medium** | • Cement volumes used will be minimised, where practicable, to limit any possible discharge of cement and associated chemicals, without compromise to well safety and integrity.<br>• All cement components will be selected on the basis of environmental performance, so as to reduce any potential environmental impacts upon the potential release of the cement. | **Likely** | **Negligible** | **Low** |

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| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | potential depletion of oxygen in surface sediments and potential loss of seafloor habitat. There is also the potential for cumulative impacts with other wells drilled in the area. | | | | • Chemical use and discharge will be closely monitored throughout the drilling program through the rig chemical tracking system and minimised by the drill crew and cement engineers where practicable, without compromising well safety. All chemical use and discharge will be controlled through the DMPO.<br>• Batch discharges of cement will be minimised, as far as possible. Great care will be taken when mixing cement on board the rig for use during cementing operations, ensuring that the potential need to discharge batches of cement due to technical and/or mixing problems is minimised. All cement discharge will be controlled through the DMPO. | | | |
| | **Discharges of domestic wastewater and food waste**<br>Discharges of domestic wastewater and food waste from the drilling rig and OSVs have the potential to cause a localised effect on water quality. The increased biological oxygen demand (BOD) in the water column could potentially disrupt biodiversity in the region, potentially giving rise to a temporary boom in opportunistic species. | **Certain** | **Minor** | **Moderate** | • On board the drilling rig and OSVs, black (sewage) and grey water will be collected on board the rig and OSVs and treated in accordance with the requirements of the MARPOL Convention prior to being discharged to sea. Food waste will also be collected and treated (macerated) in accordance with the requirements of the MARPOL Convention.<br>• The discharge of sewage is only authorised if the ship/installation is equipped with authorised sewage treatment equipment, and the results of the tests of this equipment are documented and the effluent leaves no visible floating solids and does not discolour the surrounding water.<br>• The discharge of rubbish is prohibited, with the exception of food waste that is ground and passed through a sieve with a mesh size no greater than 25 millimetres for facilities that are more than 12 nautical miles from the coast.<br>• The DMPO will be in place for the drilling operations and will include provisions for the | **Certain** | **Negligible** | **Low** |

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| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | | | | | discharge of domestic wastewater and food waste; both from the drilling rig and OSVs. | | | |
| | **Discharge of deck drainage water**<br><br>Water quality has the potential to be reduced if chemicals and/or hydrocarbons contaminate drainage water from the rig and OSVs. Fish may avoid any contaminated areas, which could potentially reduce their foraging areas. Contaminated effluents could potentially cause discomfort and/or disturbance to fish and benthic dwelling species. | **Likely** | **Minor** | **Moderate** | • Deck areas will be kept clean of debris and any hydrocarbon materials.<br>• Any unintentional releases will be thoroughly cleaned up as soon as they occur before they have the chance to be washed overboard. Waste materials (absorbent pads, etc.) will be segregated. Hazardous waste will be disposed of according to established waste oil/chemical disposal procedures.<br>• Spill kits will be readily available on deck for mopping up any minor unintentional releases. Personnel will be trained in the use of spill kits.<br>• The drilling rig and OSVs will be fitted with closed drainage containment and monitoring systems in all environmentally critical areas as part of their specification. An oily water bilge system in accordance with MARPOL regulations and an oily water separator (OWS) in accordance with International Maritime Organisation (IMO) Marine Environment Protection Committee (MEPC) 107(49) (Guidelines and Specifications for Pollution Prevention Equipment for Machinery Space Bilges of Ships) will also be present. Procedures for drainage water will be addressed within both the drilling contractor's and OSV contractor's documentation.<br>• Oily water treatment systems on board the drilling rig and OSVs must have oil discharge monitoring and control equipment installed to ensure an oil concentration in water exiting the treatment systems of less than 15 parts per million (ppm) as required under MARPOL regulations and in accordance with IMO MEPC 107(49). Records of the oil content of water discharged and calibration of equipment must be maintained in accordance with the MARPOL Convention, in the form of an Oil | **Possible** | **Negligible** | **Low** |

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| Area of Concern | Aspects | Likelihood | Severity | Potential Impact | Mitigation measures | Likelihood | Severity | Residual Impact |
| | | | | | Record Book.<br>• On the drilling rig, no direct overboard discharge of deck drainage water from environmentally critical areas (e.g. the drill floor) is to take place.<br>• All direct deck drainage on the drilling rig (e.g., walkway gratings) shall be used in clean, non-environmentally critical areas only.<br>• Rainwater runoff from the drilling rig will be routinely monitored for any residual hydrocarbon content.<br>• The DMPO will include provisions for the discharge of drainage water. | | | |
| **Bio-security** | **Discharge of ballast water**<br>The discharge of ballast water has the potential for the introduction of invasive species leading to a potential change in the local ecosystem and possibly the wider ecosystem. | **Possible** | **Moderate** | **Medium** | • All vessels associated with the drilling operations (including the drilling rig itself), will undertake ballast exchange operations well clear of the Falkland Islands in offshore waters outside of the 12 nautical mile limit.<br>• The drilling rig and OSVs will all have procedures in place for ballast water management as part of both the drilling contractor's and OSV contractor's specification. These procedures will be subject to audit/assessment by Noble. | **Remote** | **Moderate** | **Low** |
| **Underwater noise** | **Noise from drilling operations (rig and OSVs on site)**<br>Noise from the drilling operations at the well locations has the potential for disturbance of marine mammals, fish and seabirds. This could cause potential behavioural changes in fish and marine mammals due to the increase in background marine noise levels. | **Likely** | **Negligible** | **Low** | • Drilling operations inevitably give rise to noise. The drilling rig will be on location for the minimum period of time required to conduct the drilling operations, thus minimising the duration of potential noise impacts as far as possible. The operational and maintenance procedures on the drilling rig will also aim to optimise the efficiency of the equipment and the schedule of operations. | **Likely** | **Negligible** | **Low** |
| | **Noise from OSVs on sea passage**<br>Noise from the OSVs travelling to | **Possible** | **Negligible** | **Low** | • Vessel movements will avoid coastal areas (with the exception of the approaches to Port William and Stanley Harbour) where sensitive | **Possible** | **Negligible** | **Low** |

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| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | and from Stanley and the drilling rig has the potential for disturbance of marine mammals, fish and seabirds. This could cause potential behavioural changes in fish and marine mammals due to the increase in background marine noise levels. | | | | species, such as penguin colonies, may be present.<br>• Whilst transiting near beach areas (i.e. within the vicinity of the approaches to Port William, and whilst within Port William and Stanley Harbour), vessel speed will be reduced in order to minimise the chance of vessel strike with any species that may be present. Such a reduced speed would also limit noise impact from the vessels. All other applicable vessel speed limits shall also be observed when within the approaches to Port William and whilst within Port William and Stanley Harbour.<br>• Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species present within the vicinity of these islands. | | | |
| | **Underwater noise from helicopters in transit**<br>Noise from the helicopter flights on the helicopter route between Stanley Airport and the rig has the potential to disturb marine mammals, fish, seabirds, and coastal populations. This has the potential to cause behavioural changes in marine mammals, fish, and offshore and coastal seabirds due to the increase in background noise levels. | **Certain** | **Negligible** | **Low** | • The aviation contractor will be prohibited from circling or hovering over marine mammals or sites identified as sensitive for seabird colonies in accordance with the Falkland Islands low flying avoidance maps and the Falkland Islands Low Flying Handbook. The aviation contractor will pay particular attention to paragraphs 37 to 40 and 54 to 60 of the Low Flying Handbook.<br>• Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species present within the vicinity of these islands. | **Certain** | **Negligible** | **Low** |
| | **Noise from Vertical Seismic Profiling (VSP) operations**<br>Noise from VSP operations (a seismic operation performed after drilling of a well) has the potential to cause disturbance to marine mammals and fish, and potential | **Likely** | **Moderate** | **Medium** | • VSP operations will be strictly controlled in line with the JNCC *Guidelines (2010) for minimising the risk of injury and disturbance to marine mammals from seismic surveys*.<br>• A qualified Marine Mammal Observer (MMO) will be on site during VSP operations. The MMO will monitor the 500 metre safety zone | **Possible** | **Minor** | **Medium** |

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| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | physical damage to plankton, fish eggs and larvae in immediate proximity to the VSP energy source.<br>The VSP operations also have the potential to cause behavioural changes in marine mammals and fish due to the sharp temporal increase in background marine noise levels. | | | | for 60 minutes (due to the operations occurring in water deeper than 200m) prior to commencement of VSP operations to ensure that no marine mammals are present within the area.<br>• Soft-start ramp up of the seismic source during VSP operations, of no less than 20 minutes and no more than 40 minutes, will then be undertaken in line with the above JNCC guidelines. This enables fish and marine mammals in the area disturbed by the sound levels to move away from the noise source before being subject to the full force of the seismic array, thus minimising the potential for adverse impacts on these species.<br>• If marine mammals are observed within the 500 metre zone after the VSP has started, then they are deemed to be unaffected by the noise. A record of the sighting should be kept, but no further action will be taken.<br>• VSP operations will be started during daylight hours only. | | | |
| **<u>Airborne noise</u>** | **Airborne noise from helicopters in transit.**<br>Potential disturbance to coastal populations on the helicopter route between Stanley Airport and the rig. | **Likely** | **Minor** | **Medium** | • The aviation contractor will be prohibited from circling or hovering over marine mammals or sites identified as sensitive for seabird colonies unless essential for safety or operational purposes in accordance with the Falkland Islands low flying avoidance maps and the Falkland Islands Low Flying Handbook. The aviation contractor will pay particular attention to paragraphs 37 to 40 and 54 to 60 of the Low Flying Handbook..<br>• Routing over built up areas will be avoided, unless in an emergency and/or on the grounds of safety in accordance with paragraph 32 of the Falkland Islands Low Flying Handbook.<br>• Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to | **Unlikely** | **Negligible** | **Low** |

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| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | | | | | sensitive species present within the vicinity of these islands.<br>• Helicopter flight planning will be undertaken in coordination with the appropriate Falkland Island authorities (Civil Aviation Department). Under normal operations, helicopter flights will only occur during daylight hours, in order to minimise potential disturbance to the local population. | | | |
| | **Airborne noise from OSVs on sea passage.**<br>Potential disturbance to marine mammals, fish and seabirds. Potential behavioural changes in fish and marine mammals due to increase in background marine noise levels. | **Possible** | **Minor** | **Medium** | • Vessel movements will avoid coastal areas (with the exception of the approaches to Port William and Stanley Harbour) where sensitive species, such as penguin colonies, may be present.<br>• Whilst transiting near beach areas (i.e., within the vicinity of the approaches to Port William, and whilst within Port William and Stanley Harbour), vessel speed will be reduced in order to minimise the chance of vessel strike with any species that may be present. Such a reduced speed would also limit noise impact from the vessels. All other applicable vessel speed limits shall also be observed when within the approaches to Port William and whilst within Port William and Stanley Harbour.<br>• In addition, Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species present within the vicinity of these islands. | **Unlikely** | **Negligible** | **Low** |
| **Waste Management** | **Treatment and disposal of non-hazardous waste generated from drilling operations.**<br>The effects of disposal of controlled wastes associated with onshore disposal are dependent on the nature of the site or process. This has the potential to produce limitations on future land use and | **Certain** | **Minor** | **Medium** | • Noble will develop and implement a Waste Management Plan (WMPA) for the proposed drilling programme that encompasses the drilling rig, OSVs and onshore support. The WMPA will cover the storage, transport and treatment of waste generated as part of the drilling programme. The WMPA will cover both offshore and onshore aspects of the exploration drilling operations (i.e., will cover | **Certain** | **Negligible** | **Low** |

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| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | the potential to cause small scale land and air contamination. | | | | both offshore and onshore elements of the waste streams). The WMPA will identify measures to reduce waste generated during drilling and how waste will be handled and disposed of safely and responsibly. The WMPA will:<br>○ Promote minimisation of the amounts of waste generated at source;<br>○ Require segregation of waste by type;<br>○ Require appropriate storage to prevent emissions and leaks;<br>○ Promote recycling or re-use where possible, in particular for scrap metal, waste oil and surplus chemicals;<br>○ Require that waste be sent to authorised landfills or incineration facilities, depending on its precise nature, when no other option is possible;<br>○ Minimise and manage cumulative waste generation from the drilling campaign; and<br>○ Ensure a clear chain of ownership for all waste through the use of waste manifests until final disposal, particularly relating to trans-boundary matters.<br>• Noble will work closely with FIG prior to drilling operations to determine acceptable options for onshore non-hazardous waste disposal. The following measures will be included in the Waste Management Plan:<br>○ No un-combusted wastes arising from the drilling programme will be landfilled in the Falkland Islands; | | | |

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| Area of Concern | Aspects | Likelihood | Severity | Potential Impact | Mitigation measures | Likelihood | Severity | Residual Impact |
| | | | | | ○ Some non-hazardous combustible waste will be segregated and sent to a local incinerator for incineration in the Falkland Islands; and<br>○ The waste ash arising from this incineration will be landfilled in the Falkland Islands along with other incinerator waste at an existing landfill facility (Eliza Cove or Mary Hill Quarry).<br>• Noble will confirm all waste management and disposal routes within the WMPA (to be approved by FIG) prior to drilling operations commencing.<br>• All contractors will be required to adhere to the requirements outlined within the WMPA. | | | |
| | **Treatment and disposal of hazardous waste generated from drilling operations.**<br>Potential trans-boundary impacts due to the trans-boundary movement (TBM) of hazardous waste. | Certain | Moderate | High | • Special arrangements will be in place for hazardous wastes and will be detailed within the WMPA. As no suitable onshore facilities exist in the Falkland Islands for the treatment and disposal of hazardous waste, the waste will be exported in accordance with the Basel Convention. Under the Basel Convention, a trans-boundary movement (TBM) means any movement of hazardous wastes or other wastes:<br>○ From an area under the national jurisdiction of one State; and<br>○ To or through an area under the national jurisdiction of another State, or to or through an area not under the national jurisdiction of any State.<br>• The Basel Convention requires that the standard of “environmentally sound management” (ESM) of hazardous wastes or other wastes is met. ESM means taking all practicable steps to ensure hazardous wastes or other wastes are managed in a manner | Certain | Negligible | Low |

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| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | | | | | which will protect human health and the environment against the adverse effects which may result from such wastes. The final stage in the TBM procedure is for the generator and country of export to receive confirmation that the wastes moved across borders have been disposed of by the disposer as planned and in an environmentally sound manner.<br>• Noble will ensure that a dedicated waste specialist is appointed to:<br>○ Receive and handle waste (including hazardous waste) at the TDF;<br>○ Arrange for local recycling or disposal of non-hazardous waste;<br>○ Safely store any hazardous waste;<br>○ Arrange appropriate export of hazardous waste in accordance with the Basel Convention; and<br>○ Ensure confirmation from the disposer that the wastes moved have been disposed of as planned and in an environmentally sound manner in accordance with the Basel Convention.<br>• Noble will conduct an audit/assessment of any selected waste specialist and processing facilities to ensure their compliance with local and international best practice and the WMPA. | | | |
| **Light** | **Use of artificial lighting on board the drilling rig and OSVs**<br>The use of artificial lighting on board the drilling rig and OSVs has the potential to disturb offshore seabirds during hours of darkness. | **Likely** | **Minor** | **Medium** | • Heli-deck landing lights will be switched off when not in use (if not required to be left on for safety reasons, such as during an emergency incident) to reduce potential impacts of these skyward facing lights on any bird species that may be present. Night time helicopter flights will only be conducted during emergency situations and are not planned to be part of normal operations during drilling activities Under normal operations, Helicopter flights will only occur during daylight | **Possible** | **Negligible** | **Low** |

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| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | | | | | hours so requirements for heli-deck lighting will be minimal if at all.<br>• In addition, the OSV and SSV deck lighting will be switched off when not in use (if not required to be left on for safety reasons, such as during resupplying of the rig at night).<br>• The precise details of the bird monitoring on the rig are yet to be finalised. Noble will monitor the number of birds found on the rig throughout the exploration drilling programme and will report monthly to an advisory group the findings of this monitoring. In the event that it is considered that significant and unacceptable numbers of seabirds have been attracted to the rig at night this will immediately be reported to FIG. Noble will then investigate whether further measures can be implemented and will work with FIG and their advisors to develop suitable measures. However, based on the experience of a previous study offshore the Falklands (albeit in northern waters) it should be noted that an event such as this is considered highly unlikely to occur.<br>• As part of the monitoring programme, a protocol will be established for the identification and recording of species involved in the event of mortality. Species present on the rig, involved in collisions or observed attracted to the rig will be recorded, including species name, numbers observed, behaviour and location on the rig. Photographs of species observed will be taken as part of the recording procedure. However, based on the experience of a previous study offshore the Falklands (albeit in northern waters) it should be noted that mortality due to association is expected to be highly unlikely to occur. The finalised protocol for recording species observed will be developed prior to drilling operations occurring and will be agreed with FIG. | | | |
| **Seascape, Landscape and** | **Physical presence of the drilling rig, OSVs, helicopter flights and** | **Certain** | **Minor** | **Medium** | • The duration of OSVs at the TDF and within Stanley Harbour will be minimised to the extent | **Certain** | **Negligible** | **Low** |

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| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| **Visual** | **shore base**<br><br>The various elements of the drilling project have the potential to cause a temporary change in seascape, landscape and visual setting due to the presence of the drilling rig, OSVs, helicopter flights and shore base. | | | | possible through project planning activities.<br><br>• The number of helicopter flights and the time spent in the air near Stanley Airport will be minimised, to the extent possible through appropriate planning measures.<br><br>• Any land-based equipment and materials not in active use will be stored at Noble's shore base, whenever possible.<br><br>• All working areas will be maintained in a tidy condition with the aim of minimising the potential visual impact.<br><br>• All complaints associated with the effects on the seascape, landscape and visual setting of Stanley will be recorded and monitored, in accordance with the Noble Energy Community Feedback Mechanism. | | | |
| **Utilities, Transport Networks, Communications and Local Resources** | **Presence of drilling operations workers during peak tourist season**<br><br>The presence of drilling workers in Stanley has the potential to place additional demand on local guest houses and hotel accommodation during the drilling programme, especially during the tourist season | **Certain** | **Moderate** | **Medium** | • Noble will adhere to the FIG "Procurement Code of Practice by Oil and Gas Companies and their Subcontractors Operating in the Falkland Islands" (Code) which is currently under development (available as a draft only and not yet approved). This Code aims to maximise the use of businesses registered on the Falkland Islands by the oil and gas industry and minimise the need for contractors to bring in workers who will subsequently require temporary accommodation. Noble will utilise the local work force, where possible, in order to reduce the need for additional accommodation. Noble continues to work with FIG on the progress of this code of practice.<br><br>• Disturbance to local accommodation facilities will be minimised through advanced consultation with local hotels being used for overnight accommodation. Noble intends to have a permanent arrangement for housing and leasing rooms in local hotels in place in advance of drilling operations commencing and well in advance of the rooms being required. | **Possible** | **Negligible** | **Low** |

| POTENTIAL NEGATIVE ROUTINE IMPACT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | | | | | • In addition to the above accommodation arrangements, Noble, in conjunction with other operators, has initial plans to build temporary accommodation in the Stanley area. This accommodation will have a capacity of 80 rooms. Plans for this temporary accommodation have yet to be finalised. Expressions of interest for the provision of this accommodation have been released.<br>• Noble will minimise, where possible, the number of their own management staff in the Falkland Islands needed to manage the exploration drilling programme (without compromising safety and quality).<br>• The Emergency Response Plan (ERP) developed by Noble will include arrangements for the provision of emergency accommodation in Stanley, either at local hotel accommodation and/or Falkland Islands Defence Force (FIDF) that can be used in the event of an emergency rig evacuation. Each of the 80 rooms within the temporary accommodation described above will have an extra bunk to assist in emergency evacuation situations. It is also noted that the Falkland Islands Defence Force (FIDF) based in Stanley could accommodate up to 200 persons in the event of an emergency, although no guarantees of available space can be made. However, the use of this facility for emergency situations will be discussed in advance with FIG and FIDF prior to any inclusion in the ERP. | | | |
| | **Use of potable water from the municipal water supply in Stanley**<br>The drilling programme will require large volumes of water from the municipal water supply in Stanley. The water will be used to supply the drilling unit (via the OSVs) with drill water, and to supply the OSVs with drinking water. The use of water | **Certain** | **Moderate** | **Medium** | • The storage tanks on the TDF, which will be utilised for the storage of drill water, will be trickle filled from the municipal water supply, which will mitigate against the potential for sudden, high-volume 'shock' demands being placed on the local water supply network.<br>• During the exploration drilling programme, Noble will provide written notification to the FIG Public | **Certain** | **Negligible** | **Low** |

| POTENTIAL NEGATIVE ROUTINE IMPACT | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | has the potential to place pressure on the available water resources within Stanley. | | | | Works Department (PWD) a minimum of 10 calendar days before drill water is required to be taken from the municipal water supply. The written communiqué shall confirm the expected quantity of water to be taken from the regional supply network, the expected date and start/end time and the telephone contact details of the relevant Noble supervisor. | | | |
| | **Use of local road network to transport rig workers to/from Stanley, Stanley Airport and Mount Pleasant Airport (MPA) during drilling**<br>Increased traffic and potential increased risk to community health and safety and other road users. | **Certain** | **Minor** | **Medium** | • Local transport companies will be used for all road transfers of offshore personnel. This will reduce health and safety risks, as local drivers will be familiar with local roads and local conditions.<br>• Careful planning of transportation will be undertaken to ensure efficient use of vehicles and to reduce the number of trips required.<br>• Onshore personnel will be given driving training appropriate to the local roads.<br>• Complaints associated with the transport of work force and increased traffic will be monitored and dealt with through the Noble Community Feedback Mechanism. Should any major issues be identified that are causing community concern they will be raised with FIG and alternative solutions proposed and discussed. | **Certain** | **Negligible** | **Low** |

*Table B: Summary of hazards, effects and mitigation measures for non-routine hazards*

| NON-ROUTINE HAZARDS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| **Accidental Events** | **Potential uncontrolled gas release during drilling**<br><br>Atmospheric emissions have the potential to contribute to the pool of greenhouse gasses in the atmosphere ($CH_4$, $CO_2$) and increase the risk of acid effects (SOx, NOx), potentially causing a short term localised impact on air quality. If flammable gasses are involved, there will be a potential risk of fire and explosion. | **Unlikely** | **Moderate** | **Medium** | • Well control mitigations to be implemented as described below under 'Uncontrolled release of reservoir hydrocarbons'.<br>• To control fugitive emissions, operational and maintenance procedures will be implemented, which include all environmentally critical valves, flanges, fittings and seals in use on the drilling rig, to eliminate or reduce as far as possible the capacity for gas leaks and fugitive emissions.<br>• A gas/leak detection system and repair program will be in operation on the rig (requirement of rig Safety Case). | **Remote** | **Negligible** | **Low** |
| | **Potential unintentional releases of fuel or other fluids (e.g. diesel, drilling mud, hydraulic oil or lubricants) during day-to-day operations (including re-fuelling)**<br><br>During general operations associated with the drilling programme, there is the potential for unintentional releases. These releases have the potential to cause localised toxic effects on marine fauna and flora and localised pollution, which may impact local marine wildlife and rafting | **Possible** | **Major** | **Medium** | • The drilling rig will be fitted with closed drainage containment, treatment and monitoring systems in all environmentally critical areas as part of the rig specification. Procedures for drainage water management will be addressed within the drilling contractor's documentation and the Noble DMPO.<br>• Noble will ensure that the drilling and OSV contractors have procedures for fuel bunkering. These procedures will be subject to audit/assessment prior to drilling operations commencing.<br>• Offshore bulk materials and fluid transfers will be minimised, where possible, making efficient use of OSV loads and voyages.<br>• Where practicable, re-fuelling and transfer of bulk fluids will be undertaken during daylight hours only. Fluid transfer and crane operations will take place only in suitable weather conditions. Transfer operations will be supervised at all times both from the OSVs and drilling rig. | **Unlikely** | **Minor** | **Low** |

| NON-ROUTINE HAZARDS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Area of Concern | Aspects | Likelihood | Severity | Potential Impact | Mitigation measures | Likelihood | Severity | Residual Impact |
| | seabirds on the sea surface. | | | | • Non-return valves will be installed on bulk fluid transfer hoses. Hoses will be tested and inspected as a part of the drilling contractor's planned maintenance system/procedures.<br>• Spill kits will be readily available on deck for mopping up any minor spills. Personnel will be trained in unintentional release prevention and the use of spill kits. Regular drills will be held to contain and clean up deck spills.<br>• To prevent losses of drilling mud, the marine riser system will be operated and maintained in good order as per Noble and drilling contractor policies, including:<br>  ○ Lower Marine Riser Package (LMRP) to have integrated Remotely Operated Vehicle (ROV) remote interfaces for emergency use;<br>  ○ Use of low pressure alarms in the riser system;<br>  ○ Rig Emergency Disconnect System (EDS) locked-out in normal operation;<br>  ○ Regular LMRP inspection with rig ROV; and<br>  ○ Regular riser-tensioner system inspection.<br>• All contracted vessels will have a Ship-board Oil Pollution Emergency Plan (SOPEP) in place to define their response procedures in the event of a pollution incident.<br>• Drilling chemicals will be selected on the basis of environmental performance, as much as possible, within the mud programme, so as to reduce any potential environmental impacts.<br>• Noble will have Tier 1 response packages available in order to provide a timely and efficient Tier 1 spill response effort (refer to Tier 1 Response below).<br>• An Oil Spill Response Plan (OSRP) will be developed and implemented prior to drilling operations commencing.<br>• All instances of unintentional release will be handled in accordance with Falkland Islands Government Petroleum Operations Notice 8, May 2012 Revision (hereafter referred to as PON 8). In particular, the use of dispersants will be | | | |

| NON-ROUTINE HAZARDS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | | | | | coordinated with Incident Command as defined in the National Oil Spill Contingency Plan (NOSCP) as noted in Section 3 of PON 8 for approval and usage conditions. | | | |
| | **An emergency incident (e.g. vessel collision), leading to potential unintentional releases**<br><br>An emergency incident, such as a collision or catastrophic failure of equipment, could potentially cause a total loss of containment of entire inventories of diesel, utility fuels and chemicals from either the drilling rig or OSVs. This has the potential to cause significant hydrocarbon and/or chemical pollution, which will have detrimental impacts on water quality and marine wildlife in the affected area. | **Possible** | **Severe** | **High** | • All mitigation measures associated with collision avoidance as defined in 1.2 (Physical Presence).<br>• Pre-mobilisation audits/assessments will be undertaken on all vessels. Vessels will be selected which comply with IMO codes for pollution prevention.<br>• All contracted vessels will have a SOPEP in place to enable fast and effective response to any potential pollution incident.<br>• An Emergency Response Plan (ERP) and Oil Spill Response Plan (OSRP) will be developed and implemented prior to drilling operations commencing.<br>• All instances of unintentional release will be handled in accordance with Falkland Islands Government Petroleum Operations Notice 8, May 2012 Revision (hereafter referred to as PON 8). In particular, the use of dispersants will be coordinated with Incident Command as defined in the National Oil Spill Contingency Plan (NOSCP) as noted in Section 3 of PON 8 for approval and usage conditions. | **Remote** | **Major** | **Medium** |
| | **Uncontrolled release of reservoir hydrocarbons (blow-out)**<br><br>In the event of a serious well control incident, there is the potential for a significant unintentional release of hydrocarbons due to uncontrolled well flow.<br><br>A significant release of hydrocarbons has the potential to cause physical oiling and toxicity impacts to marine wildlife, and potential contamination of | **Unlikely** | **Catastrophic** | **High** | • The drilling operations will follow established drilling safety standards to minimise the risk of loss of well control. Well control systems and procedures will be in place as per all Noble and drilling contractor well control guidelines.<br>• The drilling crews will be adequately experienced, trained in well control techniques and supervised at all times. Emergency drills will be held regularly.<br>• Well designs will be reviewed by an independent well examiner.<br>• A Blow-out Preventer (BOP) will be in place 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. | **Remote** | **Severe** | **Medium** |

| NON-ROUTINE HAZARDS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Area of Concern** | **Aspects** | **Likelihood** | **Severity** | **Potential Impact** | **Mitigation measures** | **Likelihood** | **Severity** | **Residual Impact** |
| | coastal habitats.<br><br>Indirect impacts could potentially include: habitat loss, impact on tourism and fisheries, issues associated with waste disposal, trans-boundary issues, accumulation of oil and chemicals in ecosystem food chains and in sediments, loss of biodiversity and loss of revenue to local businesses and fisheries. | | | | • The BOP will be subject to a third party verification and audit prior to drilling operations commencing.<br>• The BOP specification will include one (1) shear ram, one (1) casing shear ram and a ROV remote interface to key BOP functions for emergency use.<br>• All key offshore personnel will have International Well Control Forum (IWCF) well control certification.<br>• Noble is a FULL member of Oil Spill Response Limited (OSRL), providing an enhanced Tier 2/3 oil spill response capability.<br>• Noble is a member of the Global Dispersant Stockpile provided by OSRL for the purpose of responding to unintentional releases.<br>• An Emergency Response Plan (ERP) and Oil Spill Response Plan (OSRP) will be developed and implemented prior to drilling operations commencing.<br>• All instances of unintentional release will be handled in accordance with Falkland Islands Government Petroleum Operations Notice 8, May 2012 Revision (hereafter referred to as PON 8). In particular, the use of dispersants will be coordinated with Incident Command as defined in the National Oil Spill Contingency Plan (NOSCP) as noted in Section 3 of PON 8 for approval and usage conditions. | | | |

## Conclusion

Noble is proposing to conduct exploration drilling activities offshore of the Falkland Islands. Noble will ensure that operations throughout the exploration drilling programme will follow applicable laws, regulations, standards; and environmental, socio-economic, health and safety best practices (such as effective waste management, staff awareness of environmental issues and training in pollution prevention procedures and emergency response).

Although there will be some environmental impacts during each phase of the project life cycle, adverse long-term environmental impacts from the exploration drilling programme have been assessed as **low**, and incremental cumulative impacts of the development will be minimal. Furthermore, due to the implementation of control and mitigation measures, the majority of residual impacts are considered to be **low**.

There is the potential for disturbance from planned exploration drilling operations to significantly affect the two existing shipwrecks lying within the southern region of FISA12. It is thought that an anomaly seen on the bathymetry is highly likely to be the wreck of the Atlantic Conveyor in FINA13 but the survey was unable to obtain seabed photographs so a positive identification was not possible. However, Noble has proposed the following mitigation measures to ensure these important wreck sites remain unaffected:

1. Placing an exclusion zone around the best known 'as reported' wreck locations;
2. Choosing well locations that avoid existing wrecks; and
3. Re-locating the wellhead should the location of the wrecks be found during pre-drilling surveys.

With the implementation of the above measures residual impacts to wreck sites form the proposed drilling activity will be reduced to **low**.

Underwater noise during Vertical Seismic Profiling (VSP) operations has the potential to cause injury and behavioural disturbance to marine mammals and fish. The injury and behavioural noise levels for cetaceans will be exceeded during the potential VSP operations, although only within three metres (permanent threshold shift [PTS] criteria) and six metres (temporary threshold shift [TTS] criteria) of the VSP equipment noise source.

Without mitigation, there is the potential for these impacts to be considerable to marine mammals that may be in the location during VSP operations. JNCC guidelines for minimising risk to marine mammals from VSP noise emissions and the employment of soft-start procedures will be implemented to reduce potential impacts. However, due to the uncertainty related to the distribution and abundance of marine mammals in the area the residual impact will remain **medium**. Monitoring of marine mammal populations during VSP operations will be utilised to ensure that the measures employed reduce the impact as much as possible and to ensure (as far as possible) that firing of seismic equipment occurs when marine mammals are not in the vicinity of the seismic source.

For fish species, there is potential for injury within very close proximity to the VSP energy source, although this is significantly reduced beyond 300 metres. Through the use of soft start procedures any fish that are present will be alerted to the sound and will gradually move further away from the source as the sound increases. As a result, the likelihood and severity of the impact is reduced although the residual impact is **medium**. However, it should be noted that this is a precautionary assessment and that the main fish species likely to be present (e.g., Patagonian toothfish, *Dissostichus eleginoides*) are hearing generalists and are less affected by sound and the assessment was undertaken on a precautionary basis.

Accidental events involving unintentional releases of hydrocarbons or chemicals are of **medium** impact. They require control measures to reduce the potential impacts as much as possible, including:

- Stringent well control procedures;
- Oil spill response procedures, including:
  a. the provision of Tier 1 response capability; and

b. development of an Oil Spill Response Plan (OSRP),

- Membership with a reputable international oil spill response organisation; and
- Emergency response procedures (including the production of an Emergency Response Plan [ERP]).

Noble operates under a Global Environmental, Health and Safety (EHS) Management System (GMS). Noble is committed to conducting its business in a manner that protects the environment, health and safety of employees and communities. To achieve this, Noble strives to comply with EHS laws and minimize injuries and incidents whilst protecting the environment. Noble's GMS is a consistent framework for the management of EHS issues and is instrumental in protecting the environment and the health and safety of our employees and communities.

For the Falklands Exploration drilling programme, the main method for converting the GMS policies and principles into action will be the EMPA presented in Section 7. These commitments are captured through the Noble tracking system and carried through to detailed design and operations. The plan identifies monitoring, management measures and responsibilities to be implemented.

In turn the EMPA will be transposed into the contractual obligations of contractors employed by Noble to deliver the project. The Environmental Management Systems (EMS) of each contractor will be audited to ensure compliance with the Noble GMS and as necessary bridging documents will be put in place to ensure compatibility between systems. In cases where the Noble GMS and a contractor EMS differ, the more stringent measure will apply.

Moving forward, the creation and implementation of the procedures and documents outlined in Section 7 will ensure that mitigation measures identified in the Environmental Management Plan (EMPA) and proposed within this EIS are adhered to throughout the lifetime of the exploration drilling project and will ensure that any potential impacts to the environment are minimised.

# Abbreviations

| | |
|---|---|
| 3D | Three Dimensional |
| AABW | Antarctic Bottom Water |
| AAIW | Antarctic Intermediate Water |
| ACAP | Agreement on the Conservation of Albatrosses and Petrels |
| ACC | Antarctic Circumpolar Current |
| ADCP | Acoustic Doppler Current Profiler |
| AIS | Automatic Identification System |
| APF | Antarctic Polar Front |
| API | American Petroleum Institute |
| BHCT | Bottom-hole Circulating Temperature |
| BHST | Bottom-hole Static Temperature |
| BNS | Bonaerensis-north-Patagonic Stock |
| BOD | Biological Oxygen Demand |
| BOP | Blow-out Preventer |
| BWM | Ballast Water Management |
| CCAMLR | Conservation of Antarctic Marine Living Resources |
| CCHASS | Convention on the Control of Harmful Anti-fouling Systems on Ships |
| CEFAS | Centre for Environment, Fisheries & Aquaculture Science |
| CFL | Consolidated Fisheries Limited |
| CH4 | Methane |
| CHARM | Chemical Hazard and Risk Management |
| CITES | Convention on International Trade in Endangered Species |
| CMS | Convention on the Conservation of Migratory Species of Wild Animals |
| CMS | Convention on Migratory Species |
| CO2 | Carbon Dioxide |
| COLREGS | International Regulations for Preventing Collisions at Sea |
| CPUE | Catch per Unit Effort |
| CTD | Conductivity, Temperature, Depth |
| CZ | Confluence Zone |
| DECC | Department of Energy and Climate Change |
| Defra | Department for Environment, Food and Rural Affairs |
| DMPO | Discharge Management Programme |
| DMR | Department of Mineral Resources |
| DO | Dissolved Oxygen |
| DP | Dynamic Positioning |
| DTI | Department of Trade & Industry |
| ECMWF | European Centre for Medium-range Weather Forecasting |
| EDS | Emergency Disconnect System |
| EEMS | Environmental Emissions Monitoring System |
| EEZ | Economic Exclusion Zone |
| EHS | Environmental, Health and Safety |
| EIA | Environmental Impact Assessment |
| EIS | Environmental Impact Statement |
| ENT | Ear, Nose and Throat |
| EOW | End of Well |
| EP | Equator Principles |
| ERP | Emergency Response Plan |
| ESM | Environmentally Sound Management |
| EMPA | Environmental Management Plan |
| ExCo | Executive Council |
| FAO | Food and Agriculture Organisation |
| FC | Falklands Conservation |

| | |
|---|---|
| FCO | Foreign and Commonwealth Office |
| FIC | Falkland Islands Company |
| FICS | Falkland Islands Community School |
| FICZ | Falklands Interim Conservation and Management Zone |
| FIDF | Falkland Islands Defence Force |
| FIFCA | Falkland Islands Fishing Companies Association |
| FIG | Falkland Islands Government |
| FIGAS | Falkland Islands Government Air Service |
| FINA13 | Falkland Islands Northern Area |
| FIPASS | Falklands Interim Port and Storage System |
| FIPLA | Falkland Islands Petroleum Licencees Association |
| FISA12 | Falkland Islands Southern Phase A area |
| FISP | Falkland Islands Structure Plan |
| FIST13 | Falkland Islands Southern Tilted Fault Block area |
| FITB | Falkland Islands Tourist Board |
| FIYC | Falkland Island Yacht Club |
| FMCF | Falkland/Malvinas Current Front |
| FOCZ | Falkland Islands Outer Conservation Zone |
| FOGL | Falkland Oil and Gas Limited |
| FPV | Fishery Patrol Vessel |
| FTU | Formazin Turbidity Units |
| GCSE | General Certificate of Secondary Education |
| GDP | Gross Domestic Product |
| GHG | Greenhouse Gas |
| GIRG | Global Industry Response Group |
| GIS | Geographic Information System |
| GMS | Global Environmental, Health and Safety (EHS) Management System (Noble) |
| GODAE | Global Ocean Data Assimilation Experiment |
| GWP | Global Warming Potential |
| HM | Her Majesty |
| HMS | Helideck Monitoring System |
| HOCNS | Harmonised Offshore Chemical Notification Scheme |
| HQ | Hazard Quotient |
| Hs | Significant Wave Height |
| HSE | Health & Safety Executive |
| HYCOM | Hybrid Coordinate Ocean Model |
| IBA | Important Bird Area |
| IFC | International Finance Corporation |
| IMO | International Maritime Organisation |
| IOPC | International Oil Pollution Compensation Fund |
| ITOPF | International Tanker Owners Pollution Federation |
| ITQ | Individual Transferable Quota |
| IUCN | International Union for Conservation of Nature |
| JNCC | Joint Nature Conservation Committee |
| KIAS | Knots Indicated Air Speed |
| $LC_{50}$ | Lethal Concentration, 50% |
| LME | Large Marine Ecosystem |
| LMRP | Lower Marine Riser Package |
| LTOBM | Low Toxicity Oil Based Mud |
| MARPOL | International Convention for the Prevention of Pollution from Ships |
| mb | Millibars |
| MEPC | Marine Environment Protection Committee |
| MMO | Marine Mammal Observer |
| MoD | Ministry of Defence |

| | |
|---|---|
| MODU | Mobile Offshore Drilling Unit |
| MPA | Mount Pleasant Airport |
| MSL | Mean Sea Level |
| MSPA | Media Strategy Plan |
| NABW | North Atlantic Bottom Water |
| NCODA | Navy Coupled Ocean Data Assimilation |
| NADF | Non-Aqueous Drilling Fluid |
| NASA | National Aeronautics and Space Administration |
| NEC | No Effect Concentration |
| NHS | National Health Service |
| NNR | National Nature Reserve |
| NOAA | National Oceanic and Atmospheric Administration |
| NODC | National Oceanographic Data Center |
| NOGAPS | Navy Operational Global Atmospheric Prediction System |
| NOSCP | National Oil Spill Contingency Plan |
| NOx | Oxides of Nitrogen |
| NTM | Notice to Mariners |
| OBM | Oil Based Mud |
| OCNS | Offshore Chemical Notification Scheme |
| OD | Outside Diameter |
| OGP | International Association of Oil & Gas Producers |
| OGUK | Oil & Gas UK |
| OSPAR | Convention for the Protection of the Marine Environment of the Northeast Atlantic |
| OSRP | Oil Spill Response Plan |
| OSV | Offshore Supply Vessel |
| OWS | Oily Water Separator |
| PAH | Polycyclic Aromatic Hydrocarbons |
| PAM | Passive Acoustic Monitoring |
| PCBs | Polychlorinated Biphenyls |
| PEC | Predicted Effect Concentration |
| PGS | Petroleum Geo-Services |
| PID | Project Information Document |
| PL | Production License |
| PLONOR | Poses Little or No Risk (to the environment) |
| PON | Petroleum Operations Notice |
| PPG | Pounds per Gallon |
| PPP | Public Private Partnership |
| PRP | Permanent Residence Permit |
| PS | Performance Standards |
| PSO | Protected Species Observer |
| PTS | Permanent Threshold Shift |
| PWD | Public Works Department |
| RCM | Recording Current Meters |
| RFAS | Royal Fleet Auxiliary Service |
| ROV | Remotely Operated Vehicle |
| RPS | Rural Planning Services |
| RQ | Risk Quotient |
| RSPB | Royal Society of the Protection of Birds |
| SAR | Search and Rescue |
| SASW | Sub-Antarctic Surface Water |
| SEP | Stakeholder Engagement Plan |
| SG | Specific Gravity |
| SOLAS | International Convention for the Safety of Life at Sea |
| SOPEP | Shipboard Oil Pollution Emergency Plan |

| | |
|---|---|
| SOx | Oxides of Sulphur |
| SPS | South Patagonian Stock |
| SSS | Summer-spawning Stock |
| SSV | Safety Stand-by Vessel |
| STP | Stanley Town Plan |
| TBM | Trans-boundary Movement |
| TBT | Tributyl Tin |
| TDF | Temporary Dock Facility |
| THC | Total Hydrocarbon Concentration |
| TPH | Total Petroleum Hydrocarbons |
| TTS | Temporary Threshold Shift |
| UK | United Kingdom |
| UKCS | United Kingdom Continental Shelf |
| UKOOA | UK Offshore Operators Association |
| UKOT | United Kingdom Overseas Territory |
| UNCLOS | United Nations Convention on the Law of the Sea |
| UNEP | United Nations Environment Programme |
| UNESCO | United Nations Education, Scientific and Cultural Organisation |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UXO | Unexploded Ordinance |
| VMS | Vessel Monitoring System |
| VOC | Volatile Organic Compounds |
| VSP | Vertical Seismic Profiling |
| WB | World Bank |
| WBM | Water Based Mud |
| WHO | World Health Organisation |
| WOA | World Ocean Atlas |
| WMPA | Waste Management Plan |
| YPU | Young Person's Unit |

# 1 Introduction

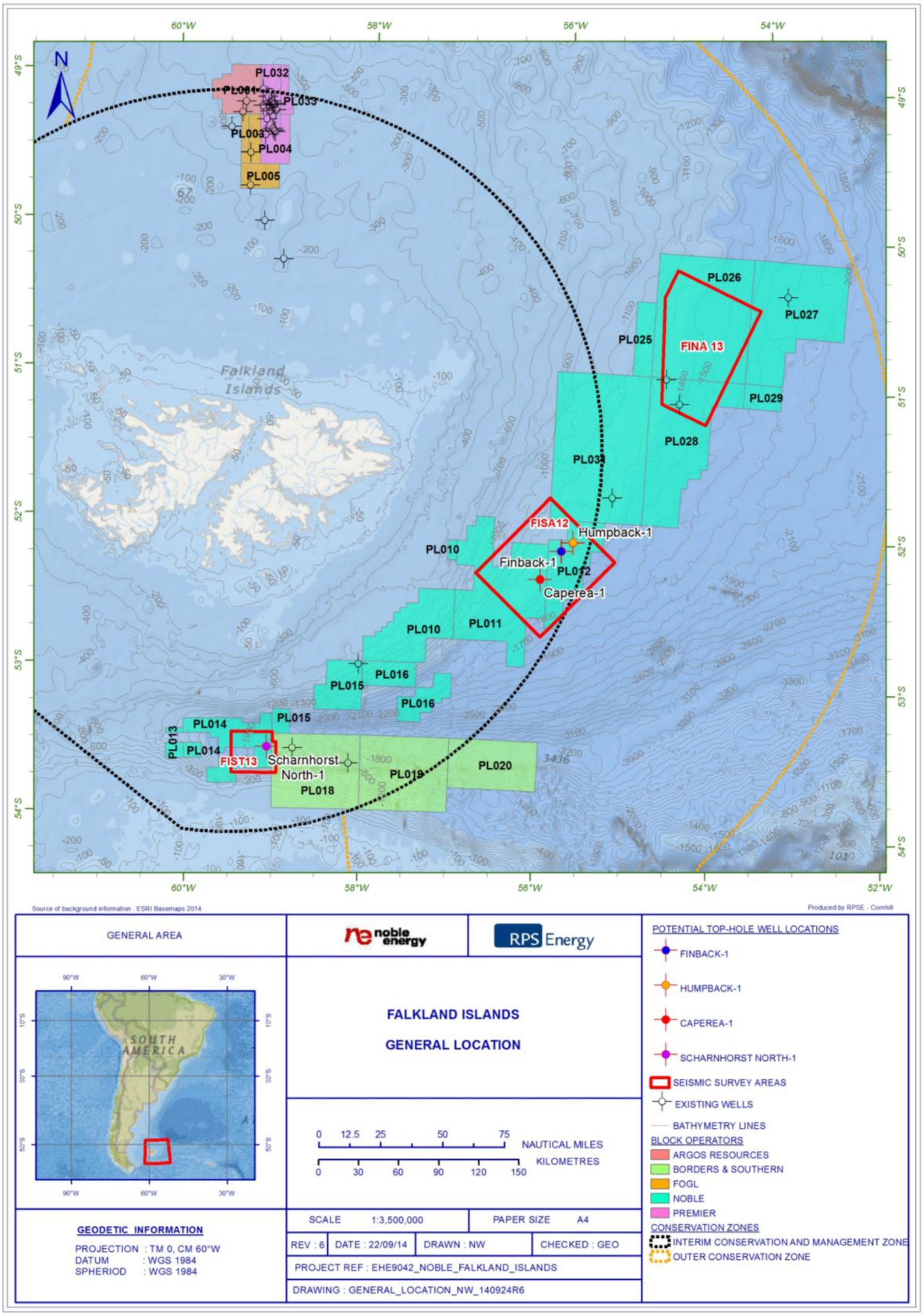
## 1.1 Background

1.1 Noble Energy Falklands Limited, a subsidiary of Noble Energy, Inc.; (hereafter referred to as 'Noble') is proposing to conduct exploration drilling activities offshore the Falkland Islands within its Production License (PL) areas. Currently, the planned drilling programme consists of two exploration wells and one optional exploration/appraisal well (a potential total of three wells). To date, four potential well locations have been identified. The exploration drilling activities are planned to commence early to mid-2015. It is currently estimated that it will take between 75 and 90 days to drill and construct each well.

1.2 In 2012, Noble acquired license interests in the southern and northern license areas offshore the Falkland Islands. As of 2014, Noble currently holds operatorship of these licenses. Figure 1.1 shows the location of the Noble operated licenses, and the location of the potential exploration well top-hole locations. Figure 1.1 also shows areas where Noble has conducted seismic surveys (red outlines).

1.3 The EIS document is required as part of the permit application to the Falkland Islands Government (FIG) Department of Mineral Resources (DMR) and is intended to identify potentially significant environmental impacts resulting from the proposed exploration drilling activities to enable an informed approval decision to be made by FIG on the exploration drilling project.

*Figure 1.1: Noble license areas offshore the Falkland Islands and potential well top-hole locations*



## 1.2 The Applicant – Noble Energy Falklands Limited

1.4 The applicant for the environmental permit to conduct exploration drilling activities offshore the Falkland Islands is Noble Energy Falklands Limited.

1.5 Noble is committed to being a positive force and a responsible member of the communities where it operates. Noble conducts its business with integrity, respect and high standards of environmental, health, safety and socio-economic stewardship. Noble's vision is to be the leader in safe and environmentally sound operations. To that end, Noble sets high expectations, takes personal ownership and establishes strict accountability for the company's environmental, health, safety and regulatory (EHSR) performance among its employees.

1.6 Noble operates under a Global Environmental, Health and Safety Management System (GMS) and is committed to conducting its business in a manner that protects the environment, health and safety of employees and communities. To achieve this, Noble strives to comply with EHS laws and minimize injuries and incidents whilst protecting the environment.

1.7 Further information on Noble can be found online at the company website:

http://www.nobleenergyinc.com/Home-4.html.

## 1.3 The Consultancy

1.8 Noble and its partners have entered into a service agreement with RPS Energy to complete an EIS document for its planned exploration drilling activities. RPS Energy is an international consultancy firm specialising in the environment, which has already completed several impact assessments for exploration drilling projects in the Falkland Islands.

## 1.4 Overview of Proposed Project

1.9 The exploration drilling campaign will use the dynamically positioned, harsh-environment semi-submersible drilling unit *Eirik Raude*. The *Eirik Raude* is owned and operated by the drilling contractor (Ocean Rig). The drilling rig will be supported by three Offshore Supply Vessels (OSVs). One of these OSVs will remain within the vicinity of the drilling unit at all times and assume the role of Safety Stand-by Vessel (SSV).

1.10 The onshore support location for the exploration drilling activities will be Stanley. The OSVs will travel to/from the drilling unit from the planned Noble Temporary Dock Facility (TDF) under installation in Stanley Harbour (which is the subject of a former planning submission). The vessels will transport the materials and supplies needed for the drilling operations to/from the drilling unit on an ongoing basis. Noble also has a shore base located on Boxer Bridge Road which will be used to store the drilling equipment, associated tools and chemicals. These items will be transferred between the shore base and TDF by road.

1.11 It is anticipated that the drilling will commence in early to mid-2015. It is currently estimated that it will take between 75 and 90 days to drill and construct each well.

### 1.4.1 Project Benefits

1.12 The proposed Noble drilling programme has the potential to contribute significantly to the economy of the Falkland Islands during operations. The following provides a summary of the potential benefits of the project to the Falkland Islands. It is recognised that such benefits of the drilling programme may only be seen during execution of the programme.

#### Additional Revenue to Local Businesses

1.13 During the exploration drilling programme, Noble will procure, using companies based in Stanley wherever possible, personnel support services (such as accommodation and local transport), food and equipment. The majority of companies used are expected to be small to medium enterprises. The procurement of goods and services has the potential to result in a rapid, temporary increase in indirect economic capital flows in Stanley. In response, business owners of the small to medium enterprises used may decide to increase their employed workforce and/or extend existing employment contracts. The capital spend is expected to have a positive effect on the households of employed workers, business owners and contribute towards the ongoing socio-economic development of Stanley.

### Additional Revenue to FIG

1.14 The drilling programme has the potential to raise taxation revenues to FIG associated with the financial spend of Noble during development of the project. This additional government revenue has the potential to support FIG in providing essential infrastructure and services to the national population.

### Oil and Gas Industry Experience

1.15 Completion of the proposed exploration drilling programme will provide local companies direct experience with working in the oil and gas industry and contribute to the rising profile of the industry in the Falkland Islands. The use of companies in Stanley has the potential to provide business owners and their workers with an opportunity to become familiar with the way in which the oil and gas industry operates, which may assist them in securing additional contracts in the future. The type of experience that will be gained, for example, includes an enhanced understanding of environmental, health and safety (EHS) requirements within the oil and gas industry (this is generally higher than those adopted for other projects), and an understanding of how oil and gas procurement contracts are implemented. Considering that the oil and gas industry is still at an early stage within the Falkland Islands, this type of direct experience is expected to place both business owners and their workers in strategically favourable positions in the future.

## 1.5 EIA Process

1.16 The Environmental Impact Assessment (EIA) process is defined as the entire process undertaken during the development of the project and execution to define, understand and manage potential impacts. As part of this process an Environmental Impact Statement (EIS) is produced. The EIS is a document which assesses the potential impact of the development on the environment and identifies how these impacts will be avoided, mitigated or compensated. The production of the statement is a key part of the wider EIA process that includes public consultation on the EIS document and its consideration by decision makers. In other words, the EIS document is a stage part-way through the process and facilitates later stages of the EIA process.

1.17 The EIA process is a useful management tool since it aims to balance environmental considerations and business priorities of the exploration company.

1.18 The legislation requires the production of an EIS which assesses the potential impact of the development on the environment and identifies how these impacts will be avoided, mitigated or compensated. The EIS document is a statutory requirement for Noble as operator of the licence. The following sections outline the process that has been undertaken in developing the EIS document before its submission to the regulator and before consultation with the public.

1.19 At the core of the EIA process (and this EIS document) is the process of impact management, which has four main elements:

- Identification of environmental impacts associated with the activity and definition of the characteristics of the existing environment;
- Assessment of the scope and extent of any associated potential impacts;
- Implementation of control techniques to eliminate or mitigate effects and manage impacts; and
- Development of plans/procedures to manage the potential impacts throughout the lifetime of the project.

1.20 In practice, environmental impact control measures constitute an integral part of engineering design and assessment. This EIS document has been undertaken in order to confirm the effectiveness of the standard control methods of engineering assessments and to identify specific cases where additional control measures may be required.

1.21 The key steps in producing the EIS document include:

- Data gathering;
- Scoping;
- Public consultation;
- Impact assessment;
- Proposing mitigation measures;
- Development of EHS management plans, as appropriate; and
- Reporting for submission.

1.22 These stages are summarised in the sections below.

### 1.5.1 Data Gathering

1.23 In this phase, information on the aspects of the project and any associated regulations were obtained. A full bibliographic reference list is included in Section 10 of this document.

1.24 A baseline study of the Noble license areas was carried out, which included physical, biological and socio-economic elements. Previous site surveys conducted in the vicinity of the Noble licenses were obtained with the permission of Noble's partner, Falkland Oil and Gas Limited (FOGL) to support this baseline study in addition to surveys undertaken with the Noble licenses. The latest fisheries statistics were also obtained from the Falkland Islands Department of Natural Resources – Fisheries Department.

1.25 Additional information sources were identified during consultation efforts undertaken in the Falkland Islands during September 2013 during the scoping consultation phase (refer to Section 1.5.2 below).

1.26 Environmental surveys took place over the FISA12, FIST13 and FINA13 areas. The results of the FISA12 survey, where drilling will be undertaken first, have been summarised in this document. The environmental surveys for FIST13 and FINA13 are not currently available, but will be reported in addenda submitted prior to drilling operations commencing.

1.27 Information on the proposed exploration drilling programme was provided by Noble. Information on the legal framework is based on RPS's prior experience in the Falkland Islands and from discussions with the FIG DMR.

### 1.5.2 Scoping

1.28 During scoping, applicable laws, regulations and standards were identified alongside the potential project impacts so that the investigation, studies or surveys required could be appropriately planned for and incorporated into the EIA process.

1.29 During scoping, a visit to the Falkland Islands was undertaken to discuss the proposed exploration drilling project with relevant FIG departments and to undertake initial scoping consultation with local community members and stakeholder groups. Following the scoping consultation visit, a Scoping Report was developed which included a summary of the project, initial identification of potential impacts and the Terms of Reference (ToR) for the EIS document. The Scoping Report was provided to stakeholders who were invited to comment on the project.

1.30 During discussions with the Department of Mineral Resources, the project area of influence (a.k.a., study area) was identified as:

- The project area of influence for the exploration drilling programme covers all activities (including vessel activities) that take place outside the 12 nautical mile limit, and all activities that occur onshore that are directly related to the exploration drilling activities. All activities that take place inside the 12 nautical mile limit that are associated with the Temporary Dock Facility (TDF) were covered within the ESHIA submitted and approved for the TDF.
- Unplanned events, such as unintentional releases of hydrocarbons originating from the activities of the exploration drilling project are also covered by this EIS document.
- Indirect project impacts on biodiversity or on ecosystem services are covered by this EIS document, including impacts on the seabed, seabirds, marine mammals and terrestrial habitats and ecosystems within the footprint of the project and within the area of influence for potential impacts from noise and accidental events.
- Potential cumulative impacts associated with the exploration drilling activities are covered by this EIS document.

1.31 Further details on the scoping process are provided in Sections 8.4 to 8.7.

### 1.5.3 Consultation

1.32 As part of the consultation process undertaken in developing the EIS document, RPS Energy (Noble's EHS consultant), visited Stanley from 31st August to 7th September 2013 to meet with stakeholders. The main objectives of the visit were to:

- Provide stakeholders with background information to raise awareness of the proposed project;
- Provide an opportunity for stakeholders to comment on the proposed exploration drilling project at an early stage during the EIA process;
- Advertise the availability of a Noble Energy Community Feedback Mechanism which can be used at any stage of the EIA process to request additional information, or to raise a complaint; and
- Provide RPS with an opportunity to ask specific questions to stakeholders, associated with existing environmental and socio-economic conditions, and the type and status of resources potentially available to Noble that could be used during the project.

1.33 A summary of the stakeholder consultation meetings were recorded. Key issues raised by stakeholders during the consultation week included:

- Concerns over the generation, storage and treatment/disposal of waste as there are limited reception facilities on the Islands;
- Navigational risk associated with increased vessel traffic to/from the drilling unit;
- Limited emergency resources on the Islands in the event of an emergency/MedEvac situation;
- Potential for oil spills and accuracy of any oil spill modelling that is carried out;
- Potential for conflict between incoming workers and local residents;
- Potential discharge of oil based mud (OBM) and discharge of drilling chemicals;
- Potential disruption of fishing activities;
- Public access to information during the public consultation process;
- The potential cumulative impact from a 3 year drilling campaign;
- Bio-security – risk of introduction of invasive species; and
- Water requirements and potential impact on public water supply.

### 1.5.4 Impact Assessment

1.34 The potential impacts from the project identified during the scoping phase have been assessed using a Risk Assessment Matrix (RAM) based on the expected severity of the impact and its likelihood of occurrence.

1.35 Once mitigation and monitoring measures are designed, the residual risk is assessed again using the same RAM. The results of this assessment are presented in matrix form in the Action Register (refer to Appendix A).

### 1.5.5 Environmental & Social Management Plan

1.36 As part of the EIA process, an Environmental Management Plan (EMPA) will be developed that summarises the project's approach to managing, monitoring and reviewing its impacts for each of the project lifecycle stages that the EIS document addresses. This section summarises the specific environmental, socio-economic and health plans and procedures that the project has developed or will develop to help manage its potential impacts. Information on the EMPA is provided in Section 7.

1.37 The summaries of these plans and procedures may include:

- Objectives of the document;
- Applicable commitments, including specific laws, regulations, Noble Energy's GMS elements, Equator Principles (EP) and/or International Finance Corporation (IFC) Performance Standards (PS) and EHS Guidelines;
- Key impacts and mitigation measures it addresses; and
- Key personnel and/or contractors responsible for developing, maintaining and implementing the plan or procedure.

### 1.5.6 EIS Report Submission

1.38 The final EIS document will be printed for submission to the FIG DMR and EPD.

1.39 Paragraphs in this report have been numbered to aid cross referencing.

# 2 Project Description

## 2.1 Introduction

2.1 Noble is proposing to conduct exploration drilling activities offshore the Falkland Islands in the southern area licenses. The exploration drilling activities are scheduled to commence in early to mid-2015.

2.2 At the present time not all details relating to the proposed drilling programme have been finalised. Noble is aware that it is common practice in the Falkland Islands for operators to submit EIS addenda prior to the commencement of drilling operations, in order to confirm the well-specific drilling details.

### 2.1.1 Seismic Survey Areas

2.3 Three dimensional (3D) seismic survey activities have taken place in the areas of potential interest to Noble within the northern and southern license areas offshore the Falkland Islands.

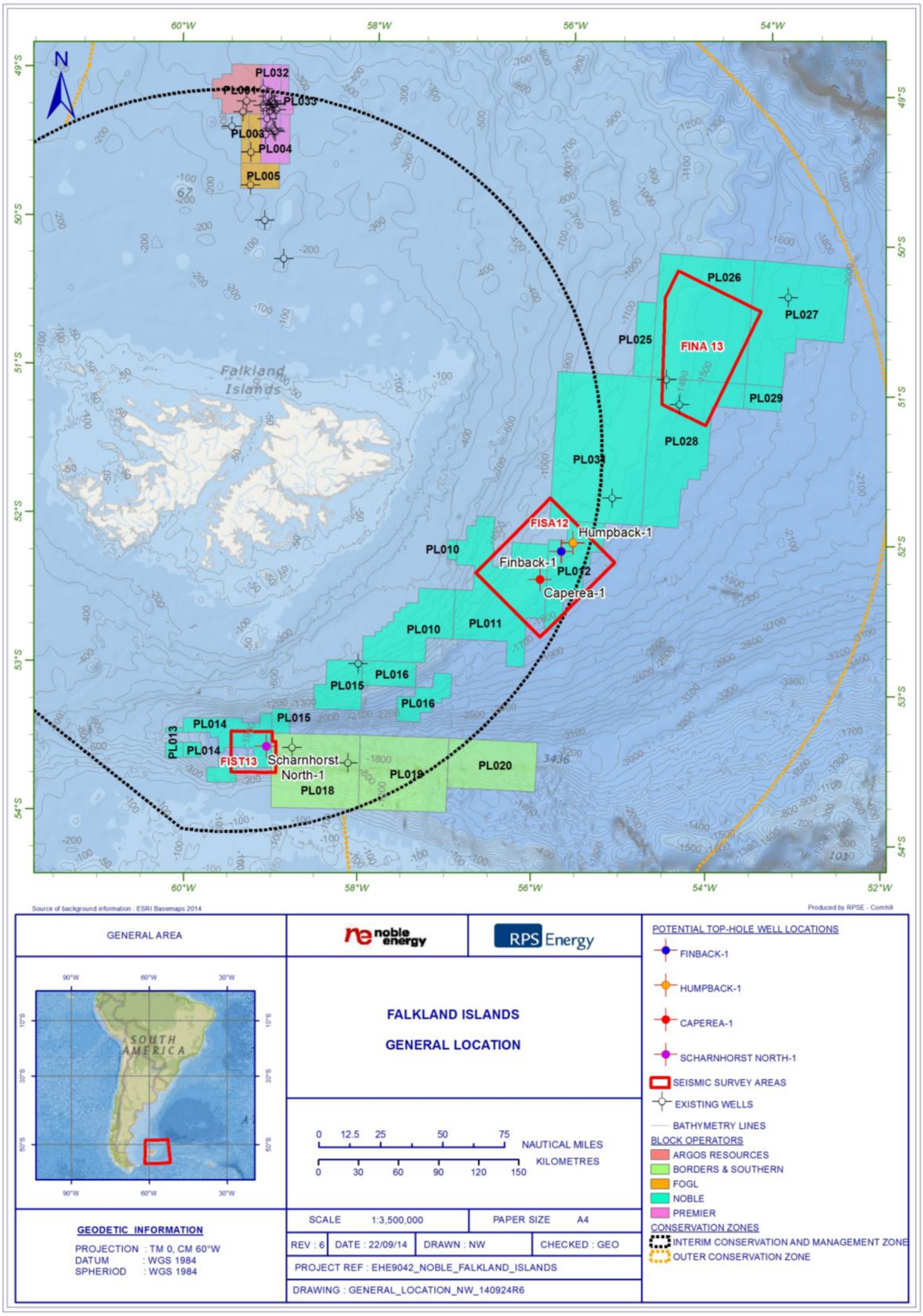
2.4 The first round of seismic survey activities was undertaken from November 2012 through June 2013. The areas surveyed were both located in the southern area licenses. The first of these surveys was the Falkland Islands Southern phase A (FISA12) survey. FISA12 is located in the East Falkland basin, approximately 100 kilometres from the nearest landfall at Cape Pembroke on the East Falkland mainland. FISA12 covers the north-western half of Production License (PL) 011, the majority of PL012 and the south-easternmost tip of PL031. Water depths across FISA12 range from approximately 900 to 1,700 metres. The seismic survey was undertaken between November 2012 and May 2013 using the Petroleum Geo-Services (PGS) survey vessel *Ramform Sterling*.

2.5 The second survey was the Falkland Islands Southern Tilted Fault Block (FIST13) survey, undertaken between May and June 2013 using the same vessel. FIST13 is located in the South Falkland basin approximately 62 kilometres from the nearest landfall at Beauchêne Island and approximately 125 kilometres from the East Falkland mainland at Bull Point. FIST13 covers the southern area of PL014 and a very small western area of PL018. Water depths across FIST13 range from approximately 660 to 2,100 metres.

2.6 The second round of seismic survey activities started in November 2013 and was completed in February 2014. The Falkland Islands Northern Area (FINA13) survey activities involved acquisition of data from the seismic survey in the northern area licenses. FINA13 covers the majority of PL026, a very small area of PL027 and the northern area of PL028. The PGS survey vessel *Ramform Titan* was used for this survey.

2.7 The locations of the seismic survey areas are shown in Figure 2.1.

*Figure 2.1: Noble seismic survey activities in the Falkland Islands and potential well top-hole locations*



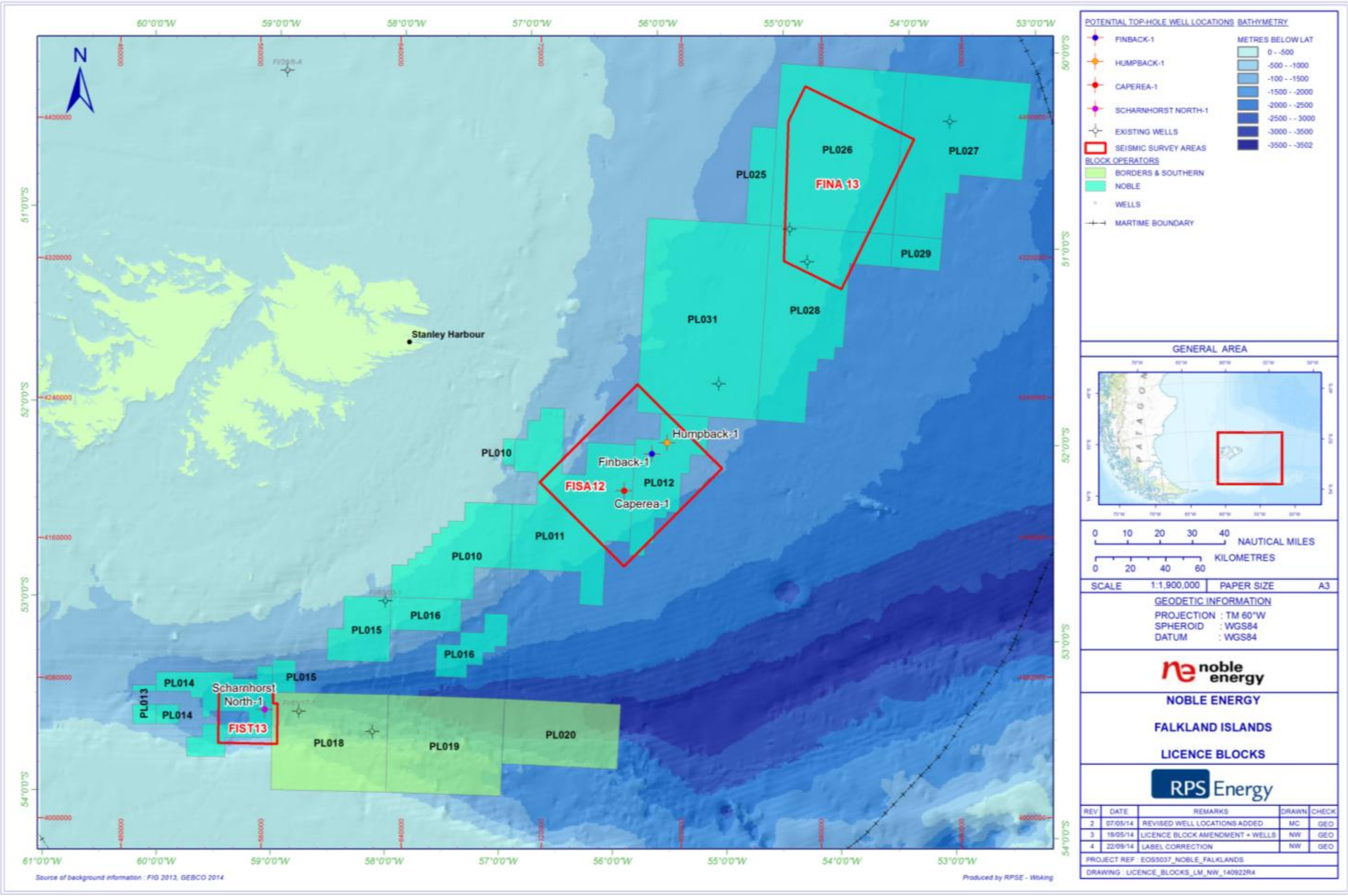
### 2.1.2 Proposed Drilling Activity

2.8 Noble is planning to drill two exploration wells. Currently, the planned drilling programme consists of two exploration wells and one optional exploration/appraisal well (a potential total of three wells). To date, four potential well locations have been identified. Analysis of seismic data is still ongoing and as such, well locations could be subject to change. The well locations presented in this EIS are the potential well locations that have been identified at the present time. It should also be noted that there is a possibility of a well location in FINA13.

2.9 At the present time, four potential top-hole well locations have been identified for the above drilling programme. These potential well locations are shown in Figures 2.1 and 2.2. It is currently unknown which of these wells will be drilled. For all confirmed well locations, EIS addenda will be prepared and submitted for approval (in agreement with FIG) prior to drilling commencing.

2.10 In addition, the well locations may be subject to change as detailed project planning evolves. Any changes to the well locations and drilling programme details will be confirmed in EIS addenda, which will be submitted at a later date prior to the commencement of drilling operations. For the purposes of this EIS, preliminary design details on the four potential wells are included in this section. It is currently anticipated that drilling activities will commence in early to mid-2015.

***Figure 2.2: Falkland Islands current offshore oil and gas license areas and potential top-hole well locations***




## 2.2 Target Reservoirs & Exploration Objectives

2.11 The objective of the drilling project is to explore potential hydrocarbon reservoirs.

2.12 The exploration well drilled within FISA12 will target either the Finback, Humpback or Caperea prospects, depending on which well is drilled. These prospects are part of the mid-Cretaceous Fan Play in the central portion of the East Falkland basin.

2.13 The exploration well drilled within FIST13 will target the Scharnhorst North prospect within the Southern Tilted Fault Block area.

2.14 There is also the potential for a well to be drilled in FINA13. Analysis of seismic data is ongoing, and any changes in well locations and drilling details will be reported in EIS addenda prior to drilling operations commencing.

2.15 It is anticipated that hydrocarbons, if discovered, would primarily comprise of light oil with an expected API (American Petroleum Institute) gravity of 35 – 40.

## 2.3 Proposed Drilling Schedule

2.16 The provisional project schedule proposes commencement of drilling operations in early to mid-2015. It is estimated that the rig will spend between 75 and 90 days on location at each well. Therefore, the rig may be engaged in drilling operations for up to 270 days, assuming that three wells are drilled (excluding rig moves between wells).

## 2.4 Drilling Operations

### 2.4.1 The Drilling Unit

2.17 The wells will be drilled with the semi-submersible drilling rig *Eirik Raude*. *Eirik Raude* is a 5th generation deep water semi-submersible drilling unit suitable for drilling in harsh and deepwater environments. The *Eirik Raude* is owned and operated by Ocean Rig (Figure 2.3). The *Eirik Raude* has been fully engaged in drilling operations since its commissioning in 2002 and has operated successfully in harsh environment and benign locations around the globe. The full specification for the *Eirik Raude* is provided in Table 2.1.

***Figure 2.3: 5th Generation deep water semi-submersible drilling rig 'Eirik Raude' (Ocean Rig, 2014)***

*Table 2.1: Ocean Rig 'Eirik Raude' specification (Ocean Rig, 2014)*

| Feature | Specification |
|---|---|
| **General** | |
| **Rig Type** | Dynamically Positioned (DP) Deep Water Semi-submersible |
| **Rig Design** | Trosvik BINGO 9000 design, 6 columns |
| **Year Built** | 2002 |
| **Flag State** | Bahamas |
| **Class** | DnV + 1A1Column Stabilised Drilling Unit, HELDK-SH, |
| **Water Depth** | 10,000ft (3000m) |
| **Dimensions** | 119.38m (391.68ft) overall by 85.50m (278.88ft) overall |
| **Drilling Depth** | 30,000 ft (9,144m) |
| **Propulsion** | 6 x Rolls Royce UCC7001 azimuth thrusters |
| **Transit Speed** | 6 knots |
| **Variable Deckload** | Operation 5,900mt<br>Survival 5,900mt<br>Transit 5,000mt |
| **Helideck** | D= 22.8m, 15mt |
| **Max. POB** | 120 for North Sea areas, 140 other areas |
| **Drilling Equipment** | |
| **Derrick** | Hydralift 170ft x 40ft x 40ft; 907mt (2,000,000 lbs) |
| **Draw-works** | Continental Emsco Electrohoist IV; 4,000hp, gear driven, regenerated braking |
| **Pipe Rack** | Hydralift Hydraracker pipe handler |
| **Top Drive** | Hydralift HPS 1000 2E AC |
| **Rotary Table** | VarcoBJ RSTT 60 ½" |
| **Iron Roughneck** | NOV HydraTong Iron Roughneck (Fwd and aft catwalk machines) |
| **Motion Compensation** | Hydralift, Crown mounted with active heave compensation. |
| | Static 907mt, compensating 454mt, 25ft stroke |
| **Riser Tensioners** | 8EA dual (16EA) Hydralift, 200,000 lbs each, total 3,200,000 lbs |
| **Deck Cranes** | 2ea Hydralift WOMCVC 75mt lattice |
| | Pipe-handling knuckle-boom crane |
| | Riser gantry crane |
| **Mud System** | |
| **Mud system** | 3ea Continental Emsco FC2200, 2200hp, 7500psi |
| | 5ea VSM 300 shale shakers |
| | NOV automatic mud mixing system with sack cutting system |
| **Cement Unit** | Free placement cement unit |
| **Well Control** | |
| **BOP** | Cameron 4 ram 18 3/4" BOP. 15,000psi |
| **BOP Control System** | Cameron Multiplex BOP control system, with deadman system |
| | In addition the BOP is equipped with acoustic back-up system and ROV intervention |
| **Wellhead Connector** | Vetco Super HD H4 DWD type |
| **Diverter** | Vetco KFDS 21 ½" 500psi |

| Feature | Specification |
|---|---|
| **Choke and Kill Manifold** | Cameron, 2ea remote chokes and 1ea manual chokes |
| **Mud Gas Separator (poor-boy)** | SWACO SMG, ventline 10”, liquid seal 18ft |
| **Power Systems** | |
| **Main Power** | 6 x Wartsila 18V32 diesel engines, rated 7,500kW each, (10,200hp), total 61,200hp |
| **Main Generators** | 6 x ABB ASG 900 XUB generators, rated 7,300kW each, total 43,800 kW |
| **Total Power** | 88,800 kW |
| **Storage Capacities** | |
| **Fuel** | 29,130bbl (4,631m$^3$) |
| **Drill Water** | 12,300bbl (1,959m$^3$) |
| **Potable Water** | 6,982bbl (1,110m$^3$) |
| **Liquid Mud** | 10,420bbl (1,657m$^3$) |
| **Base Oil** | 2,554bbl (406m$^3$) |
| **Brine** | 4,277bbl (680m$^3$) |
| **Liquid Mud** | 10,420bbl (1,657m$^3$) |
| **Bulk Mud** | 4 x 87.6m$^3$, tot 350m$^3$ (4 x 3,094cu/ft, tot 12,300cu/ft) |
| **Cement** | 4 x 87.6m$^3$, tot 350m$^3$ (4 x 3,094cu/ft, tot 12,300cu/ft) |

### 2.4.2 Safety Zone

2.18 A 500 metre safety zone will be in place around the drilling rig once it is on station. The 500 metre safety zone is in accordance with Part III, Chapter 3 of the *Offshore Minerals Ordinance 1994 (as amended)*. It is also a standard practice in the oil and gas industry. According to the *Offshore Minerals Ordinance 1994*, a 500 metre safety zone “*shall extend to every point within 500 metres of any part of the installation (ignoring any moorings) and to every point in the water which is vertically above or below such a point*”. No vessel is permitted to enter a safety zone when it is in force around an installation. One of the Offshore Supply Vessels (OSVs) will maintain station in the vicinity of the rig to take the role of Safety Stand-by Vessel (SSV) and enforce the 500 metre safety zone.

### 2.4.3 Well Details

2.19 The key characteristics of the four potential top-hole well locations identified as possible candidates for the drilling programme, are summarised in Table 2.2 below.

2.20 Note that final drilling locations and well designs may differ slightly to those reported below. Any changes to drilling locations and well design will be fully reported in addenda to the EIS.

*Table: 2.2: Proposed drilling programme well characteristics*

| Aspect | Potential Top-hole Well Locations | | | |
|---|---|---|---|---|
| | FISA 12 | | | FIST 13 |
| | Finback-1 | Humpback-1 | Caperea-1 | Scharnhorst North-1 |
| License Area | PL012 | PL012 | PL011 | PL014 |
| Top-hole Location* | 52° 12' 28.73" S<br>55° 51' 17.11" W | 52° 08' 48.11" S<br>55° 44' 0.30" W | 52° 24' 17.86" S<br>56° 04' 01.51" W | 53° 35' 20.00" S<br>59° 03' 37.08" W |
| Drilling Unit | Ocean Rig *Eirik Raude* | | | |
| Support Location | Temporary Dock Facility, Stanley Harbour, Falkland Islands | | | |
| Water Depth (m) | 1,285 | 1,270 | 1,333 | 1,880 |
| Total Depth of Well | 5,649 | 5,782 | 5,782 | 5,267 |
| Nearest Landfall (km) | 141 (Cape Pembroke) | 146 (Cape Pembroke) | 140 (Cape Pembroke) | 75 (Beauchêne Island) |
| Anticipated Spud Date | Early to mid-2015 | | | |
| Well Testing | None planned | | | |
| Anticipated Hydrocarbons | Light Oil, API gravity 35 – 40 | | | |
| ITOPF Category | Group 2 | | | |
| Anticipated Weight of Drill Cuttings (tonnes) | 2,700 | 2,750 | 2,750 | 2,750 |

** Geodetics: Datum: WGS 1984; Projection: Transverse Mercator CM 60W.*

### 2.4.4 Well Construction

2.21 Wells are drilled in sections, with the diameter of each section decreasing with increasing depth. During the drilling of the upper well sections, the drill string (the column of drilling pipe from the rig) and drill bit are typically left open to the sea (drilled open hole). Aqueous drilling fluid sweeps will be used to enhance the efficiency of the seawater to remove cuttings, with the frequency of sweeps depending on the drilling operations. The first section of the well is the largest diameter section, and is commonly called the conductor. The conductor casing will provide the structural integrity to the bore of the well during drilling of the top-hole well sections.

2.22 Once the conductor casing has been set, the next well section will be drilled. The surface casing string is then cemented in place. The surface casing provides the main well foundation and serves as a base for the surface equipment. During cementing of the surface casing, there may be some displacement of excess cement to the seabed adjacent to the well. This volume is typically no more than 10 percent of the total volume used for cementing of the top hole casing section. Installation of the surface casing will allow installation of a wellhead and the necessary equipment for the installation of the marine riser and Blow-Out Preventer (BOP). The marine riser is a conduit tube that connects the well to the drilling rig at the sea surface, allowing fluids to be circulated between the drilling rig and the well.

2.23 Once the casing has been set and the marine riser installed, the well bore is effectively isolated from the sea. The drilling fluid can then be circulated back to the rig in the space (called the annulus) between the drill string and the casing. The lengths and diameters of each section of the well are determined prior to drilling during the detailed well design stages, and are dependent upon the geological conditions anticipated through which the well is to be drilled.

2.24 Once each section is drilled, the drill string is lifted (tripped) out of the hole. At the end of every hole interval, casing is run with a casing shoe placed at the very bottom of the casing string. The purpose of the casing shoe is to provide a "check-valve" so that when the casing is cemented, the cement will not "U-tube" back inside the casing after the cement has been pumped down the well, but instead provide an annular seal that prevents wellbore fluids from being able to migrate/flow up the casing/open-hole annulus. Casing hangars are used to securely position the casing correctly in the subsea wellhead and in combination with a "seal assembly", provides a barrier to the potential flow of fluids from or into the annulus.

2.25 The drilling process uses drill bits of different sizes to drill a series of concentric holes from the seabed to the planned well total depth. The casing sections and rotating bits used are gradually reduced in diameter as the well gets deeper. As drilling progresses, drilling mud (in this case, water based mud [WBM]) is continuously pumped down the drill pipe and returned to the surface via the marine riser with the drilled cuttings. Drilling mud is circulated through the inside of the drill string to the bit. The primary function of the drilling mud is to remove cuttings from the well and to control formation pressures. Other functions of the mud system include:

- Maintaining well bore stability;
- Cooling, lubricating and supporting the drill bit and bottom-hole assembly; and
- Transmitting hydraulic energy to tools and the drill bit.

2.26 The weight of the drilling mud column also exerts a hydrostatic pressure on the exposed rock formations being drilled below. The pressure exerted by the weight of the drilling fluid on the rock formations must exceed the pressure of the reservoir being drilled in order to prevent hydrocarbons from flowing out of the rock formations and into the well. This 'hydrostatic head' of drilling mud provides the primary means of well control.

2.27 At the surface, the cuttings are separated and treated and the drilling fluid is returned to the circulation system. Casing the hole enables drilling fluid and cuttings to be re-circulated to the drilling rig whilst also sealing off the weaker shallow formations to prevent hole collapse, as well as preventing contamination of potential aquifers by hydrocarbons and drilling materials. In addition, the surface casing section provides a structural base for the BOP.

2.28 The preliminary well profiles for each of the potential top-hole well locations of the exploration drilling programme are provided in Tables 2.3 to 2.6 below. Any changes to the well locations or designs will be reported in addenda to the EIS. Each well design includes the potential for the drilling of an additional bypass interval for cores, and a geological sidetrack to allow for further reservoir evaluation. These additional well sections may be drilled in the event that a hydrocarbon discovery is made.

### FISA12 Wells

***Table 2.3: Proposed Finback-1 well profile***

| Hole Size | Depth | Section Length | Proposed Mud Use | Mud Volume |
|---|---|---|---|---|
| inches | metres | Metres | | $m^3$ |
| 42” | 1,385 | 75 | WBM | 67 |
| 26” | 2,825 | 1,440 | WBM | 493 |
| 17 ½” | 4,302 | 1,477 | WBM | 229 |
| 12 ¼” | 5,517 | 1,215 | WBM | 92 |
| 8 ½” By-pass* | 5,517 | 1,215 | WBM | 54 |
| 12 ¼” Side track* | 5,649 | 1,347 | WBM | 102 |
| | | | **Total:** | **1,037** |

** Note: These are options in the success case.*

*Table 2.4: Proposed Humpback-1 well profile*

| Hole Size inches | Depth metres | Section Length metres | Proposed Mud Use | Mud Volume $m^3$ |
|---|---|---|---|---|
| 42" | 1,373 | 75 | WBM | 67 |
| 26" | 2,813 | 1,440 | WBM | 493 |
| 17 ½" | 4,227 | 1,414 | WBM | 219 |
| 12 ¼" | 5,650 | 1,423 | WBM | 108 |
| 8 ½" By-pass* | 5,650 | 1,423 | WBM | 52 |
| 12 ¼" Side track* | 5,782 | 1,555 | WBM | 118 |
| | | | **Total:** | **1,057** |

** Note: These are options in the success case.*

*Table 2.5: Proposed Caperea-1 well profile*

| Hole Size inches | Depth metres | Section Length metres | Proposed Mud Use | Mud Volume $m^3$ |
|---|---|---|---|---|
| 42" | 1,373 | 75 | WBM | 67 |
| 26" | 2,813 | 1,440 | WBM | 493 |
| 17 ½" | 4,227 | 1,414 | WBM | 219 |
| 12 ¼" | 5,650 | 1,423 | WBM | 108 |
| 8 ½" By-pass* | 5,650 | 1,423 | WBM | 52 |
| 12 ¼" Side track* | 5,782 | 1,555 | WBM | 118 |
| | | | **Total:** | **1,057** |

** Note: These are options in the success case.*

### FIST13 Well

*Table 2.6: Proposed Scharnhorst North-1 well profile*

| Hole Size inches | Depth metres | Section Length metres | Proposed Mud Use | Mud Volume $m^3$ |
|---|---|---|---|---|
| 42" | 1,980 | 75 | WBM | 67 |
| 26" | 3,420 | 1,440 | WBM | 493 |
| 17 ½" | 4,037 | 632 | WBM | 98 |
| 12 ¼" | 5,135 | 1,098 | WBM | 83 |
| 8 ½" By-pass* | 5,135 | 1,098 | WBM | 23 |
| 12 ¼" Side track* | 5,267 | 1,230 | WBM | 94 |
| | | | **Total:** | **858** |

** Note: These are options in the success case*

### 2.4.5 Disposal of Drill Cuttings

2.29 Drill cuttings consist of various sized particles of rock cut from the rock strata as the drill bit cuts through the rock and progresses down the well bore.

2.30 The 42” and 26” top-hole well sections will be drilled without a marine riser (open-hole) to the drilling rig. Cuttings generated during this drilling period will be swept out of the hole using seawater and sweeps. These cuttings will be deposited directly on the seabed surrounding the wellbore.

2.31 All subsequent well sections will be drilled with a marine riser installed. Drilling mud and cuttings will therefore be circulated back to the rig, where they will pass through the rig shale shaker systems. Here, cuttings will be separated from the drilling mud and then passed through the cuttings cleaning system. For WBM, this typically reduces the amount of drilling fluid remaining on the cuttings to between 5 and 15%. The drill cuttings will then be discharged to sea. Cuttings will be discharged from the drilling rig approximately 5-10 metres below the sea surface. A small volume of cuttings will be periodically retained from each of the well sections drilled with a marine riser, for sampling and analysis purposes. These samples will be taken from the rig shale shaker house.

2.32 Estimated amounts of drill cuttings that will be generated for each well are detailed in Tables 2.7 to 2.10. Any changes to the well designs that result in changes to the estimated amount of drill cuttings produced will be reported in EIS addenda.

#### FISA 12 Wells

***Table 2.7: Estimate of drill cuttings generated for the Finback-1 exploration well***

| Hole Size (inches) | Estimated Drilling Duration (days) | Cuttings Volume (cubic metres) | Depth of Discharge (metres) | Drill Cuttings Mass (tonnes) |
|---|---|---|---|---|
| 42” | 2.5 to 3.0 | 67 | 1,285 | 174 |
| 26” | 7.0 to 8.5 | 519 | 1,285 | 1,282 |
| 17 ½” | 9.5 to 11.5 | 218 | 0 | 596 |
| 12 ¼” | 20.0 to 24.0 | 92 | 0 | 240 |
| 8 ½” By-pass* | 21.5 to 26.0 | 51 | 0 | 141 |
| 12 ¼” Side track* | 14.5 to 17.0 | 102 | 0 | 266 |
| Total days: | 75.0 to 90.0 | | Discharged at Seabed: | 1,456 |
| | | | Discharged at Surface: | 1,243 |
| | | | Returned to Shore: | 0 |
| | | | **Total Cuttings from Finback-1 well:** | 2,700 |

** Note: These are optional well sections in the success case*

*Table 2.8: Estimate of drill cuttings generated for the Humpback-1 exploration well*

| Hole Size (inches) | Estimated Drilling Duration (days) | Cuttings Volume (cubic metres) | Depth of Discharge (metres) | Drill Cuttings Mass (tonnes) |
|---|---|---|---|---|
| 42” | 2.5 to 3.0 | 67 | 1,270 | 174 |
| 26” | 7.5 to 9.0 | 493 | 1,270 | 1,282 |
| 17 ½” | 10.0 to 12.0 | 219 | 0 | 571 |
| 12 ¼” | 19.5 to 23.5 | 108 | 0 | 281 |
| 8 ½” By-pass* | 20.5 to 24.5 | 52 | 0 | 135 |
| 12 ¼” Side track* | 15.0 to 18.0 | 118 | 0 | 307 |
| Total days: | 75.0 to 90 | | Discharged at Seabed: | 1,456 |
| | | | Discharged at Surface: | 1,294 |
| | | | Returned to Shore: | 0 |
| | | | **Total Estimated Cuttings from Humpback-1 well:** | 2,750 |

** Note: These are optional well sections in the success case*

*Table 2.9: Estimate of drill cuttings generated for the Caperea-1 exploration well*

| Hole Size (inches) | Estimated Drilling Duration (days)† | Cuttings Volume (cubic metres) | Depth of Discharge (metres) | Drill Cuttings Mass (tonnes) |
|---|---|---|---|---|
| 42” | 2.5 to 3.0 | 67 | 1,333 | 174 |
| 26” | 7.5 to 9.0 | 493 | 1,333 | 1,282 |
| 17 ½” | 10.0 to 12.0 | 219 | 0 | 571 |
| 12 ¼” | 19.5 to 23.5 | 108 | 0 | 281 |
| 8 ½” By-pass* | 20.5 to 24.5 | 52 | 0 | 135 |
| 12 ¼” Side track* | 15.0 to 18.0 | 118 | 0 | 307 |
| Total days: | 75.0 to 90.0 | | Discharged at Seabed: | 1,456 |
| | | | Discharged at Surface: | 1,294 |
| | | | Returned to Shore: | 0 |
| | | | **Total Estimated Cuttings from Caperea-1 well:** | 2,750 |

** Note: These are optional well sections in the success case*

*† Estimated range (based on estimate between 75 and 90 days)*

### FIST13 Well

*Table 2.10: Estimate of drill cuttings generated for the Scharnhorst North-1 exploration well*

| Hole Size (inches) | Estimated Drilling Duration (days) | Cuttings Volume (cubic metres) | Depth of Discharge (metres) | Drill Cuttings Mass (tonnes) |
|---|---|---|---|---|
| 42” | 2.5 to 3.0 | 67 | 1,880 | 174 |
| 26” | 7.5 to 9.0 | 493 | 1,880 | 1,282 |
| 17 ½” | 10.0 to 12.0 | 219 | 0 | 571 |
| 12 ¼” | 19.5 to 23.5 | 108 | 0 | 281 |
| 8 ½” By-pass* | 20.5 to 24.5 | 52 | 0 | 135 |
| 12 ¼” Side track* | 15.0 to 18.0 | 118 | 0 | 307 |
| Total days: | 75.0 to 90.0 | | Discharged at Seabed: | 1,456 |
| | | | Discharged at Surface: | 1,294 |
| | | | Returned to Shore: | 0 |
| | | | **Total Estimated Cuttings from Scharnhorst North-1 well:** | 2,750 |

** Note: These are optional well sections in the success case*

2.33 For a single well, either the Humpback–1 well (Table 2.8), Caperea-1 well (Table 2.9) or the Scharnhorst North-1 well (Table 2.10) represent the worst case well based on estimated total mass of drill cuttings. The total mass of drill cuttings to be discharged from any of these wells is 2,750 tonnes (assuming both the bypass and the sidetrack sections are drilled).

2.34 For a three well drilling campaign, the worst case wells in terms of the discharge of drilling cuttings from FISA12 are Humpback-1 and Caperea-1. In the event that these two wells are drilled in FISA12, and combined with the cuttings from the Scharnhorst North-1 well (FIST13), this would result in a total estimated discharge of 8,250 tonnes of drill cuttings (assuming both the bypass and the sidetrack sections are drilled for each well).

## 2.4.6 Drilling Mud & Chemicals

2.35 Drilling mud has four basic components: a viscosifier, a weighting material, one or several special purpose additives and a base. The viscosifier thickens the fluid to obtain a viscosity capable of suspending the cuttings and other materials. Bentonite (a natural expansive clay) is the most common viscosifier.

2.36 The weighting material is added to the mud formulation to provide the proper weight to the fluid column to control down-hole pressure. The most common weighting material is barite (barium sulphate), although iron carbonate, iron oxide and other components can also be used.

2.37 The special additives normally incorporated in drilling fluid formulations respond to particular needs during the drilling process and include thinners, fluid loss reducers, corrosion inhibitors, lubricants, etc. Background information on the use of drilling mud is provided in Appendix B.

2.38 The proposed wells will be drilled using WBM. On the drilling unit, the composition of the cleaned mud will be monitored and its component contents adjusted to ensure that its properties remain as specified. The mud will be recycled through the well.

2.39 The use of WBM is common as it has fewer associated potential environmental impacts. Noble does not plan to use oil based mud (OBM) in this exploration drilling programme. WBM is proposed for all wells and all well sections.

2.40 Drilling mud is specifically formulated for each section of the well to suit the conditions in the rock strata being drilled. Selection of drilling mud chemical additives is made according to the technical requirements for the mud and the environmental credentials of the chemical.

2.41 During drilling with WBM, drill cuttings are circulated back to the drilling unit and discharged after passing through the drilling unit mud recovery (shale shaker) systems. A small amount of drilling mud and associated chemicals will remain on the cuttings when they are discharged.

2.42 Additionally, when drilling with WBM without a marine riser, drilling mud and cuttings are released directly to the sea at the seabed. When drilling sections of the well with a marine riser installed, surplus mud is occasionally discharged to the sea from the drilling unit. This can occur at the end of a well section and also at the end of well (EOW). This discharge is called a batch discharge.

2.43 Tables 2.11 to 2.14 list the drilling mud components currently proposed for use in each of the four potential exploration wells. These drilling mud components will be released to the sea during drilling operations via any of the three routes described above (either released at the seabed during drilling the riser-less top-hole well sections, released continuously with the drill cuttings at the surface, or released as a batch discharge at the surface at the end of well sections). Drilling chemical use for each well will be confirmed in addenda to this EIS.

*Table 2.11: Proposed drilling mud components for the Finback-1 well (FISA12 area)*

| Chemical Name | Chemical Function Group | Chemical Label Code | Estimated Use (tonnes) | Estimated Discharge (tonnes) | HQ Band / OCNS group |
|---|---|---|---|---|---|
| **42 inch section** | **System: Seawater/Guar Gum/Bentonite Sweeps** | | | | |
| Barite | Weighting Chemical | PLO | 58.00 | 58.00 | E |
| Bentonite | Viscosifier | PLO | 21.00 | 21.00 | E |
| Caustic Soda | Inorganic / acidity control | - | 0.25 | 0.25 | E |
| Polypac R | Viscosifier | PLO | 0.79 | 0.79 | E |
| Soda Ash | Inorganic | PLO | 0.15 | 0.15 | E |
| Guar Gum | Viscosifier | PLO | 0.59 | 0.59 | E |
| Duo-vis | Viscosifier | - | 0.48 | 0.48 | Gold |
| Safe-Cide | Biocide | SUB | 0.03 | 0.03 | Gold |
| **26 inch section** | **System: Seawater/Bentonite Sweeps** | | | | |
| Barite | Weighting Chemical | PLO | 1293.75 | 1293.75 | E |
| Duovis | Viscosifier | - | 4.12 | 4.12 | Gold |
| Bentonite | Viscosifier | PLO | 92.25 | 92.25 | E |
| Caustic Soda | Inorganic / acidity control | - | 1.19 | 1.19 | E |
| Soda Ash | Inorganic | PLO | 1.19 | 1.19 | E |
| Guar Gum | Viscosifier | PLO | 4.28 | 4.28 | E |
| Safe Cide | Biocide | SUB | 1.08 | 1.08 | Gold |
| Polypac R | Viscosifier | PLO | 10.53 | 10.53 | E |
| **17 ½ inch section** | **System: High Performance Water Base Mud** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 129.24 | 129.24 | E |
| Barite | Weighting Chemical | PLO | 158.78 | 158.78 | E |
| Safe Cide | Biocide | SUB | 0.86 | 0.86 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 85.29 | 85.29 | E |
| Polypac (all Grades) | Viscosifier | E | 4.31 | 4.31 | E |
| EMI-2224 | Defoamer | - | 0.86 | 0.86 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 47.11 | 47.11 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 6.46 | 6.46 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 36.70 | 36.70 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 8.60 | 8.60 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 258.22 | 258.22 | E |
| Duovis | Viscosifier | - | 3.37 | 3.37 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 60.97 | 60.97 | E |
| **12 ¼ inch section** | **System: High Performance Water Base Mud** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 40.77 | 40.77 | E |
| Barite | Weighting Chemical | PLO | 76.45 | 76.45 | E |
| Safe Cide | Biocide | SUB | 0.28 | 0.28 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 26.91 | 26.91 | E |
| Polypac (all Grades) | Viscosifier | E | 2.73 | 2.73 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.28 | 0.28 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 15.03 | 15.03 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 2.04 | 2.04 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 11.63 | 11.63 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 2.73 | 2.73 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 300.69 | 300.69 | E |

| Chemical Name | Chemical Function Group | Chemical Label Code | Estimated Use (tonnes) | Estimated Discharge (tonnes) | HQ Band / OCNS group |
|---|---|---|---|---|---|
| Duovis | Viscosifier | - | 1.37 | 1.37 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 28.54 | 28.54 | E |
| | | **TOTAL:** | **2799.85** | **2799.85** | |
| **8-1/2" By-Pass** | **System: High Performance Water Base Mud (OPTIONAL COMPONENT)** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 22.42 | 22.42 | E |
| Barite | Weighting Chemical | PLO | 42.05 | 42.05 | E |
| Safe Cide | Biocide | SUB | 0.15 | 0.15 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 14.8 | 14.8 | E |
| Polypac (all Grades) | Viscosifier | E | 1.50 | 1.50 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.15 | 0.15 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 8.26 | 8.26 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 1.12 | 1.12 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 6.40 | 6.40 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 1.50 | 1.50 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 165.39 | 165.39 | E |
| Duovis | Viscosifier | - | 0.77 | 0.77 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 15.70 | 15.70 | E |
| **12-1/4" Sidetrack** | **System: High Performance Water Base Mud (OPTIONAL COMPONENT)** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 45.19 | 45.19 | E |
| Barite | Weighting Chemical | PLO | 84.74 | 84.74 | E |
| Safe Cide | Biocide | SUB | 0.31 | 0.31 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 29.83 | 29.83 | E |
| Polypac (all Grades) | Viscosifier | E | 3.30 | 3.30 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.31 | 0.31 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 16.65 | 16.65 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 2.26 | 2.26 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 12.89 | 12.89 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 3.30 | 3.30 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 333.82 | 333.82 | E |
| Duovis | Viscosifier | - | 1.52 | 1.52 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 31.65 | 31.65 | E |
| | | **TOTAL (OPTIONAL COMPONENTS):** | **845.98** | **845.98** | |

*Notes:*

*PLONOR (PLO): Pose little or no risk to the environment*

*Gold = EU Harmonised Offshore Chemical Notification Scheme, lowest Hazard Quotient (HQ) **

*E = EU Harmonised Offshore Chemical Notification Scheme (scale A to E)**

*SUB = A substitution warning is an indication that one or more components of a chemical are recognised to be hazardous, and that such components have been recommended for substitution to the chemical manufacturer.*

** The EU Harmonised Offshore Chemical Notification Scheme assess hazards under the Chemical Hazard and Risk Management (CHARM) criteria. The criteria look at toxicity, biodegradation and bioaccumulation. Chemicals are awarded a colour banding based on the assessment. Colours Range from Gold –Purple. Gold is the lowest hazard followed by silver. Any inorganic substances, hydraulic fluids or chemicals used only in pipelines are not applicable to CHARM. These substances are awarded a grouping from A-E. Group A are products are considered to have the greatest potential environmental hazard and Group E the least.*

*Refer to Appendix C for further information.*

*Table 2.12: Proposed drilling mud components for the Humpback–1 well (FISA12 area)*

| Chemical Name | Chemical Function Group | Chemical Label Code | Estimated Use (tonnes) | Estimated Discharge (tonnes) | HQ Band / OCNS group |
|---|---|---|---|---|---|
| **42 inch section** | **System: Seawater/Guar Gum/Bentonite Sweeps** | | | | |
| Barite | Weighting Chemical | PLO | 58.00 | 58.00 | E |
| Bentonite | Viscosifier | PLO | 21.00 | 21.00 | E |
| Caustic Soda | Inorganic / acidity control | - | 0.25 | 0.25 | E |
| Polypac R | Viscosifier | PLO | 0.79 | 0.79 | E |
| Soda Ash | Inorganic | PLO | 0.15 | 0.15 | E |
| Guar Gum | Viscosifier | PLO | 0.59 | 0.59 | E |
| Duovis | Viscosifier | - | 0.48 | 0.48 | Gold |
| Safe Cide | Biocide | SUB | 0.03 | 0.03 | Gold |
| **26 inch section** | **System: Seawater/Bentonite Sweeps** | | | | |
| Barite | Weighting Chemical | PLO | 1293.75 | 1293.75 | E |
| Duovis | Viscosifier | - | 4.12 | 4.12 | Gold |
| Bentonite | Viscosifier | PLO | 92.25 | 92.25 | E |
| Caustic Soda | Inorganic / acidity control | - | 1.19 | 1.19 | E |
| Soda Ash | Inorganic | PLO | 1.19 | 1.19 | E |
| Guar Gum | Viscosifier | PLO | 4.28 | 4.28 | E |
| Safe Cide | Biocide | SUB | 1.08 | 1.08 | Gold |
| Polypac R | Viscosifier | PLO | 10.53 | 10.53 | E |
| **17 ½ inch section** | **System: High Performance Water Base Mud** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 123.73 | 123.73 | E |
| Barite | Weighting Chemical | PLO | 152.01 | 152.01 | E |
| Safe Cide | Biocide | SUB | 0.85 | 0.85 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 81.66 | 81.66 | E |
| Polypac (all Grades) | Viscosifier | E | 4.12 | 4.12 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.85 | 0.85 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 45.11 | 45.11 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 6.19 | 6.19 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 35.14 | 35.14 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 8.22 | 8.22 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 247.22 | 247.22 | E |
| Duovis | Viscosifier | - | 3.23 | 3.23 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 58.33 | 58.33 | E |
| **12 ¼ inch section** | **System: High Performance Water Base Mud** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 47.75 | 47.75 | E |
| Barite | Weighting Chemical | PLO | 89.53 | 89.53 | E |
| Safe Cide | Biocide | SUB | 0.33 | 0.33 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 31.52 | 31.52 | E |
| Polypac (all Grades) | Viscosifier | E | 3.20 | 3.20 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.33 | 0.33 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 17.60 | 17.60 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 2.39 | 2.39 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 13.62 | 13.62 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 3.20 | 3.20 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 352.16 | 352.16 | E |

| Chemical Name | Chemical Function Group | Chemical Label Code | Estimated Use (tonnes) | Estimated Discharge (tonnes) | HQ Band / OCNS group |
|---|---|---|---|---|---|
| Duovis | Viscosifier | - | 1.61 | 1.61 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 33.43 | 33.43 | E |
| | | TOTAL: | **2853.01** | **2853.01** | |
| **8-1/2" By-Pass** | **System: High Performance Water Base Mud (OPTIONAL COMPONENT)** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 33.13 | 33.13 | E |
| Barite | Weighting Chemical | PLO | 62.13 | 62.13 | E |
| Safe Cide | Biocide | SUB | 0.23 | 0.23 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 21.87 | 21.87 | E |
| Polypac (all Grades) | Viscosifier | E | 2.22 | 2.22 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.23 | 0.23 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 12.21 | 12.21 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 1.66 | 1.66 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 9.45 | 9.45 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 2.22 | 2.22 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 244.36 | 244.36 | E |
| Duovis | Viscosifier | - | 1.12 | 1.12 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 23.2 | 23.2 | E |
| **12-1/4" Sidetrack** | **System: High Performance Water Base Mud (OPTIONAL COMPONENT)** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 52.18 | 52.18 | E |
| Barite | Weighting Chemical | PLO | 97.83 | 97.83 | E |
| Safe Cide | Biocide | SUB | 0.36 | 0.36 | E |
| MEG | Gas Hydrate Inhibitor | PLO | 34.44 | 34.44 | Gold |
| Polypac (all Grades) | Viscosifier | E | 3.82 | 3.82 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.36 | 0.36 | E |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 19.23 | 19.23 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 2.61 | 2.61 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 14.88 | 14.88 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 3.82 | 3.82 | Gold |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 384.83 | 384.83 | E |
| Duovis | Viscosifier | - | 1.76 | 1.76 | E |
| SAFE CARB (All Grades) | Weighting Control | PLO | 36.53 | 36.53 | Gold |
| | | TOTAL (OPTIONAL COMPONENTS): | **1066.68** | **1066.68** | |

*Notes:*

*PLONOR (PLO): Pose little or no risk to the environment*

*Gold = EU Harmonised Offshore Chemical Notification Scheme, lowest Hazard Quotient (HQ) **

*E = EU Harmonised Offshore Chemical Notification Scheme (scale A to E)**

*SUB = A substitution warning is an indication that one or more components of a chemical are recognised to be hazardous, and that such components have been recommended for substitution to the chemical manufacturer.*

** The EU Harmonised Offshore Chemical Notification Scheme assess hazards under the Chemical Hazard and Risk Management (CHARM) criteria. The criteria look at toxicity, biodegradation and bioaccumulation. Chemicals are awarded a colour banding based on the assessment. Colours Range from Gold –Purple. Gold is the lowest hazard followed by silver. Any inorganic substances, hydraulic fluids or chemicals used only in pipelines are not applicable to CHARM. These substances are awarded a grouping from A-E. Group A are products are considered to have the greatest potential environmental hazard and Group E the least.*

*Refer to Appendix C for further information.*

*Table 2.13: Proposed drilling mud components for the Caperea–1 well (FISA12 area)*

| Chemical Name | Chemical Function Group | Chemical Label Code | Estimated Use (tonnes) | Estimated Discharge (tonnes) | HQ Band / OCNS group |
|---|---|---|---|---|---|
| **42 inch section** | **System: Seawater/Guar Gum/Bentonite Sweeps** | | | | |
| Barite | Weighting Chemical | PLO | 58.00 | 58.00 | E |
| Bentonite | Viscosifier | PLO | 21.00 | 21.00 | E |
| Caustic Soda | Inorganic / acidity control | - | 0.25 | 0.25 | E |
| Polypac R | Viscosifier | PLO | 0.79 | 0.79 | E |
| Soda Ash | Inorganic | PLO | 0.15 | 0.15 | E |
| Guar Gum | Viscosifier | PLO | 0.59 | 0.59 | E |
| Duovis | Viscosifier | - | 0.48 | 0.48 | Gold |
| Safe Cide | Biocide | SUB | 0.03 | 0.03 | Gold |
| **26 inch section** | **System: Seawater/Bentonite Sweeps** | | | | |
| Barite | Weighting Chemical | PLO | 1293.75 | 1293.75 | E |
| Duovis | Viscosifier | - | 4.12 | 4.12 | Gold |
| Bentonite | Viscosifier | PLO | 92.25 | 92.25 | E |
| Caustic Soda | Inorganic / acidity control | - | 1.19 | 1.19 | E |
| Soda Ash | Inorganic | PLO | 1.19 | 1.19 | E |
| Guar Gum | Viscosifier | PLO | 4.28 | 4.28 | E |
| Safe Cide | Biocide | SUB | 1.08 | 1.08 | Gold |
| Polypac R | Viscosifier | PLO | 10.53 | 10.53 | E |
| **17 ½ inch section** | **System: High Performance Water Base Mud** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 123.73 | 123.73 | E |
| Barite | Weighting Chemical | PLO | 152.01 | 152.01 | E |
| Safe Cide | Biocide | SUB | 0.85 | 0.85 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 81.66 | 81.66 | E |
| Polypac (all Grades) | Viscosifier | E | 4.12 | 4.12 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.85 | 0.85 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 45.11 | 45.11 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 6.19 | 6.19 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 35.14 | 35.14 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 8.22 | 8.22 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 247.22 | 247.22 | E |
| Duovis | Viscosifier | - | 3.23 | 3.23 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 58.33 | 58.33 | E |
| **12 ¼ inch section** | **System: High Performance Water Base Mud** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 47.75 | 47.75 | E |
| Barite | Weighting Chemical | PLO | 89.53 | 89.53 | E |
| Safe Cide | Biocide | SUB | 0.33 | 0.33 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 31.52 | 31.52 | E |
| Polypac (all Grades) | Viscosifier | E | 3.20 | 3.20 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.33 | 0.33 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 17.60 | 17.60 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 2.39 | 2.39 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 13.62 | 13.62 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 3.20 | 3.20 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 352.16 | 352.16 | E |

| Chemical Name | Chemical Function Group | Chemical Label Code | Estimated Use (tonnes) | Estimated Discharge (tonnes) | HQ Band / OCNS group |
|---|---|---|---|---|---|
| Duovis | Viscosifier | - | 1.61 | 1.61 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 33.43 | 33.43 | E |
| | | TOTAL: | **2853.01** | **2853.01** | |
| **8-1/2" By-Pass** | **System: High Performance Water Base Mud (OPTIONAL COMPONENT)** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 33.13 | 33.13 | E |
| Barite | Weighting Chemical | PLO | 62.13 | 62.13 | E |
| Safe Cide | Biocide | SUB | 0.23 | 0.23 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 21.87 | 21.87 | E |
| Polypac (all Grades) | Viscosifier | E | 2.22 | 2.22 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.23 | 0.23 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 12.21 | 12.21 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 1.66 | 1.66 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 9.45 | 9.45 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 2.22 | 2.22 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 244.36 | 244.36 | E |
| Duovis | Viscosifier | - | 1.12 | 1.12 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 23.2 | 23.2 | E |
| **12-1/4" Sidetrack** | **System: High Performance Water Base Mud (OPTIONAL COMPONENT)** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 52.18 | 52.18 | E |
| Barite | Weighting Chemical | PLO | 97.83 | 97.83 | E |
| Safe Cide | Biocide | SUB | 0.36 | 0.36 | E |
| MEG | Gas Hydrate Inhibitor | PLO | 34.44 | 34.44 | Gold |
| Polypac (all Grades) | Viscosifier | E | 3.82 | 3.82 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.36 | 0.36 | E |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 19.23 | 19.23 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 2.61 | 2.61 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 14.88 | 14.88 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 3.82 | 3.82 | Gold |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 384.83 | 384.83 | E |
| Duovis | Viscosifier | - | 1.76 | 1.76 | E |
| SAFE CARB (All Grades) | Weighting Control | PLO | 36.53 | 36.53 | Gold |
| | | TOTAL (OPTIONAL COMPONENTS): | **1066.68** | **1066.68** | |

*Notes:*

*PLONOR (PLO): Pose little or no risk to the environment**

*Gold = EU Harmonised Offshore Chemical Notification Scheme, lowest Hazard Quotient (HQ) **

*E = EU Harmonised Offshore Chemical Notification Scheme (scale A to E)**

*SUB = A substitution warning is an indication that one or more components of a chemical are recognised to be hazardous, and that such components have been recommended for substitution to the chemical manufacturer.*

** The EU Harmonised Offshore Chemical Notification Scheme assess hazards under the Chemical Hazard and Risk Management (CHARM) criteria. The criteria look at toxicity, biodegradation and bioaccumulation. Chemicals are awarded a colour banding based on the assessment. Colours Range from Gold –Purple. Gold is the lowest hazard followed by silver. Any inorganic substances, hydraulic fluids or chemicals used only in pipelines are not applicable to CHARM. These substances are awarded a grouping from A-E. Group A are products are considered to have the greatest potential environmental hazard and Group E the least.*

*Refer to Appendix C for further information.*

*Table 2.14: Proposed drilling mud components for the Scharnhorst North-1 well (FIST13 area)*

| Chemical Name | Chemical Function Group | Chemical Label Code | Estimated Use (tonnes) | Estimated Discharge (tonnes) | HQ Band / OCNS group |
|---|---|---|---|---|---|
| **42 inch section** | **System: Seawater/Guar Gum/Bentonite Sweeps** | | | | |
| Barite | Weighting Chemical | PLO | 58.00 | 58.00 | E |
| Bentonite | Viscosifier | PLO | 21.00 | 21.00 | E |
| Caustic Soda | Inorganic / acidity control | - | 0.25 | 0.25 | E |
| Polypac R | Viscosifier | PLO | 0.79 | 0.79 | E |
| Soda Ash | Inorganic | PLO | 0.15 | 0.15 | E |
| Guar Gum | Viscosifier | PLO | 0.59 | 0.59 | E |
| Duovis | Viscosifier | - | 0.48 | 0.48 | Gold |
| Safe Cide | Biocide | SUB | 0.03 | 0.03 | Gold |
| **26 inch section** | **System: Seawater/Bentonite Sweeps** | | | | |
| Barite | Weighting Chemical | PLO | 1293.75 | 1293.75 | E |
| Duovis | Viscosifier | - | 4.12 | 4.12 | Gold |
| Bentonite | Viscosifier | PLO | 92.25 | 92.25 | E |
| Caustic Soda | Inorganic / acidity control | - | 1.19 | 1.19 | E |
| Soda Ash | Inorganic | PLO | 1.19 | 1.19 | E |
| Guar Gum | Viscosifier | PLO | 4.28 | 4.28 | E |
| Safe Cide | Biocide | SUB | 1.08 | 1.08 | Gold |
| Polypac R | Viscosifier | PLO | 10.53 | 10.53 | E |
| **17 ½ inch section** | **System: High Performance Water Base Mud** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 53.99 | 53.99 | E |
| Barite | Weighting Chemical | PLO | 66.33 | 66.33 | E |
| Safe Cide | Biocide | SUB | 0.37 | 0.37 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 35.63 | 35.63 | E |
| Polypac (all Grades) | Viscosifier | E | 1.8 | 1.8 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.37 | 0.37 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 19.68 | 19.68 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 2.70 | 2.70 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 15.33 | 15.33 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 3.59 | 3.59 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 107.87 | 107.87 | E |
| Duovis | Viscosifier | - | 1.41 | 1.41 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 25.45 | 25.45 | E |
| **12 ¼ inch section** | **System: High Performance Water Base Mud** | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 36.84 | 36.84 | E |
| Barite | Weighting Chemical | PLO | 69.08 | 69.08 | E |
| Safe Cide | Biocide | SUB | 0.25 | 0.25 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 24.32 | 24.32 | E |
| Polypac (all Grades) | Viscosifier | E | 2.47 | 2.47 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.25 | 0.25 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 13.58 | 13.58 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 1.84 | 1.84 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 10.51 | 10.51 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 2.47 | 2.47 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 271.73 | 271.73 | E |

| Chemical Name | Chemical Function Group | Chemical Label Code | Estimated Use (tonnes) | Estimated Discharge (tonnes) | HQ Band / OCNS group |
|---|---|---|---|---|---|
| Duovis | Viscosifier | - | 1.24 | 1.24 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 25.79 | 25.79 | E |
| | | TOTAL: | 2284.57 | 2284.57 | |
| 8-1/2" By-Pass | System: High Performance Water Base Mud (OPTIONAL COMPONENT) | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 25.56 | 25.56 | E |
| Barite | Weighting Chemical | PLO | 43.11 | 43.11 | E |
| Safe Cide | Biocide | SUB | 0.16 | 0.16 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 15.18 | 15.18 | E |
| Polypac (all Grades) | Viscosifier | E | 1.54 | 1.54 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.16 | 0.16 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 8.47 | 8.47 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 1.15 | 1.15 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 6.56 | 6.56 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 1.07 | 1.07 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 169.56 | 169.56 | E |
| Duovis | Viscosifier | - | 0.08 | 0.08 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 16.10 | 16.10 | E |
| 12-1/4" Sidetrack | System: High Performance Water Base Mud (OPTIONAL COMPONENT) | | | | |
| Potassium Chloride | WB Drilling Fluid Additive | PLO | 41.27 | 41.27 | E |
| Barite | Weighting Chemical | PLO | 77.38 | 77.38 | E |
| Safe Cide | Biocide | SUB | 0.28 | 0.28 | Gold |
| MEG | Gas Hydrate Inhibitor | PLO | 27.24 | 27.24 | E |
| Polypac (all Grades) | Viscosifier | E | 3.02 | 3.02 | E |
| EMI-2224 | Defoamer (Drilling) | - | 0.28 | 0.28 | Gold |
| ULTRAHIB | Shale Inhibitor / Encapsulator | SUB | 15.21 | 15.21 | Gold |
| ULTRACAP | Shale Inhibitor / Encapsulator | - | 2.06 | 2.06 | Gold |
| ULTRAFREE NS | Drilling Lubricant | - | 11.77 | 11.77 | Gold |
| FLO-TROL | Fluid Loss Control Chemical | PLO | 3.02 | 3.02 | E |
| Sodium Chloride Brine | WB Drilling Fluid Additive | PLO | 304.83 | 304.83 | E |
| Duovis | Viscosifier | - | 1.39 | 1.39 | Gold |
| SAFE CARB (All Grades) | Weighting Control | PLO | 28.9 | 28.9 | E |
| | | TOTAL (OPTIONAL COMPONENTS): | 805.35 | 805.35 | |

*Notes:*

*PLONOR (PLO): Pose little or no risk to the environment*

*Gold = EU Harmonised Offshore Chemical Notification Scheme, lowest Hazard Quotient (HQ) **

*E = EU Harmonised Offshore Chemical Notification Scheme (scale A to E)**

*SUB = A substitution warning is an indication that one or more components of a chemical are recognised to be hazardous, and that such components have been recommended for substitution to the chemical manufacturer.*

** The EU Harmonised Offshore Chemical Notification Scheme assess hazards under the Chemical Hazard and Risk Management (CHARM) criteria. The criteria look at toxicity, biodegradation and bioaccumulation. Chemicals are awarded a colour banding based on the assessment. Colours Range from Gold –Purple. Gold is the lowest hazard followed by silver. Any inorganic substances, hydraulic fluids or chemicals used only in pipelines are not applicable to CHARM. These substances are awarded a grouping from A-E. Group A are products are considered to have the greatest potential environmental hazard and Group E the least.*

*Refer to Appendix C for further information.*

### 2.4.7 Well Control

2.44 Well bore pressures and drilling fluids (muds) will be continuously monitored by the drilling and mud logging crews. Independent sensors mounted in the mud pits and the return drilling mud flow line will be used to watch for early warning signs of a well control situation or kick (a well kick is an unexpected entry of hydrocarbons into the well bore).

2.45 In order to prevent a kick, the hydrostatic pressure of the mud must exceed the formation pressure. Keeping the hole full of mud is fundamental to ensuring an adequate mud hydrostatic overbalance. During normal drilling operations, the specific gravity of the mud will be checked at regular intervals on both mud being pumped into the drill pipe and that flowing out of the well bore. This data will provide an early indication of small specific gravity changes.

2.46 A fluid level change is one of the primary indications that a kick has occurred and hydrocarbons have entered the well bore. Electronic alarms warn the drill and mud logging crews of any fluid level changes in the mud pits that cannot be attributed to pump strokes. The drill crew will stop the drilling operations and visually check the well for flow.

2.47 In addition to careful monitoring and control of the mud system and installation of casing in each section of the well, the BOP stack will be installed on the wellhead at the seabed, after the top-hole sections have been drilled. The function of the BOP is to prevent uncontrolled flow from a well by physically isolating the well bore. The BOP is made up of a series of hydraulically operated rams and control valves which can be operated in an emergency from the rig and will form a number of physical barriers across the well bore. If the well is flowing uncontrollably, the drill crew will close one or a number of the BOP rams to secure the well. At this time, well control operations will be implemented in order to control the kick and return the wellbore to a safe drilling condition.

2.48 The proposed wells are not anticipated to encounter any zones of abnormal pressure. The BOP will be rated for pressures in excess of those expected in the identified formations.

### 2.4.8 Casing Cement & Chemicals

2.49 Once each section of the well has been drilled, the drill string is lifted out of the hole and the casing is lowered into the hole and cemented into place. The cement used for setting the casing is formulated specifically for each well section and contains small volumes of additives that are required to improve its technical performance and give the cement the required design characteristics once set.

2.50 Cement is mixed into slurry on the drilling unit using a cement base, fresh water and a number of additive cement chemicals. It is then pumped down the drill string to the shoe track and is forced up the annulus between the well bore and the casing. Cement wiper plugs are used during cement displacement to minimise contamination of the cement by drilling mud.

2.51 Once it is confirmed that the cement has been displaced to the required position, the drilling unit will 'wait on cement' whilst the cement sets. It is important to allow sufficient time for the cement to set fully, to give the cement ample time to develop the required compressive strengths according to the well design. Accurate estimates of required cement setting times are often obtained through the use of computer models, developed in close consultation with the cement and drilling engineers. These models take into account a large number of critical variables, including bottom-hole circulating temperature (BHCT) and bottom-hole static temperature (BHST), which have a strong influence on the amount of time that is required for the cement to set fully.

2.52 To ensure that sufficient cement is in place and that a good seal is achieved, it is common practice for a certain amount of extra cement to be pumped into the well, to allow for any losses or contamination of cement during displacement in the well bore. When cementing casing back to the seabed (the uppermost well casing), some cement may be discharged at the sea surface. Typically, this volume is less than 10% of the total volume of cement used. In some instances, there is also the possibility of larger volumes of cement being discharged from the drilling unit.

This may occur in the event of any mixing and/or mechanical problems encountered during the mixing of the cement slurry. Although this is undesirable, it is important that a cement job does not proceed if the cement slurry, for whatever reason, is not mixed according to the design specification, as it has potentially serious implications for the safety of the well construction.

2.53 It is always the goal to minimise the amount of cement discharged to the environment during any cementing operations, whilst at the same time completing the cementing job safely. This is highly important for the long term stability and safety of the well construction.

2.54 The cementing chemicals proposed for use will be fully detailed in EIS addenda.

### 2.4.9 Selection of Chemicals to be Used Offshore

2.55 Drilling offshore the Falkland Islands will follow the same model of chemical use as is required in the UK. Offshore chemical use in the UK is regulated through *The Offshore Chemicals Regulations 2002*, which applies the provisions of the Decision by the Convention for the Protection of the Marine Environment of the Northeast Atlantic (the OSPAR Convention) for a Harmonised Mandatory Control System for the use and discharge of chemicals used in the offshore oil and gas industry (although these regulations do not strictly apply in the Falkland Islands). The Offshore Chemical Notification Scheme (OCNS) ranks chemical products according to Hazard Quotient (HQ), which is defined as the ratio of Predicted Effect Concentration against No Effect Concentration (PEC:NEC). This is calculated using the CHARM (Chemical Hazard and Risk Management) model (refer to Appendix C for further information).

2.56 In the UK, the Centre for Environment, Fisheries & Aquaculture Science (CEFAS) maintains a list of chemicals under the OCNS that have been approved for use offshore for specific functions. Only chemicals on this list may be chosen for use when selecting the components of the drilling mud, cement, completion and general rig chemicals. Chemicals are therefore selected on their technical merits and are screened so that the collateral environmental effects are minimised, as far as practicable.

2.57 All of the planned chemicals, which Noble currently proposes to use for the drilling programme, appear on this Ranked List of Products approved under the OCNS. A large number of the proposed chemicals are considered to 'pose little or no risk' to the environment (PLONOR) with a corresponding chemical label code 'PLO'. A large number of the chemicals also have an OCNS category of 'E', or a Gold HQ band (i.e., are least toxic) and are naturally occurring products (e.g., barite) that are either biologically inert or readily dispersible or biodegradable (refer to Appendix C for further information on OCNS chemical bandings).

2.58 Some of the chosen chemicals have the chemical label code 'SUB', which means the chemical has a substitution warning and has been avoided wherever possible during chemical selection for the drilling programme. Chemicals may have a substitution warning attached to them due to their potential for bio-accumulation, or the presence of toxic or hazardous substances. A high Risk Quotient (RQ) may also render a chemical a candidate for substitution. The substitution warning is an indication that one or more components of a chemical are recognised to be hazardous, and have been recommended for substitution to the chemical manufacturer.

2.59 Certain chemicals will be required for specific purposes on the drilling rig, for example, pipe dope for the drill string threads and rig-wash detergent to periodically wash down rig equipment. The chemicals selected, will be chosen to minimise any potential environmental impact and will be reported in EIS addenda.

2.60 Other contingency chemicals may be required if problems or emergencies are encountered during drilling or cementing operations. These contingency chemicals will be reported in EIS addenda prior to drilling operations commencing.

2.61 Tables 2.11 to 2.14 above summarise the planned drilling chemicals to be used during drilling operations for the four potential exploration wells. Table 2.15 shows a summary of the total estimated drilling mud chemical use for each of the four potential exploration wells.

*Table 2.15: Summary of total estimated drilling mud chemical use for each of the four potential exploration wells*

| Well Name | Area | Main Well Sections (tonnes) | Optional Well Sections (tonnes) | Total (tonnes) |
|---|---|---|---|---|
| Finback-1 | FISA12 | 2,799.85 | 845.98 | 3,645.83 |
| Humpback-1 | | 2,853.01 | 1,066.68 | 3,919.69 |
| Caperea-1 | | 2,853.01 | 1,066.68 | 3,919.69 |
| Scharnhorst North-1 | FIST13 | 2,284.57 | 805.35 | 3,089.92 |

2.62 For a single well, either the Humpback–1 well (Table 2.12) or the Caperea-1 well (Table 2.13) represents the worst case well based on total mass of mud components and chemicals used. The total mass of WBM chemicals to be used and discharged for either of these wells is approximately 3,920.00 tonnes (assuming both the bypass and the sidetrack sections are drilled).

2.63 For a three well drilling campaign, the Humpback-1 and Caperea-1 wells are worst case in terms of the discharge of drilling mud components and chemicals from the wells in FISA12. Added to those from the Scharnhorst North-1 well in FIST13, this would result in a total estimated discharge of 10,930.00 tonnes of WBM chemicals.

### 2.4.10 Logging

2.64 Once drilling of the wells is complete, wire-line logging of the wells will occur. In the event that a hydrocarbon discovery is made, each well also has the option for the drilling of an 8½" by-pass section and a 12¼" side-track section, to allow for further assessment of any hydrocarbon bearing formations that may be found.

### 2.4.11 Vertical Seismic Profiling (VSP)

2.65 After drilling, Vertical Seismic Profiling (VSP) may be used to collect more data on the sub-surface geology. This consists of making seismic measurements inside the wellbore and allows for more detailed seismic images to be obtained. The provisional VSP programme is summarised in Table 2.16.

2.66 The purpose of a VSP tool is to correlate the original seismic information to the real depth information during drilling. The tool itself consists of geophones which detect seismic waves from an airgun source suspended in the sea from the rig or from an OSV.

*Table 2.16: Provisional VSP Programme*

| Programme Details (possible 2 runs per well) | |
|---|---|
| Duration | 12 hrs (approx. 7 hrs recording). |
| Seismic source location | Deployed over the side of the rig by crane. |
| Seismic source | 1,100 - 1,300 cubic inches using compressed air at approx. 2,000 psi. The source will be made up of a cluster of multiple 40, 150 and 300 cubic inch sleeve airguns for VSP. Energy is concentrated within the 0 -250 Hz band width. There are higher frequencies of 250 - 500 Hz present in the signal but at 180 dB or below. |
| Receiver system | Down-hole receiver system (5-8 receivers that are spaced approximately 50 metres apart) from which information is fed back to the recording equipment on the drilling rig. |

### 2.4.12 Well Clean-up & Testing

2.67 There are currently no plans for any well clean-up or testing to be carried out in this exploration drilling programme.

### 2.4.13 Well Abandonment

2.68 Once drilling operations at each well are complete, Noble plans to plug and abandon the exploration wells. The wells will be plugged and abandoned in accordance with Oil and Gas UK Guidelines and the well abandonment programme approved by FIG after consultation with the Health & Safety Executive (HSE).

2.69 A detailed Plugging and Abandonment (P&A) programme, with schematics, will be submitted to the independent Well Examiner and FIG Department of Mineral Resources for approval, prior to the abandonment of each well, taking into account the final as-built casing depths and sub-surface and geological conditions encountered during the drilling of each well. In the event that no hydrocarbon discovery is made, a Final P&A programme will be submitted. In the event that a significant hydrocarbon discovery is made, a Temporary P&A programme will be submitted.

2.70 The objectives of the P&A programme will be to:

- Prevent the escape of sub-surface fluids (water and any hydrocarbons) to the sea floor and into the seawater column; and
- Remove any potential seabed obstructions capable of interfering with fishing activity.

#### Fluid Escape Prevention

2.71 In order to prevent the escape of fluids from the well bore, cement plugs will be set in the wells prior to abandonment. Cement plug design will depend on the final as-built wells, but will broadly conform to the following:

- Lower open-hole section (8½ inches or 12¼ inches hole size, dependent on the final as-built well construction):. Dependent on the length of well section and the reservoir intervals encountered, more than one plug may be required to seal off open reservoirs encountered.
- Cased hole section: Plugs will be set at intervals within the cased section, from the base/seat of the last casing (26 inch casing) to the seabed/mud line. Typically, one or two plugs would be set and a plug would also be set near the seabed.

2.72 The above details are indicative only and will be dependent on the final as-built well constructions. All details will be finalised in the formal Plugging and Abandonment programmes. The cement plugs will be tested to ensure seal integrity.

#### Removal of Seabed Obstructions

2.73 Noble will comply with the FIG regulatory requirements on the removal of the wellhead and near seabed casing to three metres below the seabed.

## 2.5 Resource Use

### 2.5.1 Equipment & Chemicals

2.74 The remote drilling location will require sufficient materials and chemicals, equipment, spares and contingency supplies to be ordered in advance and shipped prior to rig mobilisation. These will be sourced in advance, mostly from outside the Falkland Islands.

## 2.5.2 Fuel

### Estimated Fuel Consumption

2.75 The *Eirik Raude* is estimated to consume 30 tonnes of diesel fuel per day during drilling operations. Up to three OSVs will be used throughout the drilling programme, each of which is estimated to consume 15 tonnes of diesel fuel per day. One of the OSVs will maintain station in the vicinity of the rig to take the role of SSV and enforce the 500 metre safety zone.

2.76 It is therefore estimated that the drilling programme will use approximately 6,750 tonnes of diesel fuel per well (based on 90 days on location) and 20,250 tonnes of diesel fuel throughout the drilling programme (270 days – based on a three well drilling campaign), although this figure does not include fuel used in transiting the rig between the well locations. Fuel will be sourced from the Falkland Islands. Table 2.17 summarises the rig and OSV fuel consumption estimates for the drilling programme.

***Table 2.17: Rig and OSV fuel consumption estimate for the drilling programme***

| Scenario | Rig[1] (tonnes) | Offshore Supply Vessel (OSV)[2] (tonnes) | Total (tonnes) |
|---|---|---|---|
| Single Well[3] | 2,700 | 4,050 | 6,750 |
| Drilling Programme[4] | 8,100 | 12,150 | 20,250 |

*Notes:*

1 *Rig is the Eirik Raude, estimated fuel consumption of 30 tonnes/day of fuel.*

2 *It is assumed there will be three OSVs in use, each consuming 15 tonnes/day of fuel.*

3 *Based on up to 90 days on location.*

4 *Based on a three well drilling campaign – up to 270 days in total.*

2.77 Routine helicopter flights will occur 10 times per week. In addition, crew changes will occur every two weeks and will require an additional 15 flights per week. There will also be an additional flight per week for search and rescue (SAR) flight check purposes. The type of aircraft to be used is likely to be the Sikorsky S92. Estimated fuel consumption is three tonnes per 1,000 kilometres, assuming possible use of larger helicopters, (e.g., Sikorsky-92). Flying between Stanley Airport and the rig is a round trip of approximately 460 kilometres using the Scharnhorst North-1 location (the location furthest from Stanley Airport). Table 2.18 summarises the helicopter fuel consumption estimate for the drilling programme.

***Table 2.18: Helicopter fuel consumption estimate for the drilling programme (assuming a three wells drilling campaign – total time on location of 396 days)***

| Days on location[1] | No. of weeks | Round trips required per week for routine ops. (*total trips*) | Additional Round trips required for crew changes (every two weeks) | Additional Round trips required for SAR[4] check (every week) | Total round trips | Round trip distance[2] | Total distance | Fuel consumption (tonnes per kilometre3) | Total fuel consumption (tonnes) |
|---|---|---|---|---|---|---|---|---|---|
| 270 | 38 (approx.) | 10 (*380*) | 15 (*285*) | 1 (*38*) | 703 | 460 km | 323,380 km | 0.003 | 970.14 |

*Notes:*

1 *Based on a three well drilling campaign – 270 days in total.*

2 *Assumes the furthest distance to well location of 230 kilometres (Scharnhorst North-1).*

3 *Assumes a fuel consumption of 3 tonnes per 1,000 kilometres.*

4 *SAR: Search and Rescue*

2.78 Based on the estimate provided in Table 2.18 above, total aviation fuel use for a three well drilling programme is estimated at 970.14 tonnes.

### Estimated Atmospheric Emissions

2.79 Table 2.19 gives a breakdown of the atmospheric emissions resulting from all fuel consumption related to the proposed drilling programme.

***Table 2.19: Estimated total atmospheric emissions resulting from the exploration drilling activities***

| Gas[1] | Drill Rig – total for drilling campaign[2] (tonnes) | Offshore Supply Vessels (OSV)[3] – total for drilling campaign (tonnes) | Helicopters[4] – total for drilling campaign (tonnes) | Total (tonnes) |
|---|---|---|---|---|
| Carbon dioxide | 25,920.00 | 38,880.00 | 3,104.45 | 67,904.45 |
| Carbon monoxide | 127.17 | 190.76 | 5.04 | 322.97 |
| Oxides of nitrogen | 481.14 | 721.71 | 12.13 | 1,214.98 |
| Nitrous oxide | 1.78 | 2.67 | 0.213 | 4.66 |
| Sulphur dioxide | 32.40 | 48.60 | 3.88 | 84.88 |
| Methane | 1.46 | 2.19 | 0.0844 | 3.73 |
| Volatile organic chemicals | 16.20 | 24.30 | 0.776 | 41.28 |

*Note 1: Emission factors used from EEMS 2008 based on methodology proposed by OGUK and DECC.*

*Note 2: Rig is estimated to consume @ 30 tonnes of fuel/day for 270 days duration (based on a three well drilling campaign).*

*Note 3: Offshore Supply Vessels @ 15 tonnes of fuel/day for 270 days duration (based on a three well drilling campaign).*

*Note 4: Helicopters estimated to consume @ 3 tonnes of fuel/1000 kilometres, based on a total of 456 round trips – refer to Table 2.18 (based on a three well drilling campaign).*

## 2.5.3 Water

2.80 Drill water will be required on the drilling rig for the mixing of drilling fluids/cements. For the supply of drill water to the drilling rig, Noble will utilise the integrated water storage facilities (1,000,000 litre capacity) installed on the Temporary Dock Facility (TDF) barge. This water will be piped from the shore to the TDF and will be sourced from the Stanley mains water supply. The storage tanks on the TDF will be trickle filled from the municipal water supply, which will mitigate against the potential for sudden, high-volume 'shock' demands being placed on the local water supply network.

2.81 Drinking water from onshore will also be needed by the OSVs. For supply of drinking water, the OSVs will utilise the fresh water services at FIPASS.

### Wastewater

2.82 Wastewater discharges from the rig and OSVs will be in the order of 200 litres per day per person. Based on a combined 185 man crew (assuming 140 crew on the rig and 15 crew on each of the OSVs), this will result in a discharge totalling 37,000 litres per day. This would result in the total discharge over a single well of 3,330,000 litres (based on a 90 day period). For a three well drilling campaign, this would result in the total discharge of 9,990,000 litres of wastewater (Table 2.20).

*Table 2.20: Total wastewater discharge summary for the drilling programme*

| | Single Well [1] | Drilling Programme [2] |
|---|---|---|
| Rig crew | 140 | 140 |
| Rate of wastewater discharge by rig crew (litres / day) [3] | 28,000 | 28,000 |
| **Total wastewater discharge by rig crew (litres)** | **2,520,000** | **7,560,000** |
| Offshore Supply Vessel (OSV) crew [4] | 45 | 45 |
| Rate of wastewater discharge by OSV crew (litres / day) [3] | 9,000 | 9,000 |
| **Total wastewater discharge by OSV crew (litres)** | **810,000** | **2,430,000** |
| Total crew (rig and OSVs) | 185 | 185 |
| Rate of wastewater discharge by total crew (litres / day) | 37,000 | 37,000 |
| **Total wastewater discharge by all crew (litres)** | **3,330,000** | **9,990,000** |

*Notes:*

*1 Assumes 90 days on location.*

*2 Based on a three well drilling campaign – 270 days in total.*

*3 Based on a discharge rate of 200 litres per day.*

*4 It is assumed there will be three OSVs in use, each with a crew of 15.*

### 2.5.4 Waste

2.83 Onshore waste disposal facilities in the Falkland Islands are extremely limited. Noble will work closely with FIG prior to drilling operations to determine acceptable options for onshore non-hazardous waste disposal. Only non-hazardous and inert waste streams generated during drilling may be disposed of or recycled locally, where possible.

2.84 Hazardous waste is waste that is, or may be considered to be, "*so dangerous or difficult to dispose of that special provision is required for its disposal*". The following list provides an example of hazardous waste that may result from the proposed drilling operations (but is not considered to be an exhaustive list):

- Waste paint and/or paint thinners;
- Waste oil;
- Oiled waste, including oil filters, oiled containers, oily rags, etc.;
- Contaminated oil;
- Spent batteries;
- Waste anti-freeze or other glycol-based substances;
- Used pipe dope/grease;
- Used light bulbs/tubes;
- Heli-fuel waste; and
- All hazardous waste packaging.

2.85 Hazardous waste generated from wells differs greatly per well, but a typical exploration well would generate between 2 to 100 tonnes of hazardous waste (average of 65 tonnes). This estimate is based on North Sea wells. Given that no OBM is proposed for use, it is assumed that the volume of hazardous waste generated per well on average would be in the range of 10 tonnes. An average volume of non-hazardous waste is estimated to be 30 tonnes per well.

2.86 Therefore, it is estimated that a total of approximately 30 tonnes of hazardous waste and 90 tonnes of non-hazardous waste will be produced by the exploration drilling campaign. Estimates of waste will be confirmed in the appropriate addendum submittal. All hazardous waste will be exported for treatment, in accordance with the Basel Convention and Nobles' wider Environmental, Health and Safety (EHS) policies and commitments.

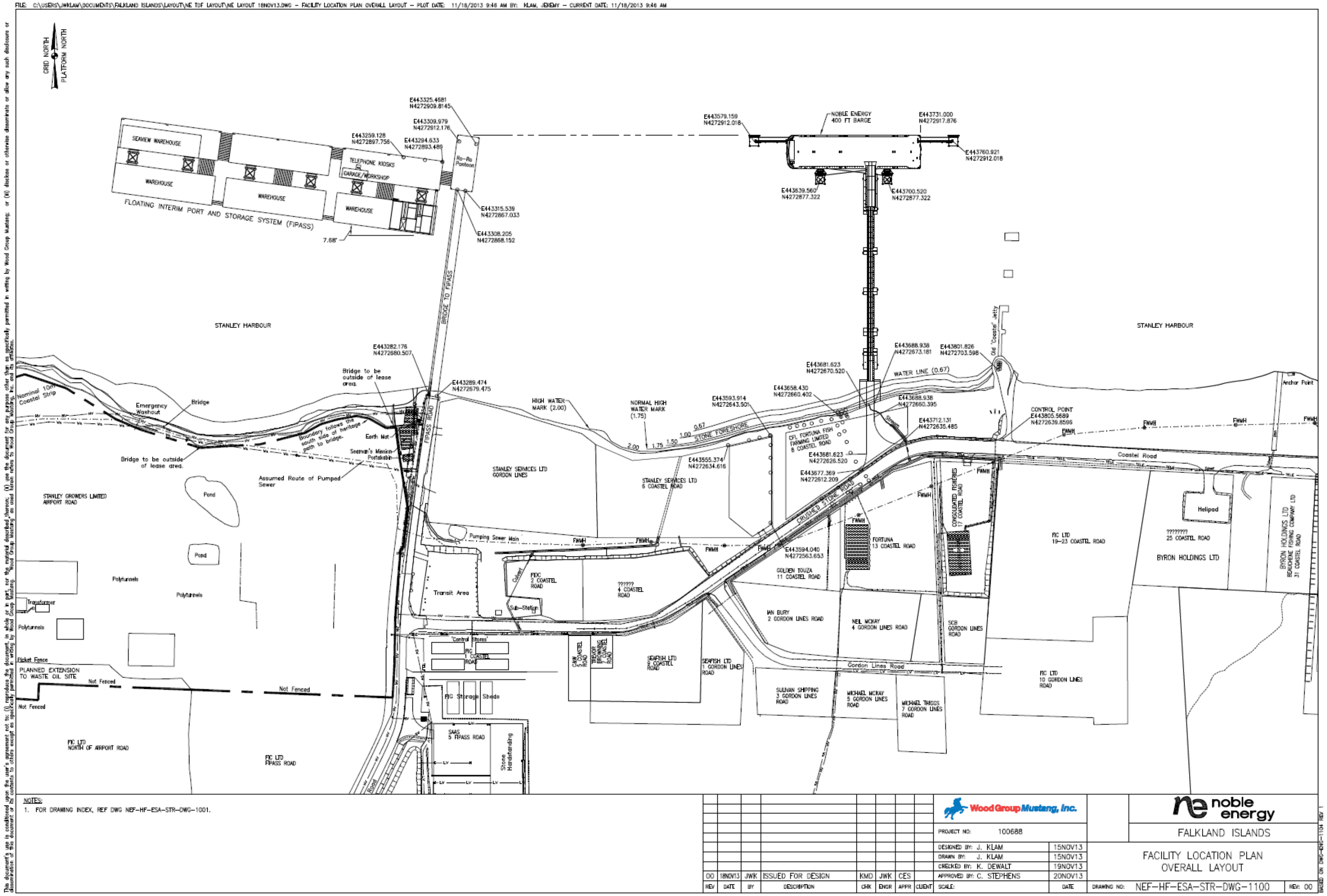
2.87 Specific waste handling, disposal routes and procedures will be detailed in a Waste Management Plan (WMPA), to be submitted for approval prior to drilling operations commencing. The WMPA will be developed in close consultation with FIG in order to find waste management solutions that are acceptable.

## 2.6 Support Operations

### 2.6.1 Onshore Support Base

2.88 The onshore support base for the exploration drilling operations will include both the existing shore base located on Boxer Bridge Road in Stanley, and the Temporary Dock Facility (TDF) in Stanley Harbour. The location of the TDF (undergoing installation) is shown in Figure 2.4. The main function of the onshore support base will be to provide logistical support for the supply of basic resources, storage of equipment and materials, as well as the embarking and disembarking of supplies from Stanley to enable the performance of the offshore drilling operations. The management office will be based at the existing Noble offices in Stanley at Argos House. Operations offices will be located at both the shore base and TDF.

*Figure 2.4: Temporary Dock Facility (TDF), Stanley Harbour*



### 2.6.2 Aerial Support

2.89 Personnel will be transferred to and from the rig by helicopter. Contractor supplied helicopters will be based at Stanley Airport and will be dedicated to Noble throughout the drilling programme. Sikorsky S-92 helicopters are expected to be used. Routine helicopter flights will occur 10 times per week. In addition, crew changes will occur every two weeks and will require an additional 15 flights in those weeks. There will also be an additional flight per week for search and rescue (SAR) flight check purposes.

2.90 Incoming crew, on arrival at Mt. Pleasant Airport, will transfer by road to Stanley Airport to await their helicopter flight. Crews departing the rig will arrive at Stanley Airport and transfer by road to Mt. Pleasant Airport for their international flights. Each crew change flight consists of an estimated round trip distance of approximately 460 kilometres, based on the proposed Scharnhorst North-1 well location (the furthest of the four potential well locations from Stanley Airport).

### 2.6.3 Offshore Supply Vessels

2.91 The drilling rig will be supported by up to three OSVs. The OSVs will rotate between the rig and the onshore supply base in Stanley. The OSVs will provide the bulk logistics and transport materials required for drilling.

2.92 One vessel will remain on station at the drilling location and take the role of SSV. The SSV will at all times be within proximity of the drilling rig for safety purposes and enforce the 500 metre safety zone. It will maintain close liaison with the drilling rig and will continuously monitor other vessel movements in the area. It will warn off vessels on a course that is likely to bring them into or near the safety zone around the rig.

### 2.6.4 Accommodation

2.93 During the proposed exploration drilling programme, there will be a requirement for local accommodation in Stanley from a combination of Noble management staff and incoming contractors who will provide specialist onshore support services. It is estimated that up to 87 people (which includes Noble personnel and service company personnel) will require permanent accommodation during the exploration drilling programme. In addition, approximately 60 offshore workers will be crew changed from the rig every two weeks. These workers may need to stay in Stanley for up to two nights during these rig crew changes before they depart either on international flights via Mt. Pleasant Airport or transfer offshore to the drilling rig.

2.94 It is noted that there is limited accommodation available on the Falkland Islands. Currently, Noble intends to have a permanent arrangement for housing and leasing rooms in local hotels in place prior to the commencement of drilling operations. This accommodation will be used for operational personnel and management on an *ad hoc* basis. It will also be utilised during a crew change operation in the event that the incoming or outgoing rig crew are required to stay overnight in Stanley.

2.95 In addition to the above accommodation arrangements, Noble, in conjunction with other operators, has initial plans to build temporary accommodation in the Stanley area. This accommodation will have a capacity of 80 rooms. Each of the 80 rooms within the temporary accommodation described above will have an extra bunk to assist in emergency evacuation situations. Expressions of interest for the provision of this accommodation have been released.

2.96 Table 2.21 below outlines the potential accommodation currently identified within Stanley. It should be noted that the utilisation of accommodation at the Falkland Islands Defence Force (FIDF) is only intended as a back-up for rig emergency situations. It is not intended to be used as routine accommodation during crew change delays.

*Table 2.21: Accommodation in Stanley, Falkland Islands*

| Name | Rooms | Number of Beds |
|---|---|---|
| Lookout Lodge* | 64 | 64 |
| Malvina House Hotel | 35 | 40 |
| Shortys Motel | 6 | 10 |
| Lafone House | 5 | 8 |
| Bennett House | 3 | 7 |
| Kay's B&B | 2 | 3 |
| The Paddock B&B | 5 | 8 |
| Susanna Binnie's Homestay | 1 | 2 |
| Waterfront Hotel | 8 | 9 |
| **Sub Total: Number of Rooms and Beds** | **129** | **151** |
| **FIDF** | Could accommodate up to 200 | 70 presently but could be increased |

*Unavailable during campaign

### 2.6.5 Waste Management

2.97 Solid wastes (other than drill cuttings) will be managed in accordance with Noble's WMPA.. To minimise the potential impact on the local waste disposal infrastructure, the top priority for the drilling programme will be waste reduction, re-use and recycling where practicable. General wastes generated on the rig will be temporarily stored onboard before transfer to shore for treatment and disposal. All waste movements will be recorded using waste transfer manifests.

2.98 The most significant risk associated with waste management is the handling of hazardous wastes generated on the rig which are typically dealt with by ports that have adequate waste reception facilities in accordance with MARPOL. The Falkland Islands is not able to provide such facilities in full compliance with MARPOL, and therefore all solid wastes will be transported to the TDF at Stanley Harbour and managed by a dedicated waste specialist. The waste specialist will have the capability to handle both hazardous and non-hazardous waste. All hazardous waste will be safely stored at the Noble shore base until its ultimate export from the Falkland Islands in accordance with the Basel Convention and Noble's wider EHS policies and commitments. It is currently anticipated that hazardous waste will be shipped to the UK.

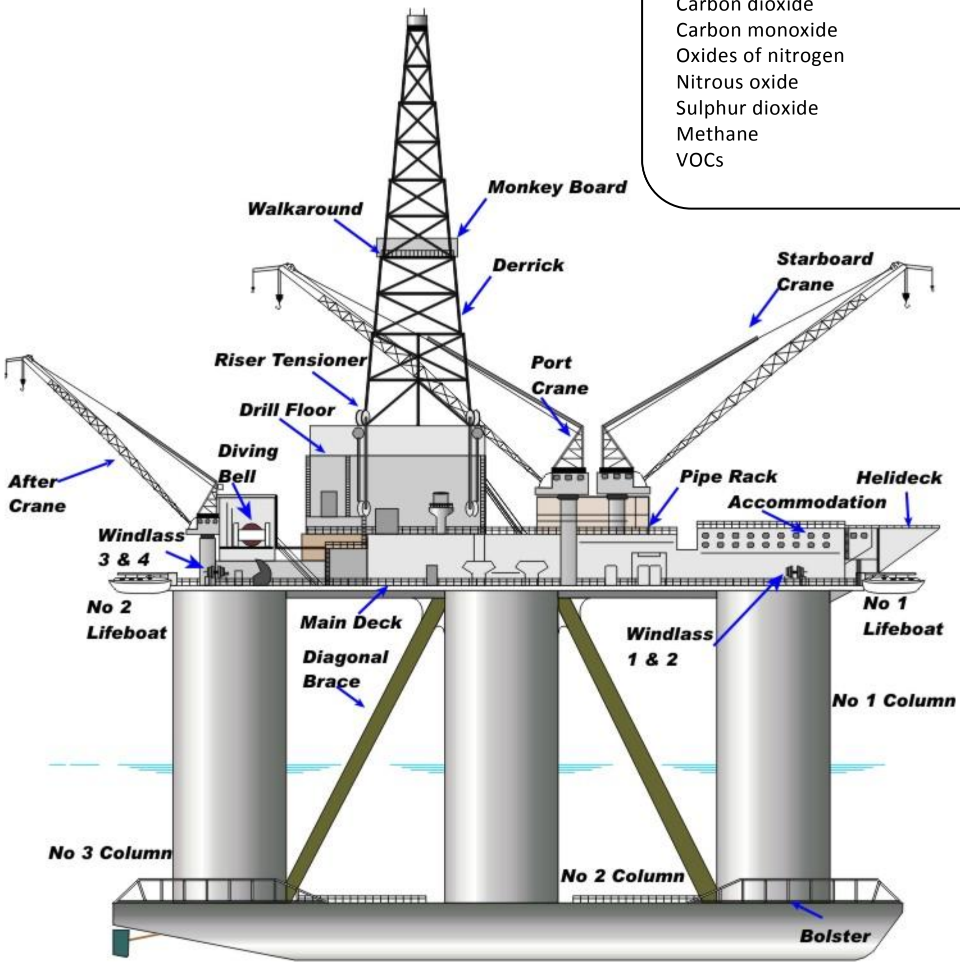
## 2.7 Total Emissions Summary

2.99 Figure 2.5 provides a summary of estimated total emissions and discharges arising from the exploration drilling campaign. The estimated total for the whole drilling campaign is based on the assumption that the rig will be engaged in operations for a total of 270 days.

***Figure 2.5: Total emissions and discharges summary for the proposed exploration drilling campaign***

**Total Emissions to Atmosphere (tonnes)**

| | |
|---|---|
| Carbon dioxide | 67,904.45 |
| Carbon monoxide | 322.97 |
| Oxides of nitrogen | 1,214.98 |
| Nitrous oxide | 4.66 |
| Sulphur dioxide | 84.88 |
| Methane | 3.73 |
| VOCs | 41.28 |




**Estimated Waste (tonnes)**

| | |
|---|---|
| Hazardous waste | 30 |
| Non-hazardous waste | 90 |

**Total Estimated Emissions to Sea (tonnes)**

| | |
|---|---|
| WBM chemicals | 10,930.00 |
| Drill cuttings | 8,250 |
| Waste water | 9,990,000 |

## 2.8 Project Alternatives Analysis

2.100 A necessary part of the impact assessment process is the consideration of alternatives to the proposed activity.

### 2.8.1 Alternatives to Drilling Location

2.101 Processed and interpreted seismic data are used to indicate areas where hydrocarbons may be trapped in oil or gas-filled geological structures. Without exploratory drilling, seismic data is unable to confirm the presence of hydrocarbons, the volume of a reservoir, whether the hydrocarbons can be commercially extracted or even the specific rock types. Hence, exploratory drilling is a necessary step in the development of commercial hydrocarbons and is a requirement under the terms of the production licenses awarded to Noble. Potential impacts from drilling activities and their management measures are discussed in subsequent sections of this EIS.

2.102 Many complex factors control the situation of oil wells (e.g., geology, topography, communications and engineering technology), meaning only a few viable alternatives need be considered from an environmental standpoint.

### 2.8.2 Alternative Drilling Units

2.103 There are alternative designs of mobile offshore drilling unit (MODU) available for hydrocarbon exploration offshore; jack-up rigs, semi-submersible rigs and drill-ships are three of the most common. Jack-up rigs have support legs which are lowered to the seabed before the floating section carrying the derrick is raised above the sea surface. They are used in shallow waters typically less than 150 meters, and are therefore not suitable for the deep water drilling environment in the blocks of interest.

2.104 Drill-ships are equipped with a drilling rig and station-keeping equipment such as anchor chains or a dynamic positioning (DP) system and thrusters. Drill-ships normally carry larger payloads than semi-submersible rigs due to their size and stability. Drill-ships are therefore well suited to operate in remote areas. Drill-ships may have the capacity to operate in water depths ranging from 100 metres to ultra-deep waters in excess of 2,000 metres, but the capacity of each individual drill-ship depends on the specifications and equipment of the individual unit. A drill-ship is required to have a DP system to operate in ultra-deep water.

2.105 A semi-submersible rig is a floating unit that is supported and stabilised on large pontoon structures submerged below the sea surface. The operating decks are elevated above the pontoons on large steel columns. Semi-submersible rigs are either anchored to the seabed with six to twelve anchor chains, or kept in position by a DP system, which is a computer controlled thruster system. Semi-submersible rigs can be used for drilling, work-over operations and as production platforms, depending on their equipment. Modern semi-submersible rigs with DP systems, have the capacity to operate in deep water in excess of 1,500 metres.

2.106 Given the water depths across the well locations of interest (1,270 to 1,880 metres), previous operator experience and rig availability, the Ocean Rig *Eirik Raude* DP semi-submersible drilling unit is an optimal and viable option (refer to Section 2.4.1). Where possible, the support services for the proposed drilling programme will be sourced from the Falkland Islands.

2.107 The use of a DP semi-submersible drilling rig would minimise seafloor disturbance, as anchoring would not be required (as would be the case with a traditional semi-submersible). Such a unit would however require continual positioning using thrusters, therefore both fuel consumption and underwater noise would therefore be higher than for an anchored unit. DP drill units are generally larger and more expensive to operate than anchored units.

### 2.8.3 No Action Alternative

2.108 The implications of not proceeding with an exploration drilling programme mean that the potential environmental and socio-economic impacts (both positive and negative) from drilling operations will not occur. The offshore environment may not necessarily maintain its current baseline condition, as impacts from routine vessel activity, such as waste water discharge, fall-out of atmospheric pollutants and ballast water discharge are still likely to take place offshore. The potential financial and social-economic benefits of oil and gas production will also not be realised.

2.109 The alternative of taking no action is not warranted. As described previously in this section, the exploration drilling project has clear technical feasibility. It also has a clear environmental and socio-economic feasibility, as supported by this EIS document and the subsequent impact assessment presented in Section 6.

2.110 The project also has clear feasibility that is in line with the long term plans of FIG to work towards a successful and sustainable hydrocarbons industry in the Falkland Islands.

# 3 Regulations, Standards & Other Commitments

3.1 This section provides a summary of the applicable regulatory and administrative framework for Noble's proposed exploration drilling activities, and summarises the national and international legal context for the project. It is not intended to provide a complete analysis of the wider legal framework within the Falkland Islands, but only legislation relevant to the exploration drilling project, the natural environment and local stakeholders. Legislation specific to local taxes and finance are outside of the scope of this study.

## 3.1 National Legal & Regulatory Framework

### 3.1.1 Government Structure & Governance

3.2 The Falkland Islands are one of 14 British Overseas Territories under the *British Overseas Territories Act 2002*, where supreme authority is vested in Her Majesty (HM) The Queen. The Governor of the Falkland Islands is the representative of the British Crown in the Falkland Islands, acting "in Her Majesty's name and on Her Majesty's behalf" as the *de facto* head of state in the absence of the British monarch, with the advice and assistance of the Executive and Legislative Assembly, and in accordance with the *Falkland Islands Constitution Order 2008*. The *Falkland Islands Constitution Order 2008* was ratified on the 5th November 2008 by HM the Queen in the Privy Council.

3.3 The supervision of environmental management in United Kingdom Overseas Territories (UKOTs), such as the Falkland Islands, is the responsibility of the government of each UKOT, in this instance the FIG.

3.4 The *Falkland Islands Constitution Order 2008* deals with all aspects of internal governance, with the exception of defence and foreign affairs, which remain the responsibility of the UK, as well as matters pertaining to overall Good Governance. The UK is also responsible for internal security, the public service and the offshore financial sector. Executive power is exercised at an Islands level in all other areas of internal governance. The Governor of the Falkland Islands, in addition to the role of representative of HM the Queen, and representing the UK Government to the people and the Government of the Falkland Islands, also represents the interests of FIG to the UK Government. The Governor has specific responsibility for foreign affairs, defence and the integrity and independence of functions such as justice and audit.

3.5 In accordance with the Constitution, the government is divided into the Legislative Assembly and Executive Council, both of which include democratically elected members. Members of the Legislative Assembly, five from Stanley and three from the area outside of Stanley (known as Camp), are elected every four years. The Legislative Assembly is chaired by a Speaker and includes two ex-officio members: the Chief Executive and the Financial Secretary.

3.6 There are no political parties currently represented in the Legislative Assembly; all Members are elected as independents. Based on the lack of political parties, there is no formal opposition and each Member takes responsibility for a particular portfolio. It is the responsibility of each Member to work closely with the departments associated with their portfolio, but the Members do not have the role of a Minister.

3.7 The Chief Executive is a civil service position, appointed by the Governor on the advice of the Executive Council (which is commonly referred to as ExCo). The Chief Executive serves a term of three years, which can be extended to an additional two years at the request of the Executive Council.

3.8 In accordance with the Constitution, the Falkland Islands also have a well-established independent judiciary. The Chief Justice of the Falkland Islands (non-resident) visits at least once a year to hear any serious or complex cases, including those relating to the Constitutional rights of residents, and appeals from the Magistrates' Court. The Senior Magistrate is based in the Falkland Islands and hears the majority of cases, including criminal and civil matters, family and children cases and admiralty and commercial disputes. The Senior Magistrate also sits as Coroner to investigate any unexplained deaths.

### 3.1.2 FIG Department of Mineral Resources

3.9 The Department of Mineral Resources (DMR) is a division of FIG responsible for the regulation of the oil and gas industry in the Falkland Islands. DMR is responsible for the assessment of applications from oil and gas operators under the *Offshore Minerals Ordinance 1994 (as amended)*, which includes applications from operators to conduct exploration drilling activities.

3.10 The Mineral Resources Committee is an advisory committee to the Executive Council (ExCo). Although the committee provides advice on matters relating to offshore hydrocarbons exploration and production activities, it has no formal powers to determine the outcome of drilling consents. General consent for offshore drilling for hydrocarbons is sought via the Governor in Executive Council. Individual drilling consents are determined by the DMR after the review of Petroleum Operations Notice 4 (PON4) applications. This is done in close consultation with the British Geological Survey (BGS), the UK Health and Safety Executive (HSE) and the UK Department of Energy and Climate Change (DECC).

### 3.1.3 Falkland Islands Offshore Hydrocarbons Environmental Forum

3.11 The Falkland Islands Offshore Hydrocarbons Environmental Forum (FIOHEF or Forum) is an integral part of the hydrocarbon industry in the Falkland Islands. The Forum was established in June 2011 as an independent, non-regulatory body of industry members, stakeholders and scientists. The Forum meets regularly and is a platform for discussion of environmental issues, sharing of ideas and resources, for operators to present updates on their projects, and for the provision of updates on new legislation and any proposed revisions or updates to regulations. However, since the Forum's inception, it has evolved further into an advisory body for the industry that reviews, discusses and advises on environmental issues, and makes recommendations to the Department of Mineral Resources and Environmental Planning Department (EPD). The Forum is administered by the EPD.

### 3.1.4 International Support and Cooperation

3.12 The Falkland Islands also receives support and advice on various matters including wildlife, the environment and hydrocarbons resources from various organisations, including the Foreign and Commonwealth Office (FCO), the Joint Nature Conservation Committee (JNCC), the Department for Environment, Food and Rural Affairs (Defra), the Royal Botanic Gardens Kew, BirdLife International (the international arm of the Royal Society of the Protection of Birds [RSPB]), the British Geological Survey (BGS), the Natural Environment Research Council (NERC), and the Department of Energy and Climate Change (DECC).

## 3.2 National Laws & Regulations

### 3.2.1 National Legislation

3.13 There is a range of legislation covering oil and gas, environmental and conservation matters in the Falkland Islands that are applicable to the proposed exploration drilling activities, which are linked to domestic, British and international policies, laws and conventions. These are summarised below in Table 3.1.

*Table 3.1: National legislation of the Falkland Islands applicable to the proposed exploration drilling project*

| Legislation | Key Requirements / Relevance to Proposed Exploration Drilling Project |
|---|---|
| **Oil & Gas Legislation** | |
| The Offshore Minerals Ordinance 1994 | The *Offshore Minerals Ordinance 1994* is the key piece of legislation for the offshore oil and gas industry in the Falkland Islands. It provides the regulatory framework for Environmental Impact Assessments (EIAs) and Environmental Impact Statements (EISs). An EIA is an assessment commissioned by the Governor. An EIS is a statement prepared by or on behalf of the applicant pursuant to a requirement made by the Governor. An EIA or EIS may be required if it is considered by the Governor that the environment may be significantly affected by the proposed activity. For all offshore drilling activity to date in the Falkland Islands, an EIS has been required as a minimum. An EIS submitted by an applicant must go through a 42 calendar day public consultation period.<br>The *Offshore Minerals Ordinance 1994* was amended in 1997 by the *Offshore Minerals (Amendment) Ordinance 1997* to make further provisions for the application of the *Health and Safety at Work etc. Act 1974*.<br>The *Offshore Minerals Ordinance 1994* was also updated in 2011 by the *Offshore Minerals (Amendment) Ordinance 2011*. The Amendment Ordinance formalises the requirement for an EIA or an EIS for the drilling of all wells in the controlled waters of the Falkland Islands. The Ordinance provides clarification on the content of an EIS under Section 64 and also formalises and provides clarification on the requirements and arrangements for the formal public consultation process under Section 65.<br>The Ordinances are the main pieces of legislation in respect of the proposed exploration drilling activities. |
| Offshore Petroleum (Licensing) Regulations 1995 | The *Offshore Petroleum (Licensing) Regulations 1995* provide the schedule, model clauses and format for the application of exploration or production licences in Falkland Islands waters, as well as conditions for record keeping, sampling and drilling. |
| Offshore Petroleum (Licensing) Regulations 2000 – Invitation to apply for open door licences | The *Offshore Petroleum (Licensing) Regulations 2000* invite applications for production licences in respect of Blocks specified within Schedules 1 and 2 of the Regulations. The Regulations specify exploration terms, conditions, financial terms and application criteria.<br>The 2000 Regulations were amended by the *Offshore Petroleum (Licensing) (Amendments) Regulations 2004*, which enable applications to be made under the *Offshore Petroleum (Licensing) Regulations 2000* in respect of areas formerly licensed under the *Offshore Petroleum (Licensing) Regulations 1995*. The amendment also prevented applications which were formerly licensed from being considered within two years (or sooner) of the expiration of the determination of that licence. |
| Offshore Petroleum (Licensing) Regulations 2005 | The *Offshore Petroleum (Licensing) Regulations 2005* amended the 2000 Regulations by inserting a new Regulation 3A, enabling the operation of the open licensing system to be suspended from time to time in relation to the whole of, or part of, the controlled waters. |
| Offshore Petroleum (Licensing) Regulations 2009 | The *Offshore Petroleum (Licensing) Regulations 2009* further amended the 2000 Regulations by removing the prohibition on the licensing of part blocks; and by amending the model clauses to increase the maximum initial term of a production licence from five to eight years, and to increase the second exploration term of a production licence from three to five years. |
| Petroleum Survey Licences (Model Clauses) Regulations 1992 | The *Petroleum Survey Licences (Model Clauses) Regulations 1992* provide the regulatory framework governing offshore exploration activity, including; field observations, geological and geophysical investigations, the use of remote sensing techniques, and sea floor sampling. |

| Legislation | Key Requirements / Relevance to Proposed Exploration Drilling Project |
|---|---|
| Health & Safety at Work etc. Act 1974 (Application outside the Falkland Islands) Order 2008 | The *Health & Safety at Work etc. Act 1974 (Application outside the Falkland Islands) Order 2008* effectively extends the provisions of the *Health & Safety at Work etc. Act 1974* to offshore installations within territorial waters or other designated areas offshore of the Falkland Islands. It ensures the implementation of the *Health & Safety at Work etc. Act 1974* on board offshore installations exploring for or producing hydrocarbons. The *Health & Safety at Work etc. Act 1974* is the primary piece of legislation covering occupational health and safety in the UK. The Health and Safety Executive (HSE), with local authorities (and other enforcing authorities) is responsible for enforcing the Act and a number of other acts and statutory instruments relevant to the working environment. |
| Offshore Health & Safety Order 1998 | The *Offshore Health & Safety Order 1998* effectively applies the provisions of the *Offshore Safety Act 1992* and Part 1 of the *Health & Safety at Work etc. Act 1974* to controlled waters of the Falkland Islands. The *Offshore Safety Act 1992* extended the *Health and Safety at Work etc. Act 1974* to enable specific rules regarding working offshore to avoid accidents in the workplace. The 1998 Order was amended by the *Offshore Minerals (Health & Safety) (Amendment) Order 2008*. |
| Management of Health & Safety at Work Order 1998 | The *Management of Health & Safety at Work Order 1998* effectively applies the *Management of Health and Safety at Work Regulations 1992* to the Falkland Islands in relation to installations and activities outside the Falkland Islands. The regulations contain the following:<br>• The Management of Health and Safety at Work Regulations;<br>• Manual Handling Operations Regulations;<br>• Workplace (Health, Safety and Welfare) Regulations;<br>• Personal Protective Equipment (PPE) at Work Regulations;<br>• Health and Safety (Display Screen Equipment) Regulations; and<br>• Provision and Use of Work Equipment Regulations (PUWER). |
| Offshore Minerals (Application of Employer's Liability [Compulsory Insurance] Act 1969) Regulations 1998 | The *Offshore Minerals (Application of Employer's Liability [Compulsory Insurance] Act 1969) Regulations 1998* implements the *Application of Employer's Liability (Compulsory Insurance) Act 1969* to employers of relevant employees employed for work on or from offshore installations, or on or from associated structures in the course of activities undertaken on, or in connection with, such installations. It effectively requires the operator and their contractors to have in place appropriate employer's liability insurance. |
| Offshore Installations (Prevention of Fire and Explosion and Emergency Response) Order 1998 | The *Offshore Installations (Prevention of Fire and Explosion and Emergency Response) Order 1998* implements the *Offshore Installations (Prevention of Fire and Explosion and Emergency Response) Regulations 1992* in the Falkland Islands. The Regulations require the duty holder to take various measures on board offshore installations in relation to the prevention and mitigation of fire and explosions, including (but not limited to): fire and explosion prevention, preparation for emergencies, muster and evacuation procedures, and emergency response plans. |

| Legislation | Key Requirements / Relevance to Proposed Exploration Drilling Project |
|---|---|
| Offshore Installations and Pipeline Works (Management & Administration) Order 1998 | The *Offshore Installations and Pipeline Works (Management & Administration) Order 1998* applies the *Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995* to the Falkland Islands. The Regulations cover various areas in relation to the safe management of offshore installations, including (but not limited to): the duties and powers of an Offshore Installation Manager (OIM), permit to work systems, record keeping, operational matters (including communications, metocean information, and identification by sea and air), provision of health services, provision of food and water supplies, and arrangements for helideck operations. |
| Diving at Work Order 1998 | The *Diving at Work Order 1998* implements the *Diving at Work Regulations 1997* in the Falkland Islands. The *Diving at Work Regulations 1997* implement various safety requirements in relation to diving projects including (but not limited to) required diving qualifications, duties of diving contractors and the requirements for diving project plans. The *Diving at Work Order 1998* was amended by the *Diving at Work Order (Correction) 1998*. |
| Offshore Installations and Wells (Design & Construction etc.) Order 1998 | The *Offshore Installations and Wells (Design & Construction etc.) Order 1998* implements the *Offshore Installations and Wells (Design and Construction, etc.) Regulations 1996* in the Falkland Islands. The Regulations set out various safety requirements for the design and construction of both offshore installations and wells. |
| Reporting of Injuries, Diseases and Dangerous Occurrences Order 1998 | The *Reporting of Injuries, Diseases and Dangerous Occurrences Order 1998* implements the *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 1995* in the Falkland Islands. The Regulations contain various requirements for the reporting of accidents, injuries and diseases. Petroleum Operations Notice (PON) No. 9 provides the reporting mechanism in the Falkland Islands for offshore installations (refer to Petroleum Operations Notices in subsequent sections of this table). |
| Personal Protective Equipment at Work Order 1998 | The *Personal Protective Equipment at Work Order 1998* implements the *Personal Protective Equipment at Work Regulations 1992* in the Falkland Islands. These Regulations make provisions for employers to supply, and employees to use, Personal Protective Equipment (PPE) according to the risks of the specific work tasks to be performed, to protect the user against health and safety risks in the workplace. |
| Offshore Installations (Safety Zone) (Exceptions) Regulations 1998 | The *Offshore Installations (Safety Zone) (Exceptions) Regulations 1998* makes provisions for exceptions to vessels entering or remaining in a safety zone established around an installation in connection with: the laying, inspection, testing, repair, alteration, renewal or removal of any submarine cable or pipe-line in or near the safety zone; provision of services, to transport persons or goods to or from the installation; the attempted saving of life or property; stress due to weather; distress situations. |
| Offshore Installations (Automatic Safety Zones) Order 1998 | The *Offshore Installations (Automatic Safety Zones) Order 1998* brings into force the provisions of section 30 of the *Offshore Minerals Ordinance 1994* so as to establish automatic safety zones around certain offshore installations. |
| Criminal Jurisdiction (Offshore Activities) Order 1998 | The *Criminal Jurisdiction (Offshore Activities) Order 1998* simply extends the criminal law of the Falkland Islands to offshore installations within the territorial sea of the Falkland Islands and to waters within 500 metres of installations. Under the order, police officers have the same powers they enjoy within the Falkland Islands themselves. |
| Civil Jurisdiction (Offshore Activities) Order 1998 | The *Civil Jurisdiction (Offshore Activities) Order 1998* applies the law of the Falkland Islands to the determination of questions arising out of “relevant acts” (as defined in article 2 of the Order) taking place within “offshore waters” and confers jurisdiction upon the Supreme Court of the Falkland Islands to determine such questions. |

| Legislation | Key Requirements / Relevance to Proposed Exploration Drilling Project |
|---|---|
| Offshore Installations (Safety Case) Order 2008 | The *Offshore Installations (Safety Case) Order 2008* implements the *Offshore Installations (Safety Case) Regulations 2005* in the Falkland Islands. The Regulations require a Safety Case for each offshore installation to operate in waters of the Falkland Islands, approved by the Health & Safety Executive (HSE). The principal regulatory aim is to reduce the risks from major accident hazards to the health and safety of the workforce at such installations by ensuring the installation itself meets specific health and safety requirements. The Order is supported by the Offshore Installations (Safety Case) Order 2008 – Guidance Notes. |
| Provision and Use of Work Equipment Order 2008 | The *Provision and Use of Work Equipment Order 2008* implements the *Provision and Use of Work Equipment Regulations (PUWER) 1992* in the Falkland Islands. The Order places duties on people and companies, who own, operate or have control over equipment in the workplace. The Regulations aim to ensure that equipment provided for use at work is: suitable for the intended purpose, safe and maintained correctly, used by trained and competent personnel only, accompanied by suitable health and safety measures, and used in accordance with specific requirements. |
| **Petroleum Operations Notices** | |
| Petroleum Operations Notice No. 1 | Specifies the record and sample requirements for seismic surveys and wells. |
| Petroleum Operations Notice No. 2 | Specifies operations reporting procedures including monthly and daily reports, drilling reports and changes to the work programme. |
| Petroleum Operations Notice No. 3 | Provides guidance on the procedure to follow for notification prior to carrying out a geophysical survey. |
| Petroleum Operations Notice No. 4 | Comprises the pro-forma and accompanying guidance notes to use for an application for consent to drill exploration, appraisal and development wells. |
| Petroleum Operations Notice No. 5 | Comprises the pro-forma and accompanying guidance notes to use for an application to abandon or temporarily abandon a well. |
| Petroleum Operations Notice No. 6 | Comprises the pro-forma and accompanying guidance notes to use for an application to complete and/or work-over a well. |
| Petroleum Operations Notice No. 7 | Specifies the definition of a well and the system to be used for numbering a well. |
| Petroleum Operations Notice No. 8 | Specifies the reporting requirements in the event of an oil spill, guidance on the use of dispersants and provides contact numbers and reporting forms to use in the event of an oil pollution incident. |
| Petroleum Operations Notice No. 9 | Sets out the requirements and reporting forms required under the *Reporting of Injuries, Diseases and Dangerous Occurrences Order 1998* (the Falkland Islands' implementation of the *Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) 1995 [as amended]*). |
| Petroleum Operations Notice No. 10 | Application for the use and/or discharge of Non-aqueous Drilling Fluids (NADFs) offshore of the Falkland Islands. Also specifies discharge quality requirements. |
| **Other Legislation** | |

| Legislation | Key Requirements / Relevance to Proposed Exploration Drilling Project |
|---|---|
| Merchant Shipping (Oil Pollution) Act 1971 | The *Merchant Shipping (Oil Pollution) Act 1971* was applied to the Falkland Islands by the 1975 Order in Council (SI 1975/2167 as amended by SI 1976/2143 and SI 1981/218). This Act defines and regulates responsibility for oil pollution from ships and effectively implemented, and slightly extended, the International Convention on Civil Liability for Oil Pollution Damage (CLC) in the UK.<br>The Act regulates the responsibilities of ship owners for damage caused by oil pollution from their ships. It has not been adopted fully in the Falkland Islands; however, parts I and II have been applied by virtue of the Falkland Islands *Merchant Shipping (Registration of Ships) Regulations 2001*. |
| Merchant Shipping (Registration of Ships) Regulations 2001 | The *Merchant Shipping (Registration of Ships) Regulations 2001* require all vessels registered in the Falkland Islands to comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78 regulations, with the exception of Annex IV (sewage from ships). It was specifically requested that this Annex not be applied, as the Falkland Islands are currently unable to comply with the legislative requirement for adequate vessel reception facilities. |
| Marine Environment Protection Ordinance 1995 | The *Marine Environment Protection Ordinance 1995* implements the conditions of the London Dumping Convention 1972 and prohibits the deposition or incineration of materials in Falkland Island waters (other than under license).<br>The ordinance offers a system of licensing and licence offences with strict liability for certain loss or damage in relation to polluting incidents.<br>This ordinance was amended by The *Environment Protection (Overseas Territories) (Amendment) Order 1997* and any conflicts between the *Marine Environment Protection Ordinance 1995* and the *Environment Protection (Overseas Territories) (Amendment) Order 1997* requires the provisions of the latter to take precedence. |
| Marine Mammals Protection Ordinance 1992 | The *Marine Mammals Protection Ordinance 1992* prohibits the killing or taking of marine mammals (or to use explosives within the Falkland Islands Outer Conservation Zone [FOCZ]) in waters up to 200 nautical miles offshore of the Falkland Islands. Under this ordinance, it is unlawful to import or export marine mammals without a licence. |
| Fisheries (Conservation and Management) Ordinance 2005 | The *Fisheries (Conservation and Management) Ordinance 2005* seeks to maintain the potential of fisheries resources whilst preserving the long term sustainability of the marine environment. The Ordinance also extends the *Conservation of Wildlife and Nature Ordinance 1999* up to the Falkland Islands Exclusive Economic Zone (EEZ) (i.e., 200 nautical miles offshore) including the Falkland Islands Interim Fishery Conservation and Management Zone (FICZ) and the Falkland Islands Outer Conservation Zone (FOCZ). |
| Protection of Military Remains Act, 1986 | This *Protection of Military Remains Act, 1986* may be applied to any aircraft or vessel that has crashed or been sunk in connection with military service. Under Section 2 (2) (a) of the Act, any person is in contravention of the Act if they: (a) Tamper with, damage, move, remove or unearth the remains; (b) Enter any hatch or other opening in any of the remains which enclose any part of the interior of an aircraft or vessel; or (c) Cause or permit any other person to do anything falling within paragraphs (a) or (b) above. This Act can be applied to any wreck in Falkland Islands territorial waters that has been sunk in connection with military service. The wreck does not need to be designated before this Act applies. |
| Protection of Wrecks Ordinance 1977 | This Act allows for the protection of wrecks in Falkland Islands waters that are either of historical, archaeological or artistic importance (Section 3), or are dangerous (Section 4). |
| Environment Protection (Overseas | The *Environment Protection (Overseas Territories) (Amendment) Order 1997* enables the provisions of the London Dumping |

| Legislation | Key Requirements / Relevance to Proposed Exploration Drilling Project |
|---|---|
| Territories) (Amendment) Order 1997 | Convention to be implemented in waters of the Falkland Islands.<br>Under Section 3, a licence is required for deposits in Falkland Islands waters or Falkland Islands controlled waters, whether in the sea or under the seabed. A licence is required for deposits in the sea from a range of sources including vessels, platforms and other man-made structures, but excludes pipelines, scuttling of vessels and incineration at sea.<br>The *Deposits in the Sea (Exemptions) Order 1995* sets out 25 categories of material that are exempt from the requirement to obtain a licence under the Order. The categories include disposal of sewage or domestic waste originating on a vessel or platform, certain types of cooling and ballast water, drill cuttings or drilling mud under certain circumstances and the incineration of hydrocarbons. There is little legislative control over ballast water management and hull bio-fouling in the Falkland Islands. Dredged material disposal is not exempt from the licensing.<br>The UK *Environment Protection (Overseas Territories) Order 1988* was enacted in the Falkland Islands by the *Environment Protection (Overseas Territories) (Amendment) Order 1997*. Although this order is largely similar to the Falkland Islands *Marine Environment (Protection) Ordinance 1995*, under the UK Colonial Laws Validity Act 1865, if there is any contradiction between the two pieces of legislation, then the UK legislation takes precedence. |
| Conservation of Wildlife and Nature Ordinance 1999 | In 1995, the FCO requested that Falklands Conservation (FC) commission a study of nature conservation law in the Falkland Islands; this led to the development of the *Conservation of Wildlife & Nature Ordinance 1999*.<br>This Ordinance protects wild birds, wild animals and wild plants, by prohibiting certain activities and making provision for National Nature Reserves.<br>The ordinance provides for the designation of National Nature Reserves on any area of crown land, marine area or on privately owned land with the agreement of the owner.<br>Fauna listed for protection under this ordinance are two species of fish, all species of butterflies and almost all species of wild bird. Protection of wild plants extends to 29 listed species, including those listed as threatened on the IUCN Red List. |
| Endangered Species Ordinance 2003 | The provisions of the *Endangered Species Ordinance 2003* allow the Falkland Islands to transpose the requirements of the Convention on International Trade in Endangered Species (CITES). |
| The Agreement on the Conservation of Albatross & Petrels | The Agreement on the Conservation of Albatross & Petrels (ACAP) was ratified by FIG in April 2004. This Agreement seeks to conserve albatrosses and petrels by coordinating international activity to mitigate known threats. ACAP has been developed under the umbrella of the Convention on Migratory Species (CMS). |
| Waste Management Framework | Apart from the requirement for the locating of disposal sites under the *Planning Ordinance 1991*, there is currently no regulatory framework specifically for waste management and disposal. |
| Environment Charter | The Environment Charter was signed in September 2001 by the FIG and the UK Minister for Overseas Territories. The Charter serves as a framework policy to guide the development of management policies and plans and outlines their joint environmental management commitments. The Charter sets out 11 key commitments, which are a range of policies and specific undertakings for both the FIG and the UK government. Objective 8 concerns the Environment – '*We will conserve and enhance the natural diversity, ecological processes and heritage of the Falkland Islands in harmony with sustainable economic development*'. |

| Legislation | Key Requirements / Relevance to Proposed Exploration Drilling Project |
|---|---|
| National Parks Ordinance 1998 | The National Parks Ordinance 1998 establishes the system for designation of National Parks, based on natural beauty and recreation value. No marine areas are currently being considered under this ordinance. |

### 3.2.2 National Policies & Strategies

3.14 A series of national policies and strategies have been developed by FIG to ensure sustainable development and protection of the environment in the Falkland Islands, including (but not limited to):

- The Falkland Islands Environmental Charter (September 2001);
- The Hydrocarbon Development Policy Statement (2013);
- Falkland Islands Structure Plan (2001-16);
- Falkland Islands Government Islands Plan (2014-18);
- Falkland Islands Biodiversity Strategy (2008-18);
- Falkland Islands Bio-security Policies;
- South Atlantic Invasive Species Strategy and Action Plan 2010;
- Falkland Islands State of the Environment Report 2008;
- Falkland Islands Government National Oil Spill Contingency Plan 2009;
- Falkland Islands Government *"Procurement Code of Practice by Oil and Gas Companies and their Subcontractors Operating in the Falkland Islands* (under development);
- Falkland Islands Species Action Plans for Cetaceans, Seals and Sea Lions (2008-18);
- Falkland Islands Species Action Plan for Southern Rockhopper Penguin (2014-2020); and
- Falkland Islands implementation plan for the Agreement on the Conservation of Albatrosses and Petrels (ACAP) 2013.

3.15 A number of these policies and strategies are summarised below.

#### Falkland Islands Environmental Charter

3.16 The Falkland Islands Environmental Charter was signed jointly by FIG and the UK Minister for Overseas Territories in September 2001. The Environment Charter outlines the environmental management commitments of the UK Government and FIG, and serves as a framework policy to guide the development of management policies and plans. The Falkland Islands Environmental Charter lays out ten key commitments for FIG and the UK Government. Of particular relevance is commitment No. 9: "*To control pollution, with the polluter paying for prevention or remedies*".

#### Hydrocarbon Development Policy Statement

3.17 The Falkland Islands Hydrocarbon Development Policy Statement (2013) introduced a set of overarching policy principles for hydrocarbon development in the Falkland Islands going forward. The statement defined a set of eight principles, which are defined below:

1. 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.
2. The Falkland Islands Government will maintain constant supervision and control over all hydrocarbon activities within the Falkland Islands Designated Areas.
3. 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 Falkland Islands for decades to come.
4. Development of the hydrocarbons industry must ensure the protection and conservation of the environment and biodiversity of the Falkland Islands.

5. Development of the hydrocarbons industry must take into consideration existing commercial activity and promote the development of local business capacity.
6. The exploitation of finite natural resources will be used to develop lasting benefits to society across the whole of the Falkland Islands.
7. Transparency and accountability must be present throughout the hydrocarbon development process from all parties involved.
8. 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.

3.18 The Hydrocarbon Development Policy Statement marks a significant point in terms of the way forward for the continued exploration and development activities that are taking place in the Falkland Islands. Of particular relevance is policy number 7 on transparency and accountability. It is important that project commitments going forward are honoured, that relevant parties are made accountable for their fulfilment, and that measures are in place to monitor and provide feedback of the effectiveness of any commitments that have been made to implement control and/or mitigation measures.

### Falkland Islands Biodiversity Strategy

3.19 The Falkland Islands Biodiversity Strategy (2008 – 2018) provides a policy for the management of biodiversity in the Falkland Islands, ensuring that all natural resources are managed sustainably. The strategy focuses on four core areas:

- Protecting the general environment;
- Protecting priority species and habitats;
- Protecting genetic resources; and
- Driving the biodiversity strategy.

3.20 The Falkland Islands Biodiversity Strategy pays dues regards to offshore commercial activities including fishing as well as oil and gas activities.

### Falkland Islands Bio-security Policies

3.21 Bio-security measures are in place in the Falkland Islands to safeguard the environment, economy and health of plants and animals from the risks associated with pests and disease. The Falkland Islands try to prevent pests and diseases from entering the country by implementing preventative protocols. Any harmful organisms already present in the Falkland Islands are eradicated and controlled to maintain the bio-security.

3.22 A major risk to bio-security are import and export trade movements including meat, poultry, dairy and eggs, and plant products (including fruit and vegetables). There are several import categories of concern of which some items require a permit. Items that do not require a permit are subject to inspection when entering the Falkland Islands.

3.23 All imports to the Falkland Islands are continually monitored by the Department of Agriculture Bio-security Section to ensure the bio-security procedures put in place are upheld at all times. Failure to comply with the protocols results in goods being temporarily withheld and may lead to their destruction.

3.24 Other bio-security protocols include the customs/declaration forms when entering the Falkland Islands, eradication of invasive species, the correct disposal of wastes, and management of ballast water from in-bound vessels.

### South Atlantic Invasive Species Strategy and Action Plan

3.25 The South Atlantic Invasive Species Strategy and Action Plan aims to draw together all elements of the invasive species issue, and to strengthen links between the South Atlantic UK Overseas territories (UKOTs) in this area. The Strategy is aimed at guiding future work involving invasive species in the South Atlantic. The specific aims of the strategy are to:

- Raise the global profile of the South Atlantic UKOTs as a haven for unique, but currently threatened biodiversity;
- Establish a common framework for all invasive species work in the South Atlantic and catalyse regional cooperation on a broader range of issues;
- Place public participation and open communication at the forefront of island invasive species actions;
- Improve coordination, efficiency and effectiveness of overseas territories (OTs) and UK Government decision-making and clarify responsibilities and functions at Territory and UK levels in relation to invasive species;
- Identify key problem areas to be addressed in relation to invasive species and facilitate prioritisation;
- Leverage efforts in and beyond the region to make best use of limited manpower, capacity and resources to address invasive species issues; and
- Guide regional and local fundraising for invasive species prevention, contingency response capabilities and longer term investments.

### Falkland Islands Government National Oil Spill Contingency Plan

3.26 The Falkland Islands National Oil Spill Contingency Plan (NOSCP) provides the framework that oil operators are required to adhere to in the area of spill response preparedness, and also outlines how FIG would respond to an oil pollution incident in the Falkland Islands. The primary objective of the NOSCP is to ensure a safe, timely and effective spill response commensurate with the severity of the oil pollution incident, and thereby protect socio-economic and environmental resources through coordinated response actions (*FIG, 2009*).

3.27 Oil operators in the Falkland Islands are required to have an oil spill contingency plan in place that is approved by FIG, with an equipment stockpile to deal with small (Tier 1) operational oil spills. Their plans are to be fully compliant with the NOSCP and the general emergency response framework of FIG (*FIG, 2009*).

### FIG Procurement Code of Practice

3.28 The Falkland Islands Government (FIG) has developed a code of practice for procurement by oil and gas companies and their subcontractors operating in the Falkland Islands. This Procurement Code of Practice sets out the principles and practices that FIG requires to be adhered to in order that local people and businesses benefit to the fullest extent possible from opportunities generated by oil and gas exploration and production activities. The Procurement Code of Practice is designed to encourage integration of the oil and gas sector with the existing sectors of the Falkland Islands economy to support national growth and development.

3.29 At present, the Procurement Code of Practice is in draft form and has yet to be finalised. Noble continues to work with FIG on the development and progress of this code of practice.

### Falkland Islands Species Action Plans for Cetaceans, Seals & Sea Lions

3.30 The Falkland Islands Species Action Plans for cetaceans and pinnipeds aim to promote the protection of these species in Falkland Islands waters from human threats. Cetacean and pinniped species require action plans as they meet one of the Falkland Islands Selection Criteria for Species and Habitat Action Plans as part of the Convention on the Conservation of Migratory Species of Wild Animals (referred to as the CMS or the Bonn Convention – refer to Section 3.3.1).

3.31 Parties to the CMS are required to provide strict protection for endangered migratory species listed in the Convention. Appendix I species are in danger of extinction throughout all or a significant proportion of their range, whilst Appendix II species have an unfavourable conservation status. Species in both categories would benefit significantly from international cooperative agreements. Cetacean species are listed in Appendix I of the CMS, whilst pinniped species are listed in Appendix II.

3.32 These species action plans enable the FIG to meet its commitment to the CMS.

3.33 The Species Action Plan for Cetaceans is centred around seven key areas:

- Determine population abundance, trends and recovery;
- Identify important calving, feeding, and migratory areas;
- Prevent commercial whaling and/or the expansion of scientific whaling;
- Protect habitat important to the survival of the species;
- Monitor and manage the potential impacts of prey depletion due to over harvesting;
- Monitor climate and oceanographic change; and
- Effort and funding issues.

3.34 The Species Action Plan for Seals and Sea Lions is centred around similar themes:

- Determine population abundance, trends and recovery;
- Identify important breeding and feeding areas;
- Protect habitat important to the survival of the species;
- Monitor and manage the potential impacts of prey depletion due to over harvesting;
- Monitor climate and oceanographic change; and
- Effort and funding issues.

#### Falkland Islands Species Action Plan for Southern Rockhopper Penguin (2014-2020)

3.35 This Plan delivers a framework of actions and measurable targets set at a national level to aid in the effective conservation and management of the species southern rockhopper penguin (*Eudyptes chrysocome*) for 2014 to 2020. The Plan identifies data gaps in environmental impact assessments and oil spill contingency plans, with respect to modelling overlaps/risks with seabirds as a high priority, which is of particular relevance to the oil and gas industry. Recommendations are made for performance of future tracking studies during periods that are most critical to survival of the birds (winter periods, incubation and pre-moult periods of breeding adult birds being the highest priority).

#### Falkland Islands Implementation Plan for the Agreement on the Conservation of Albatrosses and Petrels (ACAP) 2013

3.36 The UK ratified ACAP in 2004 on behalf of the South Atlantic UKOTs, which included the Falkland Islands. Since 2004, implementation plans have been put into effect in order to deliver ACAP in the Falkland Islands. The latest Falkland Islands ACAP Implementation Plan serves as a tool to guide and coordinate actions that are required in order to meet the UK and Falkland Islands obligations under the international agreement. Under the agreement, ACAP breeding sites have recommended actions, which include:

- Development and implementation of management plans;
- Management of bio-security and detrimental non-native species;
- Minimisation and prevention of disturbance from researchers and tourists;
- Use of Environmental Impact Assessments, where appropriate; and
- Reviewing the status at breeding sites of introduced animals, plants and disease-causing organisms known or believed to be detrimental to albatrosses and petrels.

### 3.2.3 EIS Approval Process for Exploration Drilling

3.37 This Environmental Impact Statement (EIS) is prepared to meet all national legislation applicable to the exploration drilling project, in particular, the *Offshore Minerals Ordinance 1994 (as amended)*. The Ordinance requires that an EIS be produced in support of all applications to drill a well in controlled waters.

3.38 The FIG Department of Mineral Resources (DMR) and Environmental Planning Department (EPD) are responsible for assessment of applications under the *Offshore Minerals Ordinance 1994 (as amended)*. Impact assessment documents are submitted to the DMR; however, their review is independently led by the EPD. Figure 3.1 outlines Noble's process for submission and approval of the exploration drilling EIS, and includes an outline of the Falkland Islands application and public consultation process, which is described below.

#### Scoping Report

3.39 The EIS Scoping Report was prepared by RPS, after consultation with the FIG DMR and other key stakeholders to identify key sensitivities and areas of concern to stakeholders. Once this was produced, the Scoping Report was prepared and submitted to the DMR and key stakeholders for review and comment. Stakeholder liaison will continue throughout the entire exploration drilling project lifecycle.

#### Preparation and Submission of the EIS

3.40 Following receipt of comments on the Scoping Report, the EIS document was prepared. Once complete, the EIS is submitted to the FIG DMR. At this point, an advertisement is placed in the Falkland Islands Gazette, and announcement made on the local radio station, which outlines the project and states that a formal public consultation period is open. The consultation period starts on the day that the advertisement is published in the Falkland Islands Gazette. The consultation period lasts for 42 calendar days.

3.41 The 42 calendar day period is the period from the date when the availability of the EIS is advertised in the Falkland Islands Gazette, to the deadline for comments closing.

#### Accessibility of the EIS

3.42 During the consultation period, two copies of the EIS document are made available in a public place for review, which will be the public library in Stanley. This will be made clear in the advertisement in the Falkland Islands Gazette and during the announcement on the local radio station.

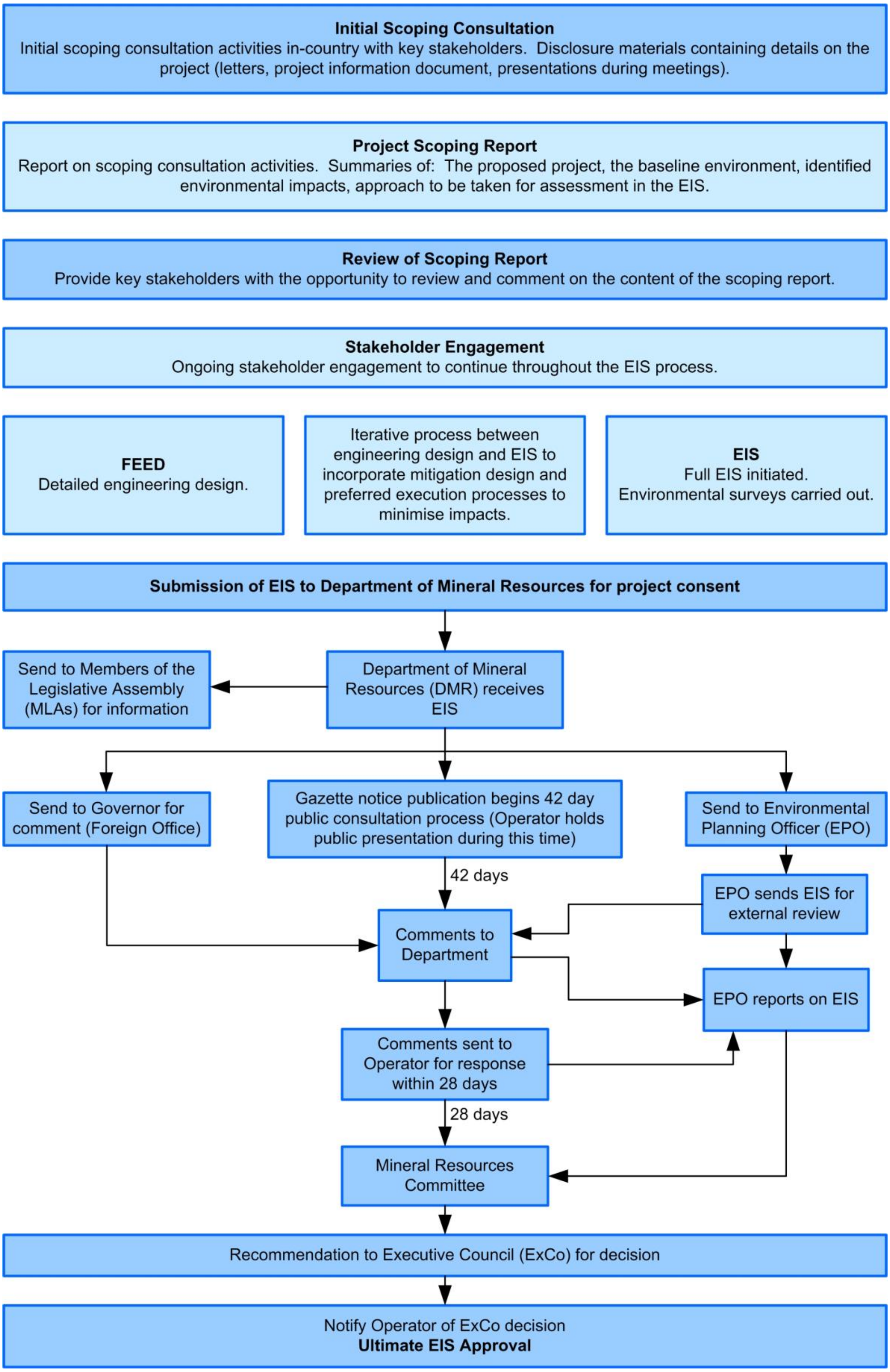
3.43 Full colour hard copies of the EIS document will be supplied to the DMR as part of the submission for internal FIG use and distribution. Hard copies are also made available to interested local agencies from the Noble local office in Stanley during the consultation process to whoever requests such a copy. These hard copies are printed locally in the Falkland Islands in the local print shop in Stanley. Demand is anticipated to be less than 50 copies.

3.44 FIG may also choose to host and publicise the EIS on its own website.

#### Public Disclosure Meetings

3.45 During the 42 day consultation period, Noble held series of further consultation meetings to present the findings of the environmental impact assessment. These meetings took place in the Falkland Islands between Monday 18$^{th}$ to Friday 22$^{nd}$ August 2014. The meeting format comprised a formal presentation given by Noble and RPS, outlining the project activities and the key findings of the EIS process, followed by an opportunity for members of the public to ask questions. The public disclosure meetings were held in the second half of the 42 calendar day consultation period in order to give the public time to receive and review the EIS.

*Figure 3.1: The EIA process*



3.46 Further details of the meetings held during the 42 day consultation period are provided in Section 8.7. Information on how stakeholders were engaged with during the scoping consultation phase prior to production of the EIS is provided in Section 8.5.

3.47 During the public consultation period, stakeholders were able to comment on the EIS, using comment forms available on the day, or sending comments directly to the DMR and/or by attending and verbally commenting at one of the public disclosure meetings.

#### EIS Review

3.48 During the formal public consultation period, the formal review of the EIS will take place and will be led by EPD. EPD also contacts other UK government agencies and organisations for review of the document, which may include DECC and/or the JNCC and the Scottish Association for Marine Science (SAMS). However, these agencies have no direct powers of intervention in any decision or recommendation made by FIG.

#### Responses to Comments

3.49 After the formal review period, FIG will submit their comments to Noble on the EIS. There is a limited timeframe to reply to these comments (normally 28 calendar days). A direct formal reply to the comments in the form of a separate document is normally an adequate response and an updated EIS incorporating all comments is not normally required. However, the EIS report can be updated, if deemed necessary.

3.50 During the process, FIG will ensure that all responses received from the operator on stakeholder comments are satisfactory.

#### Notification of Decision

3.51 Notification of the Authorities decision on the EIS will be made formally by the FIG DMR, EPD and Mineral Resources Committee shortly after they are satisfied that all stakeholder comments have been addressed. The approval is in the form of a formal letter issued by the DMR. The decision is likely to be publicised by FIG on its own website. There may be certain conditions and requirements for the consented drilling activities and/or for further work or reports attached to any approval.

## 3.3 International Requirements

3.52 The international legal framework on environmental matters is vast and consists of no fewer than 160 treaties, agreements and protocols. The Falkland Islands has ratified or is a signatory to a number of worldwide and regional conventions and agreements, which aim to protect the environment by addressing pollution and by protecting natural resources and flora and fauna.

3.53 There are a number of international conventions, agreements and initiatives that the Falkland Islands is party to, including the principal worldwide organisations active in the area of addressing pollution and promoting and developing conservation:

- The United Nations Food and Agriculture Organisation (FAO);
- The World Health Organisation (WHO); and
- The International Union for Conservation of Nature (IUCN); and
- The United Nations Framework Convention on Climate Change (including the Kyoto Protocol).

3.54 Members of the United Nations (UN) are required to adhere to all organisations operating under the UN aegis, namely the International Maritime Organisation (IMO), the United Nations Education, Scientific and Cultural Organisation (UNESCO) and certain associated programmes such as the United Nations Environment Programme (UNEP).

### 3.3.1 Relevant International Conventions

3.55 The list given below is not exhaustive and is limited to conventions and agreements relevant to the project:

- United Nations Framework Convention on Climate Change (UNFCCC), 1992;
- United Nations Convention on the Law of the Sea (UNCLOS), 1982;
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal, 1989;
- Bonn Convention on the Conservation of Migratory Species of Wild Animals, 1979 (The Bonn Convention);
- International Convention for the Prevention of Pollution from Ships, 1973/78 (The MARPOL Convention);
- Civil Liability Convention, 1992 & International Oil Pollution Compensation Fund, 1992;
- Convention on Wetlands of International Importance, especially Waterfowl Habitats (Ramsar Convention), 1971;
- Convention on Biological Diversity, 1992;
- International Convention for the Prevention of Pollution of the Sea by Oil (London, 1972);
- United Nations Conference on Environment and Development, 1992;
- OSPAR Convention, 1992;
- The Agreement on the Conservation of Albatross & Petrels (ACAP), 2004;
- CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora), 1975;
- The International Convention for the Safety of Life at Sea (SOLAS), 1974; and
- World Bank Safeguard Policies and IFC Performance Standards.

#### United Nations Framework Convention on Climate Change, 1992

3.56 The United Nations Framework Convention on Climate Change (UNFCCC) constitutes the first international treaty that imposes legal obligations and specific targets for limiting greenhouse-gas (GHG) emissions. By signing up to the UNFCCC, parties undertake to respect, among others, three main obligations:

- The reduction of GHGs in particular for developed countries;
- The establishment of national communication including an inventory of GHG emissions, a vulnerability assessment and a mitigation study; and
- The ethical undertaking to implement policies for the mitigation of GHG emissions entered into with a view to sustainable development.

3.57 Since the date when the principle of the UNFCCC was first adopted, a long process of negotiation has been undertaken to define a compromise, at a worldwide level, on how to implement and verify the targets of emission reduction. The adoption in 1997 of the Kyoto Protocol constituted a decisive turning point in this process, propelling negotiations on climate change into a new phase of implementation.

#### United Nations Convention on the Law of the Sea, 1982

3.58 The United Nations Convention on the Law of the Sea (UNCLOS) sets out a full framework for the regulation of all marine spaces. UNCLOS contains provisions regulating the limits of national jurisdictions over marine space, access to seas and oceans, means of protecting navigation and preserving the marine environment, the exploitation and conservation of living resources, scientific research missions, mining exploitation activities on the seabed and other types of exploitation of non-living resources as well as the resolution of disputes.

3.59 The Falkland Islands is one of the signatory countries to the UNCLOS Convention which was ratified by FIG in 1997. The latter requires its signatories to take measures and adopt the laws and regulations necessary in order to protect and preserve the marine environment. Laws relevant to the project include:

- Article 65 obliges signatories to take measures aimed at the conservation of marine mammals, including whales, dolphins and porpoises. This article calls upon signatories to cooperate with international organisations such as the International Whaling Commission with a view to the conservation of marine mammals.
- Articles 192 and 193 of UNCLOS acknowledge the signatories' sovereign right to rational exploitation and sustainable development of the living and non-living marine resources in their EEZ, pursuant to their environmental policies. The Convention likewise obliges its signatories to protect and preserve the marine environment.
- Article 194 establishes that signatories shall take all measures, consistent with the Convention, necessary in order to prevent, reduce and control pollution of the marine environment from any source. These measures shall include, inter alia, those designed to prevent to the fullest possible extent:
  - The release of toxic, harmful or noxious substances;
  - Pollution from vessels and the safety of operations at sea;
  - Pollution from installations and devices used in exploration or exploitation of the natural resources of the seabed and its subsoil; and
  - Pollution from other installations and devices operating in the marine environment.
- Article 194 also obliges signatories to take measures to protect fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life.
- Article 204 of UNCLOS obliges signatories to keep under surveillance the risks or consequences of their activities, authorised or in progress, in order to determine whether they are likely to pollute the marine environment.
- Articles 207 to 212 oblige signatories to adopt international regulations as well as national provisions aimed at preventing, reducing and controlling pollution of the marine environment.

### Basel Convention

3.60 The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal (the Basel Convention), is an international treaty designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries.

3.61 The overarching objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes. The scope of the Convention covers a wide range of wastes defined as "hazardous waste" based on their origin and/or composition and their characteristics, as well as two types of wastes defined as "other wastes" - household waste and incinerator ash. The provisions of the Convention centre on the following principal aims:

- The reduction of hazardous waste generation and the promotion of environmentally sound management of hazardous wastes, wherever the place of disposal;

- The restriction of trans-boundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management; and
- To provide a regulatory system applying to cases where trans-boundary movements of hazardous waste are permissible (for example, where the waste resources at the source of the hazardous waste are inadequate or unable to receive and process the waste in an environmentally acceptable manner).

3.62 In general, the Basel Convention promotes good practice for hazardous waste management and ensures that, where the export of hazardous waste may be necessary, the receiving nation has the capabilities and resources to receive, treat and dispose of the waste in an environmentally acceptable and sustainable manner. The principles of the Basel Convention provide particular protection for less developed countries that may not be able to receive hazardous waste and ultimately treat and dispose of it appropriately.

### Bonn Convention 1979

3.63 The stated aim of the Convention on the Conservation of Migratory Species of Wild Animals (The Bonn Convention, also known as CMS) is to preserve migratory species that, during their life-cycle, cross national boundaries. The migratory species are listed in Annex I and Annex II of this Convention. They include a large number of marine species such as blue whale, humpback whale, bowhead whale, right whale, porpoises and several species of dolphins.

3.64 The Convention calls for the protection and preservation of these species and offers a framework for cooperation between states for scientific research, restoration of habitats and the elimination of obstacles to the migration of the species named in the Convention. All cetacean and southern hemisphere albatross species are listed.

### MARPOL Convention, 1973/78

3.65 The International Convention for the Prevention of Pollution from Ships (MARPOL Convention) is an international agreement on the provisions governing the different types of pollution generated by vessels, including oil substances, waste, sewage, noxious liquid and dangerous substances as defined in the Convention. The Convention prohibits the discharge of pollution by vessels and sets out measures for the prevention of pollution from these sources.

3.66 The Convention also establishes a set of new standards for vessels, aimed at minimising the discharge of pollutants generated by them. It sets out a system of certification and inspection of vessels and establishes an obligation to report any incident of pollution. The aim of this system is to make operating defective vessels difficult, to pursue those who are responsible and apply current legislation. Any violation of the Convention’s requirements is prohibited and penalties must be set out in the legislation of the vessel’s flag State or the port, in accordance with the Convention.

3.67 The treaty includes 20 articles and 5 annexes. The MARPOL Convention stipulates that Annexes I and II are obligatory for the parties while Annexes III, IV and V are optional (not mandatory), unless the parties have specifically accepted them. The Falkland Islands are signatory to Annexes I, II, III and V of the Convention. The Falkland Islands specifically requested that Annex IV not be ratified as the Falkland Islands is at present unable to provide vessel reception facilities that are in full compliance with the requirements of this Annex. The ratified annexes refer to the following subjects:

- Annex I – Prevention of Pollution by Oil;
- Annex II – Control of Pollution by Noxious Liquid Substances in Bulk;
- Annex III – Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form; and
- Annex V – Prevention of Pollution by Garbage from Ships.

The provisions of Annexes I; II, III and V are summarised below.

*Annex I – Regulations for the Prevention of Pollution by Oil*

3.68 The criteria regarding oil waste that appeared in the 1969 amendments to the 1954 Convention remain; however, the total quantity of oil permitted to be discharged on a ballast voyage of new oil tankers was reduced by half from 1/15,000 of the cargo capacity to 1/30,000 of the amount of cargo carried. These criteria applied equally both to persistent (black) and non-persistent (white) oil. With regards to waste from machinery space bilges, this is only authorised when the vessel (en route) is more than 12 miles from the coast and the content of the effluent does not exceed 100 parts per million (Regulation 9).

*Annex II – Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk*

3.69 Annex II details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk. Some 250 substances were evaluated and included in the list appended to the Convention. The discharge of their residues is allowed only to reception facilities until certain concentrations and conditions (which vary with the category of substances) are met. Regardless, no discharge of residues containing noxious substances is permitted within 12 miles of the coastline.

*Annex III – Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form*

3.70 Annex III contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications.

3.71 For the purpose of this Annex, "harmful substances" are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code) or which meet the criteria in the Appendix of Annex III.

*Annex V - Prevention of Pollution by Garbage from Ships*

3.72 This Annex is applicable to all ships in the field of competence of the IMO and stipulates, among other things:

- Prohibition of the disposal of plastics (including ropes, fishing lines, synthetic fibres, plastic bags, ashes from incinerated plastics);
- Discharges authorised at greater than 25 nautical miles:
  - Dunnage[1]; and
  - Floating materials.
- Discharge authorised at greater than 12 nautical miles:
  - Food waste;
  - Paper, rags, glass items; and
  - Metal items, bottles.
- Waste authorised at greater than 3 nautical miles:
  - Food waste crushed and sifted to less than 25 mm.

### Civil Liability Convention, 1992 and International Oil Pollution Compensation Fund, 1992

3.73 Compensation for oil pollution damage caused by spills from oil tankers is governed by an international regime developed under the auspices of the International Maritime Organization (IMO). The framework for the regime was originally the 1969 International Convention on Civil Liability for Oil Pollution Damage (1969 Civil Liability Convention) and the 1971 International

[1] Typically dunnage is inexpensive or waste material (commonly wood) used to protect and secure cargo during handling and transit.

Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (1971 Fund Convention).

3.74 This 'old' regime was amended in 1992 by two protocols, and the amended Conventions are known as the *1992 Civil Liability Convention* and the *1992 Fund Convention*. The 1992 Conventions entered into force on 30 May 1996. The 1971 Fund Convention ceased to be in force on 24 May 2002, when the number of 1971 Fund Member States fell below 25.

3.75 The *1992 Civil Liability Convention* governs the liability of ship-owners for oil pollution damage by laying down the principle of strict liability for ship-owners and creating a system of compulsory liability insurance. The ship-owner is normally entitled to limit his liability to an amount which is linked to the tonnage of his ship.

3.76 The International Oil Pollution Compensation Fund 1992 (IOPC Fund 1992 or 1992 Fund) was established under the *1992 Fund Convention* in order to provide compensation for victims who do not obtain full compensation under the *1992 Civil Liability Convention*. By becoming Party to the *1992 Fund Convention*, a State becomes a Member of the 1992 Fund. The Organisation is based in London. The 1992 Fund is financed by contributions levied on any person who has received in a calendar year more than 150 000 tonnes of crude oil or heavy fuel oil after sea transport in a 1992 Fund Member State (*IOPC, 2011*).

### Ramsar Convention on Wetlands, 1971

3.77 The Convention on Wetlands is an inter-governmental treaty adopted on 2 February 1971 in the Iranian city of Ramsar. This Convention was the first worldwide intergovernmental treaty on conservation and the intensive use of natural resources. The Ramsar Convention was ratified by the FIG in 1976.

3.78 The treaty's official name, "Convention on Wetlands of International Importance especially as Waterfowl Habitat" reflects the emphasis placed from the start on the conservation and intensive usage of wetlands, especially as waterfowl habitat. Over time, the Convention has expanded its field of application to cover all aspects linked to the conservation and intensive use of wetlands, recognising these regions as being ecosystems of paramount importance for the conservation of biodiversity as a whole and the well-being of human communities. The Convention came into force in 1975, and as of 6 April 2014, 168 parties have signed. More than 2,413 wetland areas covering almost 206 million hectares (2.05 million km$^2$) have been designated for inclusion in the list of wetlands of international importance.

### Convention on Biological Diversity, 1992

3.79 The main aim of The Convention on Biological Diversity (the Rio Convention) is to promote the conservation of biodiversity and the sustainable use of genetic resources. It represents an international commitment to sustainable development and the conservation of biological diversity. The Convention is legally binding for its signatories and obliges them to work to put conservation and the protection of biodiversity at the heart of their national legislation and coordinate their efforts with other signatory countries. FIG has yet to ratify the Convention on Biological Diversity, although the FIG Biodiversity Strategy (2008-18) shares similar core values.

### International Convention for the Prevention of Pollution of the Sea by Oil (London, 1972)

3.80 The London Convention was ratified by the FIG in 1980 (however, note that the 1996 Protocol has not been ratified in the Falkland Islands). The London Convention aims to prevent pollution of the sea from dumping of waste and other substances likely to create hazards, harm living resources and marine life, damage amenities, or to interfere with other legitimate users of the sea. The dumping of Annex I materials is prohibited, Annex II materials require a prior special permit and all other wastes require a prior general permit.

3.81 This Convention specifically regulates pollution by oil from ships in order to prevent and tackle the harmful effects of marine pollution, such as damage to biologic resources, marine fauna and flora, risks to human health and the large-scale economic consequences that can have serious repercussions for waterside communities and small countries that depend on the sea's resources.

3.82 The Convention sets out penalties to be applied for any violation of the Convention's provisions, in particular with regard to illegal oil discharge by ships, failure to carry an Oil Record Book and the suspension, in full or in part, of the Convention's provisions in the event of war or hostilities and the end of the suspension when the event is over. The Convention prohibits the intentional discharge of oil and oily mixes by ships except, among others, under the following conditions:

- When a ship is proceeding en route;
- The instantaneous discharge rate does not exceed 60 litres per mile;
- The oil content of the discharge is less than 100 parts per million of the mixture, or the discharge is made as far as practicable from land; and
- In cases of necessity to secure safety of ships, save lives, prevent damage to cargo, or where leakage is unavoidable and alternative measures have been taken to minimise it.

3.83 In addition to the exceptions, the Convention also provides details of further activities required by contracting governments, which include:

- Parties are to take all possible measures to provide facilities adequate for the reception of oil residues at each port as well as at hydrocarbon loading points and ship-repair yards. Where facilities are inadequate, the Member State should report this situation to the Organisation (IMO);
- Every ship shall carry an Oil Record Book, available at all times for inspection; and
- Contracting parties are required to send the United Nations Organisation the texts of any laws, decrees, regulations and instructions aimed at ensuring the application of the Convention.

### United Nations Conference on Environment and Development, 1992

3.84 The United Nations Conference on Environment and Development was held in 1992 to find solutions to a complex set of environmental problems. Its aim was to guarantee sustainable development in numerous areas. The conference concluded with the adoption of several new Conventions such as the Earth Charter, Agenda 21, the Climate Change Convention and The Convention on Biological Diversity.

3.85 The Falkland Islands is a signatory to Agenda 21 of the Earth Summit. Agenda 21 is an action plan agreed to by governments and the international community, which is focused on key priorities in environmental and developmental matters. The Agenda includes an integrated sustainable management and development programme for coastal and maritime areas. The programme envisages the protection, rational use and development of living maritime resources as well as the deployment of the greatest possible efforts to prevent the deterioration of the marine environment and reduce the risk of effects that in the long term are irreversible.

### OSPAR Convention 1992

3.86 The Oslo-Paris (OSPAR) Convention is an important legal framework for assessing the risks resulting from exploration and production activities at sea. This Convention defines criteria, which have become an international reference standard for the legislation and management of chemical products used for oil and gas activities at sea.

3.87 The Strategy for Environmental Objectives and Management of Mechanisms for Activities at Sea were adopted during a meeting of the OSPAR Commission in 1999, and in June 2000 OSPAR introduced Decision 2000/2 which outlines the Harmonised Mandatory Control System for the Use and Reduction of Waste from Chemical Products at Sea.

### The Agreement on the Conservation of Albatross & Petrels, 2004

3.88 The Agreement on the Conservation of Albatross & Petrels (ACAP) was ratified by FIG in April 2004. This Agreement seeks to conserve albatrosses and petrels by coordinating international activity to mitigate known threats. ACAP has been developed under the umbrella of the Convention on Migratory Species (CMS).

### The Convention on International Trade in Endangered Species of Wild Fauna & Flora, 1975

3.89 The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments with the aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

### The International Convention for the Safety of Life at Sea, 1974

3.90 The International Convention for the Safety of Life at Sea (SOLAS) is an international maritime safety treaty. It ensures that ships flagged by signatory States comply with minimum safety standards in construction, equipment and operation. The SOLAS Convention in its successive forms is generally regarded as the most important of all international treaties concerning the safety of merchant ships.

### World Bank Safeguard Policies & IFC Performance Standards

3.91 The World Bank (WB) policies and guidelines aim to manage social and environmental risks, potential impacts and improve development opportunities through its organisation of private sector funding in member countries of the WB that meet the conditions required to benefit from funding.

3.92 The International Finance Corporation’s (IFCs) Performance Standards provide guidance on how to identify risks and impacts. IFC Performance Standards are designed to help avoid, mitigate, and manage risks and impacts to promote doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities. The eight Performance Standards establish standards that the client is to meet throughout the life of an investment by IFC.

3.93 Oil and gas companies often follow WB guidelines and IFC Performance Standards to achieve results through best practice and Noble is following these guidelines to ensure the Company implements best practice for its Falkland Islands projects (Table 3.2).

*Table 3.2: Relevant World Bank and IFC guidelines and policies*

| **Guidelines and Policies** | **Potential relevance to the Project** |
|---|---|
| Environmental, Health and Safety Guidelines for the exploitation of oil and gas at sea (2007). | These Guidelines are technical reference documents with general and industry-specific examples of good international practice, and contain performance levels and measures that are generally considered to be achievable in new facilities at reasonable cost by existing technology. They are relevant to seismic exploration, exploratory and production drilling, development and production activities, pipeline operations, transportation, tanker loading and unloading and decommissioning. They also address potential onshore impacts that may result from offshore oil and gas activities. |
| Performance Standards on Environmental and Social Sustainability (2012). | Performance Standard 1 establishes the importance of: i) integrated assessment to identify the environmental and social impacts, risks and opportunities of projects; ii) effective community engagements through disclosure of project-related information and consultation with local communities on matters that directly affect them, and; iii) the client's management of environmental and social performance throughout the life of the project.<br><br>Performance Standards 2 to 8 below establish requirements to avoid, minimise, offset and compensate impacts on the population and the environment, and to improve baseline conditions, if relevant.<br><br>The full list includes:<br><br>• Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;<br>• Performance Standard 2: Labour and Working Conditions;<br>• Performance Standard 3: Resource Efficiency and Pollution Prevention;<br>• Performance Standard 4: Community Health, Safety and Security;<br>• Performance Standard 5: Land Acquisition and Involuntary Resettlement;<br>• Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources;<br>• Performance Standard 7: Indigenous Peoples; and<br>• Performance Standard 8: Cultural Heritage.<br><br>The guidelines for each performance standard specify the phases of the social and environmental impact assessment process, discuss their objectives and list the requirements for each phase, including: the selection, scope and drawing up of the terms of reference, the preparation of the environmental assessment report, and the review and implementation of the project.<br><br>When environmental or social impacts are anticipated, developers are required to manage them through its social and environmental management system consistent with Performance Standard 1. |

<table>
<tr><th>Guidelines and Policies</th><th>Potential relevance to the Project</th></tr>
<tr><td>Access to information (2010).</td><td>The World Bank’s Policy on Access to Information sets out its policy on how it discloses information in its possession to the public. This policy replaces the WBs policy on the communication of information and came into force on 1 July 2010. As the WB has acknowledged for some time, a policy on open access to information is indispensable for the execution of its numerous tasks. At the same time, the WB is bound to protect the confidentiality of certain information. This policy seeks to find an appropriate balance. It is based on the following five principles:<br><br>• Maximising access to information;<br>• Setting out a clear list of exceptions;<br>• Safeguarding the deliberative process;<br>• Providing clear procedures for making information available; and<br>• Recognising requesters’ right to an appeals process.<br><br>After the introduction, the second section sets out the basic policy, the third section explains how the WB processes information in relation to member countries and other parties, while the fourth section describes aspects of policy implementation.</td></tr>
<tr><td>Pollution Prevention and Abatement Handbook (1998).</td><td>This Handbook is specifically designed to be used in the context of the World Bank’s environmental policies. It promotes the concepts of sustainable development by focusing attention on the benefits – both environmental and economic – of pollution prevention, including cleaner production and good management techniques.</td></tr>
</table>

<table>
<tr><th>Guidelines and Policies</th><th>Potential relevance to the Project</th></tr>
<tr><td>Noise<br><br>Worker exposure to noise is covered in Section 2.0 on Occupational Health and Safety (IFC EHS Guidelines: Environmental Noise Management).</td><td><u>Noise levels</u><br><br>Standards on noise apply principally to the protection of workers rather than the general public. The WBs Guidelines on offshore oil and gas production state that staff must have hearing protection when they are exposed to noise levels of more than 85 dB.<br><br><u>Underwater noise</u><br><br>IFC’s guidelines for minimising underwater noise and the measures recommended for reducing the risk of noise impact on marine species include:<br><br>• Identifying and avoiding areas sensitive for marine life such as feeding, breeding, calving, and spawning areas;<br>• Planning offshore construction activities around sensitive times of the year (e.g., breeding season);<br>• Reducing operation time, where possible;<br>• Identifying fishing areas and reducing disturbance to these areas by planning for activities to be undertaken at less productive times of the year, where possible;<br>• If it is envisaged that if sensitive animal species are found in the area, their presence must be monitored before the onset of significant noise creation activities. In areas where major impacts on sensitive species are envisaged, professional observers must be employed.</td></tr>
</table>

## 3.4 Noble Guidance on Environmental, Social & Health Impact Assessment

### 3.4.1 Environmental, Social & Health Objectives & Targets

3.94 Noble operates under a Global Environmental, Health and Safety (EHS) Management System (GMS). Noble is committed to conducting its business in a manner that protects the environment, health and safety of employees and communities. To achieve this, Noble strives to comply with EHS laws and minimize injuries and incidents whilst protecting the environment. An outline of Noble's GMS elements can be found in Appendix D.

# 4 Baseline

## 4.1 Introduction

4.1 Knowledge of the characteristics of the environment in the vicinity of the project allows an understanding of the potential for the proposed exploration drilling operations to interact with the local environment, so that appropriate controls can be adopted to mitigate any negative impacts.

4.2 The key features of the physical, biological and human environment in both the immediate vicinity of the Noble license blocks and further afield have been summarised in this section.

4.3 The Noble license areas lie in waters to the south, east and north-east of the Falkland Islands (Figure 4.1). Noble is currently operator of the following Production License (PL) areas (in order from south to north-east): PL013, PL014, PL015, PL016, PL010, PL011, PL012, PL031, PL028, PL029, PL025, PL026 and PL027.

### 4.1.1 Baseline Survey Data

#### Previous Seismic Survey Activity

4.4 Three dimensional (3D) seismic survey activities in the areas of potential petro-geological interest to Noble have been taking place within the northern and southern license areas offshore the Falkland Islands.

4.5 The first round of seismic survey activities was undertaken from November 2012 through to June 2013. The first of these surveys was the Falkland Islands Southern phase A (FISA12) survey area (Figure 4.1). FISA12 is located in the East Falkland Basin, approximately 100 kilometres from the nearest landfall at Cape Pembroke on East Falkland. FISA12 covers an area of 5,328 $km^2$. FISA12 covers the north-western half of PL011, the majority of PL012 and the south-easternmost tip of PL031. The survey was undertaken between December 2012 and May 2013 using the Petroleum Geo-Services (PGS) survey vessel *Ramform Sterling*.

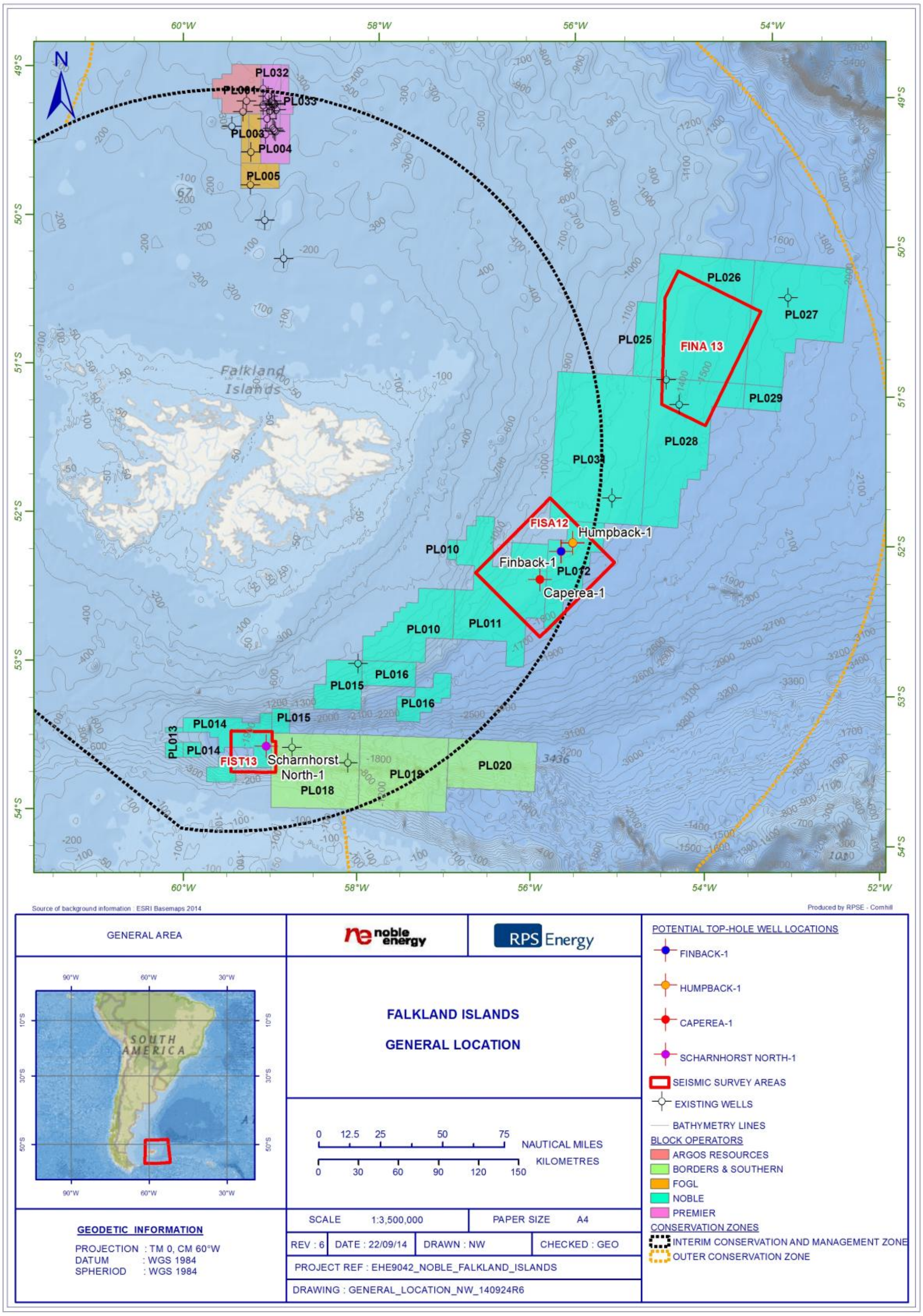
4.6 The second survey in the first seismic survey round was the Falkland Islands Southern Tilted Fault Block (FIST13) survey area, undertaken between May and June 2013 using the same vessel (Figure 4.1). FIST13 is located in the South Falkland Basin approximately 62 kilometres from the nearest landfall at Beauchêne Island and approximately 125 kilometres from the East Falkland mainland at Bull Point. FIST13 covers an area of 1,019 $km^2$. FIST13 covers the southern area of PL014 and a very small western area of PL018.

4.7 The second round of seismic survey activities took place from November 2013 to February 2014. The Falkland Islands Northern Area (FINA13) survey involved acquisition over the northern area license. FINA13 is located in the East Falkland Basin, approximately 206 kilometres from the nearest landfall at Mengeary Point on East Falkland. FINA13 covers an area of 5,380 $km^2$. FINA13 covers the majority of PL026, a very small area of PL027 and the northern area of PL028. The location of the acquisition area is shown in Figure 4.1. The PGS survey vessel *Ramform Titan* was used for this survey.

4.8 The areas of current exploration drilling interest lie within the FISA12 and FIST13 survey areas. Analysis of the seismic data acquired over these areas is constantly ongoing and is feeding into the well design (refer to Section 2).

4.9 There are also existing historic geological survey datasets, and seismic data gathered during the late 1970s and 1980s, which was used to provide early descriptions of the geological framework of the Falklands Plateau region, which extends for about 1,800 kilometres east of the Falkland Islands, and investigate potential for oil extraction (e.g., *Ludwig and Rabinowitz, 1980; Ludwig, 1983*). In the early 1990s the British Geological Survey undertook further geological survey work in the region.

*Figure 4.1: Noble project location in the Falkland Islands*



### Environmental Surveys

4.10 Environmental baseline surveys took place from December 2013 to April 2014 using the MG3 survey vessel *Poseidon*. This survey covered the FISA12, FIST13 and FINA13 survey areas. A brief description of the survey programme is given below. The full results of the FISA12 baseline survey are provided in Appendix K and summarised in the baseline text that follows.

4.11 The full results of the FIST13 and FINA13 surveys are forthcoming; these will be supplied as addenda to this submission when they become available. Ideally, all surveys should be included in this document; however, because this is an ongoing process, Noble would like to strike a balance between moving the application process forward and the survey results currently available.

4.12 It should be noted that the FISA12 area will be the first area to be drilled. All survey results will be detailed within an EIS addenda, which will be developed by Noble and approved by FIG prior to commencement of any drilling.

#### *Survey Programme*

4.13 The survey design is based on the 3D seismic seabed pick and seabed morphological mapping of the FISA12, FIST13 and FINA13 areas. The environmental survey included a habitat and baseline sampling programme using a drop-down video camera system and box coring/grab sampling methods. Swathe bathymetry and pinger data has also been acquired over selected sites, to support seabed morphological mapping. This allows for sample locations to be repositioned (if necessary) for interpretation in the field, and to provide a background onto which seabed imagery and samples can be mapped.

4.14 Water quality samples and conductivity, temperature, depth (CTD) measurements have also been taken over areas to gain further understanding of the water column characteristics. A geochemical sampling programme was also carried out to obtain macro seep samples for finger printing of hydrocarbons.

4.15 As part of the survey, an attempt was made to positively identify two un-charted World War I wrecks situated within the FISA12 area. Prior to the survey, the positions of the wrecks had never been established with any degree of confidence due to the circumstances and period in which they were sunk. The wrecks were not identified with the survey equipment.

4.16 It is thought that an anomaly seen within FINA13 during the bathymetry survey is highly likely the wreck of the *Atlantic Conveyor*; however, the survey was unable to obtain seabed photographs so a positive identification was not possible. Further information on these wrecks is provided below in Section 4.4.11.

4.17 Further details on the survey programme methodology are provided in Appendix K.

#### *Survey Results*

4.18 The results of all environmental baseline surveys are not currently available for inclusion in this EIS report. Survey results for the FISA12 area, in which Noble intends to undertake drilling first, are available within this document and have been incorporated into the baseline information presented in subsequent sections. The full results of the surveys within the FIST13 and FINA13 areas will be submitted when they become available. In light of this, environmental surveys commissioned by operators in the vicinity of the Noble licenses have been referred to in this report where relevant.

#### *Previous Site Surveys from Other Operators*

4.19 A number of previous site surveys have taken place for prospective wells across the region and these are summarised below in Table 4.1. These surveys have been referred to throughout the document. Surveys referred to in this section have been shaded in Table 4.1.

*Table 4.1: Site surveys in the region (surveys referred to have been shaded [dark shading indicates the reasoning for inclusion])*

| Operator | Survey | Position (centre) | Distance from FISA12 centre point (approx.) | Distance from FIST13 centre point (approx.) | Distance from FINA13 centre point (approx.) | Reference |
|---|---|---|---|---|---|---|
| Borders & Southern | Regional Survey, Darwin and Stebbing wells. | - | 180 km NE | 70 km ESE | 420 km NE | *Borders & Southern, 2010* |
| BHP | Endeavour Rig Site Survey | 50° 38' 31.41" S<br>54° 36' 10.45" W | 210 km NE | 450 km NE | Lies within, approx. 20 km WNW from centre point | *Fugro Survey Limited, 2009a* |
| BHP | Loligo Rig Site Survey | 51° 07' 27.358" S<br>54° 42' 29.324" W | 160 km NE | 400 km NE | Lies within, approx. 60 km SW of centre point | *Fugro Survey Limited, 2009b* |
| BHP | Nimrod Rig Site Survey | 51° 50' 44.301" S<br>55° 21' 02.018" W | 70 km NE | 320 km NE | 140 km SE | *Fugro Survey Limited, 2009c* |
| BHP | Toroa Rig Site Survey | 53° 01' 27.143" S<br>58° 02' 35.586" W | 150 km SW | 100 km NE | 360 km SW | *Fugro Survey Limited, 2009d* |
| FOGL | Hero Rig Site Survey | 50° 34' 42.952" S<br>53° 31' 50.237" W | 260 km NE | 500 km NE | 50 km E | *Gardline, 2011a* |
| FOGL | Inflexible Rig Site Survey | 53° 29' 44.282" S<br>59° 08' 33.942" W | 250 km SW | Lies within, approx. 12 km N of centre point | 450 km SW | *Gardline, 2011b* |
| FOGL | Loligo NW Rig Site Survey | 51° 00' 45.630" S<br>54° 50' 28.900" W | 160 NNE | 400 NE | Lies within, approx. 55 km SW of centre point | *Gardline, 2011c* |
| FOGL | Scotia East A | 50° 23' 42.895" S<br>053° 35' 41.087" W | 270 NE | 520 NE | 60 km ENE | *Gardline, 2011d* |
| FOGL | Vinson West | 52° 36' 09.691" S<br>055° 59' 22.580" W | Lies within, approx. 30 km S of centre point | 260 NE | 450 SW | *Gardline, 2011e* |

## 4.2 Physical Environment

### 4.2.1 Geography

4.20 The Falkland Islands are an archipelago of approximately 778 islands in the South Atlantic. The largest of these Islands are East Falkland and West Falkland. The Falkland Islands are situated some 600 kilometres north-east of Cape Horn, Chile; and approximately 400 kilometres from the nearest point on the South American mainland (the lighthouse at San Diego, on the south-easternmost tip of the province of Tierra del Fuego, Argentina). The Falkland Islands have a total land area of 12,173 km$^2$ (*Factbase, 2012*).

### 4.2.2 Bathymetry & Seabed Morphology

4.21 The Falkland Islands are situated on a projection of the Patagonian continental shelf, which is bound to the north by a steep slope (the Falklands Escarpment), separating it from the Argentine Abyssal Plain. A gently north-eastward sloping area between the Falkland Islands and the Falklands Escarpment, at water depths of between 150 and 1,800 metres, is known as the North Falkland Basin. The continental shelf extends some 200 kilometres beyond the coast of the Falkland Islands to the north, about 50 kilometres to the south-west, and about 50-100 kilometres offshore on the eastern side (*Otley et al., 2008*).

4.22 To the south, a deep east-west trough (the Falklands Trough) divides the Falklands Plateau from the Burdwood Bank. The Burdwood Bank is one of a number of elevated blocks bound by submarine ridges and troughs, which were formed as a result of compression during the Cenozoic era along the northern margins of the Scotia Sea (*Otley et al., 2008*).

4.23 The bathymetry for the wider region across the Noble license blocks is shown in Figure 4.2.

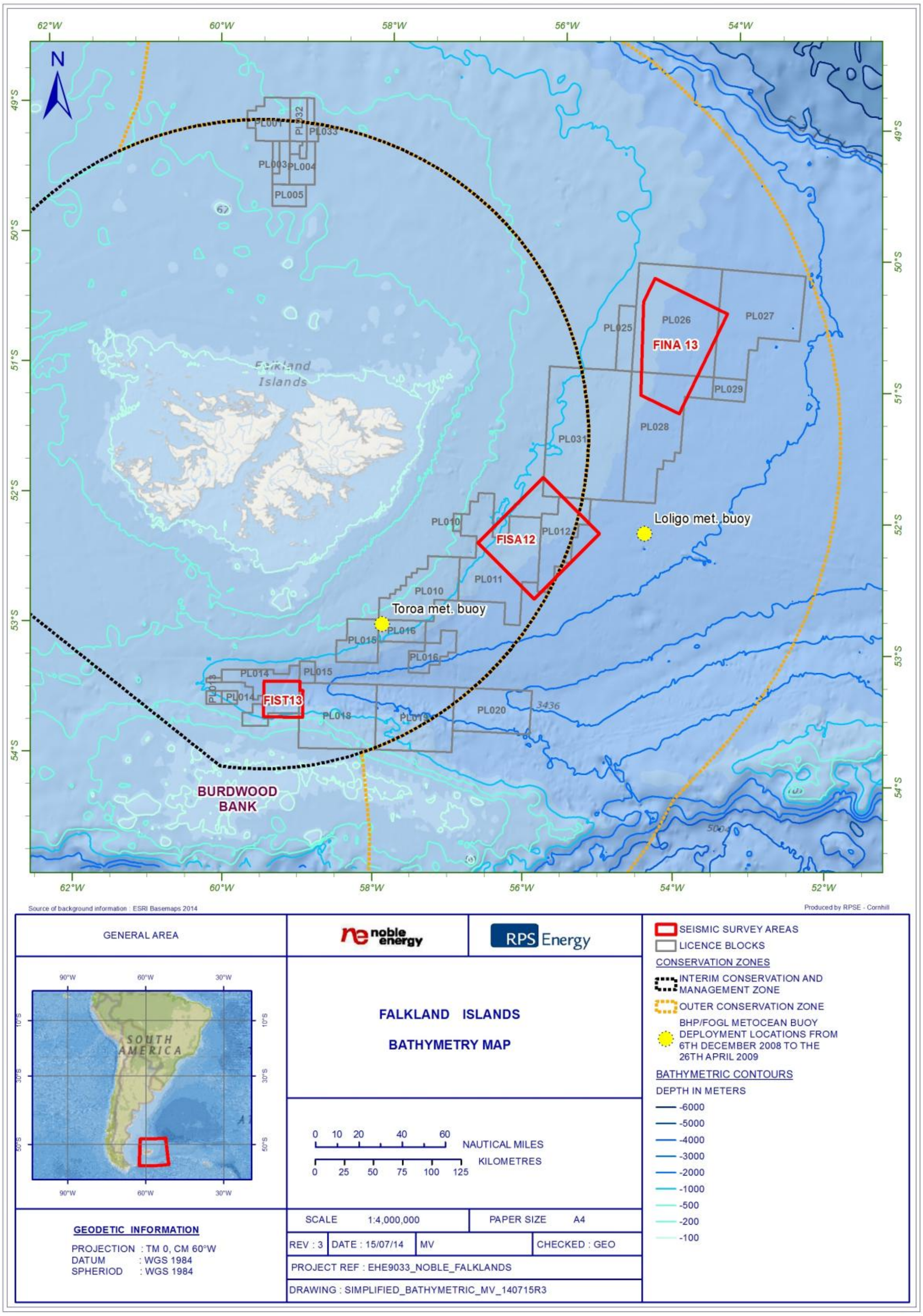
4.24 Bathymetry across the FISA12 area ranges from approximately 1,000 metres in the north-west of the area to approximately 1,600 metres in the south.

4.25 Depths across the FISA12 survey area ranged from 950 metres in the north-west, decreasing sharply to a maximum depth of 1,650m in the south-east. The gradient within the well area was generally less than 2°, but this increased to around 5° along the edge of the escarpment which was found at 1,400m depth and within a large depression in the shallowest part of the site. Here, localised gradients in excess of 45° were recorded and expected to represent rock outcrops and areas of near vertical cliff faces (*MG3, 2014*).

4.26 Bathymetry across the FIST13 area ranges from approximately 700 metres in the far south, to approximately 1,900 metres in the north and north-east. Bathymetry across FINA13 ranges from approximately 1,200 to 1,500 metres.

4.27 Detailed bathymetry for the FIST13 and FINA13 areas will be provided at a later date upon receipt of the survey results for these areas.

*Figure 4.2: Falkland Islands regional offshore bathymetry (also showing the BHP/FOGL Metocean buoy deployments from 6th December 2008 to 26th April 2009)*



### 4.2.3 Seabed Sediments & Granulometry

#### BaselineSurveys

4.28 The environmental survey programme commissioned by Noble included seabed sampling. A standard seabed sampling methodology was applied, utilising a box corer and Hamon grab. A detailed description of the sampling methodology, data analysis approach and survey results relevant to the FISA12 area are provided in Appendix K (*MG3, 2014*). The equivalent for the FIST13 and FINA13 areas will be submitted as addenda to this EIS as the final survey reports are made available.

4.29 In the absence of results for FIST13 and FINA13, reference has been made to previous environmental surveys conducted by operators in the wider area.

#### FISA 12 Survey Results

4.30 Within the FISA12 survey area the majority of the shallower sediments were dominated by relatively homogeneous and featureless slightly gravelly silty sand. The deeper sediments to the south and east were associated with a similar sediment type, but with greater erosion and a significant gravel component, indicative of ice modification from drop stones throughout. The central part of the survey area is represented by a complex bathymetry indicative of a number of underlying geological structures forming an irregular escarpment running from the south-west to the north-east. These have been interpreted as steep sloped exposures of bedrock or a hard underlying formation (such as a concretion) revealing a low energy rock exposure. In the shallower, north-western part of the survey area, this underlying formation appears to have either collapsed or has been eroded leaving steep sided depressions at a number of locations, with slump material (boulder field) at its base.

4.31 The dominant sediment type across the survey area was representative of slightly gravelly muddy sand as determined by the Folk characterisation. The average sediment composition was made up of the following: sand (60.3%); fines (32.7%); and, gravels (7.0%). However, sediments ranged from a sandy mud and muddy sand through to gravelly sand. The well locations of Humpback-1 and -2 as reported within the FISA 12 Environmental Baseline Survey (EBS) report are both located within areas of gravelly sand, with sediments at the Humpback-1 proposed well location also comprising localised exposures of cobbles or boulders.

#### Previous Surveys

##### *Surveys in Proximity to FISA12*

4.32 A rig site survey for the Vinson West well location, conducted by Gardline on behalf of FOGL, lies within the FISA12 area, approximately 30 kilometres south of the area centre point (*Gardline, 2011e*).

4.33 Through seabed photographs and sampling, seabed sediments were found to comprise medium coarse sand which became silty and clayey in places. Environmental seabed sampling was conducted at five stations across the survey area after interpretation of geophysical data on board the vessel. The seabed photography and video footage revealed sediments consisting predominantly of sand with easily disturbed silt and sparse gravel. Occasional boulders and gravel patches were seen at one station (*Gardline, 2011e*).

4.34 There was little variation in sediment samples across the survey site, with all five stations being classified as *poorly to very poorly sorted, muddy sand*. Fine sediment (silt and clay ≤63µm) accounted for between 15.6% and 23.0% of sediments, while gravel material (sediment ≥2mm) accounted for ≤2% across the surveyed area (*Gardline, 2011e*).

4.35 In addition to the above survey, a rig site survey for the Nimrod well location, conducted by Fugro, on behalf of BHP Billiton, lies approximately 70 kilometres to the north-east of the FISA12 area centre point (*Fugro Survey Limited, 2009c*). This survey covered an area of 9.6km x 7.4km.

4.36 Seabed sediments were shown to be extremely homogeneous, with the sediments at all stations classified as *poorly to very poorly sorted fine sand* (using the Wentworth classification). Sand fractions were dominant in all samples, though a moderate proportion (16.4% to 28.1%) of fine material was also recorded. Although, relatively low proportions of coarse material were identified from the particle size analysis, gravel and pebble particles were seen underlying the predominantly sandy surficial material at most stations (*Fugro Survey Limited, 2009c*).

#### *Surveys in Proximity to FIST13*

4.37 The survey conducted by Borders & Southern included regional sampling for the Darwin and Stebbing wells (*Borders & Southern, 2010*). This regional survey is located approximately 20 kilometres to the east of the FIST13 area. The Borders & Southern survey collected samples from 23 stations.

4.38 The survey results indicated that sediments ranged from *sandy silt* to *silty gravely sand* and occasional bedrock exposure. Samples collected at the proposed Darwin East well location (approximately 25 kilometres east of the FIST13 centre point) indicated the predominance of *sandy silt*, whereas at the proposed Stebbing well location (located approximately 70 kilometres from the FIST13 centre point), *slightly silty gravelly fine sand* was the predominant sediment type (*Borders & Southern, 2010*).

4.39 A full sediment granulometry analysis was performed as part of the Borders & Southern survey and showed that *sandy silt* was the most distinct size class, exhibited at three of the 22 stations, indicating a sedimentary regime typical of the low energy environment found at the western end of the South Falkland Basin. *Slightly gravelly silty sand* and *silty sand* were the next most distinct particle size distributions found, located around the central part of the surveyed region, with *silty sand* tending to occur in shallower areas. The remaining distinct particle size distributions were relatively poorly sorted but were broadly centred on *slightly silty gravelly coarse sand* and *slightly silty gravelly fine sand*. These sites demonstrated the variable levels of heterogeneity exhibited by the sediments throughout the survey area (*Borders & Southern, 2010*).

4.40 The overall granulometric results of the Borders & Southern survey showed a significant variability in sediment habitats located north of the Burdwood Bank. Whilst the presence of glacial deposits over the surface sediments indicates a low depositional regime for much of the area since the end of the Pleistocene epoch, the uneven coverage and grading of much of the coarser fractions suggests that localised surface sediments may remain quite variable and subject to ongoing oceanographic influences. Sites located in the north-west of the surveyed area indicated a notably finer sedimentary habitat, indicative of a lower energy regime in the western end of the South Falkland Basin (*Borders & Southern 2010*).

4.41 In addition to the above survey by Borders & Southern, a rig site survey for the Inflexible well location, conducted by Gardline on behalf of FOGL, lies within the FIST13 area, approximately 12 kilometres north of the area's centre point (*Gardline, 2011b*). This survey covered an area of 5km x 3km.

4.42 Seabed sediments were found to comprise mainly of *very soft silty clay*. Environmental seabed sampling was conducted at five stations. The grab sampling observations found that all samples contained loose silty clay at the surface and slightly darker, more cohesive clay from approximately 2-3 centimetres below the surface. Very small proportions of granular material, including shells, were present when the entire sample contents were sieved on board the vessel (*Gardline, 2011b*).

4.43 Sediment samples varied little across the survey area, with most stations classified as *poorly* and *very poorly sorted medium silt* (using the Wentworth Classification). The Modified Folk Classification identified all five stations as consisting of sandy mud (*Gardline, 2011b*).

4.44 The Borders & Southern survey results indicated considerable variation in sediment type. Given the similarity in bathymetry variance across the FIST13 area and the proximity to the Borders & Southern survey, sediments are expected to be similar to those encountered by Borders & Southern, although a greater bias towards finer sediments is anticipated, such as those encountered by the FOGL Inflexible survey. However, similar levels of variability between sampling sites is also possible across FIST13.

### *Surveys in Proximity to FINA13*

4.45 A number of site surveys have previously been conducted within the FINA13 area.

4.46 The Endeavour rig site survey, conducted by Fugro, on behalf of BHP, lies within the FINA13 area, approximately 20 kilometres west-north-west of the area centre point (*Fugro Survey Limited, 2009a*). This survey covered an area of 10.9km x 7.7km.

4.47 Gravity coring, drilling and box coring programmes showed that seafloor materials throughout the area predominantly consisted of fine to coarse sand with small amounts of gravel. It was thought that localised patches of cemented sediments may also exist, although this could not be confirmed by box core sampling. Several escarpments were found in the survey area, some with slopes as steep as 20 to 30 degrees. These were thought to have been created by erosion of sediments in the geological past (*Fugro Survey Limited, 2009a*).

4.48 Six environmental stations were successfully sampled for particle size analysis. All six stations were found to comprise similar sediment types. Particles in the medium to fine sand particle size range were particularly prevalent. Small quantities of gravel and pebbles were found in several of the samples, although not consistently, with considerable variation in the coarse sediment component, evident between replicate samples from the same station (*Fugro Survey Limited, 2009a*).

4.49 The Loligo rig site survey, conducted by Fugro on behalf of BHP, also lies within the FINA13 area, approximately 60 kilometres south-west of the area centre point (*Fugro Survey Limited, 2009b*). This survey covered an area of 26.2km x 15.2km.

4.50 Evidence collected from the gravity coring, drilling and ROV programmes showed that seafloor materials predominantly consisted of fine to coarse sand or gravel throughout the area. There was evidence to suggest that some of these sediments may also have been cemented in parts of the survey area (*Fugro Survey Limited, 2009b*).

4.51 Only three stations were successfully sampled for particle size analysis. All three stations showed similar levels of clay and silt particles. However, only two of the stations had similar sediment types, in which *medium to fine sand* was particularly prevalent. The sediment sample acquired at the third station was observed to have a distinctly different sediment type, in which pebble fragments were mainly found (*Fugro Survey Limited, 2009b*).

4.52 In addition to the above two surveys, the Loligo NW rig site survey, conducted by Gardline on behalf of FOGL, lies within the FINA13 area, approximately 55 kilometres south-west of the area centre point (*Gardline, 2011c*). This survey covered an area of 5km x 3km, and is located approximately 15 kilometres to the north-west of the above Loligo survey conducted by Fugro.

4.53 Five seabed locations were sampled. Seabed imagery illustrated silty sand with areas of gravel, cobbles and boulders. The steep slope, investigated as a camera transect between two of the stations appeared as a surface concretion, eroded below and dropping away vertically beyond the sight of the camera lens. It was thought that the silty sand may be thin recent sediment, while the gravel, cobbles and boulders were thought to potentially represent a short lived ice rafted event (*Gardline, 2011c*).

4.54 Grab samples were found to contain white/grey sandy silt with coarser black fine-medium sand closer to the surface. There was also gravel and occasional small cobbles found (*Gardline, 2011c*).

4.55 Sediment samples varied little across the survey area, with all stations dominated by sand, which accounted for >59% of the sample at most stations and 38% at the deepest station. The grain size distribution peaked around the medium sand size class, other than at the deepest station where it peaked at fine to medium sand. The proportional contribution of gravel sized material (>2mm) was the most variable across the survey area. The Modified Folk Classification therefore ranged from *slightly gravelly muddy sand* to *muddy sandy gravel*. However, most stations were classified as *gravelly muddy sand* (*Gardline, 2011c*).

4.56 Given the results of the above three surveys and their locations within the FINA13 area, fine to coarse sand and gravels are expected to be the dominant sediment type across the region. Localised concretion of seabed sediments is also expected to be observed.

### 4.2.4 Sediment Chemistry

4.57 As there is currently no oil and gas production or processing underway in the vicinity of the Noble license areas, there is very little data available on background hydrocarbon levels. The remoteness of the Falkland Islands license areas would suggest minimal terrestrial influence on background levels.

#### BaselineSurveys

4.58 For the site-specific surveys conducted over the FISA12, FIST13 and FINA13 areas, the chemistry analysis of the recovered seabed sediments has included:

- Total organic carbon and fractionated organic carbon;
- Hydrocarbons, including alkanes, TPH and PAHs (polycyclic aromatic hydrocarbons, 2-6 ring and alkyl derivatives):
  - Hydrocarbons: 1 µg.g$^{-1}$ (microgram per gram or 1 part per million);
  - Alkanes: 1 ng.g$^{-1}$ (nanogram per gram or 1 part per billion);
  - PAHs: 1 ng.g$^{-1}$ (as above).
- Heavy and trace metals (Al, As, Ba, Cd, Cr, Cu, Fe, Pb, Ni, V and Zn) and Hg, Sb, Be, Se, Ag, and Ti.

4.59 The results of the FISA12 environmental baseline survey are presented in Appendix K and summarised below. In the absence of results for FIST13 and FINA13 reference has been made to previous environmental surveys conducted by operators in the wider area.

#### FISA 12 Survey Results

4.60 Some of the chemical parameters surveyed followed patterns observed within the particle size analysis (see Section 4.2.3). Total organic carbon (TOC), total hydrocarbon content (THC) and saturates all indicated relatively low background concentrations with a subtle pattern of distribution relative to the mean particle size or the proportion of fines (defined as being ≥20% silt-clay or fine fractions [< 63 µm]). This relates to the increased surface area provided by silts and clays which sorbs and adsorbs organic and some inorganic components within the sediments.

4.61 The THC concentrations gave a mean of 3.1µg.g$^{-1}$, whilst alkanes indicated a mean of 313ng.g$^{-1}$, approximately 10 per cent of the total THC recovered. Inspection of the individual gas chromatograms at all stations revealed no background fingerprints throughout with no specific envelopes or peaks relating to anthropogenic or petrogenic inputs.

4.62 Whilst a review of the alkanes showed that terrestrial influences to the saturates were also minimal at the site, indicative of an offshore site influenced by Antarctic water masses, and a relatively low pyrolytic polycyclic aromatic hydrocarbon influence, the presence of 2 and 3 ring PAHs (naphthalene, phenanthrene and dibenzothiophene [NPD]) and the high occurrence of alkylated PAHs suggests a clear input from petrogenic sources, albeit at a trace level. This is likely to be from natural hydrocarbon seeps previously recorded within the region. Historical datasets on the Burdwood Bank (*BSL, 2008*) and surveys at Toroa have similarly recorded background petrogenic influences to the surface environmental samples with a suggestion that the sources are south and west of the FISA location. Total PAH concentrations (2-6 compounds) recorded a mean of 82.8 ng.g$^{-1}$ whilst the mean of the NPD fraction 43.8 ng.g$^{-1}$.

4.63 The concentrations of heavy and trace metals were consistent with historical surveys within the area. The distribution of the metals often correlated with themselves and occasionally other sediment factors. The most obvious of these was that of aluminium which indicated a strong correlation with per cent gravels and sorting coefficient. Several other metals indicated auto-correlations with each other (that is to say that they followed similar trends relating to the same parameter but not necessarily each other). One clear correlation between metals was recorded between iron and arsenic. Iron indicated a huge variability across the survey area ranging from 10.7 to 135mg.g$^{-1}$. This has been interpreted as a function of the variability of the residual glacial materials recorded at some sites, in particular the black basalt sands reworked by the currents in some areas. Arsenic, which is often adsorbed onto iron, indicated modest but quite variable concentrations ranging from 3.2 to 12.3 µg.g$^{-1}$. All metals were processed for total content using hydrofluoric acid digestion. Results recorded trace levels of cadmium and mercury, whilst the means of lead (6.2µg.g$^{-1}$), barium (331.7µg.g-1), chromium (128µg.g$^{-1}$), nickel (12.5µg.g$^{-1}$), copper (15.8µg.g$^{-1}$), vanadium (76.9µg.g$^{-1}$) and zinc (77.5µg.g$^{-1}$) all gave background concentrations.

### Previous Surveys

#### *Surveys in Proximity to FISA12 & FINA13*

4.64 The rig site survey for the Nimrod well location, conducted by Fugro on behalf of BHP Billiton, lies approximately 70 kilometres to the north-east of the FISA12 area centre point (*Fugro Survey Limited, 2009c*). This survey covered an area of 9.6km x 7.4km. Environmental seabed sampling was conducted at five stations across the survey area. Analysis of seabed sediment samples for hydrocarbons and heavy and trace metals was conducted, which included comparison of results from site surveys conducted by Fugro in the same site survey programme; Endeavour and Loligo, which lie within the FINA13 area.

4.65 Total hydrocarbon concentrations (THC) ranged from 3.2 µg.g$^{-1}$ to 4.2 µg.g$^{-1}$ across the sampled stations. Although low in comparison to the ‘background’ concentrations typically found in the North Sea (*UKOOA, 2001,* in: *Fugro Survey Limited, 2009c*), these concentrations were perhaps higher than would be expected from a pristine site with no petrogenic inputs. The levels recorded suggested diffuse petrogenic input to the sites, possibly from natural oil seeps (*Fugro Survey Limited, 2009c*).

4.66 In comparison to other sites in the same survey programme, the Nimrod site survey stations had similar THC to the comparably deep sites surveyed (Loligo and Endeavour), but substantially lower THC than the Toroa site. This trend appeared likely to relate to the fines content of the sites sediments, with highly statistically significant correlations being calculated between THC and fines when data from all sites was considered together, and when the three deep sites were considered without the shallower Toroa site. When the data for Nimrod was considered alone, a correlation was found to exist between THC and fines (*Fugro Survey Limited, 2009c*).

4.67 Total PAH concentrations were moderate when compared to ‘background’ concentrations in the North Sea and north-east Atlantic Margin (*UKOOA 2001*; *AFEN, 1998,* in: *Fugro Survey Limited, 2009c*), ranging from 56 ng.g$^{-1}$ to 91 ng.g$^{-1}$ , but were again perhaps higher than would be expected in a site with no petrogenic inputs (*Fugro Survey Limited, 2009c*).

4.68 Total PAH concentrations were lower than at the comparably deep water sites surveyed (Loligo and Endeavour) and considerably reduced in comparison to the shallower, muddier Toroa site. A highly significant correlation was calculated between fines and total PAH concentration when all sites were considered together, although this appeared to result from the highly skewed distribution of the data (the lower values at the deeper sites in comparison to Toroa) as no significant correlation was calculated between fines and total PAH concentration from the deeper sites alone, nor from the Nimrod site data alone (*Fugro Survey Limited, 2009c*).

4.69 A summary of results for the heavy and trace metal analyses is provided in Table 4.2. This includes summary values from other sites that were in the Fugro survey programme for BHP, including the Endeavour and Loligo site surveys, which both lie within the FINA13 area (*Fugro Survey Limited, 2009c*).

4.70 The concentrations of heavy and trace metals appeared consistent across the site, none being found at concentrations that suggested point source anthropogenic metal contamination. Heavy and trace metal concentrations often increase with fines content, as sediments with higher levels of fines have a greater surface area onto which metals can be adsorbed. As would be expected given the homogeneous sediments encountered throughout the Nimrod site, no relationship between metal concentrations and fines was generally apparent (*Fugro Survey Limited, 2009c*).

4.71 Statistical analysis of the pooled metals data from all sites surveyed for BHP by Fugro, revealed some trends in the data. Substantially higher levels of arsenic, chromium and iron were found at the three comparably deep sites (Loligo, Nimrod and Endeavour) than at the shallower, muddier Toroa location. The opposite trend was observed for aluminium concentration, which appeared substantially higher at the shallower Toroa site. The copper content was also higher at the shallower Toroa site than the other sites. It appeared likely that these trends were indicative of differences in the constitution of the sites' sediments, with the higher proportions of iron and chromium at the deeper sites possibly resulting from the presence of volcanic ash in the sediments (*Fugro Survey Limited, 2009c*).

*Table 4.2: Heavy and trace metal concentrations – aqua regia digestion [µg.g-1 dry weight] (Fugro Survey Limited, 2009c)*

| Station | | Fines [%] | Heavy and Trace Metals [µg.g$^{-1}$ dry weight by Aqua Regia Digest] | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Aluminium | Arsenic | Barium | Cadmium | Chromium | Copper | Iron | Lead | Mercury | Nickel | Tin | Vanadium | Zinc |
| N1 | | 22.1 | 4910 | 4.9 | 178 | 0.17 | 98.4 | 9.8 | 29200 | 4.1 | <0.1 | 9.9 | <0.5 | 39.2 | 50.7 |
| N5 | | 28.1 | 5600 | 5.0 | 233 | 0.19 | **109.9** | 10.9 | 28800 | 3.2 | <0.1 | 11.9 | <0.5 | 49.6 | 54.9 |
| N7 | | 27.8 | 4400 | 4.5 | 164 | 0.17 | 84.4 | 11.4 | 16600 | 3.5 | <0.1 | 10.2 | <0.5 | 40.0 | 48.8 |
| N8 | | 24.7 | 3970 | 5.4 | 140 | 0.19 | 112.1 | **11.7** | 21000 | 3.2 | <0.1 | 9.7 | <0.5 | 42.0 | 52.5 |
| N9 | | 23.2 | 7340 | **6.2** | 142 | 0.20 | 114.6 | **11.2** | 28700 | 4.6 | <0.1 | 13.3 | <0.5 | 51.1 | 59.5 |
| N10 | | 20.1 | 5780 | 5.0 | 154 | 0.19 | 140.2 | **14.0** | 40300 | 3.7 | <0.1 | **16.4** | <0.5 | 45.5 | 63.1 |
| N11 | | 18.6 | 6110 | 3.2 | 229 | 0.13 | 57.6 | 11.5 | 23900 | 4.8 | <0.1 | 11.7 | <0.5 | 35.2 | 52.6 |
| N12 | | 16.4 | 4260 | 4.5 | 120 | 0.16 | 95.0 | **9.3** | 26300 | 2.8 | <0.1 | 8.6 | <0.5 | 34.8 | 47.0 |
| N14 | | 22.2 | 6010 | 4.4 | 149 | 0.16 | 86.1 | **12.2** | 29600 | 3.7 | <0.1 | 12.1 | <0.5 | 38.8 | 56.5 |
| Current Survey | Mean | 22.6 | 5376 | 4.8 | 168 | 0.17 | 99.8 | **11.3** | 27156 | 3.7 | n/a | 11.5 | na | 41.8 | 54.0 |
| | SD | 3.9 | 1084 | 0.8 | 39 | 0.02 | 23.3 | 1.4 | 6602 | 0.7 | n/a | 2.3 | na | 5.8 | 5.1 |
| Endeavour* | Mean | 16.7 | 4030 | 5.0 | 149 | 0.16 | 106.5 | 14.0 | 19083 | 3.7 | n/a | 10.9 | 0.7 | 44.8 | 59.7 |
| | SD | 10.6 | 1015 | 0.3 | 29 | 0.08 | 23.9 | 2.6 | 6490 | 1.1 | n/a | 0.8 | 0.3 | 5.9 | 8.4 |
| Loligo* | Mean | 16.7 | 4520 | 3.8 | 138 | n/a | 81.9 | 13.2 | 23600 | 5.2 | n/a | 9.5 | 0.5 | 35.4 | 52.7 |
| | SD | 10.6 | 1146 | 0.3 | 27 | n/a | 7.1 | 2.7 | 5724 | 0.6 | n/a | 1.4 | 0.1 | 9.1 | 6.6 |
| Toroa | Mean | 77.8 | 7263 | 1.0 | 108 | 0.1 | 14.8 | 12.1 | 13983 | 2.9 | n/a | 10.5 | n/a | 25.6 | 41.8 |
| | SD | 1.9 | 367 | 0.2 | 15 | 0.0 | 2.4 | 1.1 | 708 | 0.7 | n/a | 1.3 | n/a | 3.7 | 2.8 |

*SD = standard deviation of dataset;*
*n/a = not applicable;*
*Bold highlighted values = concentrations that were higher than those measured by hydrofluoric acid digestion.*
** = site lies within Noble FINA13 area.*

#### *Surveys in Proximity to FIST13*

4.72 The regional survey conducted by Borders & Southern for the Darwin and Stebbing wells (*Borders & Southern, 2010*), located approximately 20 kilometres to the east of the FIST13 area collected samples from 23 stations.

4.73 The total hydrocarbons (THC) concentrations of the sediments showed moderate background concentrations at most sites, ranging from 6.4 to 24.1µg.g$^{-1}$ (ppm). The mean for the whole survey area was 12.8µg.g$^{-1}$. These levels are moderately high, and well above the range expected for uncontaminated similar sediments in the north-east Atlantic (ca. 2.9µg.g-1; *AFEN, 2000,* in: *Borders & Southern, 2010*). These can also be compared to sediment means from the neighbouring sites of Toroa and Loligo, 75km to 380km north-east of the Borders & Southern survey site, which indicate mean THC concentrations of 8.7 and 3.0µg.g$^{-1}$, respectively (*FSL, 2009a & c,* in: *Borders & Southern, 2010*). Natural hydrocarbon seeps were thought to be the predominant cause of the elevated THC concentrations observed (*Borders & Southern, 2010*).

4.74 Of the metals analysed, aluminium and iron indicated significantly high and slightly variable concentrations, with means of 40.8 and 58.0 mg.g$^{-1}$, respectively. These levels reflect the naturally high level of these residual metals in the sediments of the region. Natural barium levels remained relatively high and variable throughout the survey area, ranging from 265µg.g$^{-1}$ to 2,420µg.g$^{-1}$ (mean 782µg.g-1), with no obvious pattern of distribution. Most remaining metals analysed showed generally low level concentrations expected for an uncontaminated offshore environment (*Borders & Southern, 2010*).

4.75 The seven key metals, namely: cadmium, chromium, copper, mercury, nickel, lead and zinc all presented concentrations below Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) background reference concentrations, with the exception of cadmium which could not be determined to a low enough resolution (*Borders & Southern, 2010*).

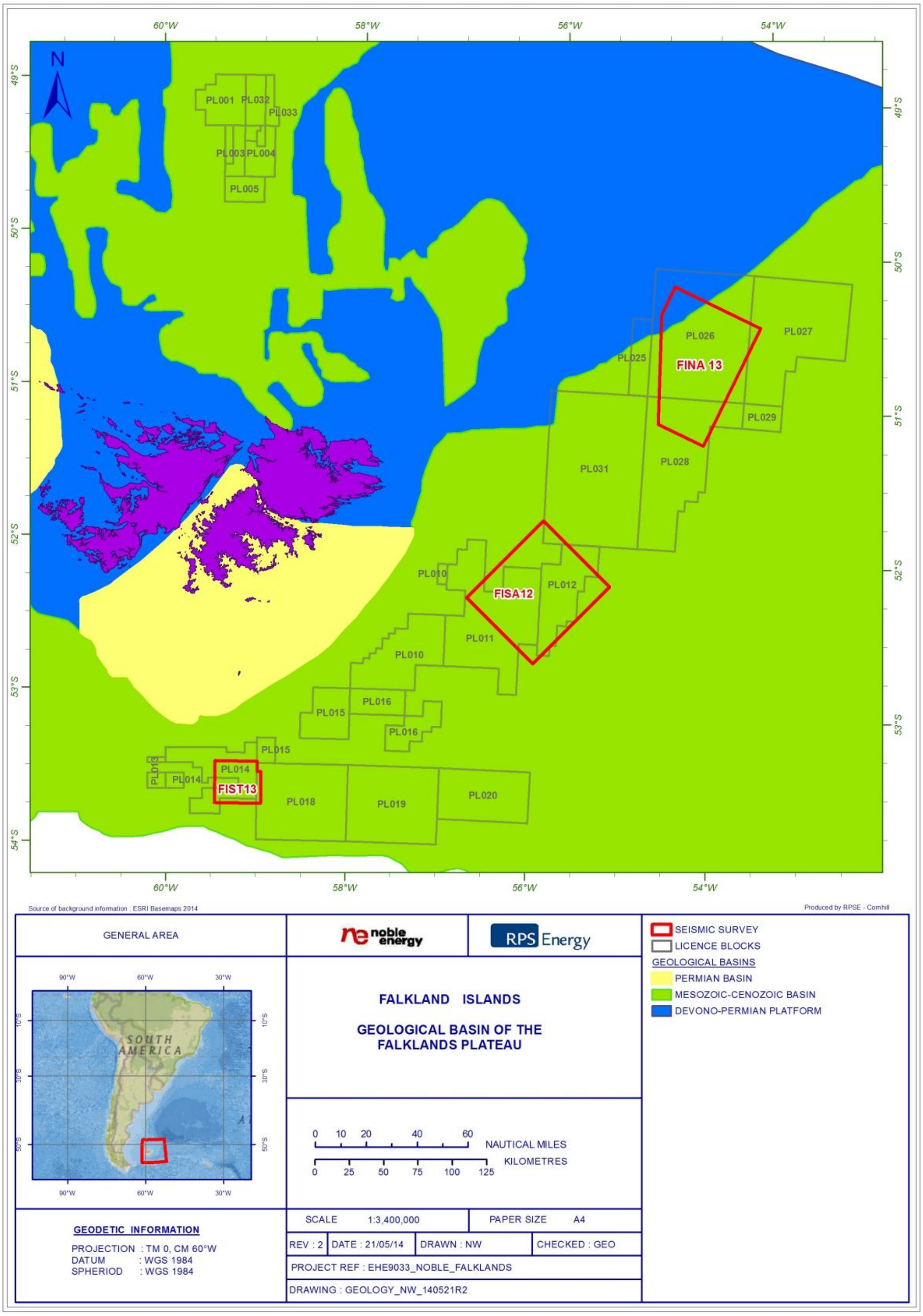
4.76 The site survey for Inflexible (*Gardline, 2011b*), which lies within the FIST13 area, did not include analysis of sediment chemistry. However, it is not unreasonable to expect that elevated levels of hydrocarbons and trace metals may be expected in this area due to the fine sediment reported to be found throughout the site.

4.77 In general, similar sediment chemistry results are expected across the wider Noble license areas, and given the remoteness of the locations, are generally expected to be below the background levels commonly illustrated by offshore areas with existing developed oil and gas assets. However, previous surveys have shown the possibility of localised elevated levels of hydrocarbons and certain trace metals, particularly associated with the finer sediments. It is thought that these are most likely to be associated with natural hydrocarbon seeps.

### 4.2.5 Geology

4.78 The regional geology and palaeogeographic evolution of the offshore Falkland Islands has been well documented (e.g., *Richards and Fannin, 1994 and 1997; Lawrence and Johnson, 1995*). The Falkland Islands are positioned over Permian, Mesozoic-Cenozoic and Devono-Permian Platform basins (Figure 4.3). Four basins surround the Falkland Islands; The Falkland Plateau Basin, Malvinas Basin and South Falkland Basin which lie to the east, west and south of the Falkland Islands respectively, while the North Falkland Basin lies directly to the north. Petroleum exploration in the region is in its infancy and is focused mainly on the North Falkland Basin, South Falkland Basin and East Falkland Basin.

*Figure 4.3: Regional petroleum basins of the Falklands Plateau*



4.79 The Noble license areas lie stretched in a south-west to north-east belt over the South Falkland and East Falkland basins.

4.80 The East Falkland Basin is essentially a passive margin basin, with Jurassic and Cretaceous marine rocks both gently onlapping onto, and prograding off a Palaeozoic Plateau. The East Falkland Basin lies beneath 200 – 2,500 metres of water to the east of the Falkland Islands. It is bounded to the west by the Falklands Platform, to the north by a steeply sloping feature termed the Falkland Escarpment, to the east by the Maurice Ewing Bank and to the south by the Scotia/South American plate boundary. The plate boundary produces a topographic feature known as the Scotia Ridge, which includes shallow water areas such as the Burdwood Bank (immediately south of the Falkland Islands), as well as the islands of South Georgia and the South Sandwich Islands. To the south-west, along the deep Falkland Trough, the basin merges with the South Falkland Basin. The central parts of the East Falkland Basin may be underlain by thinned continental crust (about 16 kilometres thick), although the northern margin of the basin (the Falkland Escarpment) is underlain by a prolongation of probably gneissic continental crust that joins the Falklands Plateau with the Maurice Ewing Bank. To the west of the basin the Falklands Plateau itself is underlain by continental crust about 30 kilometres thick. The western boundary of the basin is defined by a north-east – south-west zone of onlap and minor faulting in a linear trend approximately 650 kilometres long. There is a zone of high magnetic and gravity anomalies oriented along and (spread across) the western basin margin zone. Along the western margin significant faulting is observed at possible Permo-Triassic to Jurassic level. The apparent gentle westwards onlap of Cretaceous and Cenozoic reflectors near the basin margin suggests that the main phase of extension was in the Permo-Triassic or Jurassic. The early extension was probably followed by post-rift sag through the Cretaceous and Cenozoic (*FIG, 2014a*).

4.81 The South Falkland Basin is a narrow basin zone, located to the south of the Falkland Islands and comprises Cretaceous passive margin-type rocks similar to those found in the East Falkland Basin, but which have been partially overthrust by sequence of Cenozoic rocks along the boundary between the Scotia and South American plates. This basin forms a connection between the East Falkland Basin and the Malvinas Basin. The basin lies beneath 500 - 2500 metres of water. The basin corresponds, more or less, with the deeper water zone of the Falkland Trough, the foredeep that runs adjacent to the northern edge of the Scotia plate. The basin is contiguous with the Malvinas Basin to the west and the East Falkland Basin to the east, but has a somewhat different structural style. It exhibits numerous major normal faults downthrowing to the north, and developed in a foreland basin setting in front of the thrust front at the plate boundary. The normal faults in the foreland basin and the thrust faults in the plate boundary zone often display reactivation into recent times. Much of the normal faulting in the basin was probably of Jurassic through Early Cretaceous age, contemporaneous with the deposition of sediments in the actively rifting trough (*FIG, 2014a*).

### 4.2.6 Oceanography

#### Water Circulation & Currents

4.82 There are three distinct water masses in the area surrounding the Falkland Islands: Sub-Antarctic Surface Water (SASW), Antarctic Intermediate Water (AAIW) and Antarctic Bottom Water (AABW). In deep water (>2000 metres) there is also an intrusion of North Atlantic Bottom Water (NABW). SASW is usually limited to the top 300 metres of the water column (*Peterson & Whitworth, 1989*). The water masses vary in salinity, temperature and nutritional value. SASW, for example, is cold (8-15 degrees Celsius), with a low salinity and high levels of nutrients. Salinity increases with depth in this area, with the AABW having a higher salinity in comparison to the AAIW and SASW (*WOCE, 2002*). Temperature also decreases with depth, reaching -2 degrees Celsius in some regions of the Southern Ocean.

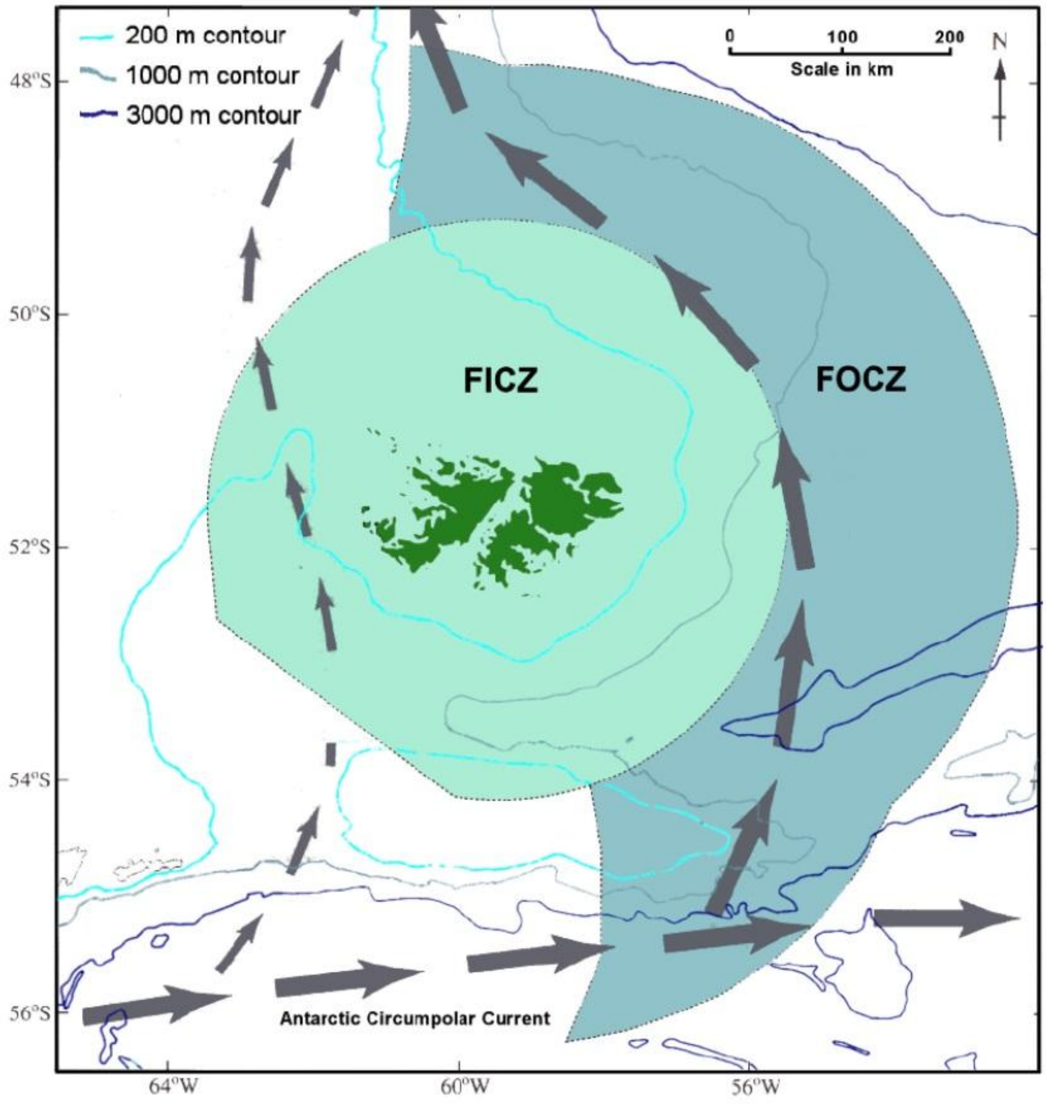
4.83 The Falkland Islands lie to the north of the Antarctic Polar Front (APF) or Antarctic Convergence, where cool surface waters from the south sink where they meet warmer surface waters from the north. The APF is ecologically important (*Munro, 2004*) and occurs between 50°S and 60°S (*Laws, 1984*). The productivity of the Patagonian Shelf is enhanced by several year-round mixing fronts (the Valdes Front, San Jorge Front and Bahia Grande Front) and seasonal fronts (the

Patagonian-Magella Front, and Tierra del Fuego Front) (*Belkin et al., 2009*). The shelf edge is framed by the Falkland/Malvinas Current Front (FMCF) (*Belkin et al., 2009*), which is a typical example of a western boundary front and runs along the continental slope from 55°S to 37°S. It consists of multiple meso-scale fronts parallel to the shelf break (*Franco et al., 2008*).

4.84 The Antarctic Circumpolar Current (ACC) is a surface current that intensifies and deviates northwards as it flows around Cape Horn in Chile, and splits to either side of the Falkland Islands (Figure 4.4) to form the Falkland Current. The West Falkland Current flows north on the west side of the Falkland Islands, whereas the stronger East Falkland Current runs north, then swings west to re-converge with the West Falkland Current at around 49° south, continuing northwards in a 100 kilometres wide band towards the warm south flowing Brazil Current (*Munro, 2004; Glorioso and Flather, 1995; Arkhipkin et al., 2013*). Average diverging current speeds are less than 25 centimetres per second (0.5 knots) to the west and 25 – 50 centimetres per second (0.5 – 1 knots) to the east of the Falkland Islands (*Hydrographer of the Navy, 2008*).

4.85 Tidal cycles around the Falkland Islands are semi-diurnal (twice daily), with tides ranging from 0.3–3.5 m above local datum (*Brown and Root, 1997*).

***Figure 4.4: Current system around the Falkland Islands***




FICZ: Falkland Islands Interim Conservation and Management Zone

FOCZ: Falkland Islands Outer Conservation Zone

4.86 From 6th December 2008 to the 26th April 2009, metocean buoys were deployed offshore of the Falkland Islands in two locations, as shown in Table 4.3. The deployments were commissioned by BHP Billiton Petroleum Inc., as part of their previous exploration drilling programme in the area. The results were passed to FOGL upon BHP Billiton's departure from the Falkland Islands licenses. The locations of the metocean buoy deployments are also shown in Figure 4.2.

*Table 4.3: BHP / FOGL metocean buoy deployment positions (Fugro, 2009)*

| Location | Deployment positions (WGS 84) | | Water Depth | Approx. distance from FISA12 | Approx. Distance from FIST13 |
|---|---|---|---|---|---|
| | Latitude | Longitude | | | |
| 'Loligo' | 52°14'13.98"S | 54°41'52.20"W | 1,421m | Approx. 21km east | Approx. 174km north-east |
| 'Toroa' | 53° 1'57.72"S | 57°57'9.84"W | 692m | Approx. 58km south-west | Approx. 46km north-east |

4.87 The Loligo mooring was equipped with a Long Ranger RDI 75kHz Acoustic Doppler Current Profiler (ADCP) and five single-point Aanderaa version 7 Recording Current Meters (RCM 7). The Toroa mooring was also equipped with a Long Ranger RDI 75kHz ADCP, and two RCM 7s.

4.88 Both ADCPs on the moorings were configured to measure current speed and direction in 20-minute records and 16 metre bins from the seabed upwards. Unfortunately, the ADCP at the Toroa mooring became flooded on approximately 08 December 2008, and the data were not recoverable for the duration of the survey thereafter. Each RCM7 was configured to measure current speed, current direction, water temperature, pressure and conductivity, at 10-minute intervals (*Fugro, 2009*).

4.89 Table 4.4 displays the summary statistics for the measured currents during the survey period at both the Loligo and Toroa deployment locations. The current measurements made during this survey period show a relatively stable north-westerly flow in the upper layers of the water column at the Loligo location. The maximum observed current speed was observed at the Loligo location; 0.75 $ms^{-1}$ measured at 41 metres below the surface in a direction of 257 degrees. Although 0.75 $ms^{-1}$ is a relatively mild speed, similar speeds were observed at deeper regions of the water column (refer to Table 4.4). At a depth of 431 metres below the surface, the maximum observed current speed was 0.64 $ms^{-1}$ with a corresponding direction of 001°. The observed directional occurrences are primarily toward the north-east to north-west directions in all observed depth levels with the exception of the lowest RCM; RCM number 5 at 10 metres above the seabed. RCM5 shows maximum speeds with directional occurrences toward the south and with the general trend of a northerly flow also present (*Fugro, 2009*).

4.90 Both RCMs at the Toroa mooring measured maximum speeds on the same date, but they had relatively different directions. The maximum current speed observed at Toroa was 0.39 $ms^{-1}$ measured at 682 metres below the sea surface, with a corresponding direction of 233°. RCM number 1 measured a high speed of 0.32 $ms^{-1}$ at 422 metres below the surface, with a corresponding direction of 012°, on 13 April 2009 at 07:00. The reason for the direction difference near the bottom is likely to be due to complicated interactions with the seabed. The dominant current directions of the maximum speeds (0.3 – 0.4 $ms^{-1}$) at Toroa are primarily north to north-east at 422 metres below mean sea level (MSL) and south-south-east to south-west at 10 metres above the seabed (*Fugro, 2009*).

*Table 4.4: Metocean current measurements at the 'Loligo' and 'Toroa' metocean buoy deployments (Fugro, 2009)*

| Data BIN No. | Depth below MSL | Height above seabed | Current Speed ($ms^{-1}$) | | | Direction of current Max. | Date and time of current Max. | % Data return |
|---|---|---|---|---|---|---|---|---|
| | metres | metres | max. | mean | std. deviation | ° true | | |
| **Loligo deployment location** | | | | | | | | |
| 25 | 41 | 1,380 | 0.75 | 0.22 | 0.13 | 257 | 26-Jan-09 03:00 | 90 |
| 24 | 57 | 1,364 | 0.67 | 0.21 | 0.13 | 272 | 15-Jan-09 00:40 | 92 |
| 23 | 73 | 1,348 | 0.68 | 0.20 | 0.12 | 276 | 15-Jan-09 23:40 | 96 |
| 22 | 89 | 1,332 | 0.69 | 0.20 | 0.12 | 271 | 15-Jan-09 23:40 | 98 |
| 21 | 105 | 1,316 | 0.70 | 0.20 | 0.12 | 269 | 15-Jan-09 23:40 | 99 |
| 20 | 121 | 1,300 | 0.66 | 0.20 | 0.12 | 271 | 15-Jan-09 23:40 | 98 |
| 19 | 137 | 1,284 | 0.63 | 0.20 | 0.12 | 274 | 15-Jan-09 23:40 | 99 |
| 18 | 153 | 1,268 | 0.63 | 0.20 | 0.12 | 267 | 26-Jan-09 07:20 | 99 |
| 17 | 169 | 1,252 | 0.64 | 0.20 | 0.12 | 266 | 26-Jan-09 07:20 | 99 |
| 16 | 185 | 1,236 | 0.67 | 0.20 | 0.11 | 264 | 26-Jan-09 07:20 | 99 |
| 15 | 201 | 1,220 | 0.66 | 0.20 | 0.11 | 263 | 26-Jan-09 07:20 | 98 |
| 14 | 217 | 1,204 | 0.66 | 0.20 | 0.11 | 259 | 26-Jan-09 07:00 | 98 |
| 13 | 233 | 1,188 | 0.64 | 0.19 | 0.11 | 260 | 26-Jan-09 07:20 | 98 |
| 12 | 249 | 1,172 | 0.63 | 0.19 | 0.11 | 266 | 26-Jan-09 07:40 | 98 |
| 11 | 265 | 1,156 | 0.63 | 0.19 | 0.11 | 264 | 26-Jan-09 07:40 | 99 |
| 10 | 281 | 1,140 | 0.64 | 0.19 | 0.11 | 266 | 26-Jan-09 09:20 | 99 |
| 9 | 297 | 1,124 | 0.65 | 0.19 | 0.11 | 258 | 26-Jan-09 07:40 | 100 |
| 8 | 313 | 1,108 | 0.64 | 0.19 | 0.11 | 256 | 26-Jan-09 07:40 | 100 |
| 7 | 329 | 1,092 | 0.61 | 0.19 | 0.11 | 256 | 26-Jan-09 07:40 | 100 |
| 6 | 345 | 1,076 | 0.59 | 0.19 | 0.11 | 263 | 26-Jan-09 08:40 | 100 |
| 5 | 361 | 1,060 | 0.58 | 0.18 | 0.11 | 262 | 26-Jan-09 08:40 | 100 |
| 4 | 377 | 1,044 | 0.57 | 0.18 | 0.10 | 255 | 26-Jan-09 08:00 | 100 |
| 3 | 393 | 1,028 | 0.53 | 0.40 | 0.06 | 287 | 15-Jan-09 15:00 | 4 |
| 2 | 409 | 1,012 | 0.48 | 0.41 | 0.04 | 035 | 31-Jan-09 21:40 | 1 |
| 1 | 425 | 996 | 0.36 | 0.34 | 0.02 | 340 | 17-Jan-09 09:00 | <1 |
| RCM1 | 431 | 990 | 0.59 | 0.19 | 0.11 | 282 | 15-Jan-09 14:10 | 95 |
| RCM2 | 641 | 780 | 0.64 | 0.19 | 0.11 | 001 | 17-Jan-09 10:20 | 100 |
| RCM3 | 901 | 520 | 0.58 | 0.15 | 0.09 | 006 | 17-Jan-09 08:20 | 100 |
| RCM4 | 1,161 | 260 | 0.51 | 0.16 | 0.09 | 034 | 31-Jan-09 11:10 | 38 |
| RCM5 | 1,411 | 10 | 0.51 | 0.13 | 0.09 | 150 | 30-Dec-08 10:10 | 100 |
| **Toroa deployment location*** | | | | | | | | |
| RCM1 | 422 | 270 | 0.32 | 0.10 | 0.06 | 012 | 13-Apr-09 07:00 | 100 |
| RCM2 | 682 | 10 | 0.39 | 0.11 | 0.06 | 233 | 13-Apr-09 16:40 | 100 |

*Note: The ADCP equipment at the Toroa location was flooded shortly after deployment. Data was rendered unrecoverable. Therefore, only RCM current meter data are available for this location.*

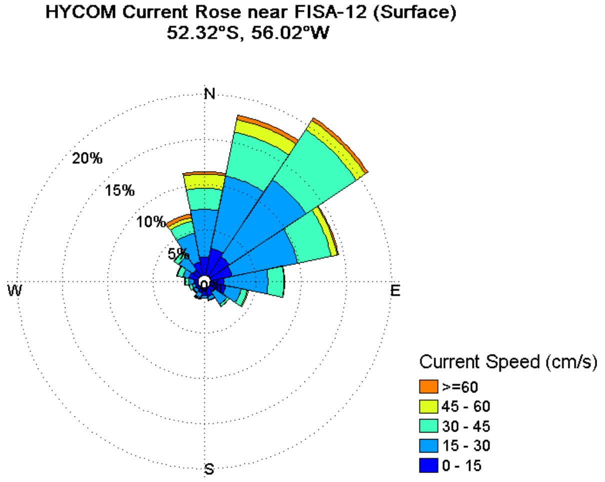
4.91 The observed currents from the metocean deployments are in general agreement with the expected currents for the area. However, it is widely known that eddies can occur in this region. This may be partially due to the effects of the Drake Passage as the Antarctic Circumpolar Current is funnelled through slightly shallower water and then branches off to the north. The observations at the Loligo deployment location show evidence of an eddy occurring on 25 January 2009. On this date, the current directions start to shift from the primary north-west direction. The direction continues to gradually shift and make a clock-wise rotation until 24-25 February 2009, when it stabilizes back to the primary north-westerly direction (*Fugro, 2009*).

4.92 In support of the modelling studies conducted as part of the impact assessment, a detailed metocean study was conducted, which included an analysis of currents in the vicinity of the Falkland Islands.

4.93 For the modeling studies (both oil spill modeling and cuttings dispersion modeling), regional currents for the area were obtained from a hindcast analysis using inputs from the HYCOM (HYbrid Coordinate Ocean Model) 1/12 degree global simulation assimilated with NCODA (Navy Coupled Ocean Data Assimilation) from the U.S. Naval Research Laboratory (*http://www.hycom.org*). The yearly average current roses obtained from this model from the centre of FISA12 and FIST13 are given in Figures 4.5 and 4.6, respectively.

4.94 As both the modelling studies are based on the obtained HYCOM current data, a detailed metocean study was produced, including analysis of the current fields in the vicinity of the FISA12 and FIST13 areas, as well as a comparison of the HYCOM data and observed ADCP data at the Toroa and Loligo locations. The metocean report is provided in Appendix L.

***Figure 4.5: HYCOM current roses in the centre of the FISA12 area averaged over the period of 2009-2012. Current roses presented for the surface (top) and 1,500 metres (bottom) water depths; Direction convention is standard (i.e., direction currents are moving to)***



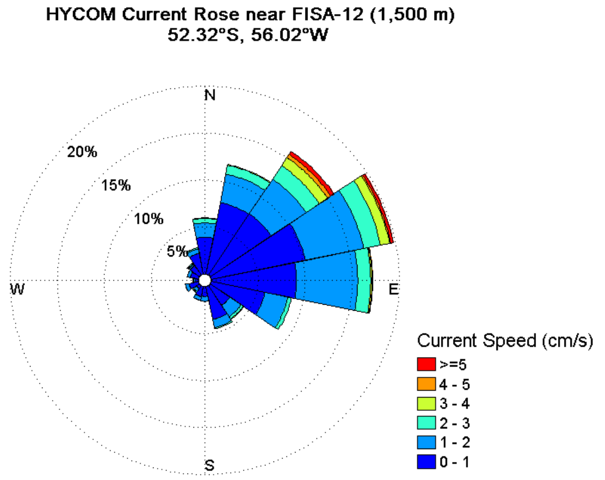
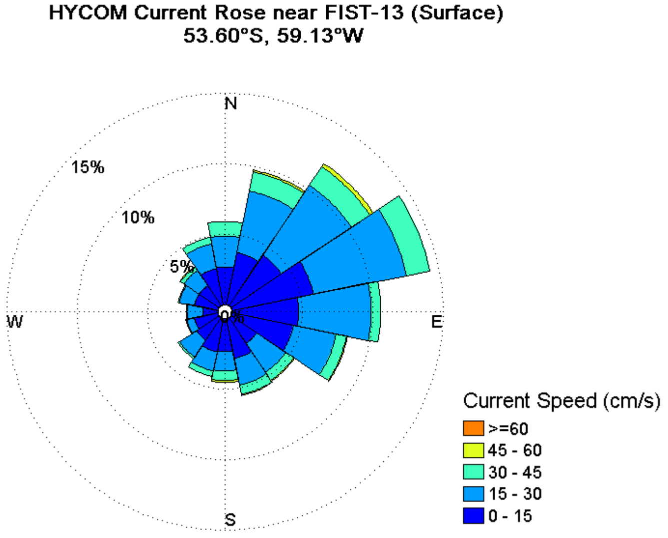
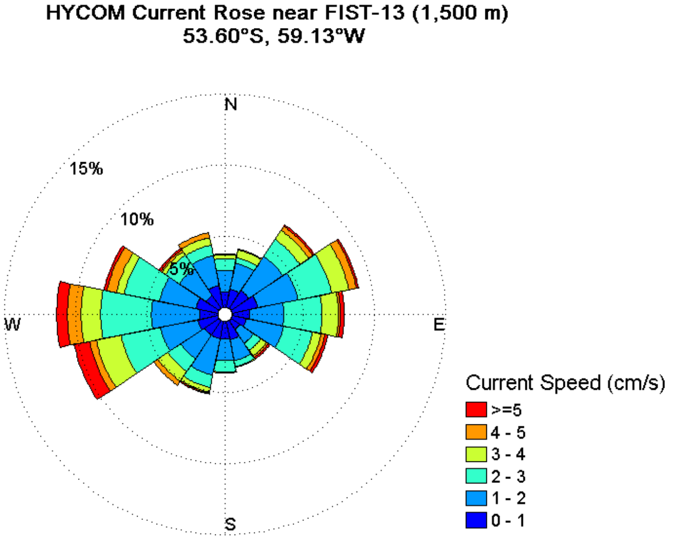



*Figure 4.6: HYCOM current roses in the centre of the FIST13 area averaged over the period of 2009-2012. Current roses presented for the surface (top) and 1,500 m (bottom) water depths. Direction convention is standard (i.e., direction currents are moving to)*

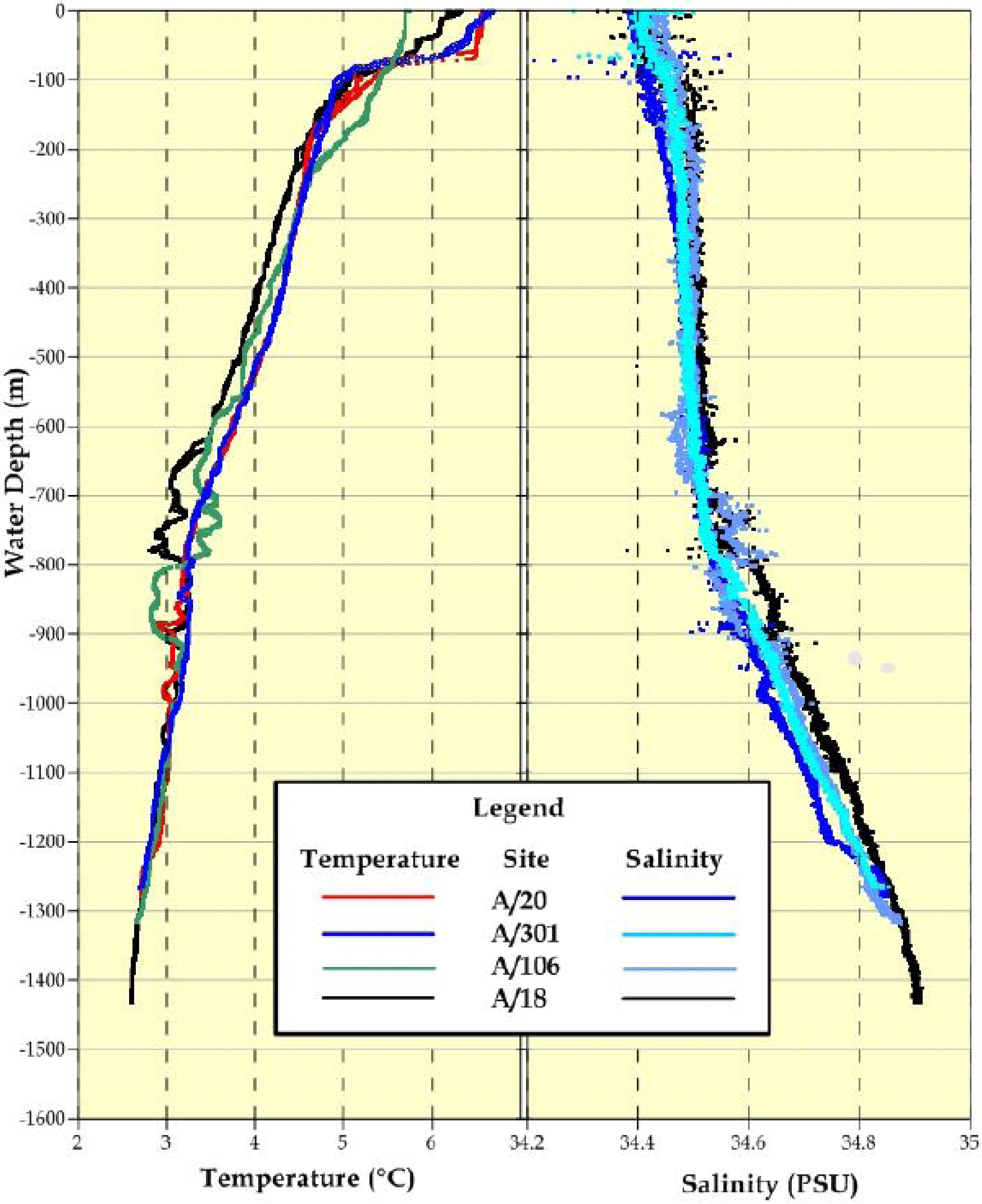



### Water Column Characteristics

4.95 During the environmental baseline survey of the FISA12 area, the water column was surveyed using a Conductivity–Temperature–Depth (CTD) probe, with temperature and salinity sensors. Four profiles were recorded during the survey, the results of which are displayed in Figure 4.7. The four sample datasets have been overlaid to show the consistency of the profile over depth and over a survey period of just over one month.

*Figure 4.7: CTD profiles obtained during the FISA12 EBS (MG3, 2014)*




4.96 Water profiles obtained from the four sampling stations (A/20/ENV, A/301/ENV, A/106/ENV and A/18/ENV – refer to Appendix K) all indicated similar and consistent profiles. Surface water temperature varied slightly from 5.73°C to 6.70°C with a small thermocline developing in the surface at 80 metres. With increasing depth, water temperature continued to decline at a relatively consistent rate to around 2.60°C recorded at the deepest point (1,432 metres). All profiles indicated a small area of mixed waters between 620 metres and 950 metres (Figure 4.7).

4.97 The salinity profiles for the same sites indicated a similar pattern, although the variability in salinity was limited to only 0.5 practical salinity units (psu) throughout the whole water column. Whilst a subtle halocline was just perceptible in the surface at 80 metres, the upper 600 metres of the water column remained relatively consistent, increasing in salinity by only 0.1psu. A slightly mixed zone was then encountered between 620 metres and 950 metres, with a slightly greater increase in salinity recorded thereafter throughout the lower water column by around 0.4psu. No significant differences were recorded between the four sampling stations.

4.98 A comparison of the CTD data with historical records is provided in the full EBS report in Appendix K.

4.99 In support of the modelling studies conducted as part of the impact assessment, a detailed metocean study was conducted, which included an analysis of the water column vertical structure at both the FISA12 and FIST13 sites. The full metocean study is provided in Appendix L.

### 4.2.7 Climate and Meteorology

#### General Climatic Conditions

4.100 The Falkland Islands climate is cool and temperate; the currents are of cold water, which is influenced by the South Atlantic Ocean and the northerly Patagonian current. Cooler waters from the south mix with warmer waters from the north, resulting in a maritime climate in the transitional region between subarctic and temperate zones (Köppen classifications Cfb and Cfc respectively)[1].

4.101 This oceanic climatic type is characterised by both low seasonal and diurnal temperature ranges and no marked wet and dry season. In the sub-arctic zone, the average monthly maximum temperature exceeds 10°C for no more than four months of the year and the average monthly minimum does not drop below −3°C.

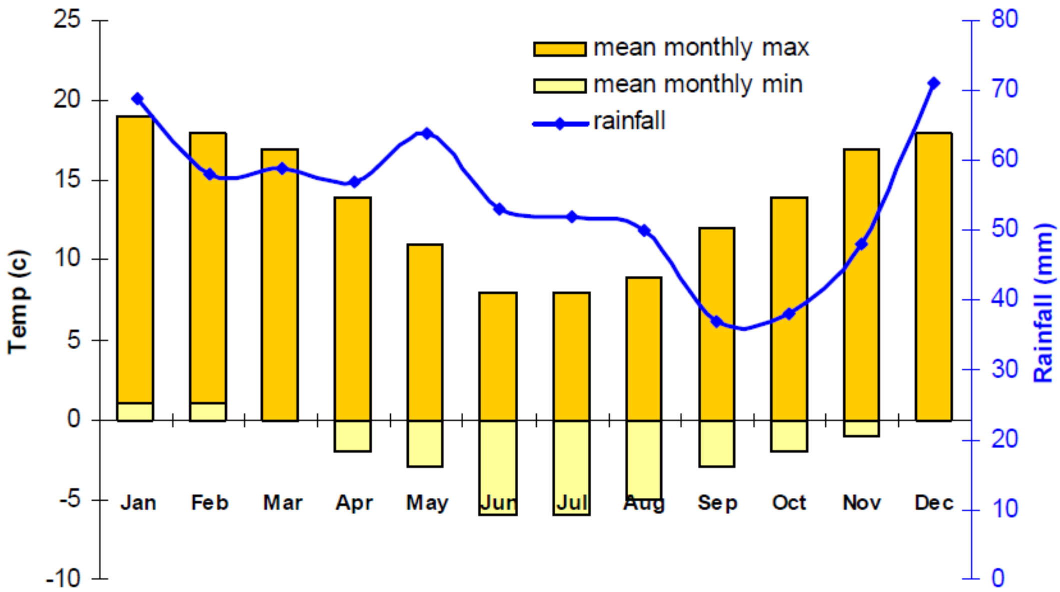
4.102 Offshore measurements of general climatic conditions were made on board the Oceanrig semi-submersible drilling unit *Leiv Eiriksson* during the previous drilling campaign in the South Falkland Basin and East Falkland Basin during 2012. Data for the whole of 2012 were compiled from the Helideck Monitoring System (HMS) on board the *Leiv Eiriksson*. During this time, the Leiv Eiriksson was employed in drilling duties for both Borders & Southern and FOGL throughout the South and East Falkland basins. Data from these observations are displayed here and throughout the remainder of this section where relevant.

#### Temperature

4.103 The location of the Falkland Islands, to the north of the Antarctic convergence, helps to moderate the temperature, as cool waters from Antarctica mix with warmer waters from the Atlantic. The Falkland Islands have a cool, narrow terrestrial temperature range, with mean annual minimum and maximum temperatures of approximately 3°C and 10°C respectively, and mean monthly temperatures ranging between - 6°C and 19°C (Figure 4.8) (*Hydrographer of the Navy, 2008*). Mean daily temperatures range from 4.8°C in winter to 9.6°C in summer. Humidity ranges from 75% in November to 89% in July.

[1] Köppen climate classification is a widely used system of classification based on the concept that native vegetation is the best expression of climate. The Falkland Islands falls within Group E; Polar Climates, although it has been suggested a maritime polar group for mild marine locations be created, separating these climates from colder, continental tundra climates. Cfb is temperate oceanic climate; Cfc is cool, oceanic climate.

*Figure 4.8: Climatic averages for Stanley Harbour (Hydrographer of the Navy, 2008)*




4.104 Offshore HMS measurements from the *Leiv Eiriksson* drilling unit for the year of 2012 are displayed in Figures 4.9, 4.10 and 4.11 for dry air temperature, air pressure and humidity, respectively. The offshore observations show that the average dry air temperature in the vicinity of the Noble licenses varies from approximately 2 degrees in mid-winter (between June and July), up to approximately 18 degrees in mid-summer (between December and January). In 2012, temperatures reached as low as approximately minus 3 degrees in winter, and peaked at 28 degrees in the summer (*Fugro Geos, 2012*).

4.105 Average air pressures offshore in 2012 ranged from approximately 990 millibars (mb) in the winter, to approximately 1000mb in the summer. The lowest pressures observed occurred in July at 963mb, whilst the highest observed occurred in August at 1032mb (*Fugro Geos, 2012*).

4.106 Average humidity stays at around 70 to 80 percent throughout the year, with occasional peaks and lows of around 100% and 50% respectively, (*Fugro Geos, 2012*).

*Figure 4.9: Leiv Eiriksson helideck monitoring system data for 2012 – dry air temperature (Fugro Geos, 2012)*

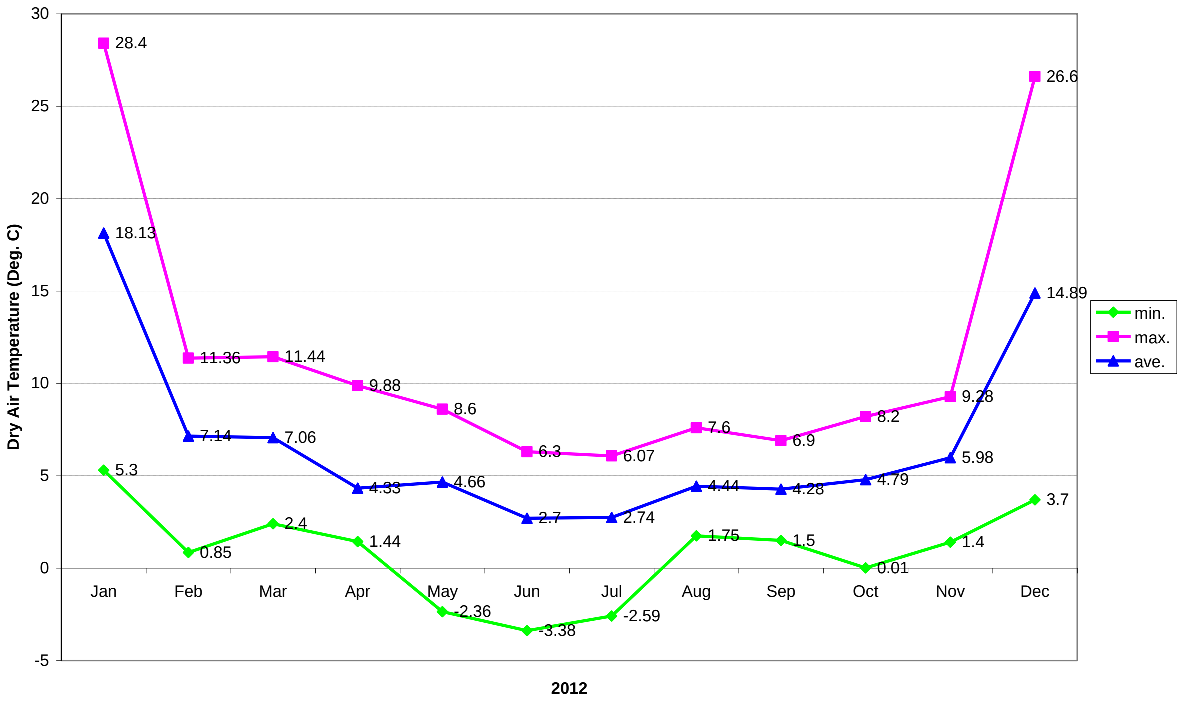



*Figure 4.10: Leiv Eiriksson helideck monitoring system data for 2012 – air pressure (Fugro Geos, 2012)*

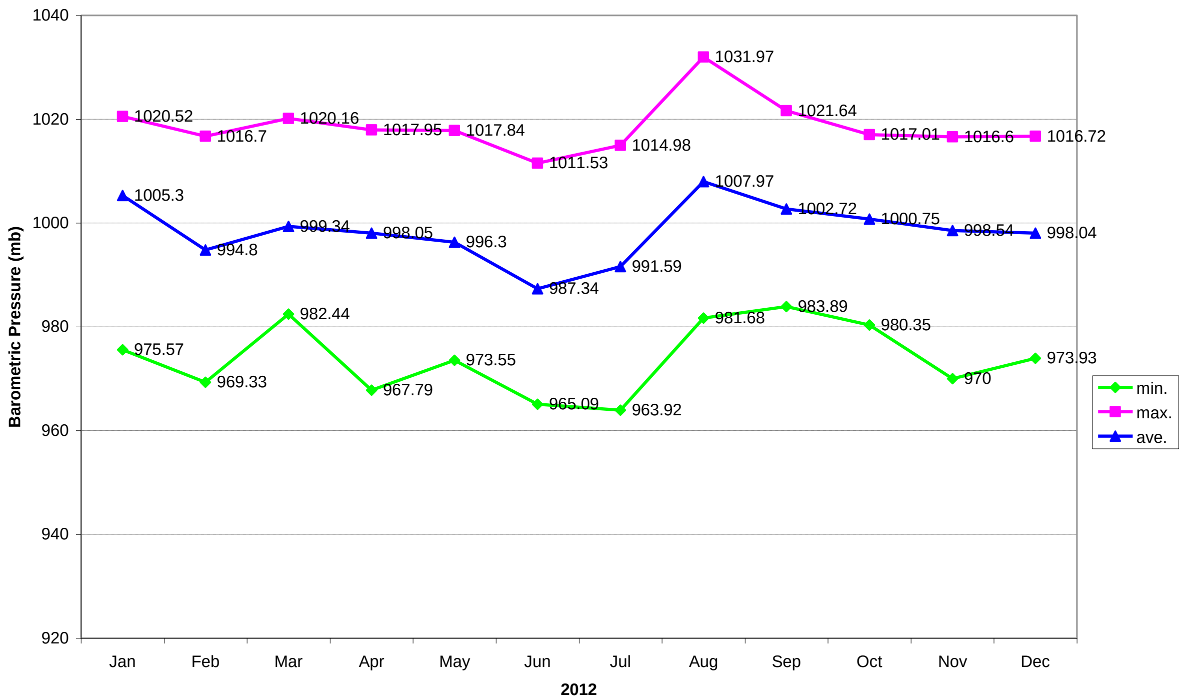
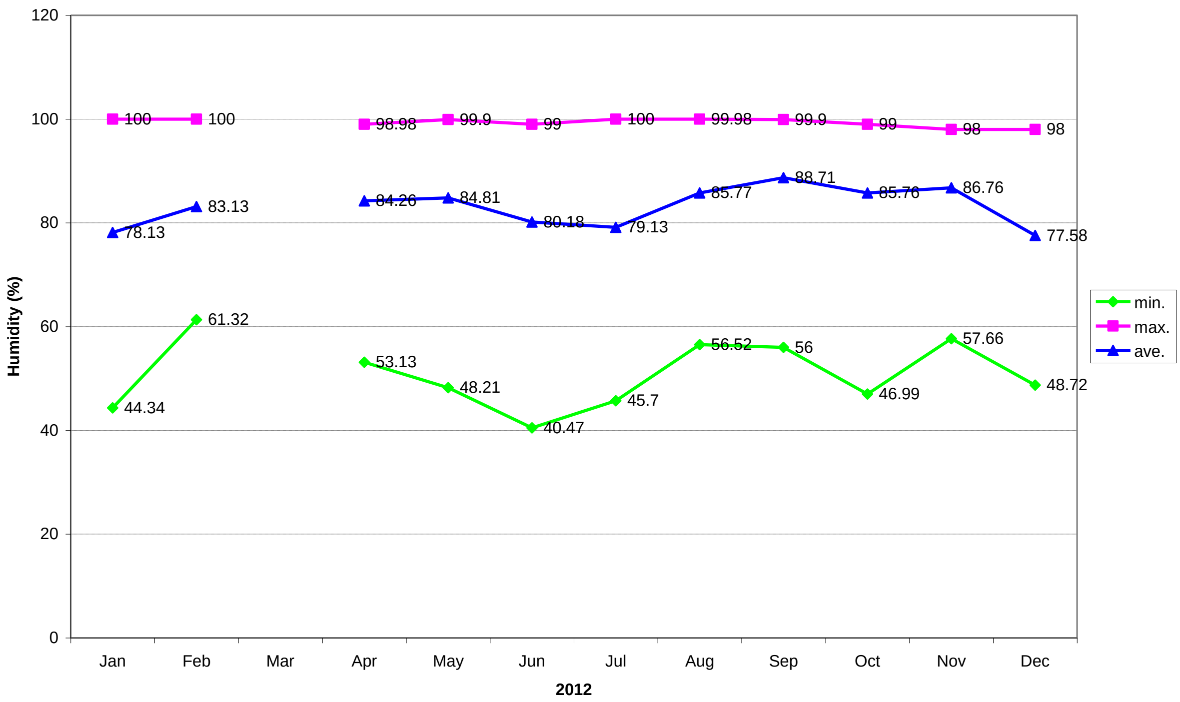


*Figure 4.11: Leiv Eiriksson helideck monitoring system data for 2012 – humidity (Fugro Geos, 2012)*

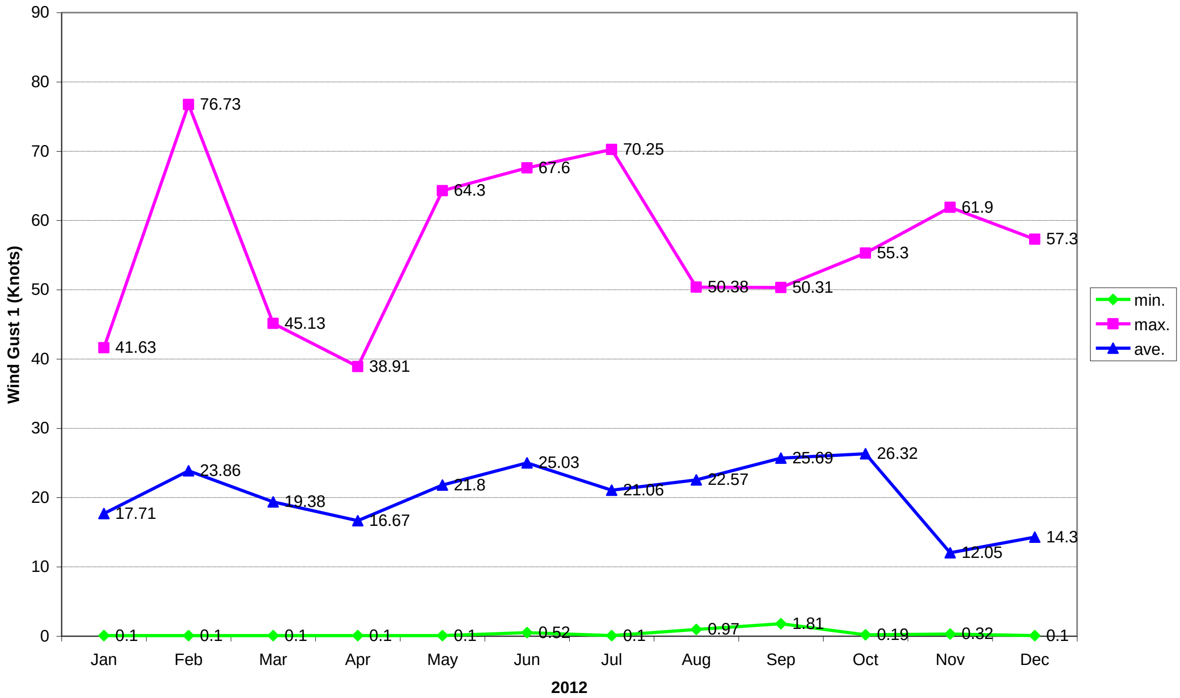



### Wind Speed and Direction

4.107 Offshore HMS measurements from the *Leiv Eiriksson* drilling unit for 2012 are displayed in figures 4.12 and 4.13 for wind speed and wind gust, respectively. In these figures it can be seen that average wind speed varies from approximately 10 to 25 knots, with peaks of approximately 60-65 knots in stormy conditions (Figure 4.12). A maximum gust speed of 76 knots was recorded in February 2012 (Figure 4.13). Average wind direction was predominantly from the south-west, ranging from 180° in January, to 260° in June.

*Figure 4.12: Leiv Eiriksson helideck monitoring system data for 2012 – wind speed data from wind sensor no. 1 (Fugro Geos, 2012)*


*Figure 4.13: Leiv Eiriksson helideck monitoring system data for 2012 – wind gust data from wind sensor no. 1 (Fugro Geos, 2012)*




4.108 In support of the modelling studies conducted as part of the impact assessment, a detailed metocean study was conducted, which included an analysis of winds in the vicinity of the Falkland Islands. The metocean study is provided in Appendix L.

4.109 For the oil spill modelling study, in the absence of an extended spatial coverage of long term observed winds, wind data was obtained from the output of the U.S. Navy Operational Global Atmospheric Prediction System (NOGAPS). The version of the NOGAPS dataset used for this modelling study is originally derived from the publically available version hosted by the U.S. Global Ocean Data Assimilation Experiment (GODAE) and subsequently has a QuikSCAT (Quick Scatterometer) correction applied by the HYCOM Consortium. This dataset of winds at 10 metres above the sea surface is provided at 0.5 degree horizontal resolution with a 3-hour time step provided from January 2009 through to December 2012.

4.110 Figures 4.14 and 4.15 present the average yearly wind roses obtained for the FISA12 and FIST13 areas, respectively. Overall, wind direction is primarily from the west and fluctuates between south-west to north-westerly winds. The full metocean report is provided in Appendix L.

***Figure 4.14: Yearly NOGAPS wind rose in the FISA12 area offshore the Falkland Islands. Wind speeds are in knots, using meteorological convention (i.e., direction wind is coming from)***

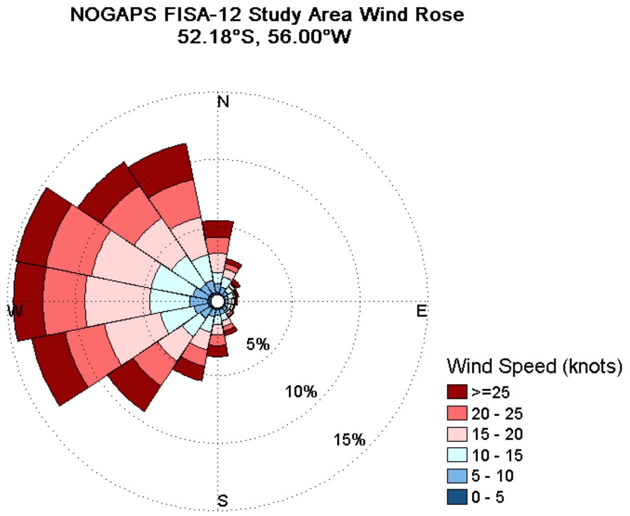
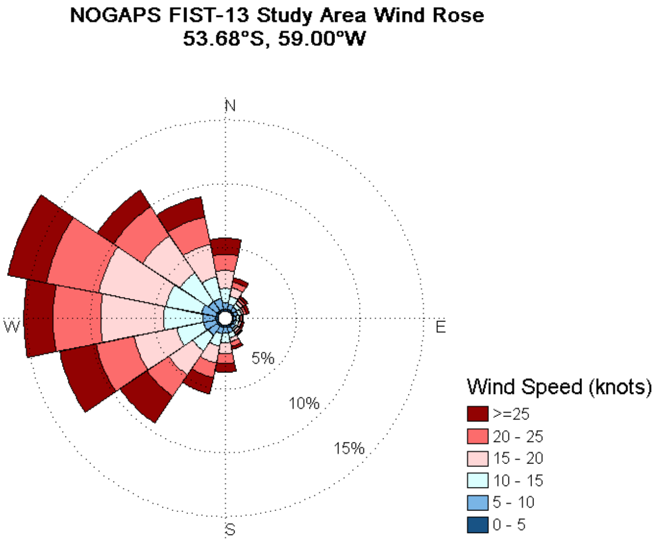



***Figure 4.15: Yearly NOGAPS wind rose in the FIST13 area offshore the Falkland Islands. Wind speeds are in knots, using meteorological convention (i.e., direction wind is coming from)***

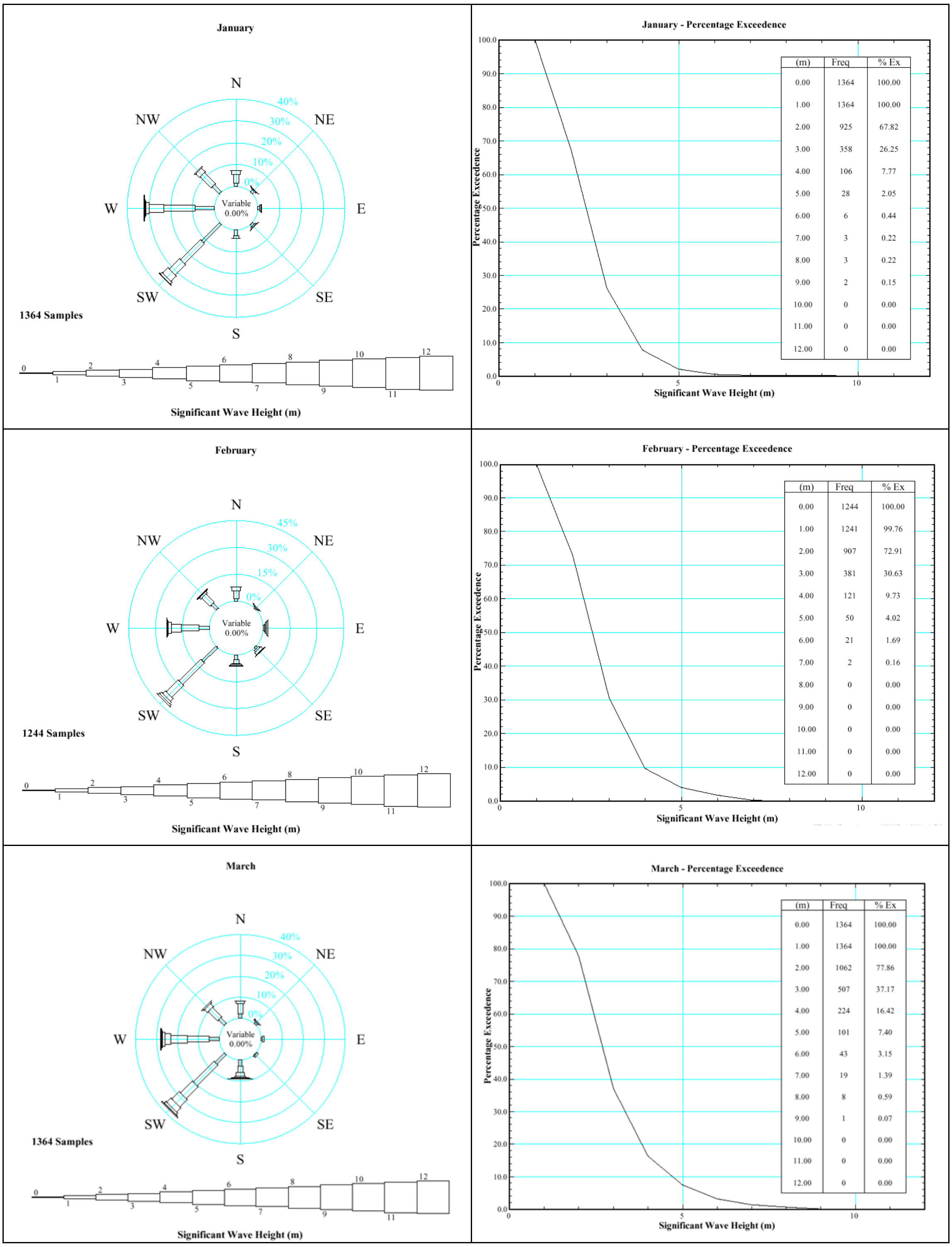



### Waves

4.111 Winds in the Falkland Islands can generate rough sea conditions, with waves of variable direction and height. Wind and wave criteria in this report were derived using data extracted from the Fugro Oceanor WorldWaves product from a grid point at 52°30'S, 57°00'W (*Fugro, 2005*). This point lies approximately 70 kilometres to the west-south-west from the FISA12 centre point, and approximately 190 kilometres to the north-east from the FIST13 centre point. The data in turn derive from operational runs of the WAM wave model performed by the European Centre for Medium-range Weather Forecasting (ECMWF), calibrated against satellite data and in-situ observations by Fugro Oceanor (*Fugro, 2005*). The report was commissioned by Falkland Oil and Gas Limited (FOGL) prior to their exploration drilling programme.

4.112 Figure 4.16 displays wave height and percentage exceedance for the above grid point throughout the year. Figure 4.17 displays one year return significant wave heights throughout the year in comparison to other harsh environment locations. Average wave heights vary between 2-3 metres (Figure 4.16) and one year return wave heights can reach up to 11 metres (Figure 4.17). Seasonality in wave height showed a more energetic wave environment between June and September, corresponding to the Southern Hemisphere winter. The general direction of wave approach is predominantly west to south-west (*Fugro, 2005*).

*Figure 4.16a: Wave height and exceedance offshore the Falkland Islands for the grid point 52°30'S, 57°00'W, January to March (Fugro, 2005)*




January - Percentage Exceedence

| (m) | Freq | % Ex |
|---|---|---|
| 0.00 | 1364 | 100.00 |
| 1.00 | 1364 | 100.00 |
| 2.00 | 925 | 67.82 |
| 3.00 | 358 | 26.25 |
| 4.00 | 106 | 7.77 |
| 5.00 | 28 | 2.05 |
| 6.00 | 6 | 0.44 |
| 7.00 | 3 | 0.22 |
| 8.00 | 3 | 0.22 |
| 9.00 | 2 | 0.15 |
| 10.00 | 0 | 0.00 |
| 11.00 | 0 | 0.00 |
| 12.00 | 0 | 0.00 |

February - Percentage Exceedence

| (m) | Freq | % Ex |
|---|---|---|
| 0.00 | 1244 | 100.00 |
| 1.00 | 1241 | 99.76 |
| 2.00 | 907 | 72.91 |
| 3.00 | 381 | 30.63 |
| 4.00 | 121 | 9.73 |
| 5.00 | 50 | 4.02 |
| 6.00 | 21 | 1.69 |
| 7.00 | 2 | 0.16 |
| 8.00 | 0 | 0.00 |
| 9.00 | 0 | 0.00 |
| 10.00 | 0 | 0.00 |
| 11.00 | 0 | 0.00 |
| 12.00 | 0 | 0.00 |

March - Percentage Exceedence

| (m) | Freq | % Ex |
|---|---|---|
| 0.00 | 1364 | 100.00 |
| 1.00 | 1364 | 100.00 |
| 2.00 | 1062 | 77.86 |
| 3.00 | 507 | 37.17 |
| 4.00 | 224 | 16.42 |
| 5.00 | 101 | 7.40 |
| 6.00 | 43 | 3.15 |
| 7.00 | 19 | 1.39 |
| 8.00 | 8 | 0.59 |
| 9.00 | 1 | 0.07 |
| 10.00 | 0 | 0.00 |
| 11.00 | 0 | 0.00 |
| 12.00 | 0 | 0.00 |

***Figure 4.16b: Wave height and exceedance offshore the Falkland Islands for the grid point 52°30'S, 57°00'W, April to June (Fugro, 2005)***

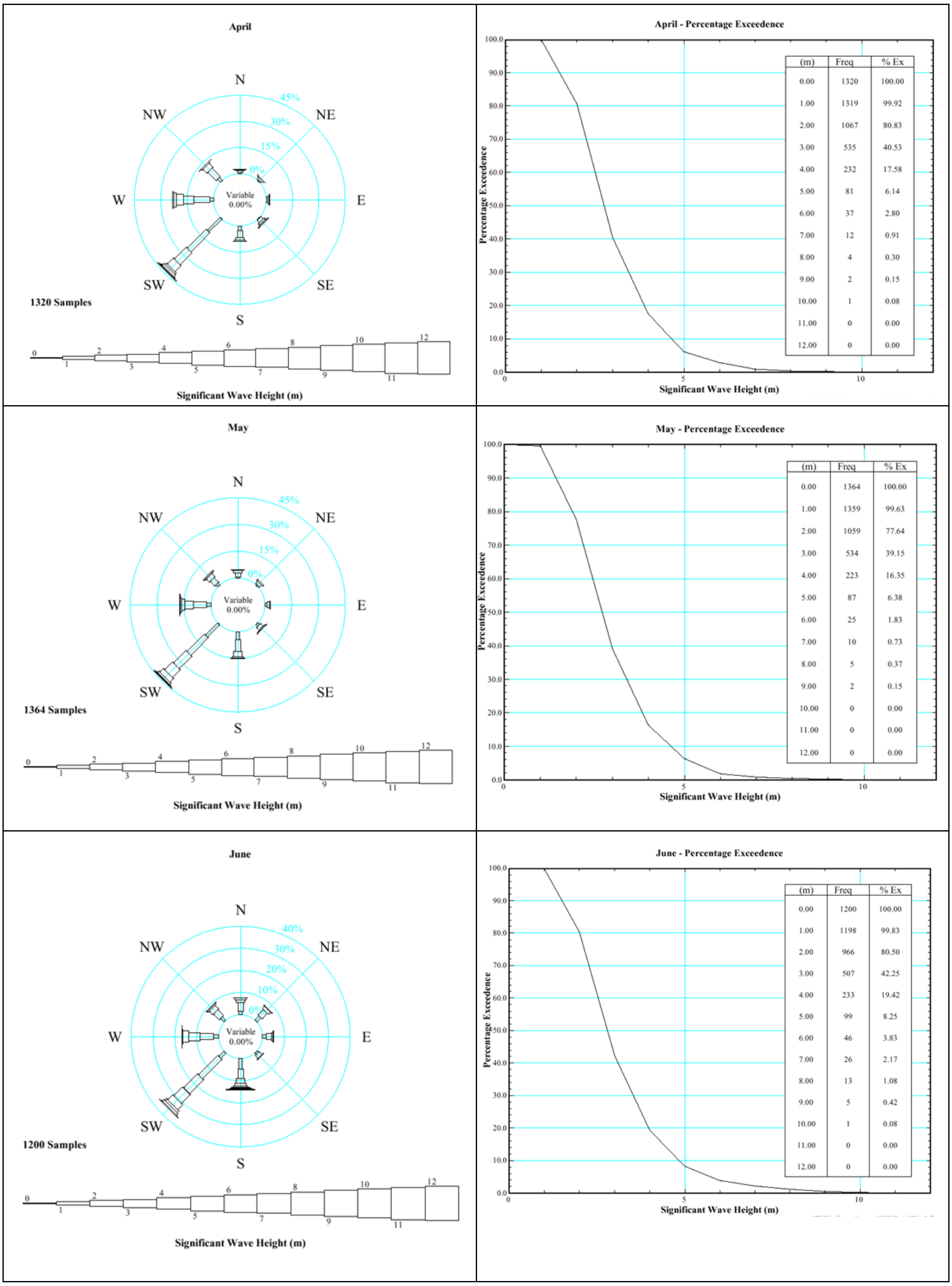
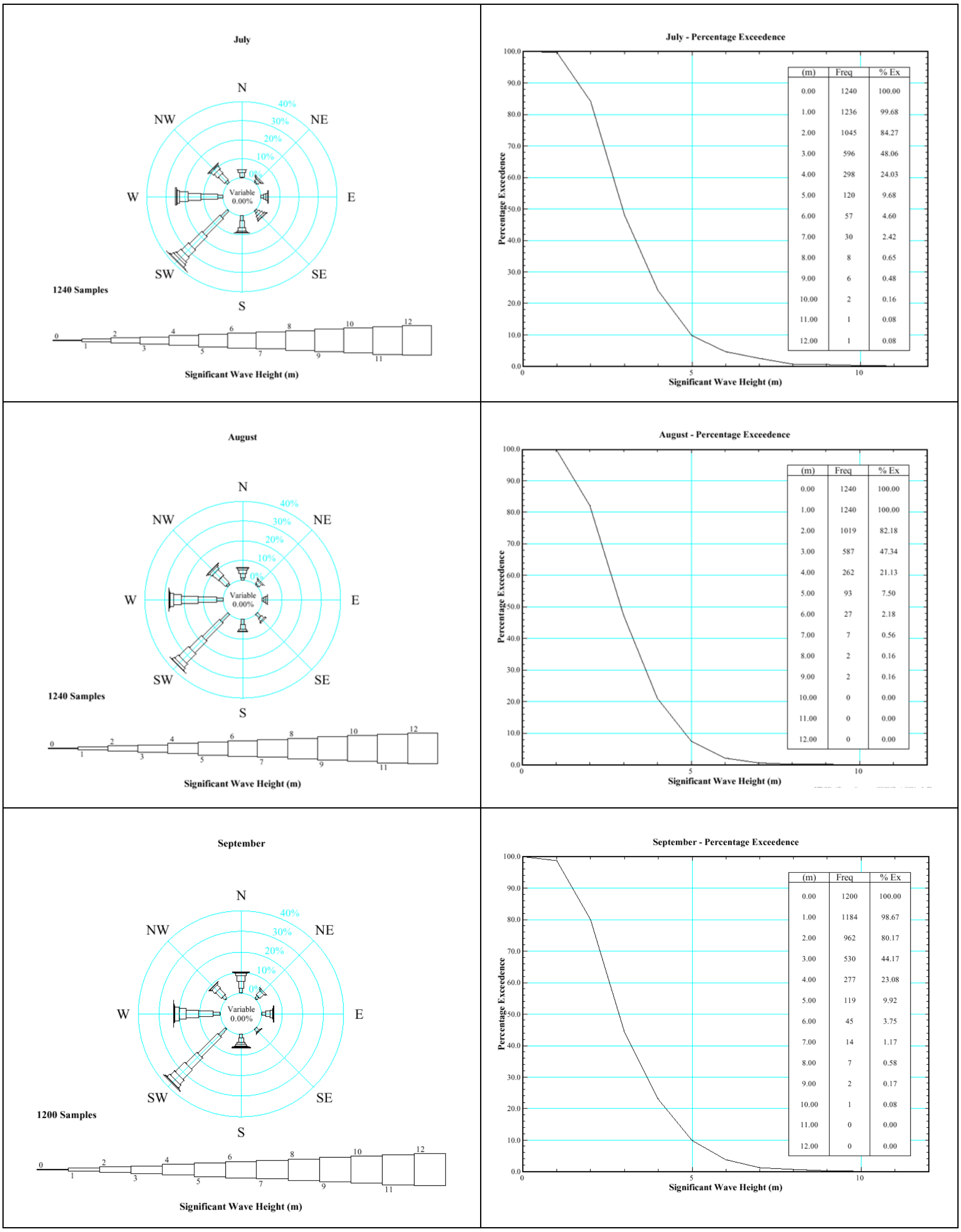


*Figure 4.16c: Wave height and exceedance offshore the Falkland Islands for the grid point 52°30'S, 57°00'W, July to September (Fugro, 2005)*




July - Percentage Exceedence

| (m) | Freq | % Ex |
|---|---|---|
| 0.00 | 1240 | 100.00 |
| 1.00 | 1236 | 99.68 |
| 2.00 | 1045 | 84.27 |
| 3.00 | 596 | 48.06 |
| 4.00 | 298 | 24.03 |
| 5.00 | 120 | 9.68 |
| 6.00 | 57 | 4.60 |
| 7.00 | 30 | 2.42 |
| 8.00 | 8 | 0.65 |
| 9.00 | 6 | 0.48 |
| 10.00 | 2 | 0.16 |
| 11.00 | 1 | 0.08 |
| 12.00 | 1 | 0.08 |

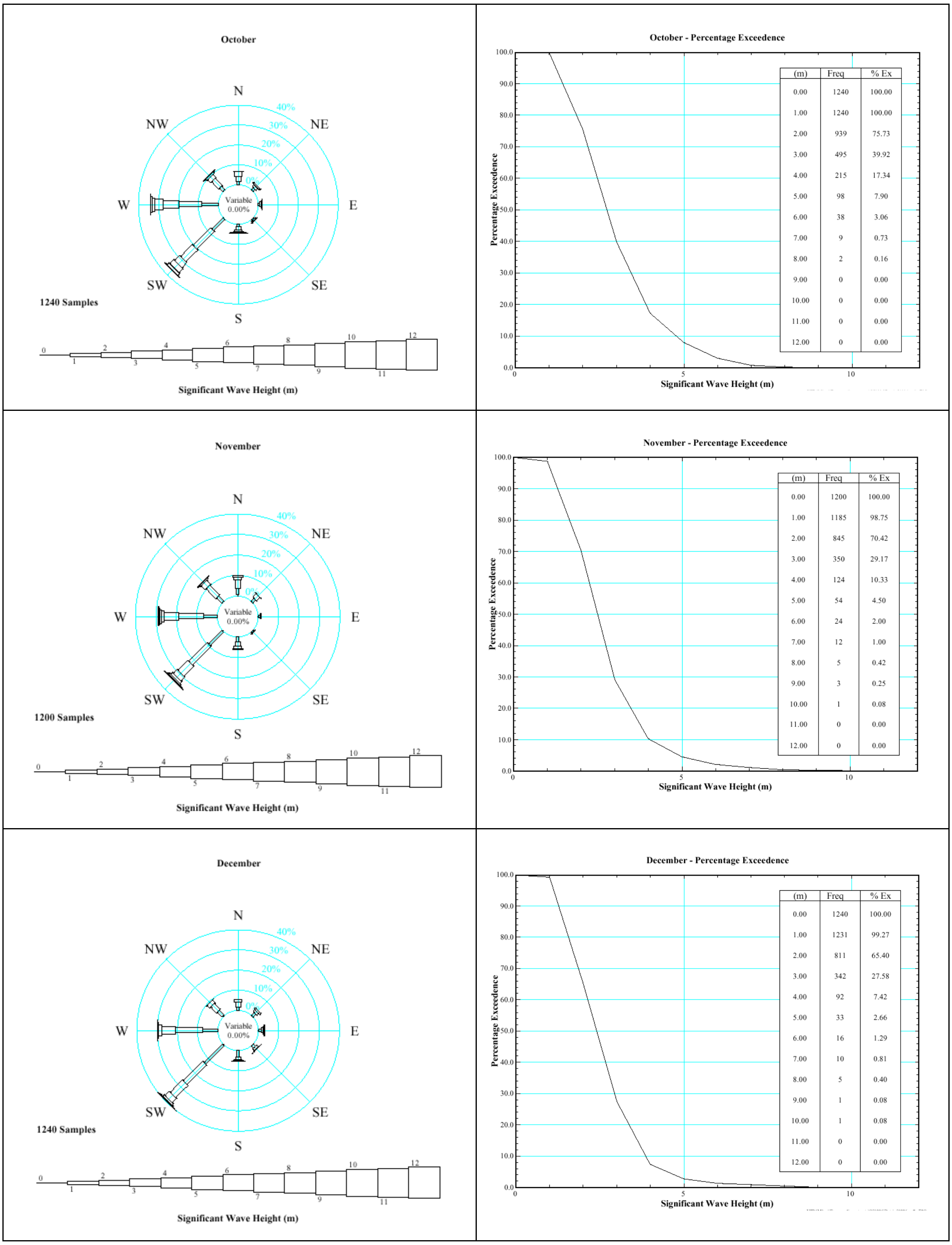
August - Percentage Exceedence

| (m) | Freq | % Ex |
|---|---|---|
| 0.00 | 1240 | 100.00 |
| 1.00 | 1240 | 100.00 |
| 2.00 | 1019 | 82.18 |
| 3.00 | 587 | 47.34 |
| 4.00 | 262 | 21.13 |
| 5.00 | 93 | 7.50 |
| 6.00 | 27 | 2.18 |
| 7.00 | 7 | 0.56 |
| 8.00 | 2 | 0.16 |
| 9.00 | 2 | 0.16 |
| 10.00 | 0 | 0.00 |
| 11.00 | 0 | 0.00 |
| 12.00 | 0 | 0.00 |

September - Percentage Exceedence

| (m) | Freq | % Ex |
|---|---|---|
| 0.00 | 1200 | 100.00 |
| 1.00 | 1184 | 98.67 |
| 2.00 | 962 | 80.17 |
| 3.00 | 530 | 44.17 |
| 4.00 | 277 | 23.08 |
| 5.00 | 119 | 9.92 |
| 6.00 | 45 | 3.75 |
| 7.00 | 14 | 1.17 |
| 8.00 | 7 | 0.58 |
| 9.00 | 2 | 0.17 |
| 10.00 | 1 | 0.08 |
| 11.00 | 0 | 0.00 |
| 12.00 | 0 | 0.00 |

***Figure 4.16d: Wave height and exceedance offshore the Falkland Islands for the grid point 52°30'S, 57°00'W, October to December (Fugro, 2005)***




October - Percentage Exceedence

| (m) | Freq | % Ex |
|---|---|---|
| 0.00 | 1240 | 100.00 |
| 1.00 | 1240 | 100.00 |
| 2.00 | 939 | 75.73 |
| 3.00 | 495 | 39.92 |
| 4.00 | 215 | 17.34 |
| 5.00 | 98 | 7.90 |
| 6.00 | 38 | 3.06 |
| 7.00 | 9 | 0.73 |
| 8.00 | 2 | 0.16 |
| 9.00 | 0 | 0.00 |
| 10.00 | 0 | 0.00 |
| 11.00 | 0 | 0.00 |
| 12.00 | 0 | 0.00 |

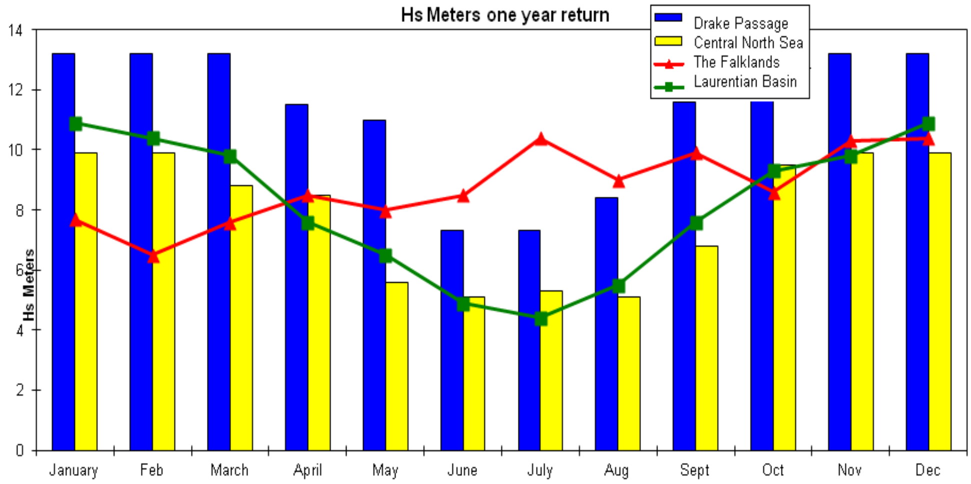
November - Percentage Exceedence

| (m) | Freq | % Ex |
|---|---|---|
| 0.00 | 1200 | 100.00 |
| 1.00 | 1185 | 98.75 |
| 2.00 | 845 | 70.42 |
| 3.00 | 350 | 29.17 |
| 4.00 | 124 | 10.33 |
| 5.00 | 54 | 4.50 |
| 6.00 | 24 | 2.00 |
| 7.00 | 12 | 1.00 |
| 8.00 | 5 | 0.42 |
| 9.00 | 3 | 0.25 |
| 10.00 | 1 | 0.08 |
| 11.00 | 0 | 0.00 |
| 12.00 | 0 | 0.00 |

December - Percentage Exceedence

| (m) | Freq | % Ex |
|---|---|---|
| 0.00 | 1240 | 100.00 |
| 1.00 | 1231 | 99.27 |
| 2.00 | 811 | 65.40 |
| 3.00 | 342 | 27.58 |
| 4.00 | 92 | 7.42 |
| 5.00 | 33 | 2.66 |
| 6.00 | 16 | 1.29 |
| 7.00 | 10 | 0.81 |
| 8.00 | 5 | 0.40 |
| 9.00 | 1 | 0.08 |
| 10.00 | 1 | 0.08 |
| 11.00 | 0 | 0.00 |
| 12.00 | 0 | 0.00 |

*Figure 4.17: 1 year return significant wave height ($H_s$) offshore the Falkland Islands for the grid point 52°30'S, 57°00'W, in comparison with other harsh environment locations (Fugro, 2005)*




### Sunlight

4.113 Variation in seasonal day length in the Falkland Islands throughout the year is similar to that of the UK due to the similarity in latitudes south and north, respectively. Due to cloud cover, the average number of hours per day in summer with direct sunlight is six and the average number in winter is two to three.

4.114 In 2011, FIG issued a directive announcing that the Falkland Islands will remain on summer time (Daylight Savings Time at UTC -3) during the winter, when the clocks would normally be set back.

### Precipitation

4.115 Rainfall is relatively low because of the archipelago's location to the east of South America. Owing to the westerlies and the shielding effect of the Andes Mountains, the western side of the archipelago is much drier than the eastern side. Rainfall is evenly distributed throughout the year. Stanley and Port Howard both have approximately 630 mm per annum. This is greater than westerly locations such as West Point Island, which averages 430 mm per annum *(Otley et al., 2008).*

4.116 The Falkland Islands experience approximately 11 days of snowfall per year, most frequently occurring in August (*Hydrographer of the Navy, 2008*). Although the climate is semi-arid, the ground remains damp as it is often impermeable to water.

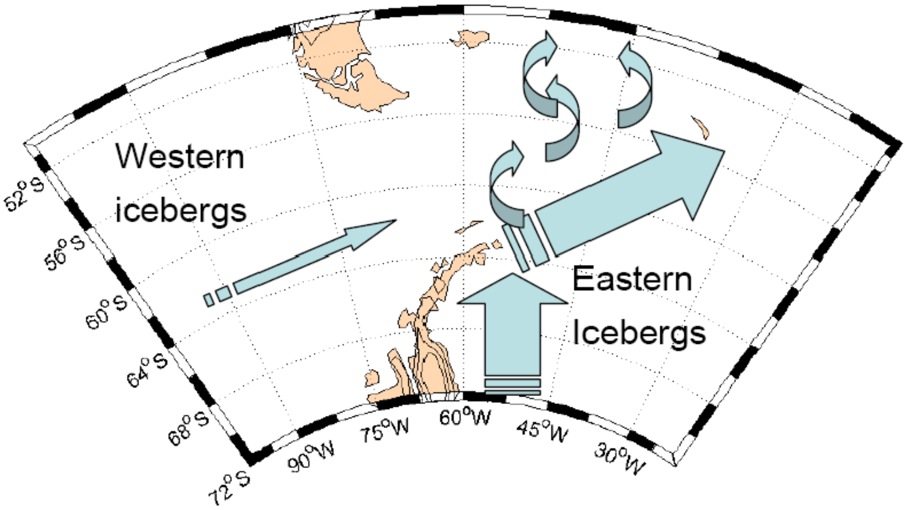
## 4.2.8 Icebergs

4.117 The oceanography of the region between the South America and the Antarctic Peninsula (the Drake Passage) plays a fundamental role in the movement of icebergs into the Falkland Islands region. The polar front, within the Antarctic Circumpolar Current (ACC), separates the cold polar waters from the warmer northern waters, coinciding with the path of the maximum westerly winds. In the Drake Passage, the convergence of fronts within the ACC creates strong eddies. The size and duration of these eddies is extremely variable, subjecting the area to the east of the Drake Passage, and south of the Falkland Islands, to a significant variation in currents, thus influencing the number of icebergs approaching the Falkland Islands (*Partington, 2005*).

4.118 Icebergs occurring in the vicinity of the Falkland Islands are likely to be derived from floating ice shelves and streams where icebergs of significant sizes may be calved. Approximately 50% of the coast of Antarctica is fringed by ice shelves. These shelves are thought to discharge approximately 2,000 gigatonnes (Gt) of icebergs of varying thickness into the Southern Ocean each year.

4.119 A desktop assessment of icebergs in the Falkland Islands (*Partington, 2005*) indicates that icebergs potentially floating through the southern and eastern license areas come from primary and secondary sources (Figure 4.18).

***Figure 4.18: Sources and movements of icebergs in the Falkland Islands region (Partington, 2005)***




4.120 The primary source is known as the 'eastern' icebergs, which are transported along the western edge of the Weddell Sea and originate from east of the Antarctic Peninsula. All but one of the 70 large icebergs (greater than 18.5 kilometres diameter) recorded floating north of 60°N and west of 40°W between 1992 and 2005 are classified as 'eastern' icebergs, following a clockwise route around the Antarctic. The majority of the icebergs (large and medium sized) following this route pass far to the east of the Falkland Islands, well outside of the southern and eastern license areas. In late 2005, however, a stronger current from the south resulted in a greater quantity of icebergs entering the Falkland Islands region (*Partington, 2005*).

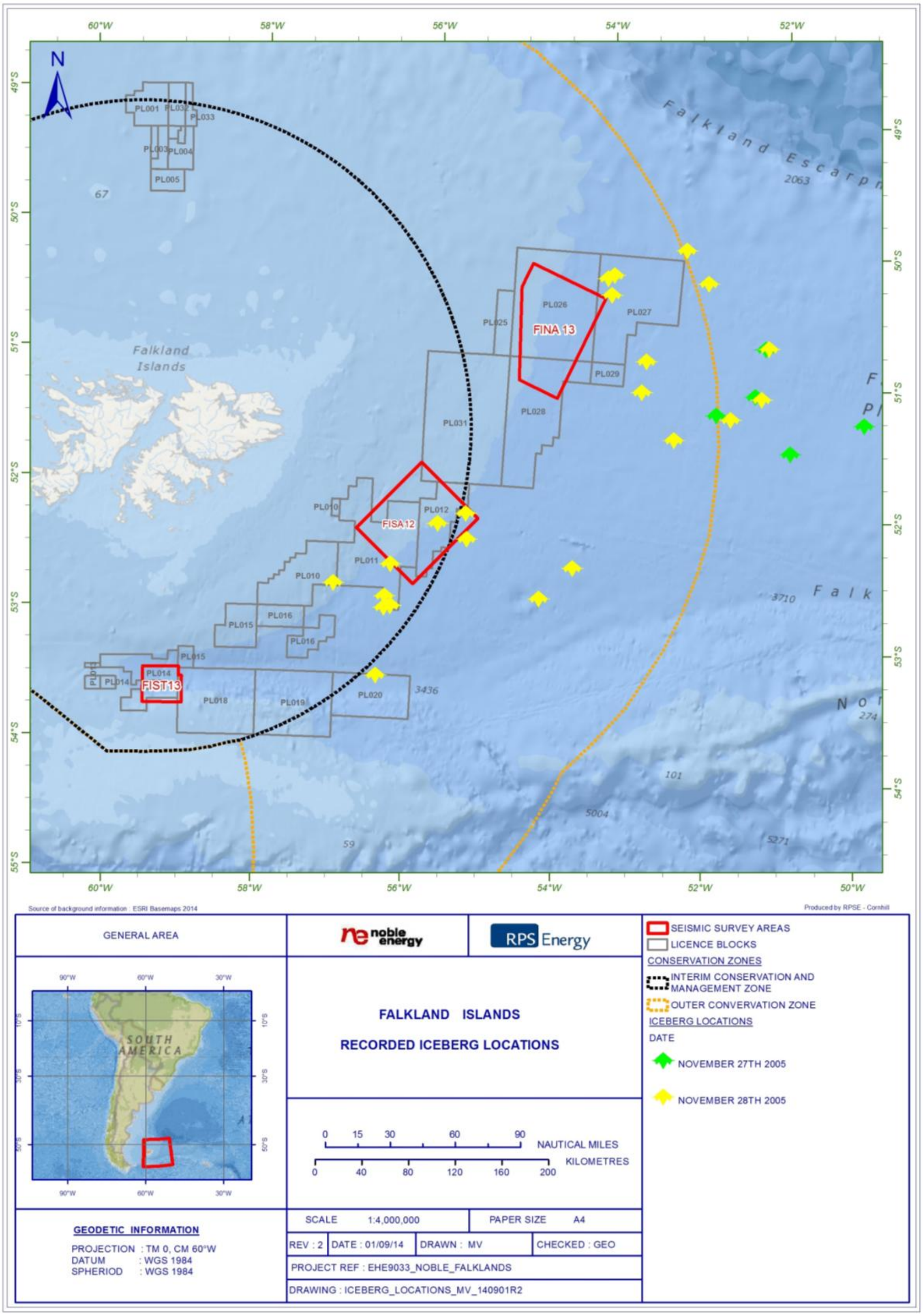
4.121 The secondary source is the 'western' icebergs that move north-east, away from the Antarctic coast predominantly in the Ross Sea and Bellingshausen Sea. These icebergs, drawn into the ACC, are transported through the Drake Passage to approach the Falkland Islands from the south-west. In comparison to the primary icebergs, the secondary source icebergs are very rare, with only one instance recorded in the large iceberg database out of 70 occurrences. The ACC has rough weather conditions which are expected to lead to rapid disintegration of icebergs. Modelling work by Gladstone *et al*. (2001) suggests that most icebergs disintegrate before reaching the Drake Passage.

4.122 The highest probability of iceberg occurrence is in the eastern portion of the license areas, as it is closer to the main export route for icebergs from the Antarctic. It is possible for icebergs to approach and enter the lease areas from the south, but the risk reduces to the west. In the extreme west of the area, west of 59°W, the probability of icebergs is considered low. However, due to the strong eddy activity in the Drake Passage and its possible (albeit rare) influence on iceberg movement, the presence of icebergs in any of the license areas, although unlikely, cannot be ruled out.

4.123 Small icebergs (up to 100 metres in diameter) are the most likely to occur in and around the license areas. In November 2005, which was considered an unusual 'outbreak' year for icebergs in the region (*Partington, 2005*), 23 icebergs were detected to the north-east and east of the Falkland Islands. Several were recorded in the vicinity of the Noble licenses (Figure 4.19).

4.124 Little evidence exists for any seasonal behaviour in iceberg numbers and drifts. There are fewer recordings of large iceberg calving during winter (as summer melt plays a large role in calving), but as icebergs can take months or even years to reach the Falkland Islands region, any pattern in seasonal calving of icebergs no longer remains by the time they arrive within the Noble license areas.

***Figure 4.19: Icebergs detected by air and surface observations during 2005 (FOGL 2005, in Partington, 2005)***



## 4.3 Biological Environment

4.125 The Patagonian Shelf, on which the Falkland Islands are located, is of regional and global significance for marine resources *(Croxall & Wood, 2002).* The current patterns and bathymetry influence nutrient circulation and marine productivity levels. The continental shelf of the Falkland Islands extends some 200 kilometres beyond the Falkland Islands coast to the north, about 50 kilometres to the south-west, and about 50-100 kilometres offshore on the eastern side. Nutrient rich waters upwell on the edge of the continental shelf, but most particularly to the north-west of the Jason Island Group, Beauchêne Island and the Burdwood Bank *(Otley et al., 2008).* These areas are rich in plankton and fish assemblages, and are important foraging grounds for seabirds and marine mammals *(White et al., 2002)*.

4.126 The following sub-sections outline the existing biological resources known to occur around the Falkland Islands and within the vicinity of Noble license areas.

### 4.3.1 The Patagonian Shelf Marine Ecosystem

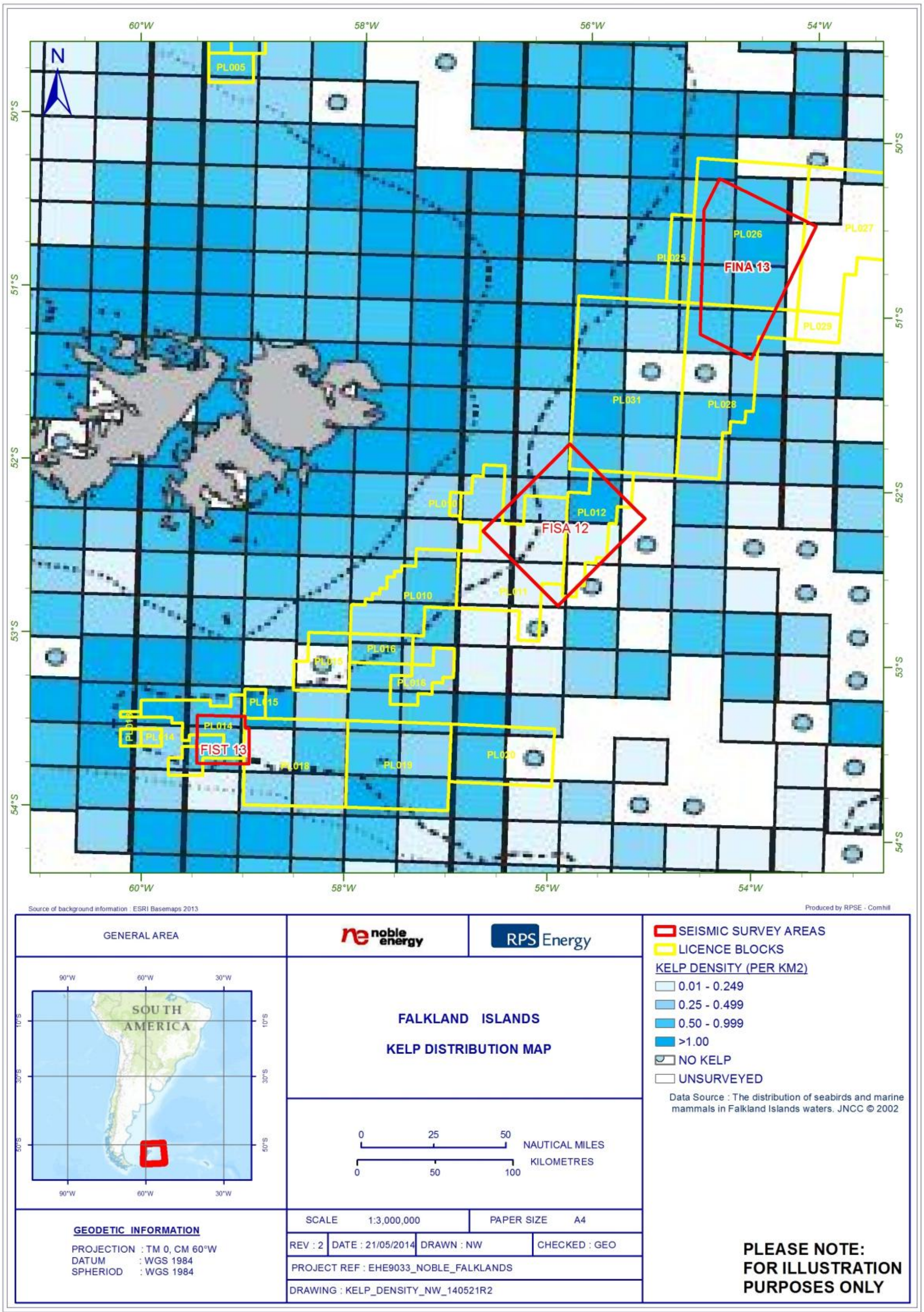
4.127 The Falkland Islands lie within the Patagonian Shelf Large Marine Ecosystem (LME), described by Heileman (*2009*) as a Class I, highly productive (>300 gC $m^{-2}$ $yr^{-1}$) ecosystem based on the SeaWiFS global primary production estimates. This ecosystem is influenced by two major wind-driven currents: the northward flowing Falklands/Malvinas Current and the southward flowing Brazil Current. The two currents provide the Patagonian Shelf LME with a distinctive ecological boundary to the east. While the southward flowing Brazil Current is warm and saline, the northward flowing Falklands/Malvinas Current carries cool, less saline, nutrient-rich sub-Antarctic water towards equatorial regions. The two currents mix at a Confluence Zone (CZ). The CZ is a wide area characterized by intense horizontal and vertical mixing. It is situated on average at the approximate latitude of 39° south, but is displaced to the north in the winter. The exchange of water masses of different temperatures and salinity affects the biological productivity of the region. The Patagonian Shelf LME is rich in a variety of biological resources.

### 4.3.2 Marine & Intertidal Vegetation

4.128 By providing food and habitat for a wide range of marine invertebrates and fish, seaweed plays an integral part of the health and biodiversity of the natural ecosystem. Giant kelp (*Macrocystis pyrifera*) and tree kelp (*Lessonia sp*.) are the most common macro-algae species in offshore zones of the Falkland Islands. These species are found in coastal waters and provide valuable habitat for shorebirds, seabirds, seals, coastal dolphin species, and other marine creatures as feeding grounds and spawning/nursery areas (*Munro, 2004; Strange, 1992; Searles, 1978*).

4.129 Given the water depths at the proposed Noble sites, kelp species are only likely to be found as free-floating patches in the area. Distribution of free-floating kelp patches in Falkland Islands waters was reported from the 'Seabirds at Sea' surveys carried out between February 1998 and January 2001 (*White et al., 2002*). Estimated kelp density over the Noble license areas is shown in Figure 4.20. This figure shows free-floating kelp density, given as the number of kelp patches observed per square kilometre. Free-floating kelp within FISA12 is rated as being denser in the northern half of the polygon, whilst density across FIST13 is rated at 0.5 – 0.999 patches per square kilometre. Free-floating kelp across FINA13 is generally higher than the two southern areas of interest, rated as 0.5-0.999 patches per square kilometre across most of the area. Offshore areas associated with free-floating kelp density are considered important for 22 seabird species recorded as associating with free-floating patches of kelp (*White et al., 2002*).

*Figure 4.20: Free floating kelp distribution offshore Falkland Islands – patches of kelp observed per square kilometre (White et al., 2002)*



### 4.3.3 Plankton

4.130 Marine plankton consists of organisms with limited swimming capabilities that drift with the prevailing currents. These organisms represent an integral part of the marine ecosystem and provide a crucial source of food to higher trophic levels (e.g., fish and cetaceans). Plankton is divided into two broad groups: phytoplankton (autotrophic) and zooplankton (heterotrophic).

#### Phytoplankton

4.131 Phytoplankton exists in the photic zone of the ocean and increase in concentration during warmer seasons when light availability is greater, particularly in polar and sub-polar regions. There may be as many as 5,000 species of marine phytoplankton with diatoms, cyanobacteria and dinoflagellates amongst the most prominent groups. Available data suggests that diatoms (e.g., *Chaetoceros atlanticus*, *Chaetoceros dichaeta* and *Pseudo-nitzschia*) comprise a significant component of the phytoplankton population in higher latitudes, compared to tropical waters (*Ingram Hendley, 1937; Barnes & Hughes, 1988; Holeton et al., 2005*).

#### Zooplankton

4.132 Zooplankton are heterotrophic plankton represented by small floating or weakly swimming animals that drift with the water current. The complex current patterns around the Falkland Islands, with the rising bathymetry and the extensive shelf area, create stable areas to the north, where high salinity and nutrient-rich waters enhance plankton activity and so support high levels of zooplankton (*Agnew, 2002*). As with phytoplankton, zooplankton numbers appear to rise sharply during austral spring and summer months. Ciechomski and Sanchez (1983) noted that total zooplankton abundance around the Falkland Islands does not peak until January / February when it is dense to the north of the Falkland Islands along the shelf break.

4.133 Important zooplankton species offshore the Falkland Islands include the swarming epi-pelagic 'krill' species such as *Munida gregaria* (lobster krill), *Euphausia lucens*, *E. vallentini* and *Thysanoessa gregaria*. *T. gregaria* is most abundant in the southern part of the continental shelf. *E. lucens* is more common on the northern shelf area, whilst *E. vallentini* is most common in the cold Falkland Current (*Agnew, 2002*). A net sampling study in Falkland Islands waters found distinct species groups which showed strong relationships to the positions of water masses in the region. The group related to the Falkland Shelf contained the least number of species of the four groups defined and was characterised by species including the chaetognath Sagitta gazellae and the hyperiid *Themisto gaudichaudii*. A second group related to the PFZ was dominated by euphausiid species; *Euphausia triacantha*, *E. similis* and *Stylocheiron maximum*. Two further groups were defined heading northwards away from the Falkland Islands towards the Brazil Current (*Tarling et al., 1995*).

4.134 Certain krill species are a key component in the food chain, consumed by squid, fish, seals, baleen whales and seabirds, particularly black-browed albatross (*Thalassarche melanophris*) and penguins (*Agnew, 2002*). *T. gaudichaudi* are important prey of commercially important species of fish such as hake (*Merluccius hubbsi*) and Argentinian shortfin squid (*Illex argentinius)* (*Temperoni et al., 2013*).

### 4.3.4 Benthos

#### Baseline Data Sources

4.135 The following data sources have been reviewed in order to characterise benthic communities within and around the project area.

##### *Noble License Area Surveys*

4.136 The FISA12, FIST13 and FINA13 areas have been subject to an environmental baseline survey (refer to Section 4.1.2 above). At the time of submission, the FISA12 baseline report is available and the results of survey in this area have been incorporated into the baseline text that follows. As they become available, baseline reports relating to the FIST13 and FINA13 areas will be provided in an EIS addendum.

4.137 Survey of the FISA12 area was planned following a review of previously gathered acoustic data to identify potentially sensitive and/or unusual seabed features (e.g., Annex I habitat, unidentified bedforms, gas and/or fluid escape features). A benthic survey was then undertaken to obtain baseline data for all habitat types recorded in close proximity to the proposed well locations, to confirm the presence of and delineate the boundaries of any seabed features of particular interest, and to gain an understanding of the wider regional conditions across the FISA12 area. The proposed well locations within the FISA12 survey area are referred to as 'Humpback-1' and 'Humpback-2', both of which are located towards the north-east boundary of the FISA12 area.

4.138 The survey comprised combined seabed sampling using drop-down video/photography, box cores and grabs. Water quality profiles and water samples were also collected. Sampling was undertaken at a total of 34 stations for the FISA12 survey area, which covers approximately 70 x 70 kilometres. Shallow geophysics and bathymetric survey operations were carried out at selected target areas within the FISA12 survey area to refine the location of ground truthing, or to resolve minor artefacts recorded in the 3D seismic data.

4.139 Data analysis was undertaken in the UK and included particle size analysis, macro-invertebrate analysis and sediment chemistry analysis. Results are presented in full in the technical survey report (*MG3, 2014*) (Appendix K).

### *Site Surveys by Previous Operators*

4.140 Baseline surveys have been commissioned by various operators around the Falkland Islands, in the North (*Gardline, 1998*), East (*Gardline, 2011a-f; Fugro 2008a-d*) and South (*BSL, 2008*) Falkland Basins. The most relevant to the Noble license areas are those undertaken in the East Falkland Basin (*Gardline, 2011e; Fugro 2009a & b*). Baseline conditions across the FIST13 and FINA13 areas are described below on the basis of the results of surveys undertaken by other operators in locations most proximate to the Noble license areas. The description of conditions across the FISA12 area is primarily informed by the results of the Noble-commissioned baseline survey (*MG3, 2014*).

### *FISA12*

4.141 The results of the FISA12 environmental baseline survey are summarised below and presented in full in Appendix K.

#### <u>Species and Habitats</u>

4.142 Macrofaunal analysis was carried out on all 59 replicates obtained at 26 baseline sediment sites, sampled within the FISA survey and processed in the field using a 500µm mesh size. Subsequent macrofaunal taxonomy of all recovered fauna identified a total of 2,874 individuals.

4.143 Of the 254 species recorded, 188 were infaunal dominated by small polychaetes. This finding is line with other regional surveys. This dominance was by both abundance and richness, with six polychaetes recorded in the top ten numerically ranked species. This dominance was closely followed by crustaceans which were also well represented, having three species in the top ten numerically ranked taxa. In overall rank order, the top five key dominant species across the area were the Polychaete *Rhamphobrachium (Spinigerium) ehlersi,* the crustaceans *Ampelisca* and a Copepoda, separated by the polychaete *Gymnonereis fauveli* and followed by another polychaete *Apistobranchus* spp.

4.144 Univariate analysis of the data indicated that the species richness and abundance were similar to previous surveys in the region by surface area. This was 20 species per 0.1 square metre and a mean of 351 individuals per square metre.

4.145 In addition to the infaunal community, the qualitative presence of the epifaunal community was reviewed from the video footage. The survey found a rich faunal assemblage, especially in areas where drop-stones were common. Key faunal groups were the sponges, class Hexactinellida, Calcarea and Demospongia; many of the genera were typical for deeper water (e.g., *Hymedesmia* spp., *Crella* and *Lissodendoryx*), with a wide and sometimes cosmopolitan distribution. The Cnidaria were represented by nine genera of thecate and athecate Hydrozoa and two genera of

Stylasteridae, in particular *Stylaster densicaulis*. The live solitary coral belonging to the species *Flabellum curvatum* (a potential CITES Appendix II coral species) was also recorded. Several Octocorallia were found, including the sea pens Pennatulidae (generally too small to identify) and two species of Gorgonacea. Bryozoa were also a very common constituent on pebbles and stones, with many species endemic to the South Atlantic region.

4.146 A further assessment of the epifaunal assemblages shown within the seabed photographs confirmed a relatively well populated community of species overall, with healthy aggregations colonising occasional drop-stones as well as *Lophelia* debris and some rooted into the sediment. Many of the species recorded were associated with deep water and/or cold water environments. Overall, the phylogenetic make-up of the conspicuous megafauna observed was dominated by the cnidarians, with octocorals and Pennatulidae remaining prevalent throughout.

4.147 Echinoderms were better represented in the seabed photography than the grab samples with ophiuroids, crinodea, asteroids and holothurians present. Where drop-stones were present, encrusting sponges were common along with anthozoans. Often rooted into soft sediments bryozoans and hydroids were observed as sparse tufts. There were also numerous burrows likely to be associated with crustacean and holothurian activity. Free-swimming megafauna included the demersal teleosts: moridae, grenadier, hake and batoids.

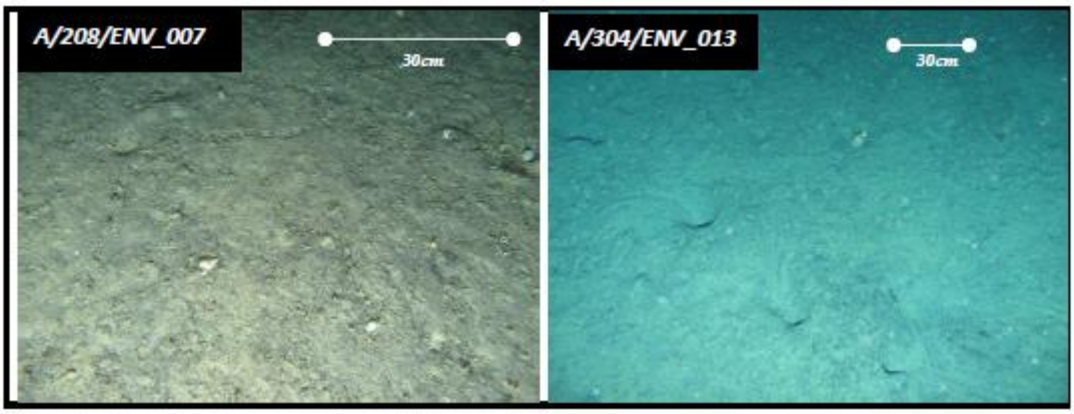
4.148 The following text describes the main habitat types encountered within the survey area. Their distribution across the FISA12 area is shown in Figure 4.21 below.

**<u>Holocene Sedimentary Slightly Gravelly Silty Sand</u>**

4.149 The majority of the seabed is described as featureless slightly gravelly silty sand. This is broadly similar to offshore circalittoral sand ([SS.SSa.OSa] *Connor et al., 2004*). This material will be related to granular Holocene sedimentary material and granular Pleistocene residues (i.e., drop-stones, recorded during faunal sieving). Seabed photography recorded a presence of bioturbation in the form of burrows from various crustaceans, as well as other "lebensspuren" (animal tracks and furrows) likely to be produced by echinoderms (in particular spatangoids) observed in both the grab sampling and seabed imagery. An example of this habitat type is shown in Figure 4.21.

4.150 Relatively few conspicuous fauna were recorded in this habitat by seabed photography, although the presence of some bioturbation would signify a relatively rich infaunal community. The seabed was generally featureless with an absence of current related bedforms indicative of a sedimentary regime and limited hydrodynamic reworking of sediments. Conspicuous fauna observed included the isopod Serolidae (possibly the deep water species *Acutiserolis neaera*), occasional ophiuroids, the potential CITES Appendix II solitary cup coral (*Flabellum* sp.) and the striped shrimp (*Nauticaris* sp.).

***Figure 4.21: Example images of Slightly Gravelly Silty Sand habitat from the FISA12 EBS***



Featureless Gravelly Silty Sands

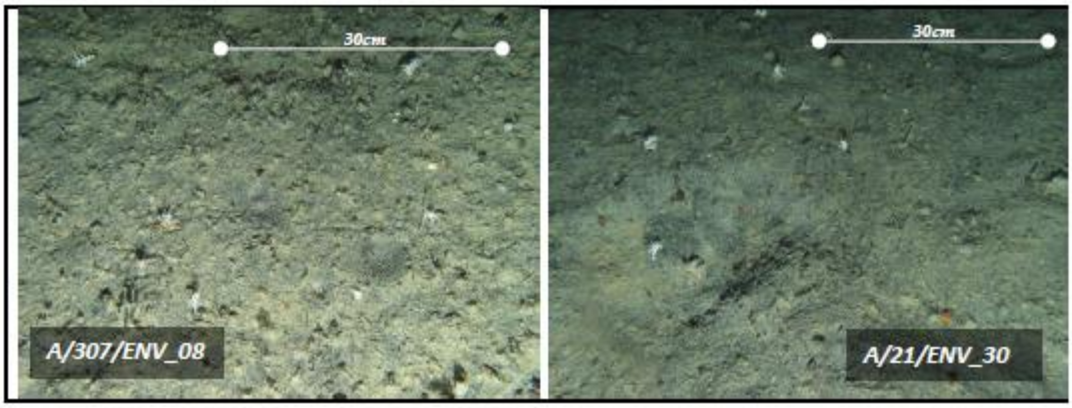
4.151 The seabed to the south-east of the escarpment indicated a featureless, slightly mixed seabed with coarser gravel admixtures recorded on the surface of the seabed (as observed by seabed photography).

4.152 As with the shallower sediments this is broadly similar to an offshore circalittoral sand ([SS.SSa.OSa] *Connor et al., 2004*), but with the addition of fine gravels, although not sufficient to alter the general habitat to an offshore circalittoral mixed sediment ([SS.SMx.OMx] *Connor et al., 2004).* Nevertheless, the presence of fine pebbles at the surface has introduced a small epifaunal community of small isolated stone coral-like Hydrozoa *Stylaster* sp.*,* usually in the form of a single branched 'sprig' only a few centimetres high. Other species recorded were echinoderms (a cushion star, the pencil urchin [*Cidaris* sp.] and a burrowing holothurian) and the same Serolidae isopod as recorded elsewhere on the FISA site (possibly *A. neaera*). The small pebble surfaces also support the occasional foliose bryozoan, ascidians and solitary sponge (*Suberites* sp.), although the solitary cup corals (*Flabellum* sp.) previously recorded on the Holocene slightly gravelly silty sands, appeared to be absent.

4.153 This sediment will be related to granular Holocene sedimentary material and coarser granular Pleistocene residues (drop-stones observed at the surface and during faunal sieving). Seabed photography indicated a presence of bioturbation in the form of spatangoid furrows and surface "lebensspuren" (animal tracks). An example of this habitat type is shown in Figure 4.22.

4.154 The Humpback-2 proposed well location is located in this sediment type.

***Figure 4.22: Example images of Gravelly Silty Sand from the FISA12 EBS***




Silty Sands with Occasional Cobbles and Boulders:

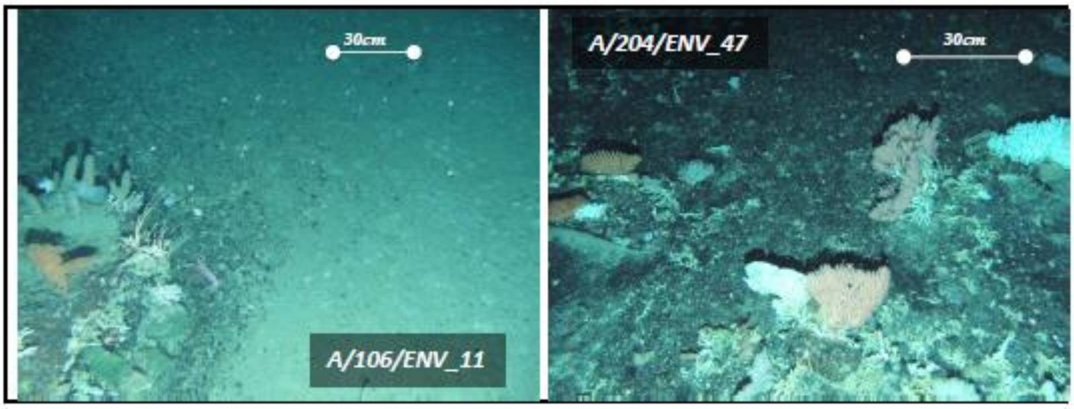
4.155 This habitat type is recorded in areas where underlying hard geology pinches out close to the surface and along the peripheral edges of the bedrock exposures where the surface granular sediments thin to a veneer. This creates a mixed habitat of featureless sands punctuated by rock outcrops, large cobbles and boulders all populated with small but conspicuous epifaunal communities, all associated with the hard substrate. An example of this habitat type is shown in Figure 4.23.

4.156 As with the previous habitat, this sediment is broadly similar to an offshore circalittoral sand ([SS.SSa.OSa] *Connor et al., 2004*), but with localised outcrops of circalittoral low energy rock ([CR.LCR] *Connor et al., 2004*). These isolated hard substrates are well populated by developed epifaunal communities based on both hard and soft corals. Examples of species recorded include the hard branched stone coral-like Hydrozoa Stylaster sp., occasionally developed into fan shaped morphology of 20-30cm in diameter. Other corals include soft octocorals (similar to *Callogorgia* sp.), and solitary cup corals, solitary sponges (*Suberites* sp.), and some foliose bryozoans. Living around these rocks are a number of echinoderms, including ophiuroids spread amongst the corals, the pencil urchin (*Cidaris* sp.), whilst several examples of larger boulders observed a resident small lobster as well as several small squat lobsters (*Munida* sp.).

4.157 Some of these boulders indicated the presence of current scour including localised areas of ripples indicative of turbulence around the feature and the subsequent reworking of the sediments by the seabed water movements.

4.158 The Humpback-1 proposed well location is located in this sediment type.

***Figure 4.23: Example images of Silty Sands with Cobble and Boulder Outcrops from the FISA12 EBS***



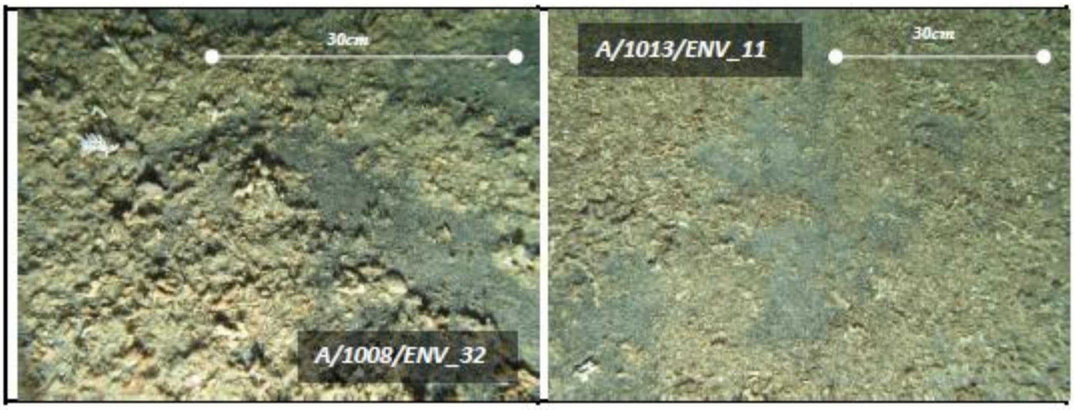

**Bedrock Exposure and Localised Patches of Relic Coral Debris**

4.159 Several exposures of bedrock were recorded within the FISA12 survey area, predominantly associated with the steeper slopes of the central escarpment and on the edges of collapsed depressions in the northwest. For the most part, the epifaunal coverage of exposed bedrock, including the areas of slumped boulders found at the base of most steep sloped areas, was limited to a low lying faunal turf of bryozoans, hydroids and the occasional soft coral. Some larger examples of well-developed *Stylaster* sp. hydrozoans were also recorded, but these were low in number. However, the most dominant species recorded in these areas was that of the reef-building stone coral *Lophelia pertusa*. This was in localised areas of high density, associated with the sides of boulders at the base of the escarpment, or low level coverage at the top of the escarpment, at the edge of the drop-off. Both areas are likely to be associated with the strongest water movement in the area.

*4.160* Generally, the coverage by *L. pertusa* was predominantly made up of relic debris of whole and fragmented material no larger than 10 centimetres in length. Relatively few examples of live material were recorded and these were all less than a few decimetres in diameter. This would suggest that larger reefs created by *L. pertusa* are absent from the area. A low ambient seabed water temperature of approximately 2.5° Celsius is thought to inhibit the growth rate and development of *Lophelia*, restricting its size and proliferation in the polar regions (*Zibrowius, 1980; Cairns, 1994*). Corals preferred temperature range is thought to be between 6° Celsius and 8° Celsius (*Frederiksen et al., 1992; Freiwald, 1998*).

4.161 The extensive coverage of *Lophelia* debris appears to be a relic feature of considerable age. An example of this habitat type is shown in Figure 4.24. As the area of proliferation is localised and limited to a rocky, non-sedimentary environment, the residues of earlier colonies are not incorporated within a carbonate mound or bioherm. Consequently, the presence of *Lophelia* (live or dead) in these areas is not thought to be of major significance to the local biodiversity in the region and therefore is not thought to be of notable conservational importance. These corals are generally considered to be vulnerable due to their sensitivity to trawling damage and their slow growth rate. The FISA area is not currently impacted by trawlers at the depth of these populations (1,300 metres to 1,400 metres), and the closest populations are expected to be around 3.8 kilometres south of the nearest proposed well (Humpback-1).

*Figure 4.24: Example images of Coral debris from Lophelia pertusa (Scleractinia)*



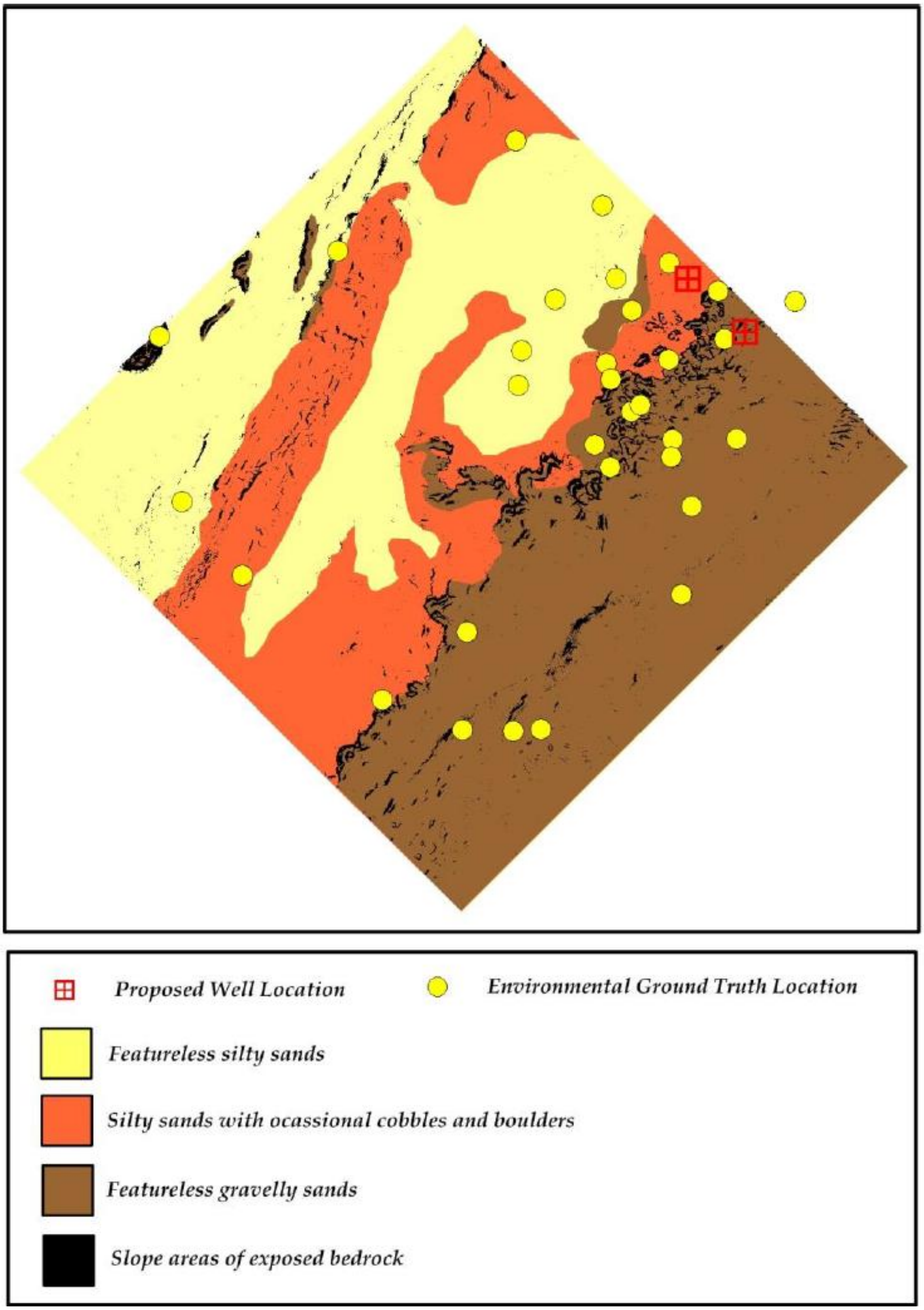

**Potential Sensitive Habitats**

4.162 The majority of evidence for the presence of *L. pertusa*, a CITES Appendix II species, relates to extensive areas of debris representative of relic residue populations located on the edge of the escarpment drop-off approximately 3.8km south-east of Humpback-1 and approximately 5.7km northwest of the proposed Humpback-2 well locations. Examples of live populations mostly show localised 'sprigs' of *Lophelia* (a few decimetres in length) recorded on the edges of prominent boulders or at the very edge of the escarpment drop-off where the current movements are greatest. No 'thickets' (aggregations large than 1m) of *L. pertusa* were recorded during the survey.

4.163 Whilst the recorded aggregations of live *Lophelia* are not generally classified as Annex I habitats, there may be instances along the edge of escarpment where larger aggregations could exist and should be protected from physical damage. However, these areas are located several kilometres from the proposed well locations.

4.164 The remainder of the survey area did not yield any evidence of particularly sensitive habitats, particularly within the immediate vicinity of the proposed exploration wells. The habitats in these areas were considered to be homogenous, gravelly or slightly gravelly silty sands with limited sensitivity to the proposed operations. A review of both stills and video footage indicate that some other potential CITES Appendix II coral species (such as *Flabellum* sp.) were observed.

*Figure 4.25: Summary habitat classifications from the FISA12 EBS*




***Surveys Relevant to FIST13***

4.165 The survey conducted by Borders & Southern included regional sampling for the Darwin and Stebbing wells (*Borders & Southern, 2010*). This regional survey is located approximately 20 kilometres to the east of the FIST13 area. The Borders & Southern survey collected samples from 23 stations across the region. Macrofaunal analysis was carried out on forty eight replicates (from 21 of the 23 sites).

4.166 The dominant macrofaunal population for the region was found to be based on that of a mobile surface dwelling polychaete, the Onuphid *Rhamphobranchium ehlersi*, nematodes, and surface or shallow burrowing crustaceans, such as a tanaid in the family Apseudidae, and the amphipods *Urothoe sp.,* and *Phoxocephaloidea sp*. Other common fauna present within the benthos were ostracods and a number of forams. Many of these groups (such as the ostracods [mostly cypridoidea], forams and nematodes) are not usually included within macrofaunal analyses due to their size (typically falling in the meiofaunal range). However, as little is known about the sediments in this area, these additional groups were included within the analysis for completeness (*Borders & Southern, 2010*).

4.167 Whilst the above described polychaetes dominated the macrofaunal population overall, the most abundant annelid recorded during the survey was the onuphid *Rhamphobranchium ehlersi.* Unlike most polychaete species which live within the surface substrate, the omnivorous onuphids live within a sediment-encrusted mucous tube which they physically drag across the surface of the seabed. Comparison of the macrofaunal population with the neighbouring sites in the eastern Falkland Continental Margin equally showed other onuphid species *Onuphis pseudoiridescens,* at the Toroa rig site survey site (*Fugro Survey Limited, 2009d*) approximately 70 kilometres to the north-east, and *Kinbergonuphis oligobranchiata* at the Loligo rig site survey site (*Fugro Survey Limited, 2009b*) approximately 400 kilometres to the north-east of the FIST13 area. *Onuphis pseudoiridescens* has commonly only been recorded from the south-west Atlantic coasts (including in the vicinity of the Falkland Islands) and from the south-east Pacific coast of Chile (*Rozbaczylo et al., 2006,* in: *Borders & Southern, 2010*).

4.168 Correlations between the environmental parameters and the multivariate trends groups indicated little or no significance, with only a very weak pattern relative to the proportion of gravels and/or medium sands within the sediments. Consequently, whilst there was significant variability recorded between sediment types throughout the survey area, this had only a marginal impact on the faunal community which appears to be diverse throughout the whole survey region. Overall, no environmentally sensitive species or habitats considered to be of conservation value were recorded within the macrofaunal analysis during the regional survey operations (*Borders & Southern, 2010*).

4.169 Epifaunal species observed during the site survey included Cnidaria, the most common of which was the species *Callozostron*. Other species observed included the octocorals which were well represented, with one stoloniferous species (*Sarcodictyon*) and four prominent Gorgonarians; *Melitodes sp.*, *Pleurocoralloides sp.*, *Callozostron carlottae* and *Stachyodes sp* (*Borders & Southern, 2010*).

4.170 The coral *Lophelia* was recorded in a couple of samples, however live tissue was only found in one specimen, in one sample. Madrepora are azooxanthellate coral species which do not rely on symbiotic algae to obtain nutrients, allowing growth to occur in dark and cold water environments well below the photic zone. However, as a result, they are very slow growing, developing by as little as 6mm a year. Consequently, larger reef structures which can be tens of metres high can take thousands of years to develop. This appeared not to be the case for the Borders & Southern study as only a small example of this species and other hard corals were recorded, although the presence of this species does confirm the potential for more developed reefs to exist (*Borders & Southern, 2010*).

4.171 Other epifauna observed during the survey included Porifera (sponges) including Hexactinellidae, Tetraxonida, and the lithistid sponge *Gastropharella sp.*, although in low numbers. Bryozoa were frequently recorded and were found encrusting as upright branches or flexible colonies including *Metalcyonidium*, with 38 taxa represented. Common colonies of the Pterobranchia *Rhabdopleura* were also recorded. The Bryozoa fauna was very rich and diverse, typical of the depth regime. Crustacea were also observed, with Cirripedia, including the stalked Barnacle *Scalpellum* sp. and the acorn barnacle *Verruca sp*. frequently recorded (*Borders & Southern, 2010*).

4.172 In addition to the above survey, a rig site survey for the Inflexible well location, conducted by Gardline on behalf of FOGL, lies within the FIST13 area, approximately 12 kilometres north of the area centre point (*Gardline, 2011b*). This survey covered an area of 5 x 3km. The survey included an environmental seabed sampling programme and habitat assessment, which was carried out at five locations across the survey area.

4.173 Seabed photography and video footage supported the geophysical interpretation, revealing a uniform seabed, consisting of rippled sandy silt/clay at all stations. There was minimal visible epifauna at all stations, with observed fauna including polychaete worm tubes both in burrows and on the sediment surface, Cnidaria (soft coral, sea pen - possibly *Benthoptilum sertum* and unidentified anemones), Echinodermata (unidentified sea urchins), and Crustacea (unidentified shrimp and lobster). There was also evidence of lebensspuren (trace fossils) at all five of the investigated stations; however, the ripples observed in the majority of the seabed images indicated that the deep water oceanography at the site has played a significant role in shaping the seabed surface - more so than bioturbation. This is unusual for deep water environments where the sediments are very fine. There was, however, no evidence of submarine structures made by leaking gases or biogenic reefs within the survey area. A selection of seabed photographs from the survey is displayed in Figures 4.26 to 4.28 (*Gardline, 2011b*).

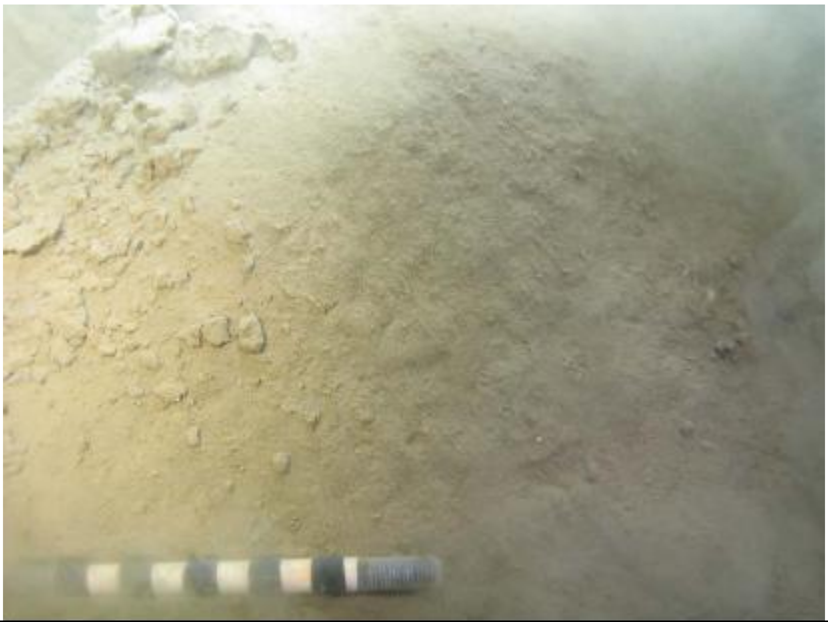
***Figure 4.26: Station ENV1 seabed photograph from the Inflexible rig site survey, which lies within the Noble FIST13 area approximately 12 kilometres north of the FIST13 centre point (Gardline, 2011b)***

| | | |
|---|---|---|
| **Camera Fix ID:** 34 | **Depth:** 1,810 metres | **Location:** 556918 E, 4072278 N |

**Sediment Description:** Fine silty clayey sediment with small ripples on the sediment surface.

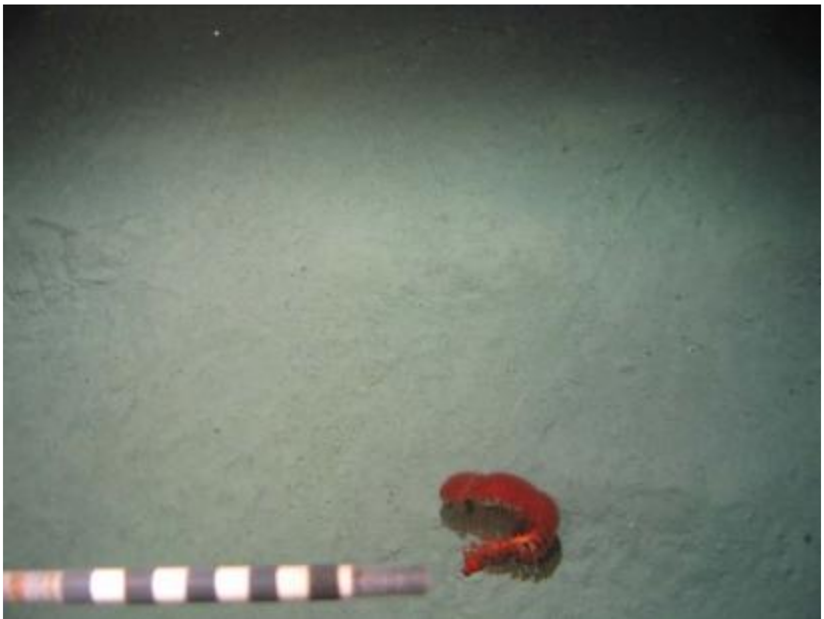
**Flora and Fauna Description:** Cnidaria (soft coral) and evidence of bioturbation in the form of burrows.

*Figure 4.27: Station ENV2 seabed photograph from the Inflexible rig site survey, which lies within the Noble FIST13 area approximately 12 kilometres north of the FIST13 centre point (Gardline, 2011b)*



| | | |
|---|---|---|
| **Camera Fix ID:** 57 | **Depth:** 1,774 metres | **Location:** 555948 E, 4073669 N |
| **Sediment Description:** Fine silty sediment with possibly clumps of clayey material. | | |
| **Flora and Fauna Description:** Unidentified polychaete worm tubes. | | |

*Figure 4.28: Station ENV3 seabed photograph from the Inflexible rig site survey, which lies within the Noble FIST13 area approximately 12 kilometres north of the FIST13 centre point (Gardline, 2011b)*



| | | |
|---|---|---|
| **Camera Fix ID:** 18 | **Depth:** 1,820 metres | **Location:** 556985 E, 4071357 N |
| **Sediment Description:** Fine silty sediment. | | |
| **Flora and Fauna Description:** Polychaeta (possibly *Chaetopterus variopedatus*), Cnidaria (sea pen – possibly *Benthoptilum sertum*) and Crustacea (unidentified shrimp). | | |

4.174 Comparable results are expected from the environmental baseline survey commissioned by Noble across the FIST13 area, with some degree of variation from existing surveys due to the marked variety of depths and sediments across the area. Even in light of the variable depths and sediments, the macrofaunal analysis is expected to comprise mainly of polychaete species, as the Borders & Southern (2010) results showed that the variation in sediments in this area had only a small effect on the apparent distribution and abundance of macrofaunal species.

#### *Surveys Relevant to FINA13*

4.175 The Endeavour rig site survey, conducted by Fugro on behalf of BHP, lies within the FINA13 area, approximately 20 kilometres west-north-west of the area centre point (*Fugro Survey Limited, 2009a*). This survey covered an area of 10.9 x 7.7 km.

4.176 No seabed camera footage was acquired during the Endeavour site survey. However, a seabed camera was used during the Loligo site survey located approximately 55 kilometres to the south of the Endeavour survey, where seabed sediments and depths were found to be similar. The most prominent colonial epifauna encountered across the Loligo site were cnidarians which included at least two species of gorgonian (soft corals) and at least one species of scleractinian (hard or stony coral). Corals, both alive and dead, were also sampled in the box corer at the Endeavour site (Figure 4.29). Examination of the ROV footage from Loligo and coral fragments recovered in the box corer suggested that the coral was at least superficially similar to the cold water coral *L.pertusa*, a widely distributed species which has previously been recorded as far south as the Brazilian slope (*OBIS, 2009*, in: *Fugro Survey Limited, 2009a*). Although more sparsely distributed than the cnidarian taxa, sponges (Porifera) were prominent in some areas of the Loligo site, and were also sampled at the Endeavour site in box cores (*Fugro Survey Limited, 2009a*).

***Figure 4.29: Photograph of hard corals taken after recovery of the box corer at sampling station E4 at the Endeavour survey location, which is located approximately 20km west-north-west of the FINA13 area centre point (Fugro Survey Limited, 2009a)***


4.177 Eleven samples were analysed from six seabed locations from the Endeavour rig site survey. A total of 101 discrete macrofaunal taxa were found, excluding two juvenile and three indeterminate taxa. Of the taxa recorded, 65 (64.4%) were annelid, 18 (17.8%) were crustacean, 11 (10.9%) were molluscan and three (3.0%) were echinoderm. Representatives of the Brachiopoda, Sipuncula and Phoronida made up the three taxa (4.0% of the total) which belonged to other phyla. In terms of abundance, the Annelida were overwhelmingly dominant, representing 70.7% of the 437 individuals recorded. The Crustacea, which contributed 19.0% of the total abundance, were the second most abundant phylum, followed by the Mollusca (5.7%) and representatives of other phyla (including Echinodermata) (4.6%). Echinoderms alone contributed just 0.7% of the total faunal abundance recorded (*Fugro Survey Limited, 2009a*). The most abundant species overall was the onuphid polychaete *Kinbergonuphis oligobranchiata,* also found to be the most abundant in both the Loligo site surveys, located approximately 55 kilometres to the south, and in the Nimrod site survey to the north of the FISA12 area (located approximately 140 kilometres to the south-south-west of the Endeavour survey) (*Fugro Survey Limited, 2009a*). The second most abundant species was the ampharetid polychaete *Melinna* sp. The third and fourth most dominant species were the ampharetid polychaete *Melinnopsis collaris* and the amphipod crustacean *Ampelisca* sp (*Fugro Survey Limited, 2009a*).

4.178 Although the majority of dominant taxa within the survey areas community were deposit feeders, the dominant *K. oligobranchiata* is an omnivorous scavenger and the sabellid polychaetes *Euchone* sp. and *Jasmineira* sp. are suspension filter feeders (*Fugro Survey Limited, 2009a*).

4.179 Crude abundance/dominance and univariate analyses of the macrofaunal data suggested that a single community occurred throughout the survey area, also shown by the multivariate analyses. Comparison with the communities identified from other sites showed that the Endeavour community was similar in structure and composition to that of the comparably deep Loligo site. Both sites had similarly rich communities, although Endeavour had a slightly higher observed and projected diversity, and the same taxa (*K. oligobranchiata* and *Melinna* sp.) were shown to characterise their communities. Both the Endeavour and Loligo site surveys were also similar in diversity to the shallower Toroa site (located approximately 350 kilometres south-west of the Endeavour survey), which exhibited a comparably rich, non-dominated community. However, while there was some overlap in the occurrence of taxa, the deeper sites (Endeavour and Loligo) appeared to have a distinctly different community to that of Toroa (*Fugro Survey Limited, 2009a*).

4.180 In addition to the above Endeavour survey, the Loligo NW rig site survey, conducted by Gardline on behalf of FOGL, lies within the FINA13 area, approximately 55 kilometres south-west of the area centre point (*Gardline, 2011c*). This survey covered an area of 5 x 3km, and is located approximately 15 kilometres to the north-west of the previous Loligo survey (*Fugro Survey Limited, 2009b*).

4.181 Observed fauna from the seabed underwater camera included Cnidaria (unidentified sea pen Pennatulacea, Primnoidae species, possible Stylaster species, unidentified actiniaria species, unidentified Cnidaria species), Crustacea (unidentified shrimp and possibly Serolis species), Echinoderm (possibly pencil sea urchin *Cidaris cidaris*), Holothuroidean (unidentified sea cucumber species), Polychaeta (possibly Serpulidae and unidentified Scaphopod species), indeterminate globose Porifera, branching Porifera (possibly *Antho dichotoma*) and unidentified encrusting Porifera, Tunicata (sea squirt, possibly *Phallusia mammallita*), and unidentified Fan Bryozoan species. There was also evidence of bioturbation in the form of burrows and polychaete worm tubes. A selection of seabed images and fauna are displayed in Figures 4.30 to 4.32 (*Gardline, 2011c*).

***Figure 4.30: Station ENV3 seabed photograph from the Loligo NW rig site survey, which lies within the Noble FINA13 area approximately 55 kilometres south-west of the FINA13 centre point (Gardline, 2011c)***

| **Camera Fix ID:** 21 | **Depth:** 1,315 metres | **Location:** 860374E, 4335551N |
|---|---|---|

**Sediment Description:** White with grey fine sandy and coarser black fine to medium sand over harder substrate with some boulders cobbles and gravel.

**Flora and Fauna Description:** Cnideria sp. (anemone – actiniaria and possible sea-pen Pennatulacea, Primnoidae sp.), Polychaeta (possible Serpulidae sp.), indeterminate globose Porifera, branching Porifera (possible *Antho dichotoma*) and unidentified encrusting Porifera, Tunicata (sea squirt, possible *Phallusia mammallita*), possible polychaete worm tubes, unidentified Fan Bryozoan sp., evidence of bioturbation.

***Figure 4.31: Station ENV3 seabed photograph from the Loligo NW rig site survey, which lies within the Noble FINA13 area approximately 55 kilometres south-west of the FINA13 centre point (Gardline, 2011c)***

| **Camera Fix ID:** 34 | **Depth:** 1,312 metres | **Location:** 860240E, 4335452N |
|---|---|---|

**Sediment Description:** White with grey fine sandy and coarser black fine to medium sand over harder substrate with some boulders cobbles and gravel.

**Flora and Fauna Description:** Cnideria sp. (unidentified actiniaria sp. And Primnoidae sp., possible Stylaster sp.), Echinoderm (pencil-spine urchin *Cidaris cidaris*), Polychaeta (possible Serpulidae sp.), branching Porifera (possible *Antho dichotoma*) and unidentified encrusting Porifera, Tunicata (sea squirt – possible *Phallusia mammallita*), possible polychaete worm tubes, unidentified Fan bryozoan species, possible anthopod sp. and evidence of bioturbation.

*Figure 4.32: Station ENV4 seabed photograph from the Loligo NW rig site survey, which lies within the Noble FINA13 area approximately 55 kilometres south-west of the FINA13 centre point (Gardline, 2011c)*

| **Camera Fix ID:** 56 | **Depth:** 1,339 metres | **Location:** 859970E, 4335231N |
|---|---|---|
| **Sediment Description:** A mix of white with grey fine sandy and coarser black fine to medium sand with some gravel. | | |
| **Flora and Fauna Description:** Echinoderm (pencil-spine urchin *Cidaris cidaris*), possible branching Porifera, Scaphopod sp. | | |

4.182 Comparable results are expected from the environmental baseline survey commissioned by Noble across the FINA13 area given the similarity of results observed between existing surveys in the region. Macrofaunal assemblages are expected to be dominated by polychaete species.

### 4.3.5 Fish, Squid & Shellfish

4.183 Much of the information used to inform this section has been extracted from Falkland Islands Department of Natural Resources - Fisheries Department publications. Additional information has been sourced from the 2008 State of the Environment Report (*Otley et al., 2008*).

4.184 Fish and squid stocks are a major component of many seabird and marine mammal diets. Any impacts on stocks are likely to have secondary impacts upon bird and marine mammal species. At least 80 species of fish have been recorded in Falkland Islands waters, ranging from small fish such as the rock cod, to larger fish including tuna and sharks (*Strange, 1992*).

4.185 Coggan *et al.*, (1996) sampled twenty deep-water stations to the east and south of the Falkland Islands by commercial bottom trawl deployed in upper, middle and lower benthopelagic zones (a depth range of approximately 500 to 1,000 metres). A number of trawl locations were close to the FINA13 and FIST13 areas, though no sampling was undertaken in the vicinity of FISA12. Forty-one species of teleost fish were recorded, 10 species of elasmobranch and one species of agnathan. Different assemblages of fish were found to characterise each depth zone (e.g., Moridae in deeper waters, Bothidae and Rajidae in shallower waters), with diversity being greatest in the mid-zone and biomass greatest in the upper and lower zones.

4.186 The Falkland Islands Interim Conservation and Management Zone (FICZ) was introduced in February 1987 to reduce uncontrolled fishing offshore of the Falkland Islands. Continuing conservation problems led to the declaration of the Falkland Islands Outer Conservation Zone (FOCZ) in December 1990, which extends 200 nautical miles from the coast of the Falkland Islands. The Noble license areas lie within the FICZ (southern area licenses) and FOCZ (eastern area licenses). Commercial fishing from a socio-economic perspective is described below in Section 4.4.12.

4.187 The main fisheries resources are the squid species, *Illex argentinus* and *Doryteuthis gahi*. The existing finfish fishery targets predominantly hake (*Merluccius sp.*), hoki (*Macruronus magellanicus*), red cod (*Salilota australis*) and blue whiting (*Micromesistius australis*). Rock cod (*Patagonotothen ramsayi*) has provided the highest finfish catches on an annual basis since 2007. A specialised small ray fishery exists, and a small longline fishery also operates, targeting Patagonian toothfish (*Dissostichus eleginoides*).

4.188 Shellfish are not an important component of the commercial fishery, although several species of crab are found around the Falkland Islands, including the false king crab (*Paralomis granulosa*) and the larger southern king crab (*Lithodes santolla*). A small-scale scallop (*Zygochlamys patagonica*) fishery was developed in the FICZ, mainly to the north-east of Stanley many years ago and a small fishery, Eagle Inshore Fishing, operates out of Speedwell Island Settlement.

4.189 The latest FIG Fishery Statistics report (*FIG, 2013*) geographically plots the distribution of catch volumes in waters around the Falkland Islands. Data indicates that the proposed area of drilling operations (FISA12 and FIST13) is targeted primarily by fisheries for the Patagonian toothfish.

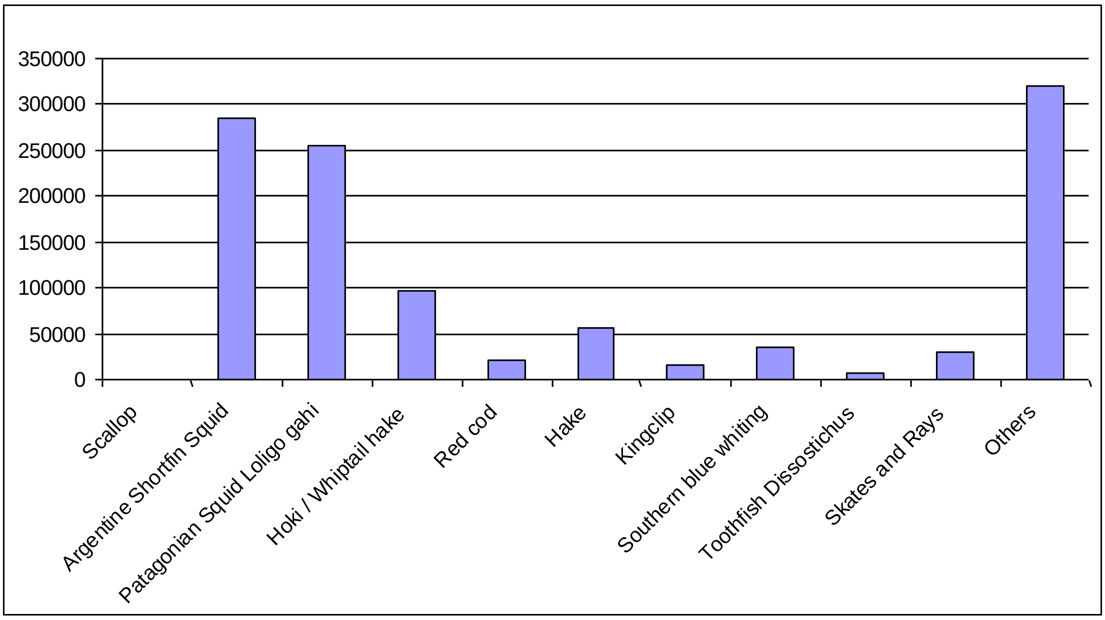
### Commercial Finfish & Shellfish Species

4.190 Over 11 species of finfish, squid and shellfish are caught in significant quantities in the Falkland Islands region. The following text provides information on the behaviour, abundance and distribution of key commercial species. Table 4.5 displays fishery catch volumes between 2008 and 2012 (*FIG, 2013*). The same data is shown graphically in Figure 4.33.

***Table 4.5: Total catch (tonnes) during the period 2008 – 2012 (FIG, 2013)***

| Fishery | 2008 – 2012 Catch Volume (tonnes) |
|---|---|
| Scallop (*Zygochlamys pataginica*) | 33 |
| Argentine shortfin squid (*Illex argentinus*) | 285,170 |
| Patagonian squid (*Doryteuthis gahi*) | 255,854 |
| Finfish: | |
| • Hoki/Whiptail hake (*Macruronus magellanicus*) | 97,265 |
| • Red cod (*Salilota australis*) | 21,160 |
| • Hake (*Merluccius sp.*) | 55,823 |
| • Kingclip (*Genypterus blacodes*) | 16,704 |
| • Southern blue whiting (*Micromesistius australis*) | 35,659 |
| Patagonian toothfish (*Dissostichus eleginoides*) | 7,123 |
| Skates and rays (Rajidae) | 29,225 |
| Others (dominated by Rock cod *Patagonotothen ramsayi*) | 320,731 |

***Figure 4.33: Total fisheries catch (tonnes) during the period 2008 – 2012 (FIG, 2013)***




4.191 The Argentine shortfin squid (*Illex Argentinus*) and Patagonian squid (*Doryteuthis gahi*) are the two most important species for the Falkland Islands fisheries. Other species often caught as by-catch make up a significant proportion of fisheries catch volumes, and include species such as butterfish (*Stromateus brasiliensis*), redfish (*Sebastes oculatus*), lobster krill (*Munida sp.*), dogfish (*Squalus acanthias*), crabs (*Lithodidae*) and Falkland herring (*Sprattus fuegensis*) amongst various others (*FIG, 2013*).

4.192 The Falkland Islands Government (FIG) Department of Natural Resources – Fisheries Department fishery statistics report for 2013 (*FIG, 2013*) geographically plots the distribution of catch volumes in waters around the Falkland Islands. The Department of Natural resources has supplied Noble with geographic information system (GIS) data tables of fisheries catch data for the period 2008 to 2013. This has enabled fisheries catch information to be plotted in detail over the Noble licenses and areas of interest for the following species:

- Southern Blue Whiting (*Micromesistius australis*);
- Grenadiers (*Macrouridae*);
- Hake (*Merluccius sp.*);
- Hoki (*Macruronus magellanicus*);
- Rays (*Rajidae*);
- Red Cod (*Salilota australis*);
- Rock Cod (*Patagonotothen ramsayi*);
- Patagonian toothfish (*Dissostichus eleginoides*);
- Kingclip (*Genypterus blacodes*);
- Argentine shortfin squid (*Illex argentinus*);
- Patagonian squid (*Doryteuthis gahi*); and
- Others (by-catch species), including butterfish (*Stromateus brasiliensis*), redfish (*Sebastes oculatus*), lobster krill (*Munida spp.*), and various other squid and fish.

4.193 Catch statistics for the above have been plotted quarterly for each year. In addition, the Vessel Monitoring System (VMS) position data has also been plotted quarterly for the years 2008 to 2012. This VMS data will generally only track vessels licensed for Falkland Islands fisheries, plus a few other vessels associated with the Falkland Islands, and therefore provide a very good historical record of fisheries industry movements. Not all the maps have been included in this section due to the sheer volume of maps produced by the GIS plotting process. The full sets of maps produced are presented in Appendix E.

4.194 The plotted data indicates that the Noble license areas are targeted primarily by fisheries for the Patagonian toothfish (*Dissostichus eleginoides*). Catches of grenadiers (*Macrouridae*) and rays (Rajidae) are also made in the license areas.

#### Southern Blue Whiting (Micromesistius australis)

4.195 Southern blue whiting is a mesopelagic species with a wide distribution in the Southern Hemisphere (*Macchi et al., 2005*). There are two distinct populations. One population, (*M. australis*), is found from approximately 38°S to nearly 62°S around the Falkland Islands and Argentine Patagonia in the western South Atlantic, as well as off South Georgia, South Shetland and South Orkney Islands and in the south-eastern Pacific off the coast of Chile (*Cohen et al., 1990*). The other population (*M. pallidus*), lives around the south island of New Zealand. The *M. australis* population inhabits the continental slope at 100-700 metre depths between 38°S and 47°S, and from 47°S to 55°S it is distributed within the Patagonian continental shelf (*Cassia, 2000*). It is most abundant at about 200 metres depth around the Falkland Islands (*Inada & Nakamura, 1975*; *Cohen et al., 1990*).

4.196 Reproductive activity of this population takes place mainly south of the Falkland Islands where they aggregate to spawn (*Madirolas, 1999*). The spawning period typically takes place from August to October, with a peak in September (*Pajaro & Macchi, 2001*). Both eggs and larvae are pelagic (*Agnew, 2002*). Pre-spawning fish congregate south of West Falkland during July (*Patterson, 1986*) and post-spawning fish disperse to feed over the shelf (*Agnew, 2002*).

4.197 Figure E.1 in Appendix E shows that southern blue whiting is rarely caught in the vicinity of the Noble licenses. Therefore, southern blue whiting are not expected to be present in high numbers over the Noble licenses. Southern blue whiting is also not expected to spawn over the FISA12 and FIST13 areas.

#### Grenadier (Macrourus sp.)

4.198 The grenadiers, or rattails, are bentho-pelagic fish that belong to the Macrouridae family which comprise more than 300 species distributed globally (*Smith et al., 2011*). *M. carinatus* and *M. holotrachys* are the two main species found around the south-west Atlantic Ocean and have also been reported within the Falkland Islands (*Laptikhovsky, 2005*). They live at depths between 150 and 1,800 metres (*Morley et al., 2004*; *Smith et al., 2011*). Within the region, they are thought to occur in high abundance and to have important ecological roles in the deep-sea bottom fish and deep water slope fish communities (*Morley et al., 2004*; *Laptikhovsky, 2005*).

4.199 Within the Falkland Islands grenadier are mainly taken as by-catch in the commercial long-line and trawl fisheries. Surveys and exploratory fisheries have been undertaken around the Falkland Islands in recent years with the view to starting a commercial fishery for grenadier. During 2009, when an exploratory deep sea trawl fishery was conducted between 50$^{o}$ 05'S and 53$^{o}$ 38'S, to the east of the Falkland Islands between depths of 512 and 931 metres, 733 tonnes of this species were caught. Spatial distribution was found to be relatively even throughout the survey period in the summer, but the population began to migrate north to the autumn spawning grounds north of 51$^{o}$S (*FIG, 2010*). On the basis of this information, it is therefore possible that there may be some overlap between spawning areas and the northern area license, which includes the FINA13 area. However, spawning areas are not expected to coincide with either the FISA12 or FIST13 areas.

4.200 Figure E.2 in Appendix E shows that grenadier is often caught in the vicinity of the Noble licenses; these catches are highly likely to be by-catch from the Patagonian toothfish longline fishery. Therefore, grenadier is expected to occur over the Noble license areas, including the FISA12, FIST13 and FINA13 areas.

#### Hake (Merluccius sp.)

4.201 Two species of hake are found in the south-west Atlantic: common hake *Merluccius hubbsi* and Patagonian (sometimes referred to as 'austral' or 'southern') hake *Merluccius australis*. The species are spatially and temporally separated within waters of the Falkland Islands, with *M. hubbsi* most abundant in the north-west of the region at depths of 200-300 metres and *M. australis* in the south-west region at depths of 400-500 metres (*Arkhipkin et al., 2003*). The two species both undertake seasonal migration from inshore spawning grounds to offshore feeding grounds (*Bezzi et al., 1995*). The waters surrounding the Falkland Islands are primarily used as feeding grounds for both species, and they have different, non-overlapping spawning seasons during which they are largely absent from Falkland Islands waters; austral summer (December to February) for *M. hubbsi* and austral winter (June to August) for *M. australis* (*Arkhipkin et al., 2003*).

4.202 During austral autumn and spring, both species are present but remain spatially segregated (*Arkhipkin et al., 2003*). A scheme of possible migrations of *M. hubbsi* has been proposed using Catch Per Unit Effort (CPUE) data from 1988-2000 (*Portela et al., 2002*). It predicted that adult fish migrate to the south and east of the Falkland Islands in austral winter, up to approximately the 500 metre contour. Hake are generally known to migrate diurnally, being found near the seabed during the day and migrating further up the water column to feed at night.

4.203 Fishing effort concentrates in the far west of the FICZ where the highest abundance of hake are found, and also to the north (*Tingley et al., 1995*), but may extend around Beauchêne Island to the south (*Lisovenko et al., 1982*; *Tingley et al., 1995*). The fisheries catch data also show that the main catches of hake also coincide with these areas. Almost no catches of hake are made within the license areas (Figure E.3, Appendix E). Therefore, it is not anticipated that the proposed drilling area will interfere with key areas of hake populations.

#### Hoki (Macruronus magellanicus)

4.204 Whiptail hake, or hoki, is a bentho-pelagic schooling species with a depth range of 30-500 metres (*Cohen et al., 1990*) and exist as a wider, highly migratory population across the south-western Atlantic (*Amato & Carvalo, 2005*). Migration patterns are attributed to the fluctuations in the Falkland Current along the Patagonian Platform and edge (*Giussi, 1996*). *M. magellanicus* migrates diurnally between deeper pelagic water by day and shallower water by night (*Amato & Carvalho, 2005*). Sexual maturity is attained at around 3-4 years old (*Giussi & Wöhler, 2001*) and individuals may live for up to 16 years (*Giussi, 1996*).

4.205 Falkland Island waters function primarily as a feeding ground for this species in the north and west of the FICZ. Most individuals of this species will migrate north to Argentina to spawn and then to Chile for the austral winter (*Middleton et al., 2001*). However some individuals will remain within the FICZ (*FIG, 2011*). Their diet consists primarily of fish (particularly herring, anchovies and lantern fishes) and also mysids, cephalopods, euphausiids and amphipods (*Cohen et al., 1990*).

4.206 Figure E.4 in Appendix E shows that hoki are very rarely caught within in the vicinity of the Noble licenses. Therefore, hoki are not expected to occur in any great abundance across the Noble licenses.

#### Skates & Rays

4.207 Over 20 species of ray (Rajidae) are known to occur within the FOCZ. Four key species account for more than two thirds of commercially exploited catch as part of a mixed fishery: *Bathyraja griseocauda* (greytail skate), *B. albomaculata* (white-dotted skate), *B. brachyurops* (Broadnose skate) and *Raja flavirostris* (yellownose skate).

4.208 *B. griseocauda* was formerly the dominant ray species, particularly in the south where it comprised 70% of catch, but this fell to less than 5% between 1993 and 1995 (*Agnew et al.,* *2000*) with catches declining further over the following years (*Wakeford et al., 2004*). Since 2007, *B. griseocauda* has been listed as endangered on the IUCN Red List. *B. albomaculata* experienced a serious decline in the Falkland Islands region following overexploitation in the early 1990s (*Agnew et al., 1999*), but are presently more abundant throughout the Falkland Shelf after replacing the former dominant species, *B. griseocauda*, in the northern fishery between 1993 and 1997 (*Agnew et al., 2000*). *B. albomaculata* has a comparably low fecundity compared to other ray species, as well as slow growth and late maturity, indicative of a higher vulnerability to overexploitation and is consequently listed as vulnerable on the IUCN Red List. *B. brachyurops* are distributed throughout the FICZ but have a concentrated population around the eastern shallow part of the shelf (*Arkhipkin et al., 2011*). Spawning aggregations can be found on the north-east Falkland Shelf between 100-200 metres. They spawn throughout the year, with periods of less spawning in the austral winter months. *R. flavirsotris* is widespread throughout the south-west Atlantic area, which encompasses both the FICZ and FOCZ (*Wakeford et al., 2004*). Larger individuals are generally found at greater depths and females represent over 83% of the commercial catch. No juveniles have ever been caught in Falkland Islands waters, suggesting adult seasonal migration onto the Patagonian Shelf (*Wakeford et al., 2004*).

4.209 Figure E.5 in Appendix E shows that ray species are occasionally caught within in the vicinity of the Noble licenses. While *B. griseocauda* has been listed as an endangered species, the broad distribution and diversity of skate and ray species throughout the Patagonian Shelf suggests that the Noble areas of interest are not of particular importance to skate and ray populations. The main species found in the license areas are the Antarctic skate (*Amblyraja georgiana*), butterfly skate (*Bathyraja papilionifera*) and the darkbelly skate (*Bathyraja meridionalis*); the endangered greytail skate is found more to the north and west of the Noble license areas.

#### *Red Cod (Salilota australis)*

4.210 Red cod (*Salilota australis*) is a shallow water demersal species inhabiting the Patagonian Shelf and south-west Atlantic Oceans in depths of between 30 to 1,000 metres, with a preferred range of 152-452 metres (*Cohen et al., 1990; Nakamura et al., 1986*). *S. australis* is also found in the Pacific Ocean up to approximately 44°S.

4.211 *S. australis* is known to spawn in batches to the south and south-west of the Falkland Islands between August and October (*Brickle et al., 2011*). It is therefore unlikely that the Noble license areas will coincide with red cod spawning areas. Figure E.6 in Appendix E also shows that red cod are very rarely caught within in the vicinity of the Noble licenses and therefore are not expected to be present in any great abundance across the Noble licenses.

#### *Rock Cod (Patagonotothen ramsayi)*

**4.212** Rock cod (*Patagonotothen ramsayi*) is the most abundant of the 14 species of its genus that inhabit the shelf waters of South America (*Ekau, 1982*). *P. ramsayi* occurs on the Patagonian Shelf from 35°S to the Burdwood Bank and from the Straits of Magellan to the west, to the shelf edge of the Falkland Islands (*Winter et al., 2010*). Recent analyses have shown the density of *P. ramsayi* to be substantially lower in the south-east than to the north (*Winter et al., 2010*).

4.213 Commercial aggregations commonly occur in the western region of the FICZ at the beginning of the year, to the north-west of the Falkland Islands from March to June, and then are evenly distributed along the north and north-western parts of the FICZ for the remainder of the year, before moving back to the western shelf areas from November to December (*FIG, 2013*). Spawning has been reported to occur in the austral autumn on the Argentinean Shelf at 42°S and in the austral spring on the Burdwood Bank (*Ekau, 1982*).

4.214 It is unlikely that the Noble licenses will coincide with rock cod spawning areas. Figure E.7 in Appendix E also shows that red cod are very rarely caught within in the vicinity of the Noble licenses and therefore are not expected to be present in any great numbers across the Noble licenses.

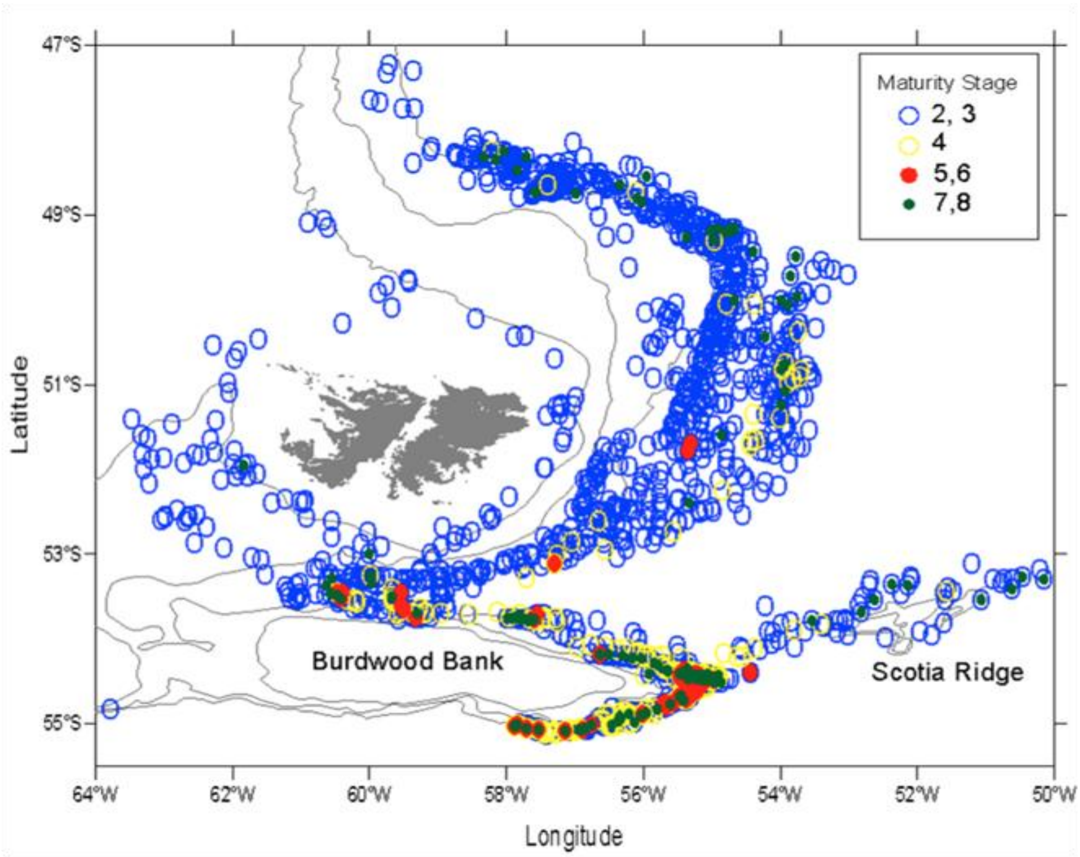
### *Patagonian Toothfish (Dissostichus eleginoides)*

4.215 The Patagonian toothfish is a slow growing, long lived notothenid (Antarctic cod), typically reaching maturity at around 8-10 years and living to over 40 years (*Collins et al., 2010*). They have a wide distribution and are found as far north as 30°S on the Patagonian Shelf and slope, to the sub-Antarctic islands of the Southern Ocean (*Evseenko et al., 1995*).

4.216 The Falkland Islands population has been found to spawn on the drop-off near the Burdwood Bank at about 1,000 metres depth (*Laptikhovsky et al., 2006*). Two peaks in population commonly occur; a minor peak occurring in May and a major peak from July to August (*Laptikhovsky et al., 2006*; *Agnew et al., 1999*). The main spawning area for toothfish has been found to occur around the edges of the Burdwood Bank (Figure 4.34). After spawning, juveniles have a long juvenile and sub-adult period which is spent in the relatively shallow and relatively warmer waters of the upper slope and outer shelf of the Burdwood Bank (*Laptikhovsky et al. 2006*). It is possible that two migrations occur within this population. Seasonal migration of adults from foraging grounds around the Falkland and Patagonian Shelf to the Burdwood Bank to breed; and an ontogenic migration from the shelf waters into bathyal waters upon maturity (*Laptikhovsky et al. 2006*).

4.217 The main area of toothfish population does coincide with the Noble license areas, particularly for the southern area licenses. Figure E.8 in Appendix E displays fisheries catch statistics for Patagonian toothfish for the period 2008 to 2013. Note that the figures do not take account of fishing effort. It can be seen that catches have been made across the Noble licenses, particularly in the southern area licenses and particularly in the summer months. It is possible that the FISA12, FIST13 and FINA13 areas of interest (particularly FIST13), may coincide with toothfish seasonal migration patterns.

***Figure 4.34: Toothfish maturity map showing the main spawning areas around the Falkland Islands (Brown, J. 2010, with data from FIG Fisheries Department).***



### *Kingclip (Genypterus blacodes)*

4.218 Kingclip, or pink cusk eel (*Genypterus blacodes*), are a species that occur widely in the oceans of southern Australia, Chile, Brazil, and around New Zealand. They commonly inhabit a broad depth range, from 20 to 1,000 metres. There is no specific targeted fishery for kingclip in the Falkland Islands, with the species being caught as by-catch of the trawl fishery (*FIG, 2013*). Kingclip has a favourable price in European markets (*Brickle et al., 2003*).

4.219 An experimental fishery for kingclip was undertaken by a single demersal long-liner between September and November 2006 in the western and southern parts of the Falkland Shelf and on northern slopes of the Burdwood Bank. The fishery set a total of approximately 1.1 million hooks and caught a total of 210 tonnes of fish, of which 55% were rays and 30% were kingclip (*FIG, 2007*). Rays were more common in catches on the south part of the shelf, and kingclip catches were greatest on the western shelf (*FIG, 2007*). The experimental fishery was stopped because of this high level of skate by-catch, which was at the time considered to be over exploited.

4.220 Kingclip have a seasonal spawning migration in and out of the western parts of the FICZ, following seasonal movement of the western front of the Falkland Current. In summer, approximately two thirds of the adult population undergo a spawning migration to the northern parts of the Patagonian Shelf to depths of 150 metres or less. The species return to feeding grounds in Falkland Islands waters in late-summer to autumn (*FIG, 2013*).

4.221 Figure E.9 in Appendix E shows that catches of kingclip from within the Noble license areas have never been made from 2008 to 2012 and are therefore not expected to be present across the Noble license areas.

### *Red Crab*

4.222 The red crab (*Paralomis granulosa*) is typically found in relatively shallow water of 10 to 40 metres depth and within sheltered inshore waters. The highest concentrations of *P. granulosa* are found around the south-east of the Falkland Islands. Juveniles and adults are found at the edges of kelp beds (*Hoggarth, 1993*). It is unlikely therefore that red crab will be directly affected by exploration drilling activities within the Noble license areas.

### *Patagonian Scallop (Zygochlamys patagonica)*

4.223 The Patagonian scallop is mainly found on sandy and muddy substrates in depths ranging from 40 to 200 metres. A small commercial fishery has existed for the Patagonian scallop to the east and north-east of the Falkland Islands at water depths of approximately 130 to 140 metres. Approximately 920 tonnes of scallops were taken in 2003 and 2004 (*Munro, 2004*), however, in recent years there has been no directed fishery for scallops, with only 3 tonnes being caught in 2010 and 11 tonnes in 2011, both caught as by-catch in the Doryteuthis and finfish fleets. No catch of scallops was made in 2012 (*FIG, 2013*).

4.224 Scallops have not been found on areas of hard rocky substrate, nor in waters greater than 200 metres deep, thus it is unlikely that scallop with be directly affected by any proposed drilling activity within the Noble licenses.

### *Commercial Cephalopod Species*

#### **Argentine Shortfin Squid (*Illex Argentinus*)**

4.225 The Argentine shortfin squid (*Illex argentinus*) is a common neritic-oceanic species within the south-west Atlantic occurring from 22°S and 54°S and is most abundant between 35°S and 52°S (*Brunetti, 1981*; *1988*). It is found at depths of between 80 and 800 metres where it plays a significant role in the ecosystem (*Arkhipkin, 2000*). The life-cycle of *Illex argentinus* is associated with the subtropical confluence of the Brazil and Falkland currents during reproduction and the early life stages (*Hatanaka, 1988*; *Brunetti & Ivanovic, 1992*; *Rodhouse et al., 1995*; *Haimovici et al., 1998*) and with the Falkland Current over the southern Patagonian Shelf during maturation, feeding and growth (*Rodhouse et al., 1995*). The life-cycle of *Illex argentinus* is short, with most individuals living for one or two years. Growth of juveniles is very fast.

4.226 Three main spawning stocks have been identified in the southern range of the distribution (*Brunetti, 1988*): summer-spawning stock (SSS); south Patagonian stock (SPS); and Bonaerensis-north-patagonic stock (BNS). The stock associated with the Falkland Islands is referred to as the south Patagonian stock. Concentrations of immature *Illex argentinus* migrate southwards over the Patagonian Shelf and slope heading towards the Falkland Islands. During this long pattern of migration, the shortfin squid grow rapidly and reach their feeding grounds at the southern end of the Patagonian Shelf, within the FICZ between March and May. The waters to the south of the Falkland Islands represent the southernmost extent of the distribution of *Illex argentinus* (*Csirke, 1987*; *Arkhipkin, 1993*; *Basson et al., 1996*). Adults then start migrating northward to spawn around July or August.

4.227 In general, the Noble license areas are not known to be popular for the fishing of *Illex argentinus*, and therefore high populations of *Illex* are not expected across the license areas. Figure E.10 in Appendix E shows that catches within the Noble licenses have seldom been made, although some catches have been made in the northern part of the northern area license, when some of the main *Illex* population has occasionally strayed further to the east than usual (2011 and 2013 for example – Figures E.10d and E.10f).

**Patagonian Squid (*Doryteuthis gahi*)**

4.228 The Patagonian longfin squid (*Doryteuthis gahi*) is a demersal, schooling species found mainly within Falkland Island waters, but also extends across both the Argentinean and Patagonian shelves in the south-west Atlantic (*FIG, 2011*). On the Falklands Shelf, *Doryteuthis* undertakes spatial ontogenetic migrations, with small juveniles moving from the shallow inshore spawning grounds of approximately 20-50 metres depth, to feeding grounds near the shelf edge (200-350 metres) (*Boyle, 1983*; *Hatfield & Rodhouse, 1994*; *Arkhipkin et al., 2001*). Feeding grounds are deeper in the northern areas (200-350 metres) than in the south (150-250 metres). On maturation, adults return to inshore kelp beds to spawn (*Hatfield et al., 1990*). More recently, studies have shown *L. gahi* can spawn in much deeper water than previously thought for this species, with adult specimens caught as deep as 626 metres and egg masses found attached to empty polychaete tubes from 61–71 metres (*Laptikhovsky, 2008*). Spawning of the adult population is thought to occur throughout the year, with distinct peaks during the austral late winter to spring (July–September) and autumn (February – April), which form the two major fishing seasons (*Patterson, 1988*; *Agnew et al., 2005*).

4.229 Patagonian squid forms an important commercial species within the region, although annual catches are highly variable dependent on annual recruitment patterns. The fishery operates within the 'Doryteuthis/Loligo Box'. The Noble licenses are situated outside of the Doryteuthis/Loligo Box. From 2008 to 2013 there has only been one occasion of by-catch from within the Noble license areas, during the period from July to September in 2011 (Figure E.11d in Appendix E). Therefore, *Doryteuthis gahi* are not expected to be present in large numbers across the Noble licenses.

***Non-Commercial Species***

4.230 The majority of finfish and squid species found on the Patagonian Shelf have low abundance and therefore are of little commercial interest. Limited information on non-commercial species found in the shallow and offshore waters of the Falkland Islands can be derived from the fisheries observer reports and FIFD research surveys, in addition to other research data such as surveys or diet studies within the south-west Atlantic. Other species caught as by-catch can make up a significant volume of the fisheries catches in Falkland Islands waters, including the Noble license areas (Figure E.12 in Appendix E). These species can include butterfish (*Stromateus brasiliensis*), redfish (*Sebastes oculatus*), lobster krill (*Munida spp.*) and various other squid and fish species (*FIG, 2013*).

4.231 An FAO report states that the entering of information on discards into logbooks is mandatory under the licenses issued for fishing by FIG, however it has been found that the information entered into the logbooks is often incomplete and unreliable. The log book records have been compared with those recorded by onboard observers and show that vessels without observers on board reported only 24 per cent of the total bycatch recorded by observers over the same period (*Clucas, I, 1997*), thus there are limitations associated with such a data source.

#### *Pelagic Species*

4.232 The greater hooked squid (*Moroteuthis ingens*) is the most abundant non-commercial squid species in waters of the Falkland Islands, but because of the erratic and unpredictable catches, has no direct commercial interest. *M. ingens* is an important prey item for many species of birds, mammals and fish (*Cheung & Pitcher, 2005*), particularly the commercially important species Patagonian toothfish (*Dissostichus eleginoides*) (*Phillips et al., 2003*). It is not considered to be of particular conservation interest (*IUCN, 2014*). Available data suggests a major recruitment of this species onto the shelf in September with a movement off the shelf during winter. There appears to be a lack of mature females on the Patagonian Shelf, indicating that females migrate into deeper offshore water to spawn (*Jackson et al., 1998*).

4.233 Blue antimora (*Antimora rostrata*) (violet cod) are globally distributed and migrate further offshore as they mature and spawn in deeper water. It is speculated that the Falkland Islands population remain there to feed and actually spawn to the north (*Cohen et al., 1990*).

4.234 Southern opah (*Lampris immaculatus*), commonly referred to as moonfish, was considered rare until the FIG Department of Natural Resources - Fisheries Department recorded sizeable numbers of by-catch in a number of fisheries in the late twentieth century (*Jackson et al., 2000*). They were found to have a surprisingly narrow prey item range of *Moroteuthis ingens* (93% of species eaten) and the commercially important *Doryteuthis gahi* (*Jackson et al., 2000*). However, no individuals were caught in 2013 (*FIG, 2013*).

4.235 Fifty tonnes of Falkland herring (*Sprattus fuegensis*) were caught in 2012 (*FIG, 2013*). This fish is an important prey item for hake, sea birds and seals in Falkland Islands waters (*Nakamura et al., 1986*). However, the species is not of direct commercial target as the catch is often erratic.

4.236 Smaller penguins feed intensively on juvenile *Gonatus antarcticus* squid, which are known to be found on the Patagonian Shelf as juveniles in spring and summer (*Laptikhovsky et al., 2010*). Smaller penguins rarely forage beyond the shelf edge and the juvenile *Gonatus antarcticus* distribution may account for this behaviour. Hoki (whiptail hake) are also known to feed on *G. antarcticus* (*Laptikhovsky et al., 2010*). This species is not considered to be of particular conservation interest (*IUCN, 2014*).

4.237 Another species commonly found in the diet of top predators in the Falkland Islands is the small-eye moray cod (*Muraenolepis microps*), a small pelagic species (*Cheung & Pitcher, 2005*).

#### Demersal Species

4.238 The frogmouth (*Cottoperca gobio*), a demersal species of fish, feeds on the commercially important species of rock cod throughout the year. They are also known to prey upon *Doryteuthis gahi* during their seasonal offshore migration in June and August (*Laptikhovsky & Arkhipkin, 2003*).

4.239 The only fish species reported to be endemic to the Falkland Islands is a demersal species known as the crested spiny plunderfish (*Harpagifer palliolatus*). It is commonly found in the littoral zone (40-50 metres) and feeds on small crustaceans (*Hureau, 1990*).

#### *Deepwater Species*

4.240 There are 41 species of deep sea finfish and squid that have been recorded within the Falkland Islands region. Because of the previous lack of data on deep sea fish and squid and related fishing activity, new species are being discovered more recently in the Falkland Islands. Additionally, the majority of deep sea species recorded in the Falkland Islands have circumglobal distribution due to the relatively homogenous environment that they live in. Data on their general biology and distribution are lacking, particularly for those species below depths of 300-400 metres (*Brickle & Laptikhovsky, 2002*).

4.241 The deep-sea cephalopod, *Opisthoteuthis hardyi*, was initially described from one male caught on Shag Rocks to the north-west of South Georgia but recent deep water trawls caught 33 conspecifics on the Patagonian slope that were confirmed through molecular analysis. Twenty four (24) were caught in one trawl indicating schooling behaviour. Other deep sea species recently found within the Falkland Islands region through exploratory observation include: the giant grenadier (*Albatrossia pectoralis*), the deepwater squid (*Asperoteuthis nesisi*) found on the Burdwood Bank, the manefish (*Caristius groenlandicus*), the cutthroat eel (*Diastobranchus capensis*), the spiny eel (*Notacanthus sexspinis*), and the southern driftfish (*Pseudoicichthys australis*) (*Brickle & Laptikhovsky, 2002*; *Arkhipkin & Laptikhovsky, 2008*).

### 4.3.6 Marine Mammals

4.242 The information on the population, distribution and habits of marine mammals occurring in offshore waters of the Falkland Islands is scarce and incomplete, particularly for deeper waters to the south and east (*Munro, 2004*). It is estimated that more than 20 species of marine mammals reside or visit the Falkland Islands, but possibly only two or three are permanent residents. It is thought that Commerson's dolphin (*Cephalorynchus commersonii*) and Peale's dolphin (*Lagenorhynchus australis*) are among those species that stay in the vicinity of the Falkland Islands year round (*Otley et al., 2008*).

#### Baseline Data Sources

4.243 The following data sources have been reviewed in order to characterise marine mammal activity within and around the project area.

##### *The JNCC and Falklands Conservation Seabirds at Sea Survey*

4.244 Following the award of the initial round of hydrocarbon exploration licenses in 1996, the threat of oil pollution to seabird and marine mammal populations was recognized. The Joint Nature Conservation Committee (JNCC) and Falklands Conservation (FC) conducted a '*Seabirds at Sea' Survey* between February 1998 and January 2001 (*White et al., 2002*) (hereafter referred to as the JNCC survey). As part of the JNCC survey, marine mammal observer data were also collected. To date, the findings from the JNCC survey are still the major body of work regarding the frequency and distribution of marine mammals, particularly cetaceans, offshore the Falkland Islands. Highest levels of effort were concentrated over Patagonian Shelf waters, particularly waters around Stanley.

4.245 In most cases, single observers were on board the survey vessel, with the remainder of surveys being conducted with two observers. All mammals within a 300 metre transect to one side of a survey vessel with known position, speed and heading were counted as per the methods described by Tasker *et al.* (1984) and Webb & Durinck (1992).

4.246 The JNCC survey programme was conducted throughout the Southwest Atlantic as far north as 35°S, extending south to 65°S, east to 28°W and west to 70°W (*Gillon et al., 2000*). Over 82% of survey effort was conducted within Falkland Islands waters. Analysis of the data by White *et al*. (2002) includes all survey effort within a rectangle defined by south-west co-ordinates 56°S, 64°W and north-east co-ordinates 47°S, 52°W. A total of 20,907 $km^2$ of survey effort was conducted within the 3-year survey period.

4.247 Figure 4.35 shows total survey effort of the seabirds as sea survey in relation to the Noble license blocks and seismic survey areas, where it can be seen that survey effort is relatively low over the Noble license areas.

4.248 Monthly survey effort ranged from as low as 262 $km^2$ to 1,279 $km^2$, with little survey effort made in the vicinity of the Noble blocks in June or August when survey effort was concentrated predominantly in north-western regions (Figure 4.36). The survey effort was more concentrated in south-eastern regions closer to the Noble licenses in November and December, although the survey effort in these regions is generally low when compared to the survey effort across the Falkland Islands as a whole.

*Figure 4.35: Total survey effort (km$^2$) between 1998 and 2001 of the JNCC 'Seabirds at Sea' Survey in relation to the Noble license areas (White et al., 2002)*

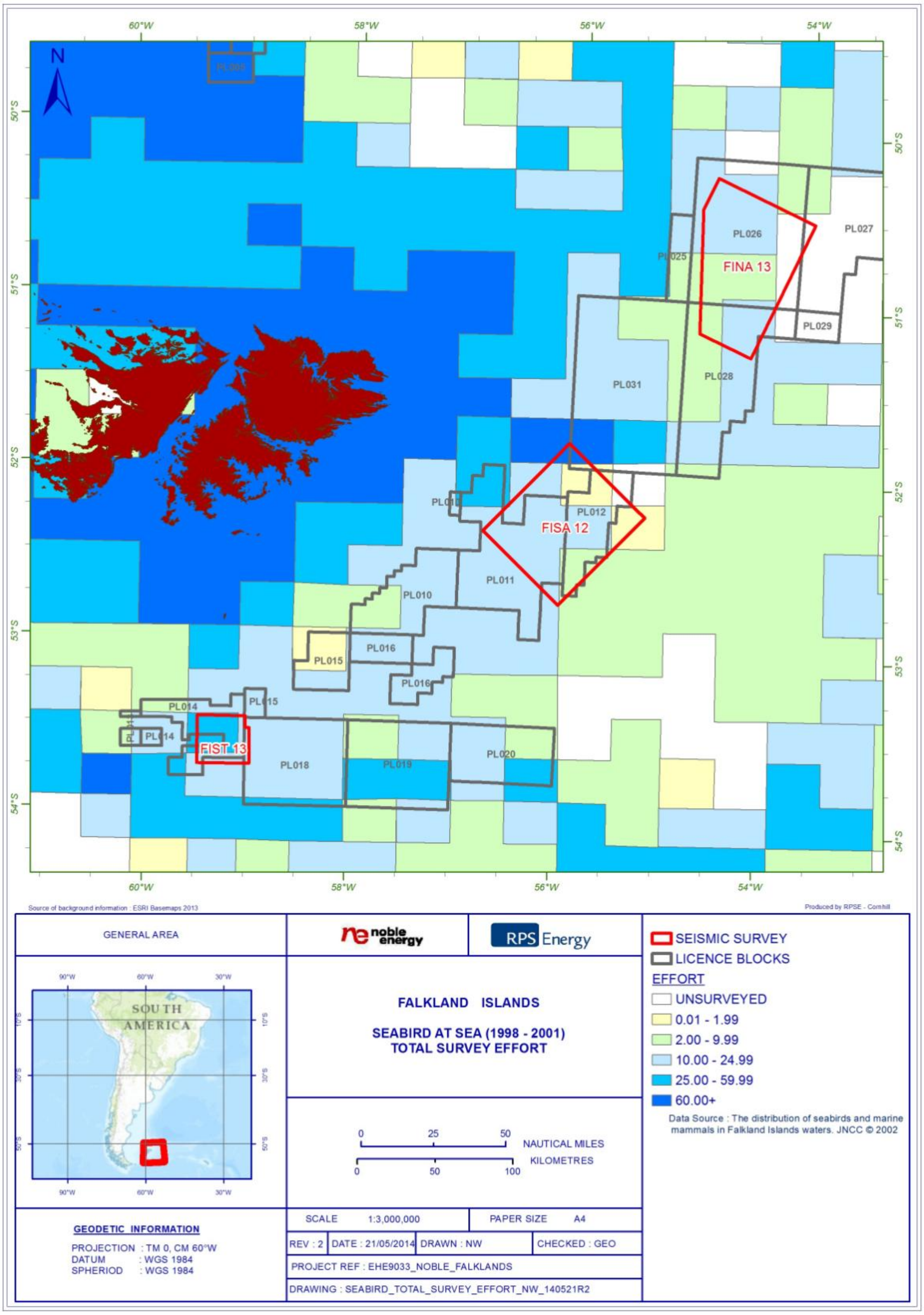


***Figure 4.36a: Monthly survey effort between 1998 and 2001 (km$^2$) of the JNCC 'Seabirds at Sea' Survey January to June (White et al., 2002)***

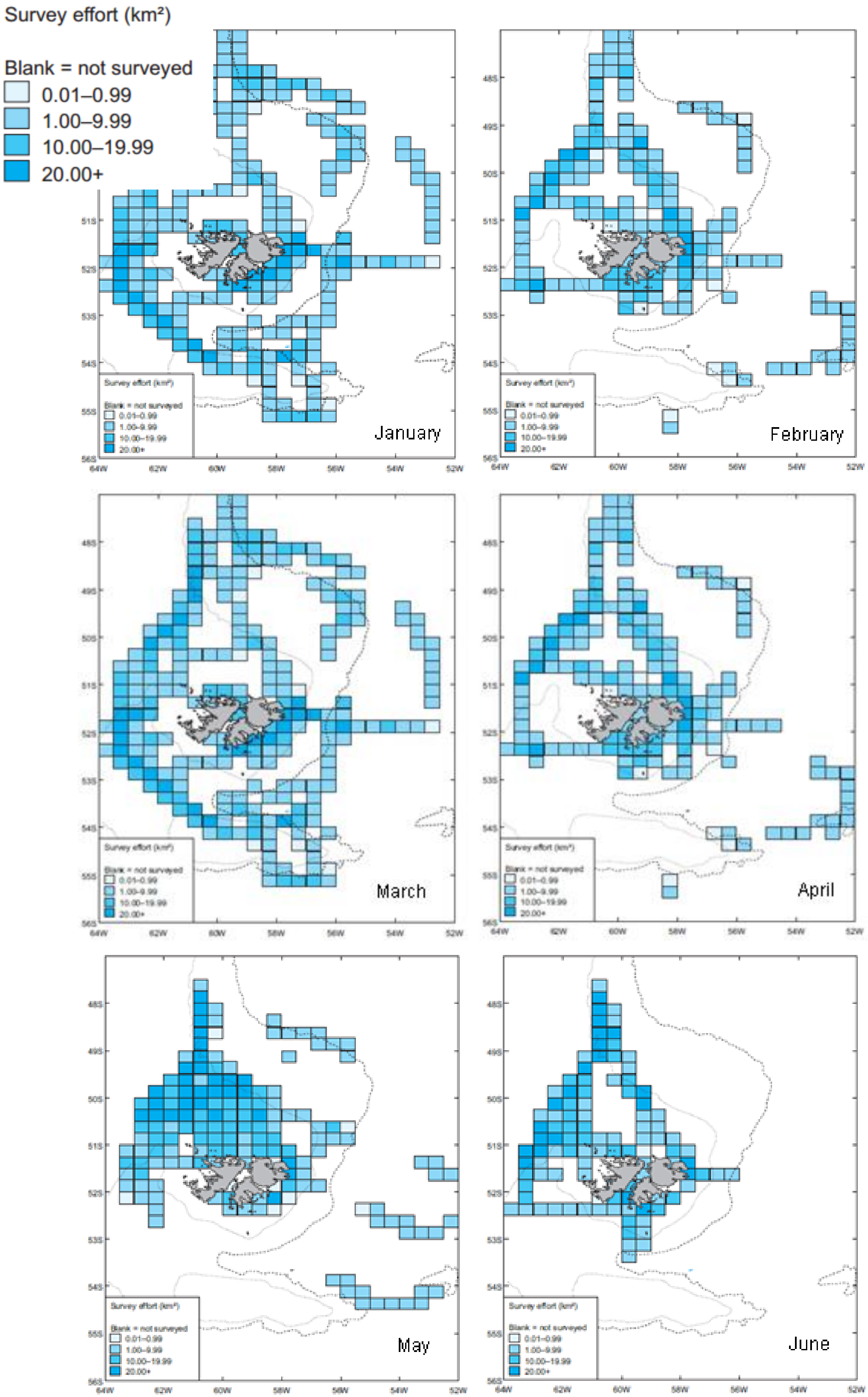
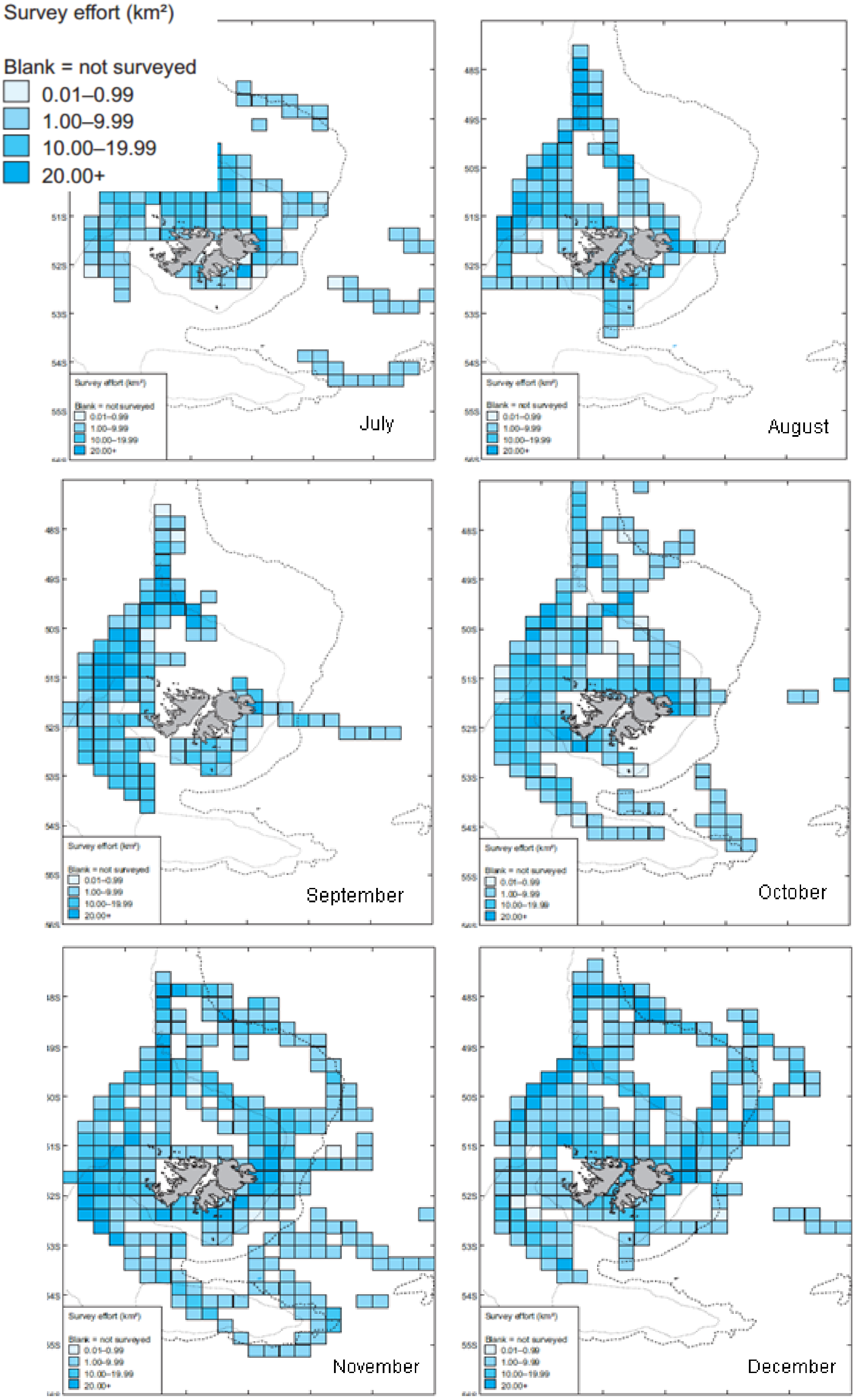


***Figure 4.36b: Monthly survey effort between 1998 and 2001 (km²) of the JNCC 'Seabirds at Sea' Survey, July to December (White et al., 2002)***



### *Limitations of Marine Mammal Surveys*

4.249 Marine mammal surveys have a number of significant limitations associated with their implementation and interpretation. The Beaufort sea state, wind speed and direction, swell height and direction, rain, fog, and the horizontal and vertical sun angle all have a direct impact on overall visibility during the survey, and therefore the reliability of data gathered (*WHOI, 2006*).

4.250 Variations in visibility may result in a lower number of marine mammals being observed, which may not necessarily be a true indication of the full extent of their presence within the survey area (*Thurman, 1997*). In order to draw more accurate and informed conclusions regarding presence and distribution, the ecology of individual species must also be considered, for example, the fact that some species exhibit more cryptic behaviour than others, or that some species may migrate to other areas during the year.

4.251 Ship or aerial observer surveys rely on human observers to detect marine mammals. However, these records are limited to daylight hours only, and the experience of observers is a very important factor in their detection and correct identification. Moreover, the efficiency of this method is dependent on working conditions on the vessel, for example, the regularity of breaks. Richardson *et al*. (1995) notes that even with conscientious and well trained observers in good weather conditions, it is unlikely that all mammals present will be detected. As a result, surveys such as the 1998 to 2001 at sea surveys (*White et al., 2002*) are often rendered time-consuming, expensive, and largely ineffective if the aforementioned meteorological, oceanographic, ecological and human variables are not fully considered and incorporated into survey outputs and conclusions (*Leite Parente & Elisabeth de Araújo, 2011*).

4.252 Surveys conducted from fishing vessels or during seismic surveys cannot provide reliable information regarding species presence or distribution within the larger area or throughout the year due to the above recognised deficiencies in the very nature of their *modus operandi*. However, they are still valuable for providing information regarding species presence in an otherwise data deficient environment.

4.253 It is acknowledged that the JNCC seabirds and marine mammals at sea data is now relatively old. For this reason, the data has been supplemented by marine mammal observer data of both marine mammals and birds obtained during the seismic survey activities undertaken over the Noble license areas (see below). At this exploration stage, a review of the existing available data is appropriate to inform impact assessment and has been presented in the EIS. For a development phase (in the event of a successful hydrocarbon discovery), specific studies may be required in order to gain further insight into marine mammal and bird abundance, distribution and behaviour in offshore areas, particularly in respect of their seasonality, to inform future impact assessments in support of development permitting.

### *Available Marine Mammal Observer (MMO) data for the Falkland Islands*

4.254 Large parts of the South and East Falkland Basins remain un-surveyed. The level of survey effort in the areas already covered during the 1998 to 2001 at sea surveys (*White et al., 2002*) could undoubtedly be improved upon. The survey is based on just three years of available data, and there is no current assessment of inter-annual variation in the patterns of marine mammal distribution. The data contained in the 1998 to 2001 at sea surveys (*White et al., 2002*) is, however, the most widespread and complete marine mammal dataset for the Falkland Islands at present.

4.255 In support of seismic surveys in the Noble license areas, marine mammal observers (MMOs) were stationed on board the seismic survey vessels during seismic acquisition over the Falkland Islands Southern Phase A 2012 (FISA12), the Falkland Islands Southern Tilted 2013 (FIST13), and the East Falkland Basin (FINA13) areas, conducted between November 2012 to February 2014. Two MMOs and a dedicated passive acoustic monitoring (PAM) operator were on board the seismic survey vessels to fulfil the regulatory requirements and reporting mandated by the JNCC. The primary objective was to ensure that disturbance to marine mammals that may have been in the vicinity of the seismic operations was minimised, following the latest JNCC guidelines for minimising disturbance to marine mammals from seismic surveys (*JNCC, 2010*). In addition, marine mammal sightings and PAM data were recorded to supplement the existing White *et al*. (2002) marine mammal sightings dataset. Available sightings and acoustic detection data gathered during seismic acquisition has been plotted and is presented in the sections below. The Protected Species Survey reports relevant to the FISA12, FIST13 and FINA13 areas are provided in full in Appendix M.

4.256 The observations in the FISA12 area began on 8th December 2012 and continued until the completion of the seismic survey on 10th May 2013. At this point, the vessel (PGS *Ramform Sterling*) returned to port to carry out a crew change. The vessel then transited to the FIST13 survey area on 19th May 2013. The FIST13 survey was completed on 7th June 2013. Observations in the FINA13 area began on 5th November 2013 and continued through to 18th February 2014 from the PGS *Ramform Titan* Observation and detection effort was proportionate to the duration of the survey with considerably more effort being expended during the FISA12 survey.

4.257 Sightings data gathered during the FISA12 and FIST13 survey, and acoustic detection data gathered during the FISA12, FIST13 and FINA13 surveys, has been used to inform baseline baseline characterisation.

#### *Visual Survey*

4.258 There were two trained and MMOs on board the Noble seismic survey vessel to visually monitor for marine mammals, record and report on observations, and request mitigation actions to the seismic operators. Visual monitoring was carried out from the “sky lounge” on board the *Ramform Titan* located above the bridge, approximately 22 meters above the waters surface, which provided the MMOs with a 360 degree viewpoint around the acoustic source. Binoculars (7x50 and 10x30 magnifications) were used for visual monitoring in addition to the naked eye. Visual monitoring was conducted each day between just before dawn until just after dusk (*RPS, 2013*).

4.259 When a species was observed, range estimations were made using reticule binoculars, the naked eye, and by relating the animal to an object at a known distance, such as the acoustic array located 750 meters from the MMO observation deck. Specific species identifications were made whenever distance, duration of the sighting and visual observation conditions allowed. The MMOs observed the physical features of the animals sighted (*RPS, 2013*).

4.260 During each sighting event MMOs recorded the position, time at first and last sighting, number of animals present (adults and juveniles), the initial and any subsequent behaviours observed, the initial range, bearing and movement of the animal(s), the source activity at the initial and final detections and any mitigation measures that were applied. Additionally, the vessel position, water depth, vessel speed, wind speed and direction, Beaufort scale, swell level, visibility, glare, and precipitation were recorded every hour as a minimum or every time environmental conditions or seismic activity changed. Each sighting event was linked to an entry on a datasheet such that environmental conditions are available for each sighting event (*RPS, 2013*).

4.261 Throughout the monitoring period, twelve species of marine mammal were positively identified, along with unidentified baleen whales, unidentified whales, unidentified cetaceans, unidentified dolphins, and unidentified pinnipeds. The total number of detection events and total number of animals recorded by species is shown in Table 4.6. MMOs undertook 1723 hours 32 minutes of visual observations over the course of the survey.

*Table 4.6: Visual detection records for each species during the FISA12 and FIST13 seismic survey MMO period (RPS, 2013)*

| | Total number of detection records | Total number of animals recorded |
|---|---|---|
| **Cetaceans** | | |
| Unidentified whale | 28 | 33 |
| Unidentified cetacean | 1 | 1 |
| **Mysticetes** | | |
| Fin whale (*Balaenoptera physalus*) | 25 | 54 |
| Sei whale (*Balaenoptera borealis*) | 21 | 47 |
| Minke whale (southern) (*Balaenoptera bonaerensis*) | 8 | 10 |
| Southern right whale (*Eubalaena australis*) | 5 | 5 |
| Humpback whale (*Megaptera novaeangliae*) | 1 | 1 |
| Unidentified baleen whale | 42 | 66 |
| **Odontocetes** | | |
| Sperm whale (*Physeter macrocephalus*) | 1 | 2 |
| Killer whale (*Orcinus orca*) | 2 | 2 |
| Long-finned pilot whale (*Globicephala melas*) | 14 | 431 |
| Hourglass dolphin (*Lagenorhynchus cruciger*) | 58 | 797 |
| Peale's dolphin (*Lagenorhynchus australis*) | 4 | 54 |
| Dusky dolphin (*Lagenorhynchus obscurus*) | 1 | 1 |
| Commerson's dolphin (*Cephalorhynchus commersonii*) | 1 | 7 |
| Unidentified dolphin | 16 | 106 |
| **Pinnipeds** | | |
| Unidentified pinniped | 3 | 3 |
| **Total** | **231** | **1,620** |

### *PAM Survey*

4.262 The FISA12 and FIST13 seismic surveys also used PAM to monitor for the presence of protected species during the night and during periods of reduced visibility. Distances for acoustic detections are primarily based upon a noise or detection score system developed by Gannier *et al*. (2002). Gannier *et al*. monitored sperm whales (*Physeter macrocephalus*) in the Mediterranean Sea both visually and acoustically. A subjective scale was developed based upon the strength or intensity of the sperm whale clicks at various distances that were measured visually when the sperm whales surfaced. Although the scale is subjective and sounds produced in marine environments will vary according to local conditions, the scale provides a measure for approximating distances when using a single, linear hydrophone array for PAM. During a detection of a vocalizing animal, information regarding position, distance, heading of vessel, water depth and range of the animal was recorded, along with any recordings of vocalizations (*RPS, 2013*).

4.263 PAM operators undertook 731 hours and 21 minutes of acoustic monitoring over the course of the survey. There was only one acoustic detection made during the seismic surveys which occurred on 27th December 2012 at 01:40. An unidentified dolphin species was detected acoustically. Low frequency whistles were noted aurally as well as via the *Pamguard* software's spectrogram. The dominant frequencies of the whistles were observed at 3-4 kHz, with harmonics peaking above 60 kHz. Lack of overlapping vocalisations suggest that only one animal was both present and vocal. The detection lasted for two minutes (*RPS, 2013*).

4.264 During the FINA13 survey the same PAM system was deployed. PAM operators undertook 452 hours and 39 minutes of acoustic monitoring over the course of the survey. The acoustic monitoring effort resulted in eight species detection records which included three baleen whales, four unidentified dolphin species and one sperm whale detection (*RPS, 2014*).

#### *Other Data Sources*

*4.265* Other research of cetacean distribution and abundance around the Falkland Islands is limited to a few publications, including published results from the aerial survey of killer whale (*Orcinus orca*) in the region (*Yates & Palavecino, 2006*).

4.266 In their report, White *et al*. (2002) review limited historical data sources, including coastal observations, records of strandings, observations from air and fishing vessels, and catch data from the New Island whaling station.

### Cetaceans

#### *Sei Whale (Balaenoptera borealis)*

4.267 Sei whale (*Balaenoptera borealis*) occurs in the North Atlantic and Pacific oceans, throughout the Southern Hemisphere and occasionally in the Mediterranean Sea (*IUCN, 2012*). Although they have been known to associate with other whales occasionally, sei whales are mainly solitary animals (*ACS, 2014*). During winter months, sei whales have been recorded migrating to warmer waters (*Bonner, 1986*; cited by: *Otley et al., 2008*). Mating occurs between May and July and calves are born approximately one year later (*Mizroch et al., 1985*). Their diet consists of euphausiids, copepods, and amphipods (*Nemoto and Kawamura, 1977,* cited by: *IUCN, 2012*).

4.268 During the JNCC survey, 45 individuals were recorded on 31 occasions (*White et al., 2002*), predominantly in coastal areas and towards the west and south of the Falkland Islands. Group size ranged from one to three individuals. Sightings were highest during the austral summer between November and March, peaking at either end of the season. The majority of records occurred in the eastern coastal waters, mainly between MacBride Head and the Sea Lion Island (*White et al., 2002*). Only one sighting of sei whale was made in the vicinity of the Noble license areas (Figure 4.37).

4.269 During the FISA12 and FIST13 seismic surveys, there were 21 visual detections of sei whale, with a total of 47 individuals being observed. Five were identified as juveniles. The majority of detections occurred at the end of November and in December (*RPS, 2013*) (Figure 4.40).

#### *Fin Whales (Balaenoptera physalus)*

**4.270** Fin whales (*Balaenoptera physalus*) migrate to subtropical waters for mating and calving during winter months and to the colder areas of the Antarctic for feeding during summer months (*ACS, 2014*). They tend to travel alone, although they have been observed in pods (*Mackintosh, 1966*). Fin whales feed mainly on euphausiids and schooling fish.

4.271 During the JNCC survey, 57 individual whales were recorded on 27 occasions (*White et al., 2002*). Of these, over half were to the east of 60°W. There were also some reported sightings to the north-east and south-east. Group sizes ranged from one to twelve individuals. A small number of sightings were recorded over the Burdwood Bank. During the study, *B. physalus* was most common between November and January. Very few species were sighted from February to September, and this is partially explained by the fact that fin whales tend to migrate to warmer northern waters during austral winter.

4.272 During the FISA12 and FIST13 seismic surveys, there were 25 visual detections of fin whale (54 animals) (Figure 4.40). Of these, three juveniles were observed. In line with the JNCC data, the majority of sightings occurred from the end of November through to January (*RPS, 2013*).

#### *Antarctic Minke Whale (Balaenoptera bonaerensis)*

4.273 Antarctic minke whale (*Balaenoptera* bonaerensis) are mainly solitary animals, although have been known to associate with other whales occasionally. Mating occurs during summer with calves being born approximately 11 months later (*ACS, 2014*). *B. bonaerensis* feed almost exclusively on krill, primarily *Euphausia superba*, but also *E. crystallorophias, E. frigid* and *Thysanoessa macura* (*Tamura & Konishi, 2006*; cited by *IUCN, 2012*).

4.274 During the JNCC survey, 68 individual minke whales were recorded on 60 occasions (*White et al., 2002*). The majority of records occurred between September and April, with only three records outside this period. Most minke whales were sighted in Patagonian Shelf waters around east and north-west of the Falkland Islands, although there were records throughout the survey area.

4.275 During the FISA12 and FIST13 seismic surveys (*RPS, 2013*), there were seven visual detections of Antarctic minke whales (nine animals) all occurring over the northern area license to the east of the Falkland Islands (Figure 4.40).

#### *Sperm Whale (Physeter macrocephalus)*

4.276 Sperm whales (*Physeter macrocephalus*) are thought to be present in all marine waters deeper than 1,000 metres that are not covered in ice, with the exception of the Black and Red Seas. They tend to feed mainly on medium sized deep water squid. Other food sources include fish, skate, octopus and small squid (*ACS, 2014*). Calving occurs during winter after a gestation period of 12 months (*Mizroch & Rice, 2013*).

4.277 During the JNCC survey, 28 individual sperm whales were recorded on 21 occasions, with group size ranging from one to four animals (*White et al., 2002*). Observations were made in all seasons. Populations appeared to be isolated to two distinct regions; one to the extreme north of the FOCZ and one to the south over the eastern reaches of the Burdwood Bank (*White et al., 2002*) (Figure 4.38). These results are mirrored by observations made by Purves *et al.*, 2004 (*Yates & Brickle, 2007*) who recorded a high density of sperm whales to the south of the Falkland Islands over the Burdwood Bank and to the north of the FOCZ. However, their results also showed sperm whales in between these two areas to the east of the Falkland Islands. This data is also strongly supported by the sightings from longline fishing vessels, which record a high occurrence of sperm whales to the north-east and south of the Falkland Islands, but also throughout the deep water fishing area. Sperm whales appear to be present around the Falkland Islands year round (*Yates & Brickle, 2007*). This conclusion was reached by Yates and Brickle by combining data from scientific observers and long line fishing vessels.

4.278 MMOs on the FISA12 and FIST13 seismic surveys reported a single visual detection of two sperm whales within the FISA12 area and a single acoustic detection of a sperm whale was recorded during the FINA13 seismic survey (Figure 4.40) (*RPS, 2013; RPS, 2014*).

#### *Southern Bottlenose Whale (Hyperoodon planifrons)*

4.279 Southern bottlenose whales (*Hyperoodon planifrons*) are common in the southern hemisphere beyond the continental shelf and over submarine canyons, typically in waters less than 200 metres deep (*IUCN, 2012*). They predominantly eat cephalopods and occasionally fish (*MacLeod et al., 2003*). Migration of Southern bottlenose whales to Antarctic waters during summer has been reported (*Jefferson et al., 1993*). During this time *H. planifrons* are commonly seen within 100 kilometres of the Antarctic ice edge (*IUCN, 2012*).

4.280 During the JNCC survey, 34 individual whales were recorded on 18 occasions, with group size ranging from one to five animals (*White et al., 2002*). All of these sightings occurred between September and February. White *et al.* (2002) noted that although a reduction in survey effort in deeper waters during winter may account for this apparent seasonality, it is likely that this is also due to *H. planifrons* migrating to the region in summer and away again in winter.

4.281 There were no sightings of *H. planifrons* during the FISA12 and FIST13 seismic surveys (*RPS, 2013*).

#### *Long-finned Pilot Whale (Globicephala melas)*

4.282 Long-finned pilot whales (*Globicephala melas*) are mostly found in offshore waters, although they do occasionally appear inshore. Near the Falkland Islands, they have been known to congregate over the continental shelf where productivity is high (*CMS, 2014*). *G. melas* is often seen in groups of 20 – 90 individuals. Calving occurs year round, but most female pilot whales give birth during the summer months (*ACS, 2014*). Long-finned pilot whales mostly eat squid, but have also been observed eating medium sized fish such as mackerel, cod, turbot, herring, hake and dogfish when available (*IUCN, 2014*).

4.283 During the JNCC survey, 872 individual whales were recorded on 27 occasions, with group size ranging from 2 to 200 animals (*White et al., 2002*). *G. melas* displayed no clear seasonality during this study, although numbers peaked in May (late austral autumn) and none were observed in January. Around the Falkland Islands, *G. melas* display no clear preference for coastal or deeper waters. Figure 4.39 displays long-finned pilot whale density in the vicinity of the Noble licenses based on the JNCC sightings data.

4.284 During the FISA12 and FIST13 seismic surveys, there were 14 visual detections of this species (431 animals) (Figure 4.40). Group sizes ranged from 8 to 50 animals. Twenty three (23) of the animals were identified as juveniles. During five of the detections the pilot whales were observed with other species such as a dwarf minke whale, an unidentified baleen whale, and hourglass dolphins (*RPS, 2013*).

#### *Southern Right Whale (Eubalaena australis)*

4.285 Southern right whales (*Eubalaena australis*) have a circumpolar distribution in the Southern Hemisphere. They are migratory, inhabiting colder waters for feeding, then moving to warmer waters for breeding and calving. Females produce calves at three to five year intervals throughout summer and autumn. *E. australis* are considered as “grazers of the sea”, and mainly eat euphausiids and copepods (*IUCN, 2014*; *ACS, 2014*).

4.286 During the JNCC survey, only seven individual whales were recorded (*White et al., 2002*). During the FISA12 and FIST13 seismic surveys there were five visual detections of this species in the FISA12 area all of which were of solitary animals (Figure 4.40). All sightings were made during February and March (*RPS, 2013*).

#### *Killer Whale (Orcinus orca)*

4.287 Killer whales (*Orcinus orca*) are common in coastal regions of high productivity where their prey congregates. This prey includes sea birds, fish (including sharks and rays), cephalopods and most other marine mammals (*Dahlheim & Heyning 1999*; *Ford & Ellis 1999*; *Ford 2002, cited by IUCN, 2014*). Killer whales have also been spotted in deeper waters (*IUCN, 2014*).

4.288 In Falkland Island waters, killer whales have been recorded congregating near Sea Lion Island during the breeding times of elephant seals and sea lions on the island. An ambush hunting technique was observed, not previously observed where certain individuals in the pod remain motionless and submerged in the water by rocky platforms, presumably waiting for pups to enter the water before lunging at their prey (*Yates & Palavecino, 2006*). Killer whale around the Falkland Islands also target minke whales (*Pitman & Ensor, 2003,* cited by: *IUCN, 2014*). Little is known about the reproductive habits of killer whale, although since calves have been spotted all year round, it is assumed that reproduction and calving must occur throughout the year (*ACS, 2014*).

4.289 During the JNCC survey, 18 killer whales were sighted, predominantly in coastal and Patagonian Shelf waters throughout the austral summer of 1998 – 1999 (*White et al., 2002*).

4.290 During the FISA12 and FIST13 seismic surveys, there were two visual detections of this species (two animals), both of which occurred in December (Figure 4.40) (*RPS, 2013*).

#### *Commerson’s Dolphin (Cephalorhynchus commersonii)*

4.291 Commerson’s dolphin (*Cephalorhynchus commersonii*) are small species, predominantly found in cold inshore waters along open coasts or in sheltered fjords, bays, harbours and river mouths.

Around the Falkland Islands they have been sighted at the edge of kelp beds. *C. commersonii* appears to be an opportunistic feeder, targeting various species of fish, cephalopods, crustaceans, and benthic invertebrates in kelp beds. They have also been known to target pelagic schooling fish in more open areas (*IUCN, 2014*). The breeding season of *C. commersonii* is in the austral spring and summer, running from September to February (*MarineBio, 2014*).

4.292 During the JNCC survey, 336 individual dolphins were recorded on 100 occasions (*White et al., 2002*). *C. commersonii* was observed in every month except May and June. White *et al*. (*2002*) speculate that this is likely due to reduced survey effort during these months, as opposed to seasonality by the dolphins. White *et al*. (2002) noted that the species have a highly coastal distribution, with 98.8% of sightings occurring within 10 kilometres of the coast and none after 25 kilometres (Figure 4.39). White *et al*. (2002) suggest that owing to the apparent low seasonality of Commerson's dolphin, it is likely that these species are resident around the Falkland Islands. Otely *et al*. (2008) and Munro (2004) corroborate this by noting that *C. commersonii* are generally sighted in waters less than 100 metres deep.

4.293 One sighting (of seven animals) of *C. commersonii* was made during the FISA12 and FIST13 seismic surveys (Figure 4.41) (*RPS, 2013*).

#### *Peale's Dolphin (Lagenorhynchus australis)*

4.294 Peale's dolphin (*Lagenorhynchus australis*) have been observed in waters deeper than 300 metres, but prefer shallower coastal waters and spend most of their time feeding and swimming in kelp forests (*IUCN, 2014*). *L. australis* feed on small cephalopods, crustaceans and bottom dwelling fish. Adults can reach a maximum length of 2.2 metres (*Shirihai & Jarrett, 2009*). Calving occurs from spring to autumn.

4.295 *L. australis* was the most commonly observed species during the JNCC survey, with 2,617 individuals recorded on 864 occasions (Figure 4.39) (*White et al., 2002*). Sightings occurred in every month, peaking in August, and group size ranged from one to fifteen. The particularly high sightings of *L. australis* may be due to their inquisitive nature and tendency to approach vessels to bow ride (*White et al., 2002*).

4.296 Four sightings (54 animals) of this species were made during the FISA12 and FIST13 seismic surveys (Figure 4.41). Most were made in inshore waters, but one sighting occurred in the vicinity of the FISA12 area (*RPS, 2013*).

#### *Hourglass Dolphin (Lagenorhynchus cruciger)*

4.297 Hourglass dolphins (*Lagenorhynchus cruciger*) are small, oceanic dolphins that occur in the cold, circumpolar waters of the sub-Antarctic and Antarctic Seas. They are usually observed in deep waters far from the coast (*FOGL, 2011*). Their diet consists of small fish, squid, and crustaceans (*Goodall, 2002,* cited by: *IUCN, 2014*). Calving occurs in winter, although the reproductive habits of *L. cruciger* are not immediately clear since mothers are thought to actively avoid research vessels when they are with their young (*MarineBio, 2014*).

4.298 During the JNCC survey, 886 individual dolphins were recorded on 177 occasions to the east, south-east and far north of the Falkland Islands (*White et al., 2002*). The majority of sightings were in waters deeper than 200 metres during the austral spring and summer (September to March). Only six records were taken outside of this time. Munro (2004) noted that hourglass dolphin numbers in the area may have been underestimated since they are known to be wary of shipping activity.

4.299 During the FISA12 and FIST13 seismic surveys, there were 58 detections of this species (797 animals). The majority of sightings occurred in February and March. The dolphins were observed in group sizes of 2 to 80 animals, with one sighting of a large pod of approximately 250 animals. Twenty three of the animals were identified as juveniles. Hourglass dolphins were frequently observed bow riding (*RPS, 2013*).

### *Other Cetaceans*

4.300 Several species have been recorded in Falkland Islands waters by independent MMOs that were not encountered by White *et al*. (2002) (*Munro, 2004*; *RPS, 2013*):

- Dusky dolphin (*Lagenorhynchus obscurus*);
- Bottlenose dolphin (*Tursiops truncatus*);
- Spectacled porpoise (*Phococena dioptica*);
- Bryde's whale (*Balaenoptera brydei*);
- Blue whale (*Balaenoptera musculus*);
- Humpback whales (*Megaptera novaeangliae*);
- Southern right whale dolphin (*Lissodelphis peronii*); and
- Dwarf minke whale (*Balaenoptera acutorostrata*).

4.301 A recent stranding event of false killer whale (*Pseudorca crassidens*) in February 2013 at Fitzroy, East Falkland, was the first record of false killer whale in Falkland Island waters (*Falklands Conservation, 2013*). A total of twenty-two stranded whales were recorded, and a further 30 individuals were seen swimming in shallow waters adjacent to the stranded group. False killer whales are oceanic dolphins, and are generally found in deeper, warmer waters to the north.

### Unidentified Species

4.302 During the JNCC survey, 44 large whales were recorded on 40 occasions (*White et al., 2002*). Eighteen (18) of these whales were thought to be fin or sei whales, while the rest were completely unidentifiable.

4.303 MMOs active during the FISA12 and FIST13 seismic surveys spotted a total of 100 unidentifiable individual whale species on 71 occasions, and 106 unidentifiable dolphin species on 16 occasions (Table 4.6, Figures 4.40 and 4.41) (*RPS, 2013*).

### *Summary*

4.304 The results of the marine mammal observations during the FISA12 and FIST13 surveys (*RPS, 2013*) correlate well with the JNCC survey results (*White et al., 2002*). Both data sets confirm that the species most frequently encountered across the Noble license areas, and their corresponding periods where they have been observed in higher numbers, are:

- Sei whale – November to March;
- Fin whale – November to January;
- Antarctic minke whale – September to April;
- Sperm whale – all year round;
- Southern bottlenose whale – September to February;
- Long-finned pilot whale – May;
- Southern right whale – February to March;
- Killer whale – November to March;
- Commerson's dolphin – all year round;
- Peale's dolphin – all year round; and
- Hourglass dolphin – September to March.

### Conservation Status

4.305 Table 4.7 displays the conservation status of each of the species described or listed in the sections above. There is no Falkland Islands National Red Data List of marine mammals. Two species (sei whale and fin whale) listed below are listed as endangered and one species (sperm whale) is listed as vulnerable. Eleven species are listed under CITES (the Convention on International Trade in Endangered Species), and nine species are listed under the Convention on the Conservation of Migratory Species of Wild Animals (CMS) (Table 4.7).

***Table 4.7: Conservation status of the regularly sighted cetaceans offshore the Falkland Islands***

| Species | IUCN Conservation Status[1] | CITES AppendiX[2] | CMS Appendix[3] |
|---|---|---|---|
| Sei whale | EN | I | I, II |
| Fin whale | EN | I | I, II |
| Antarctic minke whale | DD | I | II |
| Sperm whale | VU | I | I, II |
| Southern bottlenose whale | LC | I | Not Listed |
| Long-finned pilot whale | DD | II | II (North and Baltic Sea subpopulations) |
| Southern right whale dolphin | LC (Chile-Peru subpopulation listed as CR) | I | I |
| Killer whale | DD (Some populations greatly reduced) | II | II |
| Commerson's dolphin | DD | II | II (South American population) |
| Peale's dolphin | DD | II | II |
| Hourglass dolphin | LC | II | Not Listed |

*1: IUCN; NE – Not Evaluated; DD – Data Deficient; LC – Least Concern; NT – Near Threatened; VU – Vulnerable; EN – Endangered; CE – Critically Endangered; EW – Extinct in the Wild; EX – Extinct.*

*2: CITES Appendix I lists species that are the most endangered among CITES-listed animals and plants; CITES Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled; CITES Appendix III is a list of species included at the request of a Party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation.*

*3: CMS Appendix I – Threatened migratory species; CMS Appendix II – Migratory Species requiring International Co-operation.*

4.306 In the Falkland Islands, the Marine Mammals Ordinance 1992 protects all marine mammals in all waters, from the coast to the edge of the economic exclusion zone (EEZ).

### Pinnipeds

4.307 The size of breeding pinniped populations on the Falkland Islands has declined significantly over the past century (*Thompson, 2003*; *Thompson et al., 1998*; *Galimberti & Sanvito, 2011*). Historically, this is likely to be due to hunting for skins and oil. More recently, it is thought that the decline is due to an increase in human activity such as fisheries, oil exploration and tourism (*Thompson et al., 2005*).

4.308 Three species of pinniped, the South American sea lion (*Otaria flavescens*), South American fur seal (*Arctocephalus australis*) and southern elephant seal (*Mirounga leonina*), breed in the

Falkland Islands (*Strange, 1992*). A further two species, Antarctic (*Arctocephalus gazella*) and Subantarctic (*Arctocephalus tropicalis*) fur seals, have been recorded breeding (*D. Thompson pers. comm.,* in: *White et al., 2002*) and a further species, leopard seal (*Hydrurga leptonyx*), is recorded annually as a non-breeding visitor to the Falkland Islands.

4.309 Knowledge of the distribution and size of breeding pinniped populations indicates that the three species that regularly breed in the Falkland Islands are currently at very low levels compared to historical populations (*Strange 1992; Thompson et al., 1998*).

4.310 Little is known of the at-sea distribution of Falkland Islands pinnipeds. Prior to the start of a South American fur seal satellite tracking programme in 2000 (*Thompson & Moss, 2001*), the only previous work was a satellite tracking study of South American sea lions (*Thompson et al., 1998*). In addition, satellite tracking of southern elephant seals from Patagonia (*Campagna et al., 2007*) and Antarctic fur seals from South Georgia (*I. Boyd pers. comm. in White et al., 2002*) have both tracked animals into Falkland Islands offshore waters, but in common with satellite tracking studies of seabirds, sample sizes are small.

4.311 MMO survey observations conducted during the FISA12 and FIST13 seismic surveys reported three sightings of unidentified pinniped species (*RPS, 2013*).

#### South American Sea Lion (Otaria flavescens)

4.312 A total of 81 South American sea lions were recorded during the JNCC Seabirds and Marine Mammals at Sea Survey (*White et al., 2002*) with the majority recorded in coastal waters or Patagonian Shelf waters.

4.313 South American sea lions are found along the continental shelf around South America from the southernmost tip of Brazil to the north of Peru. Their breeding season varies by location and latitude, although at most sites both sexes will begin to arrive in mid-December, with peak numbers occurring in mid-January to early February. After a gestation period of 11 months (*IUCN*, *2014*), mothers will give birth to pups about three days after arriving at the rookery. Following this, a cycle of foraging and pup attendance commences and lasts until the pup is weaned at 8-10 months old. The diet of South American sea lions appears to be opportunistic and is characterised by a wide range of benthic and demersal fish as well as invertebrate species such as cephalopods, gastropods, crustaceans, sponges and tunicates (*IUCN, 2014*). Small cetaceans and seabirds are also part of their diet. Their predators include killer whales, sharks, and leopard seals.

4.314 The Falkland Islands population of *O. flavescens* has declined dramatically since the 1930s, with pup production falling by around 90% between then and 1965. In 1995, pup production was estimated to be just 2.5% of 1930s levels. In the past, the biggest threat to South American sea lions was from hunting for oil and skins. More recently, it is thought that the expansion of fisheries in their foraging grounds has played a more significant role in their decline (*Thompson et al., 2005; Thompson et al., 1998*). Despite the overall decline in the population, *O. flavescens* is the most widely distributed pinniped species in the Falkland Islands, with 93 documented breeding sites. Most of these sites are located on the west coast of the Falkland Islands. However, there are around 15 situated on the east coast of East Falkland.

4.315 During the JNCC survey, 81 South American sea lions were observed on 77 occasions (*White et al., 2002*) (Figure 4.42). They were recorded in every month, showing no clear seasonality. Munro (2004) reports that *O. flavescens* is more active at night during feeding; hence spotting this species is difficult. However, it is unlikely that South American sea lion will be present within the vicinity of the Noble license areas, as the majority of this species are commonly found in coastal waters and further offshore to the north of the Falkland Islands in shelf waters.

#### Southern Elephant Seal (Mirounga leonina)

4.316 Southern elephant seals have an almost circumpolar distribution in the Southern Hemisphere. They predominantly reside around the sub-Antarctic islands near the Antarctic Polar Front (*IUCN, 2014*). Sea Lion Island, in the south-eastern waters of the Falkland Islands, is home to the only notable breeding colony of southern elephant seals in the Falkland Islands. Although breeding does occur elsewhere, it is extremely limited. Most of the seals' time is spent at sea with individuals only returning to shore to mate, give birth, and moult (*Galimberti & Sanvito, 2011a*). Whilst at sea, solitary *M. leonina* individuals travel thousands of miles and can dive to depths of 500 metres for between 20 and 30 minutes (*IUCN, 2014*; *Galimberti & Sanvito, 2011b*). All foraging is done at sea, with prey consisting mainly of cephalopods and fish. As generalist feeders, their diet changes seasonally (*Campagna et al., 2007*). Predators of *M. leonina* include killer whale and, in lower latitudes, large sharks (*IUCN, 2014*).

4.317 Every year between September and November, about 550 female southern elephant seals arrive on Sea Lion Island to give birth to a single pup. After giving birth, the female suckles her pup for about 23 days, mates again and leaves the island (*Galimberti & Sanvito, 2011a*).

4.318 Similar to the South American sea lion, the population of the southern elephant seals has also declined due to hunting. Numbers appear to be recovering, although due to the relative isolation of the seals on Sea Lion Island, this population is still extremely susceptible to disturbance (*Galimberti & Sanvito, 2011a*).

4.319 During the JNCC survey 13 southern elephant seals were recorded to the north-west and north-east of the Falkland Islands (Figure 4.42). Only one seal was spotted by MMOs between March and April 2011 to the north-east of the Falkland Islands in the vicinity of the Noble northern license. Although these sightings were not near Sea Lion Island, it is likely that the animals were members of the Sea Lion Island population. Galimberti and Sanvito (2011b) also observed several females making large trips to and from Sea Lion Island as part of their normal routine (*Falklands Conservation Newsletter, 2010; Galimberti & Sanvito, 2011b*). Therefore, it is not expected that southern elephant seal will be found across the Noble license areas in high numbers, although it may be possible for single individuals to be in the vicinity if undertaking one of their long foraging trips.

#### *South American Fur Seal (Arctocephalus australis)*

4.320 South American fur seal (*Arctocephalus australis*) have an almost circumpolar distribution in the Southern Hemisphere and are most commonly found to the north of seasonally shifting pack ice. They are also found in high numbers in Argentina. Ten colonies are recorded in the Falkland Islands where reproduction takes place (*IUCN, 2014*). A population of around 16,000 has been estimated around the Falkland Islands. Pups are born between mid-October and mid-January, depending on location. When the pups are around one week old, the mother will mate again then begin a feeding cycle whereby she will go to sea for three to five days and return to land to nurse her pup for one to two days. Weaning begins at eight months. When at-sea, South American fur seals have been spotted travelling at the surface in groups (*IUCN, 2014*). Their prey includes sardines, mackerel, hakes, and euphausiids.

4.321 There are relatively few breeding sites of *A. australis* on the Falkland Islands. Most of these are located on the west coast. The closest known breeding sites to the Noble license areas are at Volunteer Point, situated on the north-eastern tip of East Falkland Island.

4.322 A satellite study by Thompson *et al*. (2003) indicates that South American fur seal can forage a significant distance away from breeding sites. Sixteen adult female fur seals and one sub-adult male fur seal were satellite tracked for 10 to 163 days from October 1999 to June 2000. Early in the pup rearing cycle, the foraging effort was limited to short duration night time foraging trips within 10 kilometres of the breeding site. By autumn, seals were foraging for up to six days more than 195 kilometres away from the colony (*Thompson et al., 2003*). During this period of the season, greater levels of foraging effort occurred to the south-west of the Falkland Islands.

4.323 During the JNCC Seabirds and Marine Mammals at Sea Survey (*White et al., 2002*) a total of 937 fur seals were recorded. Fur seals were recorded in all months, with a distinct mid-winter peak in June and July and a further peak in November. The peak in June and July was largely a result of the locally high numbers of animals recorded in coastal and Patagonian Shelf waters. The November peak was a result of a marked increase in the number of records in deep waters to the north-east of the Falkland Islands. Outside these months, fur seals were encountered in lower numbers throughout the survey area.

4.324 Figure 4.43 displays South American fur seal density data based on the JNCC survey results in the vicinity of the Noble licenses. It is possible that this species will be present across the Noble licenses, particularly from November to January.

### *Leopard Seal (Hydrurga leptonyx)*

4.325 The leopard seal is a winter visitor to the Falkland Islands, with only very occasional sightings reported. They are known to breed on sub-Antarctic pack ice. Their diet consists of warm blooded animals such as the crab eater seal (*Lobodon carcinophaga*) and fur seals (*IUCN, 2014*). Due to their occasional sightings they are highly unlikely to be sighted across the Noble license areas.

### *Conservation Status*

4.326 Table 4.8 below displays the conservation status of each of the pinniped species described or listed in the sections above.

***Table 4.8: Conservation status of the regularly sighted pinniped species***

| Species | IUCN Conservation Status[1] | CITES Appendix[2] | CMS Appendix[3] |
|---|---|---|---|
| South American fur seal | LC | II | II |
| Southern elephant seal | LC | II | No special status |
| Southern sea lion | LC | No special status | II |
| Leopard seal | LC | No special status | No special status |

*1: IUCN; NE – Not Evaluated; DD – Data Deficient; LC – Least Concern; NT – Near Threatened; VU – Vulnerable; EN – Endangered; CE – Critically Endangered; EW – Extinct in the Wild; EX – Extinct.*

*2: CITES Appendix I lists species that are the most endangered among CITES-listed animals and plants; CITES Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled; CITES Appendix III is a list of species included at the request of a Party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation.*

*3: CMS Appendix I – Threatened migratory species; CMS Appendix II – Migratory Species requiring International Co-operation.*

***Figure 4.37: Distribution of whale species sightings (all months) during the JNCC 'Seabirds at Sea' Survey (White et al., 2002)***

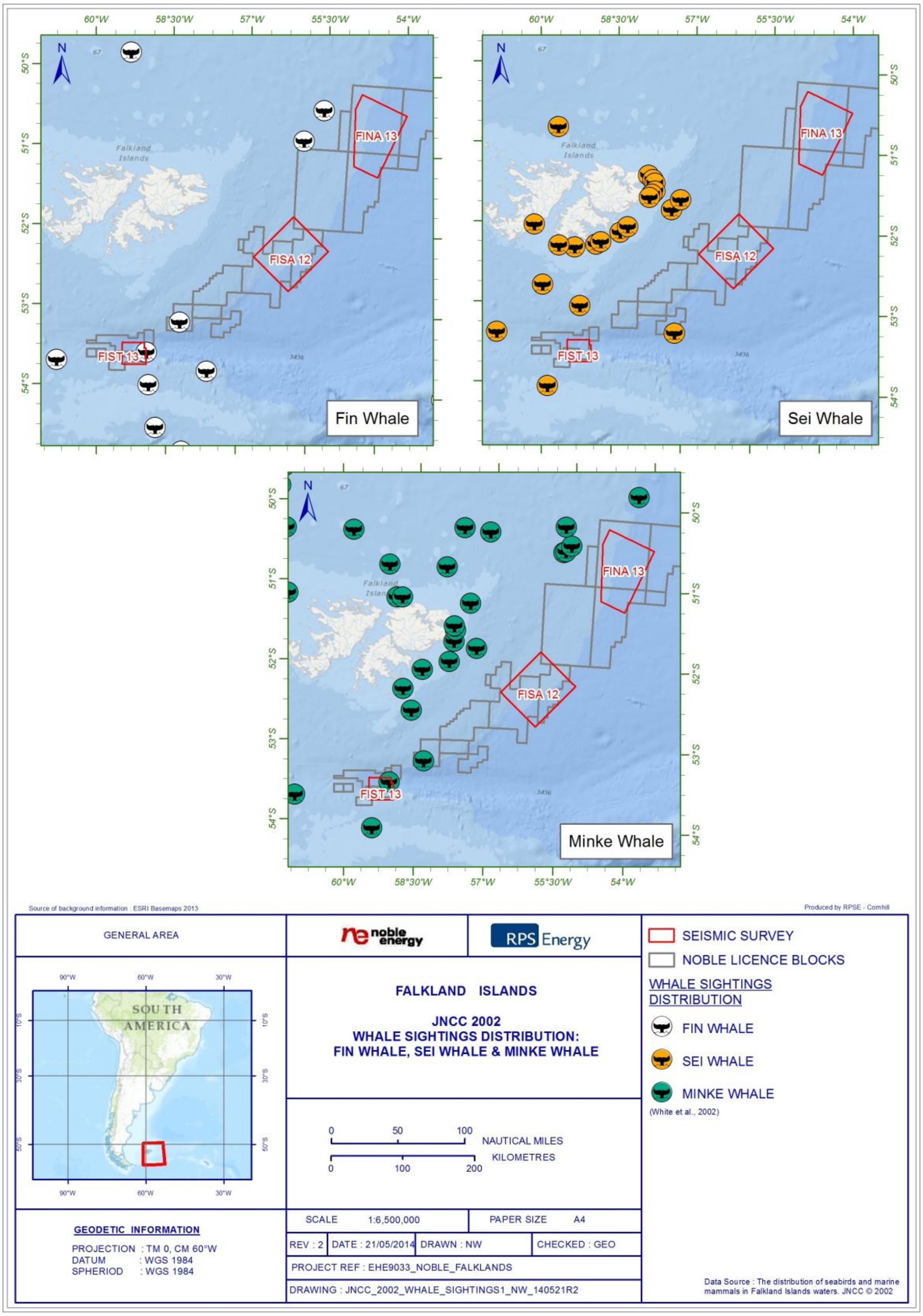


*Figure 4.38: Distribution of whale species sightings (all months) during JNCC 'Seabirds at Sea' Survey (White et al., 2002)*

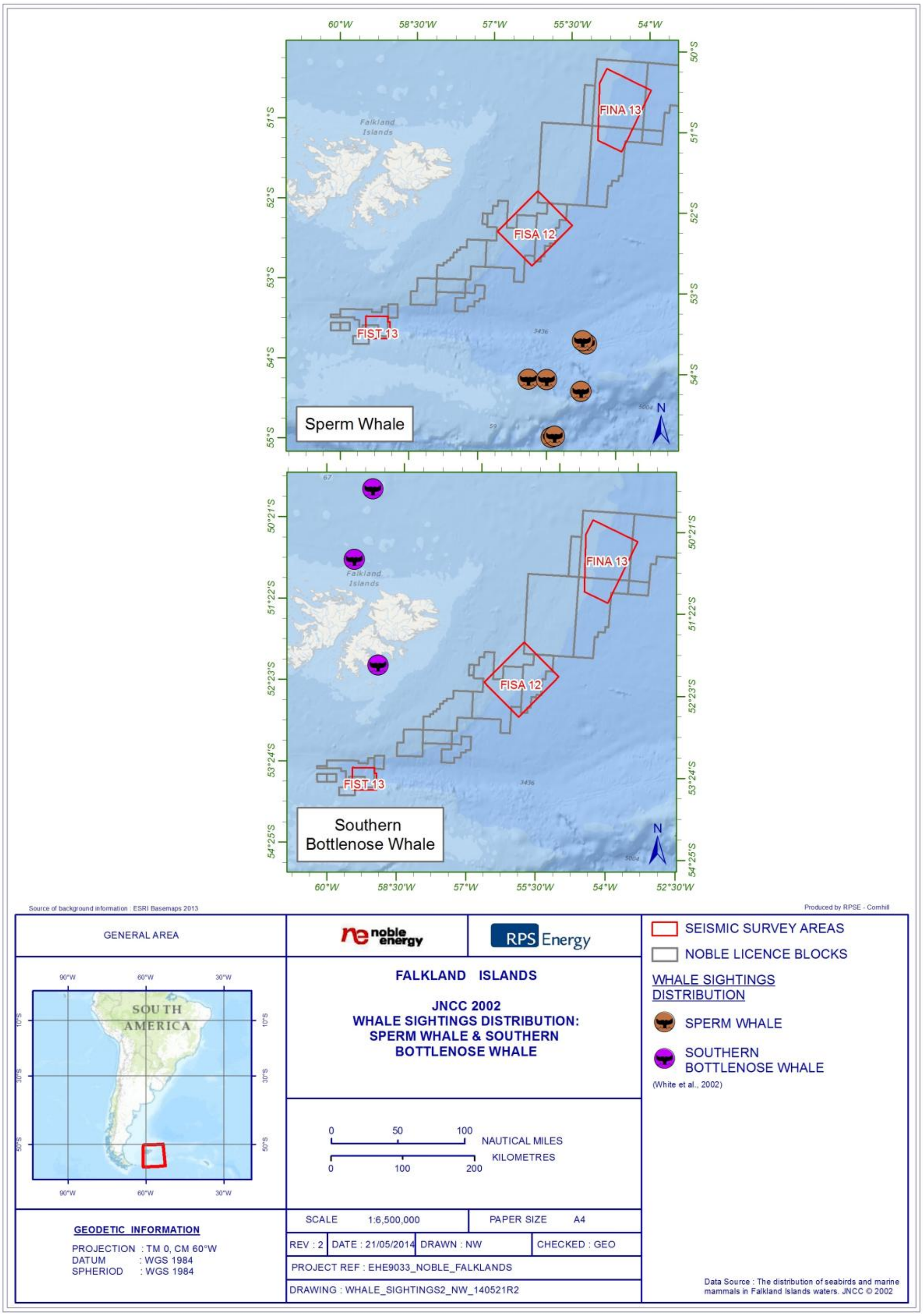


*Figure 4.39: Selected whale and dolphin species density (all months) based upon the JNCC 'Seabirds at Sea' Survey sightings data (White et al., 2002)*

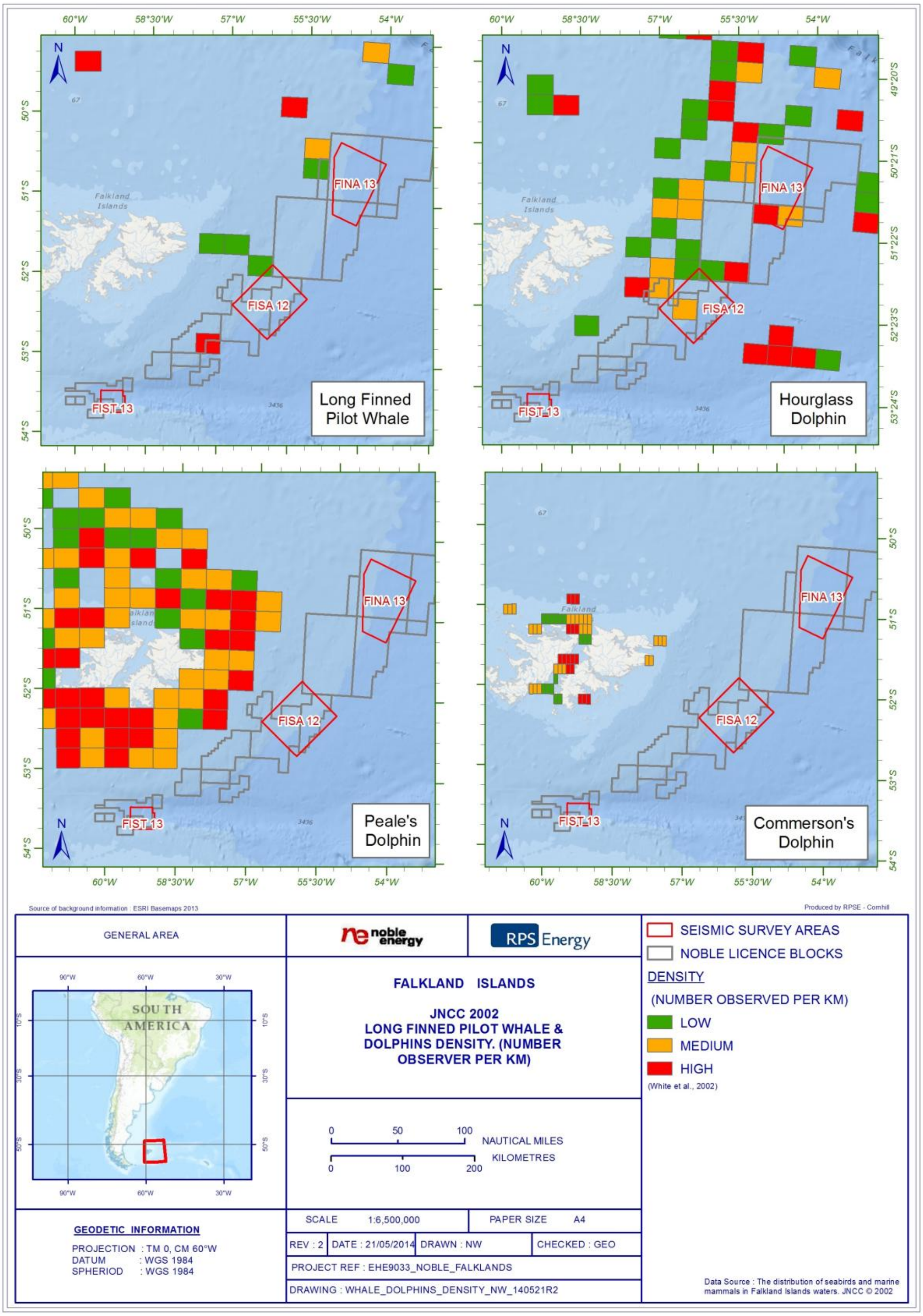


*Figure 4.40: Whale species sightings and acoustic detections recorded during recent Noble-commissioned seismic surveys of the FISA12, FIST13 and FINA12 areas (RPS, 2013 and 2014)*

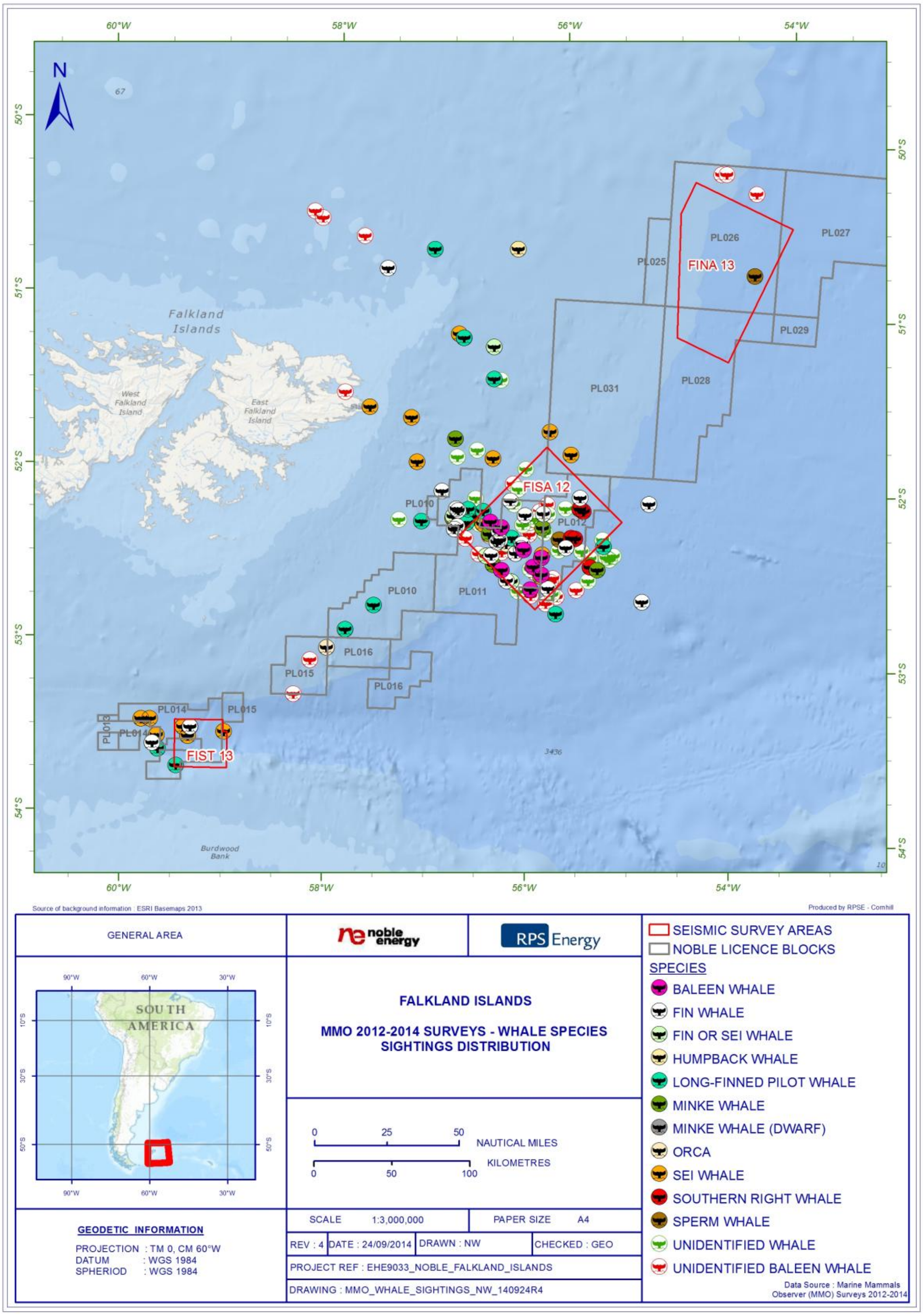


*Figure 4.41: Dolphin species sightings and acoustic detections recorded during recent Noble-commissioned seismic surveys of the FISA12, FIST13 and FINA12 areas (RPS, 2013 and 2014)*

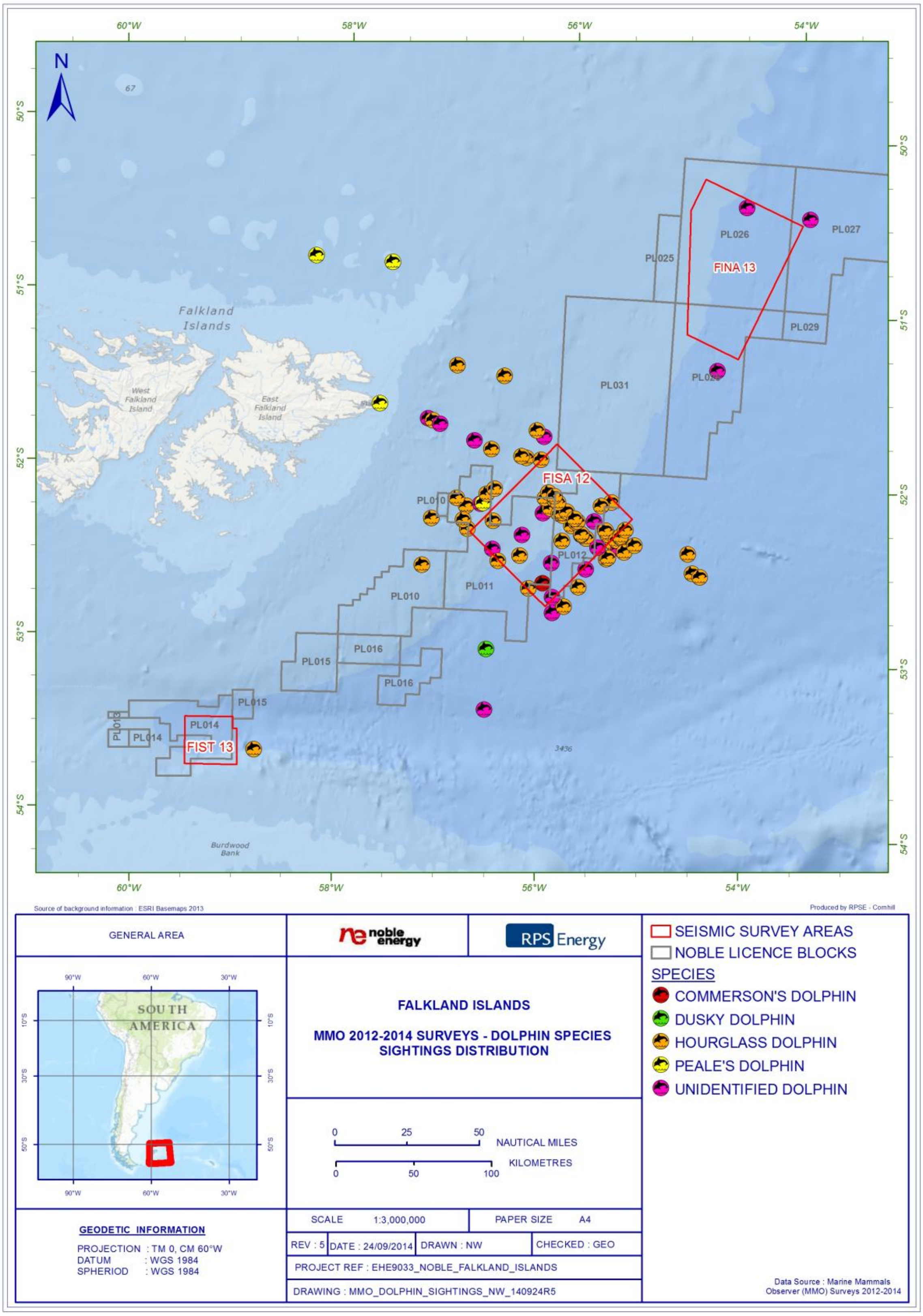


*Figure 4.42: Pinniped sightings during the 'Seabirds at Sea' Survey 1998-2001 (White et al., 2002)*

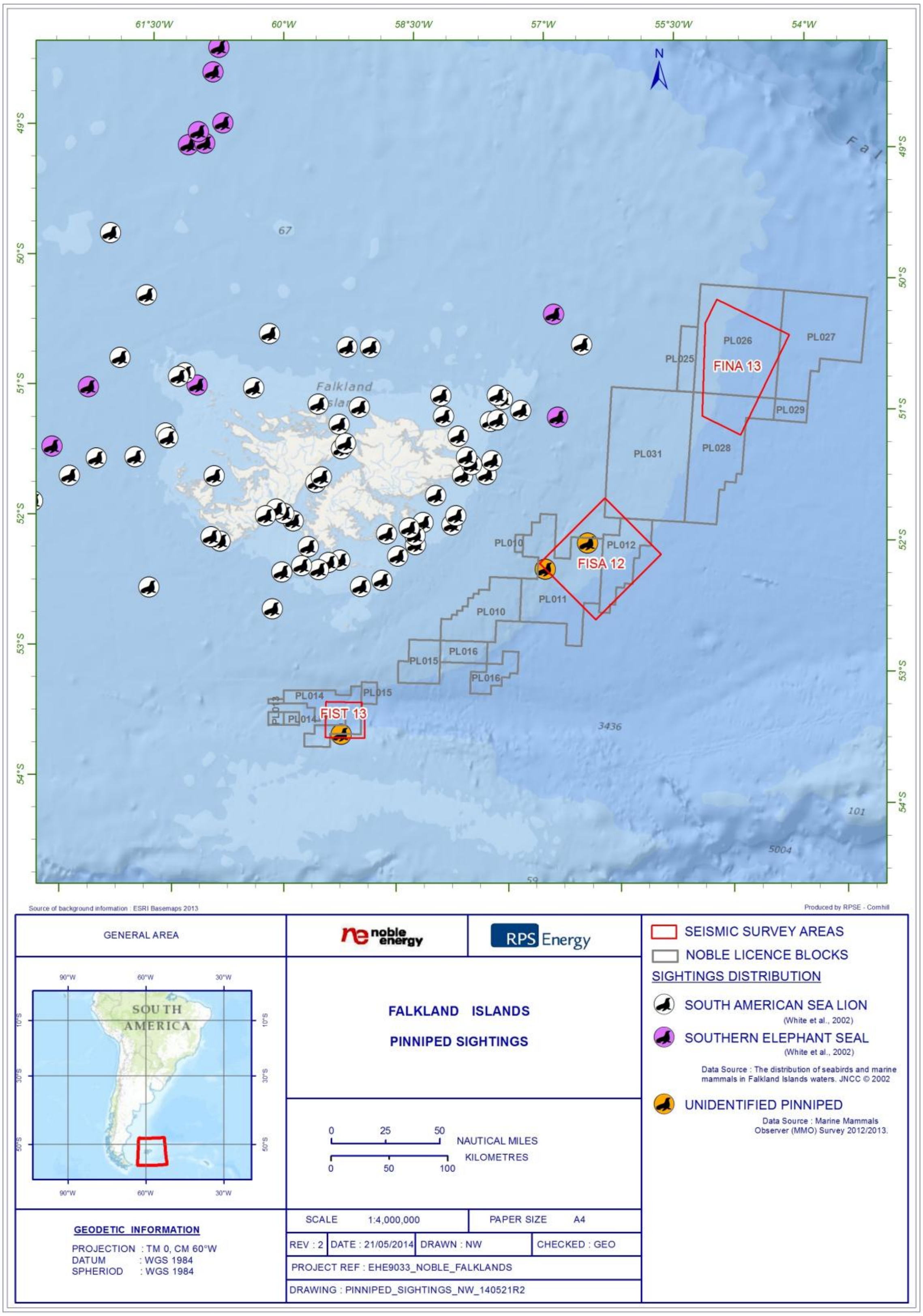
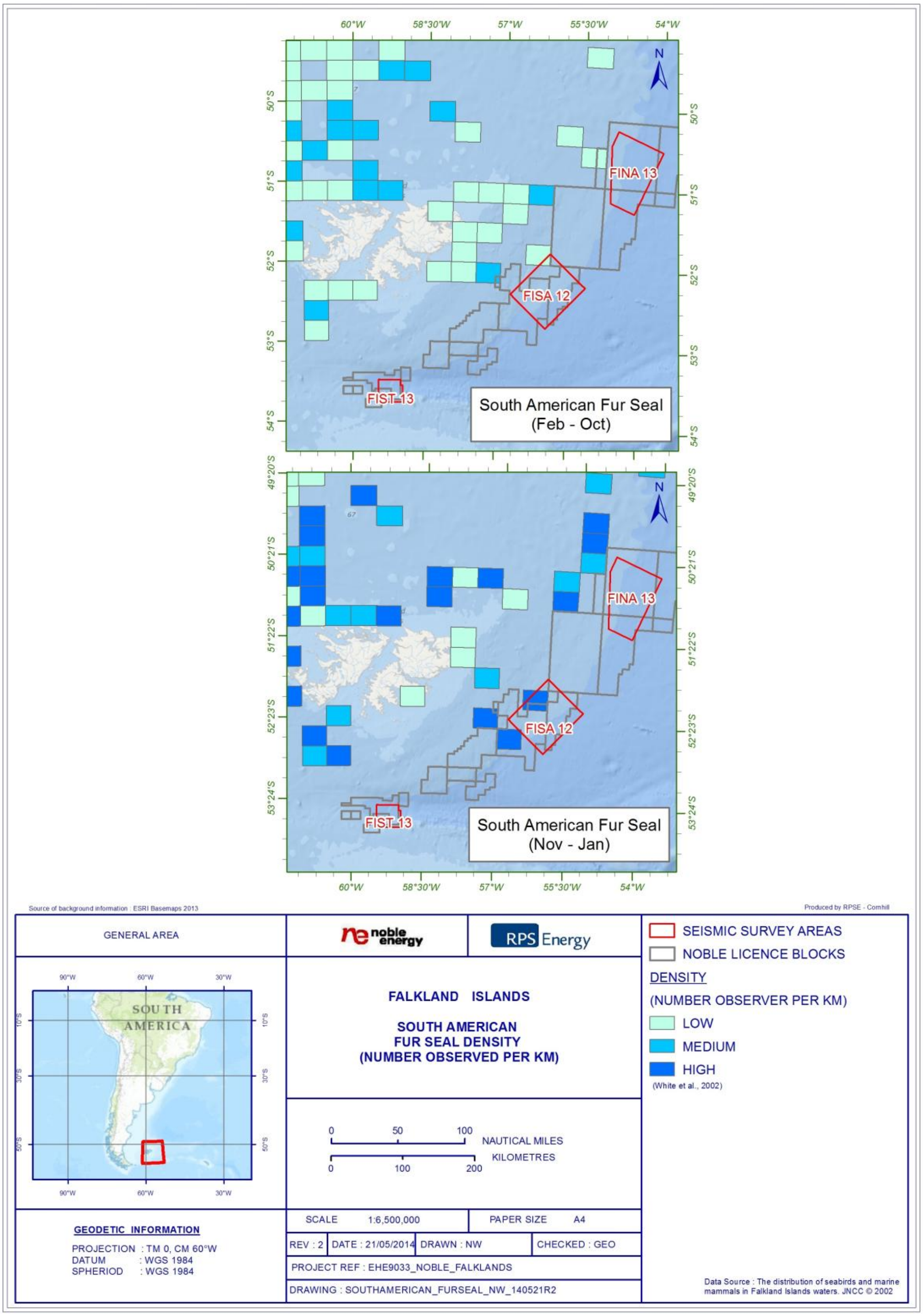


*Figure 4.43: South American fur seal density based upon the JNCC 'Seabirds at Sea' Survey sightings data (White et al., 2002)*



### 4.3.7 Seabirds

4.327 The Falkland Islands are an area of global importance for birdlife, particularly seabird populations of international significance. The East Falkland Current upwells nutrient rich water from Antarctic waters and provides an area of high plankton activity, forming the basis of the marine ecosystem and supporting seabird activity in the region.

4.328 According to Woods *et al*. (2004), there are 21 resident land birds, 18 water birds, 22 breeding seabirds, 18 annual non-breeding migrants and at least 139 occasional visitors in the Falkland Islands. The Falkland Islands support over 70 per cent of the world's breeding population of black-browed albatross (*Thalassarche melanophris*) and several rare and threatened species of petrel also breed on the Falkland Islands. There are nine species of penguins in the Falkland Islands, five of which are breeding (king penguin (*Aptenodytes patagonicus*), gentoo penguin (*Pygoscelis papua*), rockhopper penguin (*Eudyptes chrysocome*), macaroni penguin (*Eudyptes chrysolophus*) and magellanic penguin (*Spheniscus magellanicus*)).

4.329 Almost all bird species in the Falkland Islands are protected under the Conservation of Wildlife and Nature Ordinance 1999, which contains provision for the protection of wild birds, wild animals and wild plants. Other notable means of protection include the Falkland Islands Implementation Plan for the Agreement on the Conservation of Albatrosses and Petrels (ACAP) (*Wolfaardt et al., 2010*), which aims to maintain a favourable conservation status for albatrosses and petrels. The plan describes a number of measures to improve the conservation status of threatened albatross and petrel species. The plan lists out a number of species requiring protection, including those species of albatross and petrel that are considered likely to occur within the Noble license areas. The plan also identifies a total of 42 important sites for these species, nine of which are also National Nature Reserves (NNRs). The avifauna of the region is well studied and documented. Although seabird distribution, breeding and foraging patterns have been extensively studied, the data is limited to the nearshore waters and data on seabird presence, abundance and behaviour in the vicinity of the Noble licenses is patchy on both temporal and spatial scales.

4.330 The following baseline text provides information on those bird species that are known to characterise the project area and/or which may be sensitive to the proposed project. Where possible, data has been used to identify key breeding sites, describe patterns of distribution at sea, summarise populations trends and confirm species' conservation status.

#### Baseline Data Sources

4.331 The following data sources have been reviewed in order to characterise bird activity within and around the project area.

##### *The JNCC and Falklands Conservation 'Seabirds at Sea' Survey*

4.332 The JNCC and FC conducted a 'Seabirds at Sea' survey (referred to as the JNCC survey) between February 1998 and January 2001 (*White et al., 2002*). Section 4.3.6 above gives further information on data collection and survey methodology. Although the White *et al*. *(2002)* study is currently the most comprehensive study of seabirds around the Falkland Islands, the reliability of the study is limited by the age of the dataset as well as the sample methods used. During the JNCC Seabirds at Sea survey, a total of 218 bird species along with some unconfirmed sightings were recorded (*White et al., 2002*).

##### *MMO Sightings Data*

4.333 During the Noble-commissioned FISA12 and FIST13 seismic surveys, which took place from November 2012 to June 2013, bird sightings data were collected by the MMOs. Further details of the observation methodology used during the seismic surveys are given above in Section 4.3.6 and the full survey report is provided in Appendix M.

4.334 During the seismic surveys, during which a total of 1,723 hours of visual observation were undertaken, birds from a total of 12 families, including 32 positively identified species, were observed over the FISA12 and FIST13 areas. The most abundant species observed was the cape petrel (*Daption capense*), associated with a particularly large number of sightings in December and with numbers tapering off dramatically following that month. Other species with similar observation patterns (i.e., December/January peaks) included the giant petrel (*Macronectes giganteus*), southern fulmar (*Fulmarus glacialoides*), and the black-browed albatross (*Thalassarche melanophrys*). The species most regularly observed throughout the survey was the black-browed albatross, followed by the wandering albatross (*Diomedea exulans*). Relevant survey findings are presented in the species accounts in the text below.

#### Satellite Tracking Studies

4.335 Satellite-tracking data are available for a number of pelagic seabirds belonging to the Procellariiformes (albatross and petrels). These were requested for analysis from the BirdLife International Global Procellariiform Tracking Database (*BirdLife International, 2004*). This includes tracking data for several species during breeding and non-breeding seasons. A summary of the tracking data timeframes is given in Table 4.9, and the breeding seasons for these species in Table 4.10.

4.336 To better understand the potential interaction between Procellariiformes and the Noble license areas, a series of spatial maps were developed to identify their actual tracks, in addition to more general spatial density distributions for the species marked in bold in Table 4.10. The choice of species to plot was based on the amount of data available throughout the year. The spatial density distributions use utilisation distribution maps to provide probability contours based on the relative time those birds spend in particular areas (Figure 4.44). The spatial density plotted results are provided in figures 4.48 to 4.52.

4.337 It is noted that the results of more recent satellite tracking studies are also available within published papers and where relevant, reference has been made to these (e.g., *Wakefield et al., 2011*).

***Table 4.9: Seabird tracking data available in the vicinity of the Falkland Islands (BirdLife International, 2004)***

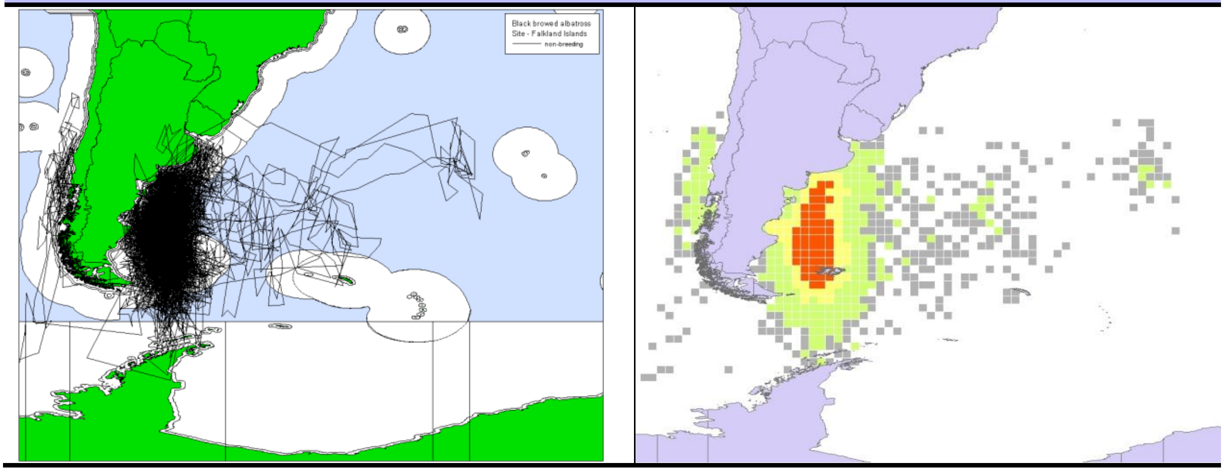
| Species | Site | Start Date | End Date | Status |
|---|---|---|---|---|
| White-chinned petrel | South Georgia | 30/11/1996 | 27/02/1998 | Breeding |
| White-chinned petrel | South Georgia | 06/02/2003 | 26/10/2003 | Non-breeding |
| Wandering albatross | South Georgia | 16/02/2004 | 05/10/2004 | Breeding |
| Northern royal albatross | Chatham Island | 04/11/1994 | 21/05/1996 | Breeding |
| Northern royal albatross | New Zealand | 06/11/1993 | 04/02/1998 | Breeding |
| Northern royal albatross | New Zealand | 11/02/1998 | 27/11/1998 | Non-breeding |
| Black-browed albatross | Falkland Islands | 13/02/2000 | 04/12/2000 | Breeding |
| Black-browed albatross | Falkland Islands | 04/11/1998 | 08/03/1999 | Breeding |
| Black-browed albatross | Falkland Islands | 03/11/2006 | 27/11/2006 | Breeding |
| Black-browed albatross | Falkland Islands | 19/04/2007 | 16/08/2007 | Non-breeding |
| Black-browed albatross | Falkland Islands | 04/01/1999 | 01/10/2000 | Breeding |
| Black-browed albatross | Falkland Islands | 28/02/1999 | 01/10/2000 | Non -breeding |
| Northern giant petrel | South Georgia | 29/10/1998 | 01/12/1998 | Breeding |
| Southern giant petrel | South Georgia | 08/11/1998 | 05/01/1999 | Breeding |

*Table 4.10: Breeding and non-breeding seasons of seabirds (BirdLife International Database, 2004)*

| Species | Breeding status | Months Covered by Data | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| **Black-browed albatross** | **Breeding (Figure 4.48)** | | | | | | | | | | | | |
| **Black-browed albatross** | **Non-breeding (Figure 4.49)** | | | | | | | | | | | | |
| **Northern royal albatross** | **Non-breeding (Figure 4.50)** | | | | | | | | | | | | |
| **Wandering albatross** | **Breeding (Figure 4.51)** | | | | | | | | | | | | |
| **White-chinned petrel** | **Non-breeding (Figure 4.52)** | | | | | | | | | | | | |
| White-chinned petrel | Breeding | | | | | | | | | | | | |
| Northern giant petrel | Breeding | | | | | | | | | | | | |
| Southern giant petrel | Breeding | | | | | | | | | | | | |
| | | | Key: | | | Breeding | | | | Non-breeding | | | |

*Figure 4.44: An example of utilisation distribution maps that can be produced from the satellite tracking data (BirdLife International, 2004)*

**Black browed albatross non-breeding**



#### *Other Studies*

4.338 Other notable studies relevant to the project area include that of Otley *et al*. (2007), who studied patterns of seabird attendance at Patagonian toothfish long-liners in the oceanic waters of the Falkland Islands, between 2001 and 2004 (*Otley, 2007*). A total of 547 sightings of 291 banded wandering albatross *Diomedea exulans* and 21 sightings of 14 banded giant petrels *Macronectes spp.* were made during the study period (*Otley, 2007*). In addition, observer data is routinely recorded on long-line fishing vessels by the Falkland Islands Department of Natural Resources - Fisheries Department. Data from 2000 to 2011 provided by the Department indicate that the most commonly observed seabirds on long-line fishing vessels include giant petrel, cape petrel and black-browed albatross (Figure 4.45). Other less abundant petrel and albatross species were also recorded (Figure 4.46). It is noted that these datasets are potentially biased as a result of seabirds being attracted to bait/vessel catches and that they do not result from targeted, robust survey.

4.339 Useful contextual information relating to breeding colonies and population trends has been gathered from data presented on the Falklands Conservation website, including the results of the Falkland Island Seabird Monitoring Programme (FISMP) (annual census of selected colonies 1990 – present), and the Island Wide Census (conducted at five-yearly intervals since 1995).

*Figure 4.45: Commonly Observed Birds From Long-line Fishing Vessels (FIFD database, 2000-2011)*

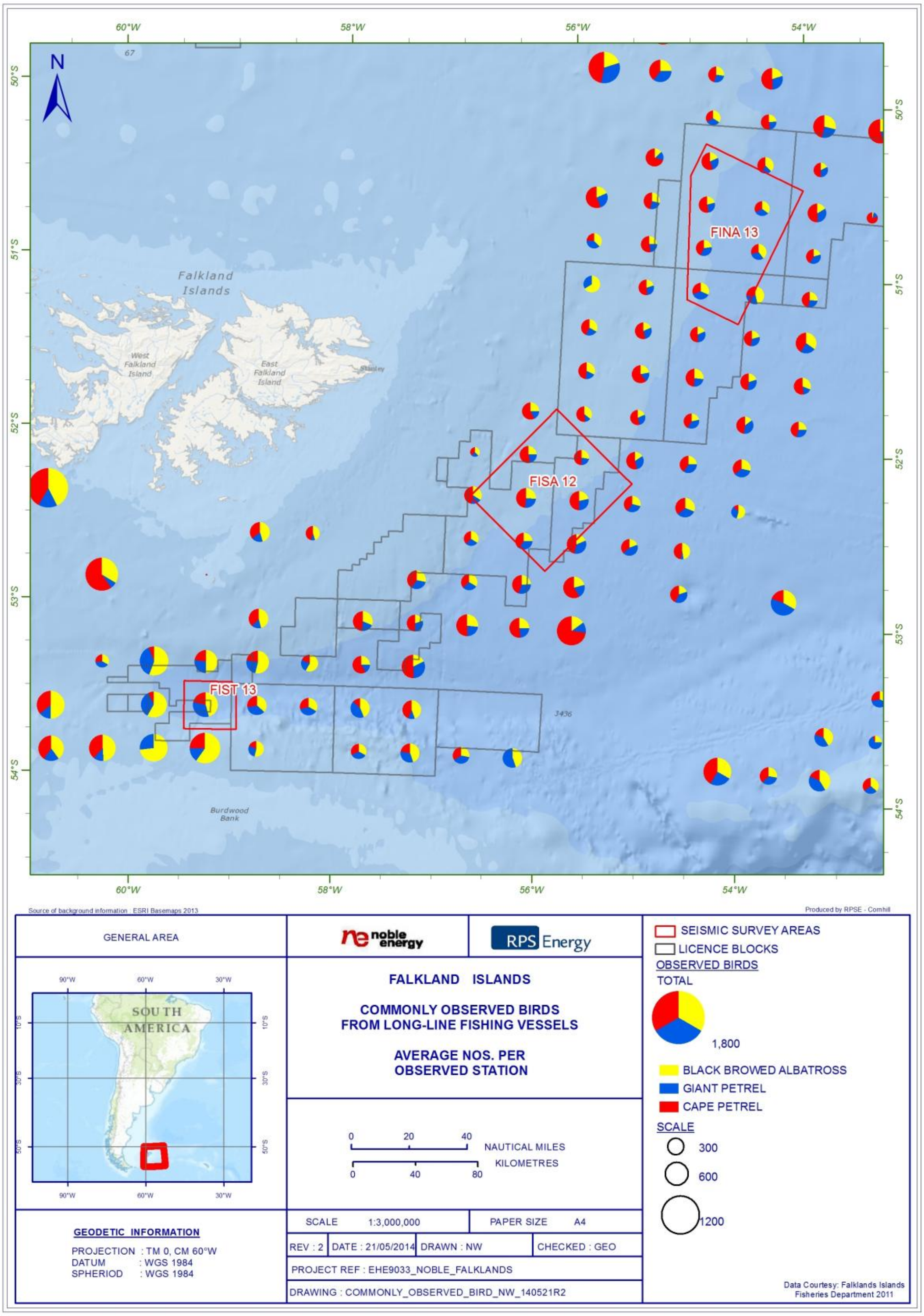
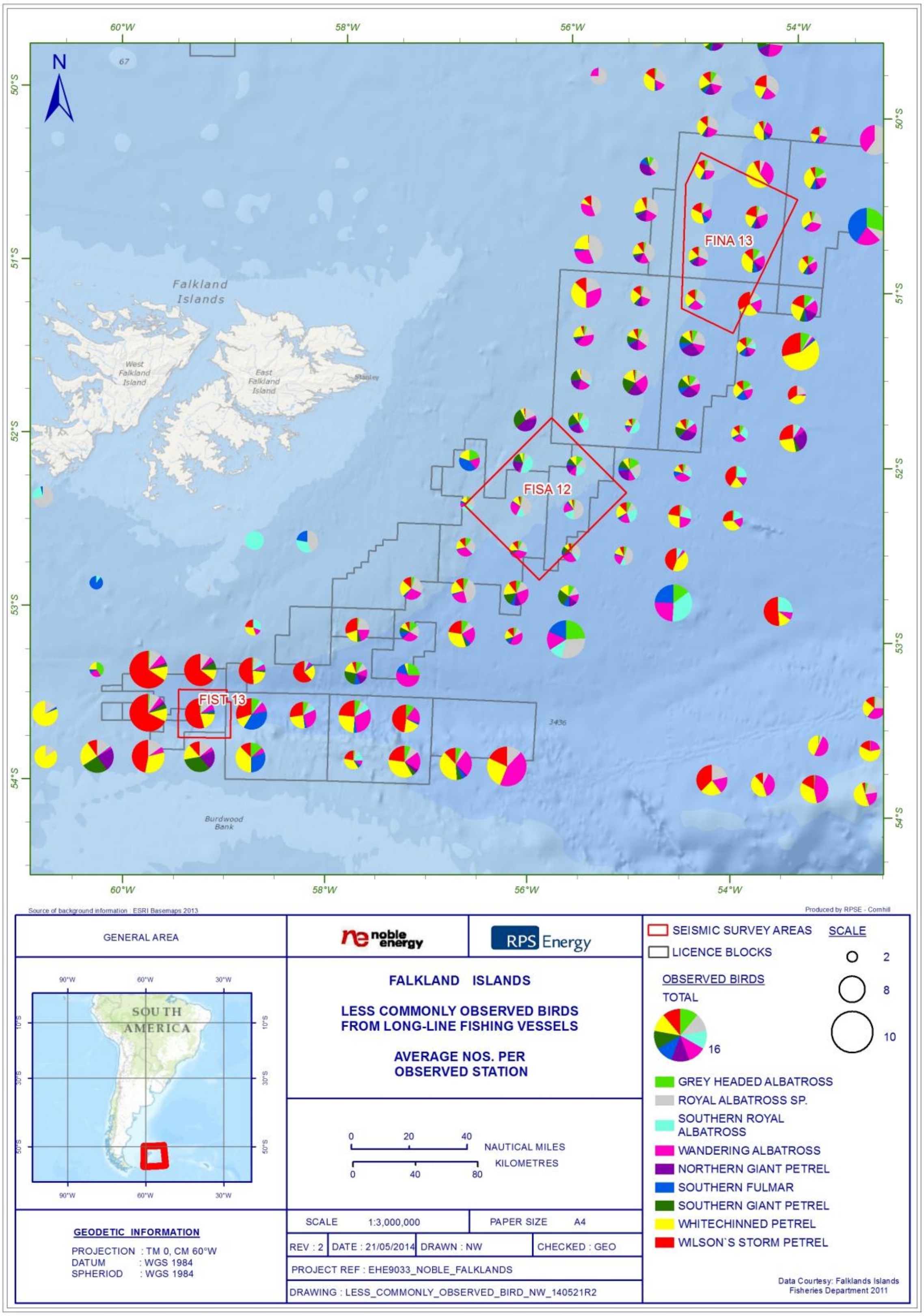


*Figure 4.46: Less Commonly Observed Birds From Long-line Fishing Vessels (FIFD database, 2000-2011)*



### Key Species Accounts

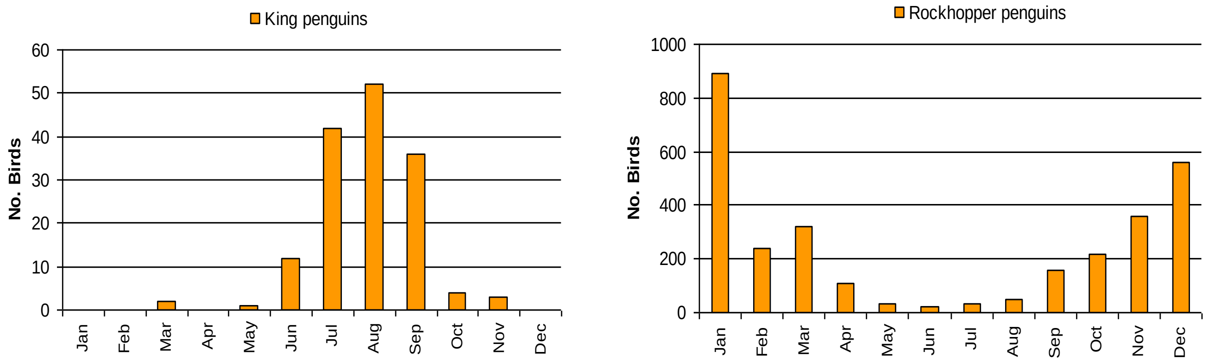
#### *Penguins*

4.340 Nine penguin species have been recorded in the Falkland Islands, of which the following six were identified during the JNCC survey between 1998 and 2001 (Figure 4.47):

- King penguin (*Aptenodytes patagonicus*);
- Gentoo penguin (*Pygoscelis papua*);
- Rockhopper penguin (*Eudyptes chrysocome*);
- Macaroni penguin (*Eudyptes chrysolophus*);
- Magellanic penguin (*Spheniscus magellanicus*); and
- Chinstrap penguin (*Pygoscelis Antarctica*).

4.341 Based on the existing sightings data (*White et al., 2002*), the species most likely to occur over the Noble licenses areas are the king penguin and rockhopper penguin. The former tend to occur in offshore waters between June and September and the latter between September and November.

***Figure 4.47: King and rockhopper penguin sightings recorded during the JNCC 'Seabirds at Sea' Survey, 1998-2001 (White et al., 2002)***




**<u>King penguin (*Aptenodytes patagonicus*)</u>**

4.342 The Falkland Islands population of king penguin (*Aptenodytes patagonicus*) makes up only 0.04 per cent of the world population and is considered to be of local rather than global importance (*Munro, 2004*). However, since the Falkland Islands population is mostly limited to one site, its vulnerability increases with regards to potential disturbance events such as oil spills. The global population of king penguin is increasing and it is considered to be a species of 'Least Concern' by the IUCN (*IUCN, 2014*). The Falkland Islands colony of king penguins is very important for tourism, as it represents the most accessible colony on earth.

4.343 The Falkland Islands population of king penguin is almost entirely concentrated at Volunteer Point on East Falkland Island, where they established themselves in the late 1970s, approximately 100 kilometres from the closest Noble license area. A few individuals can also be found nesting amongst gentoo penguins at several locations within the Falkland Islands (*Huin, 2007*). By 1980, a small breeding population was present and since 1991, the population has been monitored annually and the resulting fledgling counts analysed to assess population trends. The population demonstrated a significant increase over the past three decades, at about 10 per cent per annum. The 2012 population was estimated to be 720 breeding pairs (*Pistorius et al., 2012*) and the most recent FC seabird monitoring report states that the number of pre-fledged chicks at Volunteer in the 2013 season was down 14.9 per cent on the 2012 (*Stanworth, 2014*).

4.344 By mid-winter birds begin to forage north of the Falkland Islands around the Patagonian Continental Shelf and slope waters within the Antarctic Polar Frontal Zone, travelling over vast distances of several thousand kilometres (*Pütz , 2002*). This area is used by many bird species as a winter feeding ground. In total, 151 king penguins were recorded during the 1998 – 2001 seabirds at-sea surveys (the JNCC survey) on 81 occasions, almost entirely between May and November (Figure 4.47). The majority of king penguin records during the JNCC survey occur to the north of the Falkland Islands between June and September (*White et al., 2002*). There were some sightings around the eastern coast of the Falkland Islands and in the vicinity of the Burdwood Bank, suggesting it is possible that king penguins may be encountered foraging in the vicinity of the Noble license areas (*White et al., 2002*).

**Rockhopper Penguin (*Eudyptes chrysocome*)**

4.345 The rockhopper penguin has been split into the northern rockhopper penguin (*E. moseleyi*) and southern rockhopper penguin (*E. chrysocome*). It is the southern rockhopper penguin that breeds in the Falkland Islands. The South Atlantic region holds the sub-species of the southern rockhopper penguin (*Eudyptes chrysocome*) with breeding locations at offshore islands in southern Chile and Argentina and at the mainland and offshore islands in the Falkland archipelago. The northern rockhopper penguin is occasionally spotted on the Falkland Islands, although is not thought to breed there (*Matias et al., 2009*).

4.346 The most recent population estimate for southern rockhopper penguins at the Falkland Islands was 319,163 pairs in 2010 (*Baylis et al., 2013*) representing thirty-six percent of the South Atlantic population and the 2014 FC seabird monitoring report recorded a 6.7 per cent increase in breeding pair numbers across five monitoring locations (*Stanworth, 2014*). The Falkland Islands has experienced one of the largest population declines, from an estimated 1.5 million pairs in the 1930's (*Pütz et al., 2003*) to just under 300,000 pairs at the first comprehensive breeding census in 1995 (*Bingham, 1998; Huin, 2007*). Recent estimates of high survival rates are attributed to favourable environmental conditions between the 2005 and 2010 island wide censuses (*Dehnhard et al., 2013*) and thought to have contributed to a 51 per cent breeding population increase during this period (*Baylis et al., 2013*). The overall decline of the rockhopper population has led to the IUCN classifying it as a vulnerable species (*IUCN, 2014*) and the species is also the subject of a Falkland Islands Action Plan, which aims to aid the effective conservation and management of the species (*Crofts, 2014).*

4.347 There are around 52 breeding sites in the Falkland Islands; Steeple Jason Island and Beauchêne Island account for the two largest breeding populations at the Falkland Islands at thirty-eight percent and thirty-one percent respectively.

4.348 Rockhopper penguins have been observed at significant distances from the Falkland Islands. Foraging range studies indicate that during the brood period (small chick) in December, penguins generally forage within 40 kilometres of their colony (*Masello et al., 2010; Crofts, 2012*). Outwith this period the birds forage over much greater distances; in November during the incubation period birds forage in areas over 100 kilometres from their colonies, and during winter birds travel up to 1,250 kilometres from their colony (*Ratcliffe at al., 2014*). Tagging studies have confirmed that rockhopper penguins forage both very close (<10 km) and at great (>100 km) distances from their colonies and that they forage in and/or travel through areas designated for oil and gas development in Falkland Islands waters (e.g., *Boersma et al., 2002; Pütz et al., 2003*).

4.349 Available data suggests that rockhopper penguins may be present and possibly foraging within the project area, particularly in winter months.

**Gentoo Penguin (*Pygoscelis papua*)**

4.350 The Falkland Islands support a large proportion of the global population of Gentoo penguin. Gentoo penguins are resident in the Falkland Islands throughout the year. There are approximately 85 breeding colonies in the Falkland Islands; although Gentoo penguins are widely distributed throughout the Falkland Islands, most are found around West Falkland and the outer islands.

4.351 The population was estimated at 64,426 breeding pairs in 1995/1996, increasing to 132,321 in 2010 (*Baylis, 2012*). Annual monitoring of breeding populations takes place at fourteen locations throughout the Falkland Islands and the latest FC monitoring report states that in the 2013/2014 season, estimated numbers of penguin breeding pairs at monitored sites decreased by 13 per cent from the previous season. Given similar previous fluctuations in what has been an increasing population trend over the last nine years, there is currently no indication of any overall decline (*Stanworth, 2014*). A significant reduction in gentoo penguin numbers between 2000 and 2005 was due to paralytic shellfish poisoning resulting from a red algal bloom in 2002. This species is considered 'near threatened' by the IUCN (*IUCN, 2014*).

4.352 A total of 3,896 gentoo penguins were recorded during the JNCC survey. Penguins were recorded in all months, peaking between April and September, and only a small number of birds were recorded far offshore.

4.353 Tracking of foraging gentoo penguins shows that the birds are predominantly inshore foragers and generally do not venture more than several kilometres from the Falkland Islands coast, though in winter, foraging trips may be undertaken up to 300 kilometres from the shore (*White et al., 2002; Pistorius et al., 2010*). Based upon their known foraging behaviour and available offshore sightings data, it is unlikely that Gentoo penguins would be encountered within the Noble license areas.

**Magellanic Penguin (*Spheniscus magellanicus*)**

4.354 The magellanic penguin is a summer visitor to the Falkland Islands. It is found all around the coastline where ground is suitable for burrowing, particularly in areas of tussac or where tussac previously grew. No accurate survey has been undertaken but numbers are estimated to be about 100,000 pairs (*Woods & Woods 1997*), probably less than 10 per cent of the world population. FISMP annual reporting records penguin burrow density and burrow occupancy; the most recent FISMP reporting stated that breeding penguins showed a similar burrow occupancy rate to the previous season and that there had been no reduction in breeding area (*Stanworth, 2014*).

4.355 The total world population is estimated to comprise more than 1 million breeding pairs and the species is considered to be 'Near Threatened' by the IUCN (*IUCN, 2014*).

4.356 A study by Pütz *et al.* (2002) indicates that magellanic penguins can travel long distances and males have been recorded foraging several hundred kilometres from shore during the initial incubation period (October/November) (*BirdLife International, 2011*).

4.357 More than 12,000 Magellanic penguins were recorded during the JNCC survey, mainly between November and April, with the highest densities recorded between December and February (*White et al., 2002*). Very few sightings of magellanic penguins were made in the vicinity of the Noble licenses, although some sightings were made in the vicinity of the Burdwood Bank. On the basis of available at-sea data and known species foraging range, it is possible that Magellanic penguins may be present in small numbers in the vicinity of the Noble licenses.

**Macaroni Penguin (*Eudyptes chrysolophus*)**

4.358 The macaroni penguin is the least common breeding penguin species in the Falkland Islands, with 24 pairs recently recorded at 19 rockhopper penguin colonies, mostly on the eastern side of the Falkland Islands (*Huin, 2007*). The IUCN Red List classifies this species as 'Vulnerable' due to its decreasing population (*IUCN, 2014*). Mixed pairs of rockhopper and macaroni penguins have been observed, suggesting that hybridisation may occur between the species (*White & Clausen, 2002*).

4.359 The macaroni penguin is globally the most common species of penguin, with millions of pairs present in the Southern Atlantic and Indian Oceans (*Munro, 2004*). The occurrence of vagrant individuals in the Falkland Islands is therefore of local interest.

4.360 The JNCC survey recorded *macaroni penguins* mainly between June and October, with significant numbers present only in August and September. The data shows offshore distribution of macaroni penguins to the north-east of the Falkland Islands during these months (*White et al., 2002*), which may overlap with Noble's northern area license.

**Chinstrap penguin (*Pygoscelis antarctica*)**

4.361 Chinstrap penguins (*Pygoscelis antarctica*) do not breed in the Falkland Islands. This species has a wide circumpolar distribution and therefore their occasional presence in the vicinity of the Falkland Islands is to be expected. A total of 24 individuals were recorded on 10 occasions during the JNCC survey (*White et al., 2002*). All records occurred between August and October to the south-east of the Falkland Islands. Given their wide distribution, it is possible that this species could be encountered in the vicinity of the Noble licenses, particularly in the southern areas.

### *Albatross*

4.362 Albatross species are globally declining, with population numbers observed to have fallen by 28 percent between the 1960s and 1980s (*Woods, 1988*). Eleven species of albatross have been recorded in the Falkland Islands, although only the black-browed albatross is a resident breeding species.

4.363 The following species of albatross recorded in the Falkland Islands are listed as 'Endangered' or 'Vulnerable' on the IUCN Red List:

- Grey-headed albatross (*Thalassarche chrysostoma*) – Vulnerable;
- Northern royal albatross (*Diomedea sanfordi*) – Vulnerable;
- Southern royal albatross (*Diomedea epomophora*) – Endangered;
- Sooty albatross (*Phoebetria fusca*) – Endangered;
- Wandering albatross (*Diomedea exulans*) – Vulnerable; and
- Yellow-nosed albatross *(Thalassarche chlororhynchos)* – Endangered.

4.364 Of the species listed above, the black-browed albatross (year-round) and wandering albatross (year-round) are most likely to be encountered across the proposed exploration drilling areas (*White et al., 2002*). This assumption is supported by observations made during recent offshore Noble-commissioned seismic surveys, where the black-browed albatross was the most frequently observed species of albatross (*RPS, 2013*).

**Black-browed Albatross (*Thalassarche melanophris*)**

4.365 *Thalassarche melanophris* has a circumpolar distribution ranging from subtropical to polar waters. It breeds in several locations, including the Falkland Islands, which support 70 per cent of the world population of this species. The annual breeding population in the Falkland Islands was estimated at 475,500-535,000 pairs in 2010 (*Wolfaardt, 2012*) (increase from ~400,000 in 2005) and most recent FISMP reporting recorded stable to increasing breeding numbers in 2013 (*Stanworth, 2014*). The species is listed as 'Near Threatened' by the IUCN (*IUCN, 2014*) on the basis that it is no longer estimated to be undergoing rapid population declines. Most recent survey data from the Falkland Islands (*Stanworth, 2014*) indicates stable to increasing breeding numbers at monitored colonies.

4.366 The black-browed albatross breeds on 11 islands in the Falkland Islands and at one location on West Falkland (Grave Cove); approximately 70 percent of the Falkland albatross breed on Steeple Jason (estimated 196,600-232,700 pairs) and Beauchêne Island (estimated 140,000-170,000 pairs) (*Wolfaardt, 2012*). This species forages widely and a recent satellite tracking study has indicated that they forage more widely during the incubation period and that throughout breeding the order of habitat preference is for neritic (0-500 metres), shelf-break and upper shelf slope (500-1,000 metres), and then oceanic (>1,000 metres) (*Wakefield et al., 2011*). During the non-breeding season black-browed albatross make fewer landings, remain on the surface of the water for longer each time and spend a greater proportion of the day on the water compared to during the breeding season (*Gremillet et al., 2000*).

*Figure 4.48: Satellite Tracking utilisation distribution of black-browed albatross, breeding season (BirdLife International Database, 2004)*

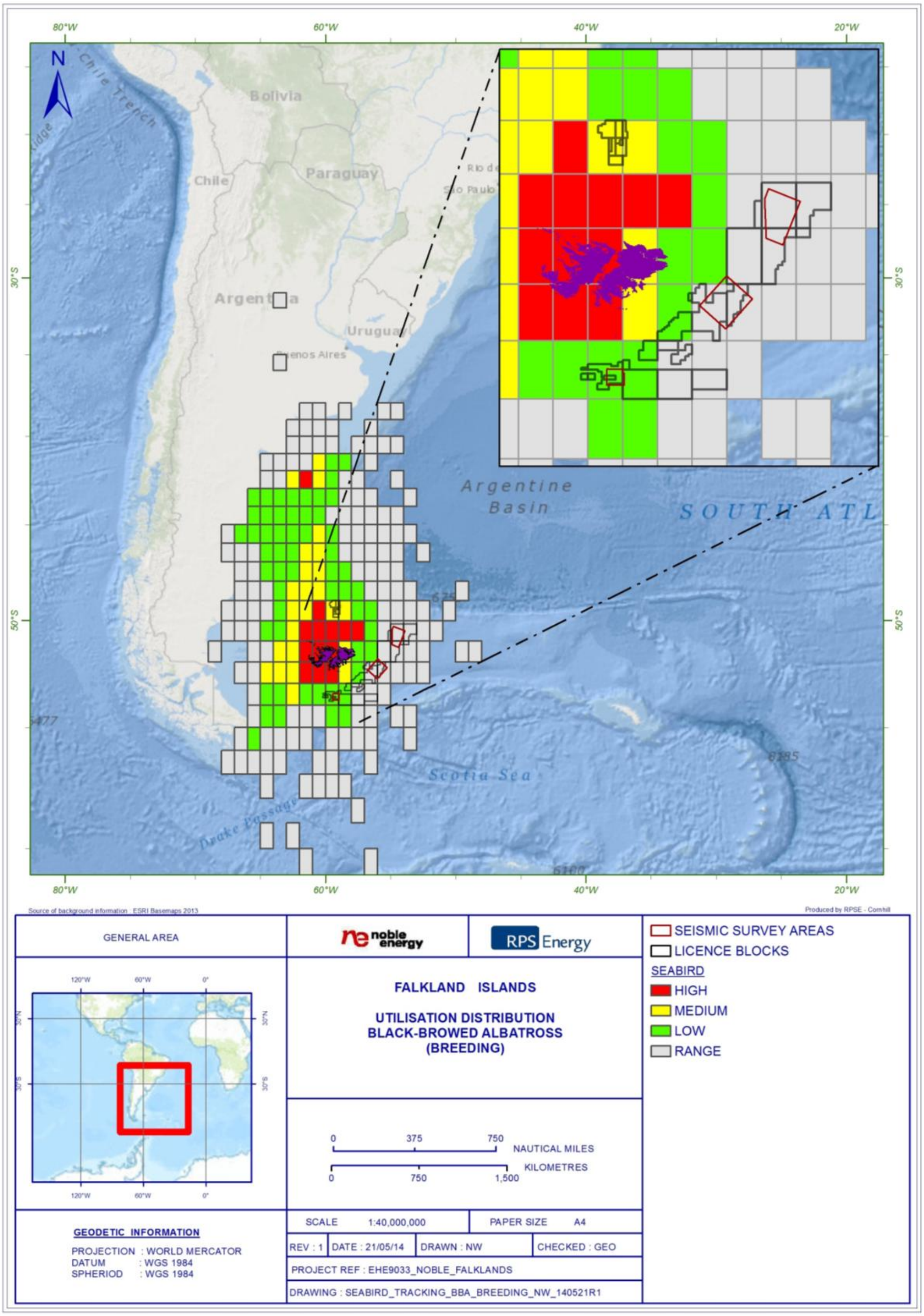
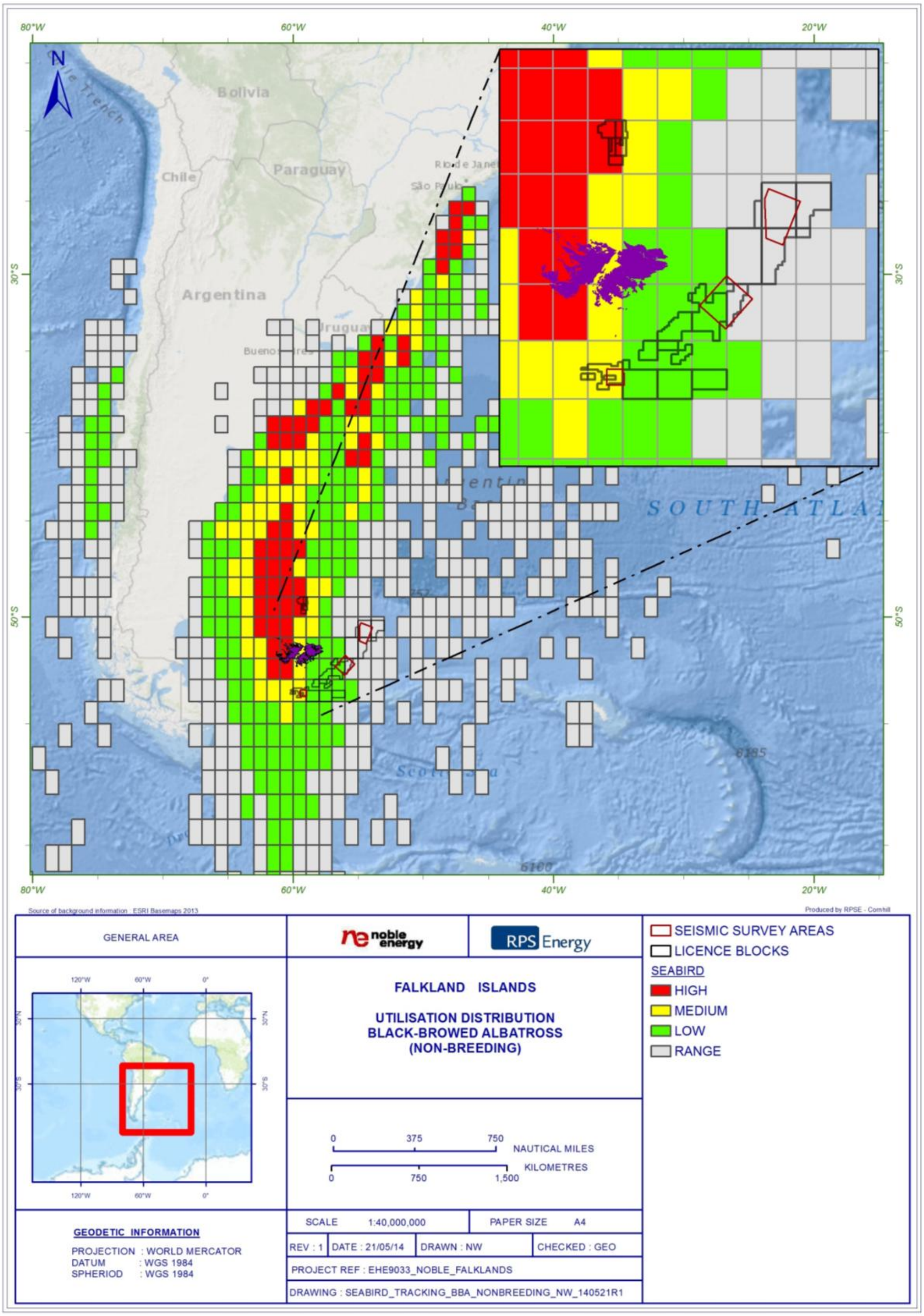


***Figure 4.49: Satellite Tracking utilisation distribution of black-browed albatross, non-breeding season (BirdLife International Database, 2004)***




4.367 During at-sea surveys, black-browed albatross were recorded throughout the year with a total of 84,614 birds being recorded (*White et al., 2002*). The highest densities were consistently observed around the west of the Falkland Islands. Observations of black-browed albatross made by MMOs during the Noble-commissioned seismic surveys indicate that this species will be encountered offshore throughout the Noble license areas with 522 individuals observed in 121 days from November 2012 to June 2013 (*RPS, 2013*). Satellite tracking data backs up such assumptions (Figures 4.48 and 4.49).

**Grey-headed Albatross (*Thalassarche chrysostoma*)**

4.368 Grey-headed albatross visit the Falkland Islands from breeding grounds in South Georgia and Diego Ramirez. This species is classified as 'Endangered' on the IUCN Red List (*IUCN, 2014*).

4.369 A total of 1,321 grey-headed albatross were recorded during the JNCC survey, in all months, with a peak between May and September (*White et al., 2002*). Distribution between July and January was concentrated in waters to the east of the Falkland Islands. During this time, the birds are likely to be present around the Noble license areas. Between February and June, grey-headed albatross were mainly spotted to the west of the Falkland Islands (*White et al., 2002*). Three grey-headed albatross were observed by the MMOs during the Noble seismic survey (*RPS, 2013*), although the JNCC survey results suggest that abundance across the Noble license areas will be higher at other times of the year.

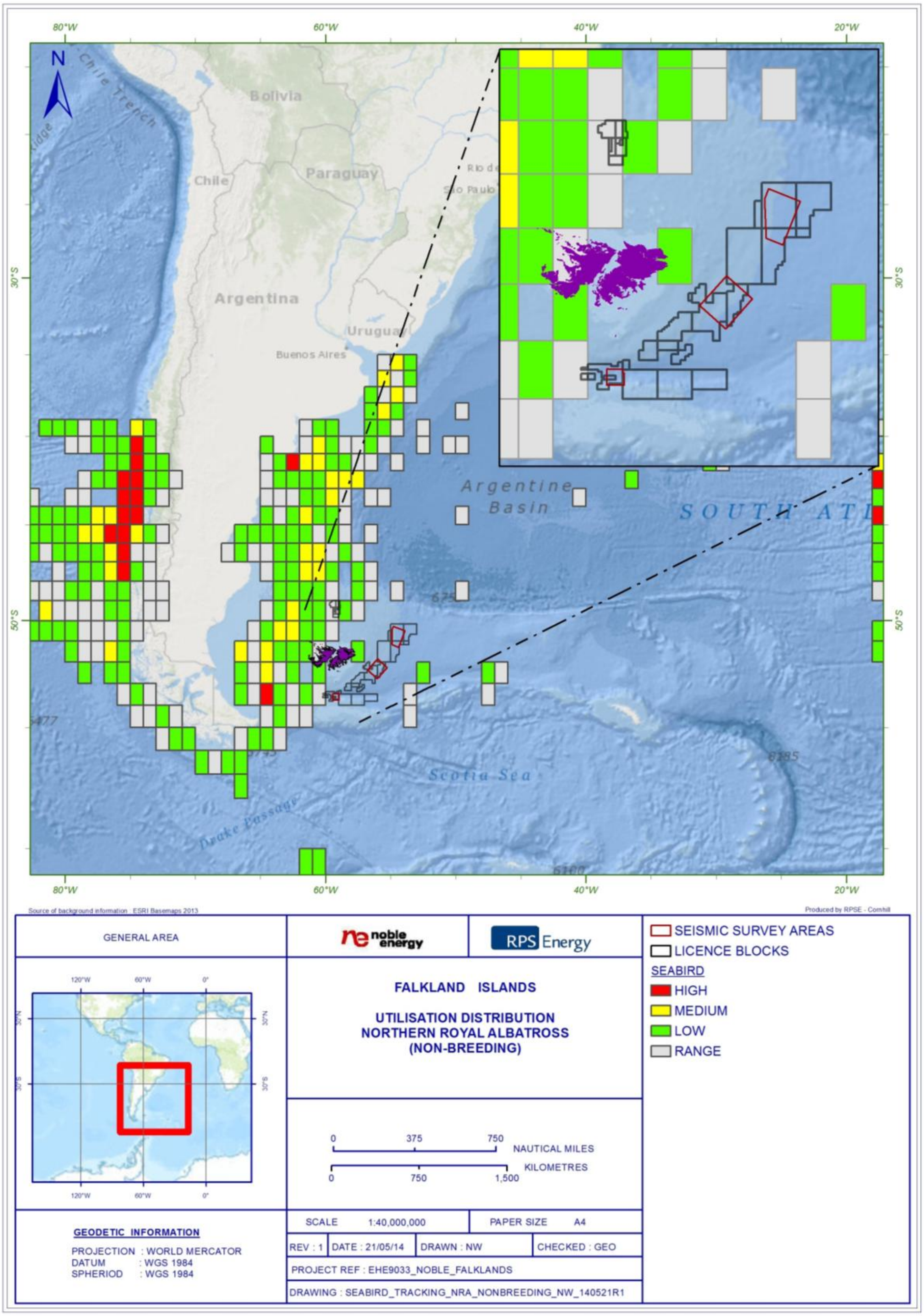
**Northern (*Diomedea sanfordi*) & Southern (*Diomedea epomophora*) Royal Albatross**

4.370 The royal albatross are also visiting species to the Falkland Islands, breeding in New Zealand and using the South Pacific and Patagonian Shelf as feeding grounds. The southern royal albatross is classified as 'Vulnerable' whereas the northern royal albatross is 'Endangered', according to the 2014 IUCN Red List.

4.371 Of the 4,114 royal albatross recorded during the JNCC survey, (1998–2001), 3,252 were identified as southern albatross and 447 as northern albatross (with 415 not determined) (*White et al., 2002*). Highest numbers of southern royal albatross were seen between March and June, particularly to the north-west of the Falkland Islands.

4.372 Seven northern royal albatross were observed over 4 days by the MMOs during the Noble seismic survey, and 12 southern royal albatross over 8 days (*RPS, 2013*). These sightings, along with satellite tracking data (Figure 4.50), suggest that it is possible that these species of royal albatross may frequent the Noble license areas, although not in as high numbers as other albatross species.

*Figure 4.50: Satellite Tracking utilisation distribution of northern royal albatross, non-breeding season (BirdLife International Database, 2004)*



### Light-mantled Sooty Albatross (*Phoebetricia palpebrata*)

4.373 The light-mantled sooty albatross (*Phoebetricia palpebrata*) is a non-breeding visitor to the Falkland Islands from the South Georgia region, where there are an estimated 5,000 –7,000 breeding pairs of this species.

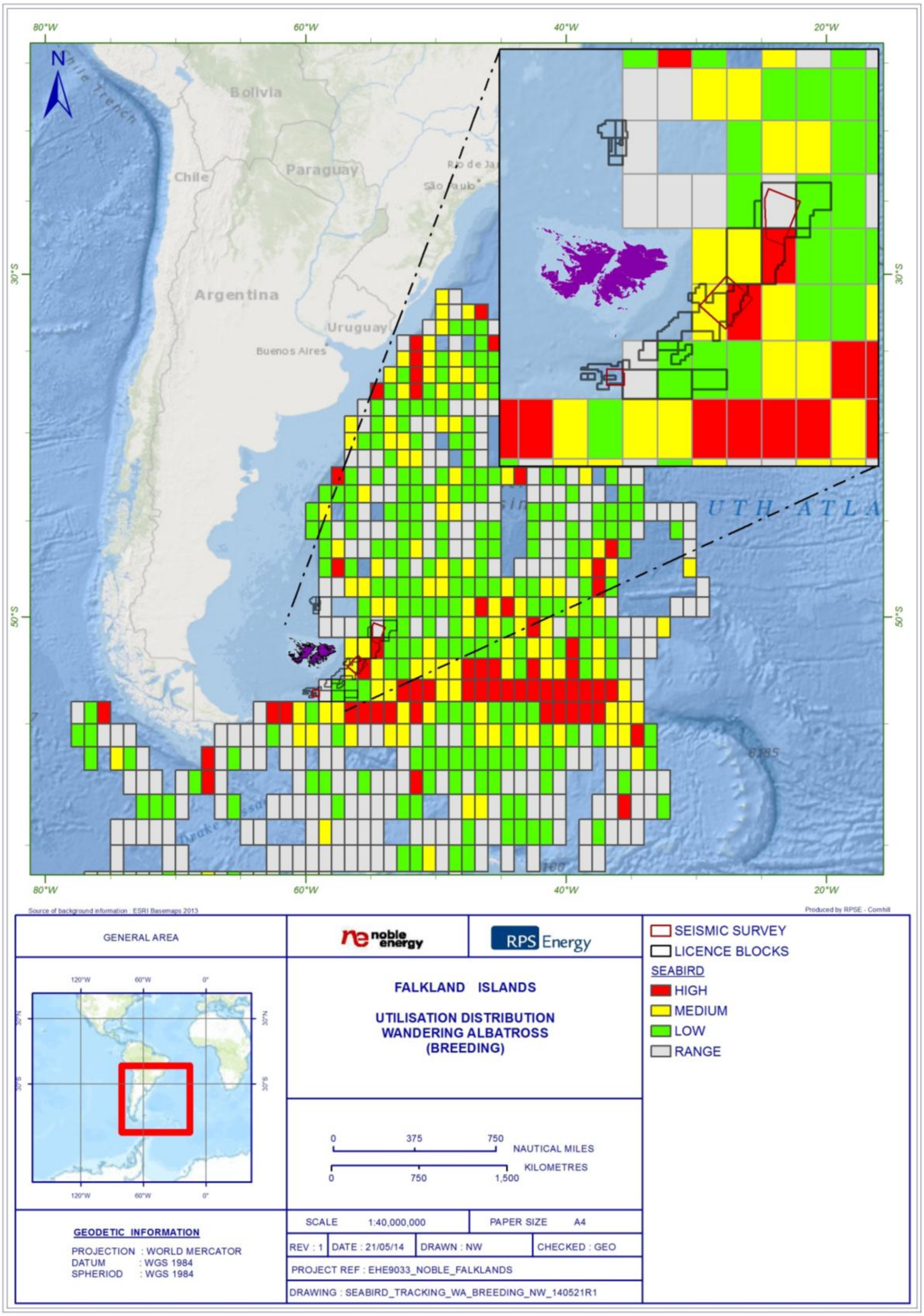
4.374 A total of 24 individuals were recorded during the JNCC survey (*White et al., 2002*). Most observations were in August to November in waters deeper than 200 metres. One or two individuals were observed each month between December and May, with none being recorded in June or July. Sightings were made predominantly to the north-east, east and south-east of the Falkland Islands. Over the course of the Noble-commissioned seismic survey, 15 individuals were observed over 11 days in the FISA12 and FIST13 areas (*RPS, 2013*). Available data indicates that *P*. *palpebrata* is likely to frequent the Noble license areas.

### Wandering Albatross (*Diomedea exulans*)

4.375 The wandering albatross (*Diomedea exulans*) originates in South Georgia and is another non-breeding visitor to the Falkland Islands. The wandering albatross is classified as 'Vulnerable' by the IUCN Red List, with the population in continual decline (*IUCN, 2014*).

4.376 Wandering albatross were recorded during the JNCC survey in all months, with a peak in November and highs between January and April (*White et al., 2002*). Fisheries observer data from long-line fishing vessels indicate a relatively ubiquitous distribution of wandering albatross around the Falkland Islands, with sightings throughout the Noble license areas. Data gathered during long-term observations from fishing vessels confirms that the Southern Patagonian Shelf is an important foraging area for wandering albatross (*Otley at al., 2007*). Studies indicate that this species flies in long, looping arcs, covering vast distances in search of presumably sparsely distributed prey species which are predominantly large squid (*Xavier et al., 2004*). Over the course of the Noble-commissioned seismic survey, 266 individuals were observed over 84 days in the FISA12 and FIST13 areas (*RPS, 2013*). Available data, including satellite tracking data (Figure 4.51), suggests that wandering albatross is likely to occur regularly, transiting or foraging, in the vicinity of the Noble license areas.

***Figure 4.51: Satellite Tracking utilisation distribution of wandering albatross, breeding season (BirdLife International Database, 2004)***



**Shy Albatross (*Thalassarche cauta*)**

4.377 Although the shy albatross (*Thalassarche cauta*) is found in Patagonian waters, their dispersal from breeding grounds in Australia and New Zealand is not well known. The shy albatross is classified as 'Near Threatened' according to the IUCN Red List (*IUCN, 2014*).

4.378 Only a few shy albatross have been recorded in the Falkland Islands previously. During the JNCC survey, a total of 25 birds were observed, all between January and May (*White et al., 2002*). There were no sightings of shy albatross during the Noble-commissioned FISA12 and FIST13 seismic surveys. This suggests that shy albatross are not likely to be found in large numbers across the Noble licenses.

### *Petrels and Shearwaters*

4.379 Petrels and shearwaters form the largest group of oceanic birds, remaining at sea throughout their lives, except for a few months each year when they return to land to breed. The most common breeding species in the Falkland Islands is the southern giant petrel (*Macronectes giganteus*) though based on sightings data, several species may be encountered across the Noble license areas (*Otley et al., 2008*). During recent offshore Noble-commissioned seismic surveys, the great shearwater and cape petrel were the most frequently observed species within this group (*RPS, 2013*). As many as 26 species have previously been recorded in the Falkland Islands, including those discussed further below.

**Southern Giant Petrel (*Macronectes giganteus*)**

4.380 Southern giant petrel was recorded in all months during the JNCC survey, peaking in June. The highest densities were recorded between March and June over the Patagonian Shelf waters to the south of the Falkland Islands.

4.381 The southern giant petrel breeds at 38 locations around the Falkland Islands, in colony sizes ranging between one and 110,000 breeding pairs (*Reid & Huin, 2005*). Most colonies concentrate around the south of the Falkland Islands and in western Falkland Islands waters. Sandy Cay, part of the Elephant Cays Group in Falkland Sound, supports the largest colony of this species with over 10,000 breeding pairs. Nearly 20,000 breeding pairs were counted in 2004/2005 across the Falkland Islands and the most recent FISMP count data indicates a steady upward trend in the population (*Stanworth, 2014*). The species is registered as being of 'Least Concern' by the IUCN (*IUCN, 2014*).

4.382 Data gathered during long-term observations from fishing vessels confirms that the Southern Patagonian Shelf is an important foraging area for southern giant petrel (*Otley at al., 2007*). During the Noble-commissioned seismic survey, 200 individuals were observed, 12 of which were of a white morph variety. The observations were made over 59 days. This suggests that the southern giant petrel will be abundant across the Noble license areas (*RPS, 2013*).

**Northern Giant Petrel (*Macronectes halli*)**

4.383 Northern giant petrels were recorded throughout the year in the JNCC survey (*White et al. 2002*), with densities peaking between March and August to the north-west of the Falkland Islands. From September to February, sightings were less concentrated and more widely scattered. *M. halli* were less likely to be recorded in coastal or inshore waters. They were sighted in the vicinity of the Noble licenses year round. The species is registered as being of 'Least Concern' by the IUCN (*IUCN, 2014*).

4.384 Data gathered during long-term observations from fishing vessels confirms that the Southern Patagonian Shelf is an important foraging area for northern giant petrel (*Otley at al., 2007*). During the Noble-commissioned seismic surveys of the FISA12 and FIST13 areas, 80 individuals were observed over 32 days (*RPS, 2013*). Both the above sightings surveys suggest that Northern giant petrel will frequent the Noble license areas.

**<u>Antarctic Petrel (*Thalassoica antarctica*)</u>**

4.385 Antarctic petrel is a winter visitor to the Falkland Islands, visiting from their breeding areas of the Ross and Weddell Seas of the Antarctic. A total of 56 individuals were recorded between July and September (*White et al., 2002*) in waters to the south-east of the Falkland Islands. During the Noble-commissioned seismic surveys, only one individual was observed throughout the whole survey from November 2012 to June 2013. Available sightings data suggests that Antarctic petrel may be sighted over the Noble license areas, particularly during late winter months, though not in significant numbers. The species is registered as being of 'Least Concern' by the IUCN (*IUCN, 2014*).

**<u>Cape Petrel (*Daption capense*)</u>**

4.386 Cape petrel is a unique looking petrel species that commonly breed around the Antarctic Peninsula and Antarctic Shelf. During the Antarctic winter however, they have a greatly extended range to the north, and can reach as far north as Angola and the Galapagos Islands. The species is registered as being of 'Least Concern' by the IUCN (*IUCN, 2014*).

4.387 Cape petrel was recorded every month during the JNCC survey, with a total of 15,199 records made throughout the survey period. Highest numbers were recorded between May and September with very few records occurring between December and April. Between May and September, observations of *D. capense* were made in the vicinity of all the Noble license areas. Fisheries observer data from long-line fishing vessels also reveals a wide distribution of *D. capense* around the southern and eastern waters of the Falkland Islands, with observations being made across all the Noble license areas, with highest distribution occurring to the east of the Falkland Islands, specifically over the northern area license.

4.388 A large number of cape petrel were observed during the seismic survey activities in the FISA12 and FIST13 areas, with 805 individuals recorded over 57 days. This ranks it among the top three most abundant species observed by the MMOs during the seismic survey activities (*RPS, 2013*). The above sightings data therefore suggest that cape petrel will be an abundant species across the Noble licenses year round, with numbers peaking from May to September.

**<u>Blue Petrel (*Halobaena caerulea*)</u>**

4.389 Blue petrel is another non-breeding visitor to the Falkland Islands. A total of 573 were recorded between May and October (*White et al., 2002*). Most of these observations were made in eastern Falkland Island waters in the vicinity of the Noble northern area license. However, during the seismic survey across the FISA12 and FIST13 areas, no sightings of blue petrel were made (*RPS, 2013*). Nevertheless, the blue petrels wide range and the JNCC survey data suggest that blue petrel may be present across the Noble licenses. The species is registered as being of 'Least Concern' by the IUCN (*IUCN, 2014*).

**<u>Kerguelen Petrel (*Lugensa brevirostris*)</u>**

4.390 A total of 152 Kerguelen petrels were recorded during the JNCC survey (*White et al., 2002*), almost solely between May and November over deep waters to the north, east and south of the Falkland Islands. Distribution of Kerguelen petrels appeared to be widespread, with peak numbers being recorded in August. During the FISA12 and FIST13 seismic survey, no individuals were sighted (*RPS, 2013*). The JNCC data however suggest that they may be present over the Noble licenses. The species is registered as being of 'Least Concern' by the IUCN (*IUCN, 2014*).

**<u>Soft-plumaged Petrel (*Pterodroma mollis*)</u>**

4.391 Soft-plumaged petrel is a non-breeding late summer visitor to the Falkland Islands. Observations during the JNCC survey occurred between November and April, peaking in January. In total, 861 soft-plumaged petrels were recorded during the JNCC survey, mainly in deep waters to the north-east of the Falkland Islands (*White, et al., 2002*). During the seismic survey conducted over the FISA12 and FIST13 areas, there were sightings of 86 individuals over a total period of 31 days (*RPS, 2013*). These data suggest that soft-plumaged petrel is present in the vicinity of the Noble licenses. The species is registered as being of 'Least Concern' by the IUCN (*IUCN, 2014*).

**Atlantic Petrel (*Pterodroma lessonii*)**

4.392 Atlantic petrels are categorised as 'Endangered' on the IUCN Red List (*IUCN, 2014*). The Atlantic petrel is an occasional visitor to the Falkland Islands, with its main breeding sites being situated on St. Helena and surrounding Islands. Its range extends across the south Atlantic from Southern Chile and Argentina to South Africa, including areas to the north and east of the Falkland Islands (*BirdLife International, 2014a*).

4.393 A total of 252 Atlantic Petrels were recorded year round during the JNCC survey (*White et al., 2002*), primarily between October and March. During the Noble-commissioned seismic surveys across FISA12 and FIST13, 63 individuals were recorded over 8 days of the MMO observations. This data, together with the Atlantic petrels extended range across the southern Atlantic, suggests that it will be present across the Noble area licenses.

**Grey Petrel (*Procellaria cinerea*)**

4.394 Grey petrels are listed as 'Near Threatened' on the IUCN Red List (*IUCN, 2014*). Grey petrel is a common species occurring throughout much of the sub-Antarctic zone. Birds return to their breeding colonies in the austral autumn, often first appearing in February and March (*BirdLife International, 2014a*).

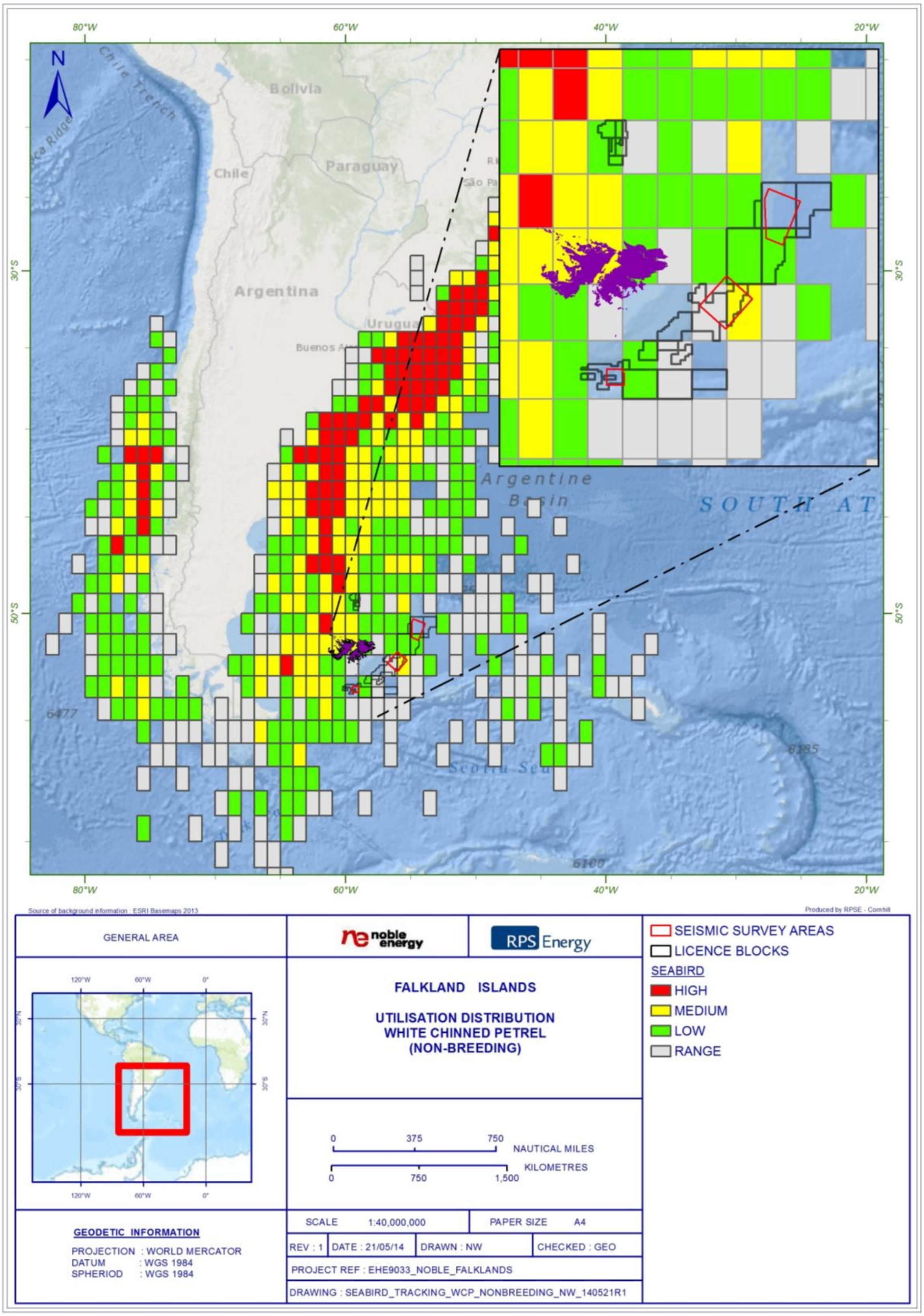
4.395 During the JNCC survey, a total of 45 grey petrels were recorded, mainly between December and March, with peak numbers occurring in February (*White et al., 2002*). All observations were made in deep waters to the north and east of the Falkland Islands, suggesting that the species could be present over the northern area license. During the Noble-commissioned seismic surveys over the FISA12 and FIST13 areas, 15 individuals were observed by the MMOs over a total of 7 days. These data suggest that the species is also present over the southern area licenses (*RPS, 2013*).

**White-chinned Petrel (*Procellaria aequinoctialis*)**

4.396 White-chinned petrel is a sub-Antarctic species, whose breeding colonies range from South Georgia, the Prince Edward Islands of South Africa, the Kerguelen Islands (French Southern Territories), Auckland and the Campbell and Antipodes Islands (New Zealand), and in small numbers (~55 pairs) in the Falkland Islands (*BirdLife International, 2014a*). The breeding colonies of the Falkland Islands are all located on Kidney Island, which lies on the east coast of East Falkland Island. *P. aequinoctialis* is categorised as 'Vulnerable' by the IUCN (*IUCN, 2014*).

4.397 A total of 8,044 white-chinned petrels were recorded throughout the JNCC survey (*White et al., 2002*). Observations occurred in all months, peaking between January and May. The furthest east sightings occurred at 58°W. During the Noble seismic surveys of the FISA12 and FIST13 areas, there were 125 individuals recorded over a total of 44 days (*RPS, 2013*). These data, along with satellite tracking data (Figure 4.52), suggest that *P. aequinoctialis* will be present across the Noble license areas.

*Figure 4.52: Satellite Tracking utilisation distribution of white-chinned petrel, non- breeding season (BirdLife International Database, 2004)*



**Wilson's Storm Petrel (*Oceanites oceanicus*)**

4.398 Wilson's storm petrel has an extremely large range, inhabiting much of the oceans of the southern hemisphere. The breeding range of Wilson's storm-petrel includes subantarctic islands from Cape Horn east to the Kerguelen Islands, and also includes coastal Antarctica (*BirdLife International, 2014a*). The species also breeds on the Falkland Islands with an estimated population in excess of 5,000 pairs (*Woods & Woods, 1997*). The species is registered as being of 'Least concern' by the IUCN (*IUCN, 2014*).

4.399 A total of 21,019 Wilson's storm petrels were recorded by the JNCC survey with observations occurring mainly between October and June (*White et al. 2002*). Most records were to the west and north-west of the Falkland Islands, although high densities also occurred to the north-east between November and February. In addition, during the Noble-commissioned seismic surveys of the FISA12 and FIST13 areas, there were a total of 81 individuals observed over 24 days (*RPS, 2013*).

4.400 The above sightings data suggests that Wilson's storm petrel will be present over the Noble licenses.

**Grey-Backed Storm Petrel (*Garrodia nereis*)**

4.401 The grey-backed storm petrel occurs in cool waters of the sub-Antarctic zone. The species has a circumpolar distribution in the subantarctic, breeding on the Falkland Islands in and on the Chatham Islands of New Zealand (*BirdLife International, 2014a*). The species is registered as being of 'Least Concern' by the IUCN (*IUCN, 2014*).

4.402 The Falkland Islands support between 1,000 and 5,000 breeding pairs of grey-backed storm petrel (*Woods & Woods, 1997*). A total of 2,758 grey-backed storm petrels were recorded during the JNCC survey, mainly between September and March (*White et al., 2002*). Observations occurred around the Falkland Islands, with high densities recorded to the north from November to March. During the Noble seismic surveys of FISA12 and FIST13, 9 individuals were recorded by the MMOs over 4 days (*RPS, 2013*). This sightings data suggests that *G. nereis* could occur in low numbers over the Noble licenses; however it is more likely that higher numbers of birds will be located to the north of the Falkland Islands.

**Black-Bellied (*Fregetta tropica*) and White-Bellied (*Fregetta grallaria*) Storm Petrel**

4.403 The black-bellied and white-bellied storm petrels are circumpolar marine species that rarely associate with land, except to breed. They have a wide range, with that of white-bellied storm petrel being concentrated in the oceans of the southern hemispheres, whilst the black-bellied storm petrel extends further northward into the oceans in the northern hemisphere. These species are registered as being of 'Least Concern' by the IUCN (*IUCN, 2014*).

4.404 Black-bellied and white-bellied storm petrel were both recorded during the JNCC survey, primarily between December and February in the deeper waters to the north-east of the Falkland Islands (*White et al., 2002*) in the vicinity of the Noble northern area license. There were 205 recorded observations of black-bellied storm petrel and 23 of white-bellied storm petrels. Numbers of both species peaked in January. During the Noble-commissioned seismic surveys of the FISA12 and FIST13 areas, only 2 white-bellied storm petrels were observed over 2 days. No black-bellied storm petrels were recorded (*RPS, 2013*).

4.405 The above sightings data suggest that these species are likely to be present over the northern area license, but are less likely to be present in the vicinity of the southern area licenses.

**Magellanic Diving Petrel (*Pelecanoides magellani*) & Common Diving Petrel (*Pelecanoides urinatrix*)**

4.406 The Magellanic diving petrel is commonly found on the southern tip of South America, from south-central Chile and Cape Horn, to the extreme south of Argentina and stretching east to the Falkland Islands. The common diving petrel is additionally found in this same region, but is also found in other discrete zones including South Georgia and the South Sandwich Islands, St. Helena, off the south-east coast of South Africa and over New Zealand and eastern Australia (*BirdLife International, 2014a*). The species is registered as being of 'Least concern' by the IUCN (*IUCN, 2014*).

4.407 A total of 6,078 diving petrels were recorded during JNCC survey, incorporating both the Magellanic (133 confirmed) and common (753 confirmed) species. The remainder were not specifically identified, but were combined with common diving petrel numbers for the purposes of the survey reporting (*White et al., 2002*). Most diving petrels were recorded between September and February, with greatest densities to the west and south of the Falkland Islands. Diving petrels were observed in all months around the south-east areas. They were only observed around the north-eastern sites between March and August. The MMO observations during the seismic surveys of the FISA12 and FIST13 areas however, did not record any sightings of this species (*RPS, 2013*). However, the above sightings data suggest that diving petrel may be found in the vicinity of the Noble license areas throughout the year, particularly across the southern area licenses.

**Great Shearwater (*Puffinus gravis*)**

4.408 Great shearwater is an Atlantic based species, inhabiting most of the Atlantic Ocean. Birds breed in small numbers in the Falkland Islands, a confirmed breeding site is Kidney Island, where 15 pairs were recorded in 1987 (*Woods, 1997,* in: *BirdLife International, 2014a*). This is the only breeding colony of great shearwater known to be located in the Falkland Islands. The species is registered as being of 'Least concern' by the IUCN (*IUCN, 2014*).

4.409 Great shearwaters were recorded primarily between December and April during the JNCC survey, with very few being observed between June and October (*White et al., 2002*). A total of 6,468 individuals were recorded, mainly over shelf slope and oceanic waters to the north and east of the Falkland Islands. During the seismic surveys over the FISA12 and FIST13 areas, 792 individuals were observed by the MMOs over a total of 58 days during observations. This ranks the great shearwater in the top three most abundant species observed over the Noble seismic survey activities (*RPS, 2013*). These sightings data suggest that this species will be present in abundance over the Noble license areas.

**Sooty Shearwater (*Puffinus griseus*)**

4.410 Sooty shearwaters are a widespread species inhabiting many of the world's oceans. The species breed in three key areas; on islands off New Zealand, Australia and Chile, and on the Falkland Islands (*BirdLife International, 2014a*). The Falkland Islands breeding population is estimated at 10,000 to 20,000 pairs (*Woods & Woods, 1997*). This species is listed as 'Near Threatened' on the IUCN Red List (*IUCN, 2014*). Due to the species' relatively limited breeding zones, the Falkland Islands breeding population is globally significant and important.

4.411 A total of 37,109 sooty shearwaters were recorded during the JNCC survey, mainly between September and March, peaking in October (*White et al., 2002*). Most records occurred throughout inshore waters and over the shelf areas to the east and south. During the Noble-commissioned seismic surveys, 21 individuals were sighted over a total period of 12 days during the survey. These sightings data suggest that sooty shearwater will be present over the Noble license areas.

**Little Shearwater (*Puffinus assimilis*)**

4.412 Little shearwater is found throughout the oceans of the Southern Hemisphere south of the Tropic of Capricorn. It is also found of the north-west coast of Africa, breeding on Cape Verde, the Azores, Portugal and the Canary Islands. It is not known to commonly inhabit areas to the east of South America (*BirdLife International, 2014a*). The species is registered as being of 'Least Concern' by the IUCN (*IUCN, 2014*).

4.413 A total of 24 little shearwaters were recorded during the JNCC survey, all between December and April with a peak in March (*White et al., 2002*). All sightings occurred in waters to the north and east of the Falkland Islands. No sightings of the species were made during the Noble-commissioned seismic surveys of the FISA12 and FIST13 areas (*RPS, 2013*). These data suggest that little shearwater will not be present in large numbers in the vicinity of the Noble licenses.

#### *Prions*

4.414 Due to the difficulty in identifying prions (small petrels) to a species level at sea, most records from the JNCC survey were recorded as just "prion species". A total of 119,610 observations were made, making prions the most numerous seabirds encountered during the JNCC survey. The highest numbers were recorded between September and January, with the highest densities being recorded to the west, north and south of the Falkland Islands. Observations were made in the vicinity of the Noble license areas.

4.415 During the Noble-commissioned seismic surveys over the FISA12 and FIST12 areas, 244 prion individuals were observed from November 2012 to June 2013. However, the majority of these species were also unidentified (*RPS, 2013*).

**Fairy Prions (*Pachyptila turtur*)**

4.416 The fairy prion is found throughout the oceans and coastal areas in the Southern hemisphere. Breeding colonies are found on the Chatham Islands, Snares Islands and Antipodes Islands of New Zealand, the Bass Strait Islands of Australia, the Crozet Islands in the South Indian Ocean, the Falkland Islands and South Georgia (*del Hoyo et al. 1992,* in: *BirdLife International, 2014a*). The species is mainly found offshore but may seek shelter on land during stormy weather (*BirdLife International, 2014a*).

4.417 The fairy prion was identifiable during the JNCC survey and was recorded separately (*White et al. 2002*). Overall, 228 Fairy Prions were recorded in all months except for February. Numbers peaked in April, August and October with birds primarily being observed in continental shelf slope and oceanic waters. Sightings of *P. turtur* were widely scattered in areas around the Noble licenses.

4.418 During the Noble-commissioned seismic surveys over the FISA12 and FIST13 areas, no fairy prion species were observed, although 241 unidentified individual species were observed over 43 days (*RPS, 2013*). The above sightings data suggests that fairy prion may be present over the Noble license areas.

#### *Shags*

4.419 Three species of shag have been recorded in Falkland Islands waters (*Woods, 1988*) of which only two are resident breeding species; the rock shag (*Phalacrocorax magellanicus*) and the imperial shag (*Phalacrocorax atriceps*). Both are classed as being of 'Least Concern' by the IUCN (*IUCN, 2014*). The other species (red-legged shag - *Phalacrocorax gaimardi*) is a vagrant species and is not known to frequent the offshore areas of the Falkland Islands, normally inhabiting the coasts of Argentina and western South America (*BirdLife International, 2014a*). Red-legged shag was not recorded during the JNCC survey.

4.420 The Falkland Islands population of rock shags is estimated at between 32,000 and 59,000 pairs (*Woods & Woods, 1997*). A total of 796 rock shags were recorded during the JNCC survey (*White et al., 2002*) peaking in July and mainly within enclosed or partially enclosed waters. All rock shags were recorded within 27 kilometres of the coast, with evidence of birds remaining closest to the coast during summer.

4.421 The population of Imperial shag in the Falkland Islands is estimated at 45,000 to 84,000 breeding pairs (*Woods & Woods, 1997*). A total of 39,264 Imperial shags were recorded during the JNCC survey, peaking between June and September. The average sighting was within 12 kilometres of the shore during the summer, and 37 kilometres from June to October (*White et al., 2002*).

4.422 During the seismic survey conducted by Noble over the FISA12 and FIST13 areas, no shag species were recorded by the MMOs (*RPS, 2013*).

4.423 Shag species prefer inshore waters, and are therefore not expected to be present over the Noble license areas.

### Skua

Five species of Skua have been recorded in the waters of the Falkland Islands:

- Falklands skua (*Catharacta antarctica*);
- South polar skua (*Catharacta maccormicki*);
- Chilean skua (*Catharacta chilensis*);
- Southern skua (*Stercorarius antarcticus*); and
- Long-tailed skua (*Stercorarius longicaudus*);

4.424 Based upon the JNCC sightings data (*White et al., 2002*), of the species listed above, the *Catharacta* skuas and long tailed skua are most likely to be encountered across the Noble license areas. These species are deemed to be of 'Least Concern' by the IUCN (*IUCN, 2014*).

#### Catharacta Skua (*Catharacta* sp.)

4.425 Of the 737 *Catharacta* skua recorded during the JNCC survey, (*White et al., 2002*), 573 were recorded as Falklands skuas, four as Chilean skuas and the remainder that could not be accurately identified. Most records occurred between November and April in inshore waters and the wider area of the north Falklands Basin. During the Noble-commissioned seismic surveys, 9 Chilean skua individuals were observed over 7 days by the MMOs. Additionally, 3 unidentified skuas were also observed over 3 days (*RPS, 2013*). Based on these sightings data, *Catharacta* skuas are likely to be observed occasionally over the Noble license areas, although not in high numbers. Studies suggest that skuas are less aerial that albatross species during the breeding season, and spend a greater proportion of time on the water (*Gremillet at al., 2000; Phalan et al., 2007*)

#### Southern Skua (*Stercorarius antarcticus*)

4.426 Southern skua is a sub-Antarctic species commonly found off the eastern coast of South America and across the southern Atlantic Ocean. This marine species is found on or around sub-Antarctic islands commonly populated by burrow-nesting seabirds or penguins. It is a highly predatory species, feeding mainly on other birds but will also scavenge around fishing boats and ships (*BirdLife International, 2014a*).

4.427 Only 35 southern skua were recorded during the JNCC survey (*White et al., 2002*) between January and April. *S. antarcticus* are summer visitors to the Falkland Islands and were recorded in inshore waters and deeper waters to the north of the Falkland Islands (*White et al., 2002*). No observations of this species were made during the Noble-commissioned seismic surveys. This sightings data suggest that *S. antarcticus* are not likely to be found over the Noble license areas.

#### Long Tailed Skua (*Stercorarius longicaudus*)

4.428 Long-tailed skua commonly breeds in the high Arctic of Eurasia and North America. The species have an extremely large range and have a circumpolar winter distribution in the Southern Oceans (*BirdLife International, 2014a*).

4.429 Long-tailed skua was recorded in the waters off the Falkland Islands between November and April during the JNCC survey (*White et al., 2002*). A total of 239 were observed, mainly in deep waters to the north and north-east of the Falkland Islands. No long tailed skua was recorded during the Noble commissioned seismic surveys. This sightings data suggests that long tailed skua may be present over the Noble license areas, particularly over the northern area license.

*Gulls*

4.430 Seven species of gull have been recorded in the Falkland Islands, of which the following three species are known to breed in the Falkland Islands:

- Dolphin gull (*Larus scoresbii*);
- Kelp gull (*Larus dominicanus*); and
- Brown-hooded gull (*Larus maculipennis*).

4.431 These species are deemed to be of 'Least concern' by the IUCN (*IUCN, 2014*).

**Dolphin Gull (*Larus scoresbii*)**

4.432 The Falkland Islands population of dolphin gulls is of global significance and importance, accounting for 85per cent of the world population. Between 3,000 and 6,000 pairs are estimated to inhabit the Falkland Islands. The species is native to the Falkland Islands and the southern coasts of Chile and Argentina. Dolphin gull is found on rocky coasts, feeding mainly on carrion, offal, bird eggs and chicks, but will also eat marine invertebrates (*BirdLife International, 2014a*).

4.433 During the JNCC survey, a total of 114 dolphin gulls on 60 occasions were observed (*White et al., 2002*). No gulls were recorded more than 20 kilometres from the coast. During the Noble commissioned seismic survey, no dolphin gull species were observed. These data suggest that this species will not be present over the Noble license areas.

**Kelp Gull (*Larus dominicanus*)**

4.434 The kelp gull (*Larus dominicanus*) breeds on coasts and islands through much of the southern hemisphere. It is found on a number of subantarctic islands, on the Antarctic Peninsula, on the southern coast of Australia and New Zealand, on the southern coast of Africa and Madagascar, and on the coast of South America as far north as Ecuador and southern Brazil (*BirdLife International, 2014a*). The Falkland Islands kelp gull population is estimated at between 24,000 and 44,000 pairs (*Woods & Woods, 1997*).

4.435 A total of 2,288 were recorded during the JNCC survey (*White et al., 2002*), covering all months and peaking from June to September. Records between November and April were primarily close to shore. This is in contrast to records from May to October which were more widespread over the Patagonian Shelf and continental shelf slope waters. Observations of *L. dominicanus* were very rare in deep waters. During the Noble commissioned seismic surveys, three individual kelp gulls were observed over two days (*RPS, 2013*).

4.436 Based on the above sightings data, it is possible that kelp gull will be present in the vicinity of the Noble license areas, although not in high numbers.

**Brown-hooded gull (*Larus maculipennis*)**

4.437 Brown-hooded gulls (*Larus maculipennis*) are commonly found around the coasts of South America and also the Falkland Islands (*BirdLife International, 2014a*). The Falkland Islands brown-hooded gull population has been estimated at between 1,400 and 2,600 pairs (*Woods & Woods, 1997*), compared to a global population of approximately 50,000 pairs.

4.438 A total of 134 brown-hooded gulls were recorded in each month during the JNCC survey (*White et al., 2002*). Numbers peaked in January, with the majority of records being made within 10 kilometres of the coast. No brown-hooded gulls were observed across the FISA12 and FIST13 seismic survey areas during the Noble commissioned seismic surveys (*RPS, 2013*). These sightings data suggest that brown hooded-gulls will not be present over the Noble license areas.

*Terns*

4.439 Three species of tern were recorded during the JNCC survey:

- South American tern (*Sterna hirundinacea*);

- Arctic tern (*Sterna paradisea*); and
- Unidentified sterna tern (*Sterna sp.*).

4.440 Identified species are deemed to be of 'Least concern' by the IUCN (IUCN, 2014).

**South American Tern (*Sterna hirundinacea*)**

4.441 The South American tern (*Sterna hirundinacea*) is found around the coasts of South America and the Falkland Islands. The species is almost exclusively coastal, breeding on rocky or sandy beaches, cliff tops and small islands (*BirdLife International, 2014a*). The South American tern is the only tern species known to breed in the Falkland Islands.

4.442 A total of 1,894 South American terns were recorded during the JNCC survey (*White et al., 2002*) in all months, peaking from March to April. These observations were made mainly in coastal waters, with no observations made in the vicinity of the Noble area licenses. The Noble commissioned seismic surveys across the FISA12 and FIST13 areas did not record any sightings of this species. Therefore, South American tern is not expected to be present across the Noble license areas.

**Arctic Tern (*Sterna paradisea*)**

4.443 Arctic terns (*Sterna paradisea*) are a summer visitor to the Falkland Islands. They commonly breed in Arctic circumpolar areas, but also frequent sub-Antarctic regions. Thus the extended range of the Arctic tern is very large indeed (*BirdLife International, 2014a*).

4.444 A total of 21 Arctic terns were recorded during the JNCC surveys, all between October and March (*White et al., 2002*). They were widely distributed throughout the survey area, mostly in offshore waters. A number of unidentified sterna terns were also recorded. Of the 160 unidentified terns recorded in offshore waters, the majority were recorded between April and November. Distribution was widely scattered. However, no sightings of Arctic tern were made by the MMOs during the Noble commissioned seismic surveys (*RPS, 2013*). These sightings data suggest that Arctic tern could potentially be present over the Noble license areas, although not in high numbers.

#### *Swans, Geese and Ducks*

4.445 According to Woods & Woods (1997), twenty-one species of swans, geese and ducks have been recorded in the Falkland Islands, including fourteen native and one introduced species. Most species are found in coastal areas, and are migratory.

4.446 The Falkland steamer duck (*Tachyeres brachydactyla*) was the only species of duck recorded during the JNCC survey. This species is endemic to the Falkland Islands, with an estimated population of between 9,000 and 16,000 pairs (*Woods & Woods, 1997*). A total of 699 individuals were recorded during the JNCC survey (*White et al., 2002*). However, all records were made in coastal waters so it is unlikely that this species will be encountered over the Noble license areas. No observations of the Falkland Islands steamer duck were made during the Noble-commissioned seismic surveys (*RPS, 2013*).

#### *Rare Seabirds*

4.447 Less than ten sightings of the below listed seabird species were recorded during the JNCC survey (*White et al., 2002*):

- Broad-billed prion (*Pachyptila vittata*);
- Great-winged petrel (*Pterodroma macroptera*);
- Manx shearwater (*Puffinus puffinus*);
- Spectacled petrel (*Procellaria conspicillata*);
- Ceyenne tern sterna (*Sterna (sandvicensis) eurygnatha*);

- Cory's shearwater (*Calonectris diomedea*);
- Grey phalarope (*Phalaropus fulicarius*);
- Sooty Albatross (*Phoebetria fusca*); and
- White-headed petrel (*Pterodroma lessonii*).

4.448 The following additional species were also recorded during the Noble-commissioned seismic surveys (sightings of less than ten individuals):

- Slender-billed prion (*Pachyptila belcheri*);
- Black-chinned siskin (*Carduelis barbata*); and
- Peregrine Falcon (*Falco peregrinus*).

4.449 It is unlikely that these species will be encountered regularly across the proposed Noble license areas.

### Seabird Vulnerability Indices for Offshore Areas

4.450 Seabirds are affected by a number of anthropogenic factors, including competition with commercial fisheries, mortality through longline fishing and contamination from various forms of pollution.

4.451 To date, reports of adverse effects to seabirds from surface pollution, such as oil, are low in the Falkland Islands, reflecting the absence of oil pollution to date. It is possible that the increasing oil and gas exploration activities in the area could be a potential threat to seabird populations in the event of any hydrocarbon releases. Further research and comparison with other activities such as fishing is likely to be required in areas of any exploration success and with the potential for field development and production.

4.452 The following information has been sourced from '*Vulnerable Concentrations of Seabirds in Falkland Islands Waters*' (1998–2000), a report produced by *White et al.* and JNCC (*White et al., 2001*) under contract to Falklands Conservation, with funding support from the Falkland Islands Government (FIG). Although this is the most comprehensive study on seabird vulnerability to oiling to date, the data have limited coverage, particularly to the east and south of the Falkland Islands. Therefore the interpretation of results has been carried out using a conservative approach and approximation of data to the areas with limited coverage.

4.453 Seabird vulnerability was assessed with regard to species-specific aspects of their feeding, breeding and population ecology. Maps produced in the report can be used to identify areas supporting seabird concentrations at greatest risk to the threat of surface pollution. Methods used for development of the vulnerability atlas are complex, well documented and widely accepted for the assessment of seabird vulnerability in offshore areas (*White et al., 2001*). A summary of the seabird vulnerability survey results analysis for each month of the year in relation to the Noble licenses and seismic survey areas is provided in Figures 4.53 to 4.55.

4.454 Table 4.11 provides a summary of the seabird vulnerability indices in relation to the Noble seismic survey areas. Where data for various months are missing, data from neighbouring surveyed areas has been used to infer the likely vulnerability index, though the limitations of such an approach should be noted.

4.455 It can be seen that much of the Noble license areas are not adequately covered by the JNCC survey results, particularly from March to May. The JNCC survey effort (*White et al., 2002*) was mostly concentrated towards the north and west of the Falkland Islands, as well as the coastal zone, therefore the findings may be more relevant for the assessment of any oil spills that may drift towards the shore. It can be seen in Figures 4.53 to 4.55 that seabird vulnerability to oiling in the vicinity of the coastline remains high throughout most of the year, reflecting the importance and sensitivity of the Falkland Islands seabird populations.

*Table 4.11: Seabird vulnerability to oiling in the vicinity of the Noble seismic survey areas according to the JNCC vulnerability indices (White et al., 2001)*

| Seismic Survey Area | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FIST13 | | ND | ND | ND | ND | | | | | | | ND |
| FISA12 | | | ND | ND | ND | | | | | | | |
| FINA13 | | ND | ND | ND | ND | | | | | | | |

| Key: | No data: | ND | Low: | | Med: | | High: | | V. high: | |
|---|---|---|---|---|---|---|---|---|---|---|

*Figure 4.53: Seabird vulnerability to oiling in the vicinity of the Noble license areas from January to April (White et al., 2001)*

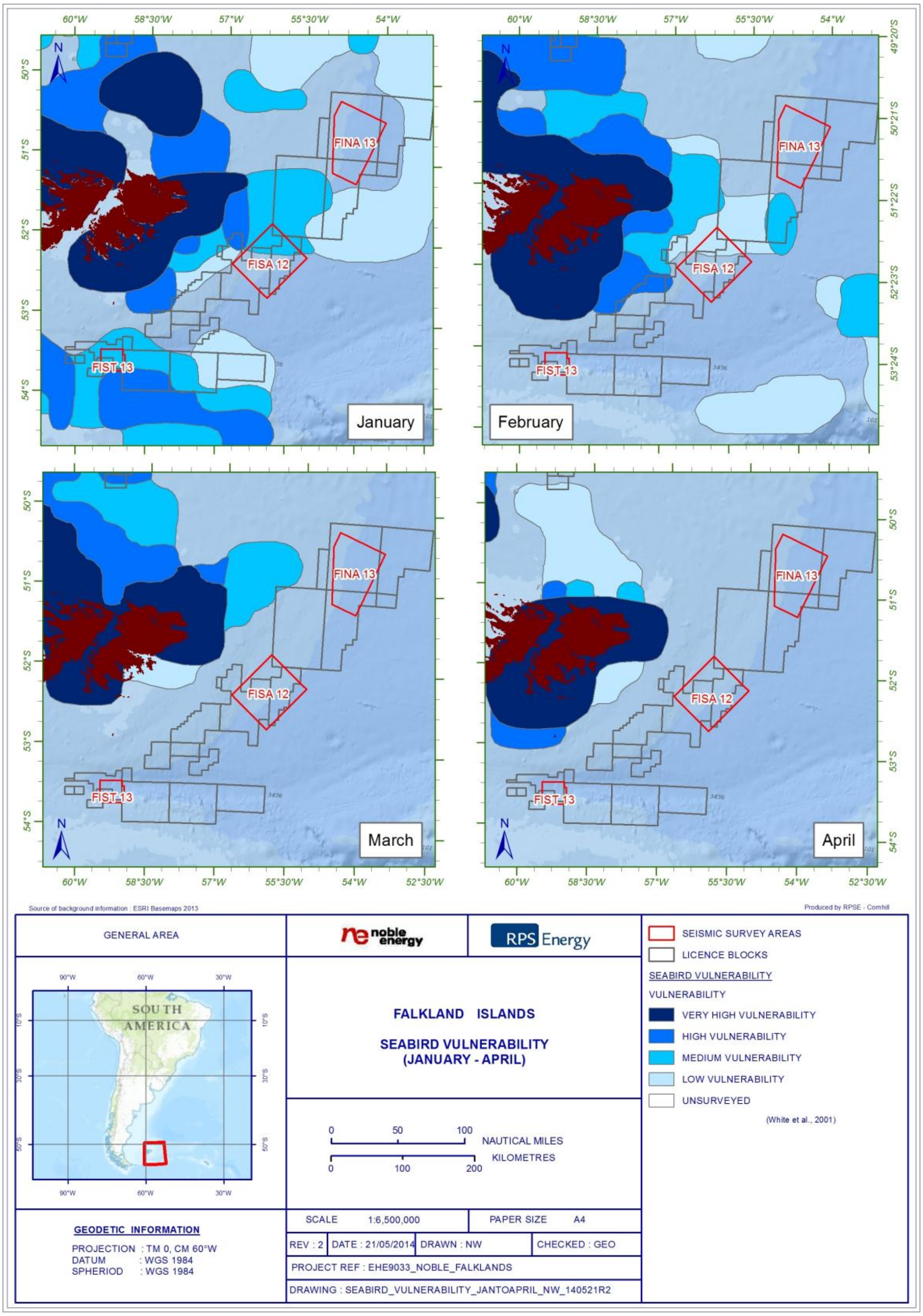


*Figure 4.54: Seabird vulnerability to oiling in the vicinity of the Noble license areas from May to August (White et al., 2001)*

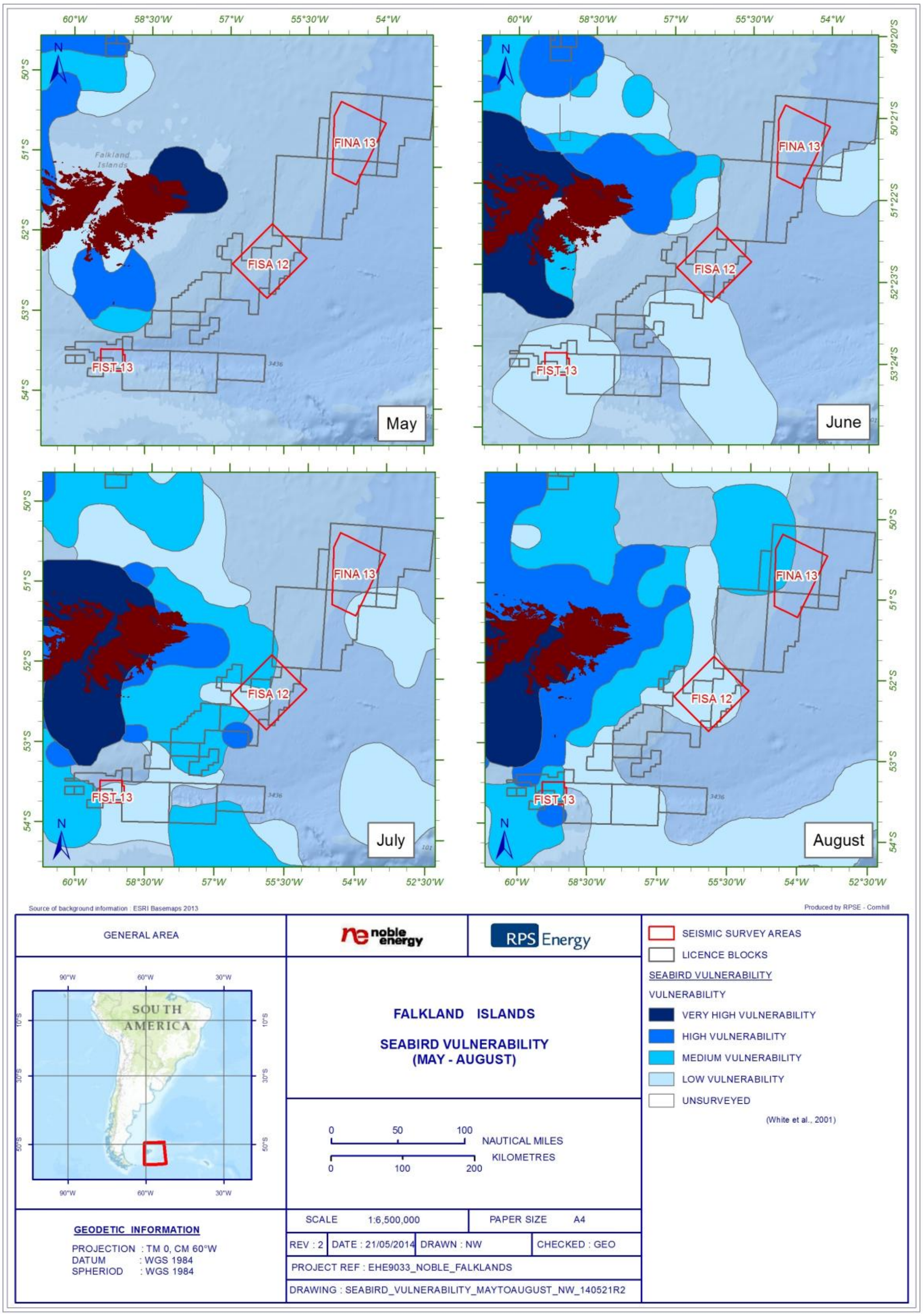
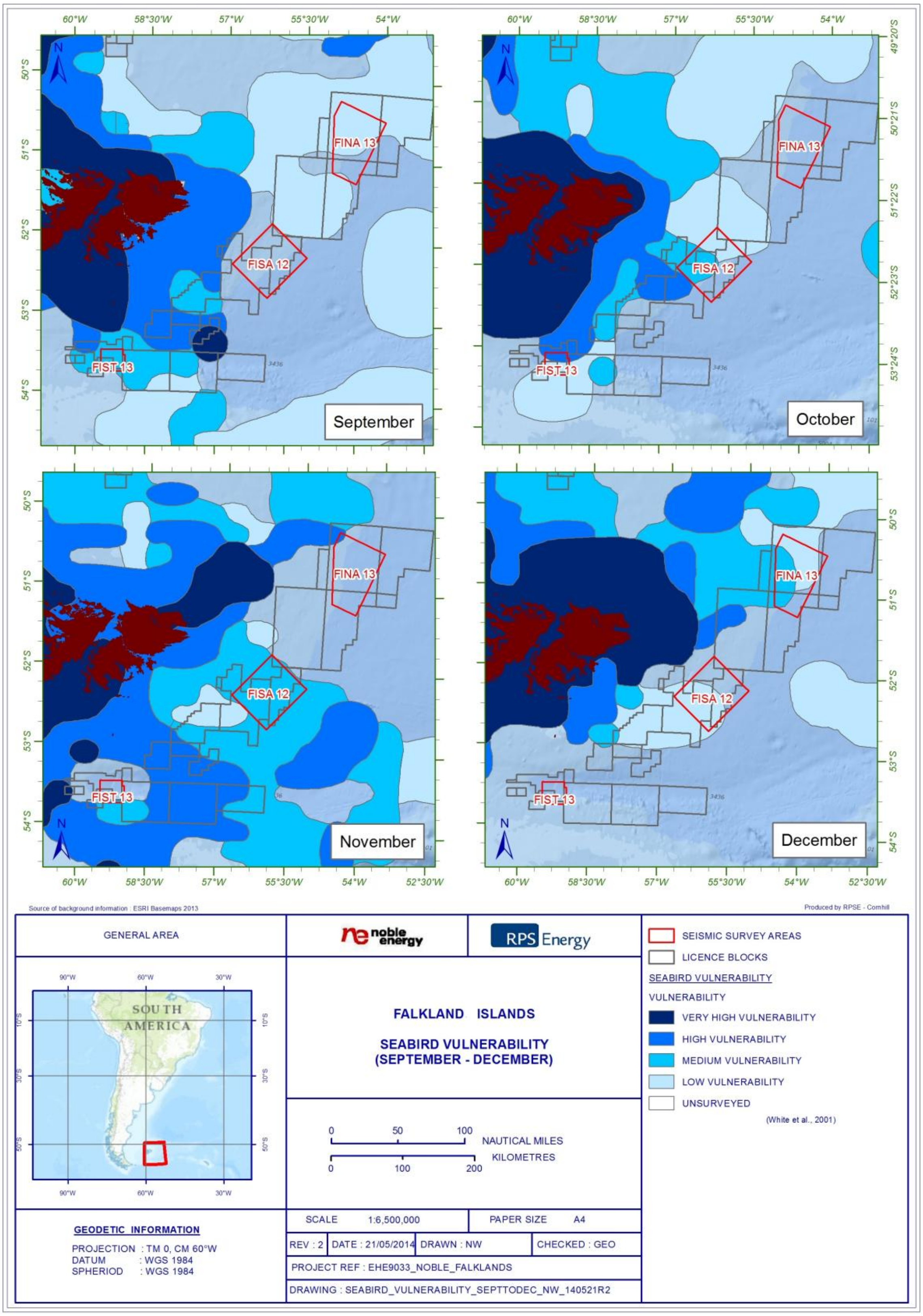


*Figure 4.55: Seabird vulnerability to oiling in the vicinity of the Noble license areas from September to December (White et al., 2001)*



### 4.3.8 Nationally Protected Areas

4.456 To date, there are no offshore protected or designated marine areas in the Falkland Islands, although there are a number of draft Important Bird Areas (IBAs) in the water around the Falkland Islands (Figure 4.56b), including two which cover the FIST13 and FINA13 licence blocks (Atlantic, Southwest 4 – Marine and Atlantic, Southwest 3 – marine, respectively). There are several protected areas in shallow waters around the Falkland Islands coastline (Figure 4.56a and b) and a number of coastal IBAs (Figure 4.57). Three types of formal nature conservation designation exist in the Falkland Islands:

- National Nature Reserves (NNRs);
- National Parks; and
- Ramsar sites.

4.457 Existing National Nature Reserves designated under the Nature Reserves Ordinance 1964 and Sanctuaries designated under the Wild Animals and Birds Protection Ordinance 1964, are now designated as NNRs. FIG has designated NNRs as areas protected under the Conservation of Wildlife and Nature Ordinance 1999. These sites have not been designated against formal criteria. There is a provision within the 1999 Ordinance to establish legally binding management agreements for sites and a number of management plans have been produced for NNRs or component areas of NNRs, some to draft status only.

4.458 Table 4.12 lists the NNRs, National Parks and Ramsar sites in the Falkland Islands. The closest of these to the Noble license areas is Beauchêne Island (approximately 62 kilometres from the FIST13 area).

***Table 4.12: National protected areas in the Falkland Islands***

| Date | | Order | Designated Area |
|---|---|---|---|
| Nature Reserve Orders (now National Nature Reserves) | 1964 | Nature Reserves (Kidney & Cochon Islands) Order 1964 (1/64). | Cochon Island<br>Kidney Island |
| | 1966 | Nature Reserves (Flat Jason Island) Order 1966 (2/66). | Flat Jason |
| | 1969 | Nature Reserves (Bird Island) Order 1969 (4/69). | Bird Island |
| | 1973 | Nature Reserves (Crown Jason Islands) Order 1973 (10/73). | Elephant Jason<br>South Jason<br>North Fur Island<br>South Fur Island<br>Jason East Cay<br>Jason West Cay<br>The Fridays<br>White Rock<br>Seal Rocks |
| | 1978 | Nature Reserves (Sea Dog & Arch Islands) Order 1978 (2/78). | Sea Dog Island<br>Arch Islands (including. Arch Island East, Natural Arch, Clump Island, Tussac Island, Pyramid Rock, Last Rock & Albemarle Rock) |
| | 2009 | Patricia Luxton National Nature Reserve (Chartres) Order 2009 (26/09) | Chartres, West Falkland |
| Sanctuary Orders (now Nature Reserves) | 1964 | Wild Animals & Birds Protection (Sanctuaries) (The Twins) Order 1964 (2/64). | The Twins,<br>Adjacent to Carcass Island, West Falkland |
| | 1964 | Wild Animals & Birds Protection (Sanctuaries) (Low Island) Order 1964 (3/64). | Low Island,<br>Adjacent to Carcass Island, West Falkland |
| | 1964 | Wild Animals & Birds Protection (Sanctuaries) (Beauchêne Island) Order 1964 (4/64). | Beauchêne Island |

| Date | | Order | Designated Area |
|---|---|---|---|
| | 1966 | Wild Animals and Birds Protection (Sanctuaries) (Middle Island) Order 1966 (4/66). | Middle Island,<br>King George Bay, West Falkland |
| | 1968 | Wild Animals and Birds Protection (Volunteer & Cow Bay Sanctuary) Order 1968 (11/68). | Volunteer Point and Inside Volunteer, Cow Bay area of Carysford Camp |
| | 1968 | Wild Animals and Birds Protection (Cape Dolphin Sanctuary) Order 1968 (12/68). | Extreme end of Cape Dolphin |
| | 1970 | Wild Animals & Birds Protection (Bleaker Island Sanctuary) Order 1970 (3/70). | Bleaker Island north of Long Gulch |
| | 1973 | Wild Animals & Birds Protection (Stanley Common and Cape Pembroke Peninsula Sanctuary) Order 1973 (1/73). | Stanley Common & Cape Pembroke |
| | 1993 | New Island South Sanctuary Order 1993 (14/93). | New Island South |
| | 1996 | Moss Side Sanctuary Order 1996 (26/96). | Pond and sand-grass flats behind Elephant Beach (Top Sandgrass Camp & Sorrel Pond Camp) |
| | 1998 | Narrows Sanctuary Order 1998 (53/98). | Narrows Farm, West Falkland |
| | 1998 | East Bay Sanctuary Order 1998 (54/98). | East Bay Farm, West Falkland |
| | n/a | Wild Animals and Birds Protection (East Bay, Lake Sulivan and River Doyle). | *Proposed* |
| | n/a | Wild Animals and Birds Protection (Pebble Island East). | *Proposed* |
| | n/a | Wild Animals and Birds Protection (Port Harriet Point and Seal Point). | Seal Point |
| **National Parks** | n/a | Hill Cove Mountains. | Proposed |
| **Ramsar Sites*** | 2001 | UK54001: Bertha's Beach | Designated |
| | n/a | UK54002: East bay, Lake Sulivan and River Doyle | Proposed |
| | n/a | UK54004: Pebble Island East | Proposed |
| | 2001 | UK54005: Sea Lion Island | Designated |
| | n/a | UK54006: Cape Dolphin | Proposed |
| | n/a | UK54007: Concordia Beach & Ponds, Limpet Creek and Cape Bouginville | Proposed |
| | n/a | UK54008: Seal bay | Proposed |
| | n/a | UK54009: Volunteer Point | Proposed |
| | n/a | UK54010: Kidney Island and Kidney Cove | Proposed |
| | n/a | UK54011: Cape Peninsula, Stanley Common and Port Harriet | Proposed |
| | n/a | UK54012: Swan Inlet and Ponds | Proposed |
| | n/a | UK54013: Flats Brook and Bombilla Flats | Proposed |
| | n/a | UK54014: Lafonia ponds and streams catchment | Proposed |
| | n/a | UK54015: Bull Point | Proposed |
| | n/a | UK54016: Beauchêne Island | Proposed |
| | n/a | UK54017: Jason Islands Group | Proposed |
| | n/a | UK54018: Keppel Island | Proposed |
| | n/a | UK54019: Hawks Nest Ponds | Proposed |

| Date | | Order | Designated Area |
|---|---|---|---|
| | n/a | UK54020: Bird Island | Proposed |
| | n/a | UK54021: New Island Group | Proposed |

*: *Note: Based on UKOTCF, 2005.*

*Figure 4.56a: Protected areas around the Falkland Islands*

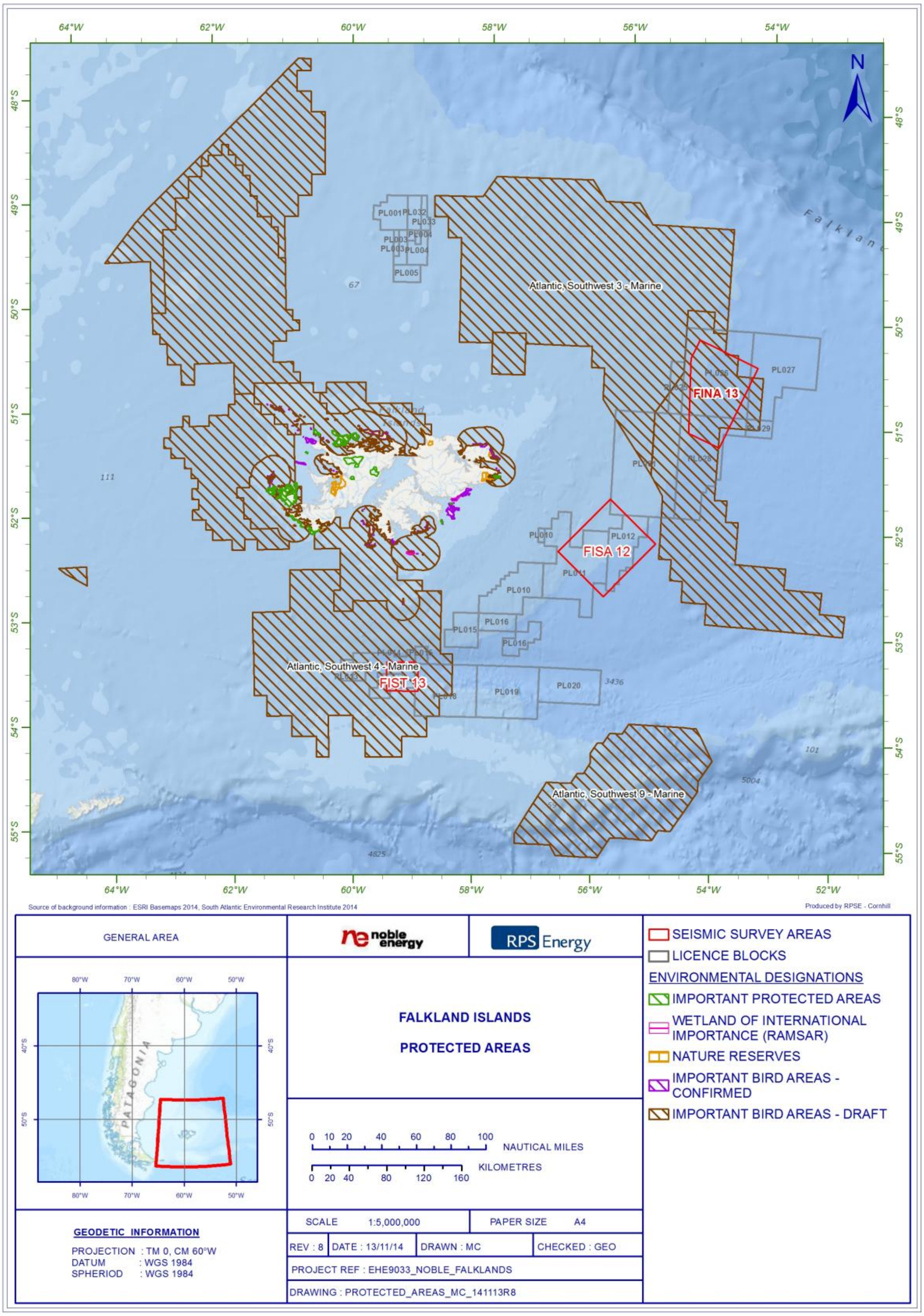
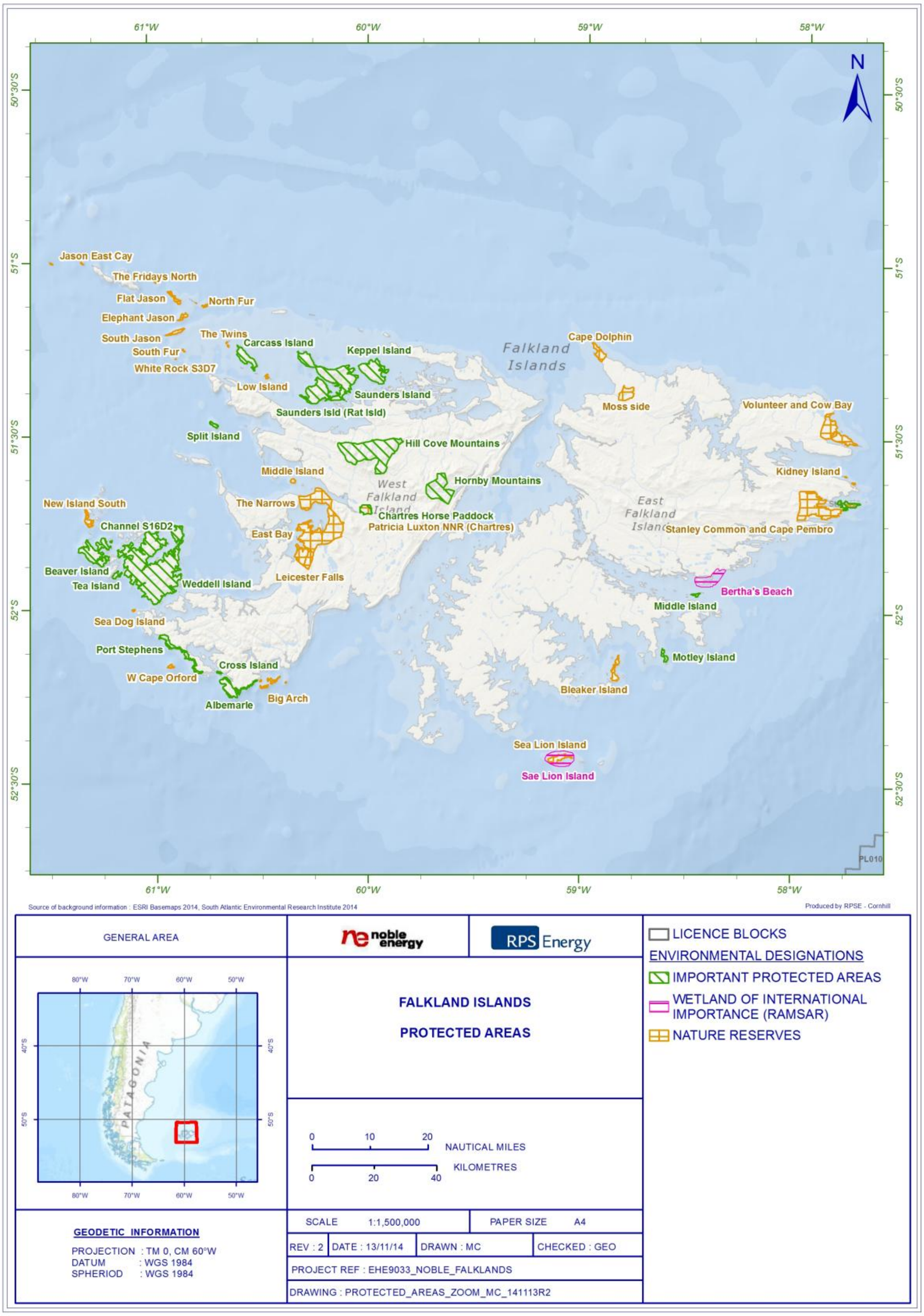


*Figure 4.56b: Protected areas around the Falkland Islands*



### Important Bird Areas

4.459 Important Bird Areas (IBAs) have also been defined in the Falkland Islands and are an initiative of BirdLife International, a global partnership of conservation organisations. IBA identification is based on a standard set of criteria applied consistently worldwide, with the FC responsible for the cataloguing and description of IBAs within the Falkland Islands. IBAs are not part of any international agreement or convention, and were created to address the increasing global threat to birds from habitat loss and fragmentation.

4.460 Currently, 22 IBA sites have been identified in the Falkland Islands (Table 4.13 and Figure 4.57). The closest of these to the Noble license areas is the Kidney Island Important Bird Group Area, located approximately 100 kilometres from the nearest Noble license area. Sea Lion Island and Beauchêne Island are also considered significant habitats with regards to the Noble project since they are home to significant numbers of birds and marine mammals.

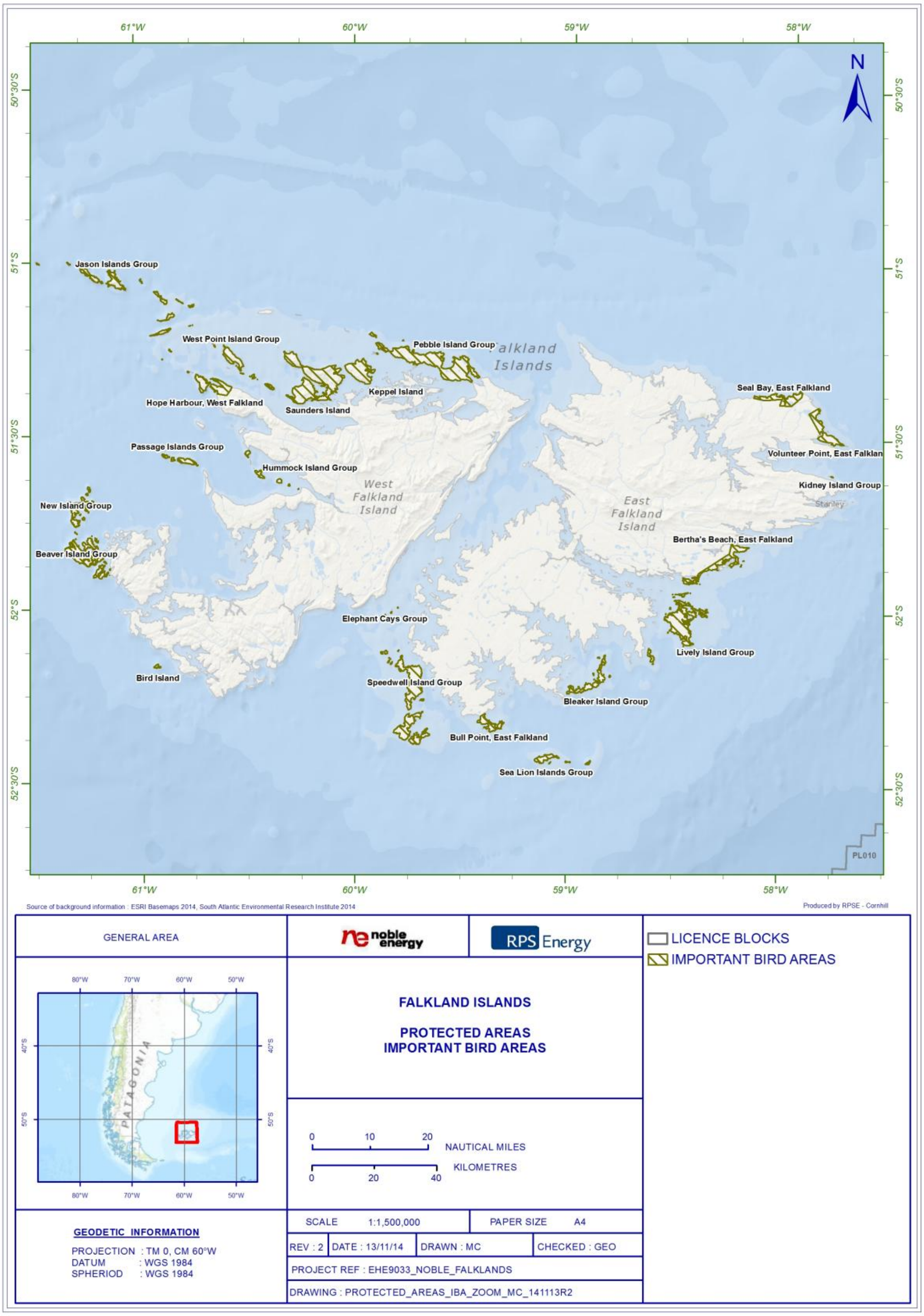
***Table 4.13: Important Bird Areas (IBAs) of the Falkland Islands***

| **Important Bird Areas in the Falkland Islands** | |
|---|---|
| Beauchêne Island | Beaver Island Group |
| Bertha's Beach (East Falkland) | Bird Island |
| Bleaker Island Group | Bull Point (East Falkland) |
| Elephant Cays Group | Hope Harbour (West Falkland) |
| Hummock Island Group | Jason Islands Group |
| Keppel Island | Kidney Island Group |
| Lively Island Group | New Island Group |
| Passage Islands Group | Pebble Island Group |
| Saunders Island | Sea Lion Island Group |
| Seal Bay (East Falkland) | Speedwell Island Group |
| Volunteer Point (East Falkland) | West Point Island Group |

4.461 Since 2005, BirdLife Partners in over 40 countries have been working to identify marine IBAs as priority sites for seabird conservation (*BirdLife International, 2010*). BirdLife International partners are currently sharing data in order to identify potential marine IBAs. At-sea seabird surveys (both vessel and aerial based) and satellite tracking studies have formed the key components of the data sources. As part of this project, the Falklands BirdLife International partner, Falklands Conservation, have proposed potential Marine IBAs for the Falkland Islands region (refer to Figure 4.56a). The majority of priority trigger species for IBA designation in the Falkland Islands are offshore foraging species. This makes designation more difficult, as marine IBAs cannot only be created by simply making seaward extensions to breeding colonies around the existing terrestrial IBA sites. Several potential marine IBA areas have been identified based on satellite tracking data of a range of breeding and visiting procellariform species, although a complete and reliable species assessment of the seabird community is needed to aid further in the designation. Penguin species, particularly the rockhopper penguin, have not yet been fully assessed (*BirdLife International, 2014b*).

4.462 Many of the proposed marine IBA areas in the Falkland Islands as they currently stand do in fact extend around existing terrestrial IBA sites. However, one potential offshore area (for sooty shearwater) extends much further to the south of the Falkland Islands, and covers the Noble southern license areas, including the FIST13 area (Atlantic, Southwest 4 – Marine, refer to Figure 4.56a).

*Figure 4.57: Important bird areas around the Falkland Islands*



### Key Protected Coastal Areas

#### *Kidney Island Group*

4.463 Kidney Island lies approximately 0.5 kilometres off the coast of East Falkland, at the southern entrance to Berkeley Sound. It is largely low lying, with the highest point at just 18 metres above sea level. It is almost entirely covered with mature tussac grass, although its coasts are characterised by boulder beaches on the east and west coasts, a large sand bay facing south-west and near vertical cliffs along much of the northern coastline. Kidney Island is located approximately 100 kilometres from the closest Noble license area.

4.464 The Kidney Island Group comprises of Kidney Island and Cochon Island, a small island lying adjacent to Kidney Island. Cochon's vegetation is limited to tussac grass, wild celery and stonecrop.

4.465 Kidney Island is an Important Bird Area, with at least 34 species breeding on the island. The most abundant is the Sooty shearwater, which burrows around the coast and inland. Kidney Island is also home to one of only three resident breeding colonies of white-chinned petrel. Furthermore, it is the only known breeding site for the great shearwater outside the St. Helena and Dough Island Group in the South Atlantic. Other species present on the Island Group include:

- Macaroni penguins (*Eudyptes chrysolophus*)
- Rockhopper penguins (*Eudyptes chrysocome*)
- Rock shag (*Phalacrocorax magellanicus*)
- Imperial shag (*Phalacrocorax atriceps*)
- Ruddy-headed goose (*Chloephaga rubidiceps*)
- Black-crowned night heron (*Nycticorax nycticorax*)
- Upland goose (*Chloephaga picta*)
- Short-eared owl (*Asio flammeus*)
- Dark-faced ground-tyrant (*Muscisaxicola maclovianus*)
- Falkland pipit (*Anthus correndera*)
- Falkland grass wren (*Cistothorus platensis*)
- Falkland Thrush (*Turdus falcklandii*)
- Long-tailed meadowlark (*Sturnella loyca*)

#### *Sea Lion Islands Group*

4.466 Sea Lion Islands Group lies 17 kilometres to the south of mainland East Falkland, and approximately 100 kilometres from the nearest Noble license area. The main island is approximately 2,200 acres in size and for many years was a sheep farm. It is now a premier wildlife site, attracting visitors year round. BirdLife International lists the island as an IBA. The following bird species have been observed on Sea Lion Island:

- Black-crowned night-heron (*Nycticorax nycticorax*)
- Black-throated finch (*Poephila cincta*)
- Brown hooded gull (*Chroicocephalus maculipennis*)
- Chiloë wigeon (*Anas sibilatrix*)
- Cobb's wren (*Troglodytes cobbi*)
- Crested caracara (*Polyborus plancus*)
- Dark-faced ground- tyrant (*Muscisaxicola maclovianus*)
- Dolphin gull (*Larus scoresbii*)
- Falkland pipit (*Anthus correndera*)
- Falkland thrush (*Turdus falcklandii*)

- Flightless steamer duck (*Tachyeres brachypterus*)
- Gentoo penguin (*Pygoscelis papua*)
- Greass wren (*Cistothorus platensis*)
- Kelp goose (*Chloephaga hybrid*)
- Kelp gull (*Larus dominicanus*)
- King penguin (*Aptenodytes patagonicus*)
- Long tailed meadowlark (*Sturnella loyca*)
- Macaroni penguin (*Eudyptes chrysolophus*)
- Magellanic oystercatcher (*Haematopus leucopodus*)
- Magellanic penguin (*Spheniscus magellanicus*)
- Patagonian-crested duck (*Lophonetta specularioides specularioides*)
- Peregrine falcon (*Falco peregrines*)
- Rock shag (*Phalacrocorax magellanicus*)
- Rockhopper penguin (*Eudyptes chrysocome)*
- Ruddy-headed goose (*Chloephaga rubidiceps*)
- Rufous – chested dotterel (*Charadrius modestus*)
- Short-eared owl (*Asio flammeus*)
- Silver teal (*Anas versicolor*)
- Silvery grebe (*Podiceps occipitalis*)
- Sooty shearwater (*Puffinus griseus*)
- South American tern (*Sterna hirundinacea*)
- Speckled teal (*Anas flavirostris*)
- Striated caracara (*Phalcoboenus australis)*
- Two-banded plover (*Charadrius falklandicus)*
- Upland goose (*Chloephaga picta*)
- White rumped sandpiper (*Calidris fuscicollis)*
- White-tufted grebe (*Rollandia rolland*)

4.467 The islands are also home to a rich assemblage of marine mammal species. Ninety-five percent of the Falkland Islands population of southern elephant seals reside on Sea Lion Island. This area is also regarded as an important breeding site for southern sea lions, although numbers being born here have declined over the past century. Killer Whales are also common around Sea Lion Island, particularly during pinniped breeding times. Peale's and Commerson's dolphins are also observed year round near the islands.

#### Beauchêne Island

4.468 Beauchêne Island compromises the southernmost landmass in the Falkland Islands archipelago, lying approximately 54 kilometres south of Porpoise Point on the mainland. Beauchêne Island lies approximately 62 kilometres from the nearest Noble license area. It has not been cultivated or settled on and is free of introduced predators. Two thirds of the island is covered with tussac grass.

4.469 More than 30 bird species have been recorded on the island. Most of these are migratory seabirds that are present in high numbers during the breeding season. The islands are home to the second largest populations in the world of black-browed albatross and rockhopper penguins. The second densest breeding population of striated caracaras (*Phalcoboenus australis*) in the Falkland Islands also reside here. Beauchêne Island is also an important site for the following species:

- Wilson's storm petrel (*Oceanites oceanicus*)
- Common diving Petrel (*Pelecanoides urinatrix*)
- Cobb's wren (*Troglodytes cobbi*)
- White-chinned petrel (*Procellaria aequinoctialis)*
- Southern giant petrel (*Macronectes giganteus*)
- Grey-backed storm-petrel (*Garrodia nereis*)
- Imperial shag (*Phalacrocorax atriceps)*
- Fairy prion (*Pachyptila turtur*)
- Magellanic penguin (*Spheniscus magellanicus*)

4.470 Southern sea lions also use the islands as a breeding site, while a large number of other pinniped individuals use it as a haul-out station during foraging trips.

## 4.4 Human Environment

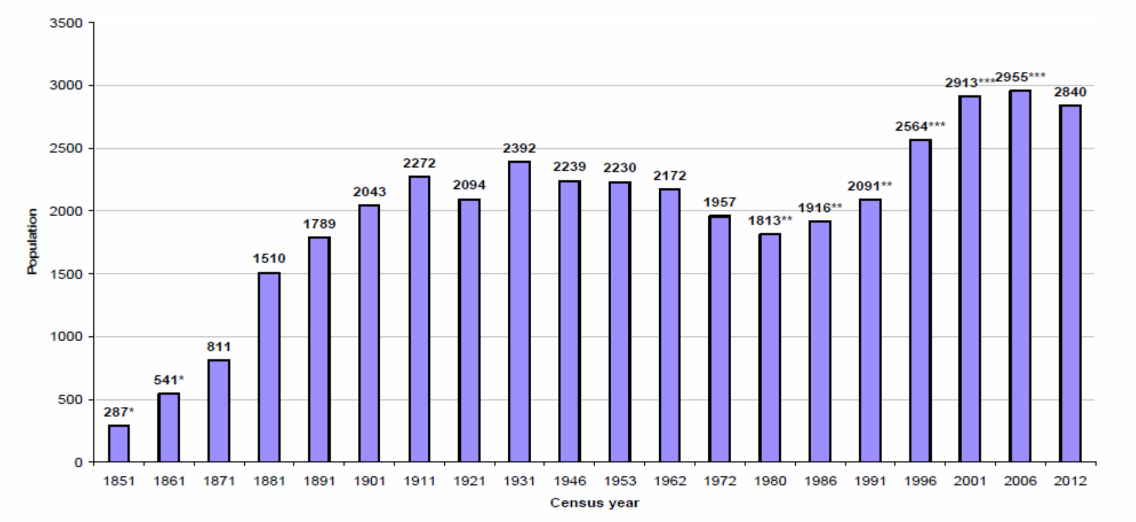
### 4.4.1 Socio-economics

#### Population

4.471 The data presented in this section was taken from the 2012 Census (*FIG, 2013*). None of the figures stated include the presence of military personnel serving in the Falkland Islands. Any references to Mount Pleasant Airport (MPA) refer to civilian contractors based at MPA and not any active military personnel.

**4.472** The 2012 Census recorded a resident population on census night of 2,840. Taking into consideration persons who usually reside in the Falkland Islands who were absent on the night of the census, the total population is calculated to be 2,931. The population trends of the Falkland Islands from the first census completed in 1851 through the 2012 Census is illustrated in Figure 4.58.

***Figure 4.58: Population Change of the Falkland Islands (1851-2012) (FIG, 2013)***




4.473 Figure 4.58 indicates that the total population has increased significantly since 1980 and reached a peak in 2006 with a population of 2,955 the night of the census. The slight drop of 4% from 2006 to 2012 is interpreted by FIG (2012) to represent a decline in the number of civilian contractors employed at MPA. Overall, the population from 2006 has remained static.

### Economy

4.474 Key economic sectors in the Falkland Islands are fisheries, tourism, agriculture, the business sector, and hydrocarbons. In recent years, the bedrock of the Falkland Islands economy has been income from the sale of licenses to fish the Falkland Islands waters. Investment income, agriculture and services, including tourism, are other principal contributors to the economy and employment.

4.475 The gross domestic product (GDP) for the Falkland Islands was estimated in 2007 as 106 million Falkland Islands Pounds (FKP), and in 2012 as 198 million FKP. In 2009, there was a marked low in GDP at 96 million FKP (*FIG, 2014g*). Figures show that the GDP is volatile, expanding considerably during some years and shrinking in others. This has been caused by unpredictability in the fisheries industry in the past; however, from 2010 to 2012 oil and gas exploration added to this instability. Corporations directly engaged in oil and gas exploration-related activities within the Falkland Islands territory were estimated to contribute about £50 to £55 million annually to the GDP during this period. Oil and gas exploration was also the main source of growth between 2009 and 2010. It is expected that the overall GDP figure has decreased significantly for 2013 as there was no oil and gas exploration.

4.476 The socio-economic effects of continued oil and gas exploration and production off the coast of the Falkland Islands have been assessed on behalf of the Falkland Islands Government (*Regeneris, 2013*). Based on the current price of oil worldwide, there would be a very substantial increase in the Falkland Islands GDP if exploration is successful from production of first oil (anticipated end 2017).

### Oil and Gas

4.477 To date, no permanent offshore oil industry infrastructure is currently in place. Shore-based resources and infrastructure are currently being utilised for the ongoing exploration and appraisal drilling programmes being run by several operators, including Noble Energy, Premier Oil, Borders and Southern, Falkland Oil and Gas Limited (FOGL) and Desire Petroleum. Drilling has identified several prospects to date, including a commercially viable discovery, though these are yet to move into production. Further exploration in the region continues.

4.478 The information presented in this section is derived from the FIG - Socio-Economic Study of Oil and Gas Development in the Falkland Islands, Final Report May 2013 prepared by Regeneris Consulting, Ltd. (*Regeneris, 2013*).

4.479 To date, oil and gas activities have involved:

- One drilling rig in Falkland Islands waters at any one time, with accompanying anchor handling vessels and supply vessels;
- Around 130 offshore workers on the rig/boats at any one time on a 28 days on/28 days off rota – with income tax payments being made to FIG;
- Around 60 workers onshore (although not necessarily all full time equivalent posts) working directly for oil and gas companies or in their local suppliers;
- Several local companies involved in the provision of goods and services to the oil and gas companies; and
- Two support helicopters, providing for crew changes as well as search and rescue functions.

4.480 Additional construction activities linked to the oil and gas sector have recently included a complex of lay-down areas and warehouses built by Byron McKay, a new hangar constructed at Stanley Airport, construction of new houses and expansion of the Malvina House Hotel and Restaurant.

4.481 The companies registered in the Falkland Islands that provide services to the oil and gas sector include, but are not limited to, the following:

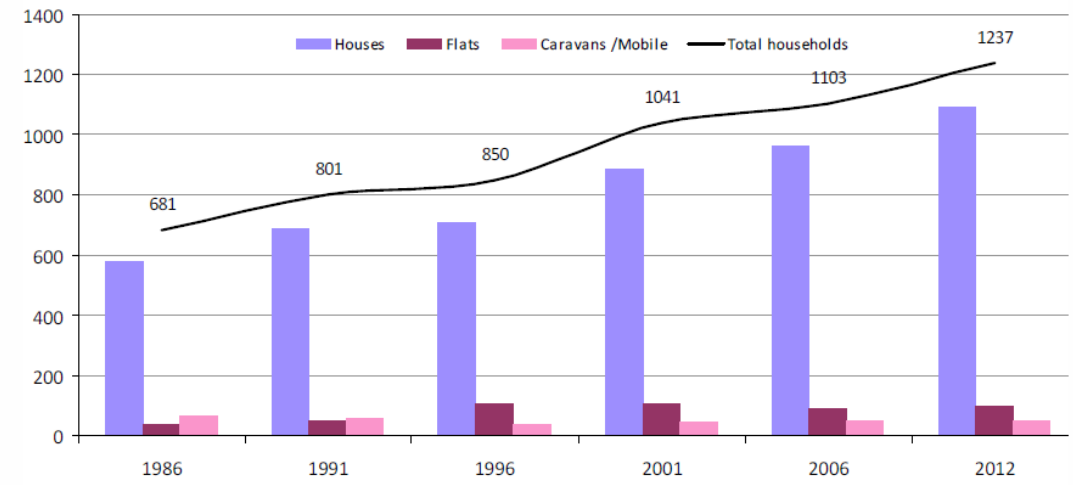
- Byron McKay – provision of warehouse and lay-down areas, house construction, charter agency, stevedoring;
- Stanley Services – fuel supply, provision of accommodation (Malvina House Hotel);
- Invenio – Health, safety, environment, security, training and consultancy service provider;
- Falkland Islands Tours and Travel – provision of transport and logistics services;
- International Tours and Travel – managing sales of additional seats on air charter flights;
- Falkland Islands Security Services – provision of security at oil yards and Falklands Interim Port and Storage System (FIPASS); and
- Shorty's – hospitality during crew changes and accommodation (Shorty's Diner); construction work at oil yards, hangar at Stanley Airport and housing construction (Shorty's Construction).

4.482 The recent oil and gas activities have generated additional onshore employment, created additional business revenue and profits for business owners and led to an increase in FIG's total tax revenues and GDP. Public opinion towards oil and gas development was reported upon in the FIG-commissioned study; results of stakeholder engagement indicate that stakeholders are broadly positive about the benefits that exploration and production can bring in terms of employment, facilities and infrastructure though note the need for controlled development (*Regeneris, 2013*).

### Housing

4.483 Since 1986, there has been a steady increase in the total number of households on the Falkland Islands, which has risen by 81%. The type of housing constructed during this period is illustrated in Figure 4.59.

***Figure 4.59: Increase in the number and type of households (1986 - 2012)***




4.484 The data in Figure 4.59 indicates that the total number of flats and caravans has not significantly changed and the 81% increase in the number of households is due to the quantity of houses. Historically, very few houses have been built each year (approximately 20 a year), which comprise largely detached houses in their own plots. There is currently very little vacancy levels within current housing stock and 82% of the housing is located in Stanley. The low availability of housing contributes significantly to the relatively high cost of living.

4.485 Using the results of the 2006 and 2012 censuses, the following trends can be observed:

- The number of people who now own their properties outright (without a mortgage) has increased by 25%, with the greatest change occurring in Camp (refers to any part of the

Falkland Islands outside the town of Stanley, [and often the large RAF base at Mount Pleasant]. It is derived from the Spanish word campo, for "countryside";

- The number of people in Stanley owning properties with a mortgage has decreased by 2.5% and the number of people renting has increased by 12%; this may be due to rising house prices in Stanley and the fact that it is becoming cheaper (and easier for young people) to rent than to buy;
- In Camp, the number of households renting has declined by 42% since 2006, along with the number of people owning properties with a mortgage which has declined by 13%. This may be due to an increasing number of people completing their mortgage payments and owning the house outright, or could be due to the fact that more people are moving away from camp; and
- The cost of mortgages and rental costs have increased since 2006. The average annual rental cost has increased by 20% since 2006 to £4,864, and the average annual mortgage cost has risen by 32% to £5,091.

4.486 In relation to the availability of temporary accommodation on the Falkland Islands, the Malvina House Hotel provides a total of 35 en-suite rooms in Stanley which comprise 15 twin-bedded rooms and 20 double rooms. These rooms are generally used by tourists and management personnel associated with the oil and gas industry (i.e., senior engineers, etc., and not offshore workers).

4.487 The Falkland Islands Company (FIC) is currently considering the construction of a 200-person temporary workers accommodation block in West Stanley. FIC is also currently building three houses in central Stanley that will take the total number of units they can provide for rental up to just under 40 flats and houses. Both of these developments are in anticipation of the (current and future) business opportunities associated with the oil and gas industry.

### Employment

4.488 A summary of the economic activity of the Falkland Islands population is presented in Table 4.14 using the results of the 2012 Census.

***Table 4.14: Employment Status of the Falkland Islands Population (FIG, 2012)***

| Employed Status | Male | Female | Total % of working age population | Total |
|---|---|---|---|---|
| Employed: | 1,089 | 831 | 82.5 | 1,920 |
| Employees | 938 | 739 | 72.0 | 1,677 |
| Self-employed | 150 | 91 | 10.4 | 241 |
| Did not specify | 1 | 1 | 0.1 | 2 |
| Unemployed | 12 | 12 | 1.0 | 23 |
| Total economically active | 1,101 | 843 | 83.5 | **1,944** |
| Not working for other reasons | 26 | 72 | 4.2 | 98 |
| Retired and not working | 122 | 123 | 10.5 | 245 |
| Unemployed not seeking work | 9 | 31 | 1.7 | 40 |
| Total economically inactive | 157 | 226 | 16.5 | **383** |
| **Total working age population** | **1,258** | **1,069** | **100** | **2,327** |

4.489 The data in Table 4.14 indicates that the economic activity for males (85%) is higher than females (79%), interpreted in the 2012 Census Report to reflect the higher proportion of females who are retired or not working for other reasons, such as home makers or family carers for the elderly. The data also indicates a position of full-employment, with very little room for new employment to be taken from the existing working age population.

4.490 The main sources of primary income from the 2012 Census data are presented in Table 4.15.

*Table 4.15: Falkland Islands Population Sources of Primary Income (FIG, 2012)*

| Source of Primary Income | Total | % of all persons in employment |
|---|---|---|
| Public Service (FIG) | 485 | 25.4 |
| Agriculture | 189 | 9.9 |
| Wholesale and Retail Trade | 183 | 9.6 |
| Hospitality (hotels, restaurants, pubs etc.) | 149 | 7.8 |
| Construction | 143 | 7.5 |
| Transport and Storage | 133 | 7 |
| Administration & Support Service Activities | 117 | 6.1 |
| Community, Social and Personal Services | 100 | 5.2 |
| Electricity, Water and Gas | 74 | 3.9 |
| Communication | 70 | 3.7 |
| Fishing | 58 | 3 |

4.491 The data presented in Table 4.15 indicates that the main source of economic activity for Falkland Islands residents is public service within FIG. The fishing industry, which does not generate significant numbers of employment, is ranked 11th and accounts for only 3% of primary income sources. An analysis of the type of primary income source and individuals' geographical location indicates that almost all agricultural activity (primarily sheep farming, for meat and wool) is based in Camp, whereas the majority of the public service and fishing industry is based in Stanley.

4.492 Data from the 2012 Census indicates that 17% of the economically active population is reliant on temporary work permits, of which there are two main groups:

- Low-skilled, low wage jobs associated with hospitality, retail and social services who are below median income levels; and
- Higher-skilled, higher paid jobs within specialist roles in public service or construction where income lies above median income levels.

4.493 In addition, approximately 20% of the working population have more than one job, highlighting the tight labour margin within the Falkland Islands and the flexibility of private sector employment arrangements. The total number of people with two jobs increased from 305 (2006) to 334 (2012) and typically involve people within the age bracket of 30 to 50.

4.494 Income data collected by the 2012 Census reflects the way in which earnings are higher in Stanley (average: £23,300, median: £17,500) when compared to Camp (average: £21,200, median: £12,500). The median income in Stanley is 40% higher than in Camp, demonstrating a significant income inequality across the Falkland Islands. Overall, incomes have increased from 2006 to 2012: average personal income has increased from £16,400 to £20,100 (increase of 23%) and median personal income from £14,000 to £17,500 (increase of 25%).

### 4.4.2 Commercial Fisheries

4.495 As a key sector of the Falkland Islands' economy, a description of the fishing industry, which uses the area of the sea covered by the Noble license blocks, is provided in the subsequent sections.

### Overview

4.496 Commercial fisheries are currently the largest source of income for the Falkland Islands. All fishing within 200 nautical miles of the Falkland Islands is subject to licensing by FIG. Fisheries typically generate £15 to £20 million per annum in license fees, approximately half of total government annual revenue.

4.497 Many of the key commercial species caught offshore the Falkland Islands are 'flash' frozen at sea and placed into onboard refrigerated storage areas. A proportion of the catch is transferred using FIPASS into refrigerated shipping container units for international export (mainly to Europe).

4.498 FIG operates a system of Individual Transferable Quotas (ITQs). Under this system, the quota is allocated by the Falkland Islands Department of Natural Resources - Fisheries Department to locally owned fishing companies for a period of up to 25 years. Currently 14 companies own an ITQ, all of which are registered in the Falkland Islands and all are members of the Falkland Islands Fishing Companies Association (FIFCA).

4.499 Target species for the commercial fisheries operating in Falkland Islands waters are:

- Argentine shortfin squid (*Illex argentinus*);
- Patagonian squid (*Doryteuthis gahi*);
- Southern blue whiting (*Micromesistius australis*);
- Hoki (*Macruronus magellanicus*);
- Patagonian toothfish (*Dissostichus eleginoides*);
- Patagonian hake (*Merluccius australis*);
- Common hake (*Merluccius hubsii*);
- Common rock cod (*Patagonotothen ramsayi*);
- Red cod (*Salilota australis*); and
- Skates and rays (*Rajidae*).

4.500 Information on the distribution an abundance of these species is provided in Section 4.3.5 above. Information obtained from the FIG Department of Natural Resources - Fisheries Department (*FIG, 2013*) presented in Table 4.16 reflects the total revenue generated from the fisheries industry from 2004 to 2012 (in million pounds).

***Table 4.16*: *Falkland Islands annual revenue from fishing licenses (million pounds sterling) (2004 - 2012)***

| 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|
| 11.912 | 10.552 | 14.402 | 15.394 | 15.309 | 10.850 | 11.485 | 19.953 | 20.479 |

4.501 The data in Table 4.16 indicates that the revenue generated from the fisheries industry has doubled from 2004 (£11.9 million) to 2012 (£20.5 million). The data shows a steady increase with the exception of 2009 and 2010.

4.502 Tabulated data for the catch tonnage of key species from 2004 to 2012 is presented in Table 4.17. The data indicates that the catch tonnage of all species is relatively stable with the exception of Patagonian squid and *Illex* squid. Analysis provided by FIG Department of Natural Resources - Fisheries Department (2013) indicates that the high variability of *Illex* could be attributed to recent climate change which could seriously impact the survival of larvae and juveniles in offshore spawning grounds in subtropical waters off Brazil and Uruguay. Additionally, the climate change could have altered the migration routes of adults. Overfishing throughout the south-west Atlantic Ocean may have also contributed to the recent drop in *Illex* stocks.

***Table 4.17**: Falkland Islands fisheries catches (tonnes) of all species by year (2003 – 2012) (FIG, 2013)*

| Species | Common name | 2004 | 2005 | 2006 | 2007 | 2008 | *2009* | *2010* | 2011 | 2012 |
|---|---|---|---|---|---|---|---|---|---|---|
| *Salilota australis* | Red cod | 2,781 | 2,467 | 3,469 | 5,195 | 4,076 | 5,119 | 3,129 | 4,206 | 4,630 |
| *Micromesistius australis* | Southern blue whiting | 28,554 | 17,047 | 20,533 | 22,204 | 13,208 | 10,395 | 6,471 | 3,974 | 1,611 |
| *Illex argentinus* | Illex *squid* | *1,720* | 7,937 | 85,614 | 161,402 | 106,608 | 44 | 12,111 | 79,384 | 87,023 |
| *Genypterus blacodes* | Kingclip | 1,841 | 1,936 | 2,821 | 3,592 | 2,226 | 3,*389* | *3*,639 | 3,942 | 3,508 |
| *Doryteuthis gahi* | Patagonian squid | 26,835 | 58,811 | 43,067 | 42,003 | 52,260 | 31,475 | 66,543 | 34,682 | 70,894 |
| *Martialia hyadesi* | Martialia squid | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Merluccius hubbsi* | Common hake | - | - | 8,414 | 11,908 | 8,805 | 13,044 | 13,606 | 9,885 | 10,473 |
| *Merluccius spp. / australis* | Austral hake | 1,926 | 2,736 | 23 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rajidae | Skates and rays | 5,151 | 5,698 | 4,679 | 5,663 | 3,853 | 5,872 | 5,891 | 6,954 | 6,655 |
| *Dissostichus eleginoides* | Patagonian toothfish | 2,002 | 1,677 | 1,572 | 1,519 | 1,429 | 1,419 | 1,403 | 1,559 | 1,313 |
| *Macruronus magellanicus* | Hoki | 25,905 | 16,721 | 19,761 | 16,669 | 15,902 | 23,403 | 19,227 | 22,864 | 15,869 |
| Macrouridae | Grenadiers | - | - | 797 | 622 | 943 | 958 | 455 | 2,058 | 225 |
| *Patagonotothen spp.* | Rock cod | - | - | 20,211 | 30,157 | 60,589 | 58,234 | 76,456 | 55,648 | 63,510 |
| *Zygochlamys patagonica* | Scallop | 1,279 | 1,358 | 1,161 | 14 | 6 | 13 | 3 | 11 | 0 |
| Osteichthyes / Chondrichthyes | Others | 5,080 | 10,717 | 1,133 | 1,099 | 502 | 246 | 225 | 358 | 301 |
| **TOTAL** | | **103,098** | **127,105** | **213,255** | **302,047** | **270,407** | **153,611** | **209,159** | **225,525** | **266,012** |

*Source: Falkland Islands Government Department of Natural Resources - Fisheries Department, Fishery Statistics, Volume 17, 2003-2012 (FIG, 2013)*

4.503 Overall, it is clear that the total catch in the Falkland Islands fisheries in 2012 (266,000 tonnes) was well above the average (191,500 tonnes) for the last decade. This was primarily due to the high performance in the *Doryteuthis* fishery that harvested approximately 70,900 tonnes and was the greatest annual catch since 1995. Similar to 2011, *Illex* squid remains one of the most important species caught in relation to total catch weight with 87,000 tonnes taken mainly by the jigging fleet. Among finfish, rock cod was most abundant, with the total annual catch being 63,500 tonnes.

### Commercial Fisheries - Activities within the Noble License Areas

4.504 The only company who has an ITQ to catch fish within the FISA12, FIST13 and FINA13 areas is Consolidated Fisheries Ltd. (CFL). CFL owns 100% of the quota (up to 1,200 metric tonnes per year) for Patagonian toothfish in the Falkland Islands. This species is caught throughout the year allowing CFL to place product on the market on a continual basis. CFL are based in Stanley and have been active in the toothfish industry since 1994, currently operating a single fishing vessel *CFL Gambler*. The fishing gear used follows the umbrella system of longlining. A summary of the vessel's characteristics is given in Table 4.18 and is graphically illustrated in Figure 4.60.

***Table 4.18: Characteristics of CFL Gambler (CFL, 2014)***

| Vessel Parameter | Description |
|---|---|
| Owner | Consolidated Fisheries Ltd. |
| Flag | Stanley, Falkland Islands (British) |
| Built | 1990, Lengthened: 2002 |
| Builders | Astilleros Jose Valina SA, La Coruna Spain. |
| Length Overall | 56.70m |
| Breadth Moulded | 9.50m |
| Call Sign | ZDLC 2. Official No; 736921 |
| IMO. No. | 8916932 |
| Gross Tonnage | 943 |
| Net Tonnage | 282 |
| Main Engine | 1078KW-DEUTZ-MWM, SBV-6M-628 |
| Fishing Gear | Umbrella system longliner |
| Crew | 40, plus one government observer |

*Figure 4.60: The fishing vessel CFL Gambler (CFL, 2014)*

4.505 RPS has obtained catch volume data from the FIG Department of Natural Resources - Fisheries Department covering the period from 2008 to 2013 across a wide geographical region, including the area of sea covered by the FISA12, FIST13 and FINA13 areas. An initial examination of the yearly data indicates that Patagonian toothfish has historically been caught within these areas.

4.506 Catch data has been compiled into quarterly periods and is illustrated in Appendix E in Figure E.8 for Patagonian toothfish. The FISA12, FIST13 and FINA13 areas are shown in light red colour within the offshore blocks allocated to Noble.

4.507 An analysis of the quarterly catch volume data for Patagonian toothfish indicates the following for each area of interest:

- **FISA12:** The volume of catch obtained appears to have slowly decreased from 2008 to 2013, although the wider trend is slightly erratic. For example, in 2008 catch volume was relatively high in Q1 and Q2, and subsequently dropped over the same period in 2009; catch decreased further still throughout 2010, picked up slightly in Q3 2011, increased slightly throughout the year in 2012 and remains about the same as the previous year in 2013, with a peak catch in Q3.
- **FIST13:** Across FIST13, the catch volume is relatively high throughout 2008, and drops over 2009 with the exception of Q4. Catches pick up again throughout the year in both 2010 and 2011, but again drops in 2012, with no catches made in Q1 and Q2. Throughout 2013, catches remained moderate, although with the exception of Q2, where no catches were made.
- **FINA13:** In 2008, catches were made in the vicinity of FINA13 throughout most of the year. In 2009, catches were made within FINA13 from April to September. Catches from within FINA13 drop off in 2010, with catches made only made from July to September. In 2011, catches were made from July to December and from April to September in 2012. In 2013, catches were made throughout the year with the exception of October to December.

4.508 The above data suggest that there are no apparent seasonal patterns to the toothfish fishery, and catches can be made from the Noble license areas at any time of year.

4.509 The catch volume data for 2008-2013 also indicates that other species of commercial fish were caught within these areas as ‘by-catch’, which represents other types of fish unintentionally caught whilst catching the main target species of Patagonian toothfish. By-catch species caught from 2008 to 2013 are listed below:

- Grenadiers;
- Skates and rays; and

- Others (by-catch species, including butterfish (*Stromateus brasiliensis*), redfish (*Sebastes oculatus*), lobster krill (*Munida spp.*) and various other squid and fish species).

4.510 Figures E.19 to E.23 in Appendix E show the fishing effort from 2008 to 2012, respectively. Across the Noble licenses, it can be seen that fishing effort is relatively constant in the area year to year. The relatively low but widespread effort suggests that the fishing vessel moves about considerably during the year, presumably to try different fishing areas. However, of note is that the FIST13 area shows a consistent focus in effort year on year, suggesting that this area is favourable to the long line fleet.

4.511 The catch statistics maps for the fisheries should be used and interpreted with caution, as the catch maps do not take into account the level of fishing effort. It is important to remember that patterns between areas could be due to differential fishing effort, as levels of fishing effort are highly likely to vary seasonally. However, the Patagonian toothfish fishery does operate year round.

#### Commercial Fisheries - Activities within the wider Noble License Areas

4.512 The catch volume data for 2008-2013 indicates that within the wider Noble license areas, the following species are caught:

- Patagonian toothfish - across all of the license areas;
- Grenadiers - primarily to the northern and southerly license areas;
- Skates and rays - primarily to the northern and southerly license areas;
- Blue whiting - within the middle license areas only to a minor extent;
- Hake - within the middle license areas only to a very minor extent;
- Hoki - within the middle license areas only to a very minor extent; and
- Illex squid - within the northernmost license area to a very minor extent.
- Others (by-catch species), including butterfish (*Stromateus brasiliensis*), redfish (*Sebastes oculatus*), lobster krill (*Munida spp.*), and various other squid and fish species, primarily in the northern and southerly license areas.

### 4.4.3 Ports and Shipping

4.513 There are currently two existing main ports in the Falkland Islands: FIPASS in Stanley Harbour, and Mare Harbour. FIPASS is a floating facility installed by the Ministry of Defence (MoD) after 1982, purchased by FIG in 1988 and is currently managed by Byron McKay Port Services Limited.

4.514 In general, the frequency of commercial shipping, primarily linked to the activities of the fishing industry, is relatively infrequent, with a maximum of one to two vessels per day entering Stanley Harbour. Peak shipping movements at the FIPASS coincide with the squidding season for *Doryteuthis gahi*, which can involve both Falkland Island and Spanish registered vessels. A small number of jiggers also use FIPASS during the *Illex* season (between mid-February and the end of April) mainly for transhipment. However, the majority of jiggers use refrigerated container (‘reefer’) vessels moored in Berkeley Sound for transhipment during the season, and as such, do not often use FIPASS other than to occasionally land personnel for crew changes. Other periods of peak activity at FIPASS include the pending arrival of container vessels, where local fishing vessels requiring transhipment or storage often transfer cargo to the FIPASS just before the container vessel arrival. Some cruise vessels also use FIPASS, although their use of the facility is limited by their displacement and/or draft.

4.515 Mare Harbour receives cargo and fuel for the military’s MPA Complex and is operated by the MoD.

4.516 Other facilities within Stanley Harbour include the Public Jetty, which is used for landing passengers from small craft, including for tenders transporting tourists to and from cruise liners moored in Port William. The Public Jetty is the responsibility of FIG. There is also the East Jetty, a commercial jetty privately owned by the Falkland Islands Company (FIC), situated on the south shore of Stanley Harbour.

4.517 For the purpose of Noble's offshore drilling exploration programme, the TDF will be used to provide support to offshore supply vessels (OSVs) who will regularly transfer equipment and materials to/from the drilling unit.

4.518 The proposed Port William development comprises a new deep water port that will include large lay-down industrial areas to support the offshore oil and gas and fishing industry. FIG is currently seeking to finance the development through the creation of a Public Private Partnership (PPP) scheme and construction work is expected to start in 2017/18

#### Commercial Shipping - Activities within the FISA12, FIST13 and FINA13 Areas

4.519 RPS has obtained Vessel Monitoring Systems (VMS) data which is collected by FIG Department of Natural Resources - Fisheries Department. The data covers the period from 2008 to 2012. VMS equipment is typically used in commercial fishing industries to allow regulators to monitor the position, time at position, course and speed of fishing vessels within a specific geographical area. This VMS data will generally only track vessels licensed for Falkland Islands fisheries, plus a few other vessels associated with the Falkland Islands, and therefore provide a very good historical record of fisheries industry movements.

4.520 For the purpose of the EIS, this type of data can be used to evaluate the frequency of commercial fishing vessels that are present within the FISA12, FIST13 and FINA13 areas. The VMS data is illustrated for the period 2008 to 2012 in Figures E.13 to E.18 in Appendix E.

4.521 The VMS data for 2008 to 2012 indicates that the only types of fishing vessels present across the Noble seismic survey areas are fishing vessels in the form of 'long-liners'. This is expected to represent the historical passage of *CFL Gambler*. Whilst the VMS data provide a good record of areas historically fished, future fishing effort is not necessarily confined to these areas, as fisheries continue to explore and test different fishing grounds within the FICZ and FOCZ as their licenses permit.

#### Commercial Shipping - Activities within the wider Noble License Areas

4.522 The fisheries VMS data for 2008 to 2012 indicates that the types of fishing vessels present within the wider Noble license areas includes long-liners, trawlers and one jigger. A summary of the yearly VMS data for the wider area is presented below:

- **2008:** The southern license areas feature a high density of fisheries shipping traffic characterised only by long-liners. The middle license areas feature a medium density of trawler traffic, with the northern license areas having a low density from the presence of (only) long-liners;
- **2009:** The southern and northern license areas have a low density of (long-liners only). The middle license areas feature medium density (trawlers only);
- **2010:** The VMS data indicates the presence of long-liners, with the exception of a single jigger in the northern license areas. The southern license areas feature a high density with the middle and northern areas being low;
- **2011:** The southern license areas have a high density with the presence of long-liners; the middle license areas feature a medium density (trawlers), and the northern license areas are characterised by a medium density of long liners; and
- **2012:** The northern and southern license areas have a high density of commercial fishing traffic with the middle license areas being low. All vessels are long-liners.

4.523 Figure 4.61 illustrates the commercial shipping activity in the Falkland Islands wider vicinity. It can be seen that there are some shipping routes that traverse through the Noble license blocks. Routes running in a south-west to north-east direction are likely to be routes passing around the southern tip of Chile (Cape Horn). Routes running from the Falkland Islands in an east-south-east direction are likely to be supply routes to the region of South Georgia and the South Sandwich Islands. Routes traversing the FISA12 area in a north-south direction are likely to be supply routes leading to the Antarctic region. However, it can be seen that shipping activity throughout the Noble license areas is very low (density shading on Figure 4.61 is difficult to detect as a result).

### 4.4.4 Tourism and Recreation

4.524 The strategic development of the tourism industry in the Falkland Islands and the marketing of the Falkland Islands tourism products is the prime responsibility of the Falkland Islands Tourist Board (FITB). In accordance with the FIG 2012 Falkland Islands Plan (*FIG, 2014*), a new Tourism Strategy is currently being implemented by FITB with the aim of attracting greater numbers of land-based tourists to complement the successful cruise ship tourism industry. The majority of visitors to the Falkland Islands originate from the UK.

4.525 The main tourist season is from October to March and in 2012, 84.4 per cent of all arrivals visited over this six month period. In 2012, 29.5 per cent of all trips occurred in December, representing the seasonality of visiting friends and relatives travel. Seasonality patterns in business and transit tourism are less obvious; however, in 2012 over two-thirds of all business tourists visited the Falkland Islands in the first six months of the year, between January and June (*MercoPress, 2013*).

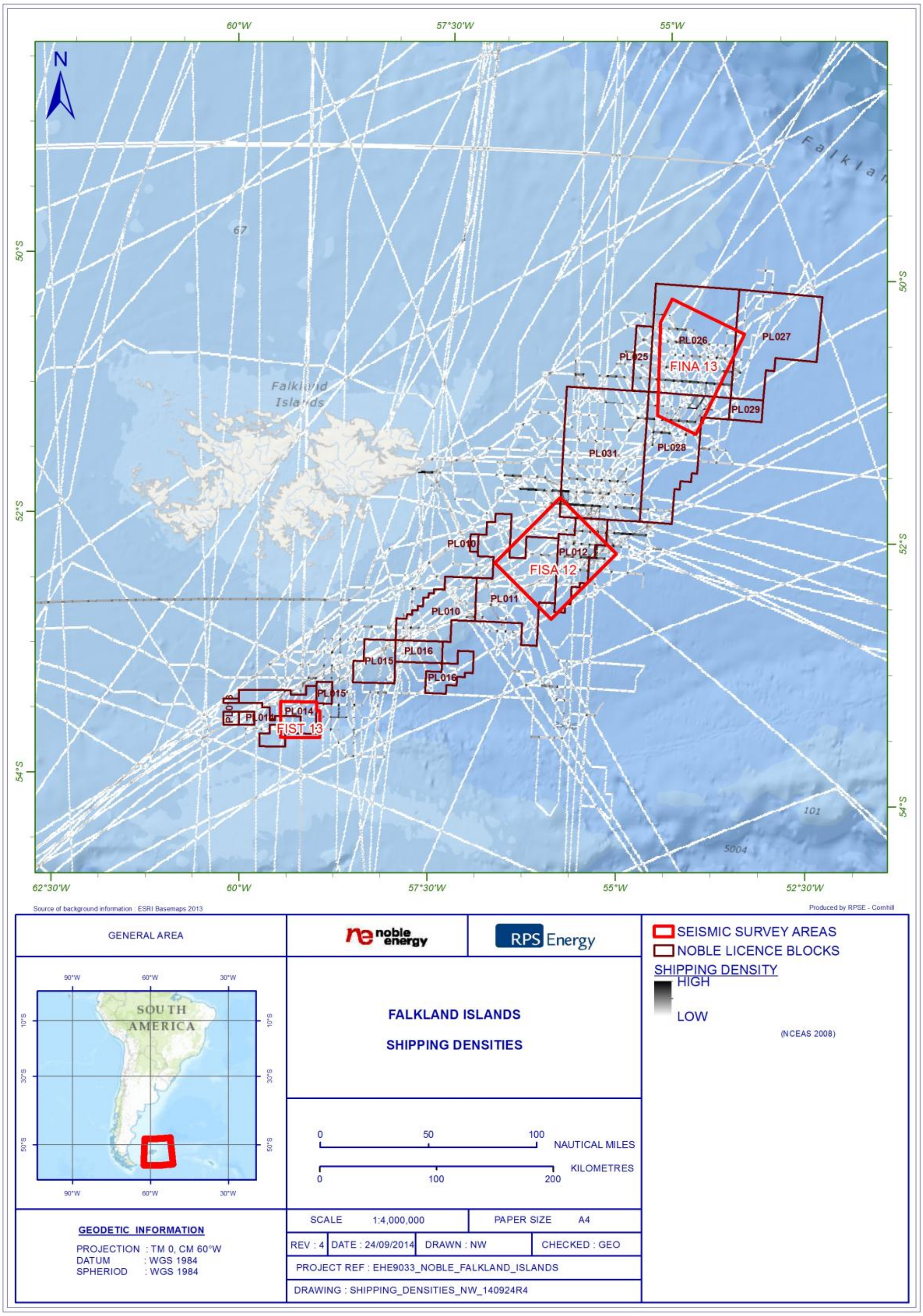
4.526 There are over 40 international tour operators offering tailor-made packages and escorted tours to the Falkland Islands (*FITB, 2014*).

4.527 Over the last five years, the tourism industry has grown rapidly, with large numbers of passengers arriving in Stanley each year from cruise ships. The main attractions are the Falkland Islands unique environment and wildlife. Total passenger numbers on cruises to the Falkland Islands peaked in the 2008 – 2009 season with 62,488; which fell to 48,359 in 2009 – 2010 and further to 40,542 in the 2010 – 2011 season. In 2012/2013, there were a total of 29,553 cruise passenger visits to the Falkland Islands. Cancellations accounted for a loss of around 23,053 passengers over the season (*MercoPress, 2013*). Up to 2,500 passengers can arrive on a single ship and the cruise ship industry generates approximately £10 million a year into the Falkland Islands economy (*The Telegraph, 2012*).

4.528 Some cruise ships use the FIPASS and receive bunker fuel and potable water, while others arrive into West Stanley Harbour and use their own small boats to come to land using a public tourism wharf which is currently being redeveloped. Larger cruise ships are not able to enter Stanley Harbour through The Narrows.

4.529 The presence of cruise ships coming into the Falkland Islands places significant demands on local infrastructural resources to cope with a large amount of passenger traffic wishing to rapidly depart, visit tourist destinations and then return on time back to their vessel. This can result in short-term local transport congestion although does not place any additional demands on local accommodation, as passengers return to their vessel for overnight stays.

*Figure 4.61: Commercial shipping activities (routes and density) in the vicinity of the Falkland Islands (Halpern et al., 2008)*



4.530 Over the period 2012 to 2013 there were 7,791 land-based tourist arrivals in the Falkland Islands, of which 1,937 were travelling for leisure (*MercoPress, 2013*). This is the second largest number of leisure arrivals ever recorded in the Falkland Islands. International visitors, not arriving by sea, can travel to the Falkland Islands on a weekly LAN charter flights via Chile, or through the RAF Brize Norton charter flight operated by the MoD.

4.531 The Falkland Islands main tourist lodges are located at Port Howard, Carcass Island, Darwin, Pebble Island, Sea Lion Island and Weddell Island. Self-catering accommodation can be found both on offshore islands, and mainland East and West Falkland. In Stanley, there is only one large hotel (the Malvina House Hotel) and a choice of guest house and bed and breakfast accommodation.

4.532 Recreational activities commonly undertaken in the Falkland Islands include sailing, diving and walking. The Falkland Island Yacht Club (FIYC) was formed in 2010 to promote boating activities in the Falkland Islands and to act as a regional focal point for round-the-world sailing events. The Canache, located in the east of Stanley harbour, provides short and long-stay moorings for local members and boat tourists, offering shelter from bad weather conditions. Current members of the Falkland Island Yacht Club have a total of eight yachts of varying size, all of which are moored in the Canache. An additional five to six vessels (mainly recreational yachts) are moored in a private marina in West Stanley.

### 4.4.5 Military Activity

4.533 After the 1982 conflict in the Falkland Islands, the UK established a garrison consisting of naval, land and air elements. It is based at the Mount Pleasant Airport (MPA) Complex, which is based approximately 35 miles from Stanley.

4.534 UK military assets are drawn from all three services and include infantry and specialist troops, air defence assets, a maritime patrol capability and RAF Typhoon aircraft. The British Forces South Atlantic Islands (BFSAI) is based at MPA; it consists of approximately 1,300 service personnel plus around 50 MOD civil servants.

4.535 Routine assets include:

- Approximately 1300 personnel;
- Four Typhoon fast-jet aircraft;
- Mk 2/3 (Airbus A330 Variant) “Voyager” tanker aircraft;
- Hercules C-130 aircraft;
- Rapier surface-to-air missiles;
- Frigate or Destroyer (from the Atlantic Patrol Task Force [South]);
- Royal Fleet Auxiliary support vessel;
- *HMS Clyde* permanently stationed in the region as Falklands Patrol;
- Infantry company;
- Sea King search and rescue helicopters;
- Sikorsky S-61 helicopters.

4.536 Fishery patrol vessels (FPVs) are also present which monitor the exclusive economic zone (EEZ) borders for infringement by unregistered vessels. The Falkland Islands has one dedicated FPV ‘*Protegat’*, with the FPV ‘*Pharos’* occasionally patrolling Falkland Islands waters in between deployments in South Georgia.

4.537 According to the Falkland Islands Ports and Harbours Information (2014), some sections of the coastline around Stanley contain mines left by Argentine forces in 1982. There is little detailed information associated with the potential for UXO to be present within Stanley Harbour. According to information provided by the Department of Mineral Resources (2013), Stanley

Harbour has not been systematically surveyed for the presence of UXO and an old military barge was historically present to the east of the existing Falklands Interim Port and Storage System (FIPASS). Whilst land mines within the Falkland Islands are plastic and hard to detect, sea mines use metal casings and can be detected using magnetic ranging equipment.

4.538 The Falkland Islands also maintain their own volunteer force; the Falkland Islands Defence Force (FIDF), previously known as the Falkland Islands Volunteer Corps. The FIDF is now a light infantry force with a permanent training Warrant Officer seconded from the Royal Marines. FIDF is fully integrated into the defence arrangements of the Falkland Islands. The FIDF HQ is based in Stanley.

### 4.4.6 Cultural Heritage

4.539 Two shipwrecks, designated as 'war graves', are located within the FISA12 area; *SMS Scharnhorst* and *SMS Gneisenau*. An additional charted wreck, the wreck of the *RFA Sir Galahad*, is located within license PL011 approximately 12 kilometres from the FISA12 area. The shipwreck of *SS Atlantic Conveyor* is also located in the FINA13 block. These vessels are protected by the *Protection of Military Remains Act 1986*.

4.540 During the environmental surveys, considerable effort was put into positively identifying the wrecks lying within FISA12 and FINA13 using the swathe bathymetry and magnetometer. However, the wrecks within FISA12 were not identified with the survey equipment. It is thought that an anomaly seen during the bathymetry survey in FINA13 is highly likely to be the wreck of the *Atlantic Conveyor*. However, the survey was unable to obtain seabed photographs so a positive identification was not possible. The likely location of the *Atlantic Conveyor* is provided in Table 4.19 below. This location was found to lay approximately 1 kilometre south-west of the current as charted UKHO location.

4.541 The locations reported by *Wrecksite.eu* have been used for the location of the *SMS Scharnhorst* and *SMS Gneisenau* for the purposes of this assessment, as these locations represent the best currently known locations of the wrecks. Due to the positional uncertainty, a 10 kilometre buffer has been placed around these locations.

4.542 A summary of the wrecks in the vicinity of the Noble areas of interest is provided in Table 4.19 and is graphically illustrated in Figure 4.62.

*Table 4.19: Summary of shipwrecks present within the Noble license areas*

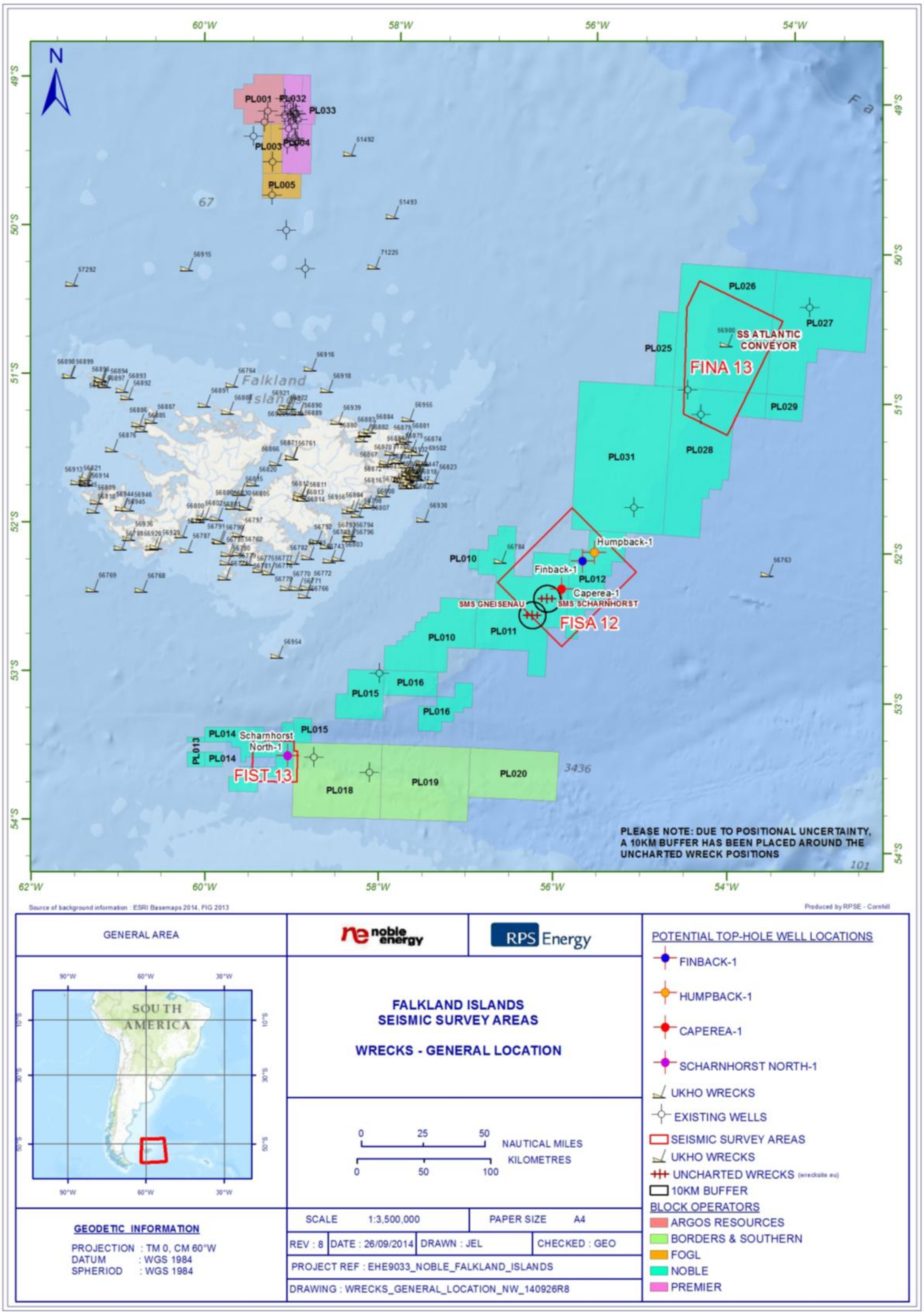
| Description | *SMS Scharnhorst* | *SMS Gneisenau* | *RFA Sir Galahad* | *SS Atlantic Conveyor* |
|---|---|---|---|---|
| Lies within PL | PL011 | PL011 | PL011 | PL026 |
| Lies within area | FISA12 | FISA12 | n/a – 12km from FISA 12 | FINA13 |
| Nationality | German | German | British | British |
| Class | Scharnhorst class cruiser | Scharnhorst class cruiser | Round Table Class Landing Ship Logistics (LSL) | Container ship |
| Type / material | Cruiser (heavy) / steel and armoured | Cruiser (heavy) / steel and armoured | LS – Landing Ship / Steel | Container ship (ro-ro) / |
| Propulsion | Steam | Steam | Diesel | Steam turbine |
| Dis. Weight (t) | 12,789 | 12,780 | 5,674 | 14,950 |
| Dimensions (m) | 144.6 x 21.6 x 8.4 | 144.6 x 21.6 x 8.4 | 126 x 18 x 4 | 212.1 x 28 x 9.1 |
| Date built / lost | 1905 / 08 December 1914 | 1906 / 08 December 1914 | 1966 / 08 June 1982 | 1970 / 25 May 1982 |
| Position‡ | 52° 28' 31.080"S<br>56° 13' 32.040"W* | 52° 35' 27.720"S<br>56° 22' 39.420"W* | 52° 12' 39.6"S<br>56° 45' 36.6"W | 50° 40' 30.58"S<br>54° 28' 29.31"W† |
| Position uncertainty | High - greater than 10km* | High - greater than 10km* | High - greater than 1km | Low |
| Chart Status | Uncharted | Uncharted | Charted | Charted |
| Depth (m) | 1,300 | 1,300 | 600 | 1,280 |
| Total casualties | 840 (no survivors) | 602 (176 survivors) | 89 lost | 12 lost |

*‡ Geodetics: Datum: WGS 1984; Projection: Transverse Mercator CM 60W.*

** Due to the circumstances under which these vessels were sunk, accurate positions on the seabed are not known. Locations as reported by Wrecksite.eu.*

*† Likely location from the FINA13 environmental survey.*

*Figure 4.62: The geographical location of shipwrecks (Note: SMS Scharnhorst and SMS Gneisenau are uncharted and are approximate locations only)*



## 4.5 Key Sensitivities

4.543 Table 4.20 below demonstrates the range of environmental sensitivities present in the vicinity of the Noble licenses and surrounding waters. Seasonal vulnerabilities likely to be present in the vicinity of the Noble licenses and for the surrounding area are summarised below.

***Table 4.20: Overview of the key seasonal environmental sensitivities in the vicinity of the Noble License areas and surrounding waters***

| Species | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plankton | | | | | | | | | | | | |

**Key:** *Peak Bloom Period* *Summer Bloom Period*

| Species | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fish, squid and shellfish** | | | | | | | | | | | | |
| Southern blue whiting (*Micromesistius australis*) | | | | | | | | | | | | |
| Grenadier (*Macrourus spp.*) | | | | | | | | | | | | |
| Hake (*Merluccius sp.*) | | | | | | | | | | | | |
| Hoki (*Macruronus magellanicus*) | | | | | | | | | | | | |
| Skates and rays | | | | | | | | | | | | |
| Red cod (*Salilota australis*) | | | | | | | | | | | | |
| Rock cod (*Patagonotothen ramsayi*) | | | | | | | | | | | | |
| Patagonian toothfish (*Dissostichus eleginoides*) | | | | | | | | | | | | |
| Kingclip (*Genypterus blacodes*) | | | | | | | | | | | | |
| Argentine shortfin squid (*Illex Argentinus*) | | | | | | | | | | | | |
| Patagonian squid (*Doryteuthis gahi*) | | | | | | | | | | | | |

**Key:** *Present* *Known spawning period* *Occurrence Unlikely*

| Species | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cetaceans** | | | | | | | | | | | | |
| Sei whale (*Balaenoptera borealis*) | | | | | | | | | | | | |
| Fin whale (*Balaenoptera physalus*) | | | | | | | | | | | | |
| Antarctic minke whale (*Balaenoptera acutorostrata*) | | | | | | | | | | | | |
| Sperm whale (*Physeter macrocephalus*) | | | | | | | | | | | | |
| Southern bottlenose whale (*Hyperoodon planifrons*) | | | | | | | | | | | | |
| Long-finned pilot whale (*Globicephala melas*) | | | | | | | | | | | | |
| Southern right whale (*Eubalaena australis*) | | | | | | | | | | | | |
| Killer whale (*Orcinus orca*) | | | | | | | | | | | | |
| Commerson's dolphin (*Cephalorhynchus commersonii*) | | | | | | | | | | | | |
| Peale's dolphin (*Lagenorhynchus australis*) | | | | | | | | | | | | |
| Hourglass dolphin (*Lagenorhynchus cruciger*) | | | | | | | | | | | | |
| **Key** | *Peak Occurrence* | | *Known Occurrence* | | | | | | | | | |

| Species | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pinnipeds** | | | | | | | | | | | | |
| South American sea lion (*Otaria flavescens*) | | | | | | | | | | | | |
| Southern elephant seal (*Mirounga leonine*) | | | | | | | | | | | | |
| South American fur seal (*Arctocephalus australis*) | | | | | | | | | | | | |
| Leopard seal (*Hydrurga leptonyx*) | | | | | | | | | | | | |
| **Key** | *Peak Occurrence* | | *Known Occurrence* | | *Occurrence Unlikely* | | | | | | | |

| Species | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Penguins** | | | | | | | | | | | | |
| King penguin (*Aptenodytes patagonicus*) | | | | | | | | | | | | |
| Gentoo penguin (*Pygoscelis papua*) | | | | | | | | | | | | |
| Rockhopper penguin (*Eudyptes chrysolophus*) | | | | | | | | | | | | |
| Magellanic penguin (*Spheniscus magellanicus*) | | | | | | | | | | | | |
| Macaroni penguin (*Eudyptes chrysolophus*) | | | | | | | | | | | | |
| Chinstrap penguin (*Pygoscelis Antarctica*) | | | | | | | | | | | | |
| **Key** | *Peak Occurrence* | | *Known Occurrence* | | *Occurrence Unlikely* | | | | | | | |

| Species | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Albatross** | | | | | | | | | | | | |
| Black – browed albatross (*Thalassarche melanophris*) | Known | Known | Known | Known | Known | Known | Known | Known | Known | Known | Known | Known |
| Grey-headed albatross (*Thalassarche chrysostoma*) | Known | Known | Known | Known | Peak | Peak | Peak | Peak | Peak | Known | Known | Known |
| Northern royal albatross (*Diomedea sanfordi*) | | | Known | Known | Known | Known | | | | | | |
| Southern royal albatross (*Diomedea epomophora*) | | | Known | Known | Known | Known | | | | | | |
| Light – mantled sooty albatross (*Phoebetricia palpebrata*) | Known | Known | Known | Known | Known | Known | Known | Peak | Peak | Peak | Peak | Known |
| Wandering albatross (*Diomedea exulans*) | Peak | Peak | Peak | Peak | Known | Known | Known | Known | Known | Known | Peak | Known |
| Shy albatross (*Thalassarche cauta*) | Known | Known | Known | Known | Known | | | | | | | |

Key: Peak Occurrence (dark blue) | Known Occurrence (light blue) | Occurrence Unlikely (white)

| Species | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Petrels and Shearwaters** | | | | | | | | | | | | |
| Southern giant petrel (*Macronectes giganteus*) | Known | Known | Known | Known | Known | Peak | Known | Known | Known | Known | Known | Known |
| Northern giant petrel (*Macronectes halli*) | Known | Known | Peak | Peak | Peak | Peak | Peak | Peak | Known | Known | Known | Known |
| Antarctic petrel (*Thalassoica antarctica*) | Known | Known | Known | Known | Known | Known | Peak | Peak | Peak | Known | Known | Known |
| Cape petrel (*Daption capense*) | Known | Known | Known | Known | Peak | Peak | Peak | Peak | Peak | Known | Known | Known |
| Blue petrel (*Haloboena caerulea*) | | | | | Known | Known | Known | Known | Known | Known | | |
| Kerguelen petrel (*Lugensa brevirostris*) | | | | | Known | Known | Known | Peak | Known | Known | Known | |
| Soft-plumaged petrel (*Pterodroma mollis*) | Peak | Known | Known | Known | | | | | | | Known | Known |
| Atlantic petrel (*Pterodroma incerta*) | Known | Known | Known | | | | | | | Known | Known | Known |
| Grey petrel (*Procellaria cinerea*) | Known | Peak | Known | Known | Known | Known | | | | Known | Known | Known |
| White-chinned petrel (*Procellaria aequinoctialis*) | Peak | Peak | Peak | Peak | Peak | Known | | | | Known | Known | Known |
| Wilson's storm petrel (*Oceanites oceanicus*) | Peak | Peak | Known | Known | Known | Known | | | | Known | Peak | Peak |
| Grey-backed storm petrel (*Garrodia nereis*) | Peak | Peak | Peak | Known | Known | Known | | | Known | Known | Peak | Peak |
| Black-bellied storm petrel (*Fragetta tropica*) | Known | Known | | | | | | | | | | Known |
| White-bellied storm petrel (*Fregetta grallaria*) | Known | Known | | | | | | | | | | Known |
| Diving petrel (*Pelecanoides magellani*) | Peak | Peak | Known | Known | Known | Known | Known | Known | Peak | Peak | Peak | Peak |
| Great shearwater (*Puffinus gravis*) | Peak | Peak | Peak | Peak | Known | Peak | Peak | Peak | Peak | Peak | Peak | Peak |
| Sooty shearwater (*Puffinus griseus*) | Known | Known | Known | Known | Known | | | | | Peak | Known | Known |
| Little shearwater (*Puffinus assimilis*) | Known | Known | Peak | Known | | | | | | | | Known |

Key: Peak Occurrence (dark blue) | Known Occurrence (light blue) | Occurrence Unlikely (white)

| Species | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Prions, Shags, Skua , Gulls and Terns** | | | | | | | | | | | | |
| Prions | | | | | | | | | | | | |
| Fairy prion (*Pachyptila tutur*) | | | | | | | | | | | | |
| Shags | | | | | | | | | | | | |
| Catharacta skua (*Stercorarius skua*) | | | | | | | | | | | | |
| Southern / skua (*Stercorarius Antarcticus*) | | | | | | | | | | | | |
| Long-tailed skua (*Stercorarius longicaudus*) | | | | | | | | | | | | |
| Dolphin gull (*Larus scoresbii*) | | | | | | | | | | | | |
| Kelp gull (*Larus dominicanus*) | | | | | | | | | | | | |
| Brown-hooded gull (*Larus maculipennis*) | | | | | | | | | | | | |
| South American tern (*Sterna hirundinacea*) | | | | | | | | | | | | |
| Arctic tern (*Sterna paradisaea*) | | | | | | | | | | | | |

**Key** — *Peak Occurrence* — *Known Occurrence* — *Occurrence Unlikely*

| | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Socio-economic Sensitivities** | | | | | | | | | | | | |
| Fishing Activity | | | | | | | | | | | | |
| Commercial Shipping | | | | | | | | | | | | |
| Tourism | | | | | | | | | | | | |
| Oil and Gas Activity | | | | | | | | | | | | |

**Key** — *Peak Occurrence* — *Known Occurrence* — *Occurrence Unlikely*

# 5 Impact Assessment Methodology

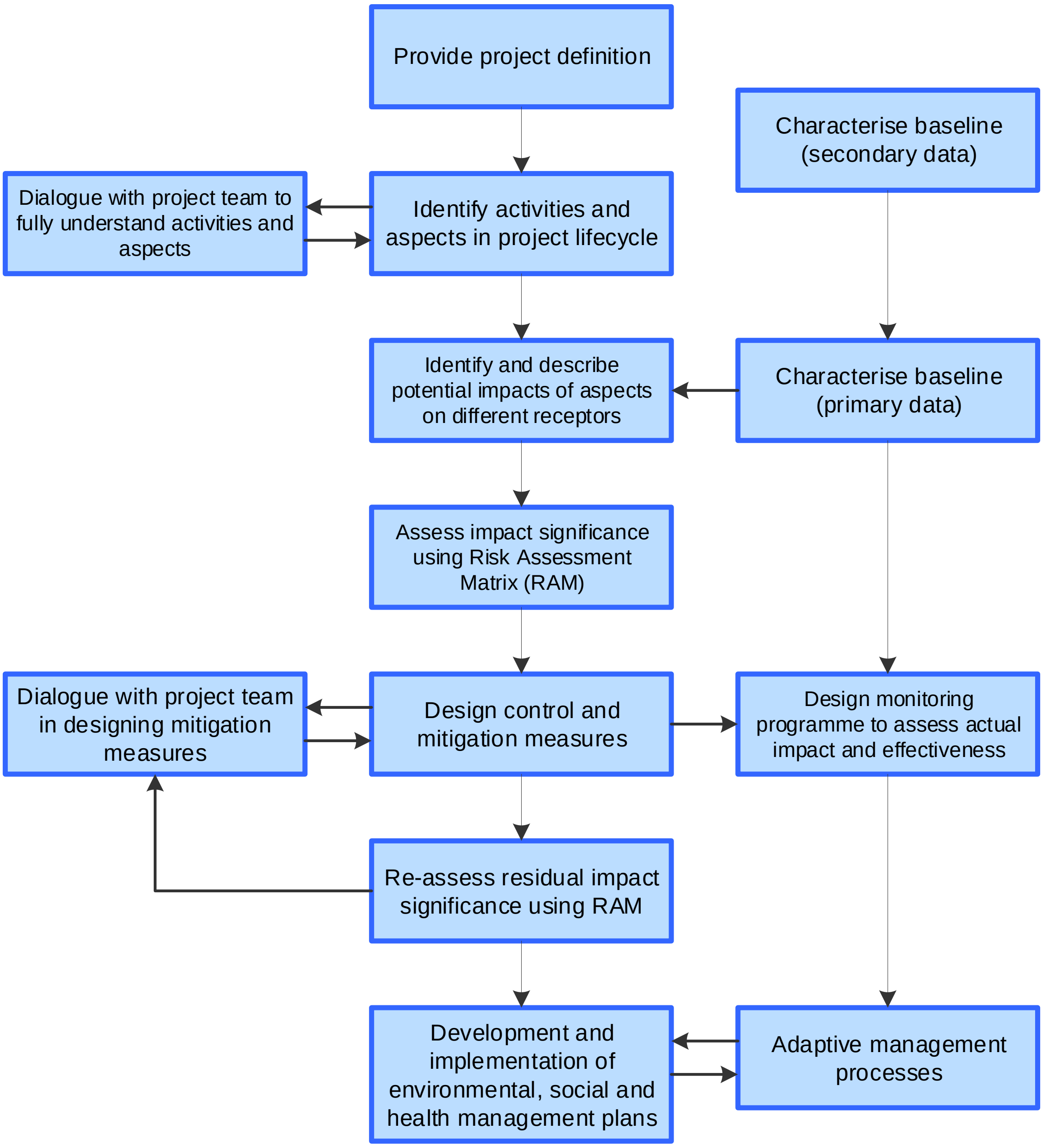
## 5.1 Introduction

5.1 The Environmental Impact Assessment (EIA) process is defined as the entire process undertaken during the development of the project and execution to define, understand and manage potential impacts. As part of this process an Environmental Impact Statement (EIS) is produced. The EIS is a document which assesses the potential impact of the development on the environment and identifies how these impacts will be avoided, mitigated or compensated. The production of the statement is a key part of the wider EIA process that includes public consultation on the EIS document and its consideration by decision makers. In other words, the EIS document is a stage part-way through the process and facilitates later stages of the EIA process. This chapter presents the impact assessment methodology used to assess the identified impacts as part of this EIS document, which informs the wider EIA process. The results of the application of the impact assessment methodology are provided in Section 6 of this EIS document.

5.2 In order to determine the impacts that a proposed project may have on environmental receptors it is necessary to conduct an impact assessment through an established and systematic process. This process is designed to identify, interpret, assess and communicate information concerning the potential impact of the project upon the environment. It also provides an opportunity to 'design out' potential environmental impacts at an early stage, i.e. proactive prevention of pollution or environmental impact rather than mitigation or remedy at a later stage.

5.3 The assessment process for the Noble exploration drilling activities project follows the sequence summarised in Figure 5.1.

*Figure 5.1: Methodology for impact assessment*




5.4 The primary function of the assessment process is to be integral to a project, assessing potential impacts and setting design and operational challenges with the aim to reduce the negative potential impacts of the project as far as practicable. Opportunities for embracing or expanding positive potential impacts are also a consideration, where feasible. It is an ongoing process, addressing project activities from first concepts through to final decommissioning.

5.5 Having completed the assessment, the applicant is required to prepare and submit an Environmental Impact Statement (EIS) to the regulator. The EIS provides a record of the assessment of the likely effects of the project on the environment and records the measures being proposed to manage potential impacts.

5.6 The impact assessment process follows a structured methodology for the identification and, where necessary, quantification of the different aspects of the project lifecycle that have the potential to affect the environment (for example, emissions and discharges) in order to determine the significance of potential impacts. The EIS must also report the mitigation measures required to prevent, avoid, minimise and mitigate the identified potential impacts.

5.7 This section introduces and describes the methodology for undertaking the impact assessment and provides a description of the impact assessment methodology that has been adopted for the EIS.

## 5.2 Identification of Interactions

5.8 Table 5.1 summarises the interactions between the proposed project and key environmental receptors. The interactions are not yet assessed but are simply identified as those that require further consideration in the impact assessment.

*Table 5.1: Interactions between project operations and receptors*

| | Physical | | | Biological | | | | | | | | Human | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Marine Water Quality | Air Quality | Soils / Sediments | Terrestrial Communities | Benthic Communities | Plankton | Fish / Shellfish | Offshore Seabirds | Coastal Seabirds | Marine Mammals | Protected / Sensitive Areas | Shipping | Fishing | Oil and Gas Activity | Pipelines / Cables | Archaeology | Tourism / Leisure | Land Use | Coastal Populations | Infrastructure | Housing |
| **Physical presence and other users of the sea** | | | ■ | | ■ | | | | | | | ■ | ■ | | | ■ | | | ■ | | |
| **Atmospheric emissions and air quality** | | ■ | | | | | | | | | | | | | | | | | | | |
| **Discharges to sea** | ■ | | ■ | | ■ | ■ | ■ | ■ | | ■ | | | | | | | | | | | |
| **Bio-security** | ■ | | | | ■ | ■ | ■ | | | ■ | | | | | | | | | ■ | | |
| **Underwater noise** | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | | | | | |
| **Airborne noise** | | | | ■ | | | | ■ | ■ | ■ | ■ | | | | | | | | ■ | | ■ |
| **Waste** | | ■ | ■ | ■ | | | | | ■ | | | | | | | | | ■ | ■ | | |
| **Light** | | | | | | | | ■ | | | | | | | | | | | | | |
| **Utilities, transport networks, communications and local resources** | | | | | | | | | | | | | | | | | ■ | | ■ | ■ | ■ |
| **Seascape, landscape and visual** | | | | | | | | | | | ■ | ■ | ■ | | | | | | | | |
| **Accidental events** | ■ | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | | |

## 5.3 Environmental Impacts from Planned & Unplanned Events

5.9 To identify project aspects, all proposed activities have been considered in terms of their direct or indirect potential to:

- Interact with the existing natural environment, including its physical, biological and human elements; and
- Breach relevant national environmental policy and/or standards, relevant international legislation, and Noble's Global Environmental, Health and Safety (EHS) Management System (GMS).

5.10 Impacts from a planned event are those resulting from the routine and intended operations/activities as part of the Noble exploration drilling project (for example, the physical presence of the drilling unit, and the discharge of drill cuttings). They may occur continuously, intermittently or on a temporary basis.

5.11 Impacts from unplanned events occur as a result of incidents and accidents such as failure of equipment, procedures not being followed, unforeseen non-routine events, or process equipment not performing as per design parameters. Typical examples of impacts occurring from accidental events include (but are not limited to) unintentional releases and leaks of oils and/or chemicals.

## 5.4 Uncertainty and the Identification and Evaluation of Impacts

5.12 When assessing impacts associated with the project a variety of project data, baseline data, modelling information and worst case assumptions are utilised in the evaluation of the significance of potential impacts. However, the assessment inherently carries levels of uncertainty, including whether impacts may or may not occur. As such, all the impacts (whether potential, residual, predicted, cumulative or trans-boundary) described in this EIS are to a greater or lesser extent potential impacts, which may occur to a lesser degree, or not at all.

5.13 For the purpose of this EIS the following definitions apply:

- **Potential impacts:** Impacts that might occur without the application of mitigation measures to reduce their likelihood or the consequence of the impact.
- **Residual impacts:** Impacts that may occur following the application of successful mitigation measures.
- **Cumulative impacts:** Impacts that may result from more than one project which may individually be insignificant but when considered in combination with each other have the potential to be significant.
- **Trans-boundary impacts:** Impacts that have the potential to impact the environment of neighbouring countries.

## 5.5 Sources of Potential Impact

5.14 Table 5.2 summarises the key potential impacts from the exploration drilling project and identifies where in the EIS document the potential impacts have been assessed. After the application of mitigation and monitoring measures, the residual impact is also described.

*Table 5.2: Key aspects of the proposed exploration drilling project*

| Aspects | Key environmental and socio-economic receptors | Action Register Ref. (refer to Appendix A) | Assessed Further in EIS Section |
|---|---|---|---|
| **Physical Presence and Other Users of the Sea** | *Sediments, Benthic Communities, Shipping, Fishing, Archaeology, Coastal Populations* | 1.1 to 1.6 | Section 6.1.1 to Section 6.1.6 |
| **Atmospheric Emissions** | *Air Quality, Coastal Populations, Human Health, Society* | 2.1 to 2.2 | Section 6.2.1 and Section 6.2.2 |
| **Discharges to Sea** | *Marine Water Quality, Sediments, Benthic Communities, Plankton, Fish / Shellfish, Offshore Seabirds, Marine Mammals* | 3.1 to 3.5 | Section 6.3.1 to Section 6.3.5. |
| **Bio-security** | *Marine Water Quality, Benthic Communities, Plankton, Fish / Shellfish, Marine Mammals, Coastal Populations* | 4.1 | Section 6.4. |
| **Underwater noise** | *Plankton, Fish / Shellfish, Offshore Seabirds, Coastal Seabirds, Marine Mammals, Protected / Sensitive Areas* | 5.1 to 5.4 | Section 6.5.6 to Section 6.5.9. |
| **Airborne noise** | *Terrestrial Communities, Offshore Seabirds, Coastal Seabirds, Marine Mammals, Protected / Sensitive Areas, Coastal Populations, Housing* | 6.1 to 6.2 | Section 6.6.1 and Section 6.6.2. |
| **Waste** | *Air Quality, Soils / Sediments, Terrestrial Communities, Coastal Seabirds, Land Use, Coastal Populations* | 7.1 to 7.2 | Section 6.7.1 and Section 6.7.2 |
| **Light** | *Offshore Seabirds* | 8.1 | Section 6.8 |
| **Seascape, Landscape and Visual** | *Protected / Sensitive Areas, Shipping, Fishing* | 9.1 | Section 6.9 |
| **Utilities, Transport Networks, Communications and Local Resources** | *Tourism / Leisure, Coastal Populations, Infrastructure, Housing, Society* | 10.1 to 10.3 | Section 6.10.1 to Section 6.10.3. |
| **Accidental Events** | *Marine Water Quality, Air Quality, Benthic Communities, Plankton Fish / Shellfish, Offshore Seabirds, Coastal Seabirds, Marine Mammals, Protected / Sensitive Areas, Shipping, Fishing, Oil and Gas Activity, Tourism / Leisure, Land Use, Coastal Populations, Health, Society* | 11.1 to 11.4 | Section 6.11.5 to Section 6.11.8. |

## 5.6 Environmental Significance

### 5.6.1 Overview

5.15 This EIS document addresses the likely significant effects of the project on the environment and the decision process related to defining whether or not a project is likely to have significant impacts on the environment is the core principle of the impact assessment process. There are no specific definitions of what constitutes a significant impact provided by the *Offshore Minerals (Amendment) Ordinance 2011*. In addition, no specific definitions of significance or methodologies for assessment are provided by the regulations around the world that govern impact assessments, such as the European EIA Directive (as Amended) 2009 or the *Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended)* which implements the European Directive into UK Law. However, these guidance documents all recommend that the methods used for identifying and assessing potential impacts should be transparent and verifiable.

5.16 The method presented here has been developed by RPS over the last decade by reference to the principles and guidance provided for oil and gas developments within the UK and across the oil and gas industry globally. It has been updated in recent years to include and adhere to the guidance provided by the *Offshore Minerals (Amendment) Ordinance 2011*, the *Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended)*, the Institute of Ecology and Environmental Management (IEEM) guidelines for marine impact assessment (IEEM, 2010) and the Equator Principles for determining, assessing and managing social and environmental risk in project financing (http://www.equator-principles.com/). This established method has been used previously for other Falkland Islands developments and for oil and gas developments in the UK North Sea. It has been benchmarked against methodologies used across the oil and gas industry within the UK and across the globe and has been regularly updated based on comments from operators, from the Department of Energy and Climate Change (DECC) in the UK and from regulators across the global oil and gas industry. The methodology presented here represents a standard risk based assessment methodology applied as best practice within the oil and gas industry.

5.17 As the determination of the significance of a potential impact can be subjective, being primarily based on professional judgement from experienced impact assessment practitioners, there is functionally a requirement for extensive scoping and consultation to support the process. This enables input from important and knowledgeable local experts and key stakeholders in the form of relevant information to the impact assessment and in the identification of potential impacts. This information can then be utilised in assessing the significance of potential impacts utilising the most up to date information available and taking into account stakeholder concerns. As described in Section 3.2.3 and Section 8, this is something Noble has given particular attention to throughout the development of the EIS document and assessment process and continues to do so.

5.18 Once the scope of the EIS document has been established, it is important to standardise the assessment of potential impacts. Despite this being a subjective process, a defined methodology is required to undertake the assessment in a manner that is as objective and as repeatable as possible.

5.19 The significance of any potential impact is determined through the use of a standard risk assessment methodology applied throughout the global oil and gas industry and employs the standard risk philosophy shown in Box 5.1.

***Box 5.1: Standard Risk Assessment Approach***

| |
|---|
| **Severity of potential impact (consequence)** |
| **X** |
| **Likelihood** |
| **=** |
| **Risk (Impact)** |

5.20 The following sections describe the criteria that have been used to assess the significance of potential impacts.

### 5.6.2 Consequence of Potential Impact

5.21 The consequence of each impact is given a score between one and six (a high score means the impact is of greatest severity), as shown in Table 5.3 and involves the consideration of four drivers:

- **Area:** Consideration of the geographical area over which an impact could occur.
- **Environmental Receptors:** Consideration of the potential environmental sensitivities and receptors and published scientific evidence on the potential environmental impacts.
- **Human Receptors:** Consideration of potential impacts on other users of the sea (potential conflict / concern resolution), interest groups and the general public and perceived potential impacts.
- **Reputation:** Consideration of impacts that may result in negative feedback from the local community, from the regulator and from NGOs.

5.22 This approach allows important consideration of public perception as well as scientifically measured potential environmental impacts. This can be very important for high profile projects where concerns raised by stakeholders can represent significant risk to a project if they are not identified and effectively managed form an early stage. It also flags up instances where certain potential impacts may not comply or be at risk of non-compliance with regulatory requirements. This allows for early action, in the form of design improvements, to be taken to address these potential impacts.

5.23 Once each of the four consequences has been assessed, a final consequence rating for the potential impact (prior to mitigation) must be assigned. Overall ranking is undertaken using agreed rules applied by experienced assessors. The following key rules are used to assess the consequence of each impact:

- In cases of uncertainty, the highest ranking of the four should be taken as the final ranking.
- A potential impact rated with the same category for two of the drivers is seriously considered for the category above, i.e. a potential impact with 2 x minor ratings is considered for the moderate category; and
- All negligible rankings are re-examined for important negative aspects before overall ranking can be considered negligible.

*Table 5.3: Definition of consequence categories*

| | Area | Environmental Receptors | Human Receptors | Reputation |
|---|---|---|---|---|
| **6 Catastrophic** | Extending over a wide area (> 100 $km^2$). | Catastrophic effect on an ecosystem at an international / trans-boundary level (e.g. significant deterioration of air quality, contamination of the marine environment; change in abundance or distribution of a population, or size of genetic pool). Catastrophic effect on the conservation of nationally / internationally protected sites, habitats and / or populations. | Significant damage and long-term loss to natural resources of international importance.<br>Considerable negative impacts on the international/ trans-boundary/ community. | Will result in immediate intervention by government bodies.<br>High profile community outrage.<br>Complete loss of public confidence in company. |
| **5 Severe** | Extending over a wide area (10 - 100 $km^2$). | Severe effect on an ecosystem at a national level (e.g. significant deterioration of air quality, contamination of the marine environment; change in abundance or distribution of a population, or size of genetic pool). Long term effect on the conservation of nationally / internationally protected sites, habitats and / or populations. | Significant damage and long-term loss to natural resources of national importance.<br>Considerable negative impacts on the national community. | May result in immediate intervention by government bodies.<br>Serious community concerns and complaints.<br>Major loss of public confidence in company. |
| **4 Major** | Extending over an area of approx. 10 $km^2$. | Serious effect on an ecosystem at a regional level, leading to observable and measurable changes (e.g. deterioration of air quality; contamination of marine environment; change in abundance or distribution of a population, or size of genetic pool). Short-term potential impact on the conservation of nationally / internationally important protected sites, habitats and / or populations. | Significant damage to natural resources of regional importance.<br>Measurable negative impacts on the national community. | May result in significant alarm raised by government bodies or stakeholders, requiring immediate implementation of mitigation measures.<br>Considerable community concern and potential single community complaint.<br>Possible loss of public confidence in company. |
| **3 Moderate** | Extending over an area of approx. 1 $km^2$. | Considerable effect on ecosystem on a local level, leading to observable and measurable changes (e.g. deterioration of air quality; contamination of marine environment; change in abundance or distribution of the population). Potential impacts on the conservation of locally important sites / habitats and / or populations. | Significant damage to natural resources of local importance.<br>Measurable negative impacts on the regional community / Vulnerable groups affected. | May result in concerns being raised by government bodies or stakeholders.<br>Some community concerns raised. |
| **2 Minor** | Extending over an area of approx. 0.01 $km^2$. | Limited effect on an ecosystem on a local level, leading to observable and measurable changes (e.g. deterioration of air quality; contamination of marine environment; change in abundance or distribution of a population similar in effect to natural variation). | Limited impact to natural resources.<br>Measurable negative impacts on the local community/ vulnerable groups affected. | Unlikely to result in concerns being raised by government bodies or stakeholders.<br>Possible community focus. |
| **1 Negligible** | Confined within the area of the project sphere. | Insignificant effects on the ecosystem in the immediate vicinity of the site, unlikely to be observable or measurable above natural variation. | Has no discernible effect on natural resources.<br>Very little negative impacts on the local/ regional/ national community. | Very unlikely to result in concerns being raised by government bodies or stakeholders. |

### 5.6.3 Likelihood

5.24 In order to assess the significance of a potential impact, the overall consequence is combined with the likelihood of the potential impact occurring. The likelihood of an aspect resulting in a potential impact is based around the frequency of occurrence within the proposed project timeframe and is scored as shown below in Table 5.4.

***Table 5.4: Definition of likelihood categories***

| Likelihood Category | Likelihood of Occurrence |
|---|---|
| A | **Remote** - Hasn't occurred in similar projects but is foreseeable |
| B | **Unlikely** - Known to happen, but only rarely |
| C | **Possible** - Occurred in a minority of similar studies or projects |
| D | **Likely** - Could easily be incurred and has generally occurred in similar projects |
| E | **Certain** - Could be expected to occur more than once during project delivery |

### 5.6.4 Combining Likelihood & Consequence to Establish Significance

5.25 All negative environmental impacts have been identified based on the information summarised in Sections 2 to 4 of this EIS document and their significance is assessed by combining the likelihood and consequence scores as shown in the Risk Classification Matrix in Table 5.5. The resulting scores from the Risk Classification Matrix are presented in the Action Register in Appendix A. Interpretation of the overall risk in terms of potential impact significance can then be undertaken (Table 5.6).

5.26 Low risk environmental impacts are generally considered not significant and are therefore discussed only briefly within Section 6 of this EIS document.

***Table 5.5: Risk classification matrix***

| | | | Likelihood | | | | |
|---|---|---|---|---|---|---|---|
| | | | A | B | C | D | E |
| | | | Remote | Unlikely | Possible | Likely | Certain |
| Severity | 6 | Catastrophic | H | H | H | H | H |
| | 5 | Severe | M | M | H | H | H |
| | 4 | Major | M | M | M | H | H |
| | 3 | Moderate | L | M | M | M | H |
| | 2 | Minor | L | L | M | M | M |
| | 1 | Negligible | L | L | L | L | L |
| Positive impact (P) | | | P | P | P | P | P |

*Table 5.6: Potential environmental risk and significance*

| . | Environmental risk | Potential impact significance |
|---|---|---|
| **High** | High Risk (intolerable risk), where the level of risk is not acceptable and control measures are required to move the risk to the lower risk categories | Considered significant |
| **Medium** | Medium Risk - requires additional control measures where possible or management / communication to maintain risk at less than significant levels. Where risk cannot be reduced to 'Low' control measures must be applied to reduce the risk as far as reasonably practicable. | Considered significant |
| **Low** | Low Risk, where the level of risk is broadly acceptable and generic control measures are already assumed in the design process but require continuous improvement. | Not significant |
| **Positive** | Positive impacts (to be enhanced if at all possible). | Positive significance |

### 5.6.5 Mitigation & Assessment of Residual Impacts

5.27 Where potentially significant impacts have been identified, mitigation measures have been considered. The intention of these measures is that the potential impacts should be removed, reduced or managed so that they are not significant and the probability and/or consequence associated with the impacts are reduced.

5.28 Section 6 of this EIS contains the findings of the detailed assessment of each potential impact and how they might be managed. In Section 6, an initial assessment of the potential impacts is undertaken without consideration of the relevant mitigation measures to be implemented. The proposed mitigation and monitoring measures are then described. The residual impacts remaining after the implementation of the proposed mitigation measures are then described and a final evaluation of their significance provided. It may not be possible to reduce all risks to an 'insignificant' level; in these cases control measures should be applied to reduce the risk as far as reasonably practicable.

5.29 For some potential impacts, mitigation has been recommended even where potential impacts are considered not significant (low risk). In these instances mitigation is recommended as part of a precautionary approach to ensure potential impacts remain not significant and to comply with best industry practice. In addition, they may be implemented to reduce either the impact consequence or likelihood, ensuring the overall risk is minimised. However, this reduction of one of the assessment criteria may not always result in the impact risk category being further reduced.

5.30 The Actions Register in Appendix A summarises the key aspects of the exploration drilling project and the scores associated with each aspect, both before and after mitigation measures. The proposed mitigation measures are also summarised.

### 5.6.6 Potential Cumulative Impacts

5.31 Cumulative impacts are those that may result from the combined or incremental effects of past, present or future activities. While a single activity may not have a significant impact when treated in isolation, it may, when combined with other impacts occurring at the same time and in the same geographical area, result in a cumulative impact that is significant. Potential cumulative impacts on the surrounding marine environment have been considered throughout the EIS and have been considered for all phases of the project.

### 5.6.7 Potential Trans-boundary Impacts

5.32 Due to the remote location of the proposed drilling operations, all of the routine activities to be completed as part of the drilling operations are unlikely to have any significant impacts on the marine environment within the territorial waters of surrounding nations.

5.33 However, there are three main areas that do have the potential for trans-boundary impacts:

- Atmospheric emissions of greenhouse gasses (GHGs);
- Trans-boundary movements of hazardous waste; and
- Accidental hydrocarbon releases.

The above potential trans-boundary impacts are considered in Section 6 of the EIS.

### 5.6.8 EIS Integration with Overall Environmental Management

5.34 This EIS represents only the beginning of an overall process. Consideration of the environment does not end once the EIS has been submitted but will continue through the delivery of the project.

5.35 To increase the likelihood that the design and operational procedures intended to remove and reduce potential impacts from the exploration drilling project prove successful, the mitigation measures identified in the impact assessment in Section 6 have been captured in the Action Register (Appendix A) and the Environmental Management Plan (EMP) in Section 7. Mitigation measures will be monitored to enable Noble to track and assess the performance of the EMP, thus ensuring improvements can be made, if necessary. Where monitoring indicates that further mitigation measures may be reasonably required, Noble is committed to put these in place.

5.36 As part of the ongoing management of operations the monitoring program will be designed to enable Noble to track and assess the performance of mitigation measures, ensuring Noble meets its regulatory and corporate requirements and to update and improve the program if necessary. To that end, Noble will monitor the potential impacts that may occur as part of their operations. As part of this process, Noble will collect information as their operations proceed on the potential impacts identified during the impact assessment process and feed collected information back into the ongoing assessment and management process.

# 6 Impact Assessment

6.1 The purpose of this section is to describe and evaluate the potential environmental impacts associated with Noble's proposed exploration drilling programme. The impacts that are expected to occur are described and assessed in accordance with the methodology presented in Section 5, and quantified where possible.

6.2 This section identifies, evaluates and rates potential project impacts from both planned and unplanned activities. While unplanned activities typically include unintentional releases of hydrocarbons, planned activities include all of the processes designed to carry out the exploration drilling programme. This section also describes the preventative measures, controls, mitigation measures or compensation that will be used to reduce impacts to acceptable levels. Where relevant, management plans that will serve to implement preventative or mitigating measures are identified. Following the implementation of mitigation and management measures, the residual impact is evaluated.

## 6.1 Physical Presence

### 6.1.1 Physical Disturbance to the Seabed - Appendix A1.1

6.3 Mobile offshore drilling units (MODUs) by their very nature are mobile and their installation is temporary. The physical presence of the drilling rig will have little physical impact on the marine environment, due to the type of drilling unit being used (as described in Section 2.4.1). The *Eirik Raude* semi-submersible drilling unit is dynamically positioned, meaning that it needs no physical ties to the seabed in order to keep on station at the drilling locations.

6.4 Physical disturbance to the seabed will occur due to the physical drilling of the wellbores and will result in potential impacts that include the permanent removal of a small area of seabed, sediment and any macrofauna associated with the seabed habitat and sediment. This is as unavoidable consequence of the construction of each well.

6.5 Given the fairly uniform nature of the seabed in each of the drilling locations, the low probability of the presence of habitats of conservation concern and the small area of seabed affected (approximately 0.9m$^2$ of seabed for each well) it is considered that the severity of the impact will be *negligible*. The likelihood of the impact occurring is assessed as *certain* as it cannot be avoided. Therefore, the potential impact of physical disturbance to the seabed as a consequence of the physical drilling of the wellbores prior to mitigation is assessed as **low** (disturbance to the seabed due to discharges of drill cuttings is discussed below in Section 6.3).

#### Mitigation & Monitoring

6.6 As this impact is an inevitable consequence of well construction and the use of dynamic positioning reduces the potential impact in comparison to other moored types of drilling units, there are no additional direct mitigation measures that can be used to further reduce the impact. However, general monitoring of the benthic environment (see Section 6.3.2 for full details) in relation to pre-drilling, during drilling and post-drilling will allow close monitoring of the impacts in situ.

6.7 During pre-drilling monitoring of the wellhead location the presence of habitats of conservation importance will be established. Should any important habitats be observed prior to commencement of drilling, the wellhead will be re-located in order to avoid these habitats.

#### Residual Impact

6.8 While the unmitigated impact of physical disturbance to the seabed is considered to be low, the monitoring presented above will be implemented as part of a precautionary approach to ensure the potential impacts remain not significant. Based on this approach, the likelihood on the impact will remain *certain*, the severity will remain *negligible* and the residual impact is considered to be **low**.

### 6.1.2 Navigation Risk – Appendix A1.2

6.9 The presence of the drilling rig presents a physical obstruction in the sea and an associated increased risk of collision with third-party vessels. The presence of Offshore Supply Vessels (OSVs) also has the potential to increase congestion in near shore areas and therefore increase the risk for collisions to occur. Vessel collision from either of these activities has a low to moderate potential to result in damage to other vessels or assets, resulting in concerns being raised by government bodies, stakeholders or regional groups affected, such as fishing communities. Such an event could also potentially lead to elevated impacts such as injury/loss of life to vessel crew members or an unintentional release of hydrocarbons. This section addresses the potential navigation risk impact of the collision itself whereas the secondary potential impact related to release of hydrocarbons is addressed in Accidental Events (Section 6.11).

6.10 The risk of a vessel collision will be greatest during periods of poor weather conditions and darkness when general visibility is limited. As described in Section 4.4.3 of the baseline, the frequency of commercial shipping operations in the Noble license areas is low and there are no major designated shipping routes that pass through the proposed well locations and safety zones.

6.11 There is a small risk of collision with icebergs that may be in the area. A review of iceberg occurrence offshore the Falkland Islands (refer to Section 4.2.8) has shown that icebergs entering the Falkland Islands waters are very rare, as the area does not lie within the main route of movement of icebergs moving northwards from the Antarctic region, which lies much further to the east of the Falkland Islands. However, due to the strong eddy activity in the Drake Passage and its possible (albeit rare) influence on iceberg movement, the presence of icebergs within the Noble license areas cannot be completely ruled out. Therefore a small risk of potential collision with icebergs exists.

6.12 If a collision between vessels, between the drilling rig and a vessel or with an iceberg were to occur, the severity of the potential asset/vessel damage impact is considered to be *major*, particularly due to the potential for the loss of life. The potential for such an occurrence is relatively, low given the minimal level of shipping traffic in the study area. However, the likelihood is considered *possible* on a precautionary basis. Therefore, the potential impact prior to mitigation is considered to be **high**.

#### Mitigation & Monitoring

6.13 Applicable mitigation measures comprise the following:

- A 500 metre radial safety zone will be implemented around the drilling unit whilst on location which will be applicable to all third-party vessels, to reduce the potential for a collision with the drilling. The 500 metre safety zone will be patrolled and enforced by a Safety Stand-by Vessel (SSV), which will be in attendance in the vicinity of the drilling unit at all times.
- Up to 3 OSVs will be used throughout the drilling programme. At all times, the role of SSV will be undertaken by one of these OSVs to patrol the safety zone and warn of the presence of the drilling unit and vessel safety zone. All OSVs will be equipped with modern radar and radio equipment. A set of procedures will be established so that vessel masters, who need to deviate from their planned route based on their current sea passage trajectory, will be asked by the SSV via VHF radio to confirm that they intend to follow the requirements of the drilling rig Automatic Identification System (AIS) warnings. The SSV will maintain close contact with the third-party vessel until they have changed their course away from entering the safety zone.
- Due regard will also be given by the officers on watch on board the OSVs to fellow sea users at all times, in line with the International Regulations for Preventing Collisions at Sea (COLREGs). Any fishing vessel encountered by the OSVs in transit to/from the drilling

unit shall be given a wide berth in full cooperation with any flags, symbols or other instructions that the fishing vessel may be displaying or may issue via VHF.

- The emergency response plans and procedures of the drilling unit and OSVs will be verified by Noble for adequacy to respond to a potential collision threat. This shall include the threat of collision from icebergs.
- The Falkland Islands Fishing Companies Association (FIFCA), Consolidated Fisheries Limited (CFL) and Falkland Islands Government (FIG) will be notified, in writing, a minimum of 30 calendar days before the start of drilling activities, so that fishing vessels can plot the drilling location on marine charts, avoid the safety zone and plan their sea passage to/from any favoured fishing grounds accordingly;
- Noble will liaise with the Fisheries Department and CFL with regard to the issue of navigation warnings advertising the presence of the drilling rig through the existing Fisheries Department Daily Shipping Forecast system. The information provided will include details on the current position of the drilling rig, presence of the OSVs, description of the 500 metre radial safety zone and the need for vessels to stay outside of this zone at all times.
- A message will be attached to the drilling unit's AIS to provide an identical set of information to the Daily Shipping Forecast described above.
- The drilling rig will be fitted with navigational lighting and a radar transponder to show its position to third-party vessels visually, and also through the use of radar equipment.
- Standard Marking Schedule provisions or International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) recommendations and guidelines will be adhered to during operations and transit to and from Stanley Harbour and the rig location by OSVs.
- Any complaints associated with the temporary loss of access to the sea will be recorded and monitored, in accordance with the Noble Energy Community Feedback Mechanism.
- Details of the as-built well locations will be provided to FIG and to hydrographic organisations to enable the location of the wells to be plotted onto navigational charts.

#### Residual Impact

6.14 Vessel masters will have sufficient time (up to 6 weeks) to plan their intended route so that they can avoid the safety zone and ensure the potential for collisions with the drilling rig are significantly reduced. International standard notification protocols will be used and it is likely that vessel masters will be familiar with the need to avoid offshore oil and gas activities. In addition, the measures outlined above will ensure that all shipping traffic is aware of the presence of the drilling rill and the three OSVs throughout operations. Given the low level of shipping activity and the measures undertaken to alert vessels to the presence of the drilling activity in advance, the likelihood of a collision occurring is considered to be significantly reduced to *remote*. The measures will also serve to reduce the severity of such an event, by giving the rig and OSVs warning of an impending event and providing time to take evasive action that will significantly reduce the potential for the loss of life. As a result, the severity is reduced to *moderate* and therefore, the residual impact is assessed as **low**.

### 6.1.3 Potential Interference with Other Users of the Sea - Appendix A 1.3

6.15 The Noble exploration drilling programme has the potential to interact with fisheries and shipping through the presence of the drilling rig and support vessels, through exclusion of fishing and shipping activity from areas of the sea where the drilling rig will be operating, and through the presence of the wellhead on the seafloor.

6.16 During the exploration drilling programme, a safety zone will be enforced by the SSV to prevent the entry of third-party vessels from travelling in close proximity to the drilling rig. The safety zone will comprise a radial area of 500 metres around the perimeter of the drilling unit, a total sea area of 0.8 $km^2$. This temporary restriction of access to the sea to third-parties has the potential to disrupt regional marine activities such as commercial shipping and fishing and to some degree increase financial costs due to the additional time (and fuel) required to deviate around the safety zone. In addition this sea area will be temporarily unavailable to fishing activity, preventing them from accessing fishing grounds within the safety zone.

6.17 The only company possessing an ITQ to catch fish within the FISA12, FIST13 and FINA13 areas is Consolidated Fisheries Ltd. (CFL). CFL operates a long line fishery targeting the Patagonian toothfish (*Dissostichus eleginoides*) (refer to Section 4.4.2). Historical catch data for 2008-2013 indicates that the total volume caught is erratic. No significant seasonal trends could be identified during evaluation of the plotted catch and Vessel Monitoring System (VMS) data, and therefore it is assumed that catches from these areas can potentially be made at any time of year (see Appendix E for a full analysis of fishing activity in the area).

6.18 Further analysis of the catch volume data also indicates that other species of commercially important fish species are caught within these areas as 'by-catch' (refer to Section 4.4.2). By-catch species caught from 2008 to 2013 are:

- Grenadiers;
- Skates and rays; and
- Others (by-catch species, including butterfish (*Stromateus brasiliensis*), redfish (*Sebastes oculatus*), lobster krill (*Munida spp.*) and various other squid and fish species).

6.19 In order to further assess the potential impact on the toothfish fishery, the VMS data for long line vessels has been plotted within the FISA12, FIST13 and FINA13 areas, together with the proposed well locations and 500 metre safety zones, in Figures 6.1, 6.2 and 6.3, respectively. The VMS data represents the historical passage of the vessel *CFL Gambler*.

*Figure 6.1: Historically fished areas by long liners in the vicinity of the FISA12 area, 2008-2012 (VMS data supplied by the Falkland Islands Department of Natural Resources – Fisheries Department)*

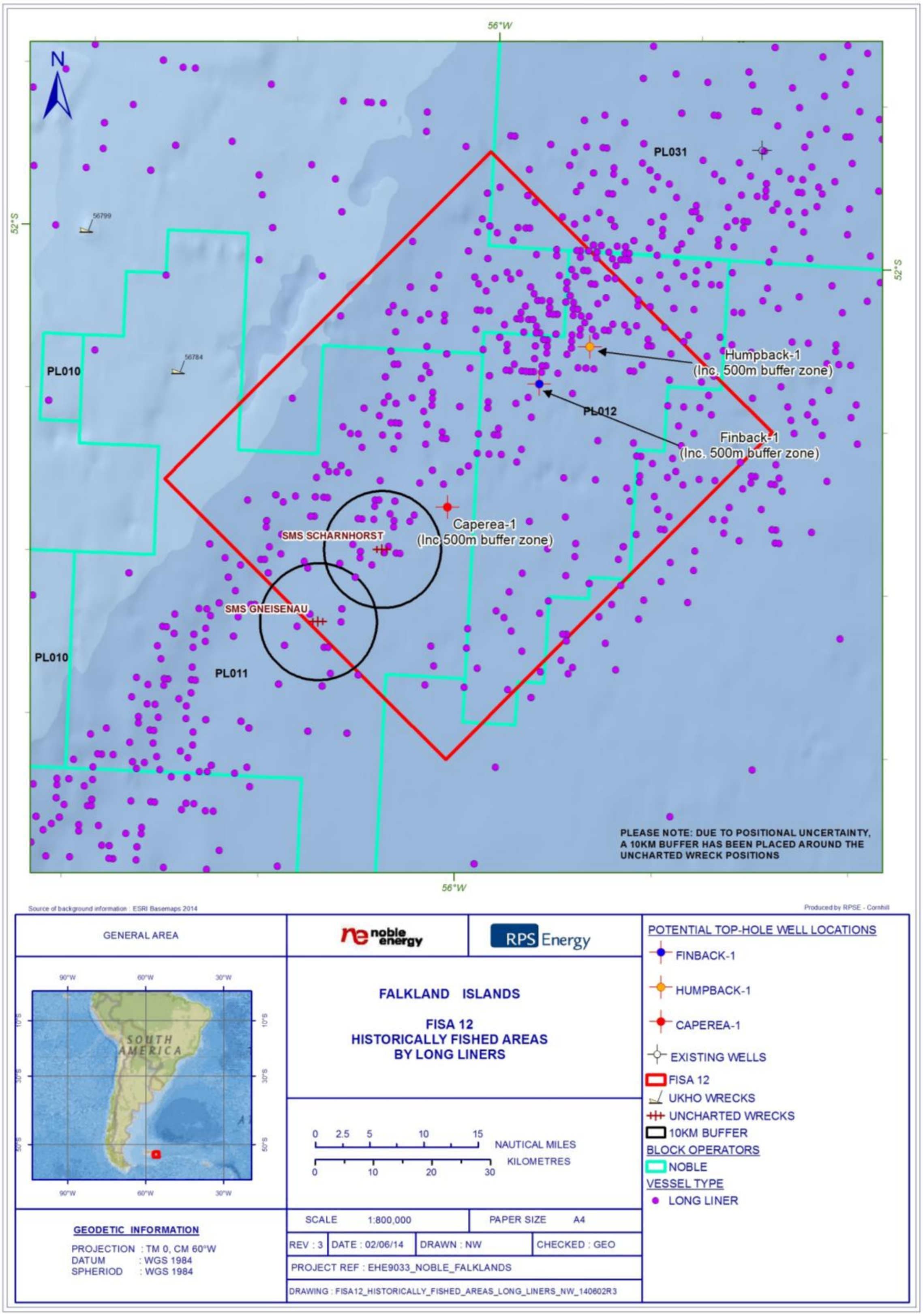


*Figure 6.2: Historically fished areas by long liners in the vicinity of the FIST13 area, 2008-2012 (VMS data supplied by the Falkland Islands Department of Natural Resources – Fisheries Department)*

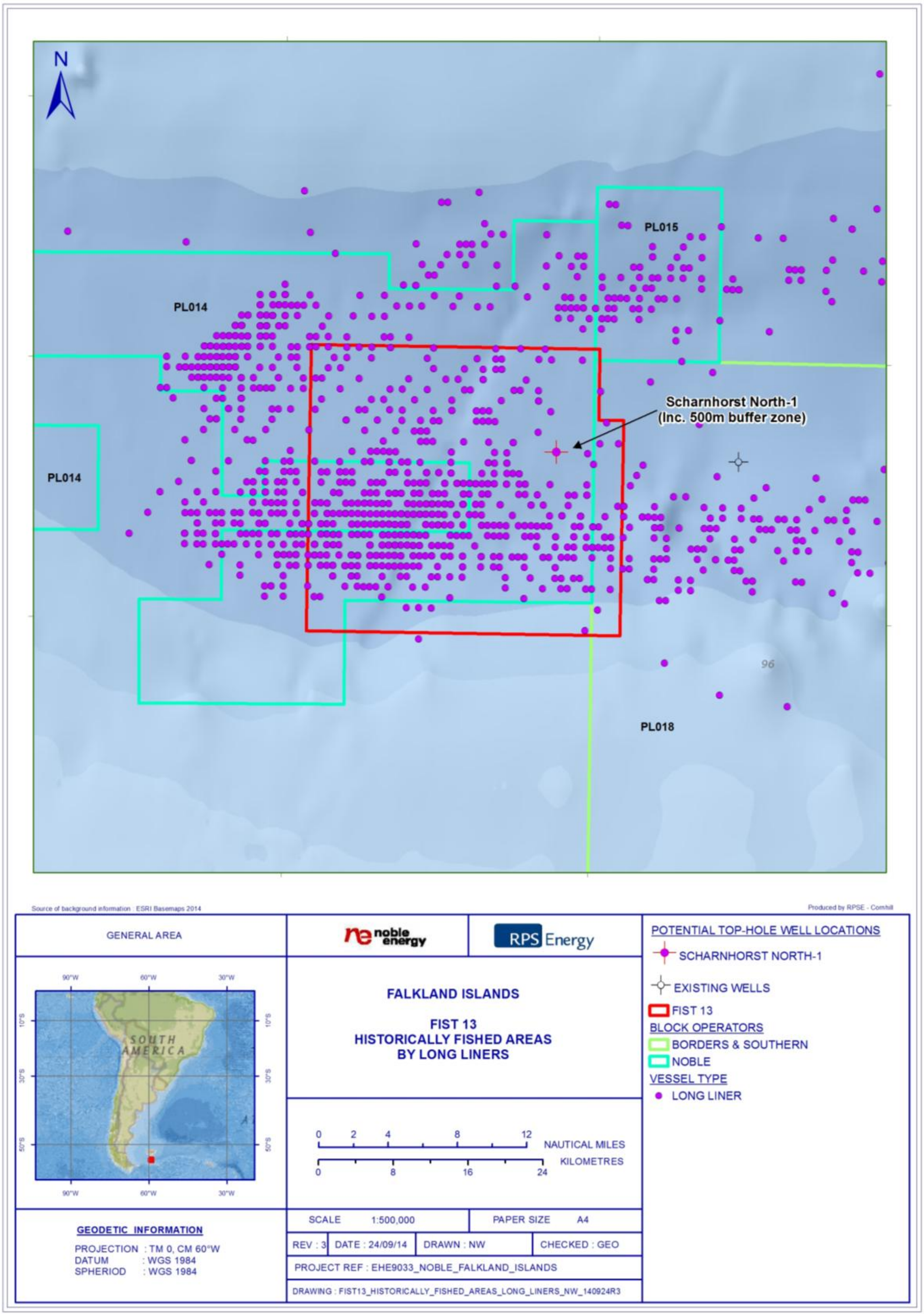
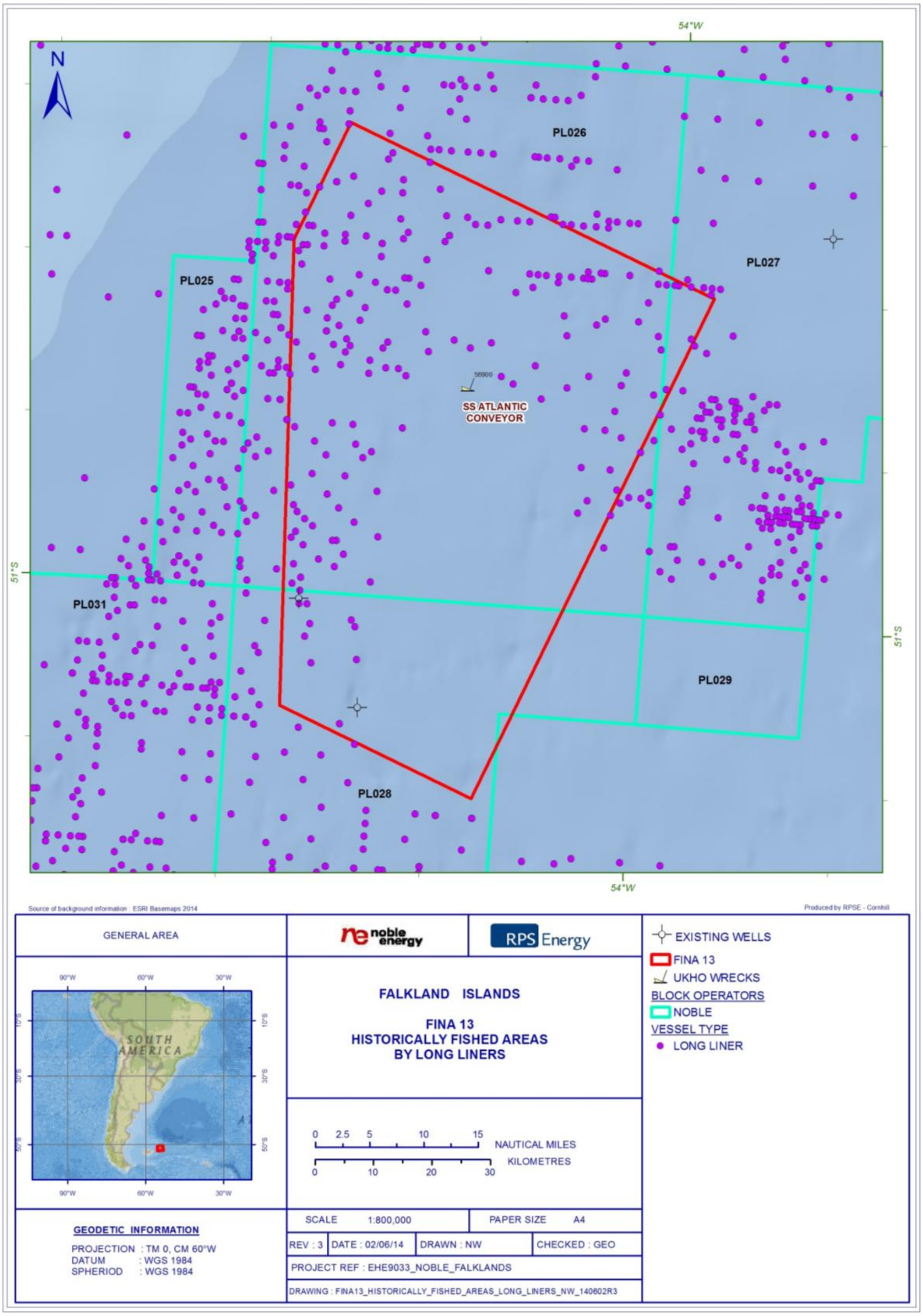


*Figure 6.3: Historically fished areas by long liners in the vicinity of the FINA13 area, 2008-2012 (VMS data supplied by the Falkland Islands Department of Natural Resources – Fisheries Department)*




6.20 The percentage of sea room taken up by a single well and 500 metre safety zone against the total available sea room in each of the three areas has been calculated, and is shown in Table

6.1. Table 6.1 and Figures 6.1 to 6.3 demonstrate that the area occupied by the drilling rig at each well location is only a small proportion (less than 0.1 %) of the available fishing area in each of the three areas.

***Table 6.1: Available sea room within the FISA12, FIST13 and FINA13 areas compared to a single well location and 500 metre safety zone***

| | Area of single well and 500 metre safety zone | Total area of sea room available | Percentage of sea room occupied by single well location and 500 metre safety zone |
|---|---|---|---|
| **FISA12** | 0.80 $km^2$ | 5,328 $km^2$ | 0.01 % |
| **FIST13** | 0.80 $km^2$ | 1,019 $km^2$ | 0.08 % |
| **FINA13** | 0.80 $km^2$ | 5,380 $km^2$ | 0.01% |

6.21 The potential FISA12 wells lay within fisheries quadrant XSAS and the potential FIST13 well lies within fisheries quadrant XYAK. Table 6.1 again demonstrates that the percentage of sea room taken up by a single well and the 500 metre safety zone is only a small proportion of the available fishing area in each of the these quadrants.

***Table 6.2: Available sea room within the relevant fisheries quadrants compared to a single well location and 500 metre safety zone***

| | Area of single well and 500 metre safety zone | Total area of sea room available[1] | Percentage of sea room occupied by single well location and 500 metre safety zone |
|---|---|---|---|
| **XSAS** | 0.80 $km^2$ | 952.50 $km^2$ | 0.08 % |
| **XYAK** | 0.80 $km^2$ | 920.50 $km^2$ | 0.09 % |

6.22 As described in Section 4.4.3 of the baseline, the frequency of commercial shipping operations in the Noble license areas is low and there are no major designated shipping routes that pass through the proposed well locations and safety zones. As demonstrated in Table 6.1 and Table 6.2, only a very small area of the sea will be unavailable for transit and this reduction is unlikely to cause significant disruption to shipping.

6.23 The area of the sea occupied by the 500 metre radial safety zone (a surface area of 0.80 $km^2$) also represents a very small proportion of the total sea available to CFL for commercial fishing, as shown in Tables 6.1 and 6.2 above. On this basis, CFL fishing vessels will be able to seek alternative sites for the duration of the drilling programme. Sufficient notice will be given to allow CFL to plan their fishing activities in order to reduce any disruption and to allow them to plan fishing activity in areas away from the drilling activity. Given the wide availability of alternative fishing grounds and the lengthy period of notice, disruption to any of CFLs fishing activity is not anticipated.

6.24 There is the potential for the wellhead on the sea floor to also cause disturbance to other sea users in the area if the well head is left in position after drilling operations are completed. Fishing gear can become snagged on the well head causing a loss of gear and a potential additional cost to the fishing vessel involved.

6.25 Standard practice in areas of commercial fishing, where seabed or near seabed netting or trawling are anticipated, is to remove the well head and surface casing to below three metres of the seabed. This avoids damage or loss of such equipment by fishing vessels. The removal of surface casing to three metres below the seabed is to avoid later potential exposure (projection

[1] The calculated areas are different due to their different locations on the curved surface of the earth. The earth is not a perfect sphere and the distances between meridians (E-W direction) and parallels (N-S direction) vary depending on the latitudes bounding the area.

above the seabed) due to possible scour of surrounding soft sediments by seabed currents. For example, in UK waters, where commercial fishing activity is widespread, it is a regulatory requirement to remove the wellhead and cut the surface casing to 3 metres below the seabed, regardless of water depth.

6.26 In similar water depth areas of petroleum exploration activity around the world, without commercial fishing at these depths, it is common practice to leave the wellhead in place as it is considered very unlikely that commercial fishing could be impacted.

6.27 For the purposes of the pre-mitigation assessment of this activity it is assumed that the wellhead will be left in place. At present, there is no commercial fishing offshore the Falkland Islands with nets/trawls at the Noble well location depths. Experimental trawl fishing may be carried out in the future to approximately 1,200 metres however, Patagonian toothfish long lines can potentially be used across all Noble license areas (refer to Figures 6.1-6.3).

6.28 Considering the very small area that the drilling rig will occupy, the limited effect on fishing and shipping activity and the resulting low potential for snagging gear on the well head, the severity of the potential impact is considered to be *moderate*. The likelihood of an impact occurring is considered to be *possible* since, although fishing and shipping activity in the area is not particularly high, the potential for disruption to these activities remains. Therefore, the potential impact on other users of the sea prior to mitigation is considered to be **medium**.

### Mitigation & Monitoring

6.29 Applicable mitigation measures comprise the following:

- Up to 3 OSVs will be used throughout the drilling programme. At all times, the role of SSV will be undertaken by one of these OSVs to patrol the safety zone and warn other users of the sea about the presence of the drilling unit and safety zone. All OSVs will be equipped with modern radar and radio equipment. A set of procedures will be established so that vessel masters, who need to deviate from their planned route based on their current sea passage trajectory, will be asked by the SSV via VHF radio to confirm that they intend to follow the requirements of the drilling rig Automatic Identification System (AIS) warnings. The SSV will maintain close contact with the third-party vessel until they have changed their course away from entering the safety zone.
- FIFCA, CFL and FIG will be notified, in writing, a minimum of 30 calendar days before the start of drilling activities, so that fishing vessels can plot the drilling location on marine charts, avoid the safety zone and plan their sea passage to/from any favoured fishing grounds and their fishing activities accordingly;
- Noble will liaise with the Fisheries Department and CFL with regard to the issue of navigation warnings advertising the presence of the drilling rig through the existing Fisheries Department Daily Shipping Forecast system. The information provided will include details on the current position of the drilling rig, presence of the OSVs, description of the 500 metre radial safety zone and the need for vessels to stay outside of this zone at all times.
- A message will be attached to the drilling unit's AIS to provide an identical set of information to the Daily Shipping Forecast described above.
- The drilling rig will be fitted with navigational lighting and a radar transponder to show its position to third-party vessels visually, and also through the use of radar equipment.
- Any complaints associated with the temporary loss of access to the sea will be recorded and monitored, in accordance with the Noble Energy Community Feedback Mechanism.
- Details of the as-built well locations will be provided to FIG and to hydrographic organisations to enable the location of the wells to be plotted onto navigational charts.
- Noble will comply with FIG regulatory requirements on the removal of the wellhead and near seabed casing to three metres below the seabed.

### Residual Impact

6.30 Following the implementation of the above mitigation measures, vessel masters will have sufficient time (up to 6 weeks) to plan their intended route so that they can avoid the safety zone. International standard notification protocols will be used and it is likely that vessel masters will be familiar with the need to avoid offshore oil and gas activities. Therefore any disruption is expected to be minimal. In addition, plans for operations include removal of the wellhead and near seabed casing to three metres below the seabed, reducing the potential for snagging and loss of gear. As a result, the likelihood of the impact will be reduced to *unlikely,* the severity will be reduced to *negligible*, and therefore the residual impact is considered to be **low**.

## 6.1.4 Collision Risk with Marine Mammals - Appendix A1.4

6.31 Shipping collision is a recognised cause of marine mammal mortality worldwide, the key factor influencing the injury or mortality caused by collisions being ship size and ship speed. Ships travelling at 13 knots or faster are most likely to cause lethal or serious injuries (*Scottish Executive, 2007; Wilson et al., 2007*). In the case of the proposed operations, the risk of collision is considered to be very low.

6.32 Any risk of collision would be increased in shallower areas where species are known to congregate. Sea Lion and Beauchêne Islands are important sites for marine mammals and pinnipeds. Sea Lion Island is home to ninety-five percent of the Falkland Islands' population of southern elephant seals and the area is also regarded as an important breeding site for southern sea lions. Killer whales are also common around Sea Lion Island, particularly during pinniped breeding periods. Peale's and Commerson's dolphins are also observed year round near the islands. Beauchêne Island is important for its significant colony of rockhopper penguins and black-browed albatross. Southern sea lions also use Beauchêne as a breeding site, while a large number of other pinniped individuals use it as a haul-out station during foraging trips. In addition cetaceans and pinnipeds are often observed in close proximity to the entrance to Stanley Harbour and coastal areas and there is again potential for collisions between vessels and marine mammals to occur.

6.33 There is the potential for the 3 OSVs to pass close to these islands during passage to and from Stanley Harbour and during these times collision risk with marine mammals could potentially increase. Therefore, on a precautionary basis the likelihood of such an impact occurring is considered to be *possible*. In the event that such an impact were to occur the temporary nature of the passage of OSVs passing Sea Lion and Beauchêne Islands and along coastal areas would mean that very few individuals would be affected (if at all) and it is considered that the severity of the potential impact would be *minor*, as it is expected that any effects would be limited on a local level. Therefore, the potential impact prior to mitigation is considered to be **medium**.

### Mitigation & Monitoring

6.34 Applicable mitigation measures comprise the following:

- Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species that may be present within the vicinity of these islands. This will also reduce any potential collision risk (however small) with marine mammals within shallower areas.
- Whilst transiting near coastal areas (i.e. within the vicinity of the approaches to Port William, and whilst within Port William and Stanley Harbour), vessel speed will be reduced in order to minimise the chance of vessel strike with any species that may be present. All other applicable vessel speed limits shall also be observed when within the approaches to Port William and whilst within Port William and Stanley Harbour.

### Residual Impact

6.35 By avoiding the sensitive Sea Lion and Beauchêne Islands during passage to and from Stanley Harbour, the OSVs will reduce the potential for collision risk between vessels and marine mammals in the waters around these islands. By further reducing vessel speeds in close proximity to coastal areas and while entering Stanley Harbour the likelihood of a collision occurring is again reduced, as is the potential severity of the impact. Vessels travelling at 7ms$^{-1}$ (13 knots or faster are those most likely to cause death or serious injury (*Scottish Executive, 2007*; *Wilson et al*., 2007). Vessels transiting to and from Stanley Harbour will be travelling at much slower speeds and as a result serious injury is considered to be unlikely. The measures proposed are aimed at reducing the likelihood of the impact occurring and on that basis the likelihood of the residual impact is considered to be *unlikely*. On a precautionary basis the severity remains *minor*. Therefore, the residual impact is considered **low**.

### 6.1.5 Potential Interference with Archaeological Remains - Appendix A 1.5

6.36 The drilling of an exploration well has the potential to disturb a wreck particularly if the drilling activity is undertaken in close proximity of a wreck, either by direct contact with the wreck itself by drilling equipment, or by discharges associated with the drilling project, such as the discharge of drill cuttings. Impacts from drill cuttings are discussed in Section 6.3.2. The following provides an assessment of the potential impacts form physical interaction between drilling activity and wrecks.

6.37 As described in Section 4.4.6 of the baseline, a total of four wrecks lay within the Noble license areas. Two of these wrecks lie within the FISA12 area and are un-charted, and one wreck lies within the FINA13 area. The other lies within PL011 approximately 12 kilometres from the FISA12 area (refer to Section 4.4.6). The two un-charted wrecks that lie within the FISA12 area are of relevance for this round of exploration drilling.

6.38 Wreck sites in the Falkland Islands are afforded protection under the Protection of Military Remains Act 1986. This Act may be applied to any aircraft or vessel that has crashed or been sunk in connection with military service. Under Section 2 (2)(a) of the Act, any person is in contravention of the Act if they:

- Tamper with, damage, move, remove or unearth the remains;
- Enter any hatch or other opening in any of the remains which enclose any part of the interior of an aircraft or vessel; or
- Cause or permit any other person to do anything falling within paragraph (a) or (b) above.

6.39 The distances from the as reported *Wrecksite.eu* positions of the *SMS Scharnhorst* and *SMS Gneisenau* wreck locations from the proposed Finback-1, Humpback-1 and Caperea-1 exploration wells are given in Table 6.3 below.

***Table 6.3: Distances of the wrecks lying within FISA12 from the proposed well locations in FISA-12 (note: positions of wrecks as reported by Wrecksite.eu, 2014)***

| Wreck | Distance from Finback-1 proposed well location | Distance from Humpback-1 proposed well location | Distance from Caperea-1 well locations |
|---|---|---|---|
| SMS Scharnhorst | 39 kilometres | 49.6 kilometres | 13.3 kilometres |
| SMS Gneisenau | 55.5 kilometres | 66.1 kilometres | 29.5 kilometres |

*Note: SMS Scharnhorst and SMS Gneisenau are uncharted and are approximate locations only*

6.40 It can be seen from Table 6.3 that the locations are some distance from the proposed top-hole well locations. The closest of the potential well locations to either of the wrecks is Caperea-1, lying 13.3 kilometres from the as reported location of *SMS Scharnhorst*. Due to the circumstances under which the above two wrecks were sunk, there is a high degree of positional uncertainty surrounding the wreck locations of approximately 10 kilometres or more.

6.41 Considering the cultural and archaeological significance to the Falkland Islands of wrecks, particularly those that have a connection with military service the severity of potential impacts to the wreck sites without mitigation is considered to be *moderate*. As the location of these wrecks is currently unknown a degree of uncertainty remains as to whether they are outside of the area where drilling will take place, and using a precautionary approach it is considered that the likelihood of occurrence is *possible*. Therefore, the potential impact on wrecks without mitigation is considered to be **medium**.

#### Mitigation & Monitoring

6.42 Applicable mitigation measures comprise the following, and form part of early project planning:

- Well locations will be chosen so that existing and reported wreck locations are avoided.
- Any subsequent changes to top-hole well locations will also actively avoid areas of existing wreck sites. Changes to the top-hole locations will be reported within subsequent addenda to this EIS (as required), and the impacts with respect to existing wrecks will be reassessed if necessary.
- As stated above, no accurate positions of the shipwrecks within FISA12 are known. It is likely that the positions reported by *Wrecksite.eu* are inaccurate. The environmental survey of the FISA12 area put considerable effort into attempting to positively identify the un-charted wrecks during the survey; however, the wrecks were not identified. Noble will therefore avoid drilling within the immediate vicinity of the reported wreck locations by placing a 10 kilometre safety zone around the current reported *Wrecksite.eu* locations.
- The absence of wrecks in the vicinity of the well locations will also be confirmed through the pre-drilling site specific environmental seabed surveys with a remotely operated vehicle (ROV). Should the wreck sites be identified during the pre-drilling survey their location will be noted and reported to FIG and the well location relocated to avoid the wreck sites.
- A reporting protocol will be instigated for the accidental discovery of archaeological material during drilling activity and all appropriate notifications will be completed.

#### Residual Impact

6.43 Active avoidance of the wreck locations when selecting well top-hole locations will significantly reduce the likelihood of direct impacts to occur to the wreck remains on the seabed during drilling activity ensuring that the likelihood is reduced to *remote*. The measures above will not reduce the potential severity of the impact which will remain *moderate*. As a result the residual impact is considered to be **low**.

### 6.1.6 Potential Conflict between Incoming Workers & Local Residents - Appendix A 1.6

6.44 During the drilling programme, oil workers based on the offshore rig will have to regularly travel into the Falkland Islands during crew changes. Additional personnel based onshore will also spend time in the Falkland Islands. It is expected that Incoming workers from offshore should be able to arrive into Stanley and then depart from Mount Pleasant Airport (MPA) on the same day to their international destinations. However, due to periods of poor weather and the frequency of international flights, this may not always be possible and overnight stays may still be required onshore.

6.45 There is a potential that incoming workers could cause conflict with local residents of Stanley from anti-social behaviour, problems arising from alcohol abuse, and public disorder/violence incidents. These types of impacts have the potential to place greater demands on local social welfare resources (such as the police) and may generate social conflict between local residents and the offshore workers.

6.46 Without mitigation, given the period of time that oil workers will be present in Stanley, the likelihood of occurrence is considered to be *possible*. The severity is considered to be *minor* as the majority of incidences are expected to be minor misdemeanours such as anti-social behaviour which while affecting the local community, are expected to have limited effect. Therefore, the potential impact without mitigation is considered to be **medium**.

#### Mitigation & Monitoring

6.47 Applicable mitigation measures comprise the following:

- Noble will use the locally available work force where possible. This will minimise the need for contractors to bring in workers from outside the Falkland Islands into Stanley.
- All Noble contractors, including the drilling contractor, will monitor individuals that are part of their work force and ensure they are made fully aware of the standards of behaviour expected, examples as to what constitutes a breach of their own Behavioural Code of Conduct, a description of the disciplinary and appeal processes and procedures to be followed for alleged misconduct. Contractors will ensure that these aspects are clearly outlined in the workers' contracts so that any termination of employment due to a breach is legally enforceable. In addition, whenever possible the contractors and Noble will limit the amount of time offshore employees spend in Stanley during crew change periods.
- All complaints associated with the behaviour of workers will be recorded and monitored, in accordance with the Noble Energy Community Feedback Mechanism.

#### Residual Impact

6.48 The above measures will ensure that drilling crew workers are aware of the standards of behaviour expected by Noble and that any behaviour that is not consistent with the Code of Conduct will be dealt with. Through the use of local companies and work force, it is expected that the potential for conflict to occur will be reduced. As a result the likelihood will be reduced to *unlikely* but the severity will remain as *minor*. The residual impact is therefore expected to be **low**.

## 6.2 Atmospheric Emissions

### 6.2.1 Emissions from Drilling Rig, Helicopters & OSVs - Appendix A 2.1

6.49 The main source of atmospheric emissions during drilling operations is power generation by the drilling rig, Offshore Supply Vessels (OSVs) and helicopters. No flaring will be undertaken, as no well testing is planned.

6.50 Diesel burnt for power generation will give rise to minor emissions of carbon dioxide ($CO_2$), nitrogen dioxide ($NO_2$) sulphur dioxide ($SO_2$) and unburned hydrocarbons. Table 6.4 below summarises the total atmospheric emissions from the project. A full analysis of the predicted atmospheric emissions can be found in Section 2.5.2.

*Table 6.4: Estimated total atmospheric emissions resulting from the exploration drilling activities*

| Gas[1] | Drill Rig – total for drilling campaign[2] (tonnes) | Offshore Supply Vessels (OSV)[3] – total for drilling campaign (tonnes) | Helicopters[4] – total for drilling campaign (tonnes) | Total (tonnes) |
|---|---|---|---|---|
| Carbon dioxide | 25,920.00 | 38,880.00 | 3,104.45 | 67,904.45 |
| Carbon monoxide | 127.17 | 190.76 | 5.04 | 322.97 |
| Oxides of nitrogen | 481.14 | 721.71 | 12.13 | 1,214.98 |
| Nitrous oxide | 1.78 | 2.67 | 0.213 | 4.66 |
| Sulphur dioxide | 32.40 | 48.60 | 3.88 | 84.88 |
| Methane | 1.46 | 2.19 | 0.0844 | 3.73 |
| Volatile organic chemicals | 16.20 | 24.30 | 0.776 | 41.28 |

*Note 1: Emission factors used from EEMS 2008 based on methodology proposed by OGUK and DECC.*
*Note 2: Rig is estimated to consume @ 30 tonnes of fuel/day for 270 days duration (based on a three well drilling campaign).*
*Note 3: Offshore Supply Vessels @ 15 tonnes of fuel/day for 270 days duration (based on a three well drilling campaign).*
*Note 4: Helicopters estimated to consume @ 3 tonnes of fuel/1000 kilometres, based on a total of 456 round trips – refer to Table 2.18 (based on a three well drilling campaign).*

6.51 It is anticipated that these types of emissions will disperse rapidly under most conditions to levels approaching background within a few tens of metres of their source. To emphasise this, a simple dispersion model (refer to Appendix F) has been used to predict the concentration of some of the key gases in the air at various distances from the drilling activity (Table 6.5). The scenario which has been modelled assumes that the drilling rig and SSV are within close proximity of each other and have a combined fuel consumption rate of 45 tonnes per day.

***Table 6.5: Contribution of predicted daily combustion gases to atmospheric concentrations downwind during the Noble exploration drilling programme***

| Pollutant | Concentration (µg/m$^3$) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0.5km | 1km | 2km | 3km | 4km | 5km | 10km | 20km | 30km | 50km |
| $CO_2$ | 2.244 | 6.987 | 4.948 | 3.308 | 2.308 | 1.684 | 0.646 | 0.219 | 0.129 | 0.071 |
| CO | 0.011 | 0.034 | 0.024 | 0.016 | 0.011 | 0.008 | 0.003 | 0.001 | 0.001 | 0.000 |
| $NO_x$ | 0.042 | 0.130 | 0.092 | 0.061 | 0.043 | 0.031 | 0.012 | 0.004 | 0.002 | 0.001 |
| $SO_2$ | 0.003 | 0.009 | 0.006 | 0.004 | 0.003 | 0.002 | 0.001 | 0.000 | 0.000 | 0.000 |
| $CH_4$ | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| VOC | 0.001 | 0.004 | 0.003 | 0.002 | 0.001 | 0.001 | 0.000 | 0.000 | 0.000 | 0.000 |

*Note: Based on the assumption that the drilling rig consumes 30 tonnes of fuel per day and the SSV consumes 15 tonnes of fuel per day.*

**Emission factors used from OGUK/DECC (2008)*

6.52 These calculations show that the atmospheric emissions will disperse rapidly and will be orders of magnitude below health or environmental guidelines (refer to Appendix G) within a short distance from their source. A minor, short term deterioration in air quality may occur over the local area, but considering the lack of other anthropogenic activities in the surrounding area (i.e. very low commercial shipping activities and oil and gas activities) the severity of the potential impact has been assessed as *minor*. As the emissions are a definite and accepted element of the project operations, the likelihood of the potential impact has been assessed as *certain*. Therefore, on a precautionary basis the potential impact without mitigation has been assessed as **medium**.

6.53 For the coastal populations of the Falkland Islands the likelihood of the potential impact is considered to be *unlikely* due to the considerable distance between the source of the emissions and the nearest landfall (70km from Beauchêne Island). By the time any emissions reach the nearest landfall they will have rapidly dispersed and will not be detectable against background air quality. Therefore, the severity of the impact is considered to be *negligible* and the impact is assessed as **low**.

#### Mitigation

6.54 The use of drilling rigs, vessels and other marine equipment inevitably give rise to atmospheric emissions. Applicable mitigation measures for atmospheric emissions will comprise the following:

- Noble will undertake extensive pre-project planning in order to ensure that the project operations are conducted efficiently, to minimise the duration of project activities as far as possible. This will also assist in optimising the number of trips for OSVs and helicopters between the rig and onshore.
- Emissions generated from the proposed drilling programme will be controlled through the use of modern and well maintained power generation equipment. The equipment shall be maintained in accordance with the written procedures based on manufacturer's guidelines, applicable industry code, or engineering standard to ensure efficient and reliable operation.
- Contracted vessels will be required to control fuel use, efficiently manage energy, and to plan voyages efficiently.

#### Residual Impact

6.55 The resultant emissions to air from the proposed drilling operations are considered to have insignificant, short term and localised impacts due to the dispersive nature of the offshore and atmospheric environments. Although, there is still the potential for trans-boundary impacts in terms of emitted greenhouse gasses (assessed further in Section 6.12.1), rapid dilution and dispersion into the atmosphere will render the total atmospheric emissions from the operation undetectable against background levels within a few kilometres of their source. The potential impact is still expected to occur and so the residual likelihood is considered to be *certain*. The measures above will ensure the most efficient use of fuel and equipment, reducing emissions into the atmosphere so that the severity is *negligible*. Therefore the residual impact is assessed as **low**.

### 6.2.2 Fugitive Atmospheric Emissions during Drilling Operations - Appendix A 2.2

6.56 Additional atmospheric emissions may also result from potential emissions of fumes and vapours (for example volatile organic compounds [VOCs]) from process equipment (e.g. pipes, tubing, valves, vents, compressor seals etc.). The emissions will result in a minor deterioration in air quality that will dissipate to negligible levels within a short distance from their source. However, due to the likely high existing air quality offshore due to the lack of other anthropogenic activities in the surrounding area (i.e. very low commercial shipping activities and oil and gas activities) the severity of the potential impact has been assessed as *minor*. The likelihood of these emissions occurring is considered to be *possible* and therefore the potential impact without mitigation is considered to be **medium**.

#### Mitigation

6.57 Applicable mitigation measures will comprise the following:

- To control fugitive emissions, operational and maintenance procedures will be implemented, which include all environmentally critical valves, flanges, fittings and seals in use on the drilling rig, to eliminate or reduce as far as possible the capacity for gas leaks and fugitive emissions.

- A gas/leak detection system and repair program will be in operation on the rig (requirement of rig Safety Case).

#### Residual Impact

6.58 The measures above are designed to ensure that the potential for fugitive emissions is significantly reduced. Through maintenance of critical valves, flanges, fittings and seals in use on the drilling rig the residual likelihood will be reduced to *unlikely*. The severity will remain *minor*. Therefore, the residual impact is assessed as **low**.

## 6.3 Discharges to Sea

### 6.3.1 Discharges of Drilling Mud - Appendix A 3.1

6.59 During drilling, discharges of water based mud (WBM) will occur. Discharge of WBM will occur via three main routes:

- Released at the seabed during drilling of the riser-less top-hole well sections;
- Released continuously with the drill cuttings as residual mud on cuttings, at or near to the sea surface, when drilling the lower well sections;
- Released as a batch discharge from the rig at or near to the sea surface at the end of well sections or at the end of well (EOW).

6.60 Tables 2.11 to 2.14 in Section 2.4.6 summarise the planned drilling chemicals to be used during drilling operations for the four potential exploration wells. For a single well, either the Humpback–1 well or the Caperea-1 well represents the worst case well based on total mass of mud components and chemicals used. The total mass of WBM chemicals to be used and discharged for either of these wells is approximately 3,920 tonnes (assuming both the bypass and the sidetrack sections are drilled).

6.61 For a three well drilling campaign, the Humpback-1 and Caperea-1 wells are worst case in terms of the discharge of drilling mud components and chemicals from the wells in FISA12. Added to those from the Scharnhorst North-1 well in FIST13, this would result in a total estimated discharge of 10,930 tonnes of WBM chemicals.

#### Potential Impacts on Water Quality

6.62 The discharge of drilling mud has the potential to have effects on the surrounding water quality. Upon discharge to the sea, the drilling mud immediately gets dispersed within the surrounding water. Chemicals within the drilling mud also get diluted rapidly on contact with the sea water. This dilution and dispersion effect has the potential for negative effects on the sea water, as concentrations of chemicals increase temporarily in the vicinity of the discharge. Water turbidity may also increase temporarily in the vicinity of the drilling mud discharge due to the fine material released. However, several studies have shown that drilling fluids discharged to the ocean are diluted rapidly to very low concentrations, usually within 1,000 to 2,000 metres of their source down-current and within two to three hours of the discharge. Often, dilutions of 1000-fold or more are encountered within 1-3 metres of the discharge (*Neff, 1987*). Therefore, impacts on water quality are expected to be highly localised and transient, with significant concentrations of drilling chemicals occurring within only a few metres from the discharge.

6.63 Based on the rapid dilution the likelihood of an impact occurring is considered *possible* as while the dilution is rapid, there is still the potential for an impact to occur. The effects will be localised (to within a few thousand metres of the discharge point), leading to a severity of *moderate*. Therefore, without mitigation, the potential impact on water quality is assessed as **medium**.

### Potential Impacts on Plankton

6.64 The discharge of drilling mud has the potential to have negative impacts on plankton populations in the immediate vicinity of the discharge, due to the potential negative impacts on water quality. However, any potential impacts will be highly localised and transient, as concentrations of drilling chemicals will only be significantly high in the immediate vicinity of the discharge before dilution effects have taken place. Given the potential for impacts to occur the likelihood of an impact occurring is considered *possible*. However, due to the localised effect on plankton in the immediate vicinity of the discharge and due to the range of potential chemicals that may be present in the drilling mud a precautionary severity of *moderate* is considered appropriate. Therefore, the potential impact without mitigation is assessed as **medium**.

### Potential Impacts on the Seabed

6.65 Drilling mud that is adhered to drill cuttings also has the potential to smother the seabed in the immediate vicinity of the well, potentially contributing to depletion of oxygen in surface sediments, leading to a potential loss of seafloor habitat. However, the chemicals in the mud discharge will rapidly disperse and by the time they reach the seabed significant dilution will have taken place. As a result, chemical concentrations will be at levels that are unlikely to affect seabed communities. In addition, the rapid dispersal and dilution of the fine material discharged in the mud will have dispersed widely by the time they reach the seabed and are unlikely to cause significant smothering of the seabed. As a result the likelihood of occurrence is considered to be *possible*. Due to the dilution and wide dispersal of chemicals and fine material in the mud the severity of the impact is considered to be *minor*. Therefore, the potential impact without mitigation is expected to be **medium**.

### Potential Impacts on Fish

6.66 The potential negative impact on water quality has the potential to negatively impact fish species that may be present in the vicinity of the discharge. Fish are highly sensitive to changes in water quality, as they are able to detect even subtle changes in water quality. Fish species known to spawn in the vicinity of the Noble license areas include the Patagonian toothfish (peaks in May and July through to August), and grenadier during March-April in more northerly areas. Other species occurring regularly across the Noble license areas include skate and rays, and rock cod (refer to Section 4.3.5). Due to the range of potential chemicals that may be present in the drilling mud and the potential for plankton and seabed communities (and therefore, potential prey for all life stages of fish species) to be affected a likelihood of occurrence of *possible* is considered. The severity of the impact is considered to be *moderate*, due to the impact occurring in a localised area, affecting only a small proportion of the population for a short period of time. Therefore, the potential impact without mitigation is assessed as **medium**.

### Mitigation & Monitoring

6.67 All of the planned chemicals which Noble currently propose to use for the drilling programme appear on the Ranked List of Products approved under the OCNS (refer to Section 2.4.9 and Appendix C for further information). A large number of the proposed chemicals are considered to ‘pose little or no risk’ to the environment (are classified as ‘PLONOR’) with a corresponding chemical label code of ‘PLO’. A large number of chemicals also have an OCNS category of ‘E’, or have a Gold HQ band (i.e. are least toxic). Others are naturally occurring products (e.g. barite) that are either biologically inert or readily dispersible or biodegradable.

6.68 Applicable mitigation measures for the discharge of drilling mud comprise the following:

- It is proposed that water based mud (WBM) is used for drilling all sections of the exploration wells. The design of the drilling programme to include the use of dedicated water based mud systems negates the use of oil based mud (OBM), which, even after the required thermal cuttings cleaning treatment to FIG PON10 standards, would have a higher toxicity upon discharge to the marine environment than WBM.

- All drilling mud components will be selected on the basis of environmental performance as much as possible within the mud programme, so as to reduce any potential environmental impacts upon the release of the drilling mud.
- A Discharge Management Programme (DMPO) will be in place for the drilling operations. The purpose of the DMPO will be to provide a consistent set of discharge requirements for the exploration drilling programme. The prohibitions, limitations and monitoring requirements in the document will be based on recognized standards and regulations that have been developed to protect the environment. The DMPO will include provisions for the discharge of drilling mud.
- Chemical use and discharge will be closely monitored throughout the drilling program through the rig chemicals tracking system and minimised by the drill crew and mud engineers where practicable, without compromising well safety. All chemical use and discharge will be controlled through the DMPO through the detailing of the reporting procedures for chemical use and discharge. The DMPO will provide a consistent set of discharge requirements for the exploration drilling programme.
- Batch discharges of drilling mud will be minimised as far as possible. All drilling mud will be recycled and used on other well sections as much as possible, without compromising well safety.

6.69 In addition to the above mitigation measures the following monitoring will be undertaken to monitor the potential impacts to the seabed and verify the conclusions of the impact assessment.

- Seabed features and habitats at the well sites will be confirmed through site specific environmental seabed surveys, which will include pre-drilling, during drilling and post-drilling elements as follows:
  - The pre-drilling survey will include a 100 metre radius (centred on the well location) remotely operated vehicle (ROV) inspection of the seabed, using an environmental specialist to interpret for habitats and species. Additional features showing important species (e.g. rocks with epifaunal communities or the presence of corals) will be marked and re-visited after drilling is completed. Seabed sampling will be carried out upstream and downstream of the prevailing currents at 50, 100 and 200 metre offset locations, using a specialist environmental ROV corer (89mm outside diameter). At each station, 2 x physico-chemical samples will be taken from the top 10 cm of sediment, and 5 x biological samples will be taken from the top 20 cm of sediment, and processed through a 500 µm mesh sieve.
  - During drilling, specially designed sediment traps will be deployed at each of the above environmental stations for the purposes of logging the settlement of any cuttings material deposited on the seabed.
  - The post-drilling survey will repeat the survey undertaken pre-drilling. Any additional features showing important species marked during the pre-drilling survey will be re-visited. In addition, a 1.5 metre ROV corer will be used to assess the vertical profile of the sediments in the thickest part of the cuttings pile, expected to be approximately 10 metres from the wellhead. This will record the settlement regime of discharged material over the duration of the drilling, with discrete layers identified, measured and analysed for their physico-chemical properties.

### Residual Impact

6.70 It is acknowledged that the use of WBM mud is outlined in the pre-mitigation assessment. However, the use of WBM has been provided in the list of mitigation measures above as its use (instead of OBM) will ensure that impacts are reduced. It is listed so that it becomes a commitment that Noble will adhere to and is made in their commitments register and all relevant management plans going forward. That being said, the residual risk assessment does not consider it in its final assessment, but bases the residual risk on the other mitigation measures listed above which address the potential issues related to chemicals associated with the discharge and the procedures in place to ensure the potential risk from the discharge of mud is minimised.

6.71 The pre-mitigation impact assessment simply states that the discharge of water based mud will occur. The use of water based mud is in itself a mitigation measure as it avoids the unnecessary risk of oil spills associated with drilling mud, and avoids the unnecessary disposal of oil based mud at an onshore facility which would have a greater environmental impact. The use of water based mud is a common mitigation measure in the oil and gas industry. It is often much more technically challenging and costly to drill a well purely with water based mud, particularly deep exploration wells, and therefore the commitment to use WBM only represents a substantial commitment that has many technical challenges. In addition, it is necessary to specify the use of WBM before the mitigation measures are applied as the cuttings dispersion modelling requires information on the drilling mud type to be used.

6.72 Therefore, implementation of the above mitigation measures will reduce the potential impacts on the seabed, the surrounding water column, plankton and fish species through the use of WBM, chemicals that ‘pose little or no risk’ (‘PLONOR’) or have a Gold HQ band (i.e. are least toxic) and other chemicals that are naturally occurring or either biologically inert or readily dispersible or biodegradable. In addition, measures to reduce the volume released will also ensure impacts are reduced. Based on these measures the likelihood is still considered *possible*. However, it is considered that the reduction in volume and the use of approved chemicals the severity is reduced to *negligible*. Therefore, the residual impacts are all considered to be **low**.

### 6.3.2 Discharges of Drilling Cuttings - Appendix A 3.2

#### Introduction

6.73 The major waste product of an offshore drilling operation is the discharge of drill cuttings (fragments of rock), plus a small amount of residual drill fluids adhering to the cuttings. Discharges of drill cuttings to the environment have the potential to impact the water column and seabed. The extent of the impact will to varying degrees be predominantly dependent on the following:

- The point of discharge, i.e. discharge at the sea surface or release on the seabed;
- The volume and rate of discharge;
- The extent of mixing and dispersion, which can be influenced by the currents and water depths through which the cuttings pass;
- The physical and chemical properties of the cuttings and base fluids (e.g. water based or non-aqueous mud); and
- Environmental sensitivities in the project area; distribution and density of the benthic flora and fauna, pelagic and demersal fish species, and the distance of the drill site from sensitive marine habitats.

6.74 Each of the wells in the drilling programme involves the discharge of drilling cuttings at both the seabed and near to the sea surface. The 42” and 26” top-hole well sections of each well will be drilled with water based mud (WBM) without a marine riser installed (open-hole). Cuttings generated during this drilling period will be swept out of the hole using seawater and sweeps. These cuttings will be deposited directly on the seabed surrounding the wellbore.

6.75 All subsequent well sections will be drilled with a marine riser installed. Drilling mud and cuttings will therefore be circulated back to the rig, where they will pass through the rig shale shaker systems. Here, cuttings will be separated from the drilling mud and then pass through the cuttings cleaning system. Cuttings will be discharged to sea from the drilling unit, approximately 5-10 metres below the sea surface.

6.76 The estimated cuttings generated from each of the four potential exploration wells are given in Tables 2.7 to 2.10 in Section 2.4.5. However, Table 6.6 below provides a summary of the total estimated drill cuttings from each of the four potential exploration wells.

*Table 6.6: Estimate of expected drill cuttings generated from the four potential exploration wells*

| | FISA12 | | | FIST13 |
|---|---|---|---|---|
| | **Finback-1** | **Humpback-1** | **Caperea-1** | **Scharnhorst North-1** |
| **Cuttings discharged at seabed (tonnes)** | 1,456 | 1,456 | 1,456 | 1,456 |
| **Cuttings discharged at sea surface (tonnes)** | 1,243 | 1,294 | 1,294 | 1,294 |

### Cuttings Associated with Seabed Discharge

6.77 Seabed discharge of drill cuttings will occur when drilling the first two 42” and 26” well sections. Following discharge at the seabed, the cuttings pile may be re-suspended and dispersed by seabed currents, which would alter the footprint of the cuttings pile over time.

6.78 As cuttings and WBM used to drill the upper sections of the well will be released at the seabed, the large or heavy cutting particles are expected to accumulate in the immediate vicinity of the wellhead. The finer particles from WBM are likely to form a dense plume which has the potential to interact with benthic communities downstream of the release point. However, the plume will only occur over a relatively short duration whilst the top sections of the wells are drilled, as the top-hole sections commonly take the least time to drill. Therefore any effects are likely to be highly localised to the well.

6.79 Studies have shown that biological impacts from smothering can occur where the depth of cuttings is of one millimetre or more (*Bakke et al., 1986*). It also has the potential to cause a localised increase in turbidity and the depletion of oxygen in surface sediments. Due to the low toxicity chemicals present in the WBM (refer to Section 6.3.1), smothering will be the main potential impact of the seabed cuttings discharge. Smothering effects on benthic communities and changes in the sediment chemistry when combined could potentially create an environment that favours certain species over others. As a result, the population of seabed fauna nearer to the well could potentially differ from that of the unaffected sediments in the short term.

6.80 Impacts from the deposition of drill cuttings are well studied and are broadly found to be only temporary in nature. The margins of the impacted area will begin to recover first as soon as the discharge of cuttings ceases. Re-colonisation of the impacted area can take place in a number of ways, either by mobile species moving in from the edges of the affected area, or from burrowing species digging back to the surface.

6.81 Last *et al.* (2012) (as cited in *ERM, 2013*) assessed the tolerance of different benthic species to burial in fine sand against a benchmark burial depth of 50 millimetres. The study found that tolerance to burial varies considerably between benthic species. In general, burrowing species (e.g. polychaetes) had a high tolerance to burial, compared to surface feeding fauna (e.g. crustaceans).

6.82 The majority of deep water fauna in the vicinity of the wells are expected to be mobile scavengers, although fixed suspension feeders and deposit feeders are also expected. Mobile scavengers will be less affected than the anchored suspension feeders or buried deposit feeders due to their increased ability to move away from any areas of smothering or increased levels of chemicals. Therefore, it is expected that there will be an increase in mobile scavenger species following the drilling, with a corresponding decrease in burrowing species.

6.83 The discharged drill cuttings also have the potential to cause enrichment of the seabed sediments through organic carbon loading (*Neff, 2005*). While organic matter in sediments is an important source of food for benthic fauna, an overabundance can cause reductions in species richness, abundance, and biomass due to oxygen depletion and build-up of toxic by-products (e.g. ammonia and sulphides) associated with the breakdown of these materials (*Hyland et al., 2005*).

6.84 Compounds from drilling fluids (including heavy metals), have been known to bio-accumulate in marine organisms, with the degree of accumulation related to the level of drill cuttings on the seabed and the toxicity of the drilling fluids.

### Cuttings Associated with Surface Discharge

6.85 Once the casing has been inserted into the well and the well has been connected by the riser to the rig at the sea surface, the riser will then circulate the cuttings and excess WBM from the lower sections to the rig. The WBM will then be extracted from the cuttings for reuse by the drilling rig shale shaker and mud recovery systems. The 'cleaned' cuttings will then be discharged from an underwater caisson which will be located approximately 5-10 metres below the sea surface.

6.86 The discharged cuttings, together with any residual drilling mud, will sink to the seabed whilst subject to dispersal by the water currents as they pass through the water column. Cuttings released at the surface have a great distance to sink (1,270 to 1,880 metres, depending on the well location) and as such will be distributed and sorted by the prevailing currents.

6.87 Following the discharge of cuttings and associated residual WBM at the sea surface, cuttings will descend through the water column to the seabed. This has the potential to lead to an initial localised decrease in water quality before any residual WBM associated with the cuttings disperses, where the increased level of contaminants have the potential to create a detrimental effect on plankton, fish and marine mammals in the area.

6.88 As the cuttings settle, they have the potential to smother benthic organisms and alter the chemical composition of the seabed sediment. The discharge could also potentially lead to an increase of background contaminant levels and potential temporary loss/change in biodiversity.

6.89 When drilling through oil bearing zones in the event of a hydrocarbon discovery, there is minimal risk for the generation of cuttings tainted with reservoir hydrocarbons. Oil bearing zones, if encountered, are usually small compared to the total length of the well (normally in the range of tens of metres). By the time cuttings from this zone are circulated back to the surface, any free oil that may be adhered to the cuttings has been mobilised into the surrounding drilling mud and becomes integrated into the wider drilling mud system, becoming diluted within the drilling mud to a great extent. The dilution factor is normally so great that free oil from reservoir tainted cuttings cannot be detected against background levels in the drilling mud system. Because of this dilution effect, it is often extremely difficult (and nearly impossible) to extract any oil from water based mud systems that may have arisen due to drilling in hydrocarbon bearing zones.

6.90 In addition, due to the mobilisation of free oil from reservoir cuttings into the mud system, the cuttings do not represent a significant source of free oil upon discharge to the marine environment after passing through the rig shale shaker and cuttings cleaning systems. In addition, the potential reservoir hydrocarbon section will be drilled "overbalanced". This means that the hydrostatic pressure of the drilling mud will be greater than the pore pressure of the potential reservoir, which ensures that there is no flow of hydrocarbons into the wellbore, and minimises the amount of any hydrocarbon tainted cuttings generated. Therefore, any discharge of such cuttings will be in very small volumes.

### Cuttings Dispersion Modelling

6.91 In summary, the discharge of drill cuttings gives rise to the following potential impacts:

- Potential reduction in water quality;
- Potential reduction in sediment quality (organic enrichment of seabed sediments) when cuttings reach the seabed;
- Potential smothering of marine organisms;

- Potential chemical toxicity to marine organisms; and
- Potential bioaccumulation in marine organisms.

6.92 In order to assess the potential impact from the deposition of drill cuttings, cuttings dispersion modelling has been undertaken, to gauge the potential pattern of deposition and to allow an estimation of the effect this could have on the seabed sediments and benthic fauna. The modelling was undertaken for the Caperea-1 well using the MUDMAP cuttings dispersion modelling programme. The Caperea-1 site was chosen as it lies within the shallower FISA12 area and also lies in closest proximity to the best known position of the un-charted wreck *SMS Scharnhorst* (refer to Section 4.4.6), allowing any potential impact from the discharge of drill cuttings on the wreck to be assessed.

6.93 The full cuttings dispersion modelling report is provided in Appendix H, which includes a full description of the MUDMAP programme. The cuttings dispersion modelling results are summarised below.

### Cuttings Dispersion Modelling Inputs

6.94 Hydrodynamic current inputs for the model were derived from the metocean study (refer to Appendix L). The current data were further refined for input into the dispersion model as described in Section 2.1 of Appendix H. Daily currents were obtained by interpolating the values from the nearest HYCOM (Hybrid Coordinate Ocean Model) model grid points. At the model cell closest to Caperea-1 release site, the water column is represented in 21 discrete vertical layers.

6.95 Because the drilling period is currently unknown, vertically and time varied currents for two representative seasonal periods were used as current forcing for the dispersion model, after further analysis of the data at the closest HYCOM model cell. These periods were identified as period 1: Jan-Mar (summer) and period 2: Jul-Aug (winter) and were subset from the full HYCOM dataset and used as forcing for the MUDMAP dispersion model. Consequently, outputs from the dispersion modelling are provided for both these periods, to examine any potential effect from seasonality. The local currents were observed to be slightly weaker and more directionally variable during the summer period whereas the winter period is characterised by relatively strong currents that are oriented toward the northeast at most depths.

6.96 The drilling discharge program used for model simulations at the proposed Caperea-1 well location is shown below in Table 6.7. For releases at the seabed, releases were simulated at 5 metres above the seabed. For releases at the sea surface, releases were simulated at 2 metres below the sea surface.

*Table 6.7: Drilling discharge program used for cuttings dispersion model simulations at the proposed Caperea-1 well location*

| Section (in) | Release Depth | Release Duration (day) | Cuttings Discharges | | Drilling Fluids Discharges | |
|---|---|---|---|---|---|---|
| | | | $m^3$ | MT | $m^3$ | MT Barite |
| 42" | seabed | 2.5 | 67 | 174 | 67 | 58 |
| 26" | seabed | 7.5 | 493 | 1,282 | 493 | 1,293.75 |
| 17-1/2" | sea surface | 10 | 219 | 571 | 219 | 152.01 |
| 12-1/4" | sea surface | 19.5 | 108 | 281 | 108 | 89.53 |
| 8-1/2" BP | sea surface | 20.5 | 52 | 135 | 52 | 62.13 |
| 12-1/4" ST | sea surface | 15 | 118 | 307 | 118 | 97.83 |
| | | | **Total (tonnes)** | **2,750** | - | **1,753.25** |
| | | | **Discharged at Seabed (tonnes)** | **1,456** | - | **1,351.75** |
| | | | **Discharged at Surface (tonnes)** | **1,294** | - | **401.5** |

The assumed discharged solids characteristics are given in Section 2.3 in Appendix H.

### Cuttings Dispersion Modelling Results

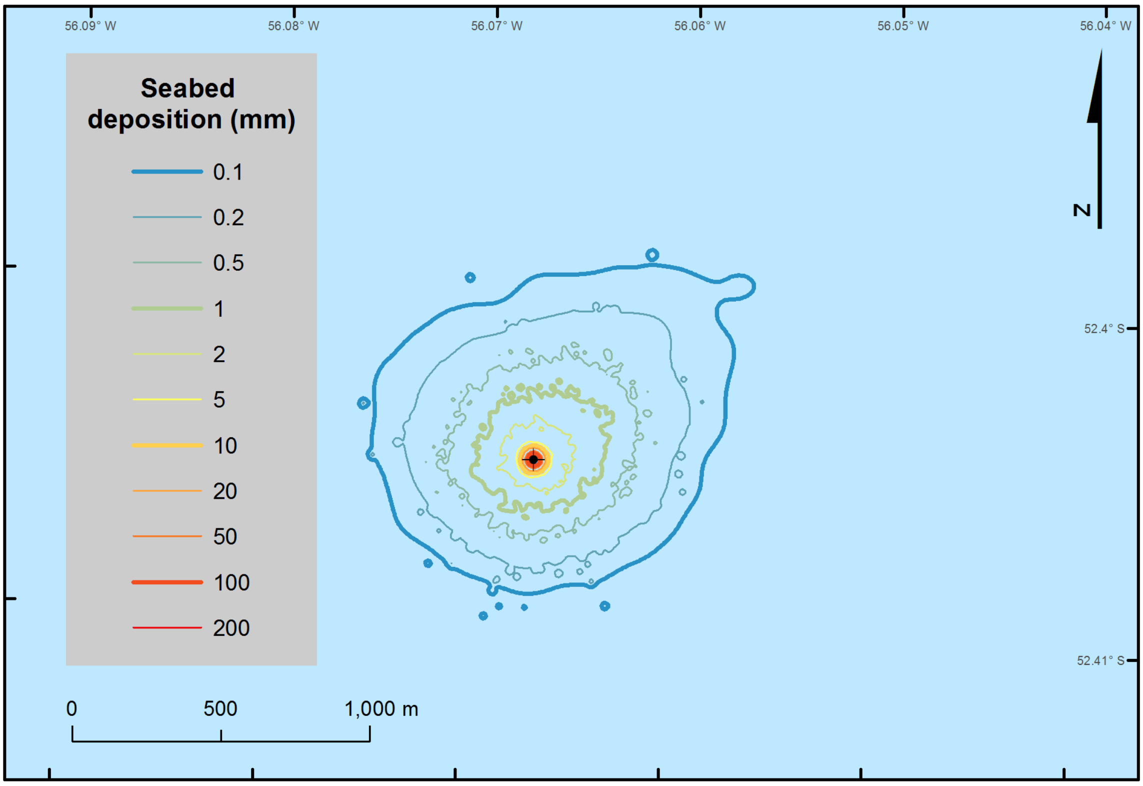
6.97 The fate of mud and cuttings released from operational drilling were assessed through two discharge model scenarios, corresponding to the parameters shown in Table 6.8. For each scenario, the MUDMAP model was used to predict the resulting bottom deposition from individual drilled sections at Caperea-1, along with the pattern of cumulative deposits. Simulations were designed to continue tracking the far field dispersion for a minimum of 72 hours following the completion of each section, to account for settling of fine material from the seawater column.

*6.8: Summary of model parameters used for each cuttings dispersion modelling scenario*

| Model Scenario | Discharge Period | Description | Discharged Cuttings (MT) | Discharged Mud (MT Barite) | Duration of Discharges (days) |
|---|---|---|---|---|---|
| Scenario 1 | Jan-Mar 2012 | WBM and cuttings from Sections 1-6 | 2,750 | 1,753 | 75 |
| Scenario 2 | Jun-Aug 2012 | WBM and cuttings for Sections 1-6 | 2,750 | 1,753 | 75 |

6.98 Figure 6.4 and 6.5 show the plan view extents of the model-predicted seabed deposition during the austral summer (period 1) and winter (period 2), respectively. Tables 6.9 and 6.10 summarize the areal extent of deposition for each scenario. Deposit thicknesses were calculated based on mass accumulation on the seabed and assume a sediment bulk density of 2,500 $kg/m^3$ and no void ratio (zero porosity).

*Figure 6.4: Predicted thickness of drilling discharges at Caperea-1 (Period 1; Jan-Mar). Top: composite deposition resulting from all drilling intervals. Bottom: contours above 1 mm (bold green) shown at an expanded scale*



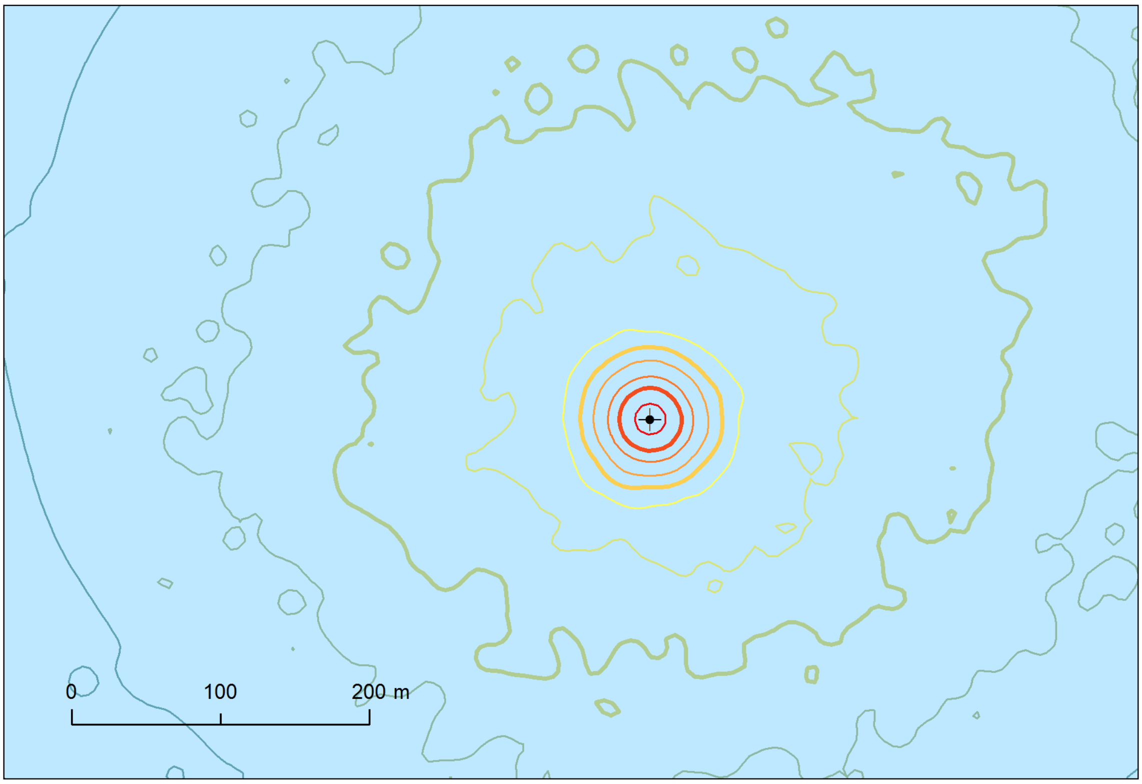



*Figure 6.5: Predicted thickness of drilling discharges at Caperea-1 (Period 2; Jun-Aug). Top: composite deposition resulting from all drilling intervals. Bottom: contours above 1 mm (bold green) shown at an expanded scale*

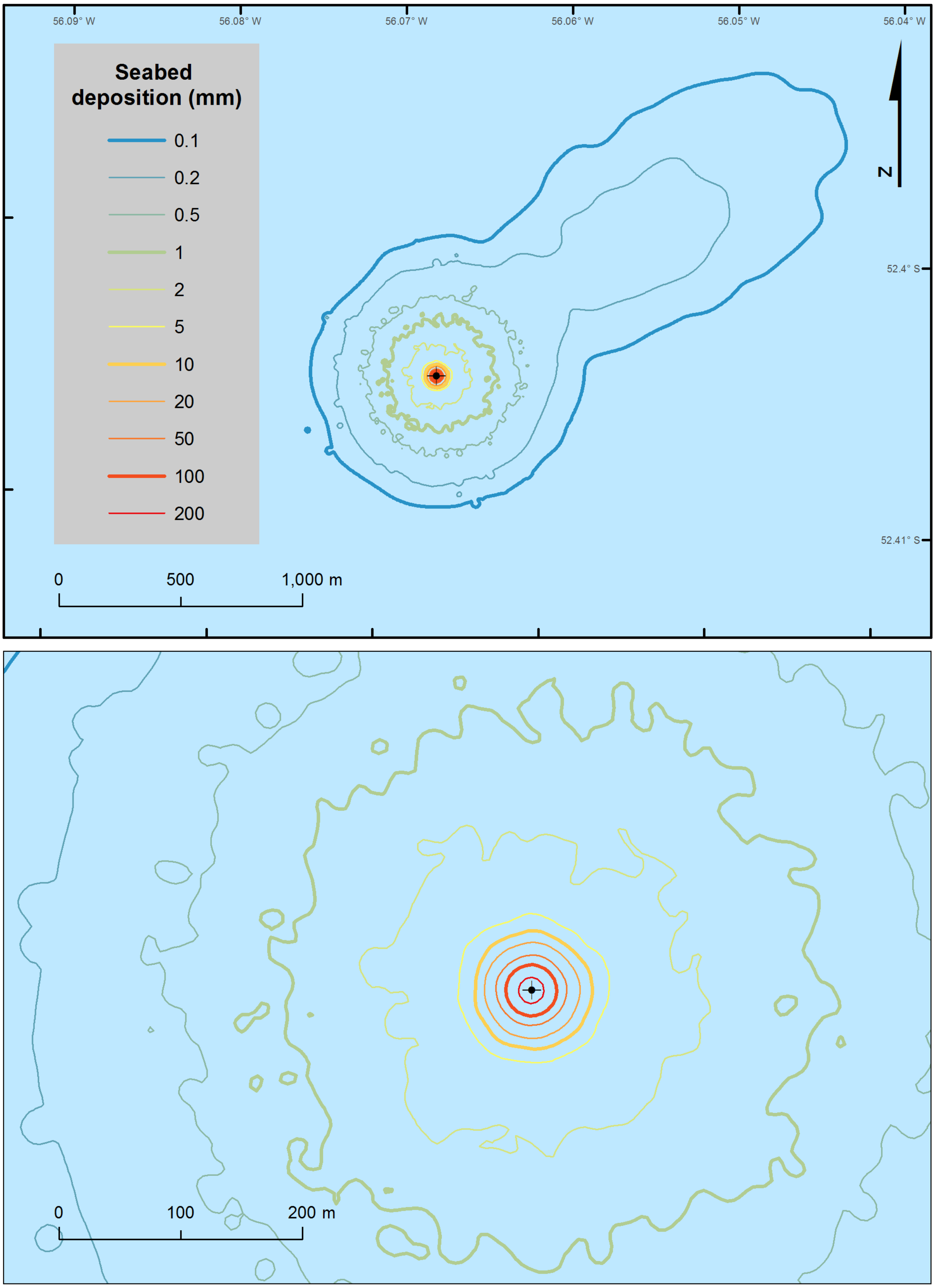


*Table 6.9: Areal extent of seabed deposition (by thickness interval) for each model scenario*

| Deposition Thickness (mm) | Cumulative Area Exceeding (ha) | |
|---|---|---|
| | Period 1 | Period 2 |
| **0.1** | **103.164** | **193.141** |
| 0.2 | 63.706 | 97.999 |
| 0.5 | 29.838 | 31.589 |
| **1** | **13.747** | **15.713** |
| 2 | 4.316 | 5.200 |
| 5 | 1.124 | 1.149 |
| **10** | **0.693** | **0.718** |
| 20 | 0.464 | 0.466 |
| 50 | 0.257 | 0.247 |
| **100** | **0.135** | **0.142** |
| 200 | 0.035 | 0.032 |

*Table 6.10: Maximum extent of thickness contours (distance from release site) for each model scenario*

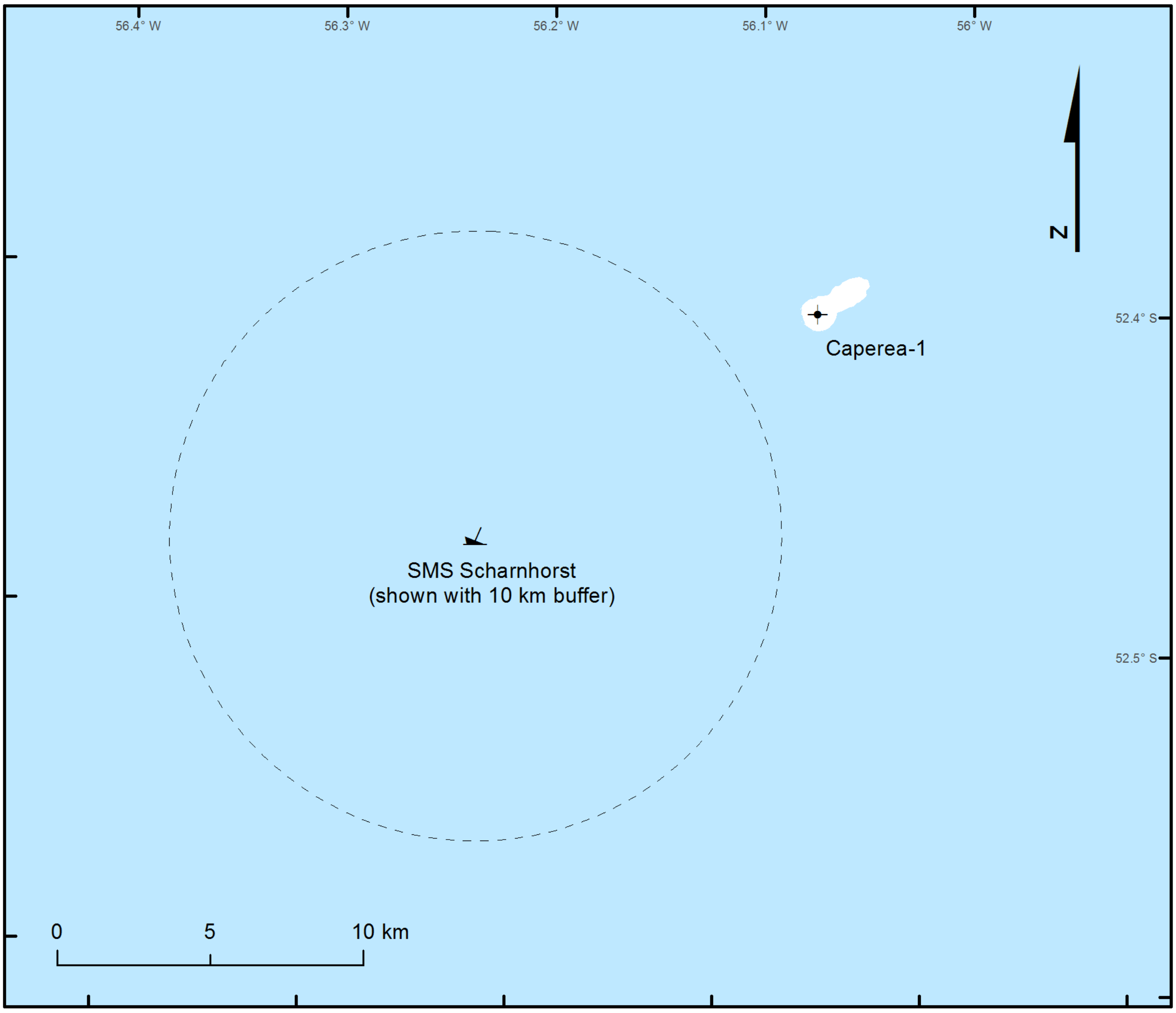
| Deposition Thickness (mm) | Maximum extent from discharge point (m) | |
|---|---|---|
| | Period 1 | Period 2 |
| 0.1 | 945 | 1,980 |
| 1 | 308 | 265 |
| 10 | 50 | 50 |
| 100 | 22 | 22 |

6.99 For both scenarios, the thin, broad blanket of sediment that extends ~1-2 kilometres from the discharge site results from the accumulation of very fine particles (which experience more variation in the current regime as they settle) and from discharges that originate at the sea surface (which disperse widely while settling in deep water). Stronger and more uniform currents during period 2 produce a cumulative deposit that is more elongated and extends nearly 2 kilometres from the discharge site toward the north-east (Figure 6.2) and as a result, the extent of deposition is considerably larger for thicknesses less than 1 mm during Period 2. For Period 1, the overall deposit is more rounded and the footprint is confined to 945 metres from the Caperea-1 well location. Both scenarios impact a similar cumulative area for contours greater than 1mm as shown in Figures 6.1 and 6.2. Deposition at or above 10 mm is uniform and concentric around the well, which indicates that dispersion processes are nearly as influential as advection from currents, due to the settling characteristics of material being released and the release depths.

6.100 Similar patterns are expected for cuttings discharge modelling at the other well sites. Additional cuttings modelling will be performed for the other drilling sites once the exploration drilling programme is confirmed. The results will be reported in addenda to this EIS submitted to FIG closer to the time of drilling.

6.101 Figure 6.6 shows the integrated footprint from both discharge scenarios with respect to the best known coordinates (according to *Wrecksite.eu*) of the wreck of the *SMS Scharnhorst*. The results from all model runs were integrated in Figure 6.6 to define the likely area of coverage for both current conditions modelled above the 0.1 mm minimum thickness threshold. A 10 kilometre buffer has been applied to the wreck location (according to Wrecksite.eu) due to the positional uncertainty of the wreck. It can be seen that impacts on the site are not expected from the discharge of drilling cuttings.

***Figure 6.6: Integrated footprint of deposition at Caperea-1 for both model periods (white polygon) shown with closest known location of the wrecks of the SMS Scharnhorst (as reported by Wrecksite.eu). Dashed line shows the 10 kilometre buffer around the location***




6.102 The above cuttings modelling results have been plotted with respect to the historically fished areas by long liners in FISA12, to gauge any potential impact to fishing operations from the discharge of drilling cuttings during proposed drilling operations. Figure 6.7 shows the maximum predicted extent of the cuttings pile from the modelled scenario for period 1 (Jan-Mar) and Figure 6.8 for period 2 (Jun-Aug).

*Figure 6.7: Historically fished areas by long liners in the vicinity of the FISA12 area, 2008-2012 (VMS data supplied by the Falkland Islands Department of Natural Resources – Fisheries Department) in relation to the predicted maximum extent of the cuttings pile from the modelled scenario for period 1 (Jan-Mar)*

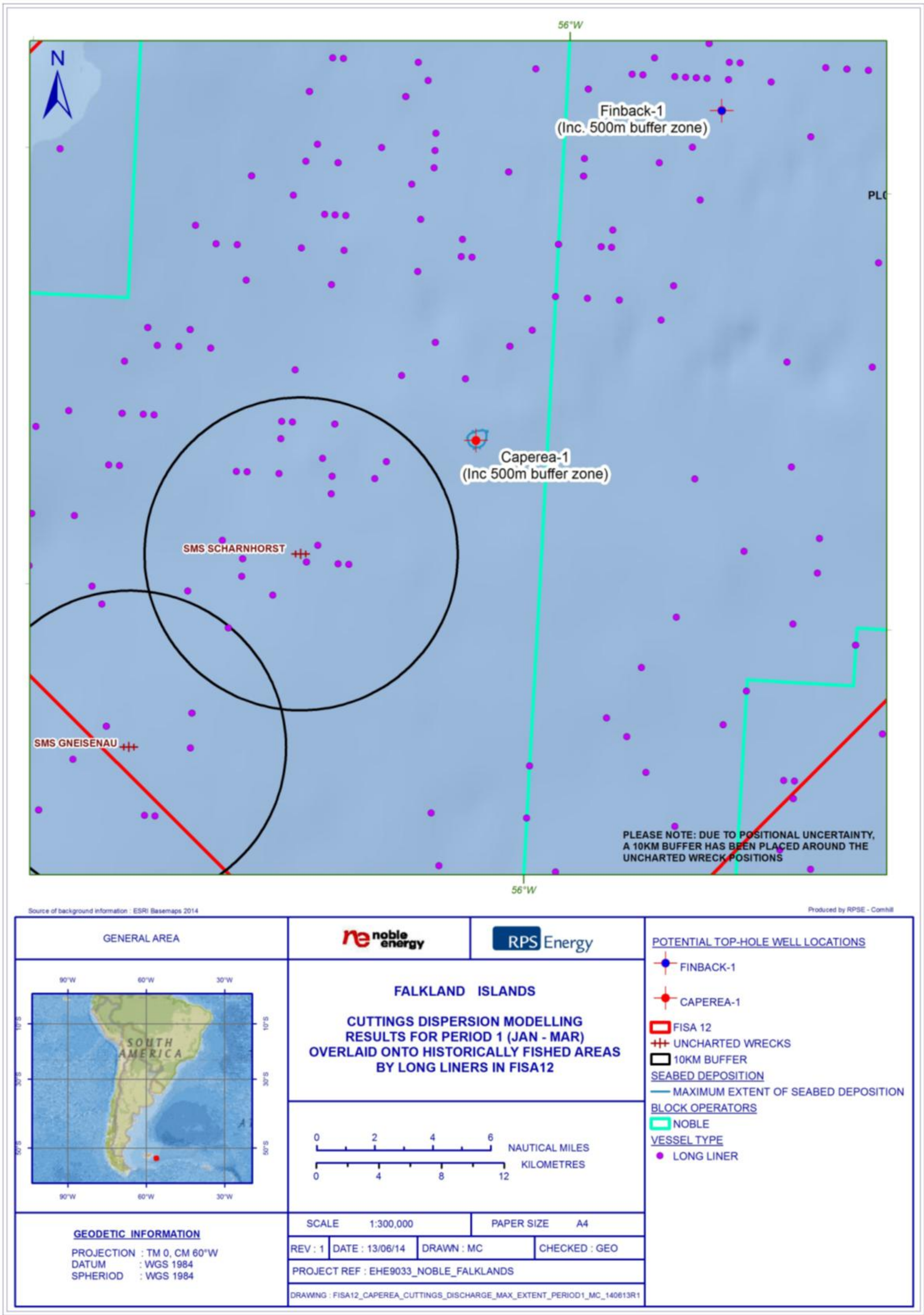
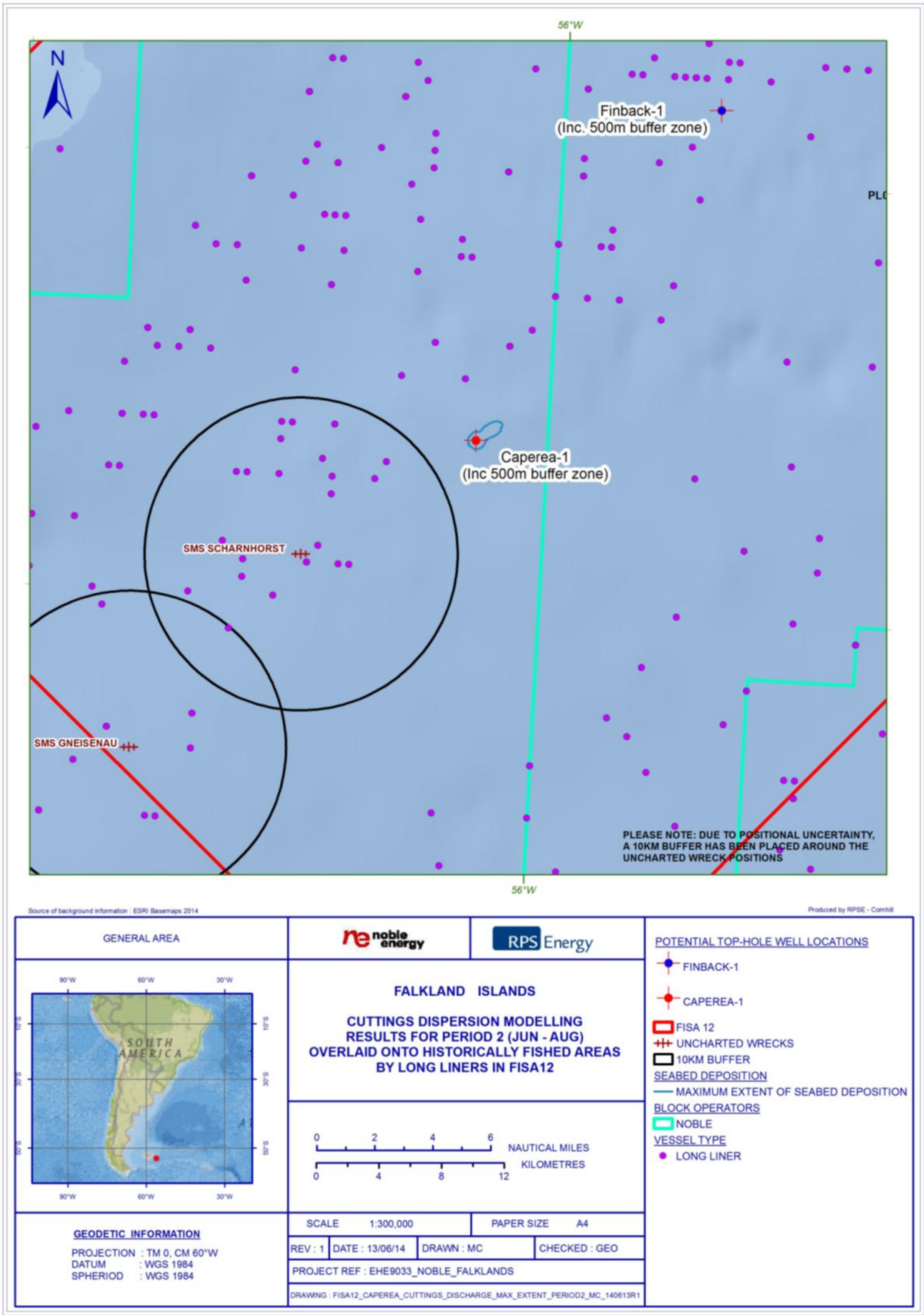


*Figure 6.8: Historically fished areas by long liners in the vicinity of the FISA12 area, 2008-2012 (VMS data supplied by the Falkland Islands Department of Natural Resources – Fisheries Department) in relation to the predicted maximum extent of the cuttings pile from the modelled scenario for period 1 (Jan-Mar)*



### Potential Impacts on Soils/Sediments & Benthic Communities

6.103 The cuttings modelling study has shown that the deposition of cuttings on the seabed will affect a limited area of seabed, which varies between the two seasons modelled. For period 1 (Jan-Mar), the residual currents in the area are weaker, resulting in a cuttings pile more limited in area than for period 2 (Jun-Aug).

6.104 Studies have shown that biological impacts from smothering are only expected where the depth of cuttings is of one millimetre or more (*Bakke et al., 1986*). Therefore, only areas of the cuttings piles where the thickness is greater than 1 mm are expected to have potential impacts on benthic species. For period 1, the area where cuttings are predicted to be greater than or equal to 1mm is approximately equal to 14.0 hectares (0.14 $km^2$) for period 1, and approximately 16.0 hectares (0.16 $km^2$) for period 2. However, previous studies have shown that impacts from the discharge of drilling cuttings associated with water based mud are transitory, and that the sediments and faunal communities will rapidly return to background conditions. Re-colonisation of impacted areas can take place in a number of ways including mobile species moving in from the edges of the area, juvenile recruitment from the plankton or from burrowing species digging back to the surface.

6.105 For example, in 1987, a benthic environmental survey was undertaken at a single well site in the Central North Sea (*AUMS, 1987*). The well had been drilled five years prior to the survey using a WBM and a total of approximately 800 tonnes of cuttings had been deposited on the seabed. The results of the survey indicated that, with the exception of a slightly elevated barium concentration, levels of sediment metals and hydrocarbons were similar to background. The analysis of the benthic fauna indicated that, even at sites closest to the wellhead, full recovery of the impacted sediments had taken place. This well site was revisited by Oil and Gas UK (formerly UKOOA) in 2005 and results now show that the area is completely consistent with background conditions (*Hartley Anderson Ltd., 2005*). In addition, field studies in the United States of America have shown that recovery of benthic communities impacted with water based drilling discharges is likely to be very rapid (i.e. within a few months) (*Neff, 1982*).

6.106 Based on the results of historical studies demonstrating recovery within 5 years of benthic communities and sediments, the severity of the potential impact is considered to be *moderate*, particularly as the potential for habitats of conservation importance to be present remains. The likelihood of the impact is considered to be *likely* as there is the potential for impacts to occur, although they are not certain to occur. As a result, the potential impact without mitigation from drill cuttings on the benthic environment (benthic habitats and sediments) is considered to be **medium**.

### Potential Impacts on Fish

6.107 Impacts could potentially occur through direct effects to the fish populations of the area through the discharge of drill cuttings. Fish species known to spawn in the vicinity of the Noble license areas include the Patagonian toothfish (peaks in May and July through to August), and grenadier during March-April in more northerly license areas. Other species occurring regularly across the Noble license areas include skate and rays (refer to Section 4.3.5). However, the Patagonian toothfish in particular are highly mobile species, and as such are expected to move away from the drilling sites during the course of the drilling operations.

6.108 With regard to potential long term effects on fish species, these are not expected, as previous studies have shown that levels of sediment metals and hydrocarbons return to levels similar to background concentrations several years after drilling operations cease. In addition, because rapid recovery of the benthic environment is also expected, long term impacts to fish populations that feed on benthic species are not expected and severity is considered to be *minor*. However, due to the potential suite of chemicals present within drilling mud that may be adhered to the cutting, a precautionary likelihood of *likely* is considered. Without mitigation, the potential impacts on fish populations are assessed as **medium**.

### Potential Impacts on Fishing

6.109 The cuttings modelling study has also shown that the predicted extent of the cuttings pile in relation to historically fished areas in the vicinity of FISA12 is limited (refer to Figures 6.6 and 6.7 above) and is unlikely to affect fishing operations in the area. Based on these conclusions the likelihood of an impact occurring is considered to be *unlikely*. The severity of an impact, given the very small area affected, is considered to be *minor*. However, due to the potential medium impact to the fish species targeted, a precautionary severity of moderate is considered. As such, the potential impacts without mitigation on other users of the sea as a result of cuttings discharge are considered to be **medium**.

### Potential Impacts on Archaeology

6.110 The cuttings' modelling has also shown that the resulting cuttings pile is not predicted to encroach the vicinity of the as-reported wreck locations (particularly the *SMS Scharnhorst*), as the predicted cuttings pile (for both period 1 and period 2) remains well outside the 10 kilometre buffer area. In addition, the residual currents in the area are towards the north-east, which is in the opposite direction to the as reported wreck locations. However, given the uncertainty of the location of the wreck a likelihood of *possible* is considered on a precautionary basis. Given the importance of the wrecks the severity is considered to be *moderate*. Therefore, the potential impact of cuttings on wrecks without mitigation is considered to be **medium**.

### Mitigation & Monitoring

6.111 The discharge of drilling cuttings to sea will inevitably give rise to potential impacts on the surrounding water and seabed. Applicable mitigation and monitoring measures comprise the following:

- All mitigation measures as described above for the release of drilling mud (refer to Section 6.3.1);
- Should either the *SMS Scharnhorst* or *SMS Gneisenau* be identified during the pre-drilling surveys, Noble will look to relocate the well location to avoid these wrecks
- The results of the post drilling surveys will be used to verify the accuracy of the cuttings dispersion modelling.
- Should any habitats of conservation importance be identified during pre-drilling surveys, Noble will look to relocate the well location to avoid these habitats.
- The DMPO will be in place for the drilling operations, as described above in Section 6.3.1, and will include provisions for the discharge of drilling cuttings.

6.112 In addition to the above mitigation measures the monitoring measures described above in Section 6.3.1 in relation to pre-drilling, during drilling, and post-drilling environmental surveys, will serve to assess any effect that the discharge of drilling cuttings and associated drilling mud and chemicals will have on the benthic environment. The results of the surveys and analyses will be reported to FIG in an Environmental Survey Report at the end of the drilling programme once the results become available.

6.113 Once the well locations are confirmed, Noble will re-assess the discharge of drill cuttings. The results of the cuttings modelling will be overlaid onto the seabed features charts from the regional environmental baseline surveys. The results of the cuttings modelling and the analysis of the modelling results in relation to the seabed feature charts from the regional environmental baseline surveys will be presented in Operational Addenda.

### Residual Impact

6.114 Following the implementation of the above measures the likelihood of an impact occurring to the benthic environment and sediments is expected to remain *likely*. However, the measures are designed to reduce the severity of the potential impact, particularly through the identification of sensitive habitats before drilling commences. Through the implementation of this process and through avoidance of these habitats the severity of the impact is considered to be *negligible*. Therefore, the residual impact is considered to be **low**.

6.115 The above measures are also expected to reduce the potential impacts to fish species that may prey on benthic species. Again, the likelihood is expected to remain *likely* but the severity will be reduced to *negligible*, therefore, a residual impact of **low** is considered.

6.116 The cuttings' modelling has also shown that the resulting cuttings pile is not predicted to encroach the vicinity of the as reported wreck locations (particularly the *SMS Scharnhorst*). Uncertainty remains regarding the location of the wreck. However, the pre-drilling survey and the proposed movement of the well head should the wreck be identified should ensure that the likelihood of impact is reduced to *remote*. Given the importance of the wrecks the severity remains *moderate*. Therefore, the potential impact of cuttings on wrecks is considered to be **low**.

6.117 The mitigation measures above are unlikely to affect the potential impact on fishing activity in terms of the interaction with fishing gear. However, due to the reduction in the impact to targeted fish species, a reduced severity of minor is considered. Alongside the unlikely likelihood the residual impact is reduced to **low**.

6.118 Similar patterns are expected for cuttings discharge modelling at the other well sites. Additional cuttings modelling will be performed for the other drilling sites once the exploration drilling programme is confirmed. The results will be reported in Addenda to this EIS closer to the time of drilling.

### 6.3.3 Discharges of Cement – Appendix A 3.3

6.119 During the drilling programme, discharges of cement will occur. When cementing casing back to the seabed (the uppermost well casing), some cement may be discharged at the seabed. Typically, this volume is less than 10% of the total volume of cement used. Additionally, there is also the possibility of larger volumes of cement being discharged from the drilling unit, in the event of any mixing and/or mechanical problems that may be experienced during the mixing of the cement slurry.

6.120 The cementing chemicals and volumes proposed for use will be fully detailed in addenda to this EIS, to be submitted at a later date prior to drilling operations commencing and once final decisions on the required chemicals have been made.

6.121 All of the chemicals which Noble will use for the cementing programme will appear on the Ranked List of Products approved under the OCNS (refer to Section 2.4.9 and Appendix C for further information).

6.122 The discharge of cement has the potential to affect the surrounding water turbidity and water quality in the event that cement is discharged from the rig at the sea surface. Cement discharged at the seabed during cementing of the uppermost well section casing also has the potential to affect the surrounding benthic environment, potentially smothering the seabed in the immediate vicinity of the well, potentially contributing to depletion of oxygen in surface sediments, leading to a potential loss of seafloor habitat.

6.123 The likelihood of the impact occurring without mitigation is considered to be *likely*, as without reasonable controls, it is likely that cement would be released into the marine environment. The *severity* of the potential impact is considered to be moderate, as significant releases could result in effects that would cause local level changes to the seabed that would eventually recover over a short period of time. Therefore, without mitigation measures, the potential impact from cement discharge is expected to be **medium**.

#### Mitigation & Monitoring

6.124 Applicable mitigation measures for the discharge of cement comprise the following:

- Cement volumes used will be minimised where practicable to limit any possible discharge of cement and associated chemicals, without compromise to well safety and integrity.

- All cement components will be selected on the basis of environmental performance, so as to reduce any potential environmental impacts upon the potential release of the cement.
- Chemical use and discharge will be closely monitored throughout the drilling program through the rig chemicals tracking system and minimised by the drill crew and cement engineers where practicable, without compromising well safety. All chemical use and discharge will be controlled through the DMPO.
- Batch discharges of cement will be minimised as far as possible. Great care will be taken when mixing cement on board the rig for use during cementing operations, ensuring that the potential need to discharge batches of cement due to technical and/or mixing problems is minimised. All cement discharge will be controlled through the DMPO.

6.125 The monitoring measures described above in Section 6.3.1 in relation to pre-drilling, during drilling, and post-drilling environmental surveys, will serve to assess any effect that the discharge of cement and associated drilling mud and chemicals will have on the benthic environment. The results of the surveys and analyses will be reported to FIG in an Environmental Survey Report at the end of the drilling programme once the results become available.

#### Residual Impact

6.126 Implementation of the above mitigation measures will reduce the likelihood and severity of potential impacts. The likelihood will be reduced to *possible*, through careful management of cement to ensure discharge is avoided as far as possible. The measures above will also serve to reduce the amount of cement discharged if it were to occur, reducing the severity to *negligible*. As a result the residual impact is considered to be **low**.

### 6.3.4 Discharges of Domestic Wastewater & Food – Appendix A 3.4

6.127 Domestic wastewater comprises a mixture of ‘grey’ water, from personnel washing, cooking, etc. and ‘black’ water from toilets (sewage). Domestic food waste comprises waste from the rig or OSV galleys.

6.128 During the drilling programme, it is estimated that 200 litres of domestic wastewater per person per day, (estimated to comprise of 150 litres of grey water and 50 litres of black water) will be generated. Assuming that the drilling rig will have 140 personnel on board, and assuming that there are 15 persons on board each of the three OSVs (185 persons total), it is estimated that a total of 9,990,000 litres of domestic wastewater will be generated (assuming a 270 day total drilling period – refer to Section 2.5.3 for assumptions on domestic wastewater). Domestic food waste will also be produced by the galleys of both the drilling rig and OSVs.

6.129 Potential direct impacts from controlled discharges of domestic wastewater and food waste include localised nutrient enrichment, saprogenic effects (effects resulting from putrefaction and decay) and low level pollution from trace oils and chemicals. Indirectly, the localised impacts could potentially lead to increased pollution of the ecosystem in culmination with other similar discharges from vessels.

6.130 Nutrients released in the domestic wastewater effluent have the potential to cause a localised increased biological oxygen demand (BOD) where they are released into the marine environment. This is due to microbial activity breaking down the organic matter released. This has the potential to have negative effects through a decrease in the availability of oxygen or through toxicity effects on plankton and local fish communities that may be present.

6.131 Without mitigation, the potential for domestic wastewater and food waste discharges to impact the water quality within the vicinity of the drilling locations is considered to be of *possible* to *certain* due to the potential for localised nutrient enrichment, saprogenic effects and the potential for low level pollution from trace oils and chemicals. If these effects were to occur they would be of *minor* severity, due to their limited effect on a local level. As a result the potential impact is considered **medium**.

#### Mitigation & Monitoring

6.132 On board the drilling rig and OSVs, black (sewage) and grey water will be collected and treated in accordance with the requirements of the MARPOL Convention prior to being discharged to sea. Food waste will also be collected and treated (macerated) in accordance with the requirements of the MARPOL Convention.

6.133 The discharge of sewage is only authorised if the ship/installation is equipped with authorised sewage treatment equipment, and the results of the tests of this equipment are documented and the effluent leaves no visible floating solids and does not discolour the surrounding water.

6.134 The discharge of rubbish is prohibited, with the exception of food waste that is ground and passed through a sieve with a mesh size no greater than 25 millimetres for facilities that are more than 12 nautical miles from the coast.

6.135 The DMPO will be in place for the drilling operations and will include provisions for the discharge of domestic wastewater and food waste; both from the drilling rig and OSVs.

#### Residual Impact

6.136 Volumes and rates of domestic wastewater and food waste discharge are limited and temporary in nature and are anticipated to have only a short-term localised impact on water quality. All discharges of domestic wastewater and food waste will be in full compliance with all relevant requirements under the MARPOL Convention. The likelihood of the potential impact will remain *possible* to *certain*. However, the treatment of sewage and food waste will ensure the severity of the impact is reduced to *negligible* and that any effects are indistinguishable from natural variation. Therefore, the residual impact from domestic wastewater and food waste discharge is considered to be **low**.

### 6.3.5 Discharges of Deck Drainage Water – Appendix A 3.5

6.137 Water generated by wash down of both the drilling rig and OSVs may contain trace amounts of oil, lubricants and residual chemicals, resulting from small leaks or unintentional releases washed out from open deck areas. The volume of these discharges depends on the frequency of wash down and also the amount of rainfall. Oily water may also be generated during routine cleaning and maintenance operations on board the drilling rig and OSVs.

6.138 Release of oily water and chemicals in deck wash run-off or rainwater run-off may cause localised declines in water quality and, depending on the nature of the contaminants, may have localised toxicity impacts on plankton and fish communities. Given the expanse of the offshore area, these discharges are not expected to cause significant impacts. Nevertheless, such discharges can have a cumulative effect on inputs of contaminants to the marine environment at both regional and international levels. It has been estimated that up to 24% of oil inputs into the marine environment originate from oil transport and shipping, compared to only 2% from offshore oil production (*Patin, 1999*). In light of this, without proper mitigation, the likelihood of impacts occurring is considered to be *likely*. The severity is considered to be *minor*, due to any affects being relatively localised and only small volumes of contaminants being in the deck drainage water. Therefore, the potential impact is considered to be **medium**.

#### Mitigation & Monitoring

6.139 A number of mitigation measures will be taken during the drilling programme to minimise potential impacts arising from the discharge of drainage water:

- Deck areas will be kept clean of debris and any hydrocarbon materials.
- Any unintentional releases will be thoroughly cleaned up as soon as they occur before they have the chance to be washed overboard. Waste materials (absorbent pads, etc.) will be segregated. Hazardous waste will be disposed of according to established waste oil/chemical disposal procedures.

- Spill kits will be readily available on deck for mopping up any minor unintentional releases. Personnel will be trained in the use of spill kits.
- The drilling rig and OSVs will be fitted with closed drainage containment and monitoring systems in all environmentally critical areas as part of their specification. An oily water bilge system in accordance with MARPOL regulations, and an oily water separator (OWS) in accordance with International Maritime Organisation (IMO) Marine Environment Protection Committee (MEPC) 107(49) (*Guidelines and Specifications for Pollution Prevention Equipment for Machinery Space Bilges of Ships*) will also be present. Procedures for drainage water will be addressed within both the drilling contractors' and OSV contractors' documentation.
- Oily water treatment systems on board the drilling rig and OSVs must have oil discharge monitoring and control equipment installed to ensure an oil concentration in water exiting the treatment systems of less than 15 parts per million (ppm) as required under MARPOL regulations and in accordance with IMO MEPC 107(49). Records of the oil content of water discharged and calibration of equipment must be maintained in accordance with the MARPOL Convention, in the form of an Oil Record Book.
- On the drilling rig, no direct overboard discharge of deck drainage water from environmentally critical areas (e.g. the drill floor) is to take place.
- All direct deck drainage on the drilling rig (e.g. walkway gratings) shall be used in clean, non-environmentally critical areas only.
- Rainwater runoff from the drilling rig will be routinely monitored for any residual hydrocarbon content.
- The DMPO will include provisions for the discharge of drainage water.

### Residual Impact

6.140 Due to the mitigation measures above, the likelihood of the discharge of drainage water containing contaminants will be reduced to *unlikely* through removing potential pathways for oil and chemicals to enter the deck drainage. Any volumes that do enter into the system are likely to be small and any effects localised. As a result the severity remains *minor*. The residual impact of the discharge of drainage water is therefore considered to be **low**.

## 6.4 Bio-security – Appendix A 4.1

6.141 Bio-security threats have the potential to have negative impacts on the native biodiversity of ecosystems. Potential impacts can include competition with and predation of native species, alteration of habitats, and potential modification of entire ecosystems. The vectors by which bio-security threats can be transported into an ecosystem can be both intentional and unintentional.

6.142 Terrestrial bio-security threats associated with the use of the TDF have been assessed within the ESHIA for the TDF, and are therefore not expanded upon further here.

6.143 Offshore bio-security threats from the proposed exploration drilling programme come mainly from the discharge/exchange of ballast water. The Falkland Islands are especially important in an international context for their marine bird and mammal populations.

6.144 The discharge of ballast water has the potential for the introduction of invasive species, leading to a potential change in the local ecosystem and potentially the wider ecosystem. Ballast water has the potential to contain larvae and eggs of marine species from other regions of the world, as well as any number of live small marine species. If these organisms find themselves in a suitable environment with an available niche in the ecosystem, there is the potential for them to gain a foothold in their newly found environment. Once present, there is the potential for these organisms to outcompete and prey upon native species, or negatively modify the habitats and ecosystem to an extent that native species are unable to maintain healthy populations.

6.145 To serve as an example, two invasive species within Stanley Harbour and the immediate vicinity of the Falkland Interim Port and Storage System (FIPASS), the vase truncate (*Ciona intestinalis*) and parchment worm (*Chaetopterus variopdatus*) have already been identified and are likely to have arrived through ballast water discharge historically conducted in Stanley Harbour. Although the effects of such an introduction offshore may not be felt by the Falkland Islands community, the principles remain the same.

6.146 The potential for the introduction of non-native marine species through ballast water without suitable mitigation and management measures is considered to be *possible* for all potential receptors. Given the effects of the introduction of non-native marine species could be considerable the severity is considered *moderate*, the potential impact without mitigation is considered to be **medium**.

#### Mitigation

6.147 Mitigation measures for bio-security comprise the following:

- All vessels associated with the drilling operations (including the drilling rig itself), will undertake ballast exchange operations well clear of the Falkland Islands in offshore waters outside of the 12 nautical mile limit.
- The drilling rig and OSVs will all have procedures in place for ballast water management as part of both the drilling contractors' and OSV contractors' specification. These procedures will be subject to audit/assessment by Noble.

#### Residual Impact

6.148 The measures implemented to ensure that no ballast water exchange is undertaken within the 12 nautical mile limit of the Falkland Islands will ensure that the likelihood of an impact occurring will be reduced to *remote*. The severity of the impact will remain *moderate*. Therefore, the residual impact of the introduction of invasive species is considered to be **low**. Noble will continue to liaise with the Department of Agriculture, Bio-security Section, on all matters related to bio-security.

## 6.5 Underwater Noise

6.149 The sources of noise from the proposed drilling programme will come from the drilling rig, OSVs, vertical seismic profiling (VSP) operations (if included in the final project outcome), and noise produced by helicopter flights.

6.150 Underwater noise has the potential to impact fauna that may be present in the area, particularly some fish species and cetaceans, by potentially modifying their behaviour patterns. Such changes in behaviour could include changes in swimming and breathing patterns and the masking of communication between marine mammals. More significantly and in extreme cases, the pressure wave associated with significant noise can potentially inflict physical harm and possibly be lethal.

6.151 A number of scientific terms are used in order to accurately describe noise levels underwater. These are defined below in Table 6.11.

*Table 6.11: Noise terminology glossary*

| Key term | Definition |
|---|---|
| Attenuation | Decrease in intensity (loudness) of a sound. |
| Decibel (dB) | Logarithmic unit commonly used to quantify the intensity (loudness) of a sound.<br><br>Decibels are a ratio between the pressure of an event and a pressure of reference.<br><br>The pressure of reference for underwater sounds is usually 1 µPa, whereas airborne sounds are usually referenced to 20 µPa. Therefore, underwater sound measurements are commonly expressed in "dB re 1µPa". |
| Frequency | Number of cycles of a sound wave per second, measured in units of hertz, or Hz.<br><br>Various species of marine mammals and fish hear sounds within certain ranges of frequencies. When sounds produced by humans fall within their range of hearing, a potential for harassment or disturbance exists. If a sound is loud enough, even though it is outside the hearing frequency range, it sometimes can still be detected by the organism and can cause injury if it is extremely loud. |
| Masking | Interference from sound sources that reduces the ability of organisms to detect or locate sounds of interest. |
| Non-Pulse Noise | Single or multiple discrete acoustic events of a similar decibel level within 24 hours (no variation greater than 3dB re 1µPa).<br><br>E.g. Vessel/aircraft passes; drilling activity. |
| Multiple Pulse Noise | Multiple acoustic events within a 24 hour period that have a difference of more than 3 dB re 1µPa between the impulse sound level and background noise level.<br><br>E.g. sequential sound source as used for seismic surveys or piling strikes. |
| Single Pulse Noise | Single acoustic event (more than 3 dB re 1µPa difference between impulse sound level and background noise level).<br><br>E.g. single sound source as used for vertical seismic profiling. |
| Hearing Threshold | Minimum intensity / loudness where an organism with unaffected hearing can hear a sound. |
| Threshold Shift | Increase (worsening) in the threshold of hearing for an ear at a specified frequency. This can take two forms:<br><br>• Temporary Threshold Shift (TTS): Describes a temporary increase in threshold that occurs during or shortly after exposure to high noise levels. This can last from a few minutes, to hours or days.<br><br>• Permanent Threshold Shift (PTS): Describes how prolonged or repeated exposure to high levels of sound accelerates the normal process of permanent gradual hearing deterioration with age. |

### 6.5.1 Estimated Noise Levels

6.152 Anthropogenic noise is only audible to receptors when it is at intensities greater than ambient noise levels (*Richardson et al., 1995*). Natural sounds in the sea are produced by wind, waves, currents, rain, ice-breaking, echo-location and communication noises generated by animals and other natural sources such as tectonic activity. Naturally occurring noise levels in the ocean as a result of wind and wave action may range from around 90 dB re 1µPa under very calm, low wind conditions to 110 dB re 1µPa under windy conditions.

6.153 Typical subsea noise levels from offshore operations are shown in Table 6.12. The sound levels at a range of distances from various activities are also provided and have been estimated based on spherical underwater noise spreading assumptions (i.e. a uniform decrease in noise level with distance from source). Various models have been identified which best fit the attenuation of sound with distance from its source for different conditions; spherical spreading of the sound produced by all underwater sources (VSP, drilling operations and vessels movements) results in sound intensities dropping quickly. Depending on the propagation conditions, the attenuation is between three and six decibels per doubling of distance from the source (*Swan et al. 1994*). However, lower intensities at longer ranges decrease more slowly and the signal may be above background levels for several tens of kilometres or more (*Swan et al., 1994*).

***Table 6.12: Sound sources from various offshore activities (adapted from: Evans & Nice, 1996; Richardson et al., 1995 and Simmonds et al., 2003).***

| Activity | Frequency range (kHz) | Average source level (dB re 1µPa-m) | Estimated received level at different ranges (km) by spherical spreading | | | |
|---|---|---|---|---|---|---|
| | | | 0.1 km | 1 km | 10 km | 100 km |
| High resolution geophysical survey; pingers, side-scan | 10 to 200 | <230 | 190 | 169 | 144 | 69 |
| Low resolution geophysical seismic survey; seismic air gun | 0.008 to 0.2 | 248 | 210* | 144* | 118* | 102** |
| | | | 208 | 187 | 162 | 87 |
| Vertical Seismic Profiling | 0.005 to 0.1 | 190 | 150 | 129 | 104 | 29 |
| Production drilling | 0.25 | 163 | 123 | 102 | 77 | 2 |
| Jack-up drilling rig | 0.005 to 1.2 | 85 to 127 | 45 to 87 | 24 to 66 | <41 | 0 |
| Semi-submersible rig | 0.016 to 0.2 | 167 to 171 | 127 to 131 | 106 to 110 | 81 to 85 | 6 to 10 |
| Drill ship | 0.01 to 10 | 179 to 191 | 139 to 151 | 118 to 130 | 93 to 105 | 18 to 30 |
| Large merchant vessel | 0.005 to 0.9 | 160 to 190 | 120 to 150 | 99 to 129 | 74 to 104 | <29 |
| Super tanker | 0.02 to 0.1 | 187 to 232 | 147 to 192 | 126 to 171 | 101 to 146 | 26 to 71 |

**Actual measurements in the Irish Sea*

***Extrapolated figure as presented in Evans & Nice (1996)*

6.154 In terms of the different categories and metrics of anthropogenic sounds in the ocean, Southall *et al.*, (2007) identified three types of sound; single pulse, multiple pulse and non-pulse. According to this classification and based upon the project description (Section 2), it is anticipated that the dominant sound sources from the proposed activities will be (sound levels presented are precautionary):

- Drilling: a non-pulse sound source of approximately 190 dB re 1µPa @ 1 metre.
- OSVs: a non-pulse sound source ranging between 130 and 180 dB re 1µPa @ 1 metre.
- VSP: a single pulse sound which will be in the region of 240 dB re 1µPa @ 1 metre.

6.155 In addition, airborne noise will result from the helicopter over-flights: approximately 94 to 97 dB re 20 µPa.

### 6.5.2 Potential Impacts on Plankton

6.156 It is considered unlikely that the level of noise from a semi-submersible rig or OSV will impact the plankton in the surface waters; however the noise levels from the VSP may impact on the phytoplankton and zooplankton populations. Responses of plankton to seismic surveys are not well documented. Under laboratory conditions, for example in experiments carried out by Kostyuchenko (1971) and Dalen and Knutsen (1986), there were no significant differences in mortalities between control and experimental groups. The level of plankton mortality in the upper water column is anticipated to vary from approximately 0.45 percent (at a water depth of 50 metres) to six percent (at a water depth of 10 metres) (*Davis et al. 1998*). Although Kostyuchenko (1971) found that airguns injured plankton (including fish eggs) out to a range of five metres, it has been estimated that the wake from passing ships propellers and bow waves will cause a similar, if not greater, volumetric effect to that of an air gun array (*Swan et al., 1994*). With regard to phytoplankton, Kosheleva (1992) reported that arrays with source levels of 220-240 dB re 1 µPa had no effect on phytoplankton or benthos at distances of 1 metre or more.

6.157 Saetre & Ona (1996) developed a 'worst-case scenario' mathematical model and applied it to investigate the effects of seismic energy on fish eggs and larvae, and concluded that mortality rates caused by exposure to seismic energy were so low compared to natural mortality, the effect of seismic activity on recruitment to a fish stock would be not significant (*Saetre & Ona, 1996*). In addition, mortality of phytoplankton and zooplankton near the acoustic source should be sufficiently localized as to negligibly affect food availability for fish, shellfish, birds and mammals (*Whitford, 2007*).

### 6.5.3 Potential Impacts on Fish

6.158 Underwater sound can potentially have a negative impact on fish species ranging from physical injury/mortality to behavioural effects.

6.159 There is currently no specific information available on the hearing sensitivity of Falkland Islands fish species. As a result, the assessment will be based upon the general hearing sensitivity of marine fish species. In addition, unlike marine mammals, there are no criteria for fish sensitivity to noise so the discussion will centre on the general understanding of fish sensitivity to noise.

6.160 Sound is perceived by fish through a number of mechanisms:

1. The "lateral line system", a system relying on numerous small hairs that respond to changes in water movements. Auditory detection begins when sound waves impact on the surface of the neuromasts and alter the firing patterns of the neurons in the system. This system is essential for fish to be able to detect currents, maintain position in a school, capture prey and avoid obstacles and predators (*Nedwell et al., 2004*).
2. Another hearing mechanism in fish is a close association between the swimbladder and the inner ear. The swimbladder is sensitive to the pressure component of a sound wave, which it resonates as a signal that stimulates the ears (*Hawkins, 1986; Hawkins, 1993*).

6.161 Similar to marine mammals, fish use sound to communicate, locate prey, detect predators and as a cue for orientation (*McCauley et al., 1996*).

6.162 Fish are generally classified as either hearing generalists or hearing specialists. Fish species with either no swim bladder (e.g. elasmobranchs, the collective name for sharks, skates and rays) or a much reduced one (many benthic species living on, in, or near the seabed like flatfish) tend to have relatively low auditory sensitivity, and generally only hear sounds at frequencies in the range 0.1 to 1.5 kilohertz, with peak hearing from 0.1 – 0.4 kHz (*Popper et al., 2004*). These fish are termed "hearing generalists" (*Amundsen & Landrø, 2011*).

6.163 Fish having a fully functional swim bladder have increased hearing sensitivity, especially when there is some form of close coupling between the swim bladder and the inner ear. These transmit oscillations of the swimming bladder wall in the pressure field to the inner ear. With the ability to perceive also the pressure component of sound, these fish are referred to as "hearing specialists". Hearing specialists have a broader hearing range, detecting sounds above 1.5 and up to three kilohertz. In addition, the auditory range of hearing specialists overlaps the frequency range of hearing generalists, with the specialists generally having lower hearing thresholds (i.e. greater sensitivity) than the generalists (*Amundsen & Landrø, 2011*).

6.164 Review of existing literature has identified a number of potential hearing specialist fish species in the project area (although no relevant location or species specific studies have been identified), for example species such as Southern blue whiting (*Micromesistius australis*) or Red cod (*Salilota australis*). As such - and on a precautionary basis - the assessment will consider that the presence of hearing specialists in the area is possible.

**Physical Effects**

6.165 The potential impact of anthropogenic noise levels (including those associated with seismic survey) on juvenile and adult fish in open water are considered to be minimal as they can readily move away from the noise source.

6.166 Direct injuries occur only when the fish, at whatever life stage, comes within a few metres distance of the sound source, where sound pressure levels are most extreme (*Swan et al., 1994; Turnpenny & Nedwell, 1994*). However, where injury effects have been demonstrated, these have been under experimental conditions which are either unrepresentative of normal operational use, or which would arise only in special circumstances. There is no recorded evidence that airguns have killed fish or caused injuries during seismic survey operations (*Turnpenny & Nedwell, 1994*).

**Behavioural Effects**

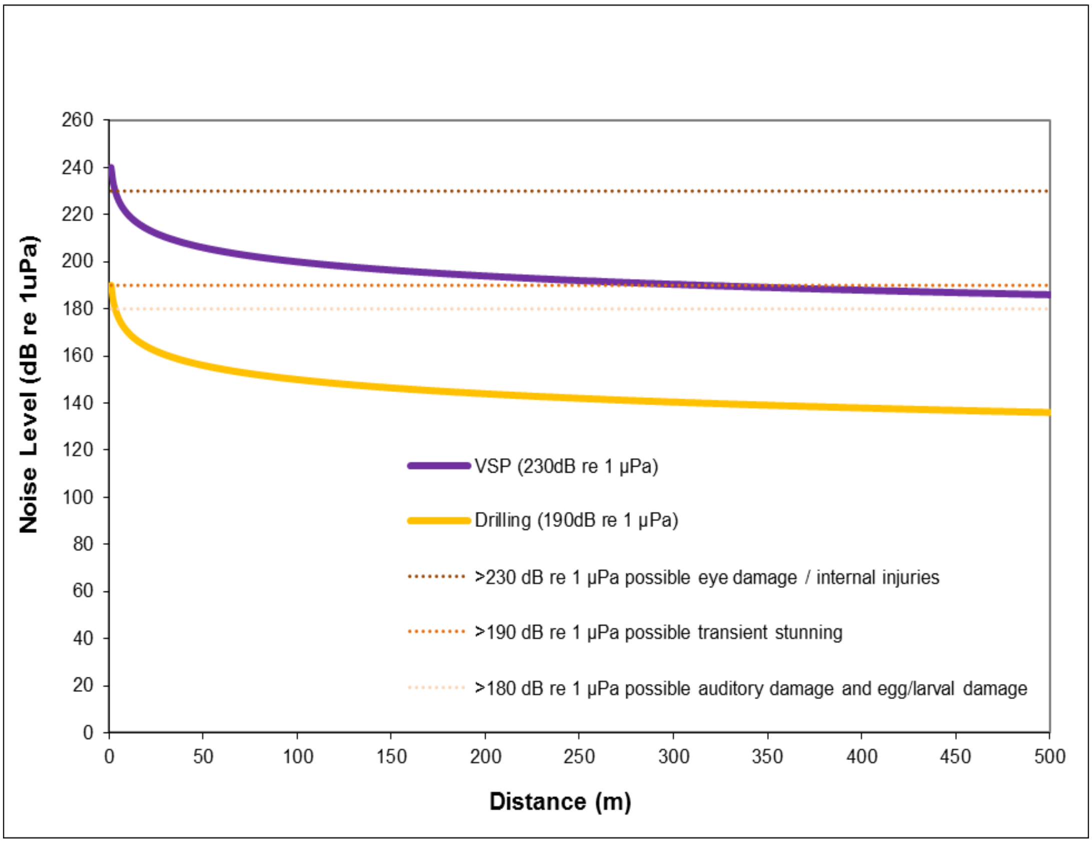
6.167 There is conflicting evidence on the behavioural effects of subsea noise on fish. Numerous studies have reported no significant effect of seismic survey on the behaviour of various fish species, even in very close proximity (1.5 metres) to the seismic source (*Pickett et al., 1994; Wardle et al., 1998*). Wardle *et al.* (2001) for example used a video system to examine the behaviours of fish and invertebrates on a coral reef in response to emissions from seismic air guns that were carefully calibrated and measured to have a peak level of 210 dB re 1 µPa at 16 metres from the source and 195 dB re 1 µPa at 109 metres from the source. They found no permanent changes in the behaviour of the fish or invertebrates on the reef throughout the course of the study, and no animals appeared to leave the reef. There was no indication of any observed damage to the animals (*Wardle et al., 2001*).

6.168 In contrast, a number of studies have concluded that fish leave the immediate area around the survey vessel for the period when the acoustic source is active (*Lokkeborg & Soldal, 1993*). Turnpenny & Nedwell (1994) have concluded that during seismic survey operations, fish tend to avoid the area out from between 200 and 2,000 metres of the source.

6.169 There are no established noise limits at which behavioural impacts on fish in response to seismic noise sources may be induced. Noise may be detected by a fish but no behavioural response may be observed. In addition, different species may perceive and react to a noise source differently based on their physiology, habitat use and size and mass of the fish itself (*Hastings & Popper, 2005*).

6.170 Figure 6.9 shows injury thresholds for fish, as demonstrated by Turnpenny & Nedwell (1994) against estimated transmission losses for VSP and drilling activity based upon outputs from a simple spherical spreading model. Eggs and larvae are seen to be the most sensitive to noise, with damage being identified at sounds levels of 180 dB re 1µPa and above; noise generated by drilling falls under this threshold within 3 metres of the source. Noise levels associated with the VSP fall below the 230dB re 1µPa threshold for possible eye damage and internal injury within 3 metres of the source, below the 190 dB re 1µPa threshold for possible transient stunning within approximately 315 metres of the source, and below the 180 dB re 1µPa threshold within one kilometre of the source.

*Figure 6.9: Sound pressure level thresholds for onset of fish injuries (adapted from Turnpenny & Nedwell, 1994) showing the upper limit of noise levels from a semi-submersible drilling rig and VSP*




### 6.5.4 Potential Impacts on Marine Mammals

6.171 Marine mammals use sound for foraging, orientation, communication, navigation, echolocation of prey and predator avoidance (*Richardson et al., 1995*). Therefore, high levels of anthropogenic underwater sound can potentially have a negative impact on marine mammals ranging from changes in their acoustic communication, displacing them from an area, and in more severe cases causing physical injury or mortality (*Richardson et al., 1995*).

#### Lethality

6.172 Very close to the source, the high peak pressure sound levels have the potential to cause death, or severe injury leading to death, of marine mammals (*Yelverton et al., 1973*). Lethal effects (mortality) for all marine mammal species occur at a SPL of 240 dB re. 1µPa (peak to peak) (*Parvin et al., 2007*).

#### Physical Injury and Hearing Impairment

6.173 High exposure levels from underwater sound sources can also cause hearing impairment. This can take the form of a temporary loss in hearing sensitivity, known as a Temporary Threshold Shift (TTS), or a permanent loss of hearing sensitivity known as a Permanent Threshold Shift (PTS). In addition, PTS may also result from prolonged exposure to noise at lower levels sufficient to cause a TTS. Although animals are able to recover fully from TTS, particularly as they move away from the source, hearing loss may become permanent if hearing does not return to normal after several weeks.

### Behavioural Effects

6.174 At levels where the underwater sound wave may not directly injure animals or cause hearing impairment, the underwater sound may have the potential to cause behavioural disturbance where an animal may incur a sustained or chronic disruption of behaviour or undergoing a significant change from their expected distribution. Southall *et al*. (2007) discuss a range of likely behavioural reactions that may occur. These include orientation or attraction to a noise source, increased alertness, modification of characteristics of their own sounds, cessation of feeding or social interaction, alteration of movement/diving behaviour, temporary or permanent habitat abandonment and in severe cases, panic, flight stampede or stranding.

6.175 Behavioural effects may result in animals being displaced from preferred foraging grounds to potentially less optimal areas, experiencing increased competition or greater energy costs associated with finding food. The effect may be a reduction in the individual's long-term fitness and survival.

6.176 The hearing sensitivity of the animal should be taken into account with a frequency weighting applied to the Received Levels (RLs). Frequency weighting provides a sound level referenced to an animal’s hearing ability either for individual species or classes of species, and therefore a measure of the potential of the sound to cause an effect. The measure that is obtained represents the perceived level of the sound for that animal. This is an important consideration because even apparently loud underwater sound may have no effect on an animal if it is at frequencies outside the animal’s hearing range.

### Hearing Thresholds

6.177 The hearing thresholds of marine mammals vary between species. Hearing sensitivity is based on both the frequency range of marine mammals and their threshold of hearing (i.e., the level of sound at which they perceive noise).

6.178 Based on current knowledge of functional hearing in marine mammals, Southall *et al.* (2007) defined five distinct, functional groups based on the frequency range at which their hearing is most sensitive: a) low frequency (LF) cetaceans (7 hertz – 22 kilohertz); b) mid-frequency (MF) cetaceans (150 hertz – 160 kilohertz); c) high frequency (HF) cetaceans (200 hertz to 180 kilohertz); d) pinnipeds in water (75 hertz – 75 kilohertz), and e) pinnipeds in air (75 hertz – 30 kilohertz).

6.179 Species known to be found within the region of the proposed drilling operations (refer to Section 4.3.6) can be placed into the following groups:

- **Low-frequency cetaceans:** with an estimated hearing range of 7 hertz to 22 kilohertz;
- **Mid-frequency cetaceans:** with an estimated hearing range of 150 hertz to 160 kilohertz; and
- **High-frequency cetaceans:** with an estimated hearing range of 200 hertz to 180 kilohertz.

6.180 The majority of cetaceans found in the vicinity of the Noble license areas can be classified as possessing low-frequency hearing (Table 6.13).

*Table 6.13: Falkland Islands cetacean hearing frequencies (Southall et al., 2007)*

| Common Name | Scientific Name | Frequency |
|---|---|---|
| Brydes whale | *Balaenoptera cf. brydei* | Low-Frequency |
| Fin whale | *Balaenoptera physalus* | |
| Humpback whale | *Megaptera novaeangliae* | |
| Minke whale | *Balaenoptera acutostrata* | |
| Sei whale | *Balaenoptera borealis* | |
| Blue Whale | *Balaenoptera musculus* | |
| Killer whale | *Orcinus orca* | Medium- Frequency |
| Sperm whale | *Physeter macrocephalus* | |
| Common bottlenose dolphin | *Tursiops truncatus* | |
| - | - | High-Frequency |
| Hourglass dolphin | *Lagenorhynchus cruciger* | Frequency not yet determined |
| Long finned pilot whale | *Globicephala melas* | |
| Southern right whale | *Eubalaena australis* | |
| Peale's dolphin | *Lagenorhynchus australis* | |
| Dusky dolphin | *Lagenorhynchus obscurus* | |
| Commerson's dolphin | *Cephalorhynchus commersonii* | |
| Spectacled porpoise | *Phocoena dioptrica* | |

Increasing acoustic overlap between cetacean hearing range and noise from proposed activities

6.181 The frequency of the noise emitted by the rig (16 hertz to two kilohertz (*Richardson et al., 1995*) is expected to lie within the hearing bandwidth of all cetaceans. It is expected that the frequencies of drilling rig noise will overlap with the majority of the low frequency cetacean hearing range and to a lesser extent the mid-frequency cetaceans. No known high frequency cetaceans are identified as being found across the Noble license areas, however on a precautionary basis it will be assumed that some of the whale species whose frequency has not been identified may be high frequency. As such, it is noted that the frequencies of rig noise will partially overlap the high frequency cetacean hearing range. Noise levels from the VSP (10 to 200 hertz (*OGP, 2011*) are most likely to affect low frequency cetaceans (such as the humpback whale or minke whale – refer to Table 6.13), and not impact any possible high frequency cetaceans.

6.182 Marine mammals are typically more tolerant of fixed location noise sources as opposed to moving sources. Dolphins and other toothed whales have been observed showing considerable tolerance to drill rigs (*Richardson et al., 1995*; *LGL, 2000*). However, bowhead whales have been observed avoiding a rig, corresponding to received sound levels of 115 dB re 1 µPa (*Richardson et al., 1995*).

### Physical Injury Thresholds

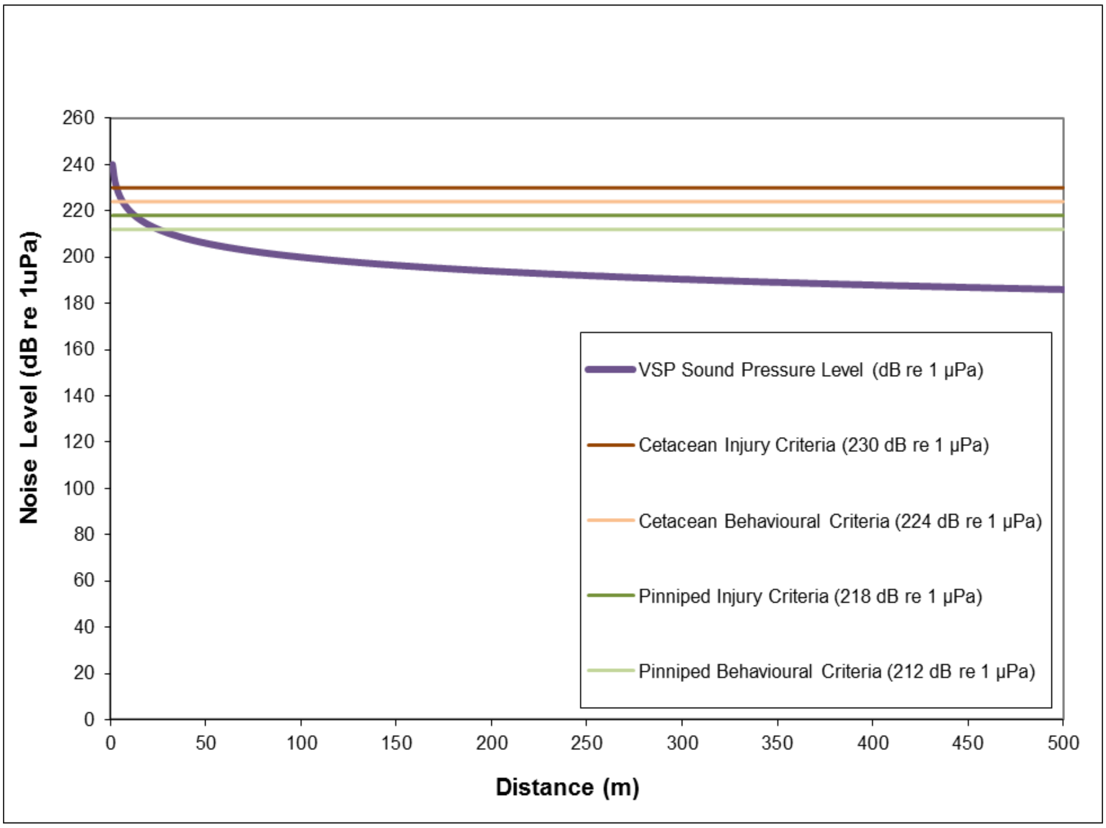
6.183 The injury criteria adopted for this assessment for low- and mid-frequency cetaceans are taken from Southall *et al*. (2007). High levels of noise exposure can cause an instantaneous auditory injury resulting in a Permanent Threshold Shift (PTS) that persists once sound exposure has ceased (i.e. a hearing loss that is not recovered). In addition, PTS may also result from prolonged exposure at lower levels sufficient to cause a Temporary Threshold Shift (TTS) (i.e. a temporary hearing loss subsequently recovered after exposure).

6.184 The relationship between these two thresholds is complex since PTS can either be induced by a single high level noise exposure or by chronic (longer term) noise exposure at lower levels (*Southall et al., 2007*). The threshold for auditory injury is therefore taken as the levels at which PTS starts to occur, based on the overall noise dose received over time, and is termed the PTS-onset criteria. Given that PTS cannot be ethically or legally induced in animals to determine the threshold, Southall *et al.* (2007) proposed that noise exposure criteria for PTS-onset should be extrapolated from the onset of TTS based on the assumed relationships between the relative levels of noise likely to cause TTS and PTS. Consequently the criteria suggested for PTS is an addition of 6 dB to sound pressure level (SPL) criteria for TTS.

6.185 For cetacean species, sound levels above 230 dB re 1 µPa (peak) (flat) would be expected to result in the onset of PTS (*Southall et al., 2007*). Sound levels above 224 dB re 1 µPa (peak) (flat) would be expected to result in the onset of TTS (*Southall et al., 2007*). Drilling noise will not exceed either of these thresholds. However, sound levels produced by the VSP will exceed the severe injury criteria for single pulse source (230 dB re 1 µPa) within three metres of the VSP source (Figure 6.11)

6.186 It is however, considered highly unlikely that a marine mammal will be within 100 metres of the seismic vessel at the commencement of the survey and furthermore, it is important to note that mitigation measures will be applied to reduce the likelihood of instantaneous injury and PTS from cumulative exposure to noise (see Mitigation Measures section below).

***Figure 6.11: Peak (flat) sound pressure levels for the onset of potential physical injury and behavioural response for cetaceans and pinnipeds (adopted from Southall et al., 2007) against VSP noise propagation levels (<u>single pulse source</u>)***




### Behavioural Response Thresholds

6.187 Behavioural impacts due to acoustic exposure are generally more variable, context-dependent and less predictable than the effects of noise exposure on hearing or physiology. This is because behavioural responses to anthropogenic sound are dependent upon operational and environmental variables and on the physiological, sensory and psychological characteristics of exposed animals. It is important to note that the animal variables may differ (greatly in some cases) among individuals of a species and even within individuals depending on various factors (e.g. sex, age, previous history of exposure, season, and animal activity). Southall *et al.*, (2007) summarised behavioural responses, indicating that responses expected in marine mammals experiencing sound levels above behaviour criteria include aggression, aversion and panic.

6.188 A range of studies have investigated the behavioural impacts on low frequency cetaceans, including baleen whales, and reported varied responses to a range of noise levels. Studies of bowhead whales and grey whales indicated that reactions varied from subtle changes in surfacing, breathing and diving behaviour, to avoidance of the sound source and cessation of feeding and social interactions. Such behavioural responses generally occurred within a few kilometres of a seismic sound source and were generally short lived (*Evans & Nice, 1996*).

6.189 Based on the Southall *et al.,* (2007) criteria, the predicted data in terms of peak (flat) sound pressure levels of underwater noise indicates that the behavioural threshold for all cetaceans of 224 dB re 1 µPa (peak) (flat) may be exceeded within six metres of the VSP source (Figure 6.11). Therefore, behavioural avoidance responses would only occur in the immediate vicinity of the VSP source array. The threshold will not be exceeded sound levels associated with the drilling rig or OSV activity.

#### Masking

6.190 If the frequency of anthropogenic noise overlaps with the frequencies used by marine mammals, this may reduce the animal's ability to detect important sounds for navigation, communication and prey detection (*Weilgart, 2007*). This "masking" effect occurs if two frequencies overlap in the "critical band" of each other. In this respect, masking may occur anywhere within a cetacean's auditory range (*Wright et al., 2007*; *Richardson et al., 1995*). Masking of important cetacean vocalisations will result in increasing information ambiguity and may culminate in cetaceans being unable to orientate themselves or hunt/evade predation in the marine environment (*Wright et al., 2007*).

6.191 However, it should be noted that cetaceans exhibit directional hearing abilities, meaning that sound detection can be localised (*Richardson et al., 1995*). This means that masking will only occur if the noise directly overlaps with the direction of the cetacean signal (*Richardson et al., 1995*). Generally, masking is reduced if the noise comes from a different direction than that targeted by the cetacean, or if the noise is omnidirectional (*Richardson et al., 1995*).

6.192 The frequency of the noise emitted by the rig and VSP is expected to overlap (at least partially) with the hearing bandwidth of low, mid and high frequency cetaceans (*NERI, 2011*). Based on this information, the noise produced by the rig and VSP is most likely to mask vocalisations of low frequency cetacean species in the vicinity of the noise source, such as the humpback and minke whale (refer to Table 6.12).

### 6.5.5 Potential Impacts on Seabirds

6.193 Very little is known about how seabirds may respond directly to underwater noise. As species which have hearing adapted primarily for use in air, it is expected that hearing sensitivity underwater will generally be low, in comparison to that for marine mammals, for example (*RPS, 2011*).

### 6.5.6 Noise from Drilling Operations (Drilling Rig & OSVs (Non-pulse Noise)) - Appendix A 5.1

6.194 Noise during drilling originates from various processes; the rotation of the drill string and abrasion against the rock formations being drilled, movement of the pipe and casings as they are fed through one another and into the wellbore and the operation of generators, pumps, hydraulic equipment and other machinery which may be on the rig depending on the project specifics (*Jacques Whitford, 2007*). Some of the OSVs that will be used to support the drilling operations may maintain their position by using thrusters when manoeuvring close to the rig (known as Dynamically Positioned (DP) vessels). Typically this equipment tends to generate more noise and of a higher frequency than a vessel's main engines (up to 170 dB).

6.195 The potential impact of noise generated during the drilling of exploration wells depends on background noise levels, the strength of the sound source, the sound transmission conditions of the receiving environment, and the proximity of marine fauna to the noise in relation to their ability to detect such sound frequencies and their sensitivities to particular sound levels and frequencies.

6.196 Naturally occurring noise levels in the ocean as a result of wind and wave action may range from around 90 dB re 1µPa under very calm, low wind conditions to 110 dB re 1µPa under windy conditions. Certain aspects of the drilling campaign (e.g. VSP and drilling into the seabed) are likely to generate noise in excess of ambient conditions.

6.197 Underwater noise levels associated with the rig are estimated at 150 dB re 1 µPa (*Turnpenny & Nedwell, 1994*). However, the particular activity being conducted by an OSV also greatly influences the noise characteristics (for example, if it is at idle, holding position using bow thrusters, or accelerating). Small commercial vessels (e.g. OSVs) have been recorded producing noise levels between 170 and 180 dB re 1µPa (*Senior et al., 2008*).

6.198 The noise generated by these processes tends to be of low frequency in the range of 0.016 to 0.2 kilohertz, meaning that it will attenuate less and will travel further from its source, when compared to a high frequency sound.

6.199 Based on the information above (Section 6.5.2) and on the potential impacts to plankton the likelihood of an impact occurring is considered to be *possible* to *likely*. Based on the fact that previous studies have shown that exposure to underwater noise from oil and gas activities (vessel activities and seismic) is low compared to natural mortality, severity is considered to be *negligible*. Therefore, the potential impact of the unmitigated drilling operations on plankton is considered to be **low**.

6.200 Noise produced by the rig operations will be within the hearing threshold of some fish species likely to be present, so on a precautionary basis may be considered to impact behaviour on a temporary basis. Noise generated by drilling may produce a startle response as the noise commences, but evidence suggest that fish species eventually become habituated to drilling noise (Westerberg, 1999). There is a range of evidence to support this from underwater video inspections of North Sea drilling and production platform jackets. These show a wide range of fish species, especially gadoids such as cod and saithe swimming calmly in the immediate vicinity of installations. The noise generated by rig operations will also not lead to possible auditory damage and egg damage as it is below 180dB re 1 µPa and as such, the severity is assessed as *negligible*. The likelihood of impacts occurring is considered to be *possible*. Potential impacts of noise on fish in the vicinity of unmitigated drilling operations are therefore considered to be **low**.

6.201 Noise produced by drilling operations is not expected to exceed the severe injury criteria or the TTS levels for cetaceans. Therefore the severity of any potential impact from these operations on cetaceans is considered to *negligible*. However, the likelihood of an impact occurring is considered to be *possible*. Therefore, the potential unmitigated impact for noise impact from drilling operations on cetaceans has been assessed as **low**.

6.202 For seabirds, which are adapted to hearing in air (as opposed to underwater) the main potential impacts are addressed in Airborne Noise (Section 6.6). For underwater noise it is considered the likelihood of an impact occurring is *unlikely* and the consequence will be *negligible*, due to the low sensitivity of seabirds to underwater noise. Therefore, the unmitigated potential impact is considered **low**.

#### Mitigation

6.203 Drilling operations inevitably give rise to noise. The drilling rig will be on location for the minimum period of time required to conduct the drilling operations, thus minimising the duration of potential noise impacts as far as possible. The operational and maintenance procedures on the drilling rig will also aim to optimise the efficiency of the equipment and the schedule of operations.

#### Residual Impact

6.204 While the above mitigation will not reduce the potential severity and likelihood of the impact for plankton, fish, seabirds and marine mammals, it will ensure that the impact remains as predicted for the unmitigated impact and that any impacts are short term in duration. As a result the residual impact for plankton, fish, marine mammals and fish does not change and remains **low**.

### 6.5.7 OSVs on Sea Passage (Non-Pulse Noise) – Appendix A 5.2

6.205 OSVs generate a range of different noise levels in the marine environment which depends on vessel size, power and propeller characteristics. Ship noise is primarily attributed to propeller cavitation (*Richardson et al., 1995*) as the vessel moves through the water and also from propeller 'singing' and noise and vibration of propulsion engines and other machinery where the noise is transmitted through the hull directly into the water (*Jacques Whitford, 2007*).

6.206 The noise characteristics and level of various vessels that will be present in the field over time can vary between 130 and 180 dB re 1µPa (*Simmonds et al, 2003*; *Richardson et al, 1995*; *Senior et al., 2008*).

6.207 The underwater noise that is produced by OSVs arises from two sources; propeller cavitation and the propulsion machinery inside the vessel. Vessel noise may be considered to be a continuous, rather than transient noise source, which is a combination of broadband noise and tonal sounds at specific frequencies.

6.208 Again, based on the information in Section 6.5.2 the likelihood of an impact occurring to plankton is considered to be *possible* to *likely*. Based on the fact that previous studies have shown that exposure to underwater noise from oil and gas activities (vessel activities and seismic) is low compared to natural mortality for plankton severity is considered to be *negligible*. Therefore, the potential impact of the drilling operations without mitigation on plankton is considered to be **low**.

6.209 The source level for OSVs is considerably below the levels at which lethal injury and physical injury to fish species might occur. However, when exposed to vessel noise, behavioural changes (avoidance, forming tighter formations, increased swimming speeds and turning away from the noise source) could potentially occur within close proximity in the order of tens of metres. Generally, fish only respond to very low or very high frequency sounds and studies have shown that vessel noise can either cause avoidance or attraction (*Vella et al*., *2001*). As such, fish may move away from the area in which numbers of vessels are routinely operating, or may be attracted to the sound sources. It is therefore concluded that the noise from vessels would result in some degree of behavioural change only for any individuals located in very close proximity to vessels, and for short periods of time. As a result the likelihood of an impact is considered *possible*. As the impact is unlikely to result in any changes in distribution or abundance other than in a very small area and for a very short period of time the severity is considered to be *negligible* Therefore, the potential impact of unmitigated underwater noise generated by vessels on fish is considered to be **low**.

6.210 Similar to the noise generated by drilling noise produced by OSV operations is not expected to exceed the severe injury criteria or the TTS levels for cetaceans. Therefore the severity of any potential impact from these operations on cetaceans is considered to be *minor*. However, the likelihood of an impact occurring is considered to be *likely*. Therefore, the potential unmitigated impact for noise impact from drilling operations on cetaceans has been assessed as **medium**.

6.211 For seabirds, which are adapted to hearing in air (it is considered the likelihood of an impact occurring is *unlikely* and the consequence will be *negligible*. Therefore, the potential impact without mitigation is considered **low**.

6.212 Based on the assessments above on the potential underwater produced by OSVs on passage to and from Stanley Harbour and the potential impact on marine mammals and seabirds, the likelihood of an impact occurring to protected areas around the coast of the Falkland Islands is considered *unlikely*. The consequence of the impact will be *negligible* and therefore, the potential impact is considered **low**.

#### Mitigation

6.213 Although the potential impacts are assessed as low, mitigation measures have been proposed on a precautionary basis to ensure that any potential impacts remain as assessed. The following mitigation measures will be applied:

- Vessel movements will avoid coastal areas (with the exception of the approaches to Port William and Stanley Harbour) where sensitive species, such as penguin colonies, may be present.

- Whilst transiting near beach areas (i.e. within the vicinity of the approaches to Port William, and whilst within Port William and Stanley Harbour), vessel speed will be reduced in order to minimise the chance of vessel strike with any species that may be present. Such a reduced speed would also limit noise impact from the vessels. All other applicable vessel speed limits shall also be observed when within the approaches to Port William and whilst within Port William and Stanley Harbour.

- Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species present within the vicinity of these islands.

#### Residual Impact

6.214 As the potential impact was assessed as low and the above mitigation are in place to ensure that the impact remains as predicted, the residual impact for plankton, fish, marine mammals and seabirds remains **low**.

### 6.5.8 Helicopter Flights – Appendix A 5.3

6.215 Over the marine environment, the airborne sound energy will largely be reflected on the surface of the water and only a small fraction of the sound produced will enter the water. The angle at which a line from the aircraft to the receiver intersects the water's surface is also important. At angles above 13° from the vertical, much of the incident sound is reflected and does not penetrate into the water. As a result, the likelihood of an impact occurring to marine organisms adapted to hearing sound underwater is considered to be *unlikely* and the consequence *negligible*. Therefore the unmitigated potential impact of underwater noise from helicopter flights is considered to be **low** for all receptors. The assessment of airborne noise generated by helicopters is provided in Section 6.6.1.

#### Mitigation

6.216 Although the potential impacts are assessed as low above, mitigation measures have been proposed on a precautionary basis to ensure that any potential impacts remain as assessed. The following mitigation measures are applicable:

- The aviation contractor will be prohibited from circling or hovering over marine mammals or sites identified as sensitive for seabird colonies (refer to Sections 4.3.7 and 4.3.8) in accordance with the Falkland Islands low flying avoidance maps and the Falkland Islands Low Flying Handbook. The aviation contractor will pay particular attention to paragraphs 37 to 40 and 54 to 60 of the Low Flying Handbook.
- Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species present within the vicinity of these islands.

#### Residual Impact

6.217 As the potential impact was assessed as low and the above mitigation are in place to ensure that the impact remains as predicted, the residual impact for plankton, fish, marine mammals, seabirds and protected areas remains **low**.

### 6.5.9 Vertical Seismic Profiling (VSP) (Single Pulse Noise) – Appendix A 5.4

6.218 It is expected that VSP will take place in the post-drilling phase of the planned exploration wells. The formation of the airgun array has not yet been finalised, however it is anticipated that the VSP will consist of a cluster of sources, with a total cluster volume of up to 1,300 cubic inches.

6.219 VSP frequencies appear to be between 60 and 250 hertz, although are more typically found around the 100 hertz frequency depending on the precise nature of the equipment used and the desired result.

6.220 The VSP survey will generate an estimated source level of 240 dB re 1µPa at one metre (peak) over a maximum duration of 24 hours with firing taking place for only portions of that time period. The sources (a number of airguns) will be hung approximately five meters below the surface of the water and will be fired simultaneously.

6.221 The VSP will produce underwater noise levels which have the potential to cause injury and behavioural changes in marine mammals and fish in close proximity (3 metres and 6 metres respectively) of the source. There is a risk of physical damage to plankton such as fish eggs and larvae in immediate proximity to the source.

6.222 Noise generated during VSP operations will also be within the hearing threshold of fish in the region and as such, similar behavioural responses as to the start-up of drilling activities may be expected. However, noise generated during the VSP operations is likely to produce a transient stunning response (noise greater than 190 dB re 1µPa) as the noise commences. VSP may even lead to potential eye damage and internal injuries (to both auditory and non-auditory organs) as it is above the 230 dB re 1 µPa threshold within three metres of the source. However, it should be noted that for the higher frequencies of 250 - 500 Hz present in the signal, the noise level will be 180 dB or lower. Physical damage is more of a threat to fish eggs and larvae, which have limited mobility and are more sensitive to noise. Offshore spawning species (such as the Patagonian toothfish and Grenadier) are therefore more susceptible to the acoustic impacts resulting from VSP. Spawning areas for Grenadier are commonly located north of 51° south (commonly peaking during March and April), and therefore are not expected to coincide with the FISA12 and FIST13 areas, but could potentially be located within the FINA13 area. Spawning areas for Patagonian toothfish are commonly concentrated around the edges of the Burdwood Bank. Spawning can occur year round, with peaks commonly occurring during March, July and August.

6.223 The noise level from the VSP drops below the injury threshold for possible auditory damage and damage to eggs and larvae (180 dB re 1 µPa) one kilometre from the VSP source, whilst transient stunning (noise >190 dB re 1µPa) would occur within 316 meters from the source. There is potential for injury within very close proximity to the VSP energy source and therefore the likelihood of impact is considered to be *likely*. The potential severity is considered *moderate* due to the fact that immediately in the vicinity of the airgun array serious injury could occur and that the potential for injury is no longer present approximately 316 metres form the source. Therefore, the potential unmitigated acoustic impact is considered to be **medium**.

6.224 The injury and behavioural noise levels for cetaceans will be exceeded during the potential VSP operations, although only within three metres (PTS criteria) and six metres (TTS criteria) of the VSP equipment noise source. As marine mammals may be in the location during VSP operations the likelihood of impact is considered to be *likely*. Due to the PTS and TTS criteria being exceeded within three and six metres of the source respectively and the fact that behavioural impacts are also likely to occur within six metres of the source the severity of the impact is considered to be *moderate*. Therefore, the unmitigated potential impact is considered to be **medium**.

6.225 For seabirds, which are adapted to hearing in air it is considered the likelihood of an impact occurring is *unlikely* and the consequence will be *negligible*, due to the low sensitivity of seabirds to underwater noise. Therefore, the unmitigated potential impact is considered **low**.

6.226 Based on the information on plankton, the likelihood of an impact occurring is considered to be *possible* to *likely*. As previous studies have shown that exposure to underwater noise from seismic activity is low compared to natural mortality (Section 6.5.2), severity is considered to be *negligible*. Therefore, the potential impact of the unmitigated drilling operations on plankton is considered to be **low**.

### Mitigation

6.227 In the event that VSP operations do go ahead, the following mitigation measures will be applied:

- VSP operations will be strictly controlled in line with the JNCC *Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys* (2010).
- A qualified Marine Mammal Observer (MMO) will be on site during VSP operations. The MMO will monitor the 500 metre safety zone for 60 minutes (due to the operations occurring in water deeper than 200m) prior to commencement of VSP operations to ensure that no marine mammals are present within the area.
- Soft-start ramp up of the seismic source during VSP operations, of no less than 20 minutes and no more than 40 minutes, will then be undertaken in line with the above JNCC guidelines. This enables fish and marine mammals in the area disturbed by the sound levels to move away from the noise source before being subject to the full force of the seismic array, thus minimising the potential for adverse impacts on these species.
- If marine mammals are observed within the 500 metre zone after the VSP has started, then they are deemed to be unaffected by the noise. A record of the sighting should be kept but no further action will be taken.
- VSP operations will be started during daylight hours only.

### Residual Impact

6.228 Implementation of the above mitigation measures during the drilling programme reduces the risk of any prolonged impact to wildlife.

**6.229** While the above measures are specifically designed to address potential impacts to marine mammals they will also mitigate potential impacts to fish species. Through the use of soft start procedures any fish that are present will be alerted to the sound and will gradually move further away from the source as the sound increases. As a result the likelihood is reduced to *possible* as fish are less likely to be present close to the source at full power. The severity of the impact is reduced to *moderate* as the soft start procedure should ensure exposure to much lower levels of noise, ensuring that any effects are significantly less than if they were unmitigated. While the likelihood and severity of the impact have been reduced the residual impact remains **medium** on a precautionary basis.

6.230 The searching protocol ensures that as far as reasonably possible the airguns will begin firing when marine mammals are not present within 500 m of the source (further than the three metres PTS threshold and the six meter TTS and behavioural threshold). In addition, through using a soft start procedure any marine mammals that are present will be alerted to the sound and will gradually move further away from the source as the sound increases. As a result the likelihood is reduced to *possible* as marine mammals are less likely to be present close to the source when firing reaches full power. The severity of the impact is also reduced as the soft start procedure should ensure exposure to much lower levels of noise, ensuring that any effects are significantly less. The residual severity is assessed as *moderate*. While the likelihood and severity of the impact have been reduced the residual impact remains **medium**.

6.231 The above measures are not designed to mitigate potential impacts to seabirds and plankton and therefore, the residual impact for these receptors is considered to remain **low**.

## 6.6 Airborne Noise

### 6.6.1 Airborne Noise from Helicopters in Transit – Appendix A 6.1

6.232 Helicopters will be used to transfer personnel to/from Stanley Airport to the drilling rig. The helicopters will transport personnel from Stanley Airport up to 260 kilometres to the drilling rig, depending on the proposed well site being drilled.

6.233 Helicopter flights from Stanley Airport to the rig are anticipated to cause an increase in background noise levels for the local residents in the area near the airfield. In addition, flights heading south may pass over Stanley Common and the Cape Pembroke Peninsula Sanctuary (National Protected Area) potentially causing a disturbance to the coastal bird population. Noise level changes on local communities can have a physiological (threshold shift) and psychological impact (for example speech interference or sleep disturbance) (*FICON, 1992*).

6.234 During a study on the disturbance caused by aircraft (including helicopters) conducted on water birds (*Komenda-Zehnder et al., 2003*), only a minimal level of disturbance was observed. The birds returned to a relaxed behaviour (resting, preening, feeding) within five minutes of the over-flights. No short-term habituation or sensitisation was observed. The disturbance effect of helicopters was higher than of aeroplanes and increased with decreasing flight altitude. The behaviour of the birds was not significantly influenced if a helicopter flew at a cruising height of above 450 metres (*Komenda-Zehnder et al., 2003*). This was supported by the work undertaken by Black *et al*. (1984), who studied wading bird colonies, with regard to the effects of low-altitude over-flights (less than 150 metres altitude above ground level). It was found that reproductive activity, including nest success, nestling survival, and nestling chronology, was independent of over-flights.

6.235 Helicopters passing over the coastline may pass close to the following areas when approaching or departing from Stanley Airport:

- The Stanley Common and Cape Pembroke Peninsula Sanctuary (National Protected Area);
- The Town of Stanley - the principle residential and industrial hub for the Falkland Islands and home to the majority of the Falkland Islands population; and
- Sea Lion and Beauchêne Islands which are home to important populations of marine mammals and seabirds.

6.236 Based on the above evidence of disturbance to bird populations in coastal areas and on the approaches to Stanley Harbour being short term and having little effect on populations exposed to low flying over-flights, the likelihood of an impact occurring is assessed as *unlikely*. The consequence of an impact is considered *negligible*. Therefore, the potential impact is considered to be **low**. However, due to the conservation status of Sea Lion and Beauchêne Islands and the populations of seabirds and marine mammals present, the severity of the impact to these protected areas, on a precautionary basis, is considered to be *minor*. Combined with a *possible* likelihood, this results in an unmitigated potential impact that is considered to be **medium**.

6.237 The likelihood of an impact occurring to residential properties and coastal populations is assessed as *likely*, as helicopters are likely to fly close to or over housing in and close to Stanley. As some residential populations could potentially be impacted by a noise level exceeding the IFC residential guidelines (i.e. residential housing being exposed to a level over 55DB) the severity as assessed as *minor*, particularly as any disturbance will be short term and temporary in duration. Therefore, the unmitigated potential impact has been assessed as **medium**.

6.238 Based on the assessments above, any effects on tourism are deemed to be of *negligible* severity and *possible* likelihood due to the short term and temporary nature of the impact. Therefore, the unmitigated potential impact has been assessed as **low**.

#### Mitigation

6.239 The following mitigation measures will be applied:

- Up to two return flights per week are expected under normal circumstances.
- The aviation contractor will be prohibited from circling or hovering over marine mammals or sites identified as sensitive for seabird colonies (refer to Sections 4.3.7 and 4.3.8) unless essential for safety or operational purposes in accordance with the Falkland Islands low flying avoidance maps and the Falkland Islands Low Flying Handbook. The aviation contractor will pay particular attention to paragraphs 37 to 40 and 54 to 60 of the Low Flying Handbook.
- Routing over built up areas will be avoided, unless in an emergency and/or on the grounds of safety in accordance with paragraph 32 of the Falkland Islands Low Flying Handbook.
- Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species present within the vicinity of these islands.
- Helicopter flight planning will be undertaken in coordination with the appropriate Falkland Island authorities (Civil Aviation Department). Under normal operations, helicopter flights will only occur during daylight hours, in order to minimise potential disturbance to the local population.

#### Residual Impact

6.240 Through the implementation of the above measures the potential for impact to occur at Sea Lion and Beauchêne Islands is considerably reduced. As exposure to noise will be significantly reduced through avoidance of these islands and through avoidance of other sensitive areas the severity will be reduced to *negligible*. The likelihood of an impact occurring will be reduced to *unlikely* as helicopters will be less likely to fly over these area. Therefore, the residual impact is considered to be **low** to protected areas along the flight path. The residual impact to seabirds and marine mammals will remain **low**.

6.241 The likelihood of an impact occurring to residential properties and coastal populations is assessed as *possible*, as helicopters will attempt to avoid residential properties. The severity of the impact will be reduced to *negligible*, through avoidance of sensitive periods (i.e. night time). Therefore, the residual impact has been assessed as **low**.

6.242 Residual impacts on tourism will remain **low**.

### 6.6.2 Airborne Noise from OSVs on Sea Passage – Appendix A 6.2

6.243 OSVs will have planned routes from the drilling rig to the Temporary Dock Facility (TDF) in Stanley Harbour, which may pass close to a number of sensitive coastal areas. Noise levels from transiting OSVs have the potential to impact on coastal wildlife (marine and ornithological) in these sensitive areas.

6.244 Vessels transiting to and from the TDF in Stanley Harbour from the possible rig locations may pass close to the Stanley Common and Cape Pembroke Peninsula Sanctuary (National Protected Area) (refer to Section 4.3.8). It is therefore possible that the species present in the Stanley Common and Cape Pembroke Peninsula Sanctuary protected area may potentially be impacted by the vessels, particularly through exposure to noise generated by the vessels during passage.

6.245 Sea Lion and Beauchêne Islands are important sites for marine mammals and pinnipeds (as described in Section 6.1.4).

6.246 Sea Lion Island and Beauchêne Island are also considered significant habitats with regards to birds. Sea Lion Island is designated as both a RAMSAR site and Important Bird Area (IBA) due to its populations of birds. More than 30 bird species have been recorded on Beauchêne Island. Most of these are migratory seabirds that are present in high numbers during the breeding season. The islands are home to the second largest populations in the world of black-browed albatross and rockhopper penguins. The second densest breeding population of striated caracaras in the Falkland Islands also reside here.

6.247 There is the potential for the 3 OSVs to pass close to these islands during passage to and from Stanley Harbour and during these passages disturbance to marine mammals and resident bird populations from airborne noise could potentially increase. Any effects will be temporary in nature and only last for the period when the vessels pass in close proximity to the islands. Disturbance is unlikely to result in effects leading to significant changes in the populations present. The severity of the impact would be considered negligible but due to the conservation importance the severity is considered *minor* on a precautionary basis. The likelihood of an impact occurring is considered to be *possible*. As a result the unmitigated potential impact is considered **medium**.

#### Mitigation

6.248 Vessel movements will avoid coastal areas (with the exception of the approaches to Port William and Stanley Harbour) where sensitive species, such as penguin colonies, may be present.

6.249 Whilst transiting near beach areas (i.e. within the vicinity of the approaches to Port William, and whilst within Port William and Stanley Harbour), vessel speed will be reduced in order to minimise the chance of vessel strike with any species that may be present. Such a reduced speed would also limit noise impact from the vessels. All other applicable vessel speed limits shall also be observed when within the approaches to Port William and whilst within Port William and Stanley Harbour.

6.250 In addition, Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species present within the vicinity of these islands.

#### Residual Impact

6.251 Both the likelihood and severity will be reduced through ensuring the vessels do not pass close to Beauchêne and Sea Lion Islands and other sensitive areas, reducing the potential for interaction and the level of noise exposure. The reduction in speed when approaching coastal and sensitive areas will also ensure that the noise produced and therefore the severity of the impact is reduced. Based on this the likelihood will be reduced to *unlikely* and the severity *negligible*. The residual impact is therefore assessed as **low**.

## 6.7 Waste Management

6.252 The offshore oil and gas industry generates several waste streams during exploration and production activities. These waste streams are of two types:

- Operational wastes that are discharged to sea under permit or authorisation, for example wastewater (considered in Section 6.3.4);
- Other wastes, which are unwanted materials that are stored on the installation and returned to shore for disposal or recycling.

6.253 These materials range from inert wastes including general waste, paper, glass, cardboards and garbage, to scrap metals, empty metal and plastic drums, oils, sludge and chemicals.

6.254 The volume of waste produced varies with the level of maintenance, drilling and production activities.

### 6.7.1 Non-Hazardous / Inert Waste – Appendix A 7.1

6.255 Non-hazardous waste means waste that is considered inert if it does not undergo any significant physical, chemical or biological transformations. Also, it does not dissolve, burn or otherwise physically or chemically react, biodegrade or adversely affect other matter with which it comes into contact in a way likely to give rise to environmental pollution or harm to human health.

6.256 The volume of non-hazardous waste likely to be generated during the proposed drilling programme has been estimated at approximately 30 tonnes per well, resulting in an estimated total of 90 tonnes for the drilling programme. The effects of disposal of non-hazardous wastes associated with onshore disposal are dependent on the nature of the site or process. It is known that landfill facilities on the Falkland Islands are limited in availability and this fact may exacerbate limitations on future land use and the potential for small scale land and air contamination. The waste generated by the drilling operations will be relatively small and would normally be ranked as negligible severity. However, in the context of the limited waste facilities available on the Falkland Islands the severity of the impact is considered to be *minor*. As waste is going to be generated the likelihood of the impact is considered to be *certain*. Therefore, the potential impact without mitigation is assessed to be **medium**.

### Mitigation

6.257 Noble will develop and implement a Waste Management Plan (WMPA) for the proposed drilling programme that encompasses the drilling rig, OSVs and onshore support. The WMPA will cover the storage, transport and treatment of waste generated as part of the drilling programme. The WMPA will cover both offshore and onshore aspects of the exploration drilling operations (i.e. will cover both offshore and onshore elements of the waste streams). The WMPA will identify measures to reduce waste generated during drilling and how waste will be handled and disposed of safely and responsibly. The WMPA will:

- Promote minimisation of the amounts of waste generated at source;
- Require segregation of waste by type;
- Require appropriate storage to prevent emissions and leaks;
- Promote recycling or re-use where possible, in particular for scrap metal, waste oil and surplus chemicals;
- Require that waste be sent to authorised landfills or incineration facilities, depending on its precise nature, when no other option is possible; and
- Minimise and manage cumulative waste generation from the drilling campaign.
- Ensure a clear chain of ownership for all waste through the use of waste transfer manifests until final disposal, particularly relating to trans-boundary matters.

6.258 Noble is aware that onshore disposal options are extremely limited. Noble will work closely with FIG prior to drilling operations to determine acceptable options for onshore non-hazardous waste disposal. The following measures will be included in the Waste Management Plan:

- No un-combusted wastes arising from the drilling programme will be landfilled in the Falkland Islands;
- Some non-hazardous combustible waste will be segregated and sent to a local incinerator for incineration in the Falkland Islands; and
- The waste ash arising from this incineration will be landfilled in the Falkland Islands along with other incinerator waste at an existing landfill facility (Eliza Cove or Mary Hill Quarry).

6.259 Noble will confirm all waste management and disposal routes within the WMPA to be approved by FIG prior to drilling operations commencing.

6.260 All contractors will be required to adhere to the requirements within the WMPA.

### Residual Impact

6.261 The likelihood of the impact remains *certain* as waste will be generated by the project. However, through application of a WMPA and measures to reduce waste and by applying a responsible waste management strategy as described above, the severity of the impact will be reduced to *negligible*. As a result the residual impact is assessed as **low**.

### 6.7.2 Hazardous Waste – Appendix A 7.2

6.262 Hazardous wastes are wastes that are toxic, ignitable, reactive or corrosive. It is also waste that may be harmful to human health or the environment.

6.263 Hazardous wastes generated in the offshore oil and gas industry arise from drilling, workover and platform maintenance activities and mostly include residual hazardous fluids e.g. biocides, surfactants, emulsifiers, corrosion inhibitors, oxygen scavengers, greases, fuels, hydraulic oils, paints, thinners, lubricants, anti-freeze (or other glycol containing substances), cleaning solvents and batteries.

6.264 It is estimated that a total of approximately 30 tonnes of hazardous waste will be produced by the exploration drilling campaign.

6.265 The handling of hazardous wastes generated by a drilling project is typically dealt with by ports that have adequate waste reception facilities in accordance with MARPOL. The Falkland Islands is currently not able to provide such facilities in full compliance with MARPOL.

6.266 Any hazardous waste generated as a result of the Noble drilling programme therefore cannot be disposed of in the Falkland Islands. Its disposal becomes a trans-boundary issue as a trans-boundary movement (TBM) will be required. Based on the lack of suitable facilities in the Falkland Islands hazardous waste represents a serious threat to the environment without mitigation. As hazardous waste is inevitability produced by oil and gas exploration activities the likelihood of the impact is considered to be *certain*. The 30 tonnes of hazardous waste that may be produced will only have potential localised impacts and, as a result the severity of the impact is considered to be *moderate.* The impact is assessed, before the application of mitigation, as being **high**.

#### Mitigation

6.267 Special arrangements will be in place for hazardous wastes and will be detailed within the WMPA. As no suitable onshore facilities exist in the Falkland Islands for the treatment and disposal of hazardous waste, the waste will be exported in accordance with the Basel Convention. Under the Basel Convention, a trans-boundary movement (TBM) means any movement of hazardous wastes or other wastes:

- From an area under the national jurisdiction of one State; and
- To or through an area under the national jurisdiction of another State, or to or through an area not under the national jurisdiction of any State.

6.268 The Basel Convention requires that the standard of “environmentally sound management” (ESM) of hazardous wastes or other wastes is met. ESM means taking all practicable steps to ensure hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes. The final stage in the TBM procedure is for the generator and country of export to receive confirmation that the wastes moved across borders have been disposed of by the disposer as planned and in an environmentally sound manner.

6.269 Noble will ensure that a dedicated waste specialist is appointed to:

- Receive and handle waste (including hazardous waste) at the TDF;
- Arrange for local recycling or disposal of non-hazardous waste;
- Safely store any hazardous waste;
- Arrange appropriate export of hazardous waste in accordance with the Basel Convention; and
- Ensure confirmation from the disposer that the wastes moved have been disposed of as planned and in an environmentally sound manner in accordance with the Basel Convention.

6.270 Noble will conduct an audit/assessment of any selected waste specialist and processing facilities to ensure their compliance with local and international best practice and the WMPA.

### Residual Impact

6.271 The likelihood of the potential impact occurring due to hazardous waste remains *certain*, as again waste will inevitably be produced by the drilling operations. However, through application of a responsible waste management strategy as described above, the severity of any impact is significantly reduced and will be reduced to *negligible*. As a result, the associated residual impact is assessed as **low**.

## 6.8 Light – Appendix A 8.1

6.272 Seabirds and other bird species, including migrants, are known to congregate around large offshore structures such as drilling rigs and ships. They can be present in above-average numbers due to artificially increased food concentrations from discharges of domestic wastewater and food waste, the use of bright lighting, and attraction to the structure itself for roosting (*Wiese et al.*, *2001*). Several studies have demonstrated that bird densities surrounding oil and gas platforms may be increased compared to those in surrounding waters (*Tasker et al., 1986*, in: *Wiese et al., 2001; Baird, 1990*).

6.273 Nocturnal breeding seabirds are particularly sensitive to artificial offshore lighting, such as petrels and shearwaters (*Le Corre et al., 2002*). Widespread mortality of petrels has been reported in many situations where the birds are attracted to artificial lights, especially on islands with large breeding populations of shearwaters, storm-petrels and gadfly petrels (*Miles et al., 2010*). This has been associated with the prevalence of artificial lights, since inexperienced fledglings foraging for bioluminescent squid may accidentally collide with a lit up structure after mistaking it for food. Many subsequently die either due to starvation or predation (*Le Corre et al., 2002*). The effect may be exacerbated during periods of low visibility, such as during misty or foggy conditions, which can create a visible 'halo' effect around any artificial light source.

6.274 On the Islands of Hawaii, urban lights have been shown to induce extensive seasonal mortalities of petrels (*Le Corre et al., 2002*). In a study of the impacts of artificial lights on the behaviour of petrels at St. Kilda in the Outer Hebrides, Miles *et al.* (2010) reported that although the numbers of petrels attracted to the artificial lights during their study were low, reducing light emissions is still recommended in order to reduce numbers of disorientated fledglings.

6.275 Light induced mortality in Procellariiformes appears to be seasonal and linked to the breeding schedule of each species (*Le Corre et al., 2002*). The Falkland Islands breeding season for seabirds is variable between species but tends to peak during austral summer for Procellariiformes (November – February). Some Procellariiformes (e.g. the wandering albatross and black browed albatross) do breed during the austral winter and have been observed around the Noble license areas (refer to Section 4.3.7). Due to their nocturnal habits during the breeding season, they could potentially be affected by artificial lighting on the drilling rig.

6.276 In a study of seabird observations during flaring operations at the Sea Lion well in the North Falkland basin, seabird species were present in 235 (73%) of the 320 radial point counts conducted. At least 12 different seabird species were identified and 1,085 seabirds recorded during the study. The observed seabird densities were relatively low. Whilst no negative interaction was observed, the data collected did suggest a level of positive association of seabirds to the drilling rig. Significantly greater numbers of seabirds were present during the morning rather than the afternoon, suggesting that there may be attraction to lighting from the drilling rig over the hours of darkness (*Munro, 2011*).

6.277 Seabird species other than shearwaters, petrels and albatross are less likely to be affected by light and evidence shows that milling behaviour around light sources generally only occur during overcast nights (*Marquenie and van de Lar*, *2004* (in *Poot et al*., *2008*)). Indeed recent evidence from offshore platforms in the North Sea have been unable to demonstrate any light impacts on seabirds and other migratory bird species (*OSPAR*, *2013*) to the degree that contracting parties, including the UK, have indicated that there is insufficient data to suggest any impacts occur from offshore installations lighting. While this evidence is for North Sea waters, it can equally be applied to seabirds likely to be present that are less affected by lighting (seabirds other than shearwaters, petrels and albatrosses).

6.278 The potential for an impact to occur with the introduction of artificial lights and the conservation status of shearwaters, petrels and albatrosses, the potential impact could be significant if large numbers were affected. However, the data from Munro (2011) suggests that while there is some attraction, there is little mortality and birds are attracted in relatively low densities. The likelihood of the impact is considered to be *likely* as previous work has shown that birds are attracted to the lights from the platform. However, the severity of the impact is considered *minor* due to the low density of birds attracted. As a result the unmitigated potential impact has been assessed as **medium**.

### Mitigation & Monitoring

6.279 Heli-deck landing lights will be switched off when not in use (if not required to be left on for safety reasons, such as during an emergency incident) to reduce potential impacts of these skyward facing lights on any bird species that may be present. Night time helicopter flights will only be conducted during emergency situations and are not planned to be part of normal operations during drilling activities so requirements for heli-deck lighting will be minimal if at all.

6.280 In addition, the OSV and SSV deck lighting will be switched off when not in use (if not required to be left on for safety reasons, such as during resupplying of the rig at night).

6.281 The precise details of the bird monitoring on the rig are yet to be finalised. Noble will monitor the number of birds found on the rig throughout the exploration drilling programme and will report monthly to an advisory group the findings of this monitoring. In the event that it is considered that significant and unacceptable numbers of seabirds have been attracted to the rig at night this will immediately be reported to FIG. Noble will then investigate whether further measures can be implemented and will work with FIG and their advisors to develop suitable measures. However, based on the experience of a previous study offshore the Falklands (albeit in northern waters) it should be noted that an event such as this is considered highly unlikely to occur.

6.282 As part of the monitoring programme, a protocol will be established for the identification and recording of species involved in the event of mortality. Species present on the rig, involved in collisions or observed attracted to the rig will be recorded, including species name, numbers observed, behaviour and location on the rig. Photographs of species observed will be taken as part of the recording procedure. However, based on the experience of a previous study offshore the Falklands (albeit in northern waters) it should be noted that mortality due to association is expected to be highly unlikely to occur. The finalised protocol for recording species observed will be developed prior to drilling operations occurring and will be agreed with FIG.

### Residual Impact

6.283 Artificial lighting on board offshore oil and gas structures is necessary for safe operations in darkened deck areas during night time activity and throughout periods of reduced visibility. There is little that can physically be done to reduce effects from artificial lighting where unacceptable health and safety risks could be introduced, such as turning off lights on deck areas while the deck area is in use for transferral of goods between the vessel and the rig.

6.284 According to BirdLife International, the main measures for addressing potential artificial lighting impacts are to removing unnecessary illumination, reduce light intensity and to eliminate unnecessary skyward and seaward light projection[2]. It is highly unusual for rig structures to have the need for extensive skyward facing lighting, with the exception of landing lights for helicopters and these will be switched off during night time, particularly as helicopter flights will only be made during daylight hours. Through ensuring that these lights are switched off the likelihood of attraction will be reduced to *possible*. Whilst a level of congregating seabirds around the drilling rig and OSVs may be expected, the reduction of the use of lighting during

[2] http://www.birdlife.org/datazone/sowb/casestudy/488

periods when lighting is not necessary will further ensure fewer birds are attracted and the severity of the impact is reduced to *negligible*. The residual impact is considered to be **low**.

## 6.9 Seascape, Landscape & Visual Impact – Appendix A 9.1

6.285 At its nearest operational point to land (the Scharnhorst North 1 location, 70 kilometres South of Beauchêne Island) the drilling rig will not be visible from shore, and as such will not be visible throughout the drilling programme. Consequently its potential impact upon the seascape from land is scoped out of the assessment.

6.286 The physical presence of OSVs going to and from the rig and the TDF in Stanley Harbour and the helicopters going to and from Stanley Airport will temporarily change the existing seascape and visual setting within the eastern part of Stanley Harbour. This has the potential to disrupt the normal recreational enjoyment of the shoreline area and the aesthetic value of specific features, such as the '*Lady Elizabeth'* wreck. Any serious disruption to the aesthetic value of Stanley Harbour could potentially reduce the overall tourism experience, lead to a potential loss of future visitors to the island, and potentially reduce the amount of time tourists spend onshore after arriving by cruise ship. However, the presence of helicopters and OSVs is not considered to constitute a serious disruption of aesthetic value, particularly vessels, as fishing vessels often transit through Stanley Harbour during the fishing season. In addition, the presence of the vessels in Stanley Harbour will be of short duration and only occur a few times a week so will only represent a temporary disturbance. The same applies to the helicopters as only up to two return flights per week are expected under normal circumstances.

6.287 Based on these assumptions the likelihood of the impact is expected to be *certain*, as vessels and helicopter movements will occur. The severity would usually be considered to be negligible, as the presence of the OSVs a few times a week will not add significantly to the vessel traffic already experienced in Stanley Harbour and the overall effect will be short lived and temporary. However, there is the potential for some community concerns to be raised so on a precautionary basis the severity is considered *minor*. As a result the unmitigated potential impact is considered to be **medium**.

### Mitigation & Monitoring

6.288 Applicable mitigation measures comprise the following:

- The duration of OSVs at the TDF and within Stanley Harbour will be minimised to the extent possible through project planning activities.
- The number of helicopter flights and the time spent in the air near Stanley Airport will be minimised to the extent possible through appropriate planning measures.
- Any land-based equipment and materials not in active use will be stored at Noble's shore base, whenever possible.
- All working areas will be maintained in a tidy condition with the aim of minimising the potential visual impact.
- All complaints associated with the effects on the seascape, landscape and visual setting of Stanley will be recorded and monitored, in accordance with the Noble Energy Community Feedback Mechanism.

### Residual Impact

6.289 While the likelihood will remain certain as vessels and helicopters will continue to move between the rig and Stanley, the severity of the impact will be reduced by the measures above. Through careful planning of movements, unnecessary journeys will be minimised reducing the time vessels are present in the harbour and that helicopters cause a disturbance. As a result the severity will be reduced to negligible and the residual impact to **low**.

## 6.10 Utilities, Transport Networks, Communication and Local Resources

### 6.10.1 Additional Demand on Local Accommodation – Appendix A 10.1

6.290 During the proposed exploration drilling programme, there will be a requirement for local accommodation in Stanley from the combination of Noble management staff and incoming contractors who provide specialist onshore support services. It is estimated that up to 87 people (which includes Noble personnel and service company personnel) will require permanent accommodation during the exploration drilling programme. In addition, approximately 60 offshore workers will be crew changed from the rig every two weeks. These workers may need to stay in Stanley for up to two nights during these rig crew changes before they depart either on international flights via Mt. Pleasant Airport or transfer offshore to the drilling rig.

6.291 In the event of an emergency evacuation of the drilling unit, the entire drilling crew onboard (which may be up to 140 persons) will need to be transferred onshore, using a combination of OSVs and helicopters, and be based in accommodation in Stanley.

6.292 The additional demand for accommodation in Stanley has the potential to place pressure on the availability of guest houses and hotels which are already limited in Stanley. The exploration drilling programme is expected to start during peak tourist season when visitor numbers in Stanley are expected to be at their highest.

6.293 Before the implementation of applicable mitigation and monitoring measures, impacts could include, but not be limited to, an increase in the price of accommodation in Stanley (rental or permanently acquired homes) (*Regeneris, 2013*), a reduction in the attractiveness of the Falkland Islands to tourists due to limited and/or expensive accommodation being available (this only applies to air travellers; tourists arriving by vessel will already have rooms onboard their cruise ship), and an increase in the revenue of businesses who may benefit from any increase in rental/permanent house prices.

6.294 Any reduction in the number of tourists arriving by air has the potential to reduce the business income of other tourism support companies who provide road transport, restaurants/bars, and guide companies. There is also the potential for this impact to disproportionally impact vulnerable groups as there is currently a shortage of housing in Stanley for individuals seeking emergency and/or sheltered accommodation, and the use of accommodation for the drilling programme could further restrict the availability of housing units which may otherwise be available (or increase their price). Based on the above and without mitigation the likelihood of the impact is considered *certain*, as accommodation will be needed by incoming personnel. The severity of the impact is considered to be *moderate* due to the low availability of total numbers of accommodation in Stanley and the potential for significant negative effects to vulnerable groups. Therefore, the unmitigated potential impact is considered to be **medium**.

#### Mitigation & Monitoring

6.295 Applicable mitigation measures comprise the following:

- Noble will adhere to the FIG "*Procurement Code of Practice by Oil and Gas Companies and their Subcontractors Operating in the Falkland Islands*" which is currently under development (available as a draft only and not yet approved). This Code aims to maximise the use of businesses registered on the Falkland Islands by the oil and gas industry and minimise the need for contractors to bring in workers who will subsequently require temporary accommodation. Noble will utilise the local work force where possible in order to reduce the need for additional accommodation. Noble continues to work with FIG on the progress of this code of practice;
- Disturbance to local accommodation facilities will be minimised through advanced consultation with local hotels being used for overnight accommodation. Noble intends to have a permanent arrangement for housing and leasing rooms in local hotels in place in advance of drilling operations commencing and well in advance of the rooms being required;

- In addition to the above accommodation arrangements, Noble, in conjunction with other operators, has initial plans to build temporary accommodation in the Stanley area. This accommodation will have a capacity of 80 rooms. Plans for this temporary accommodation have yet to be finalised. Expressions of interest for the provision of this accommodation have been released.
- Noble will minimise, where possible, the number of their own management staff in the Falkland Islands needed to manage the exploration drilling programme (without compromising safety and quality);
- The Emergency Response Plan (ERP) developed by Noble will include arrangements for the provision of emergency accommodation in Stanley. Each of the 80 rooms within the temporary accommodation described above will have an extra bunk to assist in emergency evacuation situations. It is also noted that the Falkland Islands Defence Force (FIDF) based in Stanley could accommodate up to 200 persons in the event of an emergency, although no guarantees of available space can be made. However, the use of this facility for emergency situations will be discussed in advance with FIG and FIDF prior to any inclusion in the ERP.

#### Residual Impact

6.296 The total demand placed on accommodation resources in Stanley will be reduced to the extent possible through minimising the number of management staff in country, maximising the use of the local work force and through advanced planning for rig crew changes. The severity of the impact will be reduced to *negligible*. The measures will further ensure that the use of local accommodation is carefully planned and that the number of nights required is minimised. The likelihood of an impact occurring will remain *certain* as accommodation will continue to be required. As a result of the reduction in severity the residual impact is expected to be **low**.

### 6.10.2 Additional Demand on the Regional Water Supply Network – Appendix 10.2

6.297 Drill water will be required on the drilling rig for the mixing of drilling fluids/cements. For the supply of drill water to the drilling rig, Noble will utilise the integrated water storage facilities (1,000,000 litre capacity) installed on the Temporary Dock Facility (TDF) barge. This water will be piped from the shore to the TDF and will be sourced from the Stanley mains water supply.

6.298 Drinking water from onshore will also be needed by the OSVs. For supply of drinking water, the OSVs will utilise the fresh water services at FIPASS.

6.299 Water demands may coincide with the peak summer season when water demands from residential properties and tourism activities will be highest. The demand for water will continue until the end of the drilling programme, which will last between 75 and 90 days for each well.

6.300 The use of water resources, particularly during the summer and tourist season, has the potential to place pressure on the availability of water resources within Stanley. This could impact residential properties and disrupt tourism and business operations.

6.301 The likelihood of the potential impact is *certain*, as water will be required for the operations and the municipal water supply will be used. The severity of the impact is considered *moderate*, due to the potential for the impact to occur during the tourism season when local demand is at its highest but also due to the temporary nature of the impact. Therefore, the unmitigated potential impact is considered to be **medium**.

#### Mitigation & Monitoring

6.302 Applicable mitigation measures comprise the following:

- The storage tanks on the TDF, which will be utilised for the storage of drill water, will be trickle filled from the municipal water supply, which will mitigate against the potential for sudden, high-volume ‘shock’ demands being placed on the local water supply network.

- During the exploration drilling programme, Noble will provide written notification to the FIG Public Works Department (PWD) a minimum of 10 calendar days before drill water is required to be taken from the municipal water supply. The written communiqué shall confirm the expected quantity of water to be taken from the regional supply network, the expected date and start/end time and the telephone contact details of the relevant Noble supervisor.

#### Residual Impact

6.303 Whilst a relatively large quantity of water will be continuously required for an extended period of time during the drilling programme, the use of the trickle filling method of the TDF barge tanks as described above will prevent any sudden 'shock' demands being placed on the local supply network. This is not expected to result in a reduction in household supply, or any temporary shortage of water. Therefore, while the likelihood is expected to remain certain, the severity is considered to be reduced to *negligible*. The residual impact is considered to be **low**.

### 6.10.3 Health & Safety Risks to the Local Community from Road Transport – Appendix A 10.3

6.304 During the exploration drilling period, there will be a need to use the local road network to transport workers associated with the drilling operations and also to transport drilling crew to/from the respective airports for their helicopter flights to the drilling unit offshore, or to MPA for their international flights.

6.305 The increased traffic has the potential to impact existing road users on the Islands, through temporary disruption from increased traffic congestion, and from the contribution to general wear and tear of the local road network used. An increase in traffic on the local road network also has the potential to result in an increased risk to community health and safety. The likelihood of the impact occurring is considered *certain*, as road transport will be required for workers. The severity of the impact is considered *minor*, as the impact will be temporary and short term over a short period of time. Before mitigation, the potential impact is considered to be **medium**.

#### Mitigation & Monitoring

6.306 Local transport companies will be used for all road transfers of offshore personnel. This will reduce health and safety risks, as local drivers will be familiar with local roads and local conditions.

6.307 Careful planning of transportation will be undertaken to ensure efficient use of vehicles and to reduce the number of trips required.

6.308 Onshore personnel will be given driving training appropriate to the local roads.

6.309 Complaints associated with the transport of work force and increased traffic will be monitored and dealt with through the Noble Community Feedback Mechanism. Should any major issues be identified that are causing community concern they will be raised with FIG and alternative solutions proposed and discussed.

#### Residual Impact

6.310 The use of local companies for all road transfers of personnel will reduce health and safety risks to the local community to acceptable levels, as local drivers will be familiar with local road conditions and dangers. Through careful planning of road transport logistics, the number of trips required will be reduced and the potential for significant wear and tear on the road network to occur. The likelihood of the impact will remain *certain*, however the above measures will ensure the severity of the impact will be reduced to *negligible*. The residual impact is therefore considered to be **low**.

## 6.11 Accidental Events

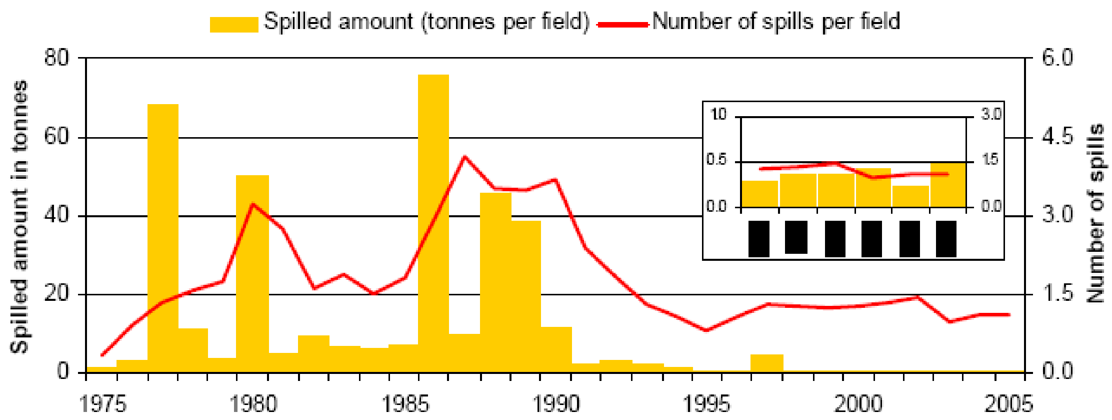
6.311 The main accidental event associated with the drilling operations is the accidental release of hydrocarbons.

### 6.11.1 Risk of Hydrocarbon Releases

6.312 The likelihood of a hydrocarbon release from a particular operation can be estimated from analysis of historic release data under similar conditions. As there is very little historical hydrocarbon release data from operations in the Falkland Islands, statistics are provided from the UK Continental Shelf (UKCS). Data is largely drawn from a report published by Oil and Gas UK; '*Report on the Analysis of DECC UKCS Oil Spill Data for the period 1975-2005*' (*UKOOA, 2006*). The report uses historical Department of Trade & Industry (DTI) oil spill data (1975-1997), historical Petroleum Operations Notice (PON) 1 spill reporting spreadsheets (1998-2005) and field information from the Brown Book, the Department of Energy and Climate Change (DECC) website and the OPL Field Development Guide. Although this data is specific to the UKCS, it is relevant to the proposed Noble drilling operations in the Falkland Islands, as the drilling contractor (Ocean Rig) operating culture, policies and procedures will be similar to UKCS standards.

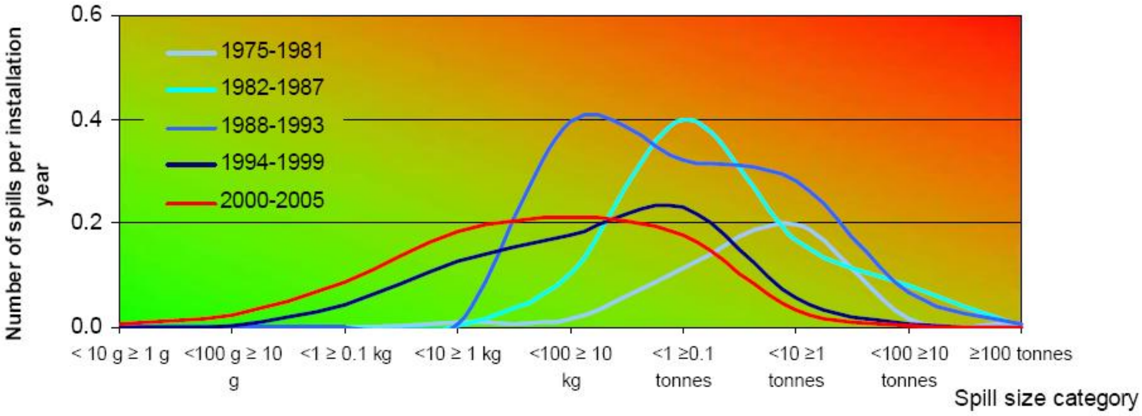
6.313 The likelihood of a hydrocarbon release occurring on the UKCS has increased over the period 1975 to 2005, as has the oil and gas activity. However, if the number of releases is normalised against the number of fields, the frequency of releases is seen to level off to approximately 1.5 per field (Figure 6.12).

***Figure 6.12: Number of hydrocarbon releases and amounts normalised by the number of fields in production (UKOOA, 2006)***



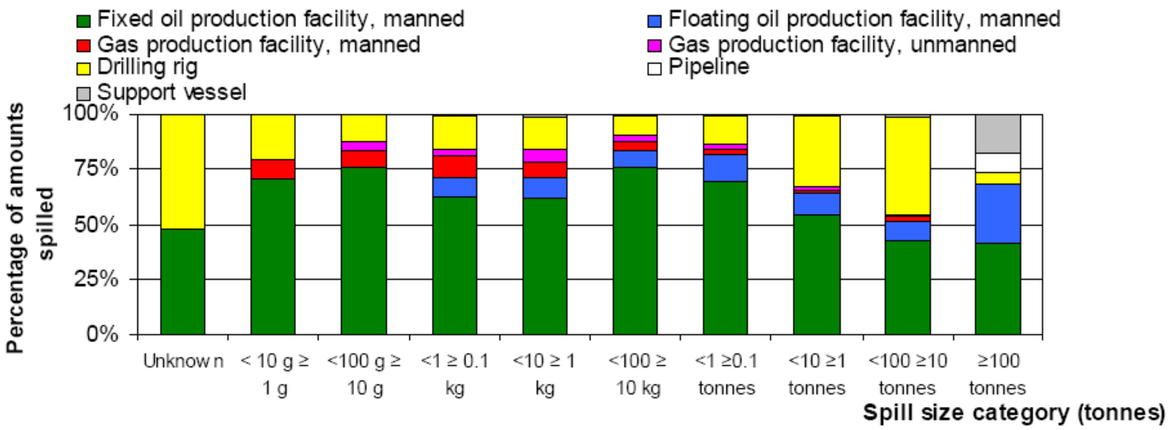

6.314 Figure 6.12 also indicates that the quantity of hydrocarbon released has decreased greatly during the 1990s. The Oil and Gas UK report (*UKOOA, 2006*) suggests this may be due to improved environmental management. The decrease in release volume in recent years on the UKCS is also highlighted by Figure 6.13, which shows that the distribution of spill sizes has shifted toward smaller volumes, with the most common hydrocarbon release size being between 0.1 tonnes and 1 tonne. There are also a significant number of releases between 0.0001 tonnes and 0.01 tonnes. This shift may be due to changes in reporting requirements; however it is reasonable to conclude from this data that releases of one tonne or less are the most likely.

***Figure 6.13: Distribution of hydrocarbon release size and likelihood (normalised per Field) (UKOOA, 2006)***




6.315 Large releases have become increasingly uncommon and Figure 6.13 indicates that this frequency has been close to zero in recent years. However, it can also be seen from Figure 6.14 that releases from drilling rigs make a significant contribution to those very large releases that do occur.

***Figure 6.14: Distribution of hydrocarbon release amounts amongst topsides types (UKOOA, 2006)***




6.316 Table 6.14 shows the number of oil releases on the UKCS greater than 100 tonnes that occurred in the UKOOA report period (1975-2005). It can be seen that, after 1997, no single incident involved an amount greater than 100 tonnes, suggesting that the number of larger incidents has significantly decreased from 1997 onwards.

*Table 6.14: Hydrocarbon releases greater than 100 tonnes in size from 1975-2005 (UKOOA, 2006)*

| Date of spill | Product spilled | Size of spill (tonnes) | Stated source and cause of pollution |
|---|---|---|---|
| 7th Jan 1977 | Crude oil | 528 | Loading buoy - cleaned by spraying, some discrepancy of amount. |
| 5th Sep 1977 | Crude oil | 396 | Flange parted during loading. Slick moved slowly, breaking in 20ft waves. |
| 28th June 1978 | Crude oil | 112 | Malfunction in separator level control and level alarm. |
| 6th April 1980 | Crude oil | 980 | Lost in pipeline rupture. Degraded and dispersed naturally. |
| 25th Nov 1986 | Oil based mud | 208 | Rig loosing stability, OBM dumped overboard. |
| 26th Nov 1986 | Crude oil | 3,000 | Spillage from pipeline. |
| 2nd July 1988 | Crude oil | 112 | Accidental discharge from platform, diverter valve failure to open. |
| 9th Sep 1988 | Crude oil | 750 | General oil releases following Piper Alpha incident. |
| 24th Dec 1988 | Crude oil | 1,504 | Floating Storage Unit, break away from subsea. |
| 7th Jul 1989 | Oil based mud | 240 | Oil based mud used in wrong section of well. |
| 13th August 1989 | Crude oil | 1,800 | Arising from planned de-oiling operation – flaring of recovered oil. |
| 1st Dec 1989 | Methanol | 120 | Loss of methanol during transfer operations. |
| 18th Jun 1990 | Crude oil | 112 | Possible open valve. |
| 24th Aug 1997 | Crude oil | 685 | Produced water system malfunction. |

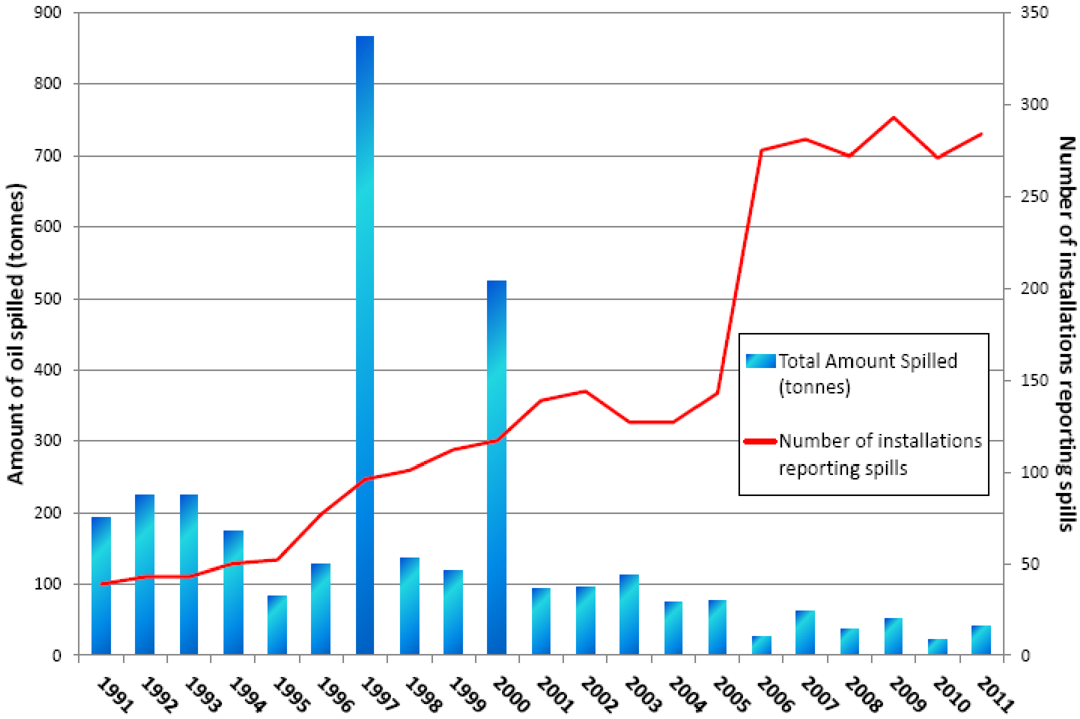
6.317 Table 6.16 shows hydrocarbon release data from 1997 to 2011 from DECC PON1 spill reporting data. This also suggests that the number of larger hydrocarbon release incidents has decreased in recent years, whilst the number of smaller release incidents involving quantities of less than 1 tonne has remained relatively high.

*Table 6.15: Hydrocarbon releases greater than 100 tonnes in size from 1997-2012 (DECC, 2014)*

| Year | Total amount of oil spilled (tonnes) | Number of spills>1 tonnes | Number of spills <1 tonnes | Comments |
|---|---|---|---|---|
| 1997 | 866 | 26 | 323 | Includes large spills of 685 tonnes, 29 tonnes and 36 tonnes. |
| 1998 | 137 | 14 | 378 | |
| 1999 | 120 | 21 | - | |
| 2000 | 524 | 18 | 405 | Hutton tension leg platform oil release. |
| 2001 | 94 | 17 | 419 | |
| 2002 | 96 | 18 | 463 | |
| 2003 | 113 | 10 | 365 | |
| 2004 | 75 | 13 | 425 | |
| 2005 | 75 | 10 | 256 | |
| 2006 | 27 | 4 | 271 | |
| 2007 | 63 | 10 | 271 | |
| 2008 | 37 | 8 | 264 | |
| 2009 | 51 | 8 | 285 | |
| 2010 | 154 | 6 | 265 | |
| 2011 | 42 | 9 | 275 | |
| 2012 | 40 | 8 | 240 | |

6.318 Figure 6.16 graphically illustrates these recent trends in hydrocarbon release history on the UKCS. It clearly shows that since 2000, the total amount of oil released has decreased. It also illustrates that the number of installations reporting hydrocarbon releases has increased, most probably due to increased awareness of DECC PON1 oil spill reporting requirements due to changes in legislation. The equivalent of the PON1 form in the Falkland Islands is the PON8 notification form, which provides the procedures and requirements for the reporting of oil pollution incidents.

*Figure 6.15: Amount of hydrocarbons released on the UKCS against total number of installations reporting spills (DECC, 2012)*




6.319 Table 6.16 also presents UKCS Health and Safety Executive (HSE) hydrocarbon release statistics for both fixed and mobile installations in terms of location, type of release and the release severity for the period 1st October 1992 to 31st March 2002 (*HSE, 2003*). This suggests that releases from fixed installations (accounting for 96.4% of total releases) are far more frequent than those from mobile installations (3.6% of total releases). It also suggests that, in terms of liquid hydrocarbons, smaller releases are the more frequent type of release.

*Table 6.16: Hydrocarbon release data by installation type and location on the UKCS for the period 1st October 1992 to 31st March 2002 (HSE, 2003)*

| INSTALLATION | | | | RELEASE TYPE | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TYPE | | 01/02 Population | | LIQUIDS | | | GAS | | | 2-PHASE | | | |
| | | Count[2] | Years[3] | MAJ[5] | SIG[6] | MIN[7] | MAJ[5] | SIG[6] | MIN[7] | MAJ[5] | SIG[6] | MIN[7] | TOTALS |
| **1. FIXED: 2,229 or 96.4% of TOTAL RELEASES** | | | | | | | | | | | | | |
| NNS[1] FIXED | Manned | 31 | 281.6 | 3 | 82 | 157 | 21 | 256 | 117 | 9 | 61 | 19 | **725** |
| | NUI | 3 | 28.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| CNS[1] FIXED | Manned | 43 | 339.8 | 1 | 106 | 195 | 30 | 258 | 114 | 7 | 52 | 6 | **769** |
| | NUI | 11 | 77.8 | 0 | 0 | 3 | 0 | 0 | 2 | 0 | 1 | 0 | **6** |
| SNS[1] FIXED | Manned | 76 | 661.2 | 2 | 30 | 47 | 18 | 107 | 40 | 0 | 3 | 0 | **247** |
| | NUI | 95 | 747.0 | 2 | 22 | 8 | 20 | 48 | 11 | 2 | 2 | 0 | **115** |
| FPS[4] | | 25 | 138.9 | 2 | 70 | 75 | 10 | 116 | 53 | 7 | 22 | 5 | **360** |
| Subsea | | 40 | - | 0 | 0 | 0 | 1 | 3 | 1 | 2 | 0 | 0 | **7** |
| TOTAL | | 324 | - | 10 | 310 | 485 | 100 | 788 | 338 | 27 | 141 | 30 | **2,229** |
| **2. MOBILES: 83 or 3.6% of TOTAL RELEASES** | | | | | | | | | | | | | |
| SEMI-SUB | NNS[1] | 21 | 159.3 | 3 | 8 | 2 | 0 | 3 | 0 | 1 | 1 | 0 | **18** |
| | CNS[1] | | | 0 | 6 | 3 | 1 | 5 | 2 | 2 | 3 | 0 | **22** |
| | SNS[1] | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| JACK-UP | NNS[1] | 16 | 127.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| | CNS[1] | | | 1 | 0 | 2 | 2 | 2 | 1 | 0 | 0 | 0 | **8** |
| | SNS[1] | | | 0 | 5 | 5 | 0 | 10 | 15 | 0 | 0 | 0 | **35** |
| TOTAL | | | | 4 | 19 | 12 | 3 | 20 | 18 | 3 | 4 | 0 | **83** |
| **GRAND TOTAL** | | | | **14** | **329** | **497** | **103** | **808** | **356** | **30** | **145** | **30** | **2,312** |

Notes:

1. Northern North Sea (NNS) = 59° N Latitude and above, Central North Sea (CNS) = between 56° N Latitude and 59° N Latitude, Southern North Sea (SNS) = 56$^{0}$ N Latitude and below. (incl. Irish Sea and English Channel).
2. 'Count' of fixed installation types comprises all installations of that type operating in that area of the UKCS as at 31st March 2002. 'Count' of mobile installations comprises known fleet operating in UK waters during 2001/2002. 'Count' of subsea installations comprises all known installations that have operated in the UKCS as at 31 March 2002, excluding single well satellite/tie-backs. Because of the small number of subsea releases, no calculation of subsea installation years has been undertaken.
3. 'Years' = estimated number of installation years (as at 31st March 2002) including those for installations abandoned since 1st October 1992.
4. 'FPS' includes FPSOs and FSUs.
5. 'MAJ' = Major Release; "*Potential to quickly impact out with the local area, e.g. affect the Temporary Refuge (TR), escape routes, escalate to other areas of the installation, causing serious injury or fatalities. A major leak, if ignited, would be likely to cause a "major accident", i.e. it would be of a size capable of causing multiple casualties or rapid escalation affecting TR, escape routes, etc.*".
6. 'SIG' = Significant Release; "*Potential to cause serious injury or fatality to personnel within the local area and to escalate within that local area, e.g. by causing structural damage, secondary leaks or damage to safety systems. A significant leak, if ignited, might have the potential to cause an event severe enough to be viewed as a "major accident" or be of a size leading to significant escalation within the immediate area or module*".
7. 'MIN' = Minor Release; "*Potential to cause serious injury to personnel in the immediate vicinity, but no potential to escalate or cause multiple fatalities. A minor leak, even if ignited, would not be expected to result in a multiple fatality event or significant escalation, but could cause serious injuries or a fatality local to the leak site or within that module only*".

6.320 During the exploration drilling programme, high standards of EHS performance will be maintained at all times through the implementation of site specific EHS plans. However, on rare occasions, an unplanned event could potentially jeopardise the safety of the personnel on board the drilling rig and OSVs and result in the accidental release of hydrocarbons. Potential non-routine events that could occur during the exploration drilling programme include:

- General operations involving the handling and day-to-day use of fluids;
- An emergency incident, such as a vessel collision; and
- An uncontrolled release of reservoir hydrocarbons (blow-out).

### General Operations Involving the Handling of Fluids

6.321 Unintentional releases from drilling operations can potentially occur through the day-to-day handling and transfer of fluid products used during the drilling programme, including diesel fuel, chemicals, hydraulic oil and lubricants.

6.322 The recent trends in hydrocarbon release history reported above suggest that accidental releases of small volumes of fluids associated with day-to-day operations represent the most likely source of unintentional releases from the drilling programme. Examples include the loss of small volumes of diesel fuel or lubricants during handling, use, or storage.

6.323 In addition to unintentional releases through the use, handling and storage of fluid products, various equipment and machinery that will be in use on board the drilling rig and OSVs also represents a possible source of leaks or unintentional releases, mainly of diesel and hydraulic oil.

### Emergency Incidents

6.324 An emergency incident, such as a collision, could potentially result in the entire inventory of hydrocarbons stored on the drilling rig (or OSVs) potentially being released to the sea. To serve as an example, for all floating offshore unit types engaged in exploration and production operations on the UKCS between 1990 and 2007, a total collision accident frequency of 0.011 occurrences per unit year was recorded (*OGUK, 2009*). For all fixed unit types on the UKCS during the same period, which includes drilling, production, wellhead, compression, pumping, injection/riser and accommodation type units, a total collision accident frequency of 0.0085 occurrences per unit year was recorded (*OGUK, 2009*). Due to the remote nature of the proposed exploration drilling locations, the equivalent figures offshore the Falkland Islands are expected to be much less.

6.325 If a collision between vessels involved in the operations, or with a third party vessel, was to occur, the vessels' inventories of diesel could potentially be released to the sea. In practice it is most likely that any release of hydrocarbons would occur over a period of time. An immediate release could, however, occur in the unlikely event that all compartment/tanks containing hydrocarbons were instantaneously fractured in some way.

### Uncontrolled Release of Reservoir Hydrocarbons (Blow-out)

6.326 An uncontrolled release of hydrocarbons could potentially result from the unlikely event of a serious well control incident.

6.327 Uncontrolled well flow can be caused by the formation pressures encountered being higher than the hydrostatic pressure exerted either by the drilling mud column or of the sea water. Typically this situation can be encountered in shallow gas pockets or in deeper over pressured formations. Over pressured gas can be exceptionally dangerous due to its extremely rapid expansion as it rises to surface, which can result in explosions and fires if an ignition source is found. Oil can also be over pressured, but liquid hydrocarbons expand far less than a gas as they rise to the surface. However, in an uncontrolled well flow situation, oil has the potential to cause considerably more pollution.

6.328 Incidents such as the Macondo exploration well blow-out in the US Gulf of Mexico in April 2010 and the Montara Platform wellhead blow-out off the northern coast of Western Australia in

August 2009, have served as an unfortunate reminder to the global offshore oil and gas industry of the possibility of serious well control situations occurring. However, it should be noted that despite these significant past events, blow-outs are still extremely rare occurrences. To serve as an example, for blowout incidents on the UKCS for the period 1990-2007, OGUK reports an occurrence frequency of 0.001 per unit year (*OGUK, 2009*).

6.329 In response to the above two incidents, the International Association of Oil & Gas Producers (OGP) established the Global Industry Response Group (GIRG) to identify, learn from and apply the lessons of Macondo, Montara and similar well accidents (*OGP, 2011*). This joint industry review process incorporated three main teams, focusing on prevention, intervention and response. Of particular relevance is the output of the Well Engineering Design & Equipment/Operating Procedures Team, which focused specifically on incident prevention. Following the review process, general industry-wide recommendations were made on well control incident prevention:

- Creation of a new, permanent, OGP Wells Expert Committee;
- Introduction of a 3-tier review process;
- The promotion of human competency management systems to ensure individual staff and management teams always have the skills they need;
- The promotion of an operational culture that fosters adherence to standards and procedures;
- Recognition of existing internationally and nationally agreed standards as a baseline for industry improvements (see Table 6.30);
- New and improved technical and operational practices for the overall governance of well construction; and
- Recommend to industry and regulators that a “two barrier” (independent and physical) policy is in place during the life of a well (during the drilling, completion, and abandonment phases of a well. A Blowout Preventer (BOP) to be regarded as a barrier for the purposes of such a policy.

6.330 Despite their rarity and unlikely event of occurrence, very large spills resulting from blow-outs cannot be ruled out and as such, as a contingency for planning purposes, oil spill modelling has been conducted to assess the potential impact from such an event.

### 6.11.2 Oil Spill Modelling Study

6.331 In order to assess the potential impact in the unlikely event of a significant hydrocarbon release, an oil spill modelling study has been conducted using SIMAP. SIMAP is a computer modelling software application that estimates physical fates and biological effects of releases of oil. In SIMAP, both the physical fates and biological effects models are three-dimensional. There is also a two-dimensional oil spill model for quick trajectories and screening of scenarios and a three-dimensional stochastic model for risk assessment and contingency planning applications. The models are coupled to a geographic information system (GIS), which contains environmental and biological data, and also to databases of physical-chemical properties and biological abundance, containing necessary inputs for the models.

6.332 A number of scenarios have been modelled and include both 2-Dimensional (2D) and 3-Dimensional (3D) scenarios. The results of the oil spill modelling study are given below, and the report is attached in Appendix I.

### Oil Spill Modelling Inputs

#### *Metocean Environmental Data*

6.333 A detailed metocean environmental data analysis was conducted (Appendix L) in support of the modelling inputs for the oil spill modelling study. The environmental datasets used for the modelling study included the following:

- Water temperature and salinity dataset, WOA-13 (World Ocean Atlas 2013), hosted by the National Oceanographic and Atmospheric Administration;
- Wind dataset, NOGAPS (Navy Operational Global Atmospheric Prediction System), a product of the United States Navy; and
- Current dataset, HYCOM (HYbrid Coordinate Ocean Model), a product of the National Oceanographic Partnership Program.

6.334 The above metocean data sources used in the oil spill modelling study are described in Appendix L.

#### *Modelling Parameters*

6.335 The expected crude oil density from the explorations wells lies within the range of 35-40 API. A light crude with the characteristics shown Table 6.17 was selected for the spill modelling, as this most closely matched the characteristics of the expected crude provided by Noble, determined through the initial reservoir modelling. A generic diesel fuel was selected for the diesel release scenarios.

6.336 Table 6.18 displays the uncontrolled release conditions used in the subsurface (3D) simulations. The gas to oil ratio (GoR), opening diameter and discharge temperature were taken from preliminary reservoir hydrocarbon models conducted by Noble.

6.337 Table 6.19 displays the simulation periods used. These periods were selected after seasonality analysis of the metocean data.

***Table 6.17: Summary of oil properties used in the simulations***

| Oil Type | API Gravity (°) | Viscosity (cP at 25°C) | Interface Tension (dyne/cm) | Emulsion maximum Water Content (%) |
|---|---|---|---|---|
| Light Crude | 38.9 | 4.00 | 26.1 | 89.6 |
| Diesel | 38.8 | 2.76 | 27.5 | 0 |

***Table 6.18: Uncontrolled release (blowout) conditions used in the subsurface simulations***

| Site | Water Depth of the release (m) | Gas to Oil Ratio (scf/bbl) | Opening Diameter (inches) | Discharge Temperature (°C) |
|---|---|---|---|---|
| FISA12 | 1,177 | 600 scf/bbl | 13.375” | 104 |
| FIST13 | 1,527 | 600 scf/bbl | 13.375” | 104 |

***Table 6.19: Seasonal simulation periods used in the simulations***

| Period | Months to Use |
|---|---|
| Period 1: Austral Summer | October - February |
| Period 2: Austral Winter | March - September |

### The SIMAP Programme

6.338 For the oil spill modelling scenarios, both stochastic and deterministic scenarios have been simulated.

#### *Stochastic Modelling*

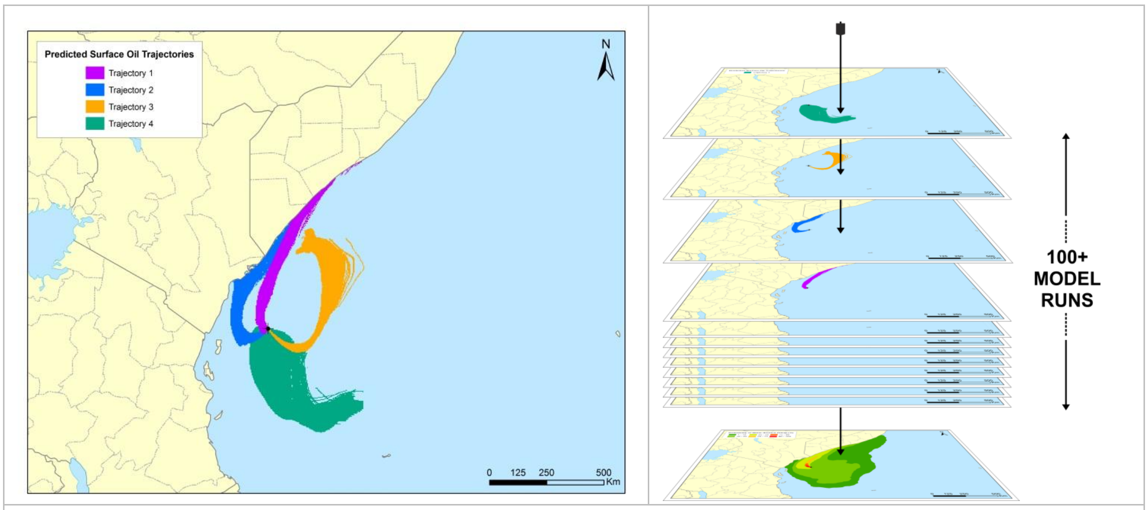
6.339 Stochastic simulations provide insight into the probable behaviour of potential oil spills in response to temporally and spatially varying meteorological and oceanographic conditions in the study area. The stochastic model compiles surface trajectories from the results of an ensemble of hundreds of individual deterministic modelling cases for each stochastic spill scenario. The simulation start time of each individual deterministic modelling case is selected randomly within the specified seasonal timeframe (in this case, October to February for summer, and March to September for winter), thus sampling the natural variability in the wind and current forcing.

6.340 In a stochastic modelling operation, SIMAP will first run each of the individual deterministic modelling cases (Figure 6.16). It will then compile the results of all the deterministic cases to produce a statistical analysis of the results, which forms the basis of the stochastic model output. The stochastic modelling output provides two types of information:

- (1) The footprint of sea surface areas that the model predicts will become oiled and the associated probability of oiling (e.g. Figure 6.17); and
- (2) The predicted shortest time for oil to reach any point within the areas predicted to be oiled.

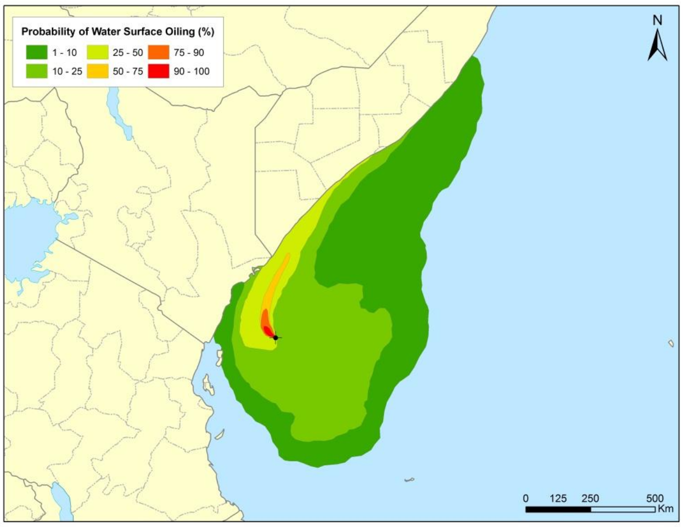
6.341 The probabilities of oiling and the stochastic footprint are generated by the statistical analysis performed by SIMAP during the stochastic modelling process. The footprint is the sum of the swept area of each individual deterministic modelling case (Figure 6.16). It is important to note that a single deterministic modelling case will represent only a relatively small portion of the total footprint. The stochastic modelling simulations are also able to provide shoreline oiling data, expressed in terms of the percentage of simulations in which oil is predicted to reach shore, together with the minimum and average beaching times.

***Figure 6.16: Example stochastic modelling scenario showing four individual deterministic spill trajectories predicted by SIMAP***




The swept area and frequency of contact with given locations is used to calculate the probability of impacts during a spill. Essentially, all 100+ model runs are overlain and compiled by SIMAP (shown as the stacked runs on the right) and the number of times that a trajectory reaches a given location is used to calculate the probability of oiling for that location.

Figure 6.17: Example stochastic model output; Predicted probability of water surface oiling (%)




This figure is the result of the overlay and compiling process of the 100+ individual deterministic model cases to calculate the probability of water surface oiling in the study area. It is important to note that this figure does not depict the areal extent of a single model run/spill.

### *Deterministic Modelling*

6.342 The individual deterministic cases from the stochastic analysis for each spill scenario can be further evaluated to select a *worst case* scenario to be analysed in more detail by performing a single worst case deterministic trajectory/fate simulation. This worst case scenario is selected from the pool of the results of the 100+ deterministic simulations used in the stochastic model.

6.343 The worst case scenario is normally selected based on the degree of shoreline oiling. Different parameters or indicators can be used to compare and assess the degree of shoreline oiling, for example, "*time to reach the coast*", "*total oil volume to reach the coast*" or "*total length of oiled coastline*". Often, a combination of these parameters is used to choose the worst case, which is usually the individual deterministic case with one of the largest volumes of shoreline oiling with oil reaching the coast in the shortest time possible. The exact criteria for choosing the worst case may be slightly different each time depending on the stochastic modelling results, but selection of the worst case deterministic scenario is always based upon the fact that it will be a scenario where a large protection and/or clean-up response would be necessary.

6.344 Definition of the worst case trajectory scenario in this way is beneficial, as it is based on the historical database of real wind and current data for the study area. The selected worst case scenario is therefore based on real wind and current conditions that have actually occurred previously in the study area. This means that the selected worst case scenario has already taken into account the natural variability in meteorological conditions in the study area. It also means that the specific meteorological conditions that have produced the worst case deterministic scenario are credible and validated, as the conditions have actually occurred previously within the study area.

6.345 Traditionally, a worst case wind speed and constant wind direction have been used to define a worst case deterministic (trajectory) scenario. However, this method is not robust and may produce invalid results. This method is not based on background data which proves that the selected constant wind direction and wind speed have actually occurred previously within the study area for any length of time. In addition, selecting a constant wind direction and speed may not in itself give rise to the worst case scenario in terms of oil reaching the coastline; there may be other factors such as other combinations of wind speed, wind direction and current conditions, which may give rise to a worst case oil beaching scenario.

6.346 Thirty knot wind scenarios with a constant direction are currently the defined worst case scenarios for oil spill modelling required by the UK Department of Energy and Climate Change

(DECC) oil pollution emergency planning guidelines (July 2012 version). Since the incidents of the Montara wellhead platform and the Macondo Deepwater Horizon accident, there has been an increased focus encouraged by DECC on oil spill preparedness. A large part of preparedness efforts is oil spill contingency planning. Therefore, DECC has implemented a number of changes in the guidelines for oil pollution emergency plans (OPEPs). A key part of this process were changes made to the oil spill modelling guidelines over the past few years, in the form of letters issued to industry and a revised set of guidelines issued in July 2012. Further changes to the guidelines are also proposed. One of the elements that the focus group looked at was the requirement for 30 knot wind scenarios. A number of questions were raised as to where this requirement originally came from and its scientific basis. It became apparent that there was no record of how this requirement had been arrived at. After other detailed considerations, mainly based on the relevance of the current OPEP guidance notes to the latest oil spill models (and one oil spill model in particular previously used extensively by the oil and gas industry in the UKCS which has recently become obsolete and is no longer supported by the manufacturer), it has been decided by the focus group that the 30 knot wind scenarios shall be dropped from future revisions of the guidance notes. The likely form of the future OPEP guidance notes is currently out for consultation, but it is clear that the 30 knot wind scenarios are not part of these draft guidelines. It is intended that the guidelines will be implemented during 2015 alongside any legislative changes required to both safety and environmental regulations in order to bring the UKCS regulatory regime fully in line with the requirements of the aforementioned Offshore Safety Directive.

6.347 Therefore, the 30 knot wind with a constant direction scenario has not been utilised as the worst case scenario in this modelling study. Instead, using the available information a worst case scenario has been defined using the available information from individual deterministic cases from the stochastic analysis for each spill scenario. As previously stated, the selected worst case scenario is therefore based on real wind and current conditions that have actually occurred previously in the study area, rather than a pre-defined criteria which does not appear to have any scientific basis. This means that the selected worst case scenario has already taken into account the natural variability in meteorological conditions in the study area and the specific meteorological conditions that have produced the worst case deterministic scenario are credible and validated.

6.348 The chosen worst case scenario is then run again through a deterministic trajectory/fate simulation, to further investigate the single specific worst case spill event that could potentially occur, using the same combination of winds and current forcing used in the corresponding stochastic simulation from which it was identified. Further information on the worst case scenario can then be obtained from the results of this single deterministic simulation.

### *Modelling Limitations*

6.349 SIMAP is a comprehensive modelling system that assesses impacts due to oil spills, surface or seabed releases. The modelling system has been developed and improved over the past two decades to include as much information as possible to simulate the fates and effects of oil spills. Typically, assumptions based on available scientific information and professional judgment are made in the development of the output models, which represents a best assessment of the processes and potential mechanisms for effects (consequences) that would result from oil spills.

6.350 As with any other numerical tool, the model has limitations. These limitations are taken into account when performing a modelling analysis and are related to the fact that input data intrinsically contain uncertainties. Additionally, as with most science disciplines, the ability to simulate the detailed behaviour of organisms and ecosystems is a challenge.

6.351 The major sources of uncertainty in the oil fates and biological effects model are:

- Oil contains thousands of chemicals of varying physical and chemical properties that determine their fate in the environment. In addition, those chemicals (their properties) change over time. The model must treat the oil as a mixture of a limited number of hydrocarbon components, grouping chemicals by physical-chemical properties.

- The fates model contains a series of algorithms that are simplifications of complex physical-chemical processes. These processes are understood to varying degrees, but can dramatically vary depending on the environmental conditions (e.g. cold versus warm waters).
- Organisms are assumed uniformly distributed in the affected habitats they occupy for the duration of the spill simulation. The accuracy of this assumption varies between organisms, but the objective is to assess potential effects for an average-expected condition, which is what this assumption most closely resembles.
- Biological effects are quantified based on acute exposure and toxicity of contaminant concentrations as a function of degree and duration of exposure. The SIMAP model used is not designed to address long-term, chronic exposure to pollutants.
- The model treats each spill as an isolated pollution event and does not account for any potential cumulative effects.
- Various physical/environmental parameters including depth/sea bottom roughness, total suspended solids concentration, etc. were not sampled extensively at each location of the extended domain (hundreds of square kilometres). What limited data that did exist was applied to each location, leading to a certain degree of homogenisation of the environmental (marine/coastal) conditions.
- As in any other modelling exercise, when setting up the oil spill model, many 'preliminary test cases' are performed to understand the particularities of the spill scenarios to be simulated, testing the sensitivity of the different model inputs and parameters (e.g. resolution of the grids, model time steps, etc). By doing this sensitive analysis, we can evaluate and control the degree of uncertainties of the different modelling inputs.

6.352 In addition, in any given oil spill, the fates and effects will be highly related to the specific environmental conditions, the precise locations of organisms, and a myriad of details related to the event. Thus, the results are a function of the scenarios simulated and the accuracy of the input data used. The goal of this study was not to capture every detail that could potentially occur, but to describe the range of possible consequences so that an informed analysis can be made as to the likely effects of spills under various scenarios. The model inputs are designed to provide representative conditions to such an analysis. Thus, the modelling is used to provide quantitative guidance in the analysis of the spill scenarios being considered. In addition, and in order to cover for existing uncertainties in the input data (e.g. winds, currents), the stochastic approaches allow for the ability to sample through longer time series and account for the uncertainty/variability of the environmental forcings. From this stochastic analysis, a worst case event is selected from the stochastic ensemble, depicting a very particular event that aims at maximizing the potential impact into specific targets (e.g. coastal oiling). This conservative approach helps in 'overcoming' the uncertainties of the modelling.

6.353 In addition to the above, there are a number of general limitations to consider when interpreting the modelling outputs from SIMAP, in particular:

- Modelling results are to be used for guidance purposes only and response strategies should not be based solely on modelling results alone.
- The resolution/quality of tidal and oceanic current data varies between regions and models. As with any other model, results are dependent on the quality of the environmental parameters and scenario inputs used. Information on the hydrodynamic and wind inputs is provided in the metocean report in Appendix L.
- The properties of the oil in the model's database may not precisely match those of the product spilled, although every effort has been made to select the most appropriate oil, particularly in terms of its weathering characteristics, where a conservative approach has been used.

- The properties and behaviour of the oils spilt in a dynamic marine environment may vary to those outputs produced using data held within the SIMAP programme. This is likely with all oils in the database and is intrinsic to all modelling.
- If the same scenario was conducted in another oil spill modelling programme of different manufacture, with identical parameters and inputs, the results may show a degree of variance. This is expected as the different fate and weathering models have been developed and programmed independently.
- Each oil in the SIMAP database is characterised from data obtained from the respective crude oil assay. The software uses the data in various algorithms to simulate the behaviour of the oil when spilled. Therefore, in consideration of the above, the information provided in the model outputs is illustrative only and is not intended to be relied upon in the event of a real oil spill incident. Actual aerial surveillance data should always be used over modelling outputs in a real oil spill situation to determine the fate of an oil spill.

### Stochastic Oil Spill Modelling Results

6.354 The spill modelling scenarios were all run from the centre of both the FISA12 and FIST13 areas. A number of stochastic spill modelling scenarios were run. These are each explained and presented below along with their results.

6.355 A number of figures are presented alongside the modelling results that illustrate the spatial extent of surface and shoreline oiling probabilities and associated minimum travel times for the spills. Only oiling above a threshold of 0.04 µm is included. This is the threshold for the visible appearance of oil sheen on the water surface, according to the Bonn Agreement oil appearance code.

6.356 For each scenario, at least two figures are presented:

- **Probability of surface oil exceeding 0.04 µm:** The map defines the area in which sea surface oil has at least a 1% chance to exceed 0.04 µm and the associated probability of exceeding the threshold based on analysis of the resulting trajectories from the ensemble of individual simulations run for each spill scenario. The map does not imply that the entire contoured area would be covered with oil in the event of a spill. The map also does not provide any information on the amount of oil in a given area.
- **Minimum time for surface oil to exceed 0.04 µm:** The footprint on this map corresponds to the surface probability map, and illustrates the shortest time required for oil to reach any point within the footprint. These results are also based on the ensemble of all individual simulations.

6.357 For scenarios where there is a model-predicted potential for shoreline oiling, two additional figures are presented:

- **Probability of shoreline oil exceeding 0.04 µm:** The map defines the area in which beached oil has at least a 1% chance to exceed 0.04 µm and the associated probability of exceeding the threshold based on analysis of the resulting trajectories from the ensemble of individual simulations run for each spill scenario. The map does not imply that the entire area would be covered with oil in the event of a spill. The map also does not provide any information on the amount of oil in a given area. In the absence of data, all shoreline segments are assumed to be 10 metre wide sandy beaches. Using actual shoreline data may alter the results, but the results provided are likely on the conservative side for shoreline impacts.
- **Minimum time for shoreline oil to exceed 0.04 µm:** The footprint on this map corresponds to the shoreline probability map, and illustrates the shortest time required for oil to reach any point within the footprint. These results are also based on the ensemble of all individual simulations. In the absence of data, all shoreline segments are

assumed to be 10 metre wide sandy beaches. Using actual shoreline data may alter the results, but the results provided are likely on the conservative side for shoreline impacts.

### *Diesel Stochastic Oil Spill Modelling Results*

6.358 Diesel stochastic oil spill modelling was conducted to determine the fate of a large unintentional release of hydrocarbons to the marine environment, representing a catastrophic failure of the fuel oil tanks on board the drilling rig. A number of stochastic scenarios were modelled and are displayed in Table 6.20. Modelling for two seasonal periods was conducted (refer to Table 6.18) to examine any potential effects of seasonality. The results of the diesel stochastic modelling scenarios are displayed in Table 6.21 and in Figures 6.18 to 6.21.

*Table 6.20: Diesel stochastic oil spill modelling scenarios*

| Scenario ID | Spill Site | Spill Event | Oil Type | Period (month) | Spill Rate | Spill Duration | Total Spilled Volume | Simulation Duration |
|---|---|---|---|---|---|---|---|---|
| 1 | FISA12 | Drilling Rig Fuel Oil Inventory | Diesel | Period 1 (10-2) | Instant | Instant | 4,631 $m^3$ | 14 Days |
| 2 | FISA12 | Drilling Rig Fuel Oil Inventory | Diesel | Period 2 (3-9) | Instant | Instant | 4,631 $m^3$ | 14 Days |
| 3 | FIST13 | Drilling Rig Fuel Oil Inventory | Diesel | Period 1 (10-2) | Instant | Instant | 4,631 $m^3$ | 14 Days |
| 4 | FIST13 | Drilling Rig Fuel Oil Inventory | Diesel | Period 2 (3-9) | Instant | Instant | 4,631 $m^3$ | 14 Days |

*Table 6.21: Diesel stochastic oil spill modelling results*

| Scenario ID (Figure) | Spill Site | Oil Type | Spill Type | Simulation Period | Total Volume Released | Sims. Reaching Shore (%) | Time to Reach Shore (days) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Min. | Avg. |
| 1 (6.18) | FISA12 | Diesel | Drilling Rig Fuel Oil Inventory | Period 1 (10-2) | 4,631 $m^3$ | 0 | - | - |
| 2 (6.19) | FISA12 | Diesel | Drilling Rig Fuel Oil Inventory | Period 2 (3-9) | 4,631 $m^3$ | 0 | - | - |
| 3 (6.20) | FIST13 | Diesel | Drilling Rig Fuel Oil Inventory | Period 1 (10-2) | 4,631 $m^3$ | 0 | - | - |
| 4 (6.21) | FIST13 | Diesel | Drilling Rig Fuel Oil Inventory | Period 2 (3-9) | 4,631 $m^3$ | 0 | - | - |

*Figure 6.18: Stochastic scenario 1 (instantaneous 4,631 $m^3$ diesel spill from the centre of FISA12 from October to February [summer]); maps for potential water surface contamination*

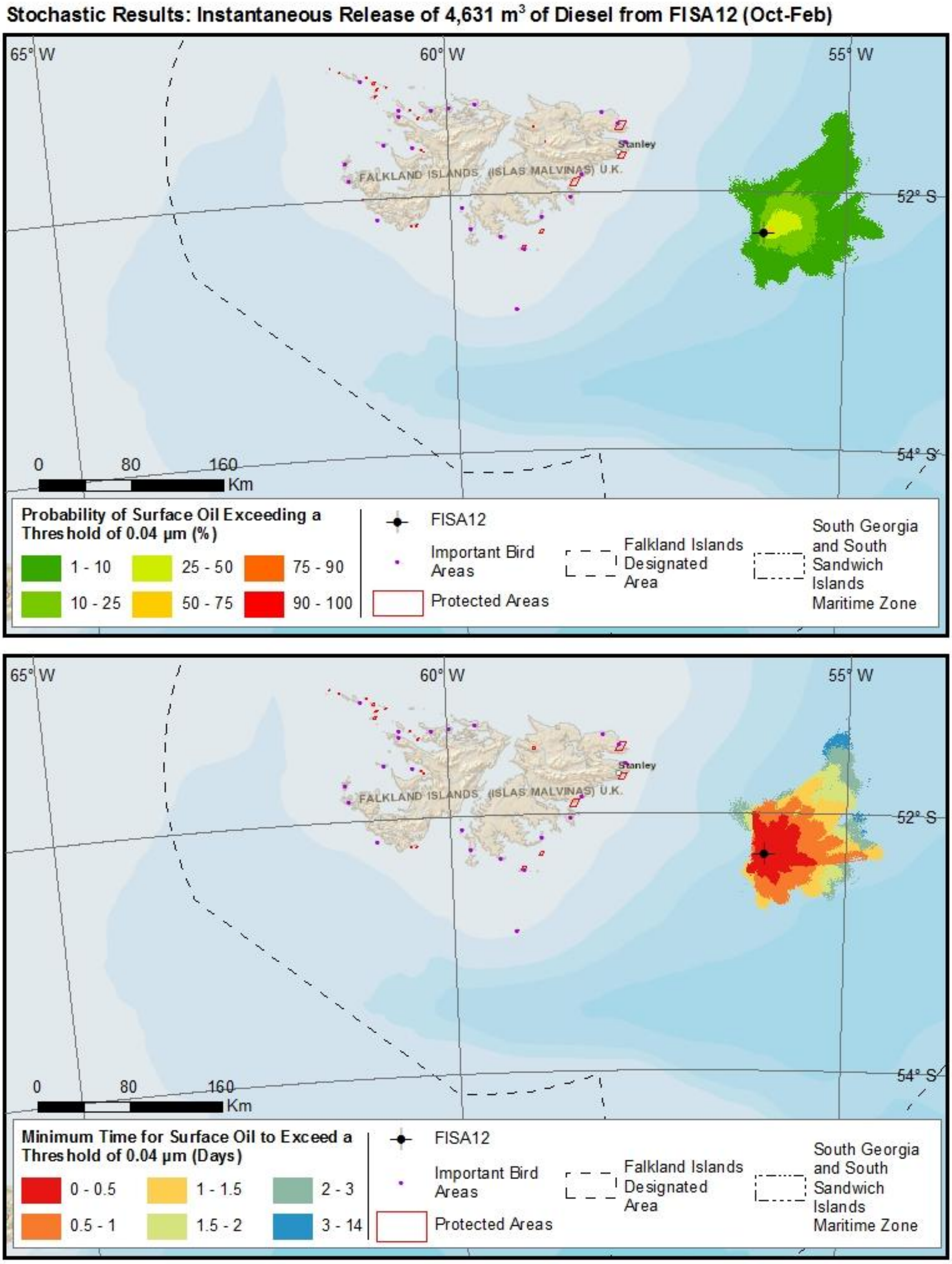


*Figure 6.19: Stochastic scenario 2 (instantaneous 4,631 m³ diesel spill from the centre of FISA12 from March to September [winter]); maps for potential water surface contamination*

Stochastic Results: Instantaneous Release of 4,631 m³ of Diesel from FISA12 (Mar-Sep)

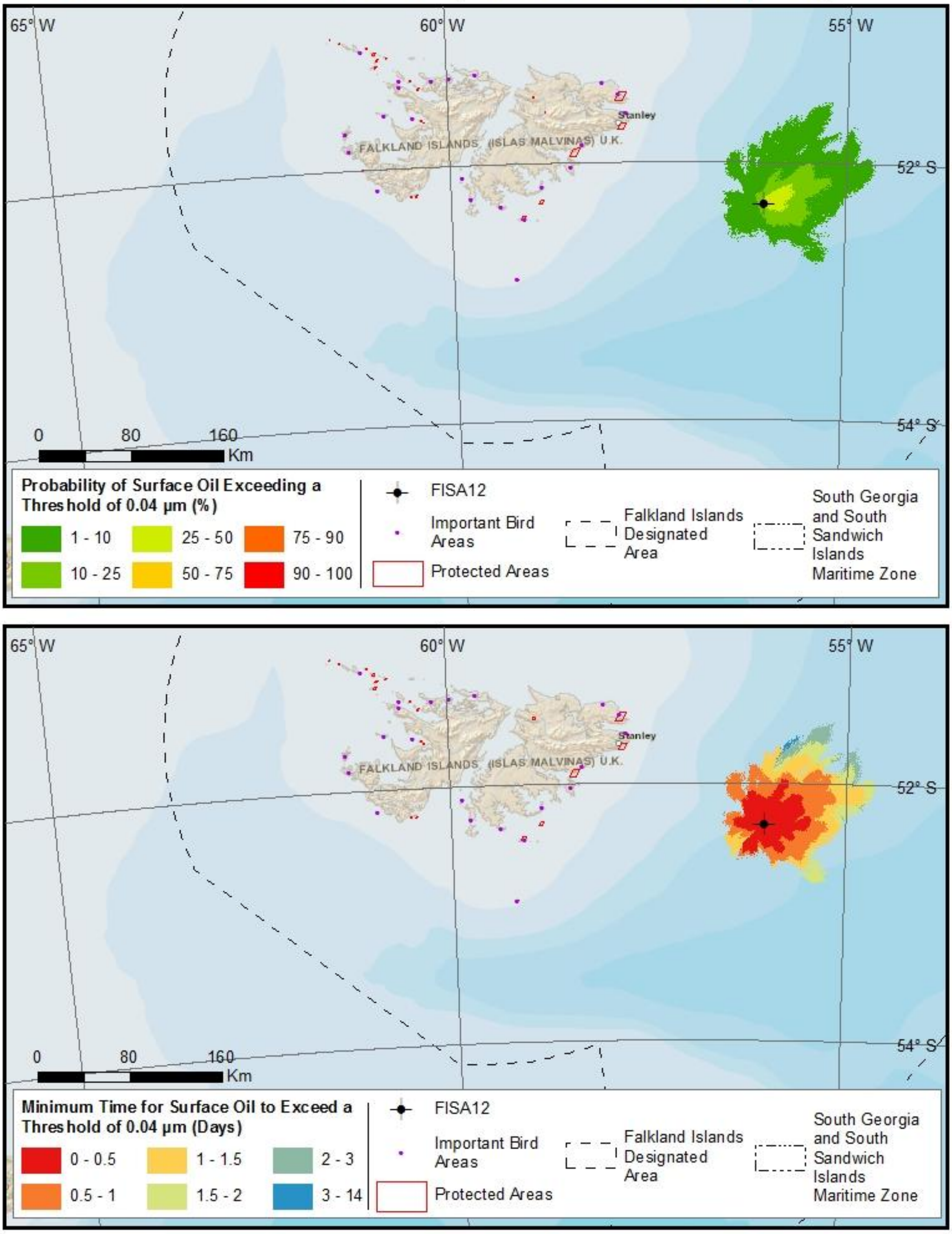


*Figure 6.20: Stochastic scenario 3 (instantaneous 4,631 m³ diesel spill from the centre of FIST13 from October to February [summer]); maps for potential water surface contamination*

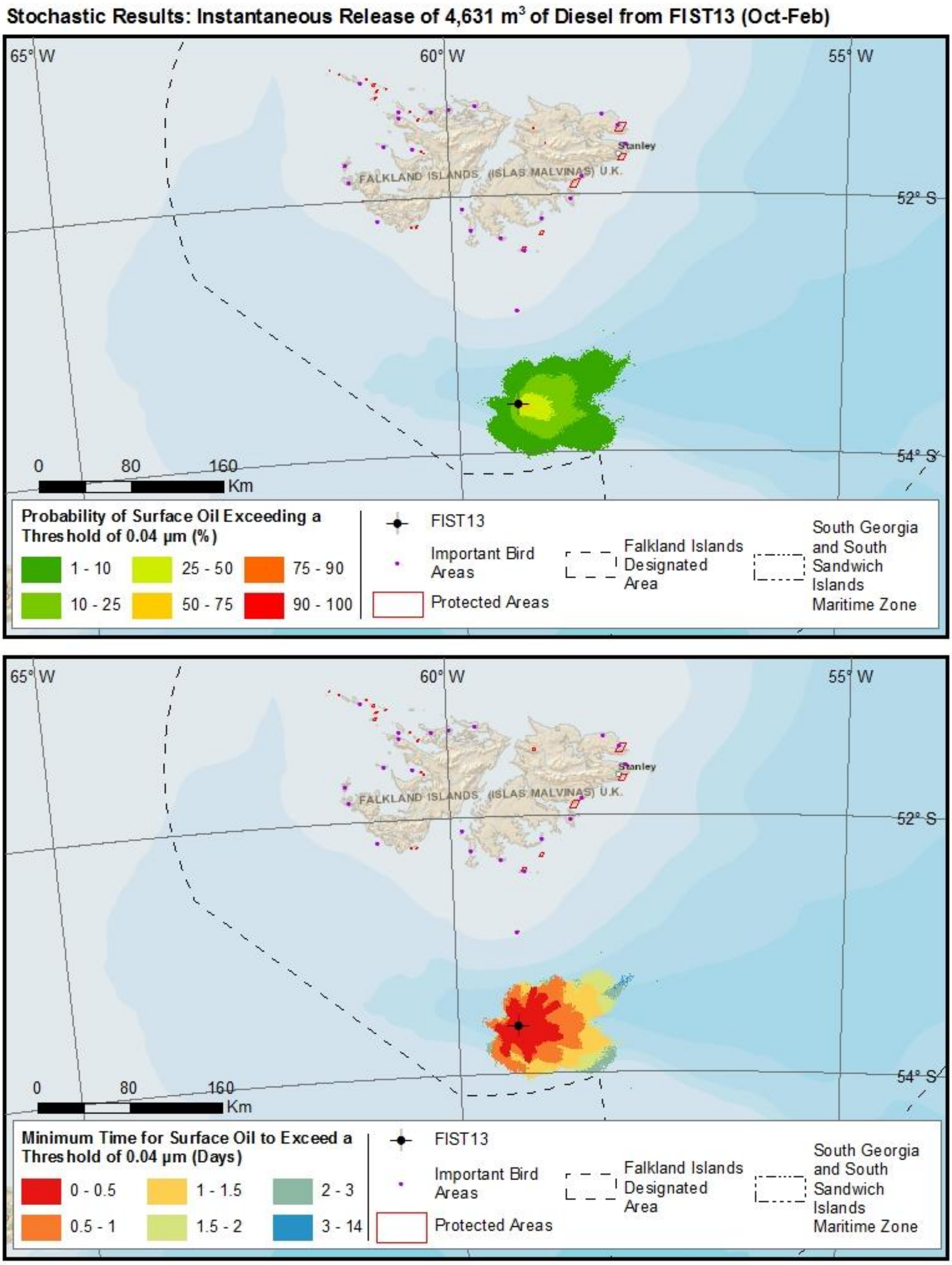
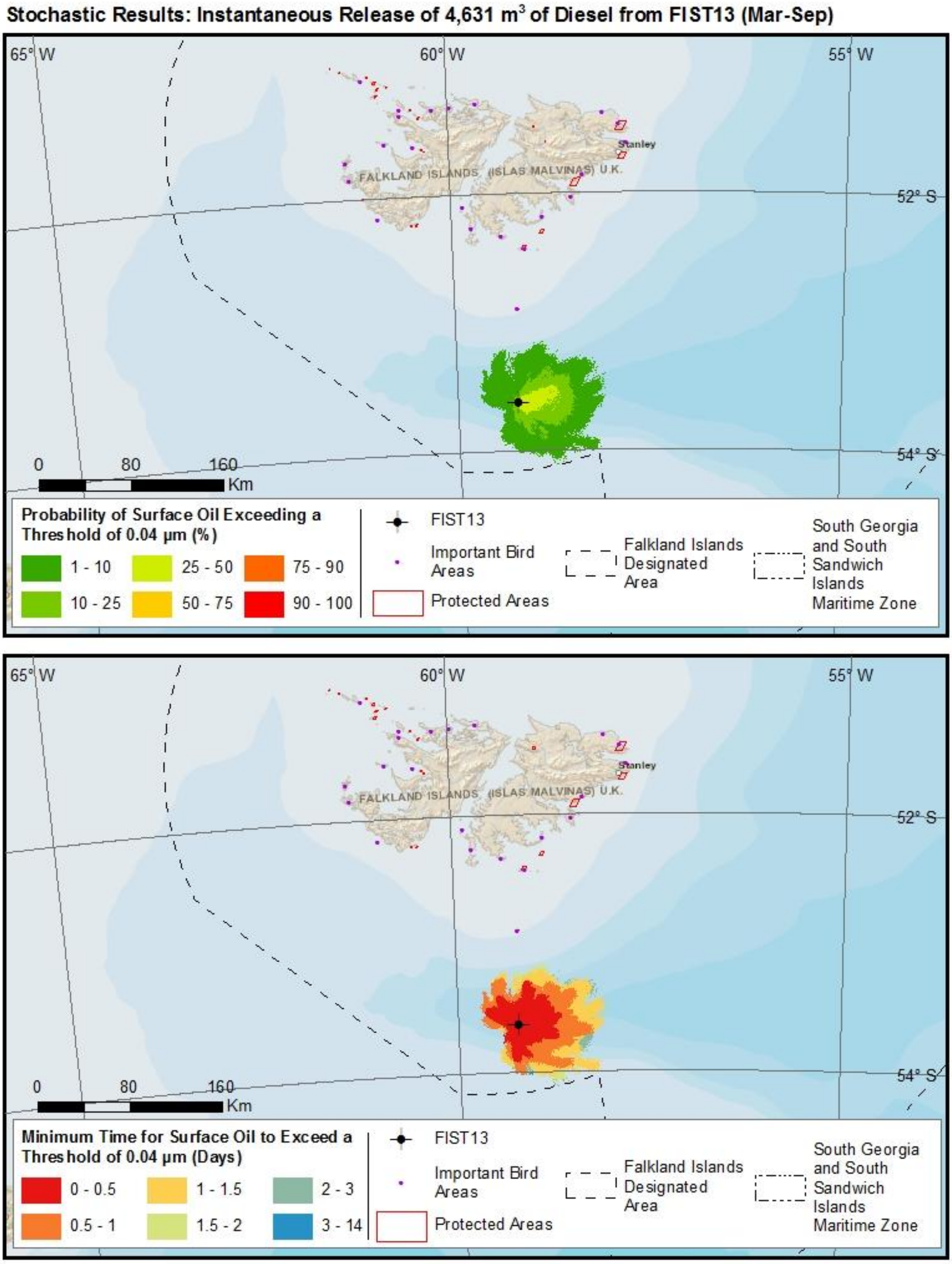


*Figure 6.21: Stochastic scenario 4 (instantaneous 4,631 m³ diesel spill from the centre of FIST13 from March to September [summer]); maps for potential water surface contamination*



### Crude Oil Surface (2D) Stochastic Oil Spill Modelling Results

6.359 2D crude oil stochastic spill modelling was conducted to determine the fate of a large unintentional release of hydrocarbons to the marine environment, representing an uncontrolled release of hydrocarbons (blowout) from the wellbore. This scenario represents catastrophic failure of the barriers in the wellbore and BOP equipment, but with the drilling rig still in communication with the riser, resulting in crude oil being released at the sea surface. A spill rate of 50,071 barrels per day was used, obtained from preliminary reservoir modelling conducted by Noble.

6.360 A number of stochastic scenarios were modelled and are displayed in Table 6.22. Modelling for two seasonal periods was conducted (refer to Table 6.18) to examine any potential effects of seasonality. The results of the crude oil stochastic modelling scenarios are displayed in Table 6.23 and in Figures 6.22 to 6.28.

***Table 6.22: Crude oil surface (2D) stochastic oil spill modelling scenarios***

| Scenario ID | Spill Site | Spill Event | Oil Type | Period (month) | Spill Rate | Spill Duration | Total Spilled Volume | Simulation Duration |
|---|---|---|---|---|---|---|---|---|
| 5 | FISA12 | Surface Blowout | Crude Oil | Period 1 (10-2) | 50,071 bbl/d | 10 days | 500,710 bbl | 30 Days |
| 6 | FISA12 | Surface Blowout | Crude Oil | Period 2 (3-9) | 50,071 bbl/d | 10 days | 500,710 bbl | 30 Days |
| 7 | FIST13 | Surface Blowout | Crude Oil | Period 1 (10-2) | 50,071 bbl/d | 10 days | 500,710 bbl | 30 Days |
| 8 | FIST13 | Surface Blowout | Crude Oil | Period 2 (3-9) | 50,071 bbl/d | 10 days | 500,710 bbl | 30 Days |

***Table 6.23: Crude oil surface (2D) stochastic oil spill modelling results***

| Scenario ID (Figure) | Spill Site | Oil Type | Spill Type | Simulation Period | Total Volume Released | Sims. Reaching Shore (%) | Time to Reach Shore (days) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Min. | Avg. |
| 5 (6.22) | FISA12 | Crude Oil | Surface Blowout | Period 1 (10-2) | 500,710 bbl | 0 | - | - |
| 6 (6.23, & 6.24) | FISA12 | Crude Oil | Surface Blowout | Period 2 (3-9) | 500,710 bbl | 2 | 10.0 | 10.5 |
| 7 (6.25 & 6.26) | FIST13 | Crude Oil | Surface Blowout | Period 1 (10-2) | 500,710 bbl | 13 | 1.7 | 16.3 |
| 8 (6.27 & 6.28) | FIST13 | Crude Oil | Surface Blowout | Period 2 (3-9) | 500,710 bbl | 32 | 1.7 | 10.2 |

*Figure 6.22: Stochastic scenario 5 (50,071 bopd crude oil spill surface release for 10 days from the centre of FISA12 from October to February [summer]); maps for potential water surface contamination*

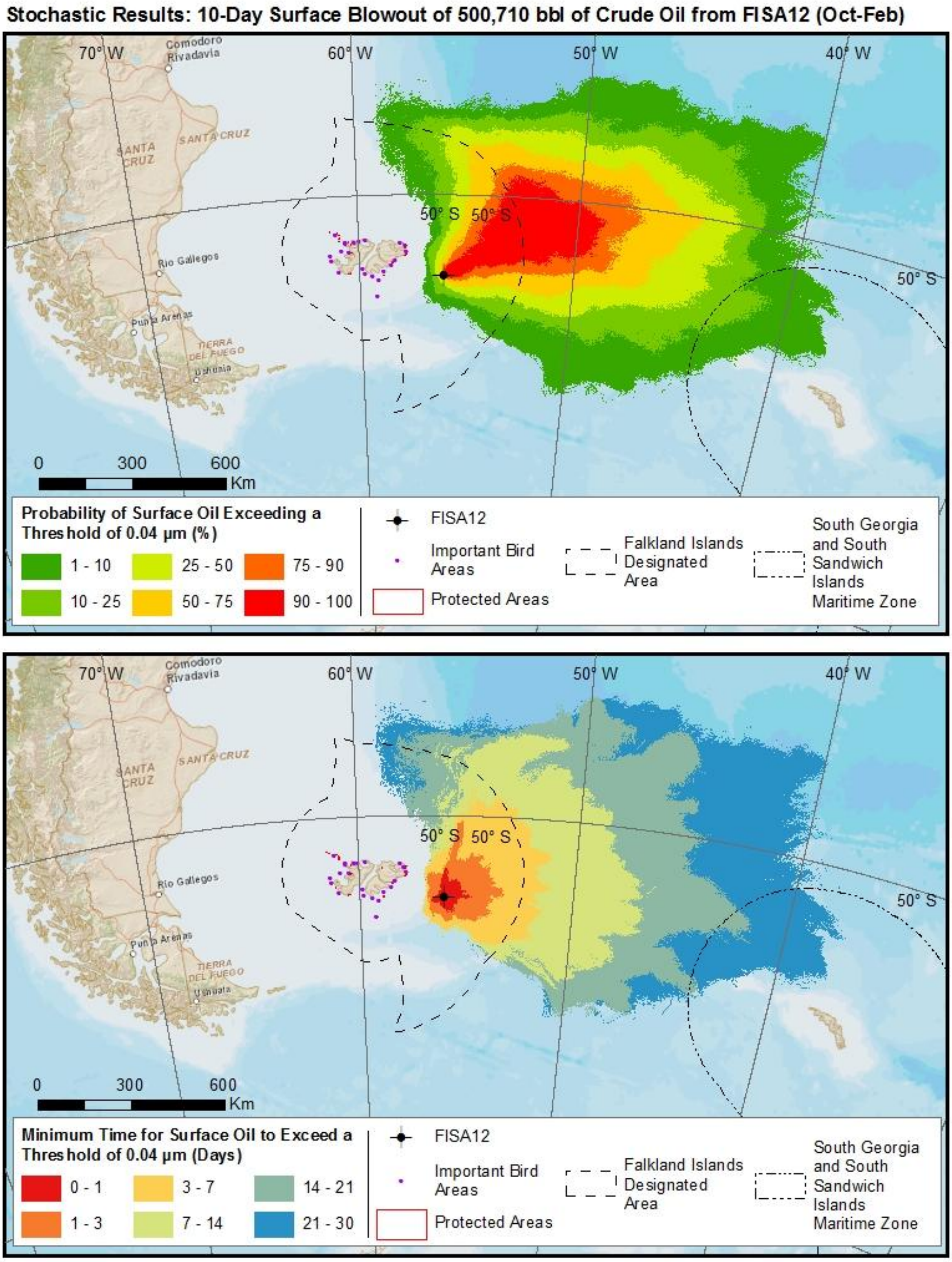


*Figure 6.23: Stochastic scenario 6 (50,071 bopd crude oil spill surface release for 10 days from the centre of FISA12 from March to September [winter]); maps for potential water surface contamination*

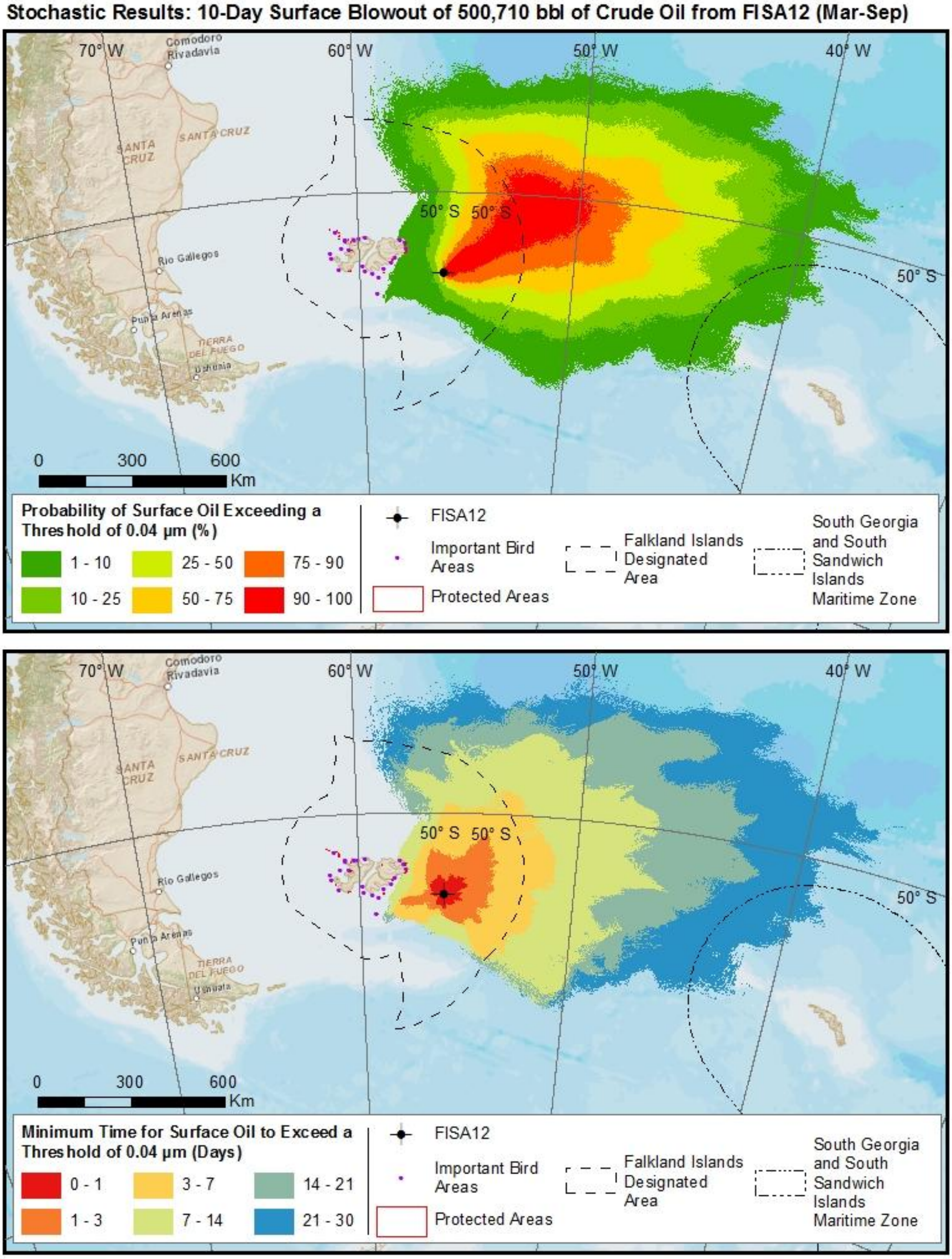


*Figure 6.24: Stochastic scenario 6 (50,071 bopd crude oil spill surface release for 10 days from the centre of FISA12 from March to September [winter]); maps for potential shoreline contamination*

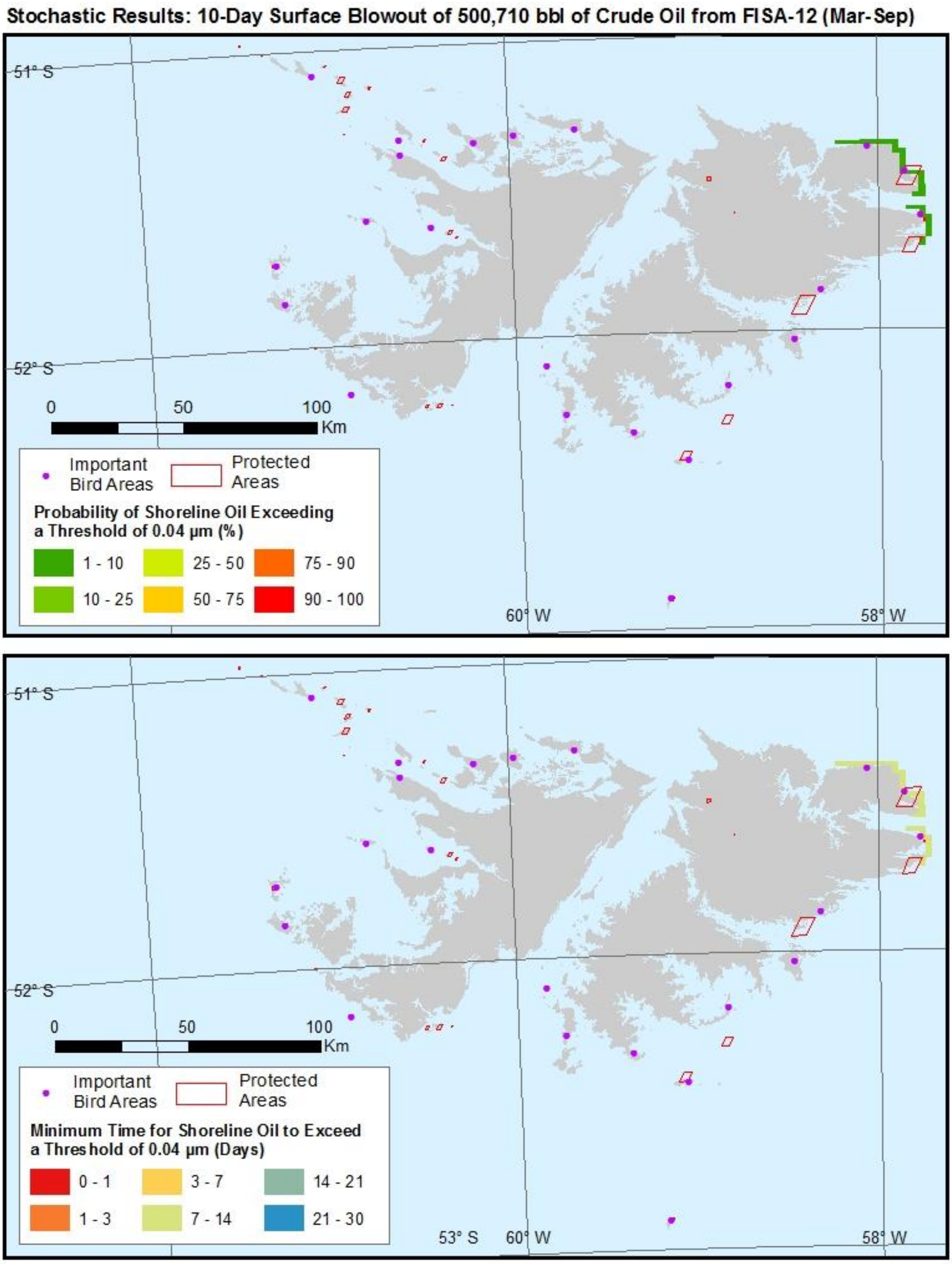


*Figure 6.25: Stochastic scenario 7 (50,071 bopd crude oil spill surface release for 10 days from the centre of FIST13 from October to February [summer]); maps for potential water surface contamination*

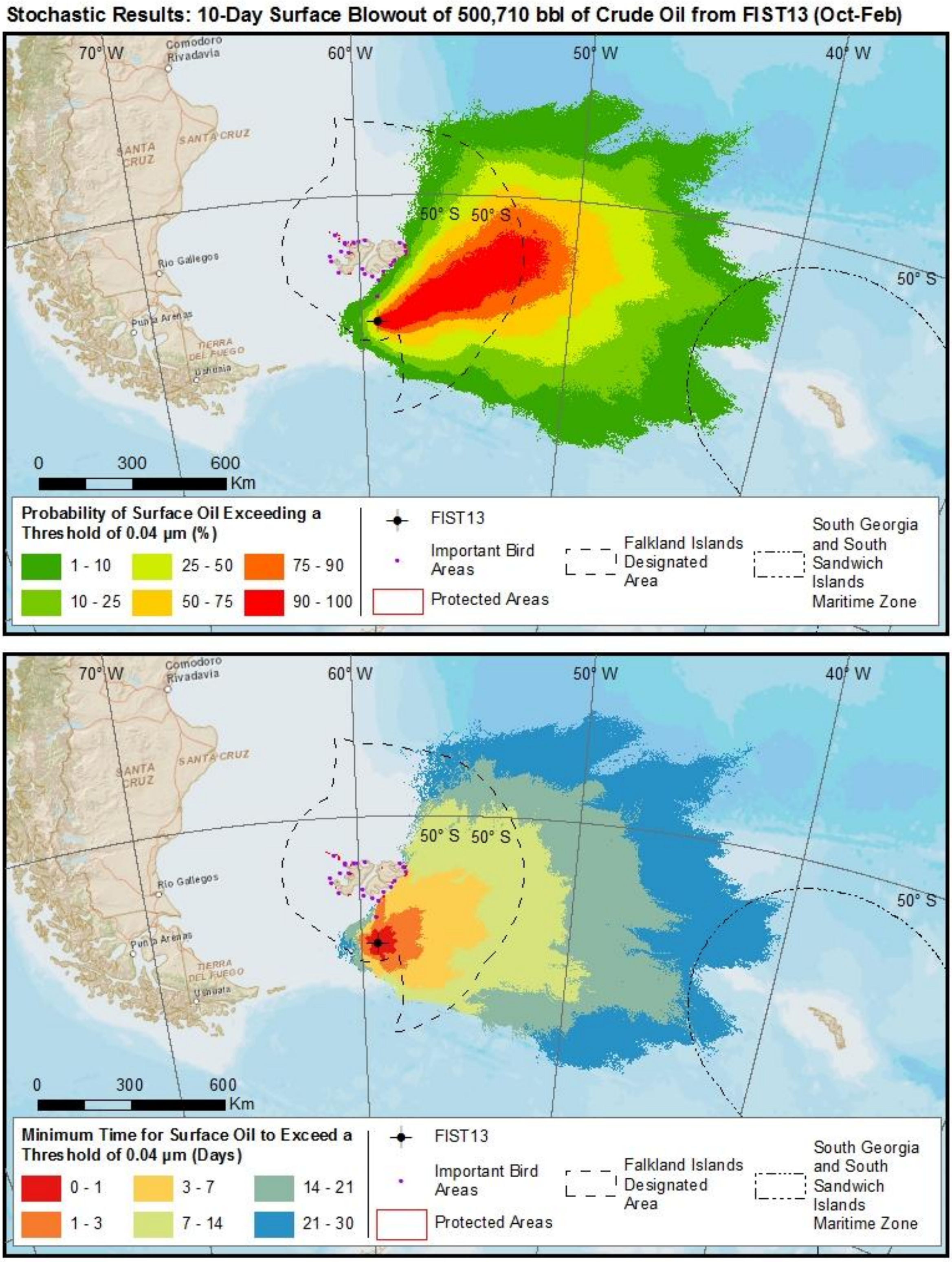


*Figure 6.26: Stochastic scenario 7 (50,071 bopd crude oil spill surface release for 10 days from the centre of FIST13 from October to February [summer]); maps for potential shoreline contamination*

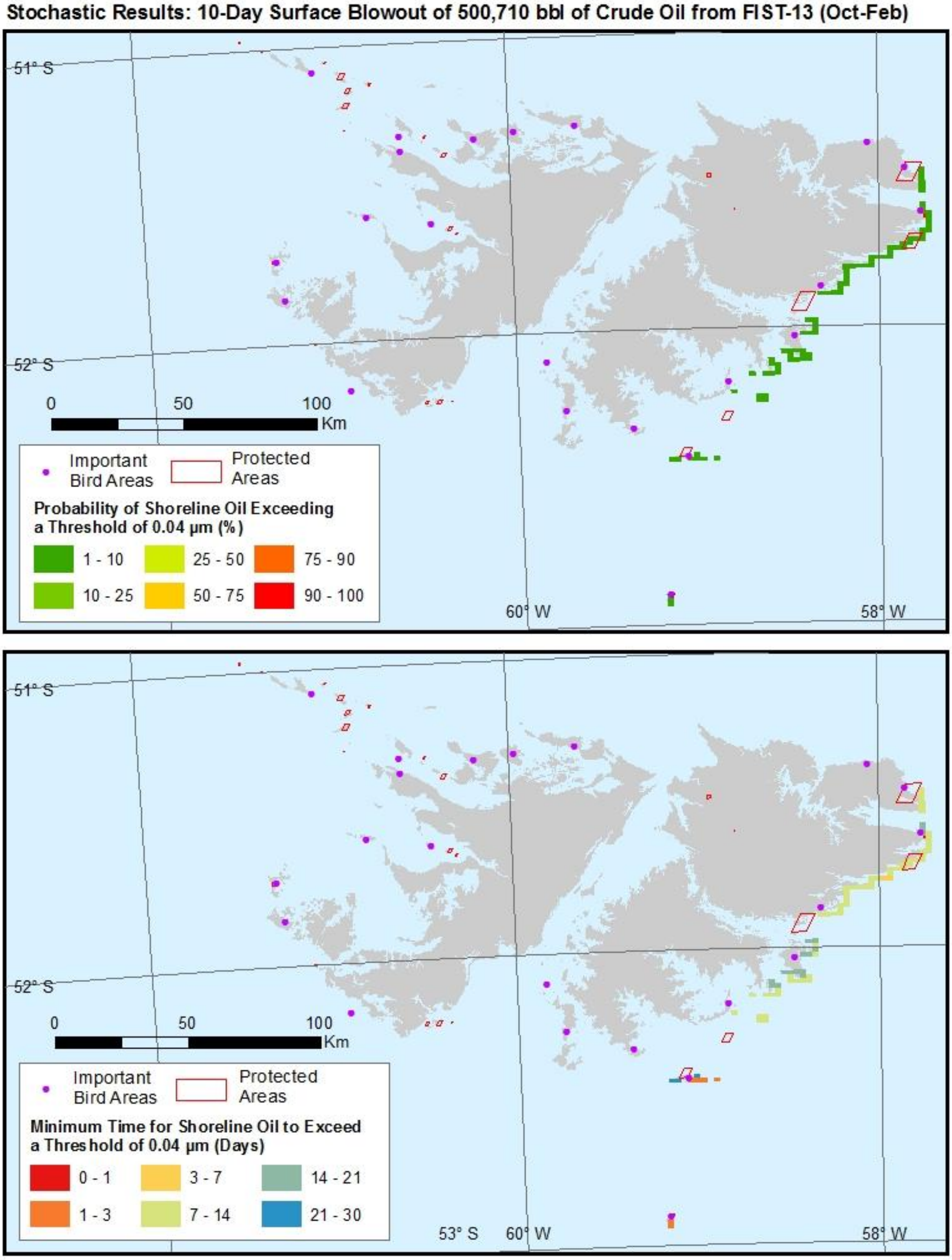


*Figure 6.27: Stochastic scenario 8 (50,071 bopd crude oil spill surface release for 10 days from the centre of FIST13 from March to September [winter]); maps for potential water surface contamination*

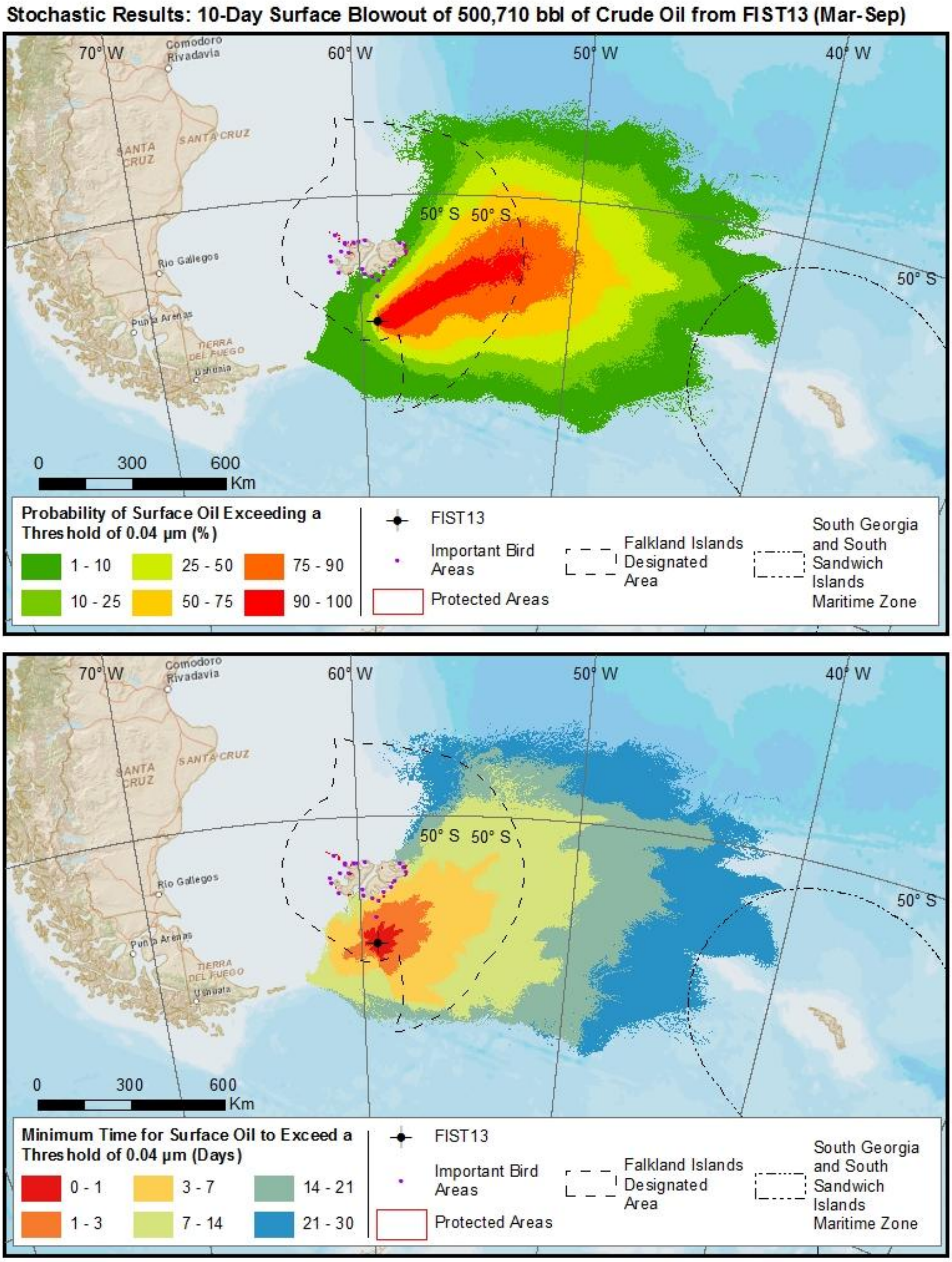
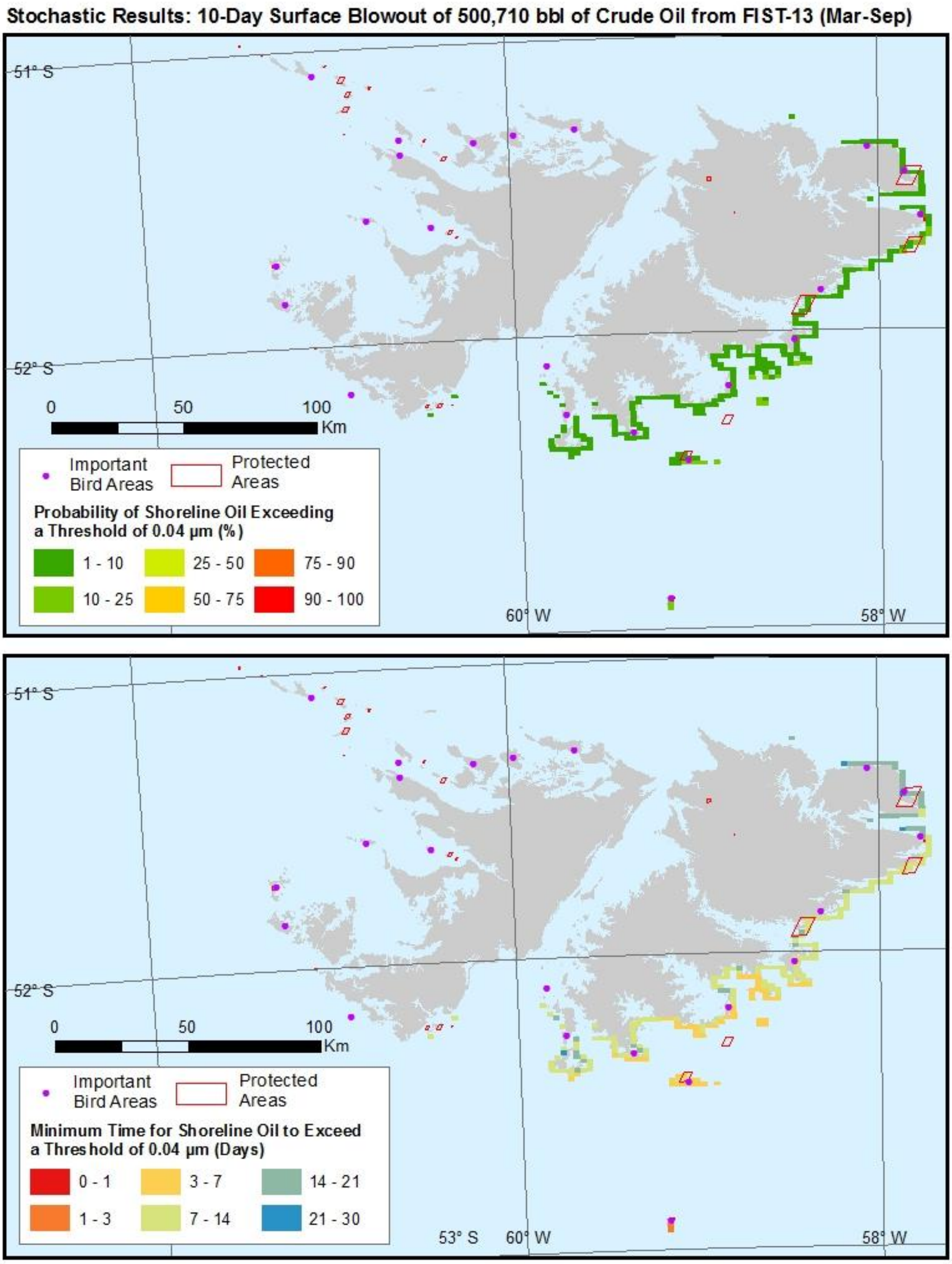


*Figure 6.28: Stochastic scenario 8 (50,071 bopd crude oil spill surface release for 10 days from the centre of FIST13 from March to September [winter]); maps for potential shoreline contamination*



### Crude Oil Sub-surface (3D) Stochastic Oil Spill Modelling Results

6.361 3D crude oil stochastic spill modelling was conducted to determine the fate of a large unintentional release of hydrocarbons to the marine environment, representing an uncontrolled release of hydrocarbons (blowout) from the wellbore. This scenario represents catastrophic failure of the barriers in the wellbore and BOP equipment, with the drilling rig and marine riser no longer in communication with the Lower Marine Riser Package (LMRP), resulting in crude oil being released at the seabed. A spill rate of 50,071 barrels per day was used, obtained from preliminary reservoir modelling conducted by Noble.

6.362 Two stochastic scenarios were modelled and are displayed in Table 6.24. Modelling for the sub-surface scenarios was conducted using period 2 (winter), which represented the worst case in terms of oil beaching for the 2D scenarios. The results of the crude oil stochastic modelling scenarios are displayed in Table 6.25 and in Figures 6.29 to 6.32.

*Table 6.24: Crude oil sub-surface (3D) stochastic oil spill modelling scenarios*

| Scenario ID | Spill Site | Spill Event | Oil Type | Period (month) | Spill Rate | Spill Duration | Total Spilled Volume | Simulation Duration |
|---|---|---|---|---|---|---|---|---|
| 9 | FISA12 | Sub-surface Blowout | Crude Oil | Period 2 (3-9) | 50,071 bbl/d | 10 days | 500,710 bbl | 30 Days |
| 10 | FIST13 | Sub-surface Blowout | Crude Oil | Period 2 (3-9) | 50,071 bbl/d | 10 days | 500,710 bbl | 30 Days |

*Table 6.25: Crude oil surface (2D) stochastic oil spill modelling results*

| Scenario ID (Figure) | Spill Site | Oil Type | Spill Type | Simulation Period | Total Volume Released | Sims. Reaching Shore (%) | Time to Reach Shore (days) | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Min. | Avg. |
| 9 (6.29 & 6.30) | FISA12 | Crude Oil | Subsurface Blowout | Period 2 (3-9) | 500,710 bbl | 2 | 11.0 | 12.0 |
| 10 (6.31 & 6.32) | FIST13 | Crude Oil | Subsurface Blowout | Period 2 (3-9) | 500,710 bbl | 18 | 4.0 | 10.9 |

*Figure 6.29: Stochastic scenario 9 (50,071 bopd crude oil spill sub-surface release for 10 days from the centre of FISA12 from March to September [winter]); maps for potential water surface contamination*

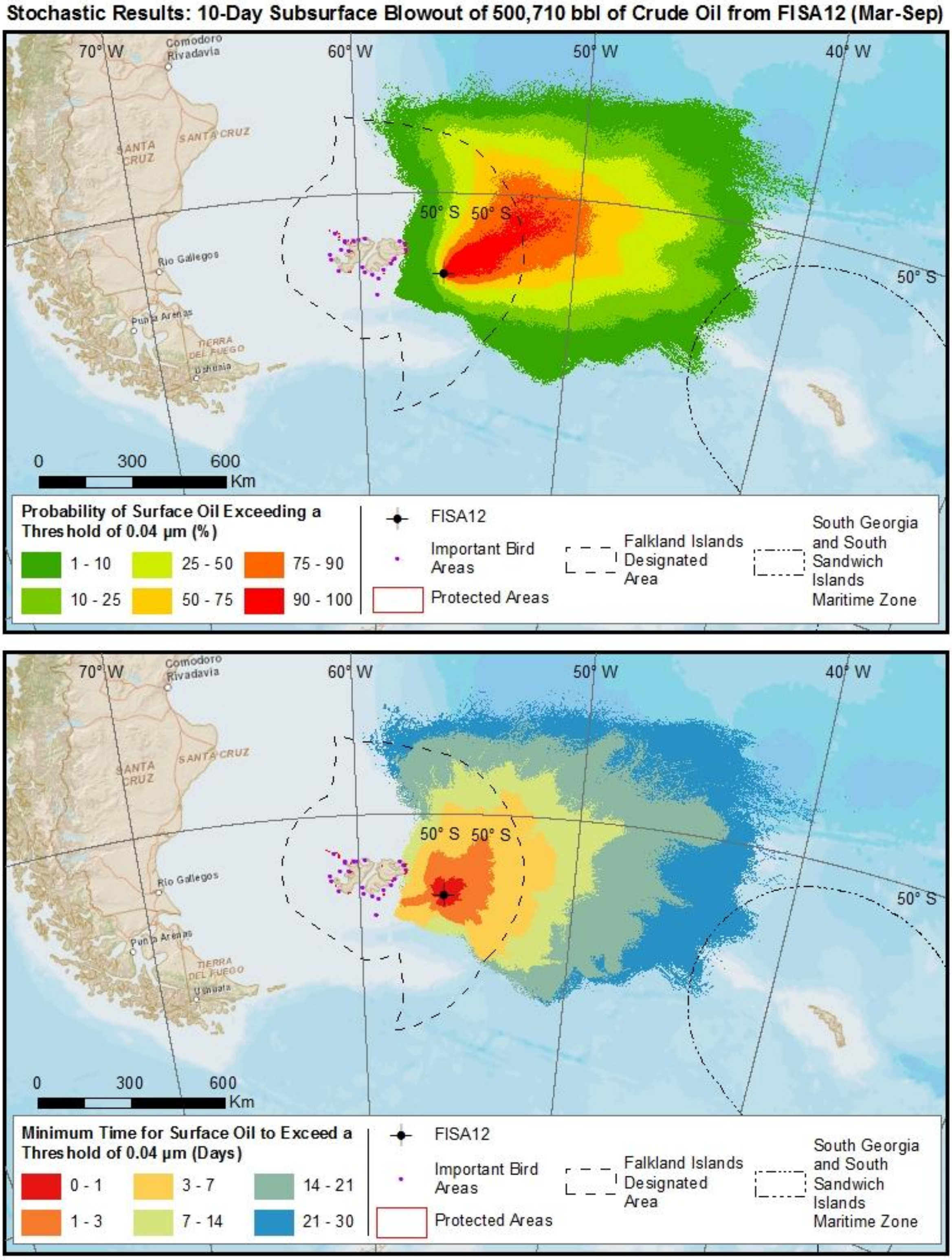


*Figure 6.30: Stochastic scenario 9 (50,071 bopd crude oil spill sub-surface release for 10 days from the centre of FISA12 from March to September (winter); maps for potential shoreline contamination*

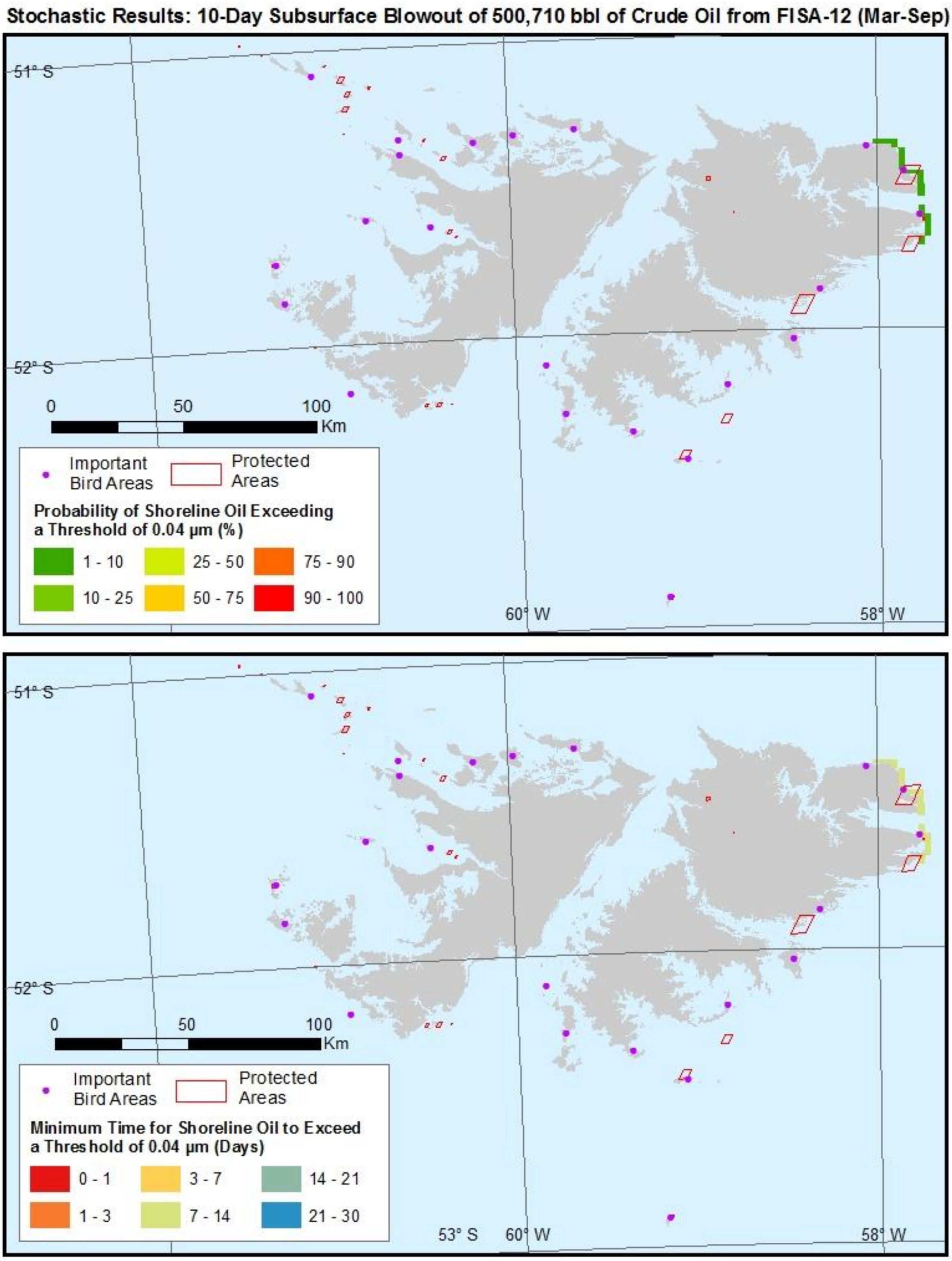


*Figure 6.31: Stochastic scenario 10 (50,071 bopd crude oil spill sub-surface release for 10 days from the centre of FIST13 from March to September [winter]); maps for potential water surface contamination*

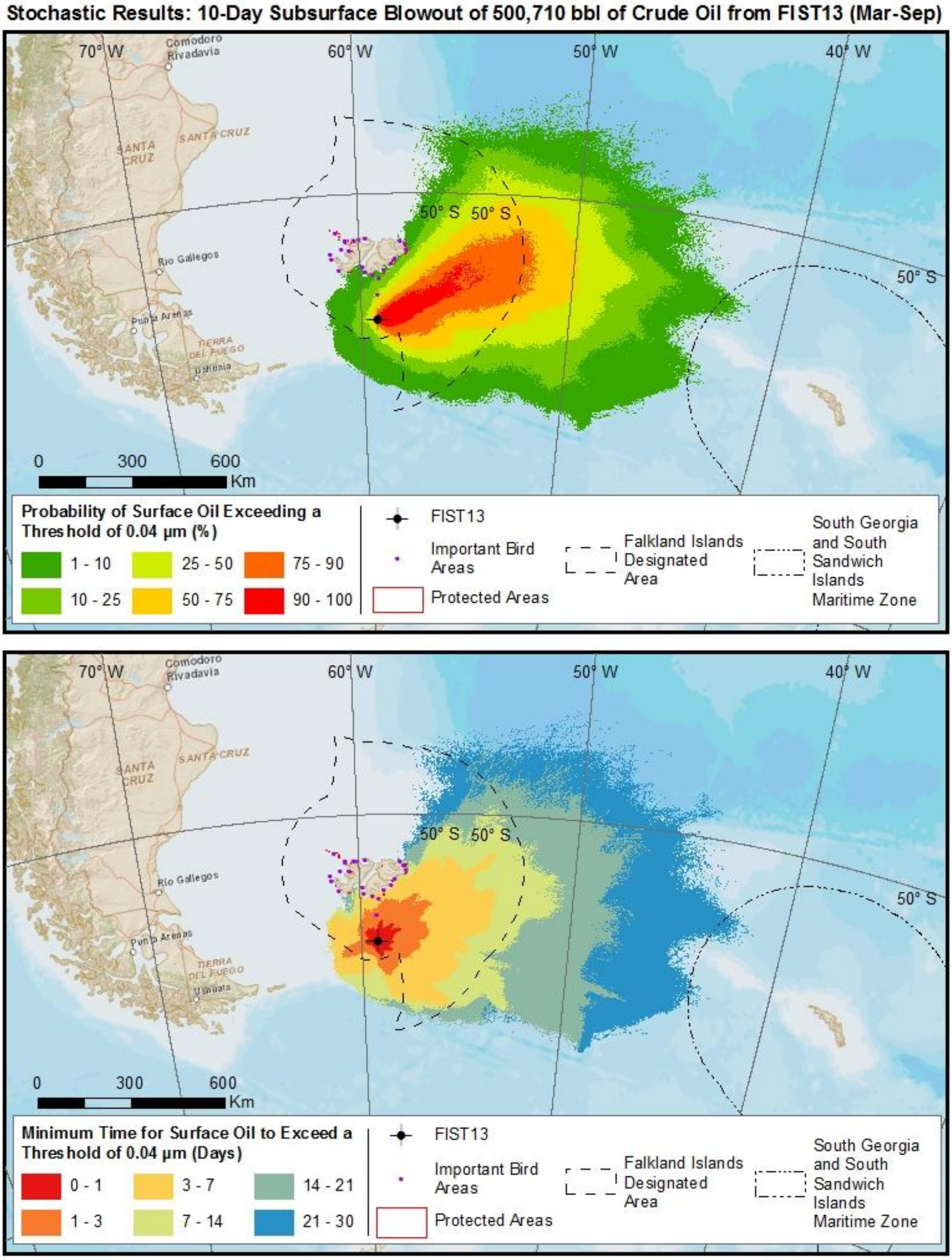
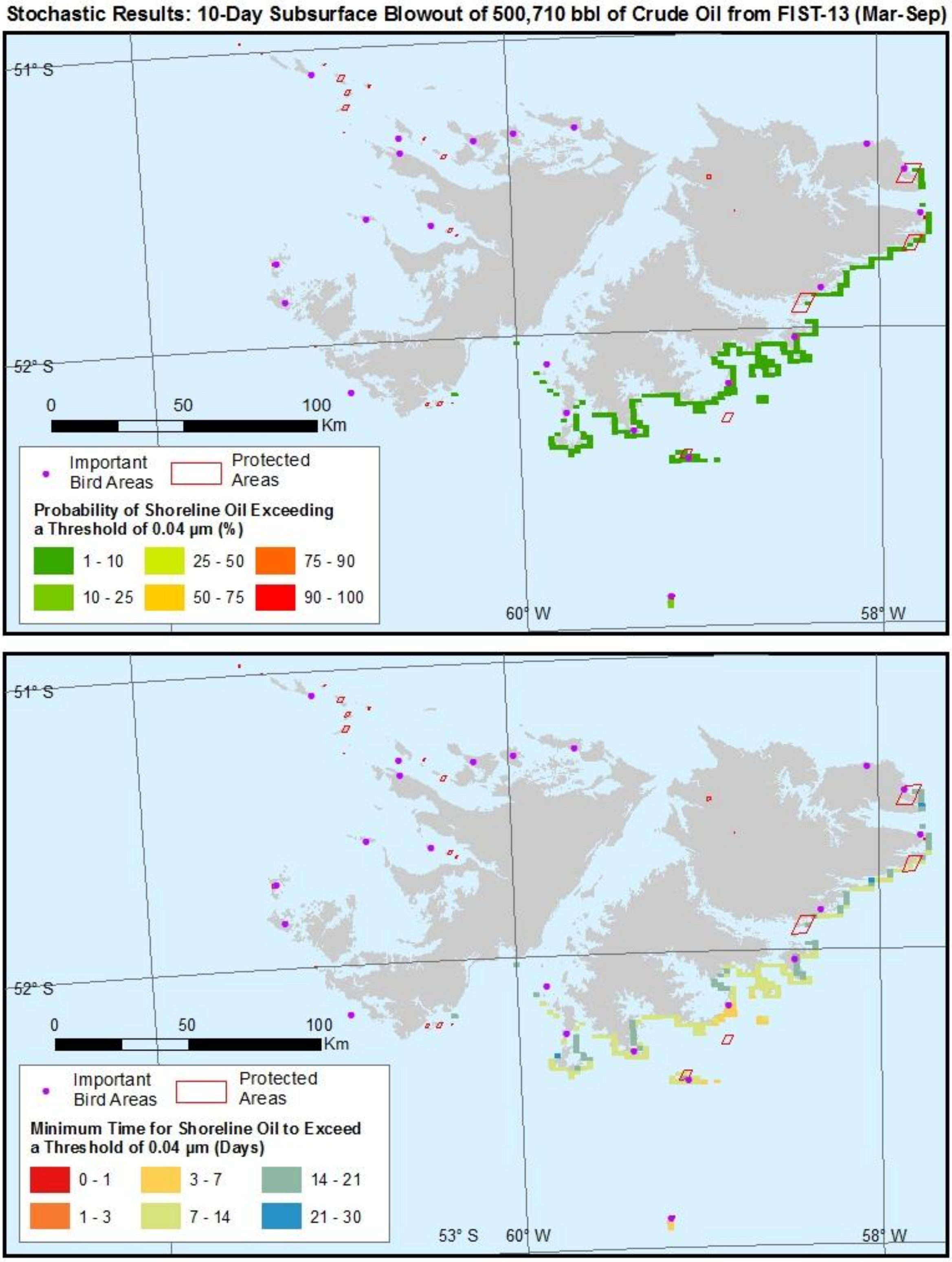


*Figure 6.32: Stochastic scenario 10 (50,071 bopd crude oil spill sub-surface release for 10 days from the centre of FIST13 from March to September (winter); maps for potential shoreline contamination*



### Stochastic Oil Spill Modelling Conclusions

#### *Diesel Stochastic Oil Spill Modelling*

6.363 The diesel modelling scenarios presented above (Figures 6.18 to 6.21) have shown that the total loss of the fuel oil inventory of the drilling rig (4,631$m^3$) is unlikely to result in beaching, and will weather offshore.

#### *Crude Oil Surface (2D) Stochastic Oil Spill Modelling*

6.364 Modelling using typical wind conditions in uncontrolled surface release (blowout) situations has shown that the majority of oil will weather offshore under the influence of the residual current and wind conditions. However, some cases have shown oil to beach on the Falkland Islands coast.

6.365 The uncontrolled release scenario for FISA12 in the summer period (Figure 6.22) showed that no simulations result in oil beaching. The same scenario in the winter period (Figures 6.23 and 6.24) showed oil to beach, with 2% of simulations reaching the shoreline, and a minimum time to beaching of 10 days (average 10.5 days).

6.366 The uncontrolled release scenario for FIST13 in the summer period (Figures 6.25 and 6.26) showed that oil beaches, with 13% of simulations reaching the shoreline and a minimum time to beaching of 1.7 days (average 16.3 days). The same scenario in the winter period (Figures 6.27 and 6.28) showed oil to beach with a greater percentage of the simulations reaching the shore (32%) and a minimum time to beaching of 1.7 days (average 10.2 days). These results clearly show that oil is more likely to beach from a significant spill from the FIST13 area.

6.367 Further deterministic modelling has been undertaken for the worst case simulations from the above 2D models to examine further the conditions that result in oil beaching (refer to Deterministic Oil Spill Modelling Results below).

#### *Crude Oil Sub-surface (3D) Stochastic Oil Spill Modelling*

6.368 Modelling using typical wind conditions in uncontrolled sub-surface release (blowout) situations has also shown that the majority of oil will weather offshore under the influence of the residual current and wind conditions. However, some cases also show beaching on the Falkland Islands coast.

6.369 Scenarios for the sub-surface simulations use the winter period, as this showed to be worst case for oil beaching from the 2D scenarios.

6.370 The uncontrolled sub-surface release scenario for FISA12 (Figures 6.29 and 6.30) showed that oil beaches, with 2% of simulations reaching the shoreline and a minimum time to beaching of 11.0 days (average 12.0 days). Compared to the results from the same 2D scenario, the results in terms of beaching are very similar, albeit with a slightly shorter minimum beaching time of 10 days for the 2D release scenario.

6.371 The uncontrolled sub-surface release scenario for FIST13 (Figures 6.31 and 6.32) showed that oil beaches, with 18% of simulations reaching the shoreline and a minimum time to beaching of 4.0 days (average 10.9 days). Compared to the results from the same 2D scenario, the results in terms of beaching are different, with the 2D surface release scenario showing a greater percentage of simulations reaching the shoreline (32% compared to 18%), and the minimum beaching time for the 2D scenario also being shorter than the 3D (1.7 days compared to 4 days). A possible reason for this is that the FIST13 area is not greatly influenced in the same way by the Falkland Islands Current (that branches off from the Antarctic Circumpolar Current [ACC]) as the FISA12 area (refer to Figure 4.4 in Section 4.2.6 and Figures 23 to 28 in Appendix L). This may allow the effect of the water column temperature and salinity profiles to have more of an influence on the modelled sub-surface release in the FIST13 area than in the FISA12 area, resulting in the greater differences in the results seen between the 2D and 3D scenarios for FIST13.

### Deterministic Oil Spill Modelling Results

#### *Crude Oil Surface (2D) Stochastic Oil Spill Modelling Deterministic Analysis*

6.372 For each stochastic surface blowout scenario where there was any shoreline impact, a worst case scenario was selected based on the time it took for oil to arrive at the shore. From each of these stochastic scenarios, the individual trajectory that impacted the coast in the shortest time was chosen for the deterministic modelling scenario. This criterion was chosen to represent the worst case, because it would require the quickest response efforts to be implemented. For the surface blowout scenario where no shoreline oiling was predicted, the trajectory that came closest to impacting the Falkland Islands was chosen as a representative case.

6.373 All deterministic simulations were run using the same variable winds and current forcing used for the corresponding stochastic simulation from which it was identified. The selected worst case deterministic runs for further analysis are shown in Table 6.26. The results of the deterministic analyses are shown in Table 6.27 and in Figures 6.33 to 6.40).

6.374 For each deterministic scenario, three figures are supplied. These are:

- **Maximum mass of floating oil per unit area (oil slick thickness):** The map depicts the maximum mass per unit area of oil on the water surface that passed by a given area at some point during the simulation.
- **Maximum mass of shoreline oil per unit area (for trajectories that impacted the coast):** The map depicts the maximum mass per unit area of oil that beached on a given area of the shoreline at some point during the simulation. In the absence of data, all shoreline segments are assumed to be 10 metre wide sandy beaches. Using actual shoreline data may alter the results, but the results provided are likely on the conservative side for shoreline impacts.
- **Predicted mass balance:** The graph shows the model-predicted mass balance for the spilled oil. The mass balance graph shows the degree of weathering that the oil undergoes during the period of the simulation.

***Table 6.26: Selected worst case deterministic runs from 2D stochastic models***

| Scenario ID | Spill Site | Oil Type | Spill Type | Total Spilled Volume (bbl) | Selected Deterministic Case | Run Type |
|---|---|---|---|---|---|---|
| 5 | FISA12 | Crude | Surface Blowout | 500,710 | 2/21/2011 | Representative |
| 6 | FISA12 | Crude | Surface Blowout | 500,710 | 8/12/2009 | Worst Case |
| 7 | FIST13 | Crude | Surface Blowout | 500,710 | 2/13/2010 | Worst Case |
| 8 | FIST13 | Crude | Surface Blowout | 500,710 | 3/13/2010 | Worst Case |

*Table 6.27: Deterministic analysis results; predicted shoreline contamination information for the selected deterministic runs*

| Scenario ID (Figure) | Spill Site | Oil Type | Spill Type | Total Spilled Volume (bbl) | Time to shore (days) | Amount of oil Ashore (bbl) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Peak | End |
| 5 (6.33 & 6.34) | FISA-12 | Crude Oil | Surface Blowout | 500,710 | - | - | - |
| 6 (6.35 & 6.36) | FISA-12 | Crude Oil | Surface Blowout | 500,710 | 10 | 9,646 | 8,012 |
| 7 (6.37 & 6.38) | FIST-13 | Crude Oil | Surface Blowout | 500,710 | 1.6 | 2,309 | 1,803 |
| 8 (6.39 & 6.40) | FIST-13 | Crude Oil | Surface Blowout | 500,710 | 1.7 | 506 | 309 |

*Figure 6.33: Deterministic analysis of stochastic scenario 5: 2/21/2011; map for potential water surface contamination*

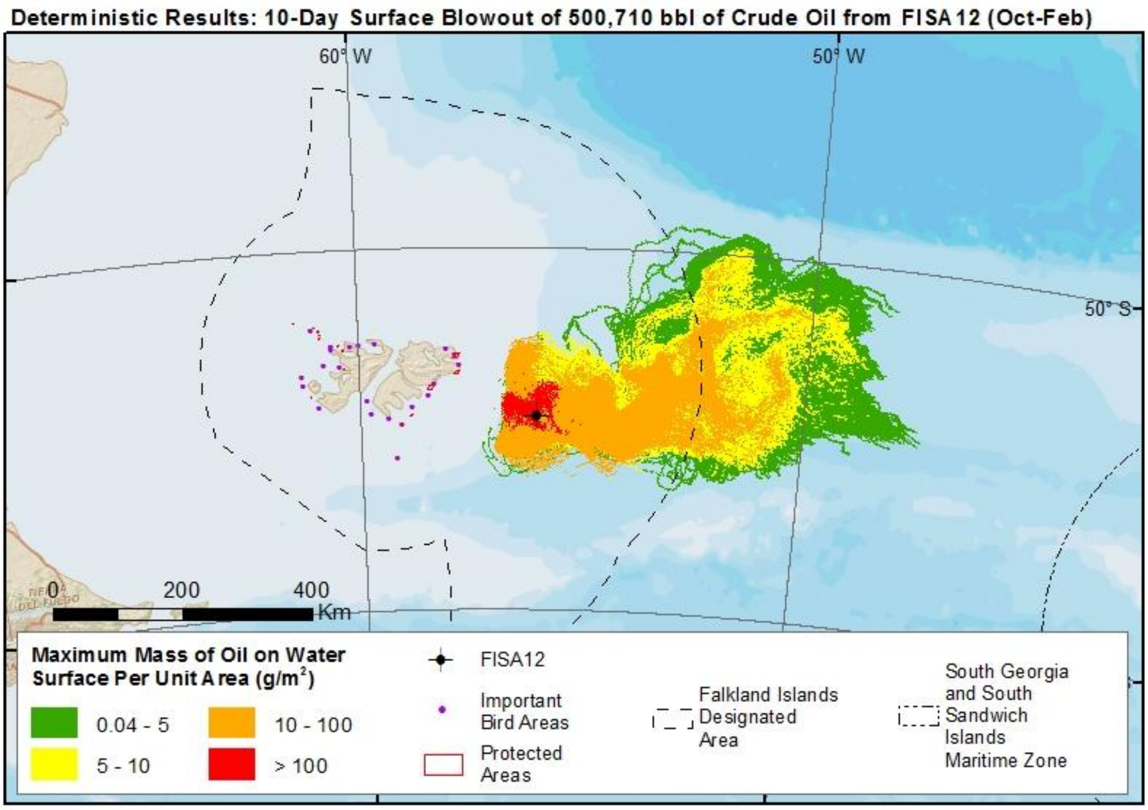


*Figure 6.34: Deterministic analysis of stochastic scenario 5: 2/21/2011; mass balance graph*

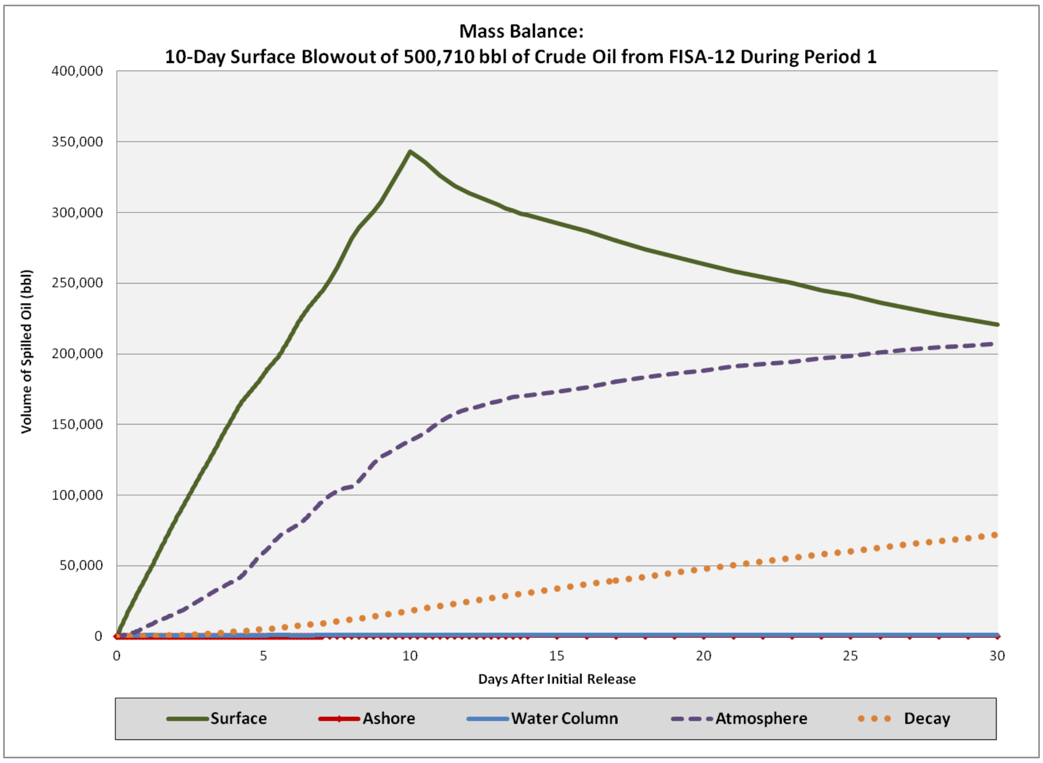
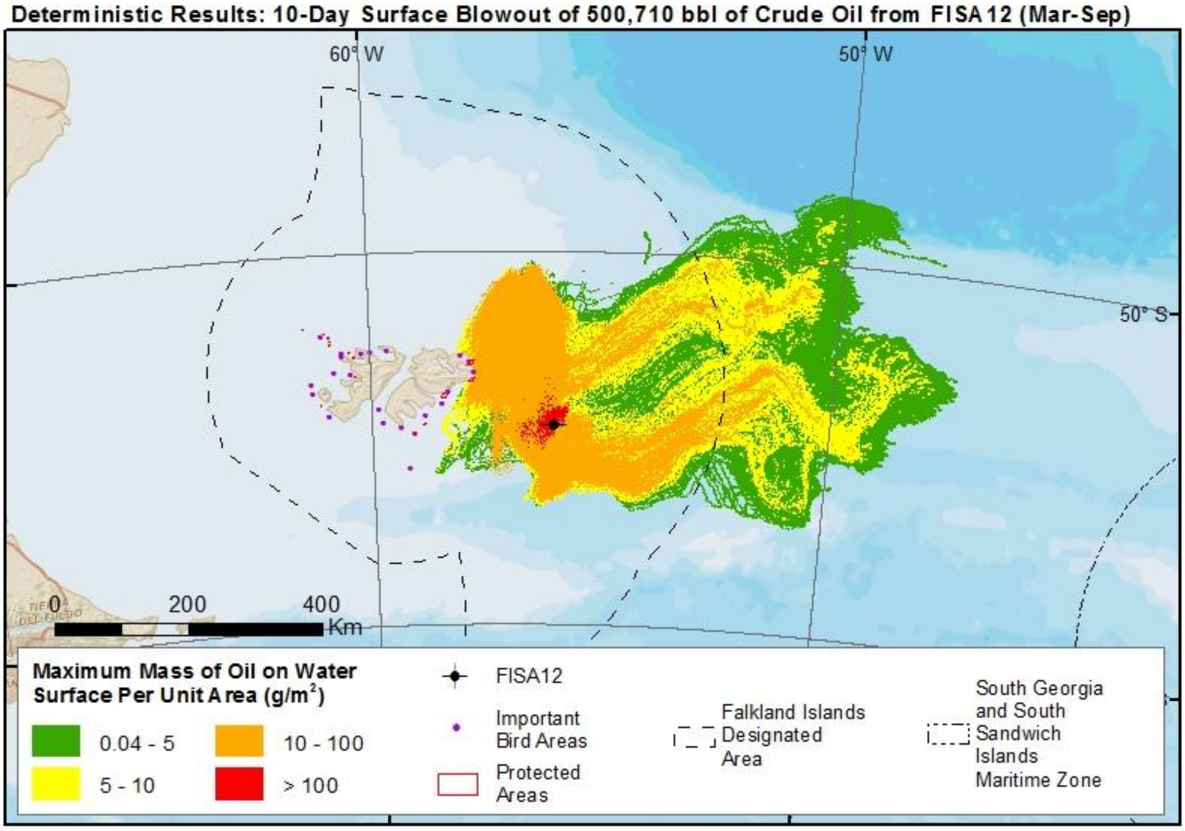


*Figure 6.35: Deterministic analysis of stochastic scenario 6: 8/12/2009; map for potential water surface (top) and shoreline (bottom) contamination*



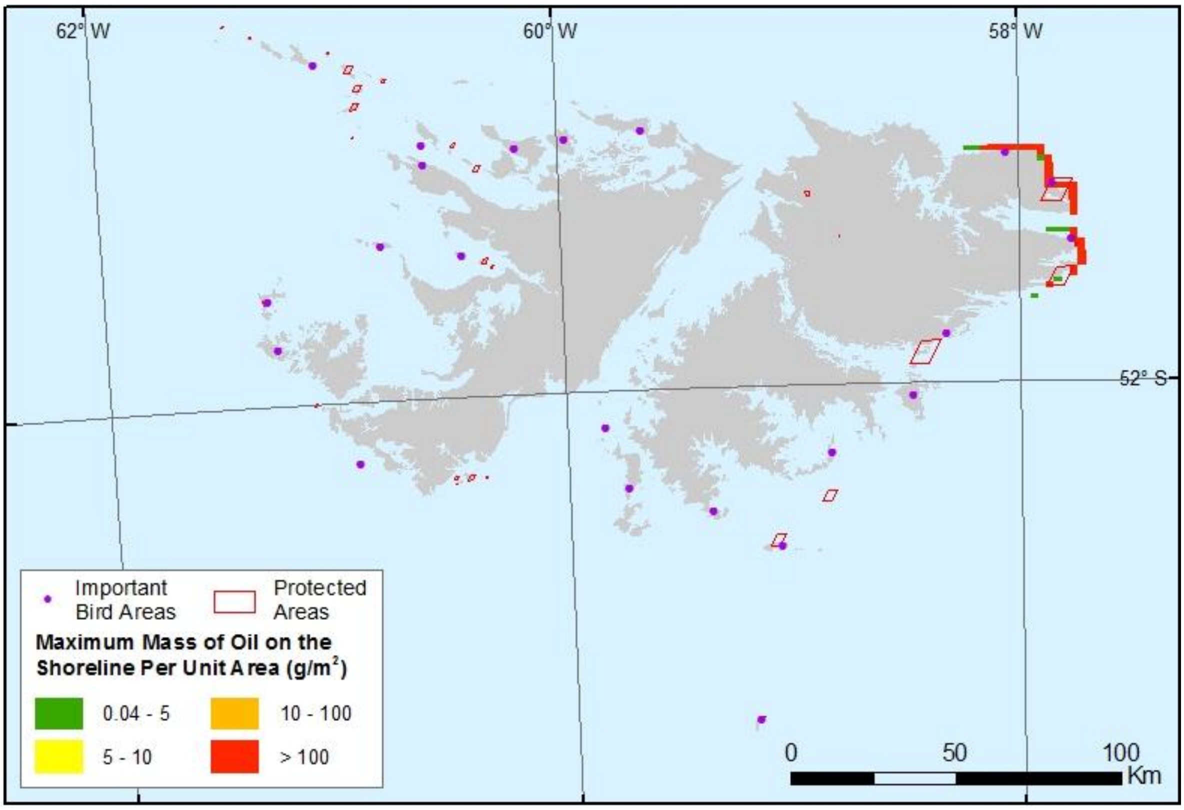



*Figure 6.36: Deterministic analysis of stochastic scenario 6: 8/12/2009; mass balance graph*

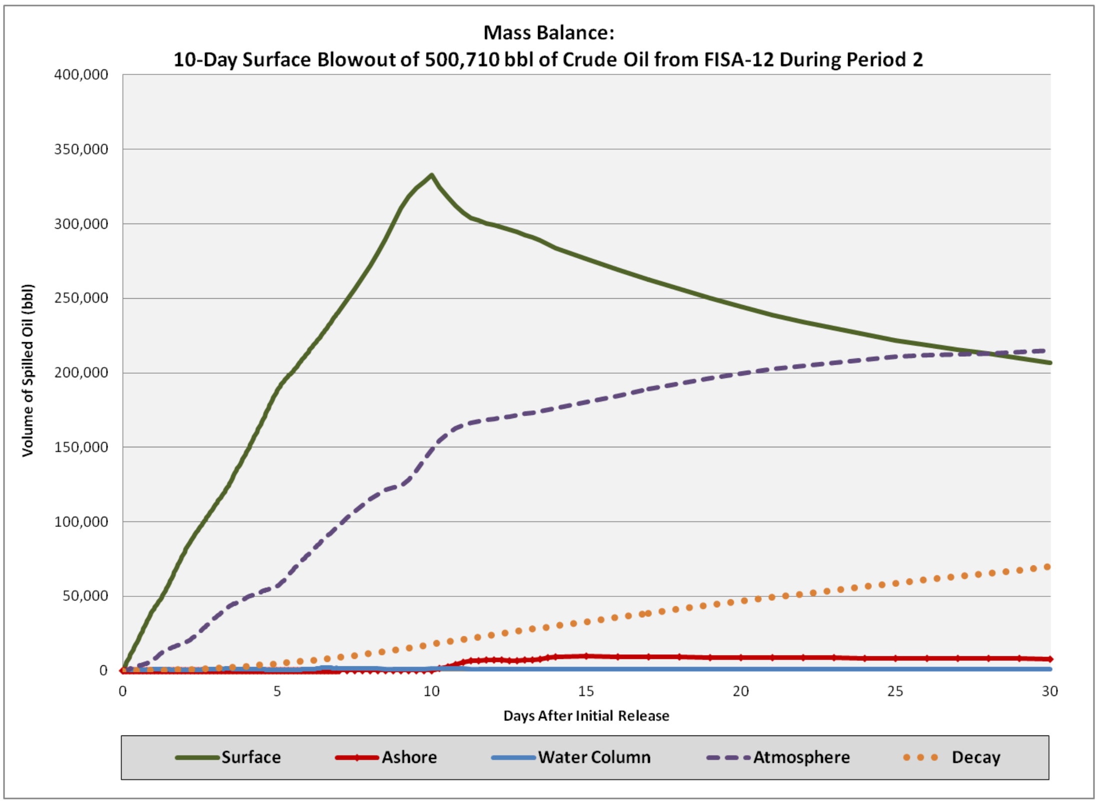


*Figure 6.37: Deterministic analysis of stochastic scenario 7: 2/13/2010; map for potential water surface (top) and shoreline (bottom) contamination*

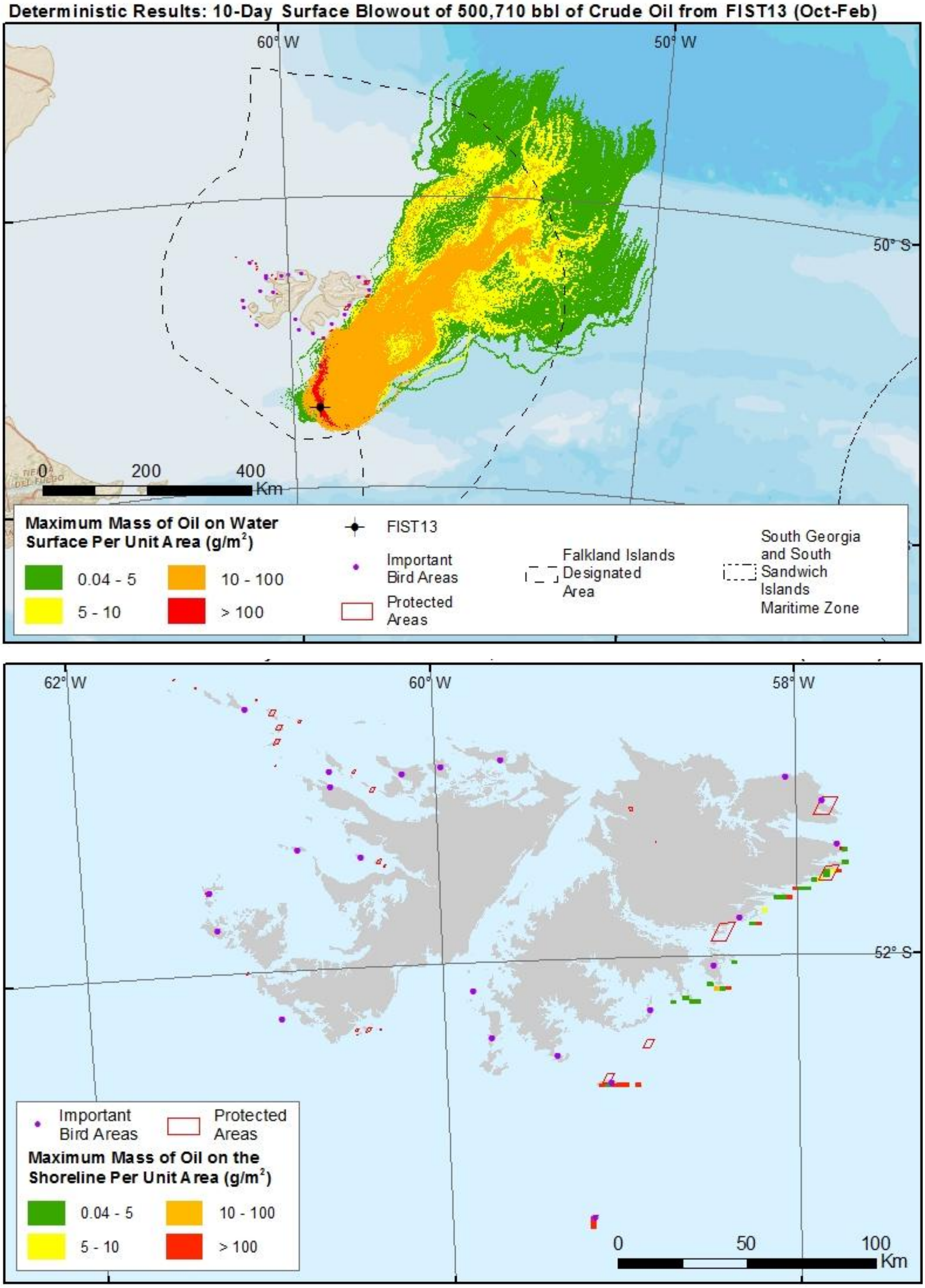


*Figure 6.38: Deterministic analysis of stochastic scenario 7: 2/13/2010; mass balance graph*

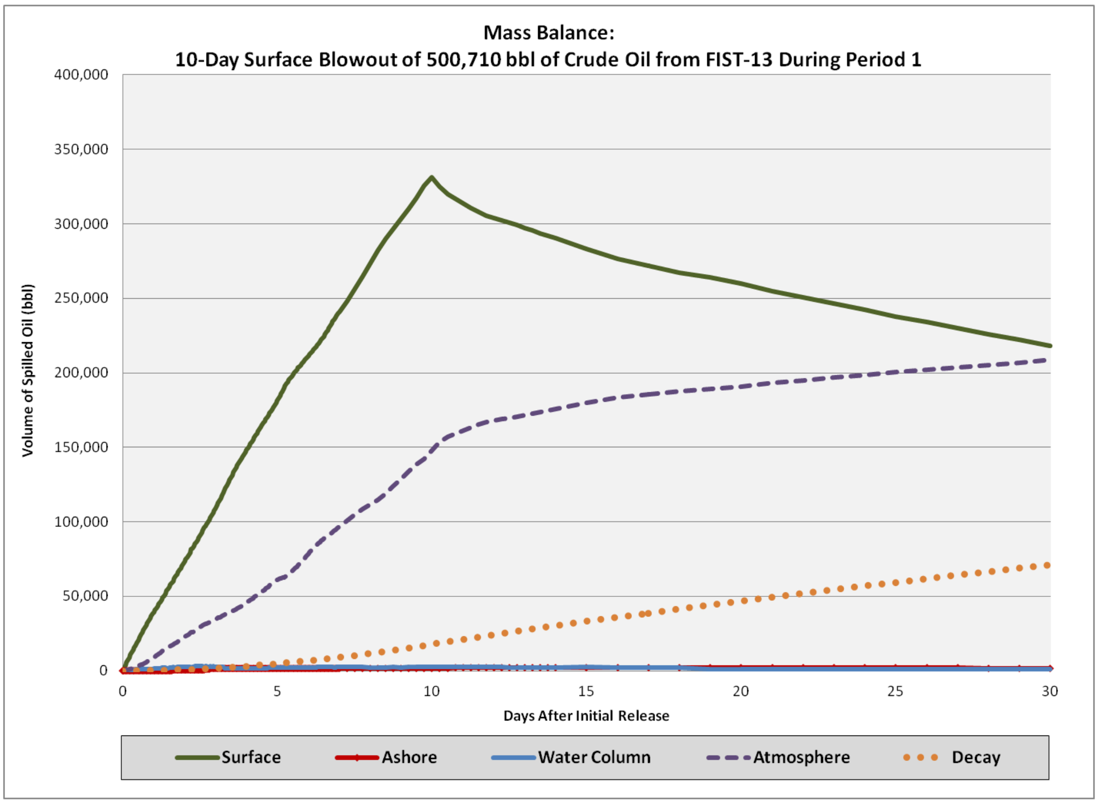
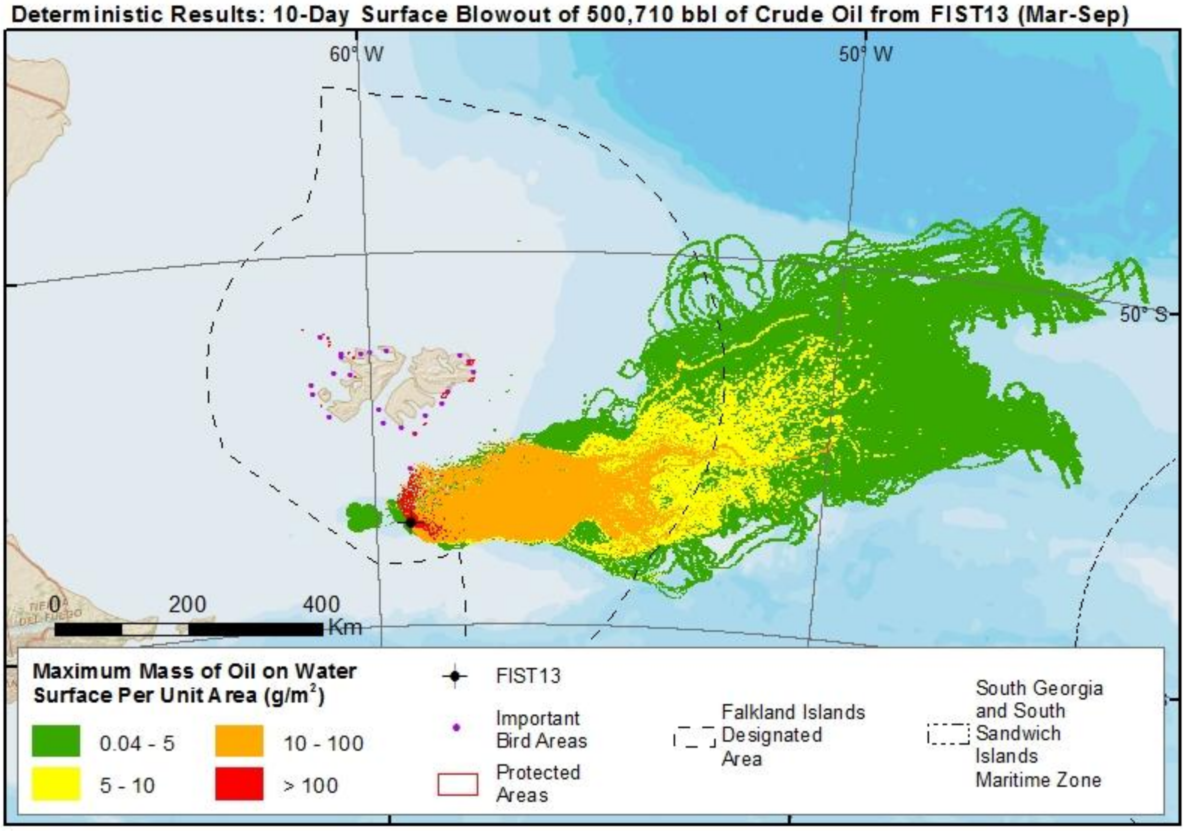


*Figure 6.39: Deterministic analysis of stochastic scenario 8: 3/13/2010; map for potential water surface (top) and shoreline (bottom) contamination*



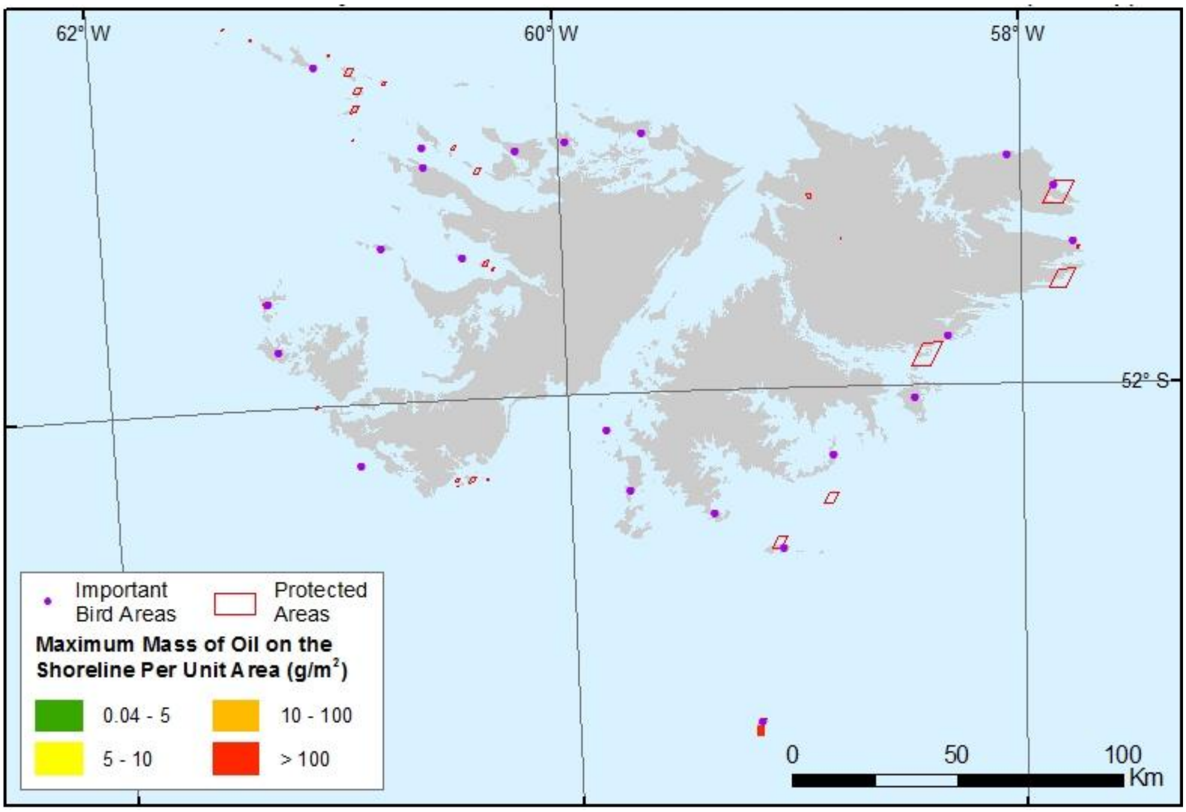
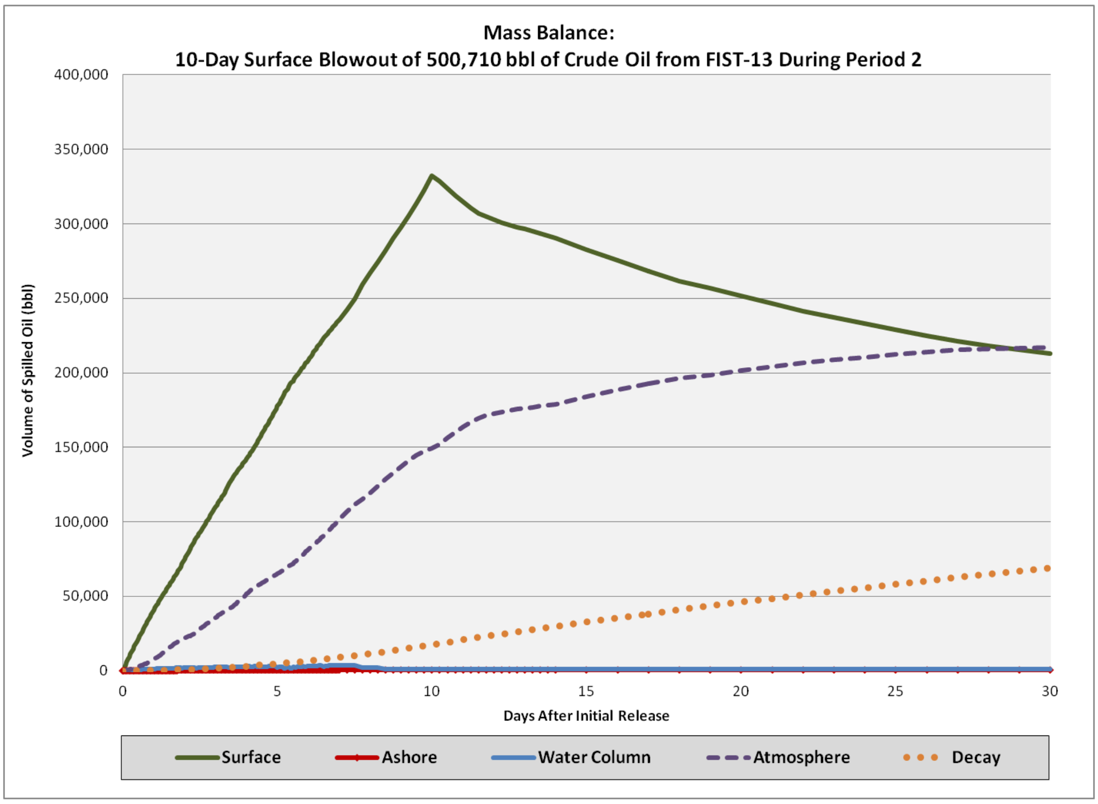



*Figure 6.40: Deterministic analysis of stochastic scenario 8: 3/13/2010; mass balance graph*



### *Crude Oil Surface (2D) DECC 30 knot Wind Deterministic Scenarios*

6.375 In accordance with the UK Department of Energy and Climate Change (DECC) Oil Pollution Emergency Plan (OPEP) Guidelines (July 2012 version), worst case trajectory modelling has also been undertaken from the centre of the FISA12 and FIST13 areas using a constant 30 knot onshore wind, and a 30 knot wind towards the nearest international trans-boundary line, which for the purposes of the modelling was chosen as the Falkland Islands/Argentinean trans-boundary line. The scenarios modelled are displayed in Table 6.28. The results are displayed in Tables 6.29 and 6.30.

6.376 Due to the uniform wind direction, oil slowly beaches in the same location until the holding capacity of the shoreline is met. After that point, additional oil collects on the water surface against the shoreline. This excess oil is referred to as “shoreline overflow” in Table 6.29. Under normal environmental conditions, the wind and current variability may result in more extensive transport along the shore, thereby increasing the amount of shoreline oil and decreasing shoreline overflow.

*Table 6.28: Parameters of the 30 knot trajectroy oil spill scenarios*

| Scenario ID | Spill Site | Spill Event | Wind Direction | Oil Type | Spill Rate | Spill Duration | Total Spilled Volume | Simulation Duration |
|---|---|---|---|---|---|---|---|---|
| 11 | FISA12 | 30 knot onshore wind speed (surface) | From ESE | Crude Oil | 50,071 bbl/d | 10 days | 500,710 bbl | 30 Days |
| 12 | FISA12 | 30 knot wind speed towards median line (surface) | From ENE | Crude Oil | 50,071 bbl/d | 10 days | 500,710 bbl | 30 Days |
| 13 | FIST13 | 30 knot onshore wind speed (surface) | From S | Crude Oil | 50,071 bbl/d | 10 days | 500,710 bbl | 30 Days |
| 14 | FIST13 | 30 knot wind speed towards median line (surface) | From ENE | Crude Oil | 50,071 bbl/d | 10 days | 500,710 bbl | 30 Days |

*Table 6.29: Predicted impact information for each scenario*

| Scenario ID | Spill Site | Wind Direction | Total Spilled Volume (bbl) | Time To Shore (days) | Time To Trans-boundary Line (days) | Countries Impacted | |
|---|---|---|---|---|---|---|---|
| | | | | | | Water Surface | Shore |
| 11 | FISA12 | Onshore (from ESE) | 500,710 | 3.0 | - | Falkland Islands | Falkland Islands |
| 12 | FISA12 | Median Line (from ENE) | 500,710 | 16 | 8.3 | Falkland Islands; Argentina | Argentina |
| 13 | FIST13 | Onshore (from S) | 500,710 | 1.7 | - | Falkland Islands | Falkland Islands |
| 14 | FIST13 | Median Line (from ENE) | 500,710 | 7.8 | 2.0 | Falkland Islands; Argentina | Argentina |

*Table 6.30: Predicted volumes of oil ashore (including shoreline overflow) for 6 time steps*

| Scenario ID | Approximate Volume Ashore + Shoreline Overflow (bbls) | | | | | |
|---|---|---|---|---|---|---|
| | Day 1 | Day 3 | Day 7 | Day 10 | Day 20 | Day 30 |
| 11 | - | - | 110,257 | 190,604 | 235,070 | 206,992 |
| 12 | - | - | - | - | 102,500 | 205,700 |
| 13 | - | 14,670 | 115,586 | 188,413 | 221,630 | 196,356 |
| 14 | - | - | - | 30,719 | 231,400 | 207,000 |

### Deterministic Oil Spill Modelling Conclusions

#### *Crude Oil Surface (2D) Stochastic Oil Spill Modelling Deterministic Analysis*

6.377 As no beaching was observed in scenario 5 (2D blowout from FISA12 during the summer period), the deterministic case was selected that encroached closest to the shoreline. The results of the deterministic analysis are shown in Figures 6.33 and 6.34, where it can be seen that the oil continues to weather offshore. The majority of the oil remains on the surface, whilst a significant volume of the oil is lost to the atmosphere through evaporation.

6.378 For scenario 6 (2D blowout from FISA12 during the winter period), the deterministic worst case selected for analysis occurred on 8/12/2009. The results of the deterministic analysis of this case are presented in Figures 6.35 and 6.36. It can be seen that the time taken to reach shore was 10 days, with a peak volume of oil ashore of 9,646 bbls (Table 6.26). The oil is predicted to beach on the north-eastern coast of East Falkland.

6.379 For scenario 7 (2D blowout from FIST13 during the summer period), the deterministic worst case selected for analysis occurred on 2/13/2010 (towards the end of the summer period). The results of the deterministic analysis of this case are presented in Figures 6.37 and 6.38. It can be seen that the time taken to reach shore was 1.6 days, with a peak volume of oil ashore of 2,309 bbls (Table 6.26). The oil is predicted to beach on the southern and north-eastern coasts of East Falkland, including Beauchêne and Sea Lion Islands.

6.380 For scenario 8 (2D blowout from FIST13 during the winter period), the deterministic worst case selected for analysis occurred on 3/13/2010. The results of the deterministic analysis of this case are presented in Figures 6.39 and 6.40. It can be seen that the time taken to reach shore was 1.7 days, with a peak volume of oil ashore of 506 bbls (Table 6.26). The oil is predicted to beach on Beauchêne Island.

6.381 It should be noted that these cases represent the worst cases from the stochastic scenarios, and in the majority of cases, the oil weathers offshore without beaching.

#### *Crude Oil Surface (2D) DECC 30 knot Wind Deterministic Scenarios*

6.382 For the FISA12 area, a constant 30 knot onshore wind results in oil beaching in 3 days, landing at Cape Pembroke, Stanley, on East Falkland Island. The total volume of oil ashore (including shoreline overflow) is predicted at day 30 to be 206,992 bbls. A 30 knot wind towards the nearest trans-boundary line with Argentina results in the oil crossing the line after 8.3 days. Beaching on the Argentinean coast also occurs after 16 days, with a predicted total volume of oil ashore (including shoreline overflow) of 205,700 bbls.

6.383 For the FIST13 area, a constant 30 knot onshore wind results in oil beaching in 1.7 days, landing at Beauchêne Island, Sea Lion Islands and around the Bay of Harbours on the south coast of East Falkland Island. The total volume of oil ashore (including shoreline overflow) is predicted at day 30 to be 196,356 bbls. A 30 knot wind towards the nearest trans-boundary line with Argentina results in the oil crossing the line after 2.0 days. Beaching on the Argentinean coast also occurs after 7.8 days, with a predicted total volume of oil ashore (including shoreline overflow) of 207,000 bbls.

6.384 It should be noted that the volumes listed in Table 6.29 are specific to artificial parameters (30 knot onshore winds) and in reality, the natural variability of environmental conditions in the area would likely result in very different volumes. The constant wind conditions are very unlikely to be realistic and do not accurately represent the observed trends of the wind conditions in the area. In reality, they are highly unlikely to occur constantly for 30 days. The constant 30 knot wind requirements therefore greatly exaggerate the potential coastal and trans-boundary impact.

### 6.11.3 Potential Environmental Impacts

6.385 The potential environmental impacts of a significant hydrocarbon release in the Falkland Islands could be severe, particularly if oil reached the shoreline. The *MS Oliva* tanker spill that occurred on the coast of Tristan da Cunha serves as an example of a similar sensitive environment that suffered from such pollution.

6.386 Tristan da Cunha is part of the British overseas territory of St. Helena, Ascension and Tristan da Cunha. On the 16th March 2011, *MS Oliva* ran aground at Spinners Point on the north-west of Nightingale Island. The vessel was a 75,300 tonne bulk carrier, carrying a cargo of soya beans, and was en route from Santos, Brazil to Singapore. On Friday 18th March, the vessel started to break up due to the poor weather and sea swells. Flows of oil were reported shortly afterwards all around Nightingale Islands' coastline, as the vessels fuel oil tanks were ruptured. The oil caused considerable impact to wildlife, particularly to populations of rockhopper penguins that regularly come ashore on Nightingale Island, as the birds became instantly oiled as they unknowingly passed through the oil slicks when jumping out of the sea to come ashore. There were also impacts on the local fishery, as fishing activities on and around Nightingale Island remained closed for a considerable period after the accident. The cleanup efforts and assessment of the environmental impacts are still ongoing to this day (*Tristandc website, 2014*).

6.387 There is general concern within the Falkland Islands community that a significant hydrocarbon release in the Falkland Islands could have similar far reaching consequences.

#### Potential Impacts on Birds

6.388 Seabirds rafting on the surface of the water are vulnerable to the effects of a hydrocarbon release. Oil clings to their feathers, reducing the insulating properties of their plumage. This can subsequently lead to hypothermia and possibly eventual mortality. Birds are also vulnerable to the toxic effects of hydrocarbons through ingestion of the oil through attempted cleaning of their plumage and through the potential ingestion of contaminated prey. Birds are particularly vulnerable to hydrocarbon spills on water as they often show no avoidance behaviour of oiled areas.

6.389 The above stochastic oil spill modelling study has shown that, in the event of a significant hydrocarbon release, the majority of oil weathers offshore under the influence of the prevailing winds and currents. It is therefore possible that extensive oiling of offshore surface waters could occur in the event of a significant hydrocarbon release. As shown in the environmental baseline section, there is the potential for a wide variety of seabird species to be present in the vicinity of the Noble license areas (refer to Section 4.3.7).

6.390 Species likely to be present in the vicinity of the Noble license areas include penguin, albatross and petrels. Of the penguin species recorded offshore the king penguin, rockhopper penguin, Magellanic penguin, macaroni penguin and chinstrap penguin may be present across the Noble license areas. Penguins can forage great distances offshore offshore, but predominantly stay closer to the shore. Black-browed albatross, grey-headed albatross, northern and southern royal albatross, light-mantled sooty albatross, wandering albatross and shy albatross are likely to be present in the vicinity of Noble licenses throughout the year. Petrels known to be present in the vicinity of the Noble license areas include southern giant petrel, northern giant petrel, Antarctic petrel, cape petrel, blue petrel, kerguelen petrel, soft-plumaged petrel, Atlantic petrel, grey petrel, white chinned petrel, Wilson's storm petrel, grey-backed storm petrel, black and white bellied storm petrel, diving petrel, great shearwater and sooty shearwater. The great shearwater and cape petrel were the most frequently observed species during recent Noble commissioned seismic surveys. Other seabird species likely to be present across include various prion species, skua species including catharacta skua and long-tailed skua, gull species including kelp gull, and tern species including Arctic tern (refer to Section 4.3.7).

6.391 There may also be potential coastal impacts from a significant hydrocarbon release. The stochastic oil spill modelling has shown that in most of the worst case uncontrolled release scenarios, there is a chance of oil beaching under certain conditions, although the majority of oil weathers offshore. As such, individuals present near to the coast, or at coastal breeding sites, may also be affected.

### Potential Impacts on Fish

6.392 There is evidence that fish have the ability to detect oil contaminated waters through olfactory (smell) or gustatory (taste) systems (*DCENR, 2011*) and therefore avoid areas contaminated with oil. This may disrupt migration, feeding or spawning patterns for some fish species by altering their routes due to the avoidance of contaminated areas. Evidence suggests that juveniles and larvae are more susceptible to oil spills, as they often lack the ability to actively move away from contaminated areas (*DCENR, 2011*).

6.393 Fish species known to spawn in the vicinity of the Noble license areas include the Patagonian toothfish (peaks in May and July through to August), and grenadier during March-April in more northerly areas. Other species occurring regularly across the Noble license areas include skate and rays, and rock cod (refer to Section 4.3.5).

6.394 It is appreciated that the crested spiny plunderfish (*Harpagifer palliolatus*), endemic to the Falkland Islands, is of conservation importance. However, the depth range of the species is stated in Section 4.3.5 as to be within the littoral zone (between 40 and 50 metres) (Hureau, 1990). As this species is clearly associated with inshore waters, for the vast majority of impacts there is no potential impact pathway, and therefore the plunderfish was not considered further within the document. In addition, although a variety of fish species could potentially be impacted by a large oil spill in the event that a significant volume of oil beaches, the model is unable to take account of these potential ecological impacts numerically. In addition, due to the low likelihood of such an impact occurring, and due to the project activities being offshore, it is not appropriate to consider individual coastal species in any great detail.

### Potential Impacts on Marine Mammals

6.395 It has been rare for marine mammals to be affected following an oil spill (*DCENR, 2011*) as they are able to move away from contaminated areas and often have the ability to move greater distances away from spills. Marine mammals are not commonly impacted by physical oiling nor are they subject to sensitivity to cold through oiling as they have a thick insulation of internal blubber to keep them warm. However, due to the extent of oiling in the event of a worst case scenario hydrocarbon release (loss of hydrocarbons due to an uncontrolled well flow [blow-out]), the typical avoidance behaviour commonly exhibited by marine mammals to areas contaminated by oiling may not be possible, or limited to some extent. There may also be potential coastal impacts from a hydrocarbon release, which could include both Beauchêne and Sea Lion Islands as shown by the above stochastic oil spill modelling from the FIST13 area. As such, individuals at coastal breeding sites may also be affected. Marine mammals may also be impacted through ingestion of toxic oil particles, and exposure to volatile hydrocarbon fractions as they evaporate near the water's surface where cetaceans surface to breathe. Irritation of the skin and mucous membranes may also be possible through direct contact (*DCENR, 2011*). The stressors above may also make individual marine mammals susceptible to secondary infections from bacteria and fungi if their immune system becomes compromised in some way.

6.396 Cetacean species most frequently encountered across the Noble licence areas are sei whale, fin whale, Antarctic minke whale, sperm whale, Southern bottlenose whale, long finned pilot whale, southern right whale, killer whale, Commersons Dolphin, Peales Dolphin and hourglass Dolphin. With regard to pinniped species, South American sea lion, southern elephant seal, South American fur seal and the rare leopard seal are known to be present in the wider Falkland Islands region. The South American fur seal has historically been sighted within the vicinity of the Noble license areas. The baseline data suggests that the presence of other species is unlikely but may be possible in the event of long foraging trips that the animals sometimes make (refer to Section 4.3.6).

### Potential Human Impacts

6.397 Any significant, negative, environmental impact from the exploration drilling programme such as a large unintentional release of hydrocarbons (e.g. a well blowout) resulting in an offshore oil spill, has the potential to directly or indirectly affect the communities and businesses based on the Falkland Islands. This type of accidental event is likely to be perceived by Falkland Islands residents as a 'national event' that has the potential to impact the onshore economy, revenue generated from the fishing industry and the reputation of the Falkland Islands as an international destination for tourism.

6.398 According to the results of the stochastic oil spill modelling (refer to Section 6.11.2 above), the potential offshore area impacted by a significant hydrocarbon release is potentially large, as the majority of oil is predicted to weather offshore under the influence of the prevailing winds and currents.

6.399 Immediately following an oil spill, the area of sea affected by hydrocarbons will not be available for fishing purposes due to the physical presence of the oil, any vessel operations that may potentially be involved in the clean-up and response effort, and from the potential presence of impacted sea life. From this time, fishing companies, which may include multiple companies, will be forced to seek out alternative fishing grounds outside of the affected area, until any flow of oil can be halted and the clean-up response effort is complete.

6.400 The total surface area of the sea that will be unavailable for fishing depends upon the total volume of oil released into the marine environment, the way it disperses from the point of release under the influence of prevailing wind and hydrodynamic conditions, and the size of the affected area. Longer-term impacts to the fishing industry could occur from a combination of potential impacts upon the functionality of key commercial fish habitats, and a potential loss of reputation for sea produce from a perception of degraded environmental quality affecting international exports. These impacts could potentially result in a loss of catch volume and a reduction in market sale price per kilo for key commercial fish species, significantly reducing the revenues of fishing companies and FIG taxation amounts.

6.401 The success of the tourism industry in the Falkland Islands is based upon the expectation of visitors experiencing pristine environmental conditions and an opportunity to see unique wildlife. Consequently, the potential impacts to the tourism industry will depend on whether or not the oil beaches, the exact location of any shoreline beaching, the total volume beached, the tourism-sensitivity of the beaching locations and the extent to which the incident affects the Islands reputation as an international tourist destination.

6.402 A significant oil spill event has the potential to result in an initial rise in the cancellations of holidays and cruise ship calls which has the potential to reduce the revenue of tourism businesses. In addition, the potential socio-economic impact of a significant oil spill could continue affecting the tourism industry long after the clean-up response effort has been completed. As stated above, this type of incident has the potential to damage the tourism brand of the Falkland Islands and may result in traveller misconceptions about the exact extent of shoreline pollution and its potential impact upon the local wildlife. This last point is particularly important, as potential travellers to the region could potentially be inundated with media information, broadcasting repeated pictures of damaged coastline (sometimes the same stretch) and impacted wildlife, even though the majority of the Falkland Islands environmental condition could remain largely unaffected.

## 6.11.4 Uncontrolled Gas Release during Drilling – Appendix A 11.1

6.403 Potential impacts on of an uncontrolled gas release during drilling are mainly related to atmospheric emissions as a result of the gas entering the atmosphere. The atmospheric emissions from an uncontrolled release will result in a minor deterioration of air quality over the local area and will dissipate within a short distance from their source, before significant air quality deterioration is a factor. Therefore, significant impacts upon air quality are not expected unless the uncontrolled release continues for some time.

6.404 However, the atmospheric emissions will contribute to the overall pool of greenhouse gasses (GHGs) in the atmosphere. GHGs differ in their ability to trap heat in the atmosphere; carbon dioxide has the lowest ability to trap heat, whilst of the emissions discussed here, nitrous oxide has the greatest ability, although it is emitted in much smaller amounts. An uncontrolled release of gas during drilling has the potential to add significantly to the GHGs in the atmosphere.

6.405 Such an event is considered to have a likelihood of *unlikely*. Such instances are known to have happened but are not common and as a rule are very rare. However, should an uncontrolled release occur, it has the potential to have a severity of *moderate* especially if the release happens for some time. As a result the unmitigated potential impact is considered to be **medium** on a precautionary basis.

### 6.11.5 Unintentional Release of Fuels or other Fluids – Appendix A 11.2

6.406 The significance of the resulting potential impacts on environmental receptors (e.g. water quality, plankton, bird, fish and marine mammal species) will depend on the size, location and nature of the spill and the receptors. Unintentional releases of fuel or other fluids are generally small in volume. Compared to other types of spills, small releases are the more frequent type of release than larger spills, although this does not suggest that they are commonplace (see Section 6.11.1). As a result, the likelihood of an impact occurring is considered *possible*. Based on the volumes being relatively small in most instances, the severity of an impact occurring is considered, on a precautionary basis as being *major*. Therefore, the unmitigated potential impact is considered to be **medium**.

6.407 For benthic communities in deep water and for coastal populations of seabirds, the likelihood of an impact occurring is considered to be *unlikely*, as the majority of unintentional releases will have dissipated long before they can impact these receptors, either due to the great water depth, or the great distance to shore. Due to the water depth and distance to shore, any material that does reach these receptors will be in very small concentrations and as a result the severity of the impact is considered *minor*. Therefore, the unmitigated potential impact is considered **low**.

6.408 Potential impacts to fishing activity and tourism will generally be as a result of impacts to fish species targeted by the fishing industry and impacts to birds and marine mammals which tourists are keen to observe. Given the medium impact to these receptors above, without mitigation measures, the potential likelihood of an impact is considered *possible*. The severity of the impact is considered *major* and therefore potential impacts to the fishing and tourism industries without mitigation are considered to be **medium**.

### 6.11.6 Emergency Incident (e.g. vessel collision) – Appendix A 11.3

6.409 The significance of the resulting potential impacts of an emergency incident on environmental receptors (e.g. water quality, plankton, bird, fish and marine mammal species) will again depend on the size, location and nature of the spill and the receptors. Assessment of the worst case scenario (complete loss of hydrocarbon inventory due to a collision) is considered to have a likelihood of possible and a severity of *severe*, due to the potential for decreases in water quality, oiling of birds, and ingestion of contaminants by fish and marine mammals. Therefore, the potential impact without mitigation is considered as **high**.

6.410 For benthic communities in deep water and for coastal populations of seabirds, the likelihood of an impact occurring is considered to be *unlikey*, as the majority of marine diesel and other contaminants will have dissipated before they can impact these receptors, particularly due to evaporation and weathering reducing the volume of any releases. As a result the severity of the impact is considered *moderate* and the unmitigated potential impact is considered **medium**.

6.411 Potential impacts to fishing activity and tourism will generally be as a result of impacts to fish species targeted by the fishing industry and impacts to birds and marine mammals which tourists are keen to observe. Given the medium impact to these receptors above, without mitigation measures, the potential likelihood of an impact is considered *possible*. The severity of the impact is considered *severe* and therefore potential impacts without mitigation to the fishing and tourism industries are considered to be **high**.

### 6.11.7 Uncontrolled Release of Reservoir Hydrocarbons (blow-out) – Appendix A 11.4

6.412 The significance of the resulting potential impacts on bird, fish and marine mammal species will depend on the size, location and nature of the spill and the receptors. Assessment of the worst case scenario for seabirds (loss of hydrocarbons due to an uncontrolled well flow [blow-out]) is rated as **high** based upon a likelihood of *unlikely* (as such instances are known to happen but have done so only rarely) and a severity of *catastrophic*. Assessment of the worst case scenario for fish (loss of hydrocarbons due to an uncontrolled well flow [blow-out]) is rated as **high** due to the potential presence of sensitive life stages (e.g. eggs and larvae). Again, the assessment is based upon a likelihood of *unlikely* (as such instances are known to happen but have done so only rarely) and a severity of *catastrophic*.

6.413 For marine mammals the significance of the resulting potential impacts will again depend on the size, location and nature of the hydrocarbon release and the receptor. Assessment of the worst case scenario (loss of hydrocarbons due to an uncontrolled well flow [blow-out]) is rated as **high**. This is again based upon a likelihood of *unlikely* (as such instances are known to happen but have done so only rarely) and a severity of *catastrophic*.

6.414 Without mitigation measures, the potential impacts to the fishing and tourism industries are considered to be **high**. Again this is based upon a likelihood of *unlikely* (as such instances are known to happen but have done so only rarely) and a severity of *catastrophic*.

### 6.11.8 Mitigation & Monitoring

6.415 Mitigation measures for accidental releases can aim at both reducing the likelihood of the release occurring, or minimising the severity of its effects should it occur. Particular focus should be given to the former in the first instance. Table 6.31 summarises the main mitigation measures that Noble will have in place for accidental release mitigation and control. These mitigation measures are designed to address the potential for a release to occur and to control a release in the unlikely event that one may occur. They are not targeted at any particular receptor or receptor group but are designed as a suite of measures through which the application of should reduce the potential impacts to all receptors.

6.416 At this stage, seasonal time restrictions based on data that is either not available or incomplete would be inappropriate and could lead to an inaccurate level of concern being attached to different times of the year - which could equally under or over-estimate sensitivity. In addition, seabird sensitivity indices to oil spills should be treated with caution, as they cannot be taken as proof of species presence or absence at specific times of year.

***Table 6.31: Possible sources of unintentional releases and mitigation/control measures planned***

| Potential Source of Accidental Release | Control Measures Planned |
|---|---|
| **Potential unintentional releases of fuel or other fluids (e.g. diesel, drilling mud, hydraulic oil or lubricants) during day-to-day operations (including re-fuelling)** | The drilling rig will be fitted with closed drainage containment, treatment and monitoring systems in all environmentally critical areas as part of the rig specification. Procedures for drainage water management will be addressed within the drilling contractor's documentation and the DMPO.<br><br>Noble will ensure that the drilling and OSV contractors have procedures for fuel bunkering. These procedures will be subject to audit/assessment prior to drilling operations commencing.<br><br>Offshore bulk materials and fluid transfers will be minimised where possible, making efficient use of OSV loads and voyages.<br><br>Re-fuelling and transfer of bulk fluids will be undertaken during daylight |

| Potential Source of Accidental Release | Control Measures Planned |
|---|---|
| | hours only. Fluid transfer and crane operations will take place only in suitable weather conditions. Transfer operations will be supervised at all times both from the OSVs and drilling rig.<br><br>Non-return valves will be installed on bulk fluid transfer hoses. Hoses will be tested and inspected as a part of the drilling contractor's planned maintenance system / procedure.<br><br>Spill kits will be readily available on deck for mopping up any minor spills. Personnel will be trained in unintentional release prevention and the use of spill kits. Regular drills will be held to contain and clean up deck spills.<br><br>To prevent losses of drilling mud, the marine riser system will be operated and maintained in good order as per Noble and drilling contractor policies, including:<br><br>• Lower Marine Riser Package (LMRP) to have integrated Remotely Operated Vehicle (ROV) remote interfaces for emergency use;<br>• Use of low pressure alarms in the riser system;<br>• Rig Emergency Disconnect System (EDS) locked-out in normal operation;<br>• Regular LMRP inspection with rig ROV; and<br>• Regular riser-tensioner system inspection.<br><br>All contracted vessels will have a Ship-board Oil Pollution Emergency Plan (SOPEP) in place to define their response procedures in the event of a pollution incident.<br><br>Drilling chemicals will be selected on the basis of environmental performance as much as possible within the mud programme, so as to reduce any potential environmental impacts.<br><br>Noble will have Tier 1 response packages available in order to provide a timely and efficient Tier 1 spill response effort (refer to Tier 1 Response below).<br><br>An Oil Spill Response Plan (OSRP) will be developed and implemented prior to drilling operations commencing.<br><br>All instances of unintentional release will be handled in accordance with Falkland Islands Government Petroleum Operations Notice 8, May 2012 Revision (hereafter referred to as PON 8). In particular, the use of dispersants will be coordinated with Incident Command as defined in the National Oil Spill Contingency Plan (NOSCP) as noted in Section 3 of PON 8 for approval and usage conditions. |
| **An emergency incident (e.g. vessel collision), leading to potential unintentional releases** | All mitigation measures associated with collision avoidance as defined in Section 6.1.2 (Physical Presence).<br><br>Pre-mobilisation audits/assessments will be undertaken on all vessels. Vessels will be selected which comply with IMO codes for pollution prevention.<br><br>All contracted vessels will have a SOPEP in place to enable fast and effective response to any potential pollution incident.<br><br>An Emergency Response Plan (ERP) and Oil Spill Response Plan (OSRP) will be developed and implemented prior to drilling operations commencing. |

| Potential Source of Accidental Release | Control Measures Planned |
|---|---|
| | All instances of unintentional release will be handled in accordance with Falkland Islands Government Petroleum Operations Notice 8, May 2012 Revision (hereafter referred to as PON 8). In particular, the use of dispersants will be coordinated with Incident Command as defined in the National Oil Spill Contingency Plan (NOSCP) as noted in Section 3 of PON 8 for approval and usage conditions. |
| **Uncontrolled release of reservoir hydrocarbons (blow-out).** | The drilling operations will follow established drilling safety standards to minimise the risk of loss of well control. Well control systems and procedures will be in place as per all Noble and drilling contractor well control guidelines.<br>The drilling crews will be adequately experienced, trained in well control techniques and supervised at all times. Emergency drills will be held regularly.<br>Well designs will be reviewed by an independent well examiner.<br>A Blow-out Preventer (BOP) will be in place 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.<br>The BOP will be subject to a third party verification and audit prior to drilling operations commencing.<br>The BOP specification will include one (1) shear ram, one (1) casing shear ram and a ROV remote interface to key BOP functions for emergency use.<br>All key offshore personnel will have International Well Control Forum (IWCF) well control certification.<br>Noble is a FULL member of Oil Spill Response Limited (OSRL), providing an enhanced Tier 2/3 oil spill response capability (refer to Tier 2/3 response below).<br>Noble is a member of the Global Dispersant Stockpile provided by OSRL for the purpose of responding to unintentional releases.<br>An Emergency Response Plan (ERP) and Oil Spill Response Plan (OSRP) will be developed and implemented prior to drilling operations commencing.<br>All instances of unintentional release will be handled in accordance with Falkland Islands Government Petroleum Operations Notice 8, May 2012 Revision (hereafter referred to as PON 8). In particular, the use of dispersants will be coordinated with Incident Command as defined in the National Oil Spill Contingency Plan (NOSCP) as noted in Section 3 of PON 8 for approval and usage conditions. |

6.417 Further detail on the OSRP and ERP is provided below.

- **Oil Spill Response Plan (OSRP):** An OSRP will be produced for the proposed drilling operations. The OSRP is a document that is intended for use in an oil spill situation so that the appropriate response measures can be implemented in a timely, organised and efficient manner. The plan will define roles and responsibilities, and the response procedures to be followed in the event of a hydrocarbon release. The OSRP will align with the existing Falkland Islands National Oil Spill Contingency Plan (NOSCP) in place for the Falkland Islands as required. The OSRP will be approved by the FIG Department of Mineral Resources prior to drilling operations commencing. Implementation of the plan will involve:

  - Familiarising all relevant personnel and contractors with the plan and their responsibilities and expectations in the OSRP;
  - Issue of the plan to OSRL for review prior to the drilling rig coming onto contract with Noble and for storage in their operations room ready for reference;
  - Training of key personnel in Noble so that they are familiar with oil spill response principles;
  - Testing of the plan through a table-top exercise prior to drilling operations commencing. Lessons learned should be fed back into the organisation and into the OSRP as necessary.

- **Emergency Response Plan (ERP):** An Emergency Response Plan (ERP) will be developed for the exploration drilling programme. The ERP is a document that provides a number of emergency scenarios, and details how each of these scenarios will be dealt with safely and efficiently in a real life emergency incident. The ERP will outline the procedures to be followed in the event of an emergency. A number of emergency scenarios will be covered, including severe weather, business continuity, MedEvac procedures, security, and emergency evacuation. Implementation of the plan will involve:
  - Issue and familiarising of the plan to key personnel and contractors so that they are familiar with their roles and responsibilities in an emergency situation;
  - Training of key personnel in Noble so that they are familiar with the principles of Emergency Response and their responsibilities and expectations within the ERP;
  - Testing of the plan through a table-top exercise prior to drilling operations commencing (which would likely be combined with an exercise to test the OSRP). Lessons learned should be fed back into the organisation and into the ERP as necessary.

6.418 In addition, all instances of unintentional release will be handled in accordance with Falkland Islands Government Petroleum Operations Notice 8, May 2012 Revision (hereafter referred to as PON 8). In particular, the use of dispersants will be coordinated with Incident Command as defined in the National Oil Spill Contingency Plan (NOSCP) as noted in Section 3 of PON 8 for approval and usage conditions.

6.419 As part of the above mitigation measures, Noble will have the following oil spill response measures in place.

### Tier 1 Response

6.420 Noble has identified Tier 1 response packages which will be in place prior to drilling operations commencing. The Tier 1 response packages will consist of offshore and onshore elements.

#### *Offshore*

6.421 The offshore spill response package will consist of an offshore oil containment boom and skimming system, type 2/3 chemical dispersant, and portable dispersant spray sets suitable for deployment from the OSVs, or vessels of opportunity.

6.422 Dispersant application would be achieved through the use of up to 2 vessel mounted spray systems and oil spill dispersant, stored in 1m$^3$ Intermediate Bulk Container (IBC) tanks, with a suggested minimum of 4 IBCs stored on each vessel. Two of the three OSVs will be outfitted with a vessel mounted dispersant spray system.

6.423 In summary, the offshore equipment package will consist of the following:

- 200m x 1500m offshore oil boom: c/w diesel hydraulic driven boom reel, tow ropes, all fixtures, fittings, power pack, plus air inflator.
- 1 x offshore oil skimmer: c/w diesel driven power pack & hoses.

- 2 x 25m$^3$ temporary floating storage bladders: c/w hoses, etc.
- 1 x diesel driven transfer pump: c/w all hoses & fittings.
- 5 x bales each of sorbent pads, boom & rolls.
- 1 x sealed plastic fish tote with spares, basic PPE.
- 3 x diesel driven dispersant spray systems (1 ashore & 2 offshore).
- 20 x 1m$^3$ IBC of oil spill dispersant (20 x IBC total).

### *Onshore (Harbour / Shore Base)*

6.424 Onshore response equipment will be kept at both the shore base and the TDF. The spill response package will include an oil and chemical spill response capability.

6.425 For the onshore response equipment, a foam-fill/ contractor type boom, a small portable (hand carry) skimmer, a collapsible storage tank, basic PPE suitable for first responders and sorbents, plastic totes for various small items and spares, have been chosen.

6.426 In summary, the onshore equipment package will consist of the following:

- 1 x harbour oil skimmer: c/w diesel driven power pack, pump & hoses.
- 500ft x 20in contractor type boom: c/w tow systems & anchor sets (6).
- 1 x 10m$^3$ temporary oil/ water storage tank: c/w groundsheet & cover.
- 7 x Fish Totes containing 2,000 pads, 200m boom & HD waste bags.
- 2 x Chemical Sorbent Spill kits (wheeled tote).
- 1 x Sealed plastic fish tote, c/w spares, hand tools & basic PPE.

### Tier 2/3 Response

6.427 Noble is a full member of Oil Spill Response Limited (OSRL). OSRL are an international oil spill response organisation. This gives Noble access to the OSRL equipment stockpile, personnel and resources 24 hours a day, 365 days per year. OSRL are available to assist at any time with oil spill response operations and to advise on potential spill response strategies. OSRL are able to provide aerial surveillance services, aerial dispersant spraying, at sea containment and recovery operations and coastal protection and clean-up resources.

6.428 If mobilised, the OSRL team will be primarily operating in the field, and will establish a command centre appropriate to the needs of the response operations.

6.429 On notification / mobilisation during an incident, the OSRL Duty Manager can offer over the phone advice and guidance on response strategies. During the early stages of a spill, OSRL may provide a number of services, including:

- Oil spill computer modelling;
- Guidance on oil weathering and movement;
- Advice on appropriate response strategies;
- Aerial surveillance services;
- Planning for deployment of equipment for shoreline protection and clean-up operations; and
- Information and advice on access to one of the pre-positioned well capping stacks.

6.430 OSRL can also mobilise a Technical Advisor to the operator's in-country emergency response facilities to support the response.

### 6.11.9 Residual Impacts

#### Uncontrolled Gas Release during Drilling

6.431 A worst case scenario consisting of a well control incident involving the significant release of hydrocarbons as gas is highly unlikely. Noble will implement numerous well control procedures and prevention measures to minimise the occurrence of such a scenario, as well as minimising the risk of all unintentional releases, regardless of size.

6.432 In summary, due to the prevention and response measures that Noble will have in place and through the implementation of the above plans, the likelihood is considered to be reduced to *unlikely* and the potential severity to *negligible*. Therefore, the residual impact to receptors through an unintentional release occurring is rated as **low**.

#### Unintentional Release of Fuels or other Fluids

6.433 Small unintentional releases from routine operations are possible, but given the control measures that Noble will have in place as described in Table 6.30 above, are unlikely to occur. The drilling contractor will have spill control procedures in place for the drilling rig. These procedures will outline the measures to be taken to prevent unintentional releases to the environment and the measures to be put in place should small releases occur. With the measures in place to prevent unintentional releases the likelihood will be reduced to *unlikely* and with the measures in place to clean up after such an incident the severity will be reduced to *minor*. Therefore, the residual impact is considered to be **low**.

#### Emergency Incident (e.g. vessel collision)

6.434 A worst case scenario consisting of a collision leading to a complete loss of inventory is highly unlikely. The measures in place to prevent a collision from occurring will minimise the risk of such an event taking place. If such an incident were to occur, the measures in place to deal with the incident will ensure that any potential impacts are reduced. Due to the prevention and response measures that Noble will have in place the likelihood is considered to be reduced to *unlikely* and the potential severity to *major*. Therefore, the residual impact to receptors through an unintentional release occurring is rated as **medium**. However, residual impact to benthic communities and coastal populations of seabirds are considered to be reduced to **low**, due to the likelihood being reduced to *unlikely* and the severity to *moderate*.

6.435 Residual impacts to fishing and tourism activities from an emergency incident are expected to be **medium** in the short-term, as all available resources are used as part of the wider clean-up and response effort. The measures in Table 6.31 above will reduce the likelihood of an impact occurring to *unlikely*, although the severity will remain as *moderate*.

#### Uncontrolled Release of Reservoir Hydrocarbons

6.436 A worst case scenario consisting of a well control incident involving the significant release of hydrocarbons (well blow-out) operations is highly unlikely. Noble will implement numerous well control procedures and prevention measures to minimise the occurrence of such a scenario, as well as minimising the risk of all unintentional releases, regardless of size.

6.437 In summary, due to the prevention and response measures that Noble will have in place and through the implementation of the above plans, the likelihood is considered to be reduced to *unlikely* and the potential severity to *severe*. Therefore, the residual impact to receptors through an unintentional release occurring is rated as **medium**.

6.438 Residual impacts to fishing and tourism activities from a significant hydrocarbon release are expected to be **medium** in the short-term, as all available resources are used as part of the wider clean-up and response effort. After the necessary clean-up and response effort has demobilised, the tourism industry is expected to gradually recover. In the long-term, the residual impact could be **low-medium**, depending upon the extent of the hydrocarbon release, timing in relation to the tourist season, location of any impacted areas and the overall success of the clean-up and response effort.

## 6.12 Trans-boundary Impacts

6.439 Due to the remote location of the proposed drilling operations in the South Falkland basin, all of the routine activities to be completed as part of the drilling operations are unlikely to have any significant impacts on the marine environment within the territorial waters of adjacent territories.

6.440 However, there are three main areas that do have the potential for trans-boundary impacts:

- Atmospheric emissions of greenhouse gasses;
- Accidental hydrocarbon releases; and
- Trans-boundary movements of hazardous waste.

6.441 Table 6.32 shows the distances from the potential exploration well top-hole locations to the neighbouring international trans-boundary lines of the Falkland Islands.

***Table 6.32: Distances from potential top-hole well locations to the nearest neighbouring international trans-boundary line locations of adjacent territories (in reference to the FOCZ)***

| | | Argentina | South Georgia and the South Sandwich Islands | Edge of Falkland Islands / Atlantic Ocean |
|---|---|---|---|---|
| FISA12 | Finback-1 | 253 km | 542 km | 231 km |
| | Humpback-1 | 264 km | 535 km | 225 km |
| | Caperea-1 | 227 km | 554 km | 233 km |
| FIST13 | Scharnhorst North-1 | 76 km | 730 km | 77 km |

### 6.12.1 Atmospheric Emissions

6.442 The atmospheric emissions from the proposed exploration drilling programme will result in a minor deterioration of air quality over the local area and will dissipate to negligible levels within a short distance from their source, before trans-boundary air quality deterioration is a factor. Therefore, trans-boundary impacts upon air quality are not expected.

6.443 However, the exploration drilling programme atmospheric emissions will contribute to the overall pool of greenhouse gasses (GHGs) in the atmosphere. GHGs differ in their ability to trap heat in the atmosphere; carbon dioxide has the lowest ability to trap heat, whilst of the emissions discussed here, nitrous oxide has the greatest ability, although it is emitted in much smaller amounts.

6.444 The ability of a GHG to trap heat is described as its Global Warming Potential (GWP) (further details on GWP are given in Appendix F). GWP is defined as the ratio of the time-integrated radiative forcing from the instantaneous release of 1 kg of a trace substance relative to that of 1 kg of a reference gas (for this purpose $CO_2$ is commonly recognised as the reference gas for GWP). As such, GWP is a measure of the relative radiative effect of a given substance compared to $CO_2$, integrated over a chosen time horizon.

6.445 The GWP value depends on how the gas concentration decays over time in the atmosphere. This is often not precisely known and hence the values should not be considered exact. For this reason when quoting a GWP, it is important to give a reference to the calculation. Typically, a time horizon of 100 years is used by regulators, as calculating GWP beyond 100 years is difficult based on the increasing number of uncertainties in the calculations (*IPCC, 1995*). Carbon dioxide is given a reference GWP of 1 to which other greenhouse gases are compared, while nitrous oxide has a GWP that is 310 times greater than carbon dioxide. The GWP of methane is 21 times greater than carbon dioxide.

6.446 $CO_2$ Equivalency is a quantity that describes, for a given mixture and amount of GHG, the amount of $CO_2$ that would have the same global warming potential (GWP), when measured over a specified timescale (generally, 100 years). For a given gas emission, the $CO_2$ Equivalent is calculated as follows:

**[Gas emission (Tonnes)] X [GWP for the emitted gas] = Total in Tonnes of $CO_2$ Equivalent**

6.447 The estimated atmospheric emissions for carbon dioxide ($CO_2$), nitrous oxide ($N_2O$) and methane ($CH_4$) for the exploration drilling project are displayed in tonnes in Table 6.33 and then expressed as GWP equivalents of $CO_2$ over a time horizon of 100 years, using factors from the United Nations Framework Convention on Climate Change (*UNFCCC, 2013*) and applied to units of mass for gasses.

***Table 6.33: Global warming potential of the exploration drilling emissions***

| Gas | Global Warming Potential (*UNFCCC, 2013*) | Quantity Emitted (tonnes) | Total in Tonnes of $CO_2$ Equivalent($C0_{2eq}$) (Based on Gas' GWP) at 100 years |
|---|---|---|---|
| $CO_2$ | 1 | 67,904.45 | 67,904.45 |
| $N_2O$ | 310 | 4.66 | 1,444.60 |
| $CH_4$ | 21 | 3.73 | 78.33 |
| Total Tonnes of $C02_{eq}$ | | | 69,427.38 |

*Note 1: The GWP for methane includes indirect effects of tropospheric ozone production and stratospheric water vapour production.*

*Note 2: Quantities of emitted $CO_2$, $N_2O$ and $CH_4$ have been taken from Section 2 – Table 2.19 (Section 2.5.2).*

6.448 Table 6.33 shows that the Noble drilling campaign will generate 69,427.38 tonnes of $C0_{2eq}$ by the cessation of operations. To put this in context, in 2012 the Crown Dependencies and relevant Overseas Territories (consisting of Jersey, Guernsey and the Isle of Man, and the Overseas Territories of the Cayman Islands, Falkland Islands, Bermuda, Montserrat and Gibraltar) emitted 584.3 million tonnes of $C0_{2eq.}$ Of this total, 485.5 million tonnes of $C0_{2eq}$ originates from the energy sector (*Webb, 2014*). The tonnes of $C0_{2eq}$ generated by the Noble exploration drilling campaign represent less than 0.014% of the energy sector value.

6.449 However, to put this figure into a more local context, the total $CO_2$ emissions from the Falkland Islands in 2012 are reported as 46,000 tonnes (*US Energy Information Administration, 2014*). These emissions mainly come from domestic power generation. This shows that, in a local context, the drilling operations will produce over 23,400 tonnes more $CO_{2eq}$ than the Falkland Islands produces annually.

6.450 GHGs have the potential for trans-boundary impacts, as they contribute to the overall pool of GHGs in the atmosphere. Trans-boundary air pollution is a particular problem for gasses that are not easily destroyed or react in the atmosphere to form secondary pollutants. These are cross-boundary pollutants that can be generated in one country and potential effects felt in others, although such effects are very difficult to quantify. Trans-boundary air pollutants can survive for periods of days or even years and can be transported hundreds or thousands of miles. They can cause a number of different problems, e.g. formation of particles, ground level ozone which is hazardous to health, the formation of acid rain and some that are toxic to human health and the environment.

6.451 The emissions presented in Table 6.33 are an inventory of emissions based on the emissions calculated in Table 2.19 in Section 2, which are calculated on the basis that no mitigation measures have been applied. These levels are calculated on the basis that the mitigation measures to address atmospheric emissions outlined in Section 6.2.1 have not been applied. The measures outlined in Section 6.2.1 are provided as mitigation to reduce the potential emissions provided in Table 6.33 from the exploration activity and are equally applicable to the potential trans-boundary impacts of emissions produced during exploration drilling. It is expected that these measures will go some way to reducing the quantity of emissions produced but at this stage the exact quantification of the reduction in atmospheric emissions is not possible as post mitigation data are not available.

6.452 The atmospheric emissions will result in a minor deterioration in air quality over the local area and will dissipate to negligible levels within a short distance from their source. However, due to the likely high existing air quality offshore due to the lack of other anthropogenic activities in the surrounding area (i.e. very low commercial shipping activities and oil and gas activities) the severity of the potential impact has been assessed as *minor*. As the emissions will happen the likelihood of the unmitigated potential impact has been assessed as *certain*. Therefore, on a precautionary basis the potential trans-boundary impact has been assessed as **medium**.

#### Mitigation

6.453 Mitigation measures for atmospheric emissions have been fully described above in Sections 6.2.1 and 6.2.2.

#### Residual Impact

6.454 The above assessment of the GWP of the expected emissions from the proposed exploration drilling project has shown that the tonnes of $C0_{2eq}$ generated by the Noble exploration drilling campaign would represent less than 0.014% of the combined 2012 $C0_{2eq}$ of the energy sector of the UK Crown Dependencies and relevant Overseas Territories. Although contributions of GHGs are undesirable, this figure represents a very small contribution. The mitigation measures described above in Section 6.2.1, including extensive pre-project planning to ensure efficiency of operations, the use of modern and well maintained power generation equipment, and the requirement to all contracted vessels to control fuel use will reduce the severity of the impact to negligible. With a likelihood that remains *certain*, the residual impact is assessed as **low**. Implementation of the mitigation measures proposed above will ensure that emissions of GHGs will be kept as low as reasonably practicable.

### 6.12.2 Trans-boundary Movement of Hazardous Waste

6.455 Any hazardous waste generated as a result of the Noble drilling programme cannot be disposed of in the Falkland Islands. Its disposal becomes a trans-boundary issue, and therefore has a potential trans-boundary impact, as a trans-boundary movement (TBM) will be required.

6.456 Section 6.7 has fully described and assessed the impacts and proposed mitigation measures for the management and trans-boundary movement of hazardous waste. Implementation of the mitigation measures proposed by Noble will ensure that potential trans-boundary impacts from hazardous waste are minimised to the extent possible by following the principles of the Basel Convention. The residual impact has been assessed as **low**.

### 6.12.3 Unintentional Hydrocarbon Releases

6.457 Significant unintentional hydrocarbon releases have the potential for trans-boundary impacts, depending on the volume of hydrocarbons released.

6.458 The above worst case 30 knot wind deterministic oil spill modelling (refer to Section 6.11.2) has shown that, in the event of a 30 knot wind towards the nearest international trans-boundary line with Argentina from the FISA12 and FIST13 areas, oil is predicted to reach the trans-boundary line in 8.3 and 2.0 days, respectively. Following this, oil is also predicted to beach on the Argentinean coastline after 16 and 7.8 days, respectively. However, it has already been explained that the constant wind conditions are unrealistic and are out of touch with the observed trends in the wind conditions in the area. In reality, they are highly unlikely to occur constantly for 30 days. The constant 30 knot wind requirements therefore greatly exaggerate the potential coastal and trans-boundary impact. It is therefore more informative to consider the stochastic spill modelling scenarios.

6.459 On consideration of the stochastic spill modelling scenarios, there is a possibility that oil could enter the offshore waters of the territories shown in Table 6.34 in the event of an uncontrolled release scenario (blowout). The table gives the predicted percentage probability range of surface oiling within the international waters of the territories shown.

*Table 6.34: Probability of surface water oiling of international waters of surrounding territories*

| Surrounding Territory | International waters potentially affected (predicted % probability range of surface oiling)* | Scenario ID (Figure) | Spill Site | Spill Event | Period (month) |
|---|---|---|---|---|---|
| South Georgia and the South Sandwich Islands | 1-25% | 5 (6.22) | FISA12 | 2D blowout | Period 1 (10-2) |
| | 1-25% | 6 (6.23) | FISA12 | 2D blowout | Period 2 (3-9) |
| | 1-10% | 7 (6.25) | FIST13 | 2D blowout | Period 1 (10-2) |
| | 1-10% | 8 (6.27) | FIST13 | 2D blowout | Period 2 (3-9) |
| | 1-10% | 9 (6.29) | FISA12 | 3D blowout | Period 2 (3-9) |
| | 1-10% | 10 (6.31) | FIST13 | 3D blowout | Period 2 (3-9) |
| Argentina | 1-75% | 7 (6.25) | FIST13 | 2D blowout | Period 1 (10-2) |
| | 1-75% | 8 (6.27) | FIST13 | 2D blowout | Period 2 (3-9) |
| | 1-90% | 10 (6.31) | FIST13 | 3D blowout | Period 2 (3-9) |

* Determined by examining the results Figures.

6.460 It can be seen that in the event of a significant hydrocarbon release in the unlikely event of a blowout, there is a risk of oil crossing the trans-boundary lines of the international waters of surrounding nations. Due to the prevailing winds and currents towards the east, the trans-boundary line of South Georgia and the South Sandwich Islands is crossed in every modelled scenario, with a predicted probability of water surface contamination ranging between 1 and 25% (refer to the corresponding Figures as listed above in Table 6.33). In addition, there is a risk of hydrocarbons crossing into the waters of Argentina in scenarios 7, 8 and 10. These are the release scenarios from the FIST13 area, with a predicted probability of water surface contamination ranging between 1 and 90% (refer to the corresponding Figures as listed above in Table 6.33). However, due to the prevailing winds and currents towards the east, it should be noted that none of the above scenarios resulted in any predicted beaching in any overseas territories.

6.461 The above spill modelling results have shown therefore, that there are potential trans-boundary impacts associated with potential water surface contamination in the unlikely event of a significant hydrocarbon release. However, it should be noted that significant uncontrolled hydrocarbon releases, such as blowouts, are extremely rare events and due to the control measures that Noble will have in place (as described above in Section 6.11.9), the risks associated with uncontrolled hydrocarbon releases are minimised as far as practicable. For that reason, and based on the assessment of an uncontrolled release (blow-out) in Section 6.11.8, the potential impact is considered to be **medium**.

## 6.13 Cumulative Impacts

6.462 Cumulative impacts with other oil and gas projects are unlikely to be significant, due to the geographical and temporal separation of the individual projects. In general, cumulative impacts have largely been avoided through the use of a rig-share agreement between Noble and Premier Oil, whereby a single rig will be used to drill offshore wells for each of these operators. The rig-share agreement aims to reduce the type and potential consequence of cumulative impacts generated between oil and gas companies to a minimum. Under this agreement, the drilling unit will be engaged in the drilling of no more than one well at any time. The drilling unit will then move off location and move on to the next well. This rig share agreement also means that support resources from onshore, including the offshore supply vessels (OSVs), helicopter flights and accommodation, will only need to support the drilling of a single well at any one time.

6.463 Cumulative impacts are those that may result from the combined or incremental effects of past, present or future activities. While a single activity may not have a significant impact when treated in isolation, it may, when combined with other impacts occurring at the same time and in the same geographical area, result in a cumulative impact that is significant.

6.464 Potential cumulative impacts with other oil and gas projects are unlikely to be significant, due to the geographical and temporal separation of the individual drilling projects. Previously drilled and proposed wells are located relatively large distances apart from each other, and from the potential top-hole well locations proposed by Noble. The drilling unit share agreement with Premier Oil also aims to reduce the type and potential consequence of cumulative impacts generated between oil and gas companies to a minimum, so that there is only one active offshore drilling unit at any one time.

6.465 The activities from the proposed exploration drilling project with the potential to generate cumulative impacts include the following:

- Disturbance to marine fauna (including seabirds) from the generation of underwater noise and vibration associated with the combined movement of vessels (i.e. the drilling unit, AHVs and OSVs);
- Changes to seawater quality from the combined effects of discharges (i.e. the discharge of treated sewage, food waste, drill cuttings and associated chemicals);
- The discharge of drill cuttings onto the sea floor combined with the cuttings generated by the drilling of additional petroleum wells from both Noble and other oil and gas operators;
- The generation of atmospheric emissions;
- The generation of waste; and
- Potential cumulative impacts from small operational spills.

6.466 Each of these is discussed in turn in the sections below.

### 6.13.1 Potential Cumulative Impacts from Underwater Noise

6.467 The drilling of the exploration wells will generate noise, both above and below the sea surface, from the drilling rig itself, from the OSVs and helicopter flights. The most significant source of noise has been identified as the potential Vertical Seismic Profiling (VSP) operations that may take place. These impacts are fully described and assessed above in Section 6.5.9.

6.468 The effects of these noise sources in combination with each other are not anticipated to cause a significant cumulative impact. This is because the VSP operations will take place after drilling operations have ceased (i.e. when the hole has been constructed). In addition, the noise sources from the OSVs, drilling unit and helicopters are sufficiently spaced apart in the operational environment so as not to create a significant cumulative impact in combination with each other.

6.469 The main potential for cumulative noise impacts arises if similar activities occur nearby at the same time as those for the Noble exploration drilling programme. Due to the rig share agreement that Noble has with Premier Oil, cumulative impacts from underwater noise are not expected.

### 6.13.2 Potential Cumulative Impacts on Seawater Quality

6.470 The discharges associated with the drilling programme (discharges of domestic food waste, treated sewage, drill cuttings and associated chemicals) are expected to have an impact on water quality in the vicinity of the exploration wells. The impacts of these discharges are fully described and assessed above in Section 6.3.

6.471 The main potential for cumulative impacts on water quality arises if similar activities occur nearby at the same time as those for the proposed Noble exploration drilling programme. Due to the rig share agreement and the relative localised impacts of these kinds of discharges, cumulative impacts on water quality are not expected, as there will be no similar activities in the vicinity of the exploration wells, or in the wider areas, at the time of the proposed exploration drilling activities in 2015. In addition, shipping in the vicinity of the proposed exploration wells is rated as very low (refer to Section 4.4.3), and therefore cumulative impacts with routine discharges from passing vessels are not expected to be occur.

### 6.13.3 Potential Cumulative Impacts on the Seabed

6.472 The discharge of drill cuttings has the potential to have cumulative impacts on the seabed. This could occur if the discharge of drill cuttings occurs from other wells in the same vicinity. The drilling programme will include the drilling of two wells; one well within the FISA12 area and one within the FIST13 area. There is also the potential for one optional well, to be drilled in either the FISA12 or FIST13 area. If the optional well is drilled, there is potential for an additional well to be drilled in the vicinity of an existing well.

6.473 The cuttings modelling study presented in Section 6.3.2 above has shown that the maximum extent of the cuttings pile during period 2 (June-August, which has been shown to be the worst case period in terms of effects on the extent of the cuttings pile due to the influence of currents) is 1,980 metres from the discharge point. Similar patterns are expected for cuttings discharge modelling at the other well sites. The wells are therefore spaced apart such that no overlap of the cuttings depositions will occur from the drilling programme. Cumulative impacts from the discharge of drill cuttings are therefore not expected.

### 6.13.4 Potential Cumulative Impacts from Waste

6.474 The exploration drilling programme will produce volumes of non-hazardous waste. It has been estimated that the three well drilling programme will generate 90 tonnes of non-hazardous waste (estimated at 30 tonnes per well). The potential use of onshore landfill for the disposal of wastes constitutes a cumulative impact associated with the planned drilling activities. Any waste that is produced that goes to landfill, regardless of its source, contributes to a cumulative impact at the landfill site. The effects of disposal of non-hazardous wastes associated with onshore disposal are dependent on the nature of the site or process.

6.475 As landfill facilities on the Falkland Islands are extremely limited in availability, this fact may exacerbate limitations on future land use and the potential for small scale land and air contamination. Although waste generated by the drilling operations will be relatively small, in the context of the limited waste facilities available on the Falkland Islands the severity of the impact is considered to be *moderate*. As waste is going to be generated the likelihood of the impact is considered to be *certain*. Therefore, the unmitigated potential cumulative impact is considered to be **medium**.

#### Mitigation Measures

6.476 Onshore waste disposal facilities in the Falkland Islands are extremely limited. Noble will work closely with FIG prior to drilling operations to determine acceptable options for onshore non-hazardous waste disposal. Only non-hazardous and inert waste streams generated during drilling may be disposed of locally where possible to do so, and will be recycled where possible.

6.477 Noble will develop and implement a Waste Management Plan (WMPA) for the proposed drilling programme that encompasses the drilling rig, OSVs and onshore support (as described in Section 6.7 above). The WMPA will cover the storage, transport and treatment of waste generated as part of the drilling programme. The WMPA will identify measures to reduce waste generated during drilling and how waste will be handled and disposed of safely and responsibly.

#### Residual Impact

6.478 The likelihood of the impact remains *certain* as waste will be generated by the project. However, through application of a WMPA and measures to reduce waste and by applying a responsible waste management strategy as described above, the severity of the impact will be reduced to *negligible*. The residual cumulative impact from waste disposal is therefore assessed as **low**.

### 6.13.5 Potential Cumulative Impacts from Atmospheric Emissions

6.479 Atmospheric emissions arising from the exploration drilling project have the potential for cumulative impacts on air quality in the area. Atmospheric emissions expected from the exploration drilling project are fully described and assessed above in Section 6.2.

6.480 Any atmospheric emissions arising from the exploration drilling project will disperse rapidly in the remote offshore environment. The atmospheric dispersion modelling presented in Section 6.2.1 above has shown that atmospheric emissions arising from drilling operations will disperse rapidly and are orders of magnitude below health or environmental guidelines (refer to Appendix G) within a short distance from their source. In addition, the waters offshore the Falkland Islands are subject to strong winds throughout the year, predominantly from a south-westerly to north-westerly direction (refer to Section 4.2.7). These winds will aid the rapid dispersion of any emissions resulting from the exploration drilling activities.

6.481 Due to the rig sharing agreement and the relatively localised impacts of atmospheric emissions (as shown by the atmospheric dispersion modelling), cumulative impacts arising from atmospheric emissions are not expected, as there will be no similar activities in the vicinity of the exploration wells, or in the wider areas, at the time of the proposed Noble exploration drilling activities.

### 6.13.6 Potential Cumulative Impacts from Small Operational Spills

6.482 It is recognised that small spills are often the most frequent type of spill in oil and gas operations. However, potential impacts through small spills are not considered to pose a significant cumulative impact, as due to the planned rig share agreement, operations of a similar nature will not occur in the vicinity of the proposed exploration well locations during the same time period. In addition, the effects of rapid natural dispersion on any Tier 1 spill in the vicinity of the drilling operations would ensure that any previous spills will have virtually disappeared before any other spills occurred (if they do occur at all).

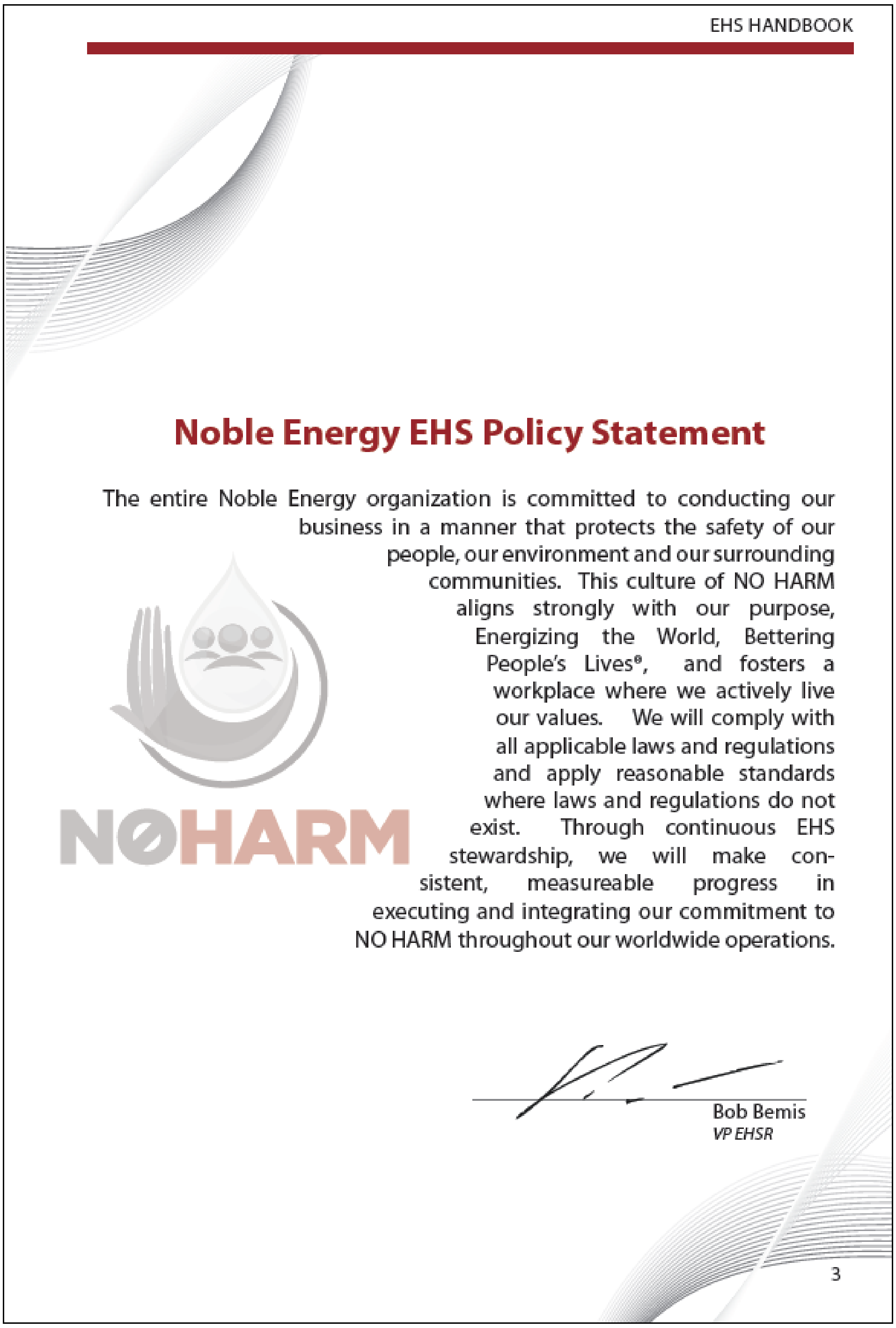
6.483 Although it is stated that, of the spills that do occur, Tier 1 type spills are the most frequent, this does not mean that Tier 1 spills are a regular occurrence. Oil spills in general are not regular occurrences. The mitigation measures proposed by Noble will ensure that the risk of spills is kept to almost nil. In addition, the provision of Tier 1 spill response equipment both for offshore and onshore at the TDF, will ensure that a rapid and efficient spill response is implemented in the event of any small unintentional releases. The spill response arrangements will be further detailed within the Oil Spill Response Plan (OSRP) that Noble will produce and submit to the Department of Mineral Resources prior to drilling operations commencing, in line with the requirements of the *Offshore Minerals Ordinance 1994 (as amended)* and Department of Mineral Resources guidelines. Based on the measures proposed in Section 6.11.8, the likelihood of small operational spills occurring is considered to be *unlikely*. The severity is considered to be *negligible*, particularly as spills are considered to be very small in size and the measures implemented will reduce the volume spilled to almost nil. Therefore, the potential cumulative impact after mitigation is considered **low**.

# 7 Environmental Management Plan (EMPA)

## 7.1 Background

7.1 Noble recognises that effective environmental, health and safety (EHS) management contributes significantly to Noble's long-term business success. Noble's EHS Policy Statement (Figure 7.1) applies to all activities where Noble has any legal and/or moral accountability, or where operations activities may present any risk to the business. The application of the EHS Policy will ensure that the Noble's responsibilities under all relevant regulations are met.

***Figure 7.1: Noble EHS Policy Statement***



EHS HANDBOOK

**Noble Energy EHS Policy Statement**

The entire Noble Energy organization is committed to conducting our business in a manner that protects the safety of our people, our environment and our surrounding communities. This culture of NO HARM aligns strongly with our purpose, Energizing the World, Bettering People's Lives®, and fosters a workplace where we actively live our values. We will comply with all applicable laws and regulations and apply reasonable standards where laws and regulations do not exist. Through continuous EHS stewardship, we will make consistent, measureable progress in executing and integrating our commitment to NO HARM throughout our worldwide operations.

NOHARM

Bob Bemis
*VP EHSR*

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7.2 As described in Section 6, the proposed exploration drilling programme will result in a range of routine interactions with the environment and the potential for non-routine activities or unintentional releases to occur. The impact assessment process has systematically identified and assessed all related potential environmental impacts associated with the execution of the exploration drilling programme. During the assessment process a number of mitigation, monitoring and management measures were identified to be used to avoid and reduce the probability and/or consequence associated with the impact. These measures were also utilised to develop the Environmental Management Plan (EMPA).

### 7.1.1 Objectives

7.3 The EMPA describes the actions and measures that will be undertaken in order to mitigate the potential impacts on the environment and community, and assigns responsibility for those actions within the Noble management system. The EMPA summarises the project's approach to managing, monitoring and reviewing its impacts for each aspect of the project that the Environmental Impact Statement (EIS) addresses.

## 7.2 Noble's Global Environmental, Health and Safety Management System (GMS)

7.4 Noble operates under a Global Environmental, Health and Safety (EHS) Management System (GMS). Noble is committed to conducting its business in a manner that protects the environment, health and safety of employees and communities. To achieve this, Noble strives to comply with EHS laws and minimize injuries and incidents whilst protecting the environment. Noble's GMS is a consistent framework for the management of EHS issues and is instrumental in protecting the environment and the health and safety of our employees and communities. Noble's GMS incorporates legal requirements and best practices under an umbrella framework consisting of 14 elements:

**Prepare**

1. Management Commitment and Employee Participation
2. Legal Aspects and Document Control
3. Safe Work and Operating Practices
4. Process Safety and Environmental Information
5. Emergency Preparedness and Community Awareness

**Execute**

6. Safety and Environmental Training
7. Contractor Safety Management
8. Pre-startup Review
9. Management of Change
10. Risk Assessment and Management

**Verify**

11. Performance Monitoring and Measuring
12. Incident Reporting, Analysis and Corrective Action
13. Management System Compliance Audit

**Perform**

14. Operational Integrity and Continual Improvement

7.5 The GMS formalises the roles and responsibilities of managers and the workforce in complying with Noble Policy. It also provides the basis for planning, performance improvement and monitoring the results from the planning process. To fulfil commitments, environmental responsibilities are assigned for initiating, executing and checking them.

7.6 For the Falklands Exploration drilling programme, the main method for converting the GMS policies and principles into action will be the EMPA presented in Tables 7.1 and 7.2. These commitments are captured through the Noble tracking system and carried through to detailed design and operations. The plan identifies monitoring, management measures and responsibilities to be implemented.

7.7 The Environmental Management Systems (EMS) of each contractor will be assessed to ensure compliance with the Noble GMS. In cases where the Noble GMS and a contractor EMS differ, the more stringent measure will apply.

## 7.3 Mitigation & Management Measures

7.8 Mitigation measures were identified as part of the Impact Assessment (refer to Section 6) to ensure that all potential impacts are reduced to as low as reasonably practicable. These mitigation measures are shown in Tables 7.1 and 7.2. The timing of implementation for each measure is also identified along with the responsible parties for each measure. The EMPA will be communicated to project personnel as required.

### 7.3.1 Roles & Responsibilities

7.9 Noble will have overall responsibility for implementing the mitigation and management measures for the project. During the exploration drilling programme, Noble will have the additional responsibility for ensuring contractors adhere to the measures and plans in place for managing the environmental impacts of the project. The contractors will have responsibility for ensuring they adhere to the requirements that Noble places upon them.

7.10 Noble’s responsibilities in terms of specific mitigation and management measures are provided in Table 7.1 and 7.2.

### 7.3.2 Implementation Schedule

7.11 The implementation schedule for the management measures within the EMPA depends on the stage of the drilling programme and the specific measures that are being implemented. Table 7.1 and 7.2 provide details of the timing of each measure and when they are to be executed.

*Table 7.1: List of actions and measures to prevent/mitigate potential negative impacts and enhance benefits of the proposed exploration drilling programme – planned / routine events*

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | **1.0 Physical Presence** | | | |
| 1.1 | Removal of small area of seabed for well construction. (*Permanent removal of a small area of seabed, sediment and any macrofauna associated with that sediment. Potential for disturbance of sensitive species that may be present*). | As this impact is an inevitable consequence of well construction, there are no mitigation measures that can be used to reduce the impact. However, the mitigation measures described below under 'Discharges to Sea' in relation to pre-drilling, during drilling and post-drilling environmental surveys will allow close monitoring of the impacts in situ. | Pre-drilling and during operations | Noble / Environmental Survey Contractor / Drilling Contractor | Pre and post drilling Environmental Survey |
| | | During pre-drilling monitoring of the wellhead location the presence of habitats of conservation importance will be established. Should any important habitats be observed prior to commencement of drilling, the wellhead will be re-located in order to avoid these habitats. | Pre-drilling | Noble / Environmental Survey Contractor / Drilling Contractor | Pre and post drilling Environmental Survey |
| 1.2 | Physical presence of the drilling rig and OSVs. (*Navigation hazard, collision risk*). | A 500 metre radial safety zone will be implemented around the drilling unit whilst on location which will be applicable to all third-party vessels, to reduce the potential for a collision with the drilling unit. The 500 metre safety zone will be patrolled and enforced by a Safety Stand-by Vessel (SSV), which will be in attendance in the vicinity of the drilling unit at all times. | During operations | Noble / Drilling Contractor | Daily report from OSVs |
| | | Up to 3 OSVs will be used throughout the drilling programme. At all times, the role of SSV will be undertaken by one of these OSVs to patrol the safety zone and warn of the presence of the drilling unit and vessel safety zone. All OSVs will be equipped with modern radar and radio equipment. A set of procedures will be established so that vessel masters, who need to deviate from their planned route based on their current sea passage trajectory, will be asked by the SSV via VHF radio to confirm that they intend to follow the requirements of the drilling rig Automatic Identification System (AIS) warnings. The SSV will maintain close contact with the third-party vessel until they have changed their course away from entering the safety zone. | During operations | Noble / Vessel Contractor | Daily report from OSVs |

| **Ref.** | **Aspect (*Potential Impact*)** | **Actions and Mitigation Measures** | **Timing** | **Responsible** | **Feedback mechanism** |
|---|---|---|---|---|---|
| | | Due regard will also be given by the officers on watch on board the OSVs to fellow sea users at all times, in line with the International Regulations for Preventing Collisions at Sea (COLREGs). Any fishing vessel encountered by the OSVs in transit to/from the drilling unit shall be given a wide berth in full cooperation with any flags, symbols or other instructions that the fishing vessel may be displaying or may issue via VHF. | During operations | Noble / Vessel Contractor | Daily report from OSVs |
| | | The emergency response plans and procedures of the drilling unit and OSVs will be verified by Noble for adequacy to respond to a potential collision threat. This shall include the threat of collision from icebergs. | Pre-drill planning | Noble / Drilling Contractor | Audit records |
| | | The Falkland Islands Fishing Companies Association (FIFCA), Consolidated Fisheries Limited (CFL) and Falkland Islands Government (FIG) will be notified, in writing, a minimum of 30 calendar days before the start of drilling activities, so that fishing vessels can plot the drilling location on marine charts, avoid the safety zone and plan their sea passage to/from any favoured fishing grounds accordingly. | Pre-drill planning | Noble | Correspondence with FIFCA. |
| | | Noble will liaise with the Fisheries Department and CFL with regard to the issue of navigation warnings advertising the presence of the drilling rig through the existing Fisheries Department Daily Shipping Forecast system. The information provided will include details on the current position of the drilling rig, presence of the OSVs, description of the 500 metre radial safety zone and the need for vessels to stay outside of this zone at all times. | Pre-drill planning and during operations | Noble | Correspondence with Fisheries Department |
| | | A message will be attached to the drilling unit's AIS to provide an identical set of information to the Daily Shipping Forecast as described above. | During operations | Noble / Drilling Contractor | Daily reports |
| | | The drilling rig will be fitted with navigational lighting and a radar transponder to show its position to third-party vessels visually, and also through the use of radar equipment. | During operations | Noble / Drilling Contractor | Audit records |
| | | Standard Marking Schedule provisions or International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) recommendations and guidelines will be adhered to during operations and transit to and from Stanley Harbour and the rig location by OSVs. | During operations | Noble / OSV Contractor | Audit records |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | Any complaints associated with the temporary loss of access to the sea will be recorded and monitored, in accordance with the Noble Energy Community Feedback Mechanism. | During Operations | Noble | Community Feedback Mechanism records |
| | | Details of the as-built well locations will be provided to FIG and to hydrographic organisations to enable the location of the wells to be plotted onto navigational charts. | End of Operations | Noble | Correspondence with hydrographic organisations |
| 1.3 | Physical presence of the drilling rig and OSVs. (*obstruction to fishing operations, economic costs to fisheries, Increased marine traffic to and from port facilities*) | Up to 3 OSVs will be used throughout the drilling programme. At all times, the role of SSV will be undertaken by one of these OSVs to patrol the safety zone and warn other users of the sea about the presence of the drilling unit and safety zone. All OSVs will be equipped with modern radar and radio equipment. A set of procedures will be established so that vessel masters, who need to deviate from their planned route based on their current sea passage trajectory, will be asked by the SSV via VHF radio to confirm that they intend to follow the requirements of the drilling rig AIS warnings. The SSV will maintain close contact with the third-party vessel until they have changed their course away from entering the safety zone. | During operations | Noble / Vessel Contractor | Daily report from OSVs |
| | | FIFCA, CFL and FIG will be notified, in writing, a minimum of 30 calendar days before the start of drilling activities, so that fishing vessels can plot the drilling location on marine charts, avoid the safety zone and plan their sea passage to/from any favoured fishing grounds and their fishing activities accordingly. | Pre-drill planning | Noble | Correspondence with FIFCA |
| | | Noble will liaise with the Fisheries Department and CFL with regard to the issue of navigation warnings advertising the presence of the drilling rig through the existing Fisheries Department Daily Shipping Forecast system. The information provided will include details on the current position of the drilling rig, presence of the OSVs, description of the 500 metre radial safety zone and the need for vessels to stay outside of this zone at all times. | Pre-drill planning and during operations | Noble | Correspondence with Fisheries Department |
| | | A message will be attached to the drilling unit's AIS to provide an identical set of information to the Daily Shipping Forecast described above. | During operations | Noble / Drilling Contractor | Daily reports |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | The drilling rig will be fitted with navigational lighting and a radar transponder to show its position to third-party vessels visually, and also through the use of radar equipment. | During operations | Noble / Drilling Contractor | Audit records |
| | | Any complaints associated with the temporary loss of access to the sea will be recorded and monitored, in accordance with the Noble Energy Community Feedback Mechanism. | During operations | Noble | Community Feedback Mechanism records |
| | | Details of the as-built well locations will be provided to FIG and to hydrographic organisations to enable the location of the wells to be plotted onto navigational charts. | During operations | Noble / Drilling Contractor | Correspondence with hydrographic organisations |
| | | Noble will comply with FIG regulatory requirements on the removal of the wellhead and near seabed casing to three metres below the seabed. | During operations | Noble / Drilling Contractor | Daily reports |
| 1.4 | Physical presence of the drilling rig and OSVs. (*Collision risk with marine mammals*) | Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species that may be present within the vicinity of these islands. This will also reduce any potential collision risk (however small) with marine mammals within shallower areas. | During operations | Noble / OSV Contractor / Aviation Contractor | Daily report from OSVs |
| | | Whilst transiting near coastal areas (i.e., within the vicinity of the approaches to Port William, and whilst within Port William and Stanley Harbour), vessel speed will be reduced in order to minimise the chance of vessel strike with any species that may be present. All other applicable vessel speed limits shall also be observed when within the approaches to Port William and whilst within Port William and Stanley Harbour. | During operations | Noble / Vessel Contractor | Daily report from OSVs |
| 1.5 | Physical presence of the drilling rig. (*Wreck disturbance*). | Well locations will be chosen so that existing and reported wreck locations are avoided. | Pre-drill planning | Noble | Pre and Post Drilling Environmental Survey |
| | | Any subsequent changes to top-hole well locations will also actively avoid areas of existing wreck sites. Changes to the top-hole locations will be reported within subsequent addenda to this EIS (as required), and the impacts with respect to existing wrecks will be reassessed if necessary. | Pre-drill planning | Noble | Drill planning |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | No accurate positions of the shipwrecks within FISA12 are known. It is likely that the positions reported by Wrecksite.eu are inaccurate. The environmental survey of the FISA12 area put considerable effort into attempting to positively identify the un-charted wrecks during the survey; however, the wrecks were not identified. Noble will therefore avoid drilling within the immediate vicinity of the reported wreck locations by placing a 10 kilometre safety zone around the current reported Wrecksite.eu locations. | Pre-drill planning | Noble | Drill planning |
| | | The absence of wrecks in the vicinity of the well locations will also be confirmed through the pre-drilling site specific environmental seabed surveys with a remotely operated vehicle (ROV). Should the wreck sites be identified during the pre-drilling survey their location will be noted and reported to FIG and the well location relocated to avoid the wreck sites. | During operations | Noble / Environmental Survey Contractor | Pre and Post Drilling Environmental Survey |
| | | A reporting protocol will be instigated for the accidental discovery of archaeological material during drilling activity and all appropriate notifications will be completed. | During operations | Noble / Environmental Survey Contractor / Drilling Contractor | Archaeological Reporting Protocol |
| 1.6 | Workforce required by drilling operations on rig.<br>(*Conflict between workers and locals*). | Noble will use the locally available work force where possible. This will minimise the need for contractors to bring in workers from outside the Falkland Islands into Stanley. | Pre-drill planning and during operations | Noble | Drill planning |
| | | All Noble contractors, including the drilling contractor, will monitor individuals that are part of their work force and ensure they are made fully aware of the standards of behaviour expected, examples as to what constitutes a breach of their own Behavioural Code of Conduct, a description of the disciplinary and appeal processes and procedures to be followed for alleged misconduct. Contractors will ensure that these aspects are clearly outlined in the workers' contracts so that any termination of employment due to a breach is legally enforceable. In addition, the contractors and Noble will limit the amount of time offshore employees spend in Stanley during crew change periods. | Pre-drill planning and during operations | Noble / Drilling Contractor | Audit records |
| | | All complaints associated with the behaviour of workers will be recorded and monitored, in accordance with the Noble Energy Community Feedback Mechanism. | During operations | Noble | Community Feedback Mechanism records |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | **2.0 Atmospheric Emissions & Air Quality** | | | |
| 2.1 | Power generation by rig, OSVs and helicopter(s). (*Air quality, contribution to greenhouse gasses*). | Noble will undertake extensive pre-project planning in order to ensure that the project operations are conducted efficiently, to minimise the duration of project activities as far as possible. This will also assist in optimising the number of trips for OSVs and helicopters between the rig and onshore. | Pre-drill planning | Noble / Drilling Contractor / Vessel Contractor | Daily report from OSVs and rig |
| | | Emissions generated from the proposed drilling programme will be controlled through the use of modern and well maintained power generation equipment. The equipment shall be maintained in accordance with the written procedures based on manufacturer's guidelines, applicable industry code, or engineering standard to ensure efficient and reliable operation. | During operations | Noble / Drilling Contractor / Vessel Contractor | Maintenance records<br>Daily report from OSVs and rig |
| | | Contracted vessels will be required to control fuel use, efficiently manage energy, and to plan voyages efficiently. | During operations | Noble / Vessel Contractor | Daily report from OSVs and rig |
| 2.2 | Fugitive emissions (e.g. volatile organic compounds - VOCs) associated with (for example), leaks, vents and fuel bunkering. (*Air quality, contribution to greenhouse gasses, risk of fire/explosion*). | To control fugitive emissions, operational and maintenance procedures will be implemented, which include all environmentally critical valves, flanges, fittings and seals in use on the drilling rig, to eliminate or reduce as far as possible the capacity for gas leaks and fugitive emissions. | Pre-drill planning and during operations | Noble / Drilling Contractor | Maintenance records<br>Daily report from OSVs and rig |
| | | A gas/leak detection system and repair program will be in operation on the rig (requirement of rig Safety Case). | Pre-contract and during operations | Noble / Drilling Contractor | Daily report from rig |
| | | **3.0 Discharges to Sea** | | | |
| 3.1 | Discharge of, drilling mud and associated chemicals. (*Smothering of seabed, increased localised turbidity; oxygen depletion in surface sediments, seafloor habitat loss, cumulative impact with other wells*). | It is proposed that water based mud (WBM) is used for drilling all sections of the exploration wells. The design of the drilling programme, to include the use of dedicated water based mud systems, negates the use of oil based mud (OBM), which, even after the required thermal cuttings cleaning treatment to FIG PON10 standards, would have a higher toxicity upon discharge to the marine environment than WBM. | Pre-drill planning and during operations | Noble / Drilling Contractor | Daily report from rig |
| | | All drilling mud components will be selected on the basis of environmental performance as much as possible within the mud programme, so as to reduce any potential environmental impacts upon the release of the drilling mud. | Pre-drill planning and during operations | Noble / Drilling Contractor | Chemical risk assessment |
| | | A Discharge Management Programme (DMPO) will be in place for the drilling | Pre-drill planning | Noble / Drilling | Daily report from |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | operations. The purpose of the DMPO will be to provide a consistent set of discharge requirements for the exploration drilling programme. The prohibitions, limitations and monitoring requirements in the document will be based on recognized standards and regulations that have been developed to protect the environment. The DMPO will include provisions for the discharge of drilling mud. | and during operations | Contractor / Vessel Contractor | rig |
| | | Chemical use and discharge will be closely monitored throughout the drilling program through the rig chemicals tracking system and minimised by the drill crew and mud engineers where practicable, without compromising well safety. All chemical use and discharge will be controlled through the DMPO through the detailing of the reporting procedures for chemical use and discharge. The DMPO will provide a consistent set of discharge requirements for the exploration drilling programme. | During operations | Noble / Drilling Contractor | Daily report from rig |
| | | Batch discharges of drilling mud will be minimised as far as possible. All drilling mud will be recycled and used on other well sections as much as possible, without compromising well safety. | During operations | Noble / Drilling Contractor | Daily report from rig |
| | | Seabed features and habitats at the well sites will be confirmed through site specific environmental seabed surveys, which will include pre-drilling, during drilling and post-drilling elements as follows:<br>• The pre-drilling survey will include a 100 metre radius (centred on the well location) remotely operated vehicle (ROV) inspection of the seabed, using an environmental specialist to interpret for habitats and species. Additional features showing important species (e.g. rocks with epifaunal communities or the presence of corals) will be marked and re-visited after drilling is completed. Seabed sampling will be carried out upstream and downstream of the prevailing currents at 50, 100 and 200 metre offset locations, using a specialist environmental ROV corer (89mm outside diameter). At each station, 2 x physico-chemical samples will be taken from the top 10 cm of sediment, and 5 x biological samples will be taken from the top 20 cm of sediment, and processed through a 500 µm mesh sieve.<br>• During drilling, specially designed sediment traps will be deployed at each of the above environmental stations for the purposes of logging the settlement of any cuttings material deposited on the seabed. | During operations | Noble | Pre and Post Drilling Environmental Survey<br>Ad-hoc reporting to FIG as required |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | • The post-drilling survey will repeat the survey undertaken pre-drilling. Any additional features showing important species marked during the pre-drilling survey will be re-visited. In addition, a 1.5 metre ROV corer will be used to assess the vertical profile of the sediments in the thickest part of the cuttings pile, expected to be approximately 10 metres from the wellhead. This will record the settlement regime of discharged material over the duration of the drilling, with discrete layers identified, measured and analysed for their physico-chemical properties. | | | |
| 3.2 | Discharge of drill cuttings<br>(*Smothering of seabed, increased localised turbidity; oxygen depletion in surface sediments, seafloor habitat loss, cumulative impact with other wells*). | All mitigation measures as described above for the release of drilling mud (3.1). | As above | As above | As above |
| | | Should any habitats of conservation importance be identified during pre-drilling surveys, Noble will look to relocate the well location to avoid these habitats. | During operations | Noble | Pre and Post Drilling Environmental Survey<br>Ad-hoc reporting to FIG as required |
| | | Should either the SMS Scharnhorst or SMS Gneisenau be identified during the pre-drilling surveys, Noble will look to relocate the well location to avoid these wrecks. | During operations | Noble / Drilling Contractor | EIS addenda |
| | | The results of the post drilling surveys will be used to verify the accuracy of the cuttings dispersion modelling. | Post operations | Noble | Verification report |
| | | The DMPO will be in place for the drilling operations, as described above in 3.1, and will include provisions for the discharge of drilling cuttings. | Pre-drill planning and during operations | Noble / Drilling Contractor / Vessel Contractor | Daily report from rig |
| | | Once the well locations are confirmed, Noble will re-assess the discharge of drill cuttings. The results of the cuttings modelling will be overlaid onto the seabed features charts from the regional environmental baseline surveys. The results of the cuttings modelling and the analysis of the modelling results in relation to the seabed feature charts from the regional environmental baseline surveys will be presented in Operational Addenda. | Prior to commencement of operations | Noble | Operational Addenda to EIS |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| 3.3 | Discharge of cement.<br>(*Smothering of seabed, increased localised turbidity; oxygen depletion in surface sediments, seafloor habitat loss, cumulative impact with other wells*). | Cement volumes used will be minimised where practicable, to limit any possible discharge of cement and associated chemicals, without compromise to well safety and integrity. | During operations | Noble / Drilling Contractor | Daily report from rig |
| | | All cement components will be selected on the basis of environmental performance, so as to reduce any potential environmental impacts upon the potential release of the cement. | Pre-drill planning and during operations | Noble / Drilling Contractor | Daily report from rig |
| | | Chemical use and discharge will be closely monitored throughout the drilling program through the rig chemicals tracking system and minimised by the drill crew and cement engineers where practicable, without compromising well safety. All chemical use and discharge will be controlled through the DMPO. | During operations | Noble / Drilling Contractor | Daily report from rig |
| | | Batch discharges of cement will be minimised as far as possible. Great care will be taken when mixing cement on board the rig for use during cementing operations, ensuring that the potential need to discharge batches of cement due to technical and/or mixing problems is minimised. All cement discharge will be controlled through the DMPO. | During operations | Noble / Drilling Contractor | Daily report from rig |
| 3.4 | Discharge of domestic wastewater and food waste.<br>(*Water quality, disruption of biodiversity, temporary boom in opportunistic species*). | On board the drilling rig and OSVs, black (sewage) and grey water will be collected and treated in accordance with the requirements of the MARPOL Convention prior to being discharged to sea. Food waste will also be collected and treated (macerated) in accordance with the requirements of the MARPOL Convention. | During operations | Noble / Drilling Contractor / Vessel Contractor | Daily reports from OSVs and rig |
| | | The discharge of sewage is only authorised if the ship/installation is equipped with authorised sewage treatment equipment, and the results of the tests of this equipment are documented and the effluent leaves no visible floating solids and does not discolour the surrounding water. | During operations | Noble / Drilling Contractor / Vessel Contractor | Audit of contractor documentation |
| | | The discharge of rubbish is prohibited, with the exception of food waste that is ground and passed through a sieve with a mesh size no greater than 25 millimetres for facilities that are more than 12 nautical miles from the coast. | During operations | Noble / Drilling Contractor / Vessel Contractor | Daily reports from OSVs and rig |
| | | The DMPO will be in place for the drilling operations and will include provisions for the discharge of domestic wastewater and food waste; both from the drilling rig and OSVs. | Pre-drill planning | Noble | Daily reports from OSVs and rig |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| 3.5 | Discharge of deck drainage water.<br>(*Water quality, discomfort and/or disturbance to fish and benthic dwelling species*). | Deck areas will be kept clean of debris and any hydrocarbon materials. | During operations | Noble / Drilling Contractor / Vessel Contractor | Daily reports from OSVs and rig |
| | | Any unintentional releases will be thoroughly cleaned up as soon as they occur before they have the chance to be washed overboard. Waste materials (absorbent pads, etc.) will be segregated. Hazardous waste will be disposed of according to established waste oil/chemical disposal procedures. | During operations | Noble / Drilling Contractor / Vessel Contractor | Daily reports from OSVs and rig |
| | | Spill kits will be readily available on deck for mopping up any minor unintentional releases. Personnel will be trained in the use of spill kits. | Pre-drill planning and during operations | Noble / Drilling Contractor / Vessel Contractor | Audit records |
| | | The drilling rig and OSVs will be fitted with closed drainage containment and monitoring systems in all environmentally critical areas as part of their specification. An oily water bilge system in accordance with MARPOL regulations, and an oily water separator (OWS) in accordance with International Maritime Organisation (IMO) Marine Environment Protection Committee (MEPC) 107(49) (Guidelines and Specifications for Pollution Prevention Equipment for Machinery Space Bilges of Ships) will also be present. Procedures for drainage water will be addressed within both the drilling contractor's and OSV contractor's documentation. | Pre-drill planning and during operations | Noble / Drilling Contractor / Vessel Contractor | Audit of contractor documentation<br>Daily reports from OSVs and rig |
| | | Oily water treatment systems on board the drilling rig and OSVs must have oil discharge monitoring and control equipment installed to ensure an oil concentration in water exiting the treatment systems of less than 15 parts per million (ppm) as required under MARPOL regulations and in accordance with IMO MEPC 107(49). Records of the oil content of water discharged and calibration of equipment must be maintained in accordance with the MARPOL Convention, in the form of an Oil Record Book. | During operations | Noble / Drilling Contractor / Vessel Contractor | Audit of contractor documentation<br>Daily reports from OSVs and rig |
| | | On the drilling rig, no direct overboard discharge of deck drainage water from environmentally critical areas (e.g. the drill floor) is to take place. | During operations | Noble / Drilling Contractor | Daily reports from OSVs and rig |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | All direct deck drainage on the drilling rig (e.g. walkway gratings) shall be used in clean, non-environmentally critical areas only. | During operations | Noble / Drilling Contractor | Daily reports from OSVs and rig |
| | | Rainwater runoff from the drilling rig will be routinely monitored for any residual hydrocarbon content. | During operations | Noble / Drilling Contractor | Daily reports from OSVs and rig |
| | | The DMPO will include provisions for the discharge of drainage water. | Pre-drill planning | Noble | Daily reports from OSVs and rig |
| | | **4.0 Bio-security** | | | |
| 4.1 | Discharge of ballast water. (*Introduction of invasive species, change in local ecosystem and possibly wider ecosystem*). | All vessels associated with the drilling operations (including the drilling rig itself), will undertake ballast exchange operations well clear of the Falkland Islands in offshore waters outside of the 12 nautical mile limit. | During operations | Noble / Drilling Contractor / Vessel Contractor | Daily reports from OSVs and rig |
| | | The drilling rig and OSVs will all have procedures in place for ballast water management as part of both the drilling contractor's and OSV contractor's specification. These procedures will be subject to audit/assessment by Noble. | Pre-drill planning and during operations | Noble / Drilling Contractor / Vessel Contractor | Audit records<br>Daily reports from OSVs and rig |
| | | **5.0 Underwater Noise** | | | |
| 5.1 | Underwater noise from drilling operations (rig and OSVs on site). (*Disturbance to marine mammals, fish and seabirds, behavioural changes*). | The drilling rig will be on location for the minimum period of time required to conduct the drilling operations, thus minimising the duration of potential noise impacts as far as possible. The operational and maintenance procedures on the drilling rig will also aim to optimise the efficiency of the equipment and the schedule of operations. | Pre-drill planning and during operations | Noble / Drilling Contractor | Daily reports from OSVs and rig |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| 5.2 | Underwater noise from OSVs on sea passage.<br>(*Disturbance to marine mammals, fish and seabirds, behavioural changes*). | Vessel movements will avoid coastal areas (with the exception of the approaches to Port William and Stanley Harbour) where sensitive species, such as penguin colonies, may be present. | During operations | Noble / Vessel Contractor | Daily reports from OSVs and rig |
| | | Whilst transiting near beach areas (i.e. within the vicinity of the approaches to Port William, and whilst within Port William and Stanley Harbour), vessel speed will be reduced in order to minimise the chance of vessel strike with any species that may be present. Such a reduced speed would also limit noise impact from the vessels. All other applicable vessel speed limits shall also be observed when within the approaches to Port William and whilst within Port William and Stanley Harbour. | During operations | Noble / Vessel Contractor | Daily reports from OSVs and rig |
| | | Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species present within the vicinity of these islands. | During operations | Noble / Vessel Contractor | Daily reports from OSVs and rig |
| 5.3 | Underwater noise from helicopters in transit.<br>(*Disturbance to marine mammals, fish and seabirds, behavioural changes*). | The aviation contractor will be prohibited from circling or hovering over marine mammals or sites identified as sensitive for seabird colonies in accordance with the Falkland Islands low flying avoidance maps and the Falkland Islands Low Flying Handbook. The aviation contractor will pay particular attention to paragraphs 37 to 40 and 54 to 60 of the Low Flying Handbook. | During operations | Noble / Aviation Contractor | Helicopter flight plans |
| | | Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species present within the vicinity of these islands. | During operations | Noble / Aviation Contractor | Helicopter flight plans |
| 5.4 | Noise from Vertical Seismic Profiling (VSP) operations.<br>(*Disturbance to marine* | VSP operations will be strictly controlled in line with the JNCC *Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys* (2010). | During operations | Noble / Drilling Contractor | MMO daily reports |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | *mammals, fish and seabirds, behavioural changes*). | A qualified Marine Mammal Observer (MMO) will be on site during VSP operations. The MMO will monitor the 500 metre safety zone for 60 minutes (due to the operations occurring in water deeper than 200m) prior to commencement of VSP operations to ensure that no marine mammals are present within the area. | Pre-drill planning and during operations | Noble / Environmental Contractor | MMO daily reports |
| | | Soft-start ramp up of the seismic source during VSP operations, of no less than 20 minutes and no more than 40 minutes, will then be undertaken in line with the above JNCC guidelines. This enables fish and marine mammals in the area disturbed by the sound levels to move away from the noise source before being subject to the full force of the seismic array, thus minimising the potential for adverse impacts on these species. | During operations | Noble / Environmental Contractor / Drilling Contractor | MMO daily reports |
| | | If marine mammals are observed within the 500 metre zone after the VSP has started, then they are deemed to be unaffected by the noise. A record of the sighting should be kept, but no further action will be taken. | During operations | Noble / Environmental Contractor / Drilling Contractor | MMO daily reports |
| | | VSP operations will be started during daylight hours only. | During operations | Noble / Environmental Contractor / Drilling Contractor | MMO daily reports |
| | | **6.0 Airborne noise** | | | |
| 6.1 | Airborne noise from helicopters in transit.<br>(*Disturbance to coastal populations, disturbance to marine mammals and birds and protected areas*) | The aviation contractor will be prohibited from circling or hovering over marine mammals or sites identified as sensitive for seabird colonies unless essential for safety or operational purposes in accordance with the Falkland Islands low flying avoidance maps and the Falkland Islands Low Flying Handbook. The aviation contractor will pay particular attention to paragraphs 37 to 40 and 54 to 60 of the Low Flying Handbook. | During operations | Noble / Aviation Contractor | Helicopter flight plans |
| | | Routing over built up areas will be avoided, unless in an emergency and/or on the grounds of safety in accordance with paragraph 32 of the Falkland Islands Low Flying Handbook. | During operations | Noble / Aviation Contractor | Helicopter flight plans |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species present within the vicinity of these islands. | During operations | Noble / Aviation Contractor | Helicopter flight plans |
| | | Helicopter flight planning will be undertaken in coordination with the appropriate Falkland Island authorities (Civil Aviation Department). Under normal operations, helicopter flights will only occur during daylight hours, in order to minimise potential disturbance to the local population. | During operations | Noble / Aviation Contractor | Correspondence with Civil Aviation Department |
| 6.2 | Airborne noise from OSVs on sea passage.<br>(*Disturbance to terrestrial communities, birds, marine mammals and protected areas*) | Vessel movements will avoid coastal areas (with the exception of the approaches to Port William and Stanley Harbour) where sensitive species, such as penguin colonies, may be present. | During operations | Noble / Vessel Contractor | Daily reports from OSVs and rig |
| | | Whilst transiting near beach areas (i.e. within the vicinity of the approaches to Port William, and whilst within Port William and Stanley Harbour), vessel speed will be reduced in order to minimise the chance of vessel strike with any species that may be present. Such a reduced speed would also limit noise impact from the vessels. All other applicable vessel speed limits shall also be observed when within the approaches to Port William and whilst within Port William and Stanley Harbour. | During operations | Noble / Vessel Contractor | Daily reports from OSVs and rig |
| | | In addition, Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species present within the vicinity of these islands. | During operations | Noble / Vessel Contractor | Daily reports from OSVs and rig |
| | | **7.0 Waste Management** | | | |
| 7.1 | Treatment and disposal of non-hazardous waste generated from drilling operations.<br>(*Limitations on future land* | Noble will develop and implement a Waste Management Plan (WMPA) for the proposed drilling programme that encompasses the drilling rig, OSVs and onshore support. The WMPA will cover the storage, transport and treatment of waste generated as part of the drilling programme. The WMPA will cover both offshore and onshore aspects of the exploration drilling operations (i.e. | Pre-drill planning | Noble | Audit records<br>Contractor waste management plan |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | *use, small scale land and air contamination*). | will cover both offshore and onshore elements of the waste streams). The WMPA will identify measures to reduce waste generated during drilling and how waste will be handled and disposed of safely and responsibly. The WMPA will:<br>○ Promote minimisation of the amounts of waste generated at source;<br>○ Require segregation of waste by type;<br>○ Require appropriate storage to prevent emissions and leaks;<br>○ Promote recycling or re-use where possible, in particular for scrap metal, waste oil and surplus chemicals;<br>○ Require that waste be sent to authorised landfills or incineration facilities, depending on its precise nature, when no other option is possible;<br>○ Minimise and manage cumulative waste generation from the drilling campaign; and<br>○ Ensure a clear chain of ownership for all waste through the use of waste manifests until final disposal, particularly relating to trans-boundary matters. | | | |
| | | Noble will work closely with FIG prior to drilling operations to determine acceptable options for onshore non-hazardous waste disposal. The following measures will be included in the Waste Management Plan:<br>○ No un-combusted wastes arising from the drilling programme will be landfilled in the Falkland Islands;<br>○ Some non-hazardous combustible waste will be segregated and sent to a local incinerator for incineration in the Falkland Islands; and<br>○ The waste ash arising from this incineration will be landfilled in the Falkland Islands along with other incinerator waste at an existing landfill facility (Eliza Cove or Mary Hill Quarry).<br>Noble will confirm all waste management and disposal routes within the WMPA to be approved by FIG prior to drilling operations commencing. | Pre-drill planning | Noble | Approval letter from FIG |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | No un-combusted wastes arising from the drilling programme will be landfilled in the Falkland Islands | During operations | Noble / Drilling Contractor / Vessel Contractor / Aviation Contractor / Waste Specialist | Contractor waste management plan<br>Waste manifests |
| | | Some non-hazardous combustible waste will be segregated and sent to a local incinerator for incineration in the Falkland Islands. | During operations | Noble / Drilling Contractor / Vessel Contractor / Aviation Contractor / Waste Specialist | Contractor waste management plan<br>Waste manifests |
| | | The waste ash arising from this incineration will be landfilled in the Falkland Islands along with other incinerator waste at an existing landfill facility (Eliza Cove or Mary Hill Quarry) | During operations | Noble / Waste Specialist | Contractor waste management plan<br>Waste manifests |
| | | All contractors will be required to adhere to the requirements outlined within the WMPA. | During operations | Noble / Drilling Contractor / Vessel Contractor / Aviation Contractor / Waste Specialist | Contractor waste management plan<br>Waste manifests |
| 7.2 | Treatment and disposal of hazardous waste generated from drilling operations.<br>(*Limitations on future land use, small scale land and air contamination, trans-boundary impacts from hazardous waste*). | Special arrangements will be in place for hazardous wastes and will be detailed within the WMPA. As no suitable onshore facilities exist in the Falkland Islands for the treatment and disposal of hazardous waste, the waste will be exported in accordance with the Basel Convention. Under the Basel Convention, a trans-boundary movement (TBM) means any movement of hazardous wastes or other wastes:<br>• From an area under the national jurisdiction of one State; and<br>• To or through an area under the national jurisdiction of another State, or to or through an area not under the national jurisdiction of any State. | Pre-drill planning and during operations | Noble / Drilling Contractor / Vessel Contractor / Waste Specialist | Audit records<br>TBM Procedure |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | The Basel Convention requires that the standard of "environmentally sound management" (ESM) of hazardous wastes or other wastes is met. ESM means taking all practicable steps to ensure hazardous wastes or other wastes are managed in a manner which will protect human health and the environment against the adverse effects which may result from such wastes. The final stage in the TBM procedure is for the generator and country of export to receive confirmation that the wastes moved across borders have been disposed of by the disposer as planned and in an environmentally sound manner. | Pre-drill planning and during operations | Noble / Drilling Contractor / Vessel Contractor / Waste Specialist | Audit records<br>TBM Procedure<br>Confirmation of disposal |
| | | Noble will ensure that a dedicated waste specialist is appointed to:<br>• Receive and handle waste (including hazardous waste) at the TDF;<br>• Arrange for local recycling or disposal of non-hazardous waste;<br>• Safely store any hazardous waste;<br>• Arrange appropriate export of hazardous waste in accordance with the Basel Convention; and<br>• Ensure confirmation from the disposer that the wastes moved have been disposed of as planned and in an environmentally sound manner in accordance with the Basel Convention. | Pre-drill planning and during operations | Noble | Audit records<br>TBM Procedure<br>Waste manifests |
| | | Noble will conduct an audit/assessment of any selected waste specialist and processing facilities to ensure their compliance with local and international best practice and the WMPA. | Pre-drill planning and during operations | Noble | Audit records |
| | | **8.0 Light** | | | |
| 8.1 | Use of artificial lighting on board the rig and OSVs.<br>(*Potential disturbance to offshore seabirds during hours of darkness*). | Heli-deck landing lights will be switched off when not in use (if not required to be left on for safety reasons, such as during an emergency incident) to reduce potential impacts of these skyward facing lights on any bird species that may be present. Night time helicopter flights will only be conducted during emergency situations and are not planned to be part of normal operations during drilling activities Under normal operations, Helicopter flights will only occur during daylight hours so requirements for heli-deck lighting will be minimal if at all. | During operations | Noble / Drilling Contractor | Daily reports from rig |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | In addition, the OSV and SSV deck lighting will be switched off when not in use (if not required to be left on for safety reasons, such as during resupplying of the rig at night). | During operations | Noble / Drilling Contractor | Daily reports from OSVs |
| | | The precise details of the bird monitoring on the rig are yet to be finalised. Noble will monitor the number of birds found on the rig throughout the exploration drilling programme and will report monthly to an advisory group the findings of this monitoring. In the event that it is considered that significant and unacceptable numbers of seabirds have been attracted to the rig at night this will immediately be reported to FIG. Noble will then investigate whether further measures can be implemented and will work with FIG and their advisors to develop suitable measures. However, based on the experience of a previous study offshore the Falklands (albeit in northern waters) it should be noted that an event such as this is considered highly unlikely to occur. | During operations | Noble / Contract ornithologist | Monthly report<br>Ad-hoc reports to FIG |
| | | As part of the monitoring programme, a protocol will be established for the identification and recording of species involved in the event of mortality. Species present on the rig, involved in collisions or observed attracted to the rig will be recorded, including species name, numbers observed, behaviour and location on the rig. Photographs of species observed will be taken as part of the recording procedure. However, based on the experience of a previous study offshore the Falklands (albeit in northern waters) it should be noted that mortality due to association is expected to be highly unlikely to occur. The finalised protocol for recording species observed will be developed prior to drilling operations occurring and will be agreed with FIG. | During operations | Noble / Contract ornithologist | Monthly report<br>Ad-hoc reports to FIG |
| | | **9.0 Seascape, Landscape & Visual** | | | |
| 9.1 | Physical presence of the drilling rig, OSVs, helicopter flights and shore base.<br>(*Temporary change in seascape, landscape and visual setting*). | The duration of OSVs at the TDF and within Stanley Harbour will be minimised to the extent possible through project planning activities. | Pre-drill planning and during operations | Noble / Vessel Contractor | Helicopter flight plans |
| | | The number of helicopter flights and the time spent in the air near Stanley Airport will be minimised to the extent possible through appropriate planning measures. | Pre-drill planning and during operations | Noble / Aviation Contractor | Helicopter flight plans |
| | | Any land-based equipment and materials not in active use will be stored at Noble's shore base, whenever possible. | During operations | Noble | EHS reports from shore base |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | All working onshore areas will be maintained in a tidy condition with the aim of minimising the potential visual impact. | During operations | Noble | EHS reports from shore base |
| | | All complaints associated with the effects on the seascape, landscape and visual setting of Stanley will be recorded and monitored, in accordance with the Noble Energy Community Feedback Mechanism. | During operations | Noble | Community Feedback Mechanism records |
| **10.0 Utilities, Transport Networks, Communications & Local Resources** | | | | | |
| 10.1 | Presence of drilling operations workers during peak tourist season. (*Additional demand on local guest house and hotel accommodation*). | Noble will adhere to the FIG "Procurement Code of Practice by Oil and Gas Companies and their Subcontractors Operating in the Falkland Islands" (Code) which is currently under development (available as a draft only and not yet approved). This Code aims to maximise the use of businesses registered on the Falklands Islands by the oil and gas industry and minimise the need for contractors to bring in workers who will subsequently require temporary accommodation. Noble will utilise the local work force where possible in order to reduce the need for additional accommodation. Noble continues to work with FIG on the progress of this code of practice. | Pre-drill planning and during operations | Noble | Community Feedback Mechanism records |
| | | Disturbance to local accommodation facilities will be minimised through advanced consultation with local hotels being used for overnight accommodation. Noble intends to have a permanent arrangement for housing and leasing rooms in local hotels in place in advance of drilling operations commencing and well in advance of the rooms being required. | Pre-drill planning and during operations | Noble | Accommodation arrangements<br>Community Feedback Mechanism records |
| | | In addition to the above accommodation arrangements, Noble, in conjunction with other operators, has initial plans to build temporary accommodation in the Stanley area. This accommodation will have a capacity of 80 rooms. Plans for this temporary accommodation have yet to be finalised. Expressions of interest for the provision of this accommodation have been released. | Pre-drill planning and during operations | Noble | Accommodation arrangements<br>Community Feedback Mechanism records |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | Noble will minimise, where possible, the number of their own management staff in the Falkland Islands needed to manage the exploration drilling programme (without compromising safety and quality). | Pre-drill planning and during operations | Noble | Accommodation arrangements<br>Community Feedback Mechanism records |
| | | The Emergency Response Plan (ERP) developed by Noble will include arrangements for the provision of emergency accommodation in Stanley. Each of the 80 rooms within the temporary accommodation described above will have an extra bunk to assist in emergency evacuation situations. It is also noted that the Falkland Islands Defence Force (FIDF) based in Stanley could accommodate up to 200 persons in the event of an emergency, although no guarantees of available space can be made. However, the use of this facility for emergency situations will be discussed in advance with FIG and FIDF prior to any inclusion in the ERP. | Pre-drill planning and during operations | Noble | Emergency Response Plan<br>Meeting minutes |
| 10.2 | Use of water from the municipal water supply in Stanley.<br>(*Additional pressure on water resources*). | The storage tanks on the TDF, which will be utilised for the storage of drill water, will be trickle filled from the municipal water supply, which will mitigate against the potential for sudden, high-volume 'shock' demands being placed on the local water supply network. | Pre-drill planning and during operations | Noble | Water meter readings |
| | | During the exploration drilling programme, Noble will provide written notification to the FIG Public Works Department (PWD) a minimum of 10 calendar days before drill water is required to be taken from the municipal water supply. The written communiqué shall confirm the expected quantity of water to be taken from the regional supply network, the expected date and start/end time and the telephone contact details of the relevant Noble supervisor. | Pre-drill planning and during operations | Noble | Notifications written to PWD<br>Correspondence with PWD |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| 10.3 | Use of local road network to transport rig workers to/from Stanley, Stanley Airport and MPA.<br><br>(*Increased traffic, increased risk to community health & safety and other road users*). | Local transport companies will be used for all road transfers of offshore personnel. This will reduce health and safety risks, as local drivers will be familiar with local roads and local conditions. | Pre-drill planning and during operations | Noble | Agreements with local transport companies<br><br>Community Feedback Mechanism records |
| | | Careful planning of transportation will be undertaken to ensure efficient use of vehicles and to reduce the number of trips required. | Pre-drill planning and during operations | Noble | Agreements with local transport companies |
| | | Onshore personnel will be given driving training appropriate to the local roads. | Pre-drill planning and during operations | Noble | Training records |
| | | Complaints associated with the transport of work force and increased traffic will be monitored and dealt with through the Noble Community Feedback Mechanism. Should any major issues be identified that are causing community concern they will be raised with FIG and alternative solutions proposed and discussed. | Pre-drill planning and during operations | Noble | Community Feedback Mechanism records |

*Table 7.1: List of actions and measures to prevent/mitigate potential negative impacts and enhance benefits of the exploration drilling programme – unplanned / non-routine events*

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | **11.0 Accidental Events** | | | |
| 11.1 | Uncontrolled gas release during drilling.<br>(*Air quality, contribution to greenhouse gasses, risk of fire/explosion*). | Well control mitigations to be implemented as described below under 'Uncontrolled release of reservoir hydrocarbons' (11.4). | Pre-drill planning and during operations | Noble / Drilling Contractor | Maintenance records<br>Daily report from OSVs and rig |
| | | To control fugitive emissions, operational and maintenance procedures will be implemented, which include all environmentally critical valves, flanges, fittings and seals in use on the drilling rig, to eliminate or reduce as far as possible the capacity for gas leaks and fugitive emissions. | Pre-contract and during operations | Noble / Drilling Contractor | Daily report from rig |
| | | A gas/leak detection system and repair program will be in operation on the rig (requirement of rig Safety Case). | Pre-drill planning and during operations | Noble / Drilling Contractor | Maintenance records<br>Daily report from OSVs and rig |
| 11.2 | Potential unintentional releases of fuel or other fluids (e.g. diesel, drilling mud, hydraulic oil or lubricants) during day-to-day operations (including re-fuelling).<br>(*Localised toxic effects on marine fauna and flora, localised pollution, rafting seabirds on the sea surface*). | The drilling rig will be fitted with closed drainage containment, treatment and monitoring systems in all environmentally critical areas as part of the rig specification. Procedures for drainage water management will be addressed within the drilling contractor's documentation and the Noble DMPO. | Pre-contract and during operations | Noble / Drilling Contractor | DMPO<br>Daily reports from rig |
| | | Noble will ensure that the drilling and OSV contractors have procedures for fuel bunkering. These procedures will be subject to audit/assessment prior to drilling operations commencing. | Pre-drill planning | Noble / Drilling Contractor / Vessel Contractor | Audit records<br>Fuel bunkering procedures |
| | | Offshore bulk materials and fluid transfers will be minimised where possible, making efficient use of OSV loads and voyages. | Pre-drill planning and during operations | Noble / Drilling Contractor / Vessel Contractor | Cargo manifests |
| | | Where practicable, re-fuelling and transfer of bulk fluids will be undertaken during daylight hours only. Fluid transfer and crane operations will take place only in suitable weather conditions. Transfer operations will be supervised at all times both from the OSVs and drilling rig. | During operations | Noble / Drilling Contractor / Vessel Contractor | Fuel bunkering procedures<br>Daily reports from OSVs and rigs |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | Non-return valves will be installed on bulk fluid transfer hoses. Hoses will be tested and inspected as a part of the drilling contractor's planned maintenance system / procedure. | Pre-drill planning and during operations | Noble / Drilling Contractor / Vessel Contractor | Audit records |
| | | Spill kits will be readily available on deck for mopping up any minor unintentional releases. Personnel will be trained in unintentional release prevention and the use of spill kits. Regular drills will be held to contain and clean up deck spills. | Pre-drill planning and during operations | Noble / Drilling Contractor / Vessel Contractor | Audit records<br>Training records<br>On board Ship-board Oil Pollution Emergency Plan (SOPEP)<br>Noble Energy Emergency Response Plan |
| | | To prevent losses of drilling mud, the marine riser system will be operated and maintained in good order as per Noble and drilling contractor policies, including:<br>• Lower Marine Riser Package (LMRP) to have integrated Remotely Operated Vehicle (ROV) remote interfaces for emergency use;<br>• Use of low pressure alarms in the riser system;<br>• Rig Emergency Disconnect System (EDS) locked-out in normal operation;<br>• Regular LMRP inspection with rig ROV; and<br>• Regular riser-tensioner system inspection. | During operations | Noble / Drilling Contractor | Audit records<br>Inspection records<br>Daily reports from OSVs and rigs |
| | | All contracted vessels will have a Ship-board Oil Pollution Emergency Plan (SOPEP) in place to define their response procedures in the event of a pollution incident. | Pre-drill planning and during operations | Noble / Vessel Contractor | SOPEP audit records |
| | | Drilling chemicals will be selected on the basis of environmental performance as much as possible within the mud programme, so as to reduce any potential environmental impacts. | Pre-drill planning and during operations | Noble / Drilling Contractor | Chemical risk assessment |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | Noble will have Tier 1 response packages available in order to provide a timely and efficient Tier 1 spill response effort. | Pre-drill planning and during operations | Noble / Drilling Contractor / Vessel Contractor | Audit records<br>Training records<br>Noble Energy Emergency Response Plan |
| | | An Oil Spill Response Plan (OSRP) will be developed and implemented prior to drilling operations commencing. | Pre-drill planning and during operations | Noble | OSRP approval process |
| | | All instances of unintentional release will be handled in accordance with Falkland Islands Government Petroleum Operations Notice 8, May 2012 Revision (hereafter referred to as PON 8). In particular, the use of dispersants will be coordinated with Incident Command as defined in the National Oil Spill Contingency Plan (NOSCP) as noted in Section 3 of PON 8 for approval and usage conditions. | During operations | Noble / Drilling Contractor | Communication with FIG<br>Audit records |
| 11.3 | An emergency incident (e.g. vessel collision), leading to potential unintentional releases.<br>(*Significant hydrocarbon and chemical pollution, impacts on water quality and marine wildlife*). | All mitigation measures associated with collision avoidance as defined in 1.2 (Physical Presence). | Pre-drill planning and during operations | Noble / Drilling Contractor / Vessel Contractor | As above |
| | | Pre-mobilisation audits/assessments will be undertaken on all vessels. Vessels will be selected which comply with IMO codes for pollution prevention. | Pre-contract and Pre-drill planning | Noble | Audit records |
| | | All contracted vessels will have a SOPEP in place to enable fast and effective response to any potential pollution incident. | Pre-drill planning and during operations | Noble / Vessel Contractor | SOPEP audit records<br>Noble Energy Emergency Response Plan |
| | | An Emergency Response Plan (ERP) and Oil Spill Response Plan (OSRP) will be developed and implemented prior to drilling operations commencing. | Pre-drill planning and during operations | Noble | OSRP approval process<br>ERP approval process |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | All instances of unintentional release will be handled in accordance with Falkland Islands Government Petroleum Operations Notice 8, May 2012 Revision (hereafter referred to as PON 8). In particular, the use of dispersants will be coordinated with Incident Command as defined in the National Oil Spill Contingency Plan (NOSCP) as noted in Section 3 of PON 8 for approval and usage conditions. | During operations | Noble / Drilling Contractor | Communication with FIG<br><br>Audit records |
| 11.4 | Uncontrolled release of reservoir hydrocarbons (blow-out).<br><br>(*Significant hydrocarbon pollution, impacts on water quality, marine wildlife, coastal habitats, impacts on tourism and fisheries, waste disposal impacts, trans-boundary impacts, food chain impacts, loss of biodiversity, loss of revenue to local businesses and fisheries*). | The drilling operations will follow established drilling safety standards to minimise the risk of loss of well control. Well control systems and procedures will be in place as per all Noble and drilling contractor well control guidelines. | During operations | Noble / Drilling Contractor | Well Basis of Design<br><br>FIG Approval |
| | | The drilling crews will be adequately experienced, trained in well control techniques and supervised at all times. Emergency drills will be held regularly. | During operations | Noble / Drilling Contractor | Training records |
| | | Well designs will be reviewed by an independent well examiner. | Pre-drill planning and during operations | Noble / Drilling Contractor | Independent review report |
| | | A Blow-out Preventer (BOP) will be in place 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. | During operations | Noble / Drilling Contractor | Test results / report |
| | | The BOP will be subject to a third party verification and audit prior to drilling operations commencing. | Pre-drill planning and during operations | Noble / Drilling Contractor | Audit and verification records |
| | | The BOP specification will include one (1) shear ram, one (1) casing shear ram and a ROV remote interface to key BOP functions for emergency use. | Pre-drill planning and during operations | Noble / Drilling Contractor | Audit and verification records |
| | | All key offshore personnel will have International Well Control Forum (IWCF) well control certification. | Pre-drill planning | Noble / Drilling Contractor | Certification audit |

| Ref. | Aspect (*Potential Impact*) | Actions and Mitigation Measures | Timing | Responsible | Feedback mechanism |
|---|---|---|---|---|---|
| | | Noble is a FULL member of Oil Spill Response Limited (OSRL), providing an enhanced Tier 2/3 oil spill response capability. | Pre-drill planning | Noble | OSRL membership details<br>Noble Energy Emergency Response Plan |
| | | Noble is a member of the Global Dispersant Stockpile provided by OSRL for the purpose of responding to unintentional releases. | Pre-drill planning and during operations | Noble / Vessel Contractor | OSRL membership details<br>Noble Energy Emergency Response Plan |
| | | An Emergency Response Plan (ERP) and Oil Spill Response Plan (OSRP) will be developed and implemented prior to drilling operations commencing. | Pre-drill planning and during operations | Noble | OSRP approval process<br>ERP approval process |
| | | All instances of unintentional release will be handled in accordance with Falkland Islands Government Petroleum Operations Notice 8, May 2012 Revision (hereafter referred to as PON 8). In particular, the use of dispersants will be coordinated with Incident Command as defined in the National Oil Spill Contingency Plan (NOSCP) as noted in Section 3 of PON 8 for approval and usage conditions. | During operations | Noble / Drilling Contractor | Communication with FIG<br>Audit records |

## 7.4 Plans & Procedures

7.12 The following identifies and summarises the plans and procedures that will be developed for the project and provides a brief summary of their contents.

### 7.4.1 Environment, Health & Safety (EHS) Management Plan

7.13 In accordance with Noble's GMS, comprehensive risk assessments of occupational health and safety will be conducted and effective management plans and corrective actions will be implemented. An EHS Management Plan will be developed for the exploration drilling programme by the selected drilling contractor.

7.14 The purpose of the EHS Management Plan is to provide a clear description of the EHS management policies, procedures, systems and control measures to be used in executing the exploration drilling programme.

### 7.4.2 Well Basis of Design

7.15 Prior to exploration drilling operations commencing, Noble will develop a Well Basis of Design. The Well Basis of Design will confirm all operational details related to the exploration drilling project. This document will be produced once all operational details are confirmed and will be submitted alongside a PON4.

7.16 FIG recommends that documents confirming exploration drilling operational details be submitted at least two months prior to exploration activities commencing. This will allow sufficient time between submission to FIG and final response.

### 7.4.3 Emergency Response Plan (ERP)

7.17 An Emergency Response Plan (ERP) should be in place for the exploration drilling operations and commensurate with the potential impacts identified in the EIS and any other relevant assessments. The ERP will outline the procedures to be followed in the event of an emergency. The ERP will cover a range of areas, including:

- Oil Spill Contingency;
- Severe Weather;
- MedEvac;
- Security;
- Emergency Evacuation; and
- Facility Plan(s) (where relevant).

7.18 In accordance with Noble's EHS Guidelines, response planning will be based on the findings from the EIS and other relevant risk/hazard assessments the project may conduct. The ERP will be prepared to align with the National Oil Spill Plan for the Falkland Islands where relevant. Additionally, Noble will review and interface to emergency response documents for relevant contractors.

7.19 The ERP is intended to guide Noble personnel and those of other responsible organisations through the processes required to manage an emergency during the exploration drilling programme. The ERP includes an overview of potential risks (for example an unintentional release of diesel from a hose leak), potential environmental impacts based on the baseline in the vicinity of the well sites, training requirements, the general strategy for response and the response process in the event of an emergency. The ERP will provide details of the full emergency response exercise, required by Department of Mineral Resources (DMR) guidelines, to be undertaken shortly after taking control of the drilling rig in Falkland Islands waters.

7.20 The ERP will include any Management System interface document (MSID) or bridging documents covering the interface between the operator, duty holder and other entities such as the drilling contractor. The ERP will be assessed by FIG's Director of Emergency Services in conjunction with other relevant FIG officials.

### 7.4.4 Media Strategy Plan

7.21 The Media Strategy Plan will provide details on key media contacts, draft holding statements, and primacy for response in the event of various types of incidents occurring, including but not limited to oil spills, rig safety incidents, vessel incidents and helicopter incidents. The Media Strategy Plan will provide details of the process and procedures to be followed in the event of an incident including holding discussions on the response with FIG. The Media Strategy Plan may form part of the emergency response documents (e.g. could be included within the ERP), although a separate document is preferred by DMR for clarity.

### 7.4.5 Oil Spill Response Plan (OSRP)

7.22 An Oil Spill Response Plan (OSRP) will be created as per the DMR guidelines. The OSRP will provide the actions to be taken in the event of an unintentional release of hydrocarbons. It will define the roles and responsibilities of interested parties and also provide an action plan, description of the available oil spill response resources and proposed response procedures. In accordance with the Noble EHS Guidelines and other international industry best practice, oil spill response planning will be based on oil spill modelling, findings from the impact assessment process (as reported in this EIS) and other relevant risk/hazard assessments the project may conduct.

7.23 In the Falkland Islands, operators must submit a detailed OSRP for assessment by FIG. This will be assessed by DMR who are the lead authority on oil spill response. In accordance with guidance from DMR, the OSRP will take into account any changes in best practice that have been implemented since the Gulf of Mexico Deepwater Horizon incident, and will assess the worst-case oil spill scenario and provide a detailed analysis of the availability and mobilisation timetable for relief well drilling and available well intervention devices.

#### Purpose & Scope

7.24 The OSRP provides guidance on the actions and reporting requirements in the event of an unintentional release of hydrocarbons originating from drilling activities offshore the Falkland Islands in the Noble license areas.

7.25 The plan will guide the various onshore and offshore personnel through the actions and decisions which will be required in the event of an oil spill.

7.26 Where oil spillage is part of an emergency situation, such as a well control incident, fire or explosion, the emergency aspects of the incident must be addressed as a priority and reference shall be made to the Noble ERP and relevant contractor bridging/interface documents, which include a detailed description of the emergency response arrangements between Noble and its contractors.

7.27 The OSRP will be aligned with both the FIG National Oil Spill Contingency Plan (NOSCP) and the Noble emergency response arrangements. The OSRP will be written to the latest UK Department of Energy and Climate Change (DECC) guidelines prevailing at the time. FIG broadly follows the DECC guidelines for oil pollution emergency planning, although the regulations and guidelines have not been formally adopted in the Falkland Islands.

7.28 The OSRP will conform to the following structure:

- **PART I: Response Procedures -** This section of the OSRP will define the roles and responsibilities of interested parties, outline the offshore and onshore response procedures, define the communications between Noble key personnel and external parties, outline the response strategies available and the preferred response strategy, provide all response forms that may be necessary in the event of an oil spill and finally provide a contact directory.

- **Part II: Supporting Information –** This section provides all supporting information, including a risk assessment, details on provisions for well control, the national regulatory regime and interface with the FIG NOSCP, training and exercise details and proposed frequencies, general guidelines on fate and effects of oil in the marine environment, general response strategy guidelines, and information on oil spill waste management during clean-up.
- **PART III: Well Specific Appendices –** Part III of the OSRP will consist of the well specific appendices, containing well specific details, risk assessment, oil spill modelling, location specific environmental sensitivities information, and relief well planning details.

7.29 The plan will provide full details of Tier 1 and Tier 2/3 arrangements that Noble will implement before exploration drilling operations commence. The following provides a summary Table of Contents for the OSRP:

1. Introduction
   - 1.1. Purpose & Scope
   - 1.2. Interface with Falklands NOSCP
   - 1.3. Area Description

**PART I: RESPONSE PROCEDURES**

2. Offshore Response Procedures
   - 2.1. Response Organisation & Management
   - 2.2. Initial Offshore Response
   - 2.3. Oil Spill Reporting Requirements
   - 2.4. Responsibilities Checklists
3. Onshore Response Procedures
   - 3.1. Response Organisation & Management
   - 3.2. Onshore Response Teams
   - 3.3. Oil Spill Reporting Requirements
   - 3.4. Responsibilities Checklists
4. Communications Summary
5. The Role of the FIG Incident Command Team (ICT)
   - 5.1. Incident Command Centre
6. Response Strategies
   - 6.1. Tiered Response
   - 6.2. Selection of Strategy by Oil Type
7. Response Resources
   - 7.1. Oil Spill Response
   - 7.2. Tiered Response
   - 7.3. Mobilisation of Oil Spill Response
   - 7.4. Response Forms
8. Contacts Directory

**PART II: SUPPORTING INFORMATION**

9. Training & Exercises

9.1. Oil Spill Response Training

9.2. Exercises & Drills

9.3. Recording of Exercises

10. Legal Framework

10.1. Regulatory Regime

10.2. Statutory Authorities Roles & Responsibilities

10.3. Other Support Agencies

10.4. Interfaces with National Contingency Plans and Others

11. Drilling Area Risk Assessment

11.1. Likelihood of an Oil Spill Occurring

11.2. Possible Spill Scenarios

11.3. Spill Prevention & Mitigation

12. Relief Well Contingency

12.1. Blowout Contingencies

12.2. Relief Well Locations

12.3. Relief Well Designs

12.4. Relief Well Equipment

12.5. Rigs for Relief Well Drilling

12.6. Well Control Specialist Services & Equipment

12.7. Lessons from the Macondo & Montara Blowouts

13. Fate & Effects of Spilt Oil in the Marine Environment

13.1. Fate of Spilt Oil

13.2. Effect of Spilt Oil and Environmental Risk

14. Response Strategy Guidelines

14.1. Options Available

14.2. Monitor & Evaluate

14.3. Natural Dispersion

14.4. Chemical Dispersant Application

14.5. Containment & Recovery

14.6. Shoreline Protection & Cleanup

14.7. Oiled Wildlife Response

**PART III: PROJECT SPECIFIC APPENDICES**

### 7.4.6 Waste Management Plan (WMPA)

7.30 Noble will develop a Waste Management Plan (WMPA) for the exploration drilling programme. The WMPA will cover all stages of the project lifecycle and will cover all operations on the drilling rig and OSVs. The WMPA will:

- Promote minimisation of the amounts of waste generated at source;
- Require segregation of waste by type;

- Require appropriate storage to prevent emissions and leaks;
- Require the use of an authorised waste specialist;
- Promote recycling or re-use where possible, in particular for scrap metal, waste oil and surplus chemicals;
- Require that waste be sent to authorised landfills or incineration facilities, depending on its precise nature, when no other option is possible;
- Minimise and manage cumulative waste generation from the drilling campaign; and
- Ensure a clear chain of ownership for all waste through the use of waste transfer manifests until final disposal, particularly relating to trans-boundary matters.

7.31 Noble is aware that onshore disposal options are extremely limited. Noble will work closely with FIG prior to drilling operations to determine acceptable options for onshore non-hazardous waste disposal. The following measures will be included in the Waste Management Plan:

- no un-combusted wastes arising from the drilling programme will be landfilled in the Falkland Islands;
- some non-hazardous combustible waste will be segregated and sent to a local incinerator for incineration in the Falkland Islands; and
- the waste ash arising from this incineration will be landfilled in the Falkland Islands along with other incinerator waste at an existing landfill facility (Eliza Cove or Mary Hill Quarry)".

7.32 Noble will confirm all waste management and disposal routes within the WMPA to be approved by FIG prior to drilling operations commencing.

7.33 All contractors will be required to adhere to the requirements within the WMPA.

7.34 The WMP will be aligned with Noble's waste management standards and will provide a structure for waste guidance and disposal at all stages of the project. Specifically the WMPA will include:

- Government regulations;
- The waste management philosophy for the project;
- A detailed waste inventory;
- Description of waste collection, handling, labelling and storage;
- Definition of the types of inspections, including the frequency and relevant documentation;
- Description of requirements associated with waste movements;
- Description of where waste will be sent for storage or disposal;
- Individual roles and responsibilities of key personnel administering the WMPA;
- Identification of personnel responsible for the use and storage of all resources;
- The processes for waste disposal, including documentation requirements (such as waste manifests) to storage and final disposal (as applicable);
- Arrangements for hazardous waste, including storage, export, treatment and disposal, in accordance with the Basel Convention;
- Identification of waste specialists and procedures to correctly document, transport, process and dispose of waste in an environmentally responsible manner and according to all relevant legislation;

- Defined waste tracking requirements(including documentation and waste manifests) and reporting;
- Recordkeeping requirements, including a monthly waste disposal log and waste register non-conformance log;
- Reporting procedure for any incidents; and
- Audit/assessment programme to verify implementation of the WMPA.

7.35 Monitoring of waste will be undertaken through a Waste Disposal Log which will identify the date and amount of waste generated and transported. Any reuse or recycling efforts for waste shall also be documented. The recorded values will be checked against targets set during the development of the WMPA. Following review of the recorded data and evaluation of waste reduction targets, any revised targets or waste reduction procedures will be communicated to relevant personnel and updated within the WMPA.

### 7.4.7 Discharge Management Programme (DMPO)

7.36 The Discharge Management Programme (DMPO) will provide specific requirements, limits and expectations with regards to discharges. Discharges expected from the exploration drilling programme include:

- Drill Cuttings;
- Drilling mud;
- Cement;
- Ballast water;
- Wastewater; and
- Drainage water.

7.37 The purpose of the DMPO is to provide a consistent set of discharge requirements for the exploration drilling programme. The prohibitions, limitations and monitoring requirements in the document will be based on recognized standards and regulations that have been developed to protect the environment. The programme is to be used in conjunction with any applicable laws and regulations.

7.38 The DMPO will establish effluent limitations, prohibitions, reporting requirements and other conditions on discharges from the exploration drilling programme and may include the following:

- Roles and responsibilities of personnel on the rig and OSVs;
- The overall framework of the programme; and
- Sampling, monitoring, record keeping and review requirements.

7.39 The implementation of the DMPO will conform to the Noble GMS, which establishes guiding principles for environmental, personnel, facility and public protection.

### 7.4.8 Stakeholder Engagement Plan (SEP)

7.40 Stakeholder engagement is a key aspect of any successful project. Whether the stakeholders are affected communities, government regulators, non-government organizations (NGOs), the media or other key individuals or groups interested in or affected by a project's activities, they play an important role in identifying, communicating, mitigating and monitoring project impacts.

7.41 The objectives of the Stakeholder Engagement Plan (SEP) are to:

- Describe the regulatory, company (i.e. Noble) and/or other requirements for consultation and disclosure;

- Identify and prioritise key stakeholder groups, focusing on affected communities (the communities and residents of the Falkland Islands who collectively, represent a single affected community that may potentially be impacted [either directly or indirectly] by various aspects of the proposed exploration drilling activities. This includes disadvantaged people and/or vulnerable groups);
- Describe the strategy and present the timetable for sharing information and consulting with each of these groups;
- Describe the internal resources and individual responsibilities assigned to implement stakeholder engagement activities; and
- Describe how the effectiveness of the SEP will be monitored and how lessons learned will be recorded, with the aim of improving stakeholder engagement activities during the environmental impact assessment and during future implementation of the project itself.

7.42 The SEP is a live, document and is regularly updated for all lifecycle stages. The SEP includes Noble's Community Feedback Mechanism and plans for public consultation. The SEP has been based upon a detailed stakeholder identification and analysis process and includes input from the scoping consultation undertaken as part of the project, and from the EIS itself. The SEP can be found in Appendix J.

## 7.5 Monitoring & Review

7.43 In order to ensure that the mitigation measures and management plans described within this EIS will be implemented effectively, a monitoring and review programme will be required. Some monitoring activities may be described in detail in the management plans. Others may need additional monitoring and review activities, as outlined below in this Section. Additional monitoring and review activities may still be required.

7.44 In order to ensure that adequate monitoring and review is undertaken, Noble will undertake an assessment of all contractors involved in the exploration drilling programme before activities commence and during offshore operations. The initial assessment will compare EHS and security data from the contractor with previously established corporate and project benchmarks and requirements. Any deficiencies will be identified and corrective and preventive actions will be undertaken to ensure improved performance. Once exploration drilling is underway, the status of implementation, compliance with commitments and an evaluation of the effectiveness of controls and mitigation measures will be monitored in order to ensure that the obligations of the contractors are being met.

7.45 Throughout all stages of the project, contractors will be required to comply with all relevant environmental legislation and to take account of published standards, accepted industry practice, national guidelines and codes of practice appropriate to the exploration drilling programme. For the duration of the contract, the environmental performance of the contractor will be monitored through inspections and audits.

7.46 Contractors will be required to operate an induction program to ensure all employees are aware of the relevant rules and their environmental responsibilities. Contractors are also required to identify additional training needs for personnel and to provide the identified training to all relevant personnel. The training will include toolbox talks to maintain an appropriate level of awareness of EHS issues.

### 7.5.1 Monitoring During Operations

7.47 Monitoring for Noble's exploration drilling programme falls into two broad categories:

- Performance monitoring is required so that Noble will be able to gather monitoring data for compliance with consents and regulatory requirements. Moreover, it allows tracking of performance against established targets and objectives and international standards of best practice and against the requirements of Noble's GMS. Performance measures for Noble's exploration drilling programme will include:

    - Chemical use and dosing rates of chemicals;
    - Drilling mud use;
    - Oil-in-water levels;
    - Waste generation; and
    - Accidental release of oil or chemicals

- Environmental effects monitoring will focus on monitoring of impacts which are considered to be of particular concern to the regulator and key stakeholders and include the following:
    - Monitoring of the benthic environment pre, during and post drilling to investigate potential impacts on seabed habitats and fauna;
    - Monitoring of marine mammals during certain noise generating activities (e.g. deploying a Marine Mammal Observer (MMO) during Vertical Seismic Profiling (VSP) operations); and
    - Monitoring the effects of light emissions on important populations of seabirds.

7.48 The following sections provide details of the monitoring and feedback mechanisms put in place to ensure the impact predicted in this EIS remain as predicted (or indeed are reduced below the predicted level).

### Performance Monitoring

7.49 In order to monitor the performance of contractors and the performance of the rig in particular, Noble will set up a system of daily reporting from the rig which will provide details of the following:

- A high level overview of operations undertaken in the previous 24 hours;
- Weather conditions experienced and any measures put in place to deal with extreme weather conditions;
- Drill Cuttings – volume produced and discharged;
- Drilling mud – volumes produced and discharged;
- Chemical – volumes used and dosing rates of chemicals;
- Cement – volumes used and discharged, volumes discharged due to incorrect mixing;
- Ballast water – exchange volumes and locations;
- Wastewater – volumes treated and discharged against set standards detailed in contractual obligations;
- Drainage water – volumes treated and discharged against set standards detailed in contractual obligations, oil-in-water levels;
- Food waste – weight / volume of food waste, disposal methods and volumes;
- A detailed waste inventory including description of waste collected, handling methods and storage;
- Refuelling undertaken – weather conditions at time of refuelling, details of the watch undertaken to ensure proper implementation of refuelling procedures, details of any accidental releases and clean up measures employed; and

- Details of any minor accidental releases of fuel or fluid occurring during operations, including volumes released and clean up measures employed.

7.50 Through this daily reporting mechanism any issues with contractor performance can be identified. The daily reports will be provided by rig operator to the company man on board the rig. The company man on board the rig will report any non-compliance to the Noble EHS manager. If any issues are identified Noble will meet with the contractor to discuss options for performance improvement which will require immediate implementation. Details of these discussions and proposed improvements will be provided to FIG in order to demonstrate Noble's continued adherence to the standards expected of the drilling operations.

### Environmental Monitoring

7.51 As part of the ongoing management of operations the monitoring program has been designed to enable Noble to track and assess the performance of mitigation measures, ensuring Noble meets its regulatory and corporate requirements and to update and improve the controls implemented, if necessary. To that end, Noble will monitor the potential impacts that may occur as part of their operations. As part of this process, Noble will collect information as their operations proceed, on the potential impacts identified during the impact assessment process and feed collected information back into the ongoing assessment and management process.

7.52 It should be noted that the mitigation measures proposed in this EIS have been implemented across the global oil and gas industry and have been demonstrated to successfully remove, reduce or manage the identified impacts to a level that is as low as reasonably practicable. It is expected that the predicted outcome of the impact assessment will not change and that most impacts will be of less consequence than predicted within the impact assessment. However, should it be identified through monitoring that a potential impact is greater than expected, Noble will record the instance and propose further measures to ensure that the potential impact is successfully mitigated. This will be undertaken through a proactive process involving relevant parties within the Falkland Islands.

7.53 Monitoring is an important activity for measuring performance against regulatory and corporate requirements and is directly linked to the goals and improvement programmes put in place for the project. Monitoring enables the assessment of progress against project goals and overall environmental performance of the project from initial design work through to delivery and completion of the project.

7.54 The monitoring programmes below have been provided in the impact assessment as management tools which will be used to identify whether predicted impacts are as assessed. However, in order for these monitoring programmes to work, they require a feedback mechanism to ensure that any potential issues are identified quickly so that a remedial action can be employed to ensure impacts remain as low as possible. Without successful adaptive management of impacts there is the potential for unforeseen circumstances to occur where impacts are higher than predicted, particularly where uncertainty is present in the assessment.

7.55 To that end, it is proposed that an advisory group of Noble and contractor personnel is set up to oversee the monitoring. The monitoring advisory group would review outputs from the monitoring program. All monitoring undertaken as part of operations will be reported to the advisory group on a monthly basis so that they are aware of any changes as they happen and can be advised of subsequent measures proposed if impacts are considered to be greater than predicted. Should any critical issues develop that require rapid resolution, Noble will inform DMR and EPD as soon as practicable and request a meeting to be held as soon as possible to resolve the issue.

7.56 Within three months following completion of the exploration drilling supported by this EIS a report shall be provided to the Falkland Islands Government reviewing the accuracy of the EIS and the effectiveness of the mitigation measures (including any additional remedial action taken), this shall include details, and analysis of, any detailed monitoring/reporting set out in this EIS.

### *Seabed Monitoring*

7.57 Seabed features and habitats at the well sites will be confirmed through site-specific environmental seabed surveys, which will include pre-drilling, during drilling and post-drilling elements.

7.58 The pre-drilling survey will include a 100 metre radius (centred on the well location) remotely operated vehicle (ROV) inspection of the seabed, using an environmental specialist to interpret for habitats and species. Additional features showing important species (e.g. rocks with epifaunal communities or the presence of corals or important infaunal assemblages) will be marked and re-visited after drilling is completed. Seabed sampling will be carried out upstream and downstream of the prevailing currents at 50, 100 and 200 metre offset locations, using a specialist environmental ROV corer (89mm outside diameter).

7.59 During drilling, specially designed sediment traps will be deployed at each of the above environmental stations for the purposes of logging the settlement of any cuttings material deposited on the seabed.

7.60 The results of the surveys and analyses will be reported to FIG at the end of the drilling programme once the results become available. However, should any habitats of conservation important be identified at any point of the pre-drilling surveys, Noble will look to relocate the well location to avoid these habitats. The location of the habitats and the proposed new well location will be reported to FIG as soon as possible, to allow FIG to have as much information as possible and for Noble to formulate their strategy for avoiding sensitive habitats.

### *Marine Mammal Monitoring*

7.61 During Vertical Seismic Profiling (VSP) operations (should they take place), Marine Mammal Observers (MMOs) will be deployed to implement the JNCC *Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys* (2010). During VSP operations, records will be kept of marine mammals observed, their location in relation to the seismic apparatus, whether the airguns were engaged in soft start procedures or firing at full energy.

7.62 The MMO will provide a daily report on their observations during VSP operations, which will be provided to the company representative on board the rig. This will then be passed onto Noble management for review. Should any issues be identified within the reports, Noble will identify these in their report to FIG and request a meeting to discuss potential options for ensuring continued environmental performance in line with the predictions of this EIS.

### *Seabird Monitoring*

7.63 There is some concern that seabirds may be attracted to the lights of the rig and OSVs at night, which could lead to potential issues related to stalling of migration, diversion of migration routes and even collision with the rig itself. While these issues have been considered as resulting in a low impact in the assessment, it is recognised that monitoring is required to ensure this is the case and to report this to FIG.

7.64 The precise details of the bird monitoring on the rig are yet to be finalised. Noble will monitor the number of birds found on the rig throughout the exploration drilling programme and will report monthly to an advisory group the findings of this monitoring. In the event that it is considered that significant and unacceptable numbers of seabirds have been attracted to the rig at night this will immediately be reported to FIG. Noble will then investigate whether further measures can be implemented and will work with FIG and their advisors to develop suitable measures. However, based on the experience of a previous study offshore the Falklands (albeit in northern waters) it should be noted that an event such as this is considered highly unlikely to occur.

7.65 As part of the monitoring programme, a protocol will be established for the identification and recording of species involved in the event of mortality. Species present on the rig, involved in collisions or observed attracted to the rig will be recorded, including species name, numbers observed, behaviour and location on the rig. Photographs of species observed will be taken as part of the recording procedure. However, based on the experience of a previous study offshore the Falklands (albeit in northern waters) it should be noted that mortality due to association is expected to be highly unlikely to occur. The finalised protocol for recording species observed will be developed prior to drilling operations occurring and will be agreed with FIG.

### 7.5.2 Monitoring Post Operations

7.66 Following completion of drilling activity, a post-drilling survey will be undertaken to provide feedback on the predicted impacts provided in this EIS. The post-drilling survey is intended to provide feedback on the results of the drill cuttings modelling and the impacts predicted based on the modelling outputs. The post-drilling survey will include a 100 metre radius (centred on the well location) ROV inspection of the seabed, using an environmental specialist to interpret for habitats and species. Any additional features showing important species marked during the pre-drilling survey will be re-visited. Seabed sampling will again be carried out at the same offset locations as the pre-drilling survey. In addition, a 1.5 metre ROV corer will be used to assess the vertical profile of the sediments in the thickest part of the cuttings pile, expected to be approximately 10 metres from the wellhead. This will record the settlement regime of discharged material over the duration of the drilling, with discrete layers identified, measured and analysed for their physico-chemical properties.

7.67 The collected data will be compared to the predicted cuttings pile form the modelling study presented in Section 6.3.2. The report will provide analysis on the accuracy of the model and based on this analysis will include recommendation for improvement of the model. In addition the report will provide recommendations for measures to be implemented (if required) in future drilling campaigns.

### 7.5.3 Community Feedback Mechanism

7.68 In order to monitor potential impacts to the local community Noble has implemented a Community Feedback Mechanism to allow the local community to lodge complaints related to Nobles operations. The Community Feedback Mechanism is to be used by any third-party to provide comments and raise any concerns or complaints associated with the project at any stage of the development, including throughout the lifecycle of the exploration drilling project.

7.69 Any feedback received through the mechanism will be logged, an appropriate action will be identified and the person responsible for implementing the action will be confirmed. Once the action has been completed, the person that logged the feedback will be provided with a response.

# 8 Public Consultation

## 8.1 Introduction

8.1 This section outlines the steps that Noble has taken regarding public consultation and disclosure activities, which were conducted during the scoping phase.

## 8.2 Stakeholder Engagement

### 8.2.1 Stakeholder Engagement Plan (SEP)

8.2 At an early stage during scoping for the EIS, a Stakeholder Engagement Plan (SEP) was prepared specifically for the proposed exploration drilling project. The objectives of the SEP were to:

- Describe the applicable national regulatory and Noble policy requirements for consultation and disclosure activities;
- Identify stakeholder groups, focusing on affected communities;
- Describe a clear strategy and timetable for sharing information and consulting with identified stakeholders, indicating when this will occur during the EIA process;
- Describe individual roles and responsibilities between Noble and RPS associated with stakeholder engagement activities; and
- Describe how the effectiveness of the SEP will be monitored and how lessons learned will be recorded, with the aim of improving stakeholder engagement activities during the EIA process, and also during the operational stages of the exploration drilling project.

8.3 A copy of the SEP is provided in Appendix J.

### 8.2.2 Community Feedback Mechanism

8.4 During the EIA process, the requirement for a Community Feedback Mechanism was implemented, where the following local telephone number and e-mail address were established:

- Phone line: +500 22986
- Email address: FalklandsSocialResponsibility@nobleenergyinc.com

8.5 The Community Feedback Mechanism is to be used by any third-party to provide comments and raise any concerns or complaints associated with the project at any stage of the EIA process and throughout the lifecycle of the exploration drilling project. The Community Feedback Mechanism will remain open during the EIA process and throughout the operational stages of the exploration drilling project.

## 8.3 Stakeholder Identification

8.6 For the purpose of this EIS, stakeholders were defined as, "*persons, groups or communities external to the core operations of a project who may be affected by the project or have interest in it. This may include individuals, businesses, communities, local government authorities, local non-governmental and other institutions, and other interested or affected parties*" (*IFC, 2012*).

8.7 The results of the stakeholder identification process are described in the SEP. Table 8.1 describes the categories of stakeholders who were consulted during the EIA process.

*Table 8.1: Categories of stakeholders identified*

| Stakeholder Group | Connection to the Project |
|---|---|
| Public institutions and regional authorities | Ministries, departments and agencies who implement legislation associated with planning and approval for oil and gas exploration activities, statutory agencies associated with environmental protection or that have a role in the project planning and approval process.<br>The Governor of the Falkland Islands and functional departments within the administration with regulatory responsibilities delegated from the Falkland Islands Government (FIG) that are relevant to the project planning and approval process. |
| Local businesses | Private companies with interest in the Falkland Islands whose business may be impacted by the proposed exploration drilling activities. Service companies relevant to the project (including for example, logistics support). |
| Users of the sea | People and businesses reliant on the quality of the sea and seashore for fishing, recreational activities and tourism. |
| Affected Communities | The communities and residents on the Falkland Islands who collectively, represent a single Affected Community that may potentially be impacted (either directly or indirectly) by various aspects of the proposed exploration drilling activities. This includes disadvantaged people and/or vulnerable groups. |
| Local, national and international environmental NGOs and research institutions | Organisations with interests in sustainability and the environment, who aim to represent the views and interests of their members and/or the general public, with regards to exploration drilling activities. |

## 8.4 Consultation & Disclosure Activities Completed during Scoping

### 8.4.1 Invitation

8.8 All consultation and disclosure activities completed to date were undertaken during Scoping.

8.9 A formal letter was electronically distributed to all identified stakeholders (with the exception of the Affected Community – refer to Focus Group Discussion in Section 8.4.3) inviting them to participate in a series of consultation meetings held at Noble's local office in Stanley. A Project Information Document (PID) was provided as an attachment to the letter, containing a concise summary of the project, proposed location, a summary of the potential environmental impacts, and an overview of the EIA process including planned stakeholder engagement activities. A series of meetings were subsequently arranged in advance of an in-country visit by the Noble management team and RPS.

### 8.4.2 Stakeholder Engagement Meetings

8.10 In-country stakeholder consultation meetings were completed from 31$^{st}$ August 2013 to 7$^{th}$ September 2013 in Stanley with each of the stakeholder groups that showed an interest in participating. At the start of each meeting, a PowerPoint presentation was given to provide an overview of the proposed exploration drilling project and the EIA process. After the presentation, a discussion was facilitated which focused on the stakeholder's specific area of interest.

### 8.4.3 Focus Group Discussion

8.11 On the evening of 5$^{th}$ September 2013, a focus group discussion was held in the Chamber of Commerce in Stanley, with the aim of obtaining representative views and opinions on the proposed exploration drilling project from the Affected Community. In order to achieve a representative group, the following selection criteria and targets were used to identify suitable individuals to attend:

- Gender - with the aim of achieving a male/female ratio of at least 60:40 so that the views and interests of women were adequately represented;
- Age - so that both young people and the elderly were adequately represented;
- Vulnerability or contact with vulnerable people - so that individuals or groups who may be proportionally disadvantaged by the project were adequately represented;
- Representatives of educational and healthcare establishments such as teachers, educational professionals and nurses; and
- Location - individuals from West Falkland were specifically invited to attend, particularly those involved in farming activities.

8.12 The FGD was facilitated by an RPS professional experienced in stakeholder consultation activities. Falkland Islands Tours and Travel (FITT) agreed to help identify members of the public to attend the FGD based on the criteria listed above. FITT were also employed to provide transport services for attendees to the Chamber of Commerce.

## 8.5 Scoping Report

8.13 Following the completion of the in-country stakeholder meetings, a Scoping Report was subsequently prepared and distributed electronically to stakeholders. The Scoping Report was sent out on 6th May 2014 with a request for comments to be received by 20th May 2014. Specific objectives of the scoping report were to:

- Provide an overview of the exploration drilling project;
- Provide an overview of the environment that is present within the predicted project area of influence, and to describe any recent and ongoing trends;
- Identify potential environmental impacts, and suggest mitigation and monitoring measures which could be implemented;
- Identify relevant data gaps and provide an outline of future studies required to address identified data gaps; and
- Describe the methodology used to assess identified impacts.

## 8.6 Summary of Key Issues

8.14 A summary of the key issues and concerns raised by stakeholders during the Scoping process is presented below in Table 8.2.

***Table 8.2: Issues raised during scoping consultation***

| Issues Raised | Noble response summary | EIS Section |
|---|---|---|
| **Stakeholder Consultation Meetings** | | |
| Concerns over the generation, storage and treatment/disposal of waste as there are limited waste reception facilities on the Falkland Islands, plus the potential to have a joint waste management plan with other operators. | Noble is aware that the onshore disposal options in the Falkland Islands are limited. Noble will work closely with FIG prior to drilling operations to determine acceptable options for onshore non-hazardous waste disposal. Noble will confirm all waste management and disposal routes in the Waste Management Plan (WMPA), to be approved by FIG prior to drilling operations commencing. Hazardous waste associated with the exploration drilling project will be stored safely at the Noble shore base prior to export to adequate facilities that can deal with such waste appropriately, according to the Basel Convention. All contractors will be required to adhere to the processes and procedures defined within the WMPA. Noble will investigate the potential for a joint WMPA with other operators. | Section 6.7.1 and Section 6.7.2 |
| Navigational risk associated with increased vessel traffic to/from the drilling unit. | During the drilling programme, it is anticipated that a maximum of three Offshore Supply Vessels (OSVs) will be used to support the drilling unit. Due to the very low shipping activity in the area, potential impacts on existing shipping activity are anticipated to be low. In addition, one of the vessels will remain in close proximity to the rig and act as a Safety Stand-by Vessel (SSV). This vessel will enforce the 500 metre safety zone around the drilling unit by continuously monitoring shipping traffic in the area and making VHF contact with vessels if necessary. An assessment of navigational risk is made within the EIS document in Section 6.1.2. | Section 6.1.2 |
| Limited emergency resources on the Falkland Islands in the event of an emergency / MedEvac situation. | Noble recognises that the Falkland Islands have limited emergency resources available in the event of a major offshore incident where MedEvac may be required. Emergency MedEvac procedures will be defined fully within the drilling contractor's Health, Safety and Environmental Management Plan. In addition, Noble will also have an Emergency Response Plan (ERP) in place and approved by FIG prior to the commencement of drilling operations, which will also fully describe the MedEvac procedures in place, amongst arrangements for other emergency situations. In the event of any such emergency incident, Noble will work closely with the local emergency services on the Falkland Islands and ensure that MedEvac procedures are implemented according to these plans. | Section 6.11.9 |
| Potential for oil spills. | Noble recognises the potential for oil spills from exploration drilling operations. An oil spill modelling study has been conducted to assess the potential impacts in the unlikely event of a major incident involving the significant release of hydrocarbons. The findings of the oil spill modelling study will feed into the development of an Oil Spill Response Plan (OSRP) to be in place and implemented prior to the commencement of drilling operations. The OSRP will be approved by the FIG Department of Mineral Resources (DMR), and interface with the existing Falklands National Oil Spill Contingency Plan (NOSCP). In addition, Noble will ensure that all contracted vessels will have on board Ship-board Oil Pollution Emergency Plans (SOPEP) in place to define their response procedures in the event of a pollution incident. | Section 6.11 |
| Metocean data quality and effects on accuracy of modelling studies. | During the consultation meetings, discussions took place with regard to metocean and oceanography data for the Noble license areas. Many parties raised issues regarding the quality of the metocean data and its subsequent input into oil spill and cuttings dispersion models and the effect on the accuracy and reliability of any outputs from such models.<br><br>Noble will ensure that metocean data is obtained from sources of recognised quality. A detailed metocean study was conducted, which included an analysis of currents in the vicinity of the Falkland Islands. The data obtained during this study is reported in Section 4.2.6 and Appendix L of the EIS. This data was used in support of the oil spill and cuttings dispersion modelling studies. | Section 4.2.6Appendix L |

| Issues Raised | Noble response summary | EIS Section |
|---|---|---|
| Labour related issues that may arise from having contract workers on the Falkland Islands and the potential for conflict between workers and local residents. | The exploration drilling programme will require the use of outside workers, mainly for the drilling unit. These workers will require local accommodation in Stanley during routine crew changes. Disturbance to local accommodation facilities will be minimised through advanced consultation with local hotels being used for overnight accommodation. Noble intends to have a permanent arrangement for housing and leasing rooms in local hotels in place in advance of drilling operations commencing and well in advance of the rooms being required.<br><br>All Noble contractors, including the drilling contractor, will monitor individuals that are part of their work force and ensure they are made fully aware of the standards of behaviour expected, examples as to what constitutes a breach of their own Behavioural Code of Conduct, a description of the disciplinary and appeal processes and procedures to be followed for alleged misconduct. Contractors will ensure that these aspects are clearly outlined in the workers' contracts so that any termination of employment due to a breach is legally enforceable. In addition, the contractors and Noble will limit the amount of time offshore employees spend in Stanley during crew change periods. | Section 6.10.1 and Section 6.1.6 |
| Potential discharge of oil based mud (OBM) and discharge of drilling chemicals. | Noble can confirm that no oil based mud is planned to be used for the drilling campaign and that water based mud (WBM) will be used. Mud chemicals will be selected on the basis of environmental performance as far as possible. All drilling chemicals for use will be on the Convention for the Protection of the Marine Environment of the Northeast Atlantic (OSPAR) Harmonised Mandatory Control Scheme (HMCS) Definitive Ranked List of Registered Products approved for use on the United Kingdom Continental Shelf (UKCS). Oil industry products on this list have been subject to rigorous environmental testing. | Section 6.3.1 |
| Potential interaction / disruption to the fisheries industry. | Through meetings held with the Falkland Islands Department of Natural Resources - Fisheries Department, it is recognised that the Fisheries Department holds extensive fisheries records. The most up to date fisheries information has been obtained and presented in the EIS for the assessment of potential impacts. A complete set of records of the previous six years of fisheries statistics has been requested and obtained from the Falkland Islands Department of Natural Resources - Fisheries Department for this purpose. Additional correspondence was undertaken with relevant stakeholder groups (Falkland Islands Fishing Companies Association, etc.).<br><br>To date, little has been reported in previous operators' Environmental Impact Statement (EIS) submissions of vessel positions in relation to the fisheries catch reported. Vessel monitoring system (VMS) data has also been obtained to aid the interpretation of the data and to assist with the assessment of potential fisheries industry interaction. | Section 4.4.2, Appendix E and Section 6.1.3 |
| Potential disturbance to marine mammals and limited information on marine mammal distribution and abundance data. | To date, little is known of the distribution and abundance of marine mammals offshore the Falkland Islands, particularly in zones of deeper water such as those in the South Falkland Basin. It is therefore important to supplement existing information with other available data where possible.<br><br>During the seismic surveys across FISA12 and FIST13, Noble acquired MMO data. This data has been plotted and interpreted within the EIS in Section 4.3.6. Through consideration of the sightings data, marine mammal abundance across the Noble license areas can be inferred (although a degree of caution is required when interpreting MMO data). An assessment of the potential impacts to marine mammals from drilling operations has been made within the EIS document based on the data available. | Section 4.3.6 and Section 6 |
| Public access to information during the public consultation process. | Noble will ensure that the EIS document and any associated information are readily available to the public during the 42 day public consultation period. The start of the public consultation period will be publicised in the Falkland Islands Gazette by the Department of Mineral Resources. Noble will also place an advertisement in the Penguin News. In addition, the start of the public consultation period will be announced on the local radio station. Two copies of the EIS document will be available in a public place (anticipated to be the public library in Stanley) for inspection during normal business hours. In addition, Noble will supply a hard copy of the document to whoever requests such a copy. | Section 3.2.3 |

| Issues Raised | Noble response summary | EIS Section |
|---|---|---|
| Cumulative work with other operators (Premier/ Borders & Southern) in regards to rig use across a three year drilling campaign. | Cumulative impacts with other operators in the area will mostly be avoided under the planned rig share agreement. This preference to share facilities follows general feedback from FIG to cut down on activity and disturbance in offshore areas as much as possible. An assessment of potential cumulative impacts is given in Section 6.13 of the EIS. | Section 6.13 |
| Measures put in place to ensure the monitoring and management of bio-security. | All vessels associated with the exploration drilling project will undertake any necessary ballast exchange operations well clear of the Falkland Islands in offshore waters outside of the 12nm limit.<br><br>The drilling rig and OSVs will all have procedures in place for ballast water management as part of both the drilling contractor's and OSV contractor's specification. These procedures will be subject to audit/assessment by Noble. | Section 6.4 |
| Potential interactions with wrecks. | Within the south-western region of the FISA12 area of interest, it has been confirmed that there are two un-charted shipwreck sites present. The *SMS Scharnhorst* and the *SMS Gneisenau*, cruisers in the German Imperial Navy, were sunk in 1914 during the Battle of the Falklands. No accurate positions of the vessel losses are known and only approximate wreck locations are provided (*Wrecksite.eu, 2014*). It is likely that the positions reported are inaccurate by several kilometres or more.<br><br>The environmental survey of the FISA12 area put considerable effort into attempting to positively identify the un-charted wrecks during the survey; however, the wrecks were not identified with the survey equipment. Noble will therefore avoid drilling within the immediate vicinity of the reported wreck locations by placing a 10km exclusion zone around the *Wrecksite.eu* locations.<br><br>In addition, the cuttings dispersion modelling has shown that a potential interaction with the reported wreck site locations from the discharge of drill cuttings is not expected.<br><br>Should either the SMS *Scharnhorst* or SMS *Gneisenau* be identified during the pre-drilling surveys, Noble will look to relocate the well location to avoid these wrecks. It is thought that the location of the wreck of the *Atlantic Conveyor* in FINA13 was identified during the survey. However, Noble were unable to obtain seabed photographs so a positive identification was not possible. However, it is thought that the anomaly seen on the bathymetry is highly likely to be the location of the wreck of the *Atlantic Conveyor*. | Section 6.1.5 and Section 6.3.2 |
| Water requirements for the drilling campaign and potential impact on public water supply. | Drill water will be required on the drilling rig for the mixing of drilling fluids/cements. For the supply of drill water to the drilling rig, Noble will utilise the integrated water storage facilities (1,000,000 litre capacity) installed on the Temporary Dock Facility (TDF) barge. This water will be piped from the shore to the TDF and will be sourced from the Stanley mains water supply. The storage tanks on the TDF will be trickle filled from the municipal water supply, which will mitigate against the potential for sudden, high-volume 'shock' demands being placed on the local water supply network. Drinking water from onshore will also be needed by the OSVs. For supply of drinking water, the OSVs will utilise the fresh water services at FIPASS. | Section 6.10.2 |
| Poor knowledge of benthic habitats and species. | Noble recognises the limited available information regarding benthic habitats offshore the Falkland Islands. Noble has conducted regional environmental surveys within the FISA12, FIST13 and FINA13 areas. Site specific pre-drilling, during drilling and post drilling environmental surveys, are also proposed at the well sites. These surveys will gain further insight and add to the pool of knowledge gained so far on the offshore benthic environment. The results of the FISA12 survey are presented in Section 4.3.4 of the EIS as this is the first location that Noble will drill. The results of the FIST13 and FINA13 surveys are not currently available and will be reported in EIS addenda, to be submitted at a later date prior to drilling. | Sections 4.1.1, Section 4.2 and Section 4.3.4. Appendix K. |

| Issues Raised | Noble response summary | EIS Section |
|---|---|---|
| | Details on the environmental survey strategy used in the FISA12, FIST13 and FINA13 areas are included in the EIS. Reference has been made to existing surveys conducted by operators in the vicinity of the areas of interest to Noble. Details of the strategy for the well site specific environmental surveys are also included in the EIS. | |
| **Scoping Report Review** | | |
| **Comments from the Fisheries Department** | | |
| Please provide the guidelines and contingencies for fuel bunkering of the drilling rig at sea. | Noble can confirm that fuel bunkering of the drilling rig will occur at sea. Once the contractors are formally appointed, Noble will ensure that fuel bunkering procedures are addressed within the drilling and OSV contractor’s operational plans and procedures. These plans and procedures will be subject to audit/assessment prior to drilling operations commencing. General mitigation measures for unintentional releases related to fuel or other fluids (e.g. diesel, drilling mud, hydraulic oil or lubricants) during day-to-day operations (including re-fuelling) are described within the EIS in Section 6.11.9. | Section 6.11.9 |
| Question on whether or not a diffuser is used at the end of the fall pipe from which cuttings are discharged at the sea surface from the drilling rig. | Noble can confirm that a diffuser is not commonly used for the discharge of mud and cuttings at or near to the sea surface. Such a device would be likely to cause operational problems related to restriction of flow, potentially leading to blockage of flow lines. It should be noted that the water depths in the proposed drilling areas are great. Therefore, cuttings discharged at or near to the sea surface have a great distance to fall through the water column, where they will be subject to the effects of the water column currents. Due to the great water depths at the drilling location, any use of such a diffusion device is considered to have a minimal effect on the discharge of drilling cuttings. Cuttings dispersion is discussed further within the EIS, where cuttings discharge modelling has taken place. The discharge of drilling mud and cuttings will be addressed within the Discharge Management Programme (DMPO). | Section 6.3.2 |
| Provide information on the well plug, and whether or not it will present a hazard to fishing operations. | Details of well abandonment are provided in the EIS, including the plugging and abandonment programme and the removal of seabed obstructions. Details of the as built well locations will be provided to FIG and to hydrographic organisations to enable the location of the wells to be plotted on navigational charts. | Section 2.4.13 |
| **Comments from the Harbour Master** | | |
| Clarification on current use of FIPASS required, in relation to local fishing vessels, jiggers and cruise vessels. | Details relating to the use of FIPASS have been clarified within the baseline section of the EIS. | Section 4.4.3 |
| Clarification on other docking facilities that exist within Stanley Harbour. | Details relating to other docking facilities within Stanley Harbour have been clarified within the baseline section of the EIS. | Section 4.4.3 |
| **Comments from Falklands Conservation** | | |
| Consideration of cetacean seasonality, especially with regard to the potential disruption to migration/feeding. It is appreciated that this is a difficult judgement without specific data for that area. In this respect, it would be especially valuable if Noble considered (in the longer term, ahead of any exploitation phase) replicating the JASCO Applied Sciences Ltd. acoustic study that was conducted for the Sea Lion Field. This would give a | In the event that a significant hydrocarbon discovery is made, Noble will consider a specific cetacean acoustic study at a later stage, in advance of any hydrocarbon development phase. | - |

| Issues Raised | Noble response summary | EIS Section |
|---|---|---|
| good data set for any future exploitation impact assessment and for measures of cumulative impact. | | |
| Impacts to key wildlife sites, especially Beauchêne and Sea Lion Islands, both of which are of global significance. Beauchêne Island holds a significant proportion of the Falkland Islands population (and therefore world population) of black browed albatross and southern rockhopper penguin. Sea Lion Island has the largest breeding assemblage of southern elephant seals in the Falkland Islands and the most records for Orcas. Impacts are possible from noise, vessel movements, spillages, collision, introduction of invasive species, light, etc. Bio-security is a major concern in the Falkland Islands. | Key wildlife species are discussed in detail within the EIS. Noble appreciates the potential impacts on marine wildlife from various potential sources. These sources and potential impacts are described in Section 6 of the EIS, in relation to the baseline information provided in Section 4, along with the mitigation and control measures planned to reduce any potential negative impacts.<br><br>Potential impacts from noise are addressed in Section 6.5 of the EIS. Noise from all aspects of the exploration drilling operations have been assessed, including the drilling operations themselves, vessel movements, helicopter flights and the planned vertical seismic profiling (VSP) operations following drilling. The impact assessment has shown that underwater noise impacts are expected to be low, with the exception of the VSP operations, for which specific mitigation will be implemented. This includes following the JNCC *Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys (2010)*. These guidelines require the use of marine mammal observers (MMOs) and a soft start of the seismic equipment. The impact assessment has also shown that terrestrial noise impacts on seabirds are expected to be low. Mitigation measures include efficient planning of helicopter flights and OSV voyages throughout drilling operations, and prohibiting the aviation contractor from circling or hovering over marine mammals or sites identified as sensitive for seabird colonies, unless essential for safety or operational purposes.<br><br>Potential impacts associated with collision risk are discussed in Section 6.1.4 of the EIS. The risk of collision with marine mammals is considered to be very low; however, any risk of collision would be increased in shallower areas where species are known to congregate. In light of this, Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species that may present. This will reduce any potential collision risk (however small) with marine mammals.<br><br>Potential impacts associated with the introduction of invasive species are discussed in Section 6.4 of the EIS. The main risk of introducing invasive species for the offshore drilling operations is from the discharge/exchange of ballast water. Mitigation measures include the requirement for all vessels associated with the drilling operations (including the drilling rig itself) to undertake ballast exchange operations well clear of the Falkland Islands in offshore waters outside of the 12 nautical mile limit, and for the drilling rig and OSVs to have procedures in place for ballast water management.<br><br>Potential impacts associated with light are discussed in Section 6.8 of the EIS. In a study of seabird observations during flaring operations at the Sea Lion well in the North Falkland basin, seabird species were present in 235 (73%) of 320 radial point seabird counts. No negative interactions were observed, although significantly greater numbers of seabirds were present during the morning rather than the afternoon, suggesting that there may be attraction to lighting from the drilling rig during hours of darkness. However, due to the rarity of mortality associated with seabird attraction to offshore lighting, the potential impact has been assessed as low. Mitigation measures include switching off heli-deck landing lights (skyward facing lights) on the drilling rig, and deck lights on the OSVs when not in use and when safe to do so.<br><br>Monitoring of birds on the rig in relation to potential impacts from light and monitoring of marine mammal populations during VSP operations will also be carried out. | Section 6.1.4, Section 6.4, Section 6.5, Section 6.6, Section 6.8 and Section 6.11.3 |
| Suggestion of whether a 10 kilometre avoidance area can be placed around Beauchêne and Sea Lion Islands. | Noble appreciates the sensitivity of these areas. Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species present within the vicinity of these islands. Vessels and helicopters will not have the need to approach these islands during operations. | Section 6.1.4, Section 6.5.7 and Section 6.6.2 |

| Issues Raised | Noble response summary | EIS Section |
|---|---|---|
| If there are any plans to monitor background, baseline noise levels? This could be very important when considering cumulative impacts on marine mammals. | Noble has no plans for the monitoring of background baseline underwater noise levels. However, in the event that a significant hydrocarbon discovery is made, Noble may consider the monitoring of baseline background underwater noise levels in advance of any hydrocarbon development phase.<br><br>Noble appreciates that drilling operations have the potential to cause noise impacts. Underwater noise impacts upon marine mammals and fish are discussed in detail within the EIS in Section 6.5. The impact assessment has shown that noise impacts are expected to be low, with the exception of vertical seismic profiling (VSP) operations, for which specific mitigation will be implemented. This includes following the JNCC *Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys* (2010). These guidelines require the use of MMOs and a soft start of the seismic equipment.<br><br>In addition, Noble agrees to place a 10 kilometre avoidance area around both Beauchêne and Sea Lion Islands to avoid disturbance to sensitive species present within the vicinity of these islands, which will reduce any potential noise impacts from passing vessels and helicopter flights in these areas. | Section 6.5 |
| Is there a modelling basis for the 100 metre survey radius for the monitoring of discharged drilling cuttings? Isn't an elongated cuttings plume more likely? Could a basic radius plus a longer transect in the most likely direction of dispersal be carried out? This seems to imply solely monitoring rather than any attempt at mitigation. | Remotely operated vehicle (ROV) inspection of the seabed is limited by the distance that can be reached with the ROV umbilical. It is anticipated that the ROV will be able to reach 200 metres from the wellhead. The pre-drilling, during drilling and post-drilling surveys are designed to increase understanding of the behaviour of discharged drill cuttings in the benthic environment in these regions, and to aid further understanding of any potential impacts. Cuttings discharge associated with water based mud is an inevitable part of drilling operations. Mitigation measures associated with the discharge of drill cuttings are described within Section 6.3.2 of the EIS, and include the selection of drilling mud components on the basis of environmental performance as much as possible, the close monitoring of chemical use and discharge throughout the drilling program which will be minimised by the drill crew and mud engineers where practicable, the limitation of batch discharges of drilling mud as far as possible, and the implementation of a Discharge Management Programme (DMPO) which will provide a consistent set of discharge requirements for the exploration drilling programme, describe the prohibitions, limitations and monitoring requirements based on recognised standards and regulations that have been developed to protect the environment. The DMPO will also include provisions for the discharge of drilling cuttings.<br><br>Cuttings dispersion modelling has been carried out and is presented within the EIS. The results of the cuttings modelling study show that there are seasonal differences in the predicted cuttings pile extent, with results from the winter period (where residual currents are stronger) showing a greater predicted extent of fine particles than for the modelled summer period. Therefore, an elongated plume is more likely to occur in the event of cuttings discharges during the winter period. However, the results also show that the thicker parts of the cuttings pile remain centred around the well bore, regardless of seasonal influences on currents, hence the reasoning behind the proposed pre-drilling, during drilling, and post drilling monitoring. | Section 6.3.2 |
| Impacts from light. Concern over petrel strikes, particularly in the juvenile dispersal period. | Potential impacts from offshore light sources on bird species are discussed in Section 6.8 of the EIS. In a study of seabird observations during flaring operations at the Sea Lion well in the North Falkland basin, seabird species were present in 235 (73%) of 320 radial point seabird counts. No negative interactions were observed, although significantly greater numbers of seabirds were present during the morning rather than the afternoon, suggesting that there may be attraction to lighting from the drilling rig during hours of darkness. However, due to the rarity of mortality associated with seabird attraction to offshore lighting, the potential impact has been assessed as low. Mitigation measures include switching off heli-deck landing lights (skyward facing lights) on the drilling rig, and deck lights on the OSVs when not in use and when safe to do so.<br><br>Noble will monitor the numbers of birds found on the rig throughout the exploration drilling programme and will report monthly to the monitoring advisory group the findings of this monitoring. In the event that it is considered that significant | Section 6.8 |

| Issues Raised | Noble response summary | EIS Section |
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| | and unacceptable numbers of seabirds have been attracted to the rig at night, Noble will investigate whether further measures can be implemented and will work with FIG to develop suitable measures. | |
| Vertical Seismic Profiling (VSP) operations, energy levels and duration of operation to be provided. | The energy levels of the VSP source and anticipated duration of VSP operations has been described in Sections 2.4.11 and 6.5 of the EIS. The duration of VSP operations at each well is anticipated to be approximately 12 hours. The energy source is expected to comprise of between 1,100 - 1,300 cubic inches using compressed air at approx. 2,000 psi. The source will be made up of a cluster of multiple 40, 150 and 300 cubic inch sleeve airguns for VSP. An assessment of the potential impacts associated with VSP operations utilising the expected energy levels of the VSP equipment has been made which has shown that injury and behavioural noise levels for marine mammals will be exceeded during the potential VSP operations, although only within three metres (Permanent Threshold Shift [PTS] criteria) and six metres (Temporary Threshold Shift [TTS] criteria) of the VSP equipment noise source. Mitigation measures for the VSP operations include limiting the duration of VSP operations to requirement minimum as far as possible and strict control of the VSP operations in line with the JNCC *Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys* (2010), which require the use of a MMO and the implementation of a soft start of the VSP equipment. | Section 2.4.11 and Section 6.5 |
| **Comments from the Department of Mineral Resources** | | |
| Operators are reminded that at the present time disposal options for offshore waste are severely limited, and, as per the last drilling campaign, disposal of offshore waste at the Eliza Cove landfill site will not be permitted. | Noble is aware that the onshore disposal options are limited. Noble will work closely with FIG prior to drilling operations to determine acceptable options for onshore non-hazardous waste disposal. Noble will confirm all waste management and disposal routes in the WMPA, to be approved by FIG prior to drilling operations commencing. Waste management is discussed in Section 6.7 of the EIS. | Section 6.7 |
| Past practice has varied regarding whether operators have submitted an onshore Waste Management Plan for direct exploration support activities (for example, waste generated at the port and at the supply base). For completeness, FIG would prefer, in future, to see either offshore and onshore waste management plans (or a single complete plan covering both) to present a clear whole-campaign view of the waste output, processing and final destination of all waste originating from exploration activity. It may be the intention that all land-based support activity is covered within the TDF ESHIA (it refers to "waste generated from onshore activities at the TDF", but it is not clear whether "the TDF" includes all the landward support facilities) but if not, this will require further discussion. The format for submission can be discussed. | Noble recognises the need to be clear about the scope of the waste management plans. Noble can confirm that waste generated at the TDF from day-to-day operations at the TDF will be covered by a WMPA for the TDF facility. This can be considered as the WMPA for the TDF structure itself for ongoing operations, whether engaged in support for exploration drilling activities or not. The WMPA for drilling operations will therefore need to cover both offshore and onshore aspects of the exploration drilling operations (i.e. will cover both offshore and onshore elements of the waste streams). The format for the waste management plan(s) will be discussed with the DMR during the development of the document(s). | Section 6.7 |

| Issues Raised | Noble response summary | EIS Section |
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| In the event of an oil discovery, the potential amount of reservoir tainted cuttings to be discharged, and associated reservoir hydrocarbons, should be estimated, and the consequent potential environmental impact and mitigation or reduction measures should be addressed in the EIS. | Noble appreciates DMRs concern over the release of cuttings potentially tainted with reservoir hydrocarbons. Oil bearing zones, if encountered, are usually small compared to the total length of the well (normally in the range of tens of metres). By the time cuttings from this zone are circulated back to the surface, any free oil adhered to the cuttings has been mobilised into the surrounding drilling mud and becomes integrated into the wider drilling mud system, becoming diluted within the drilling mud to a great extent. The dilution factor is normally so great that free oil from reservoir tainted cuttings cannot be detected against background levels in the drilling mud system. Because of this dilution effect, it is often extremely difficult (and nearly impossible) to extract any oil from water based mud systems that may have arisen due to drilling in hydrocarbon bearing zones. To do so would entail excessive costs and would not be in line with BATNEEC (Best Available Technology Not Exceeding Excessive Cost) principles. In addition, due to the mobilisation of free oil from reservoir cuttings into the mud system, the cuttings do not represent a significant source of free oil upon discharge to the marine environment after passing through the rig shale shaker and cuttings cleaning systems. Therefore, any discharge of such cuttings is considered to be low impact. In addition, the potential reservoir hydrocarbon section will be drilled "overbalanced", meaning the hydrostatic pressure of the drilling mud will be greater than the pore pressure of the potential reservoir, which ensures that there is no flow of hydrocarbons into the wellbore, and minimises the amount of any hydrocarbon tainted cuttings. | Section 6.3.2 |
| **Comments from the Environmental Planning Department** | | |
| Please liaise with the Department of Agriculture Bio-security Section with regard to matters relating to Bio-security. | Noble will continue to liaise with the Department of Agriculture, Bio-security Section on all matters related to bio-security. Potential impacts and mitigation measures for bio-security are discussed within the EIS. | Section 6.4 |
| References to previous studies looking at the attraction of seabird species to light sources should be made, particularly combined with mist/fog conditions. | Potential impacts from offshore light sources on bird species are discussed in Section 6.8 of the EIS. References have been made to previous studies, and include Wiese *et al.*, 2001, Le Corre *et al.,* 2002, Miles *et al.,* 2010, and Munro, 2011. In a study of seabird observations during flaring operations at the Sea Lion well in the North Falkland Basin (*Munro, 2011*), seabird species were present in 235 (73%) of 320 radial point seabird counts. No negative interactions were observed, although significantly greater numbers of seabirds were present during the morning rather than the afternoon, suggesting that there may be attraction to lighting from the drilling rig during hours of darkness. However, due to the rarity of mortality associated with seabird attraction to offshore lighting, the potential impact has been assessed as low. Mitigation measures include switching off heli-deck landing lights (skyward facing lights) on the drilling rig, and deck lights on the OSVs when not in use and when safe to do so.<br><br>Noble will monitor the numbers of birds found on the rig throughout the exploration drilling programme and will report monthly to the monitoring advisory group the findings of this monitoring. In the event that it is considered that significant and unacceptable numbers of seabirds have been attracted to the rig at night, Noble will investigate whether further measures can be implemented and will work with FIG to develop suitable measures. | Section 6.8 |
| **Comments from the Falkland Islands Fishing Companies Association (FIFCA)** | | |
| What literature review has the Fisheries Department done of the potential impacts of the drilling activity, plus the vertical seismic profiling on the fishery in general, and in the circumstances of the wells proposed here in particular, bearing in mind that the location is one of the few areas of Patagonian toothfish spawning? What work and | Noble is not aware of specific studies of seismic activities associated with the Patagonian toothfish fishery conducted by the Fisheries Department. It should be noted that VSP operations are temporary in nature and will be of far less duration than seismic survey activities already carried out in the areas of interest to Noble. An assessment of the potential impacts associated with VSP operations utilising the expected energy levels of the VSP equipment has been made within Section 6.5 of the EIS. The assessment has shown that potential impacts on fish species that are classified as hearing specialists (i.e., those species that possess a swim bladder) are expected to be medium. Mitigation measures include following the JNCC *Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys* (2010), which requires the | Section 2.4.11 and Section 6.5 |

| Issues Raised | Noble response summary | EIS Section |
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| with what conclusions has the Fisheries Department carried out? | implementation of a soft start of the seismic equipment. Although the JNCC guidelines are centred on marine mammals, the soft start procedure will allow fish species to move away from the seismic source if they are disturbed by it, without being subject to the full energy of the seismic source on first start up of the equipment. Impacts on fish species that are classified as hearing generalists, including the Patagonian toothfish), are expected to be less, as these 'hearing generalists' tend to have relatively low auditory sensitivity, and generally only hear sounds at frequencies in the range 0.1 to 1.5 kilohertz. The majority of the energy in the seismic source will be concentrated in the 0 -250 Hz band width. There are higher frequencies of 250 - 500 Hz present in the signal, but at -180 dB or below. Therefore, these types of fish are unlikely to be disturbed to any great extent by the VSP operations.<br><br>The impact assessment has shown that physical damage to fish species could occur at very close proximity to the seismic source, as the energy level is above the 230 dB re 1 µPa threshold within three metres of the VSP equipment. However, the soft start procedures described above will mitigate against the possibility of physical injury.<br><br>VSP operations generally have greater impacts on fish eggs and larvae, which have limited mobility and are more sensitive to noise. Offshore spawning species (such as the Patagonian toothfish and grenadier) are therefore more susceptible to the acoustic impacts resulting from VSP. Spawning areas for grenadier are commonly located north of 51° south (commonly peaking during March and April), and therefore are not expected to coincide with the FISA12 and FIST13 areas, but could potentially be located within the FINA13 area. Spawning areas for Patagonian toothfish are commonly concentrated around the edges of the Burdwood Bank. Spawning can occur year round, with peaks commonly occurring during March and in July and August. The noise level from the VSP drops below the injury threshold for possible auditory damage and damage to eggs and larvae (180 dB re 1 µPa) one kilometre from the VSP source, whilst transient stunning (noise >190 dB re 1µPa) would occur within 316 meters from the source. | |
| Please provide information on what grid squares the wells will lie in, and how big the exclusion zones around the wells are to be. | Noble has provided this information within the EIS, together with an assessment of the potential impacts to fishing operations in relation to the proposed exclusion zone around the drilling rig, and the available sea room for fishing within the proposed FISA12 and FIST13 areas. | Section 6.1.3 |
| What do fisheries think of the impacts of waste and sewage being discharged onto the spawning grounds, and the likely impact of oil based mud? | Noble can confirm that no oil based mud (OBM) is proposed for this exploration drilling campaign. An assessment of the potential impacts from the discharge of food waste and treated sewage has been made within the EIS in Section 6.3.4. | Section 6.3.4 |
| **Comments from the Shallow Marine Surveys Group (SMSG)** | | |
| References suggested and provided by SMSG on water circulation and tidal currents, zooplankton and marine mammals. | Noble is grateful for the supplied studies and has made reference to these studies in the baseline section of the EIS. | Section 4 |
| **Comments from Consolidated Fisheries Limited (CFL)** | | |
| Patagonian Toothfish is a deepwater fish which lives and feeds on the sea bed. Therefore the fish may be susceptible to the cuttings and other chemical and physical deposits and discharges that find their | Noble recognises that there are potential impacts from the discharge of drilling cuttings on fish species that may be present. Unfortunately, the discharge of drilling cuttings is an inevitable consequence of exploration drilling with WBM. In order to assess the potential impacts from the discharge of drilling cuttings on the seabed, Noble has carried out cuttings dispersion modelling. The modelling has shown that the thickest parts of the cuttings pile are predicted to remain centred around the | Section 6.1.3 and Section 6.3 |

| Issues Raised | Noble response summary | EIS Section |
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| way to the ocean floor from drilling operations.<br><br>Not only may this have a direct impact on the health and quality of the fish but also on any other species the Patagonian toothfish feed on.<br><br>There is a remote possibility that quality of the fish stocks might be contaminated as a result of ingesting any harmful materials that might be contained in sea bed discharges. Patagonian toothfish move around unpredictably, so to isolate a suspect area would not necessarily solve a contamination issue. | wellbore at an approximate radius of 200 metres. There are seasonal influences on the results due to differences in currents during the winter period, but only appear to be influential to finer particles discharged at the sea surface. The potential effects of cuttings discharge are therefore expected to be limited to relatively small areas. The cuttings modelling results have also been plotted with respect to the historically fished areas by long liners in FISA12, to gauge any potential impact to fishing operations. This has shown that the predicted extent of the cuttings pile in relation to historically fished areas in the vicinity of FISA12 is limited, and that the sea room taken up by both the drilling rig and associated cuttings deposition is small compared to the available sea room for fishing in the wider area.<br><br>The discharge of drilling cuttings and drilling mud has been assessed within the EIS. After the implementation of appropriate mitigation measures, the residual impacts are assessed as low. All chemicals for use during the drilling programme will be selected on the basis of environmental performance as much as possible. Chemicals will be selected from the OSPAR HMCS Definitive Ranked List of Registered Products. These chemical products have been approved for use on the UKCS after rigorous environmental testing. Other mitigation measures will include the close monitoring of chemical use and discharge throughout the drilling program which will be minimised by the drill crew and mud engineers where practicable, the limitation of batch discharges of drilling mud as far as possible, and the implementation of a DMPO, which will provide a consistent set of discharge requirements for the exploration drilling programme, describe the prohibitions, limitations and monitoring requirements based on recognized standards and regulations that have been developed to protect the environment.<br><br>The vast majority of chemicals associated with drilling mud and drill cuttings have been shown to be, or are considered to be, biologically unavailable to organisms on the seabed (and subsequently their predators) as they are generally utilised in inert forms (e.g. *Jenkins et al., 1989*; *Starczak et al., 1992*; *Neff, 2008*). However, some drilling chemicals do have toxicity and/or bioaccumulation potential, although these are generally additives to the drilling fluid that perform a specific function, and make up only a small percentage of the drilling fluid mix. Chemicals that are worst in terms of toxicity and/or bioaccumulation potential are generally marked with a SUB (Substitution) warning by the Offshore Chemical Notification Scheme (OCNS). This indicates to both the operator and chemical manufacturer that the chemical contains components marked for priority substitution. It encourages operators to seek alternatives to these chemicals where possible, and encourages chemical manufacturers to develop formulations of the chemical that perform the same function but do not exhibit toxicity/bioaccumulation to the point that requires a Substitution warning. It should be noted however, that some chemicals exhibit toxicity by the very nature of the function they need to perform (for example, Biocide) and hence finding an alternative formulation is very difficult. Chemicals will be selected from the OSPAR Harmonised Mandatory Control Scheme (HMCS) Definitive Ranked List of Registered Products. These chemical products have been approved for use on the UKCS after rigorous environmental testing, including their eco-toxicology and bioaccumulation properties. Through the use of chemicals from the approved list, and by minimising the use of SUB labelled chemicals where technically possible, the potential for bioaccumulation to occur and potential effects on fish (including toothfish) populations will be minimised. | |
| There is no data on how seismic in general, and VSP operations, could affect Patagonian toothfish. | Noble is not aware of specific studies of seismic activities associated with the Patagonian toothfish fishery conducted by the Fisheries Department. It should be noted that VSP operations are temporary in nature and will be of far less duration than seismic survey activities already carried out in the areas of interest to Noble.<br><br>An assessment of the potential impacts associated with VSP operations utilising the expected energy levels of the VSP equipment has been made within Section 6.5 of the EIS. The assessment has shown that potential impacts on fish species that are classified as hearing specialists (i.e. those species that possess a swim bladder) are expected to be medium. Mitigation measures include following the JNCC *Guidelines for minimising the risk of injury and disturbance to marine mammals from seismic surveys* (2010), which requires the implementation of a soft start of the seismic equipment. Although the JNCC guidelines are centred on marine mammals, the soft start procedure will allow fish species to move away from the | Section 2.4.11 and Section 6.5 |

| Issues Raised | Noble response summary | EIS Section |
|---|---|---|
| | seismic source if they are disturbed by it, without being subject to the full energy of the seismic source upon first start up of the equipment. Impacts on fish species that are classified as hearing generalists (including the Patagonian toothfish) are expected to be less, as these 'hearing generalists' tend to have relatively low auditory sensitivity, and generally only hear sounds at frequencies in the range 0.1 to 1.5 kilohertz. The majority of the energy in the seismic source will be concentrated in the 0 -250 Hz band width. There are higher frequencies of 250 - 500 Hz present in the signal but at -180 dB or below. Therefore, these types of fish are unlikely to be disturbed to any great extent by the VSP operations.<br><br>The impact assessment has shown that physical damage to fish species could occur at very close proximity to the seismic source, as the energy level is above the 230 dB re 1 µPa threshold within three metres of the VSP equipment. However, the soft start procedures described above will mitigate against the possibility of physical injury.<br><br>VSP operations generally have greater impacts on fish eggs and larvae, which have limited mobility and are more sensitive to noise. Offshore spawning species (such as the Patagonian toothfish and grenadier) are therefore more susceptible to the acoustic impacts resulting from VSP. Spawning areas for grenadier are commonly located north of 51° south (commonly peaking during March and April), and therefore are not expected to coincide with the FISA12 and FIST13 areas, but could potentially be located within the FINA13 area. Spawning areas for Patagonian toothfish are commonly concentrated around the edges of the Burdwood Bank. Spawning can occur year round, with peaks commonly occurring during March and in July and August. The noise level from the VSP drops below the injury threshold for possible auditory damage and damage to eggs and larvae (180 dB re 1 µPa) one kilometre from the VSP source, whilst transient stunning (noise >190 dB re 1µPa) would occur within 316 meters from the source. | |
| There are concerns over any restrictions imposed on our fishing operations due to surveying or other oil related work. The *CFL Gambler* can set up to four 7 mile long lines per day, each taking between 4 and 6 hours to haul. Due to the nature of long lining, there is no opportunity to stop or change course. Once hauling starts it has to be completed. Leaving a longline in the water for too long can result in the catch being attacked by other sea creatures. It is essential that in order to minimise conflict, we have good communications with the oil operators, agree and exchange programmes and keep each other up to date with last minute amendments. | Noble fully recognises the potential impacts upon the fishing industry that the physical presence of the drilling operations poses. An assessment of potential impacts to the fisheries industry has been made within the EIS. This has included an assessment of the proposed exclusion zones on potential fishing operations that may occur within the proposed areas of exploration drilling.<br><br>Noble will liaise closely with the Fisheries Department, FIFCA and CFL in advance of drilling operations commencing, ensuring that the final locations of the proposed exploration wells are reported as soon as they are confirmed.<br><br>Noble will also liaise with the Fisheries Department and CFL with regard to the issue of navigation warnings advertising the presence of the drilling rig through the existing Fisheries Department Daily Shipping Forecast system. The information provided will include details on the current position of the drilling rig, presence of the OSVs, a description of the 500 metre safety zone and the need for vessels to stay outside of this zone at all times. | Section 6.1.3 |

## 8.7 Consultation Activities Following Submission

8.15 The document was formally submitted for review on 21st July 2014. Following this submission, during the 42 day public consultation period, Noble undertook a series of further consultation meetings to present the findings of the environmental impact assessment. These meetings took place in the Falkland Islands between Monday 18th to Friday 22nd August 2014. The meetings undertaken are presented below in Table 8.3.

*Table 8.3: Public consultation meetings undertaken during the 42 day public consultation period*

| Date | Time | Group | Location |
|---|---|---|---|
| Monday 18th August | 0900-1000 | Department of Mineral Resources and Environmental Planning Department | Argos House |
| | 1030-1200 | FIG Officials | Chamber of Commerce (9 attendees) |
| | 1300-1430 | Environmental Planning Department | Argos House |
| | 1500-1630 | Colin Roberts, Sandra Tyler-Haywood, Martin Collins (GSGSSI) | Government House |
| Tuesday 19th August | 1000-1100 | Members of the Legislative Assembly | Gilbert House (5 attendees) |
| | 1400-1530 | Industry Associations (CoC, FIFCA, RBA, FITB, FIDC) | Chamber of Commerce (22 attendees) |
| | 1700-1930 | General Public Presentation No. 1 | Narrows Bar (38 attendees) |
| Wednesday 20th August | 1030-1230 | Hill Cove | Camp, West Falkland (7 attendees) |
| | 1400-1600 | Fox Bay | Camp, West Falkland (9 attendees) |
| | 1900-2030 | General Public Presentation No. 2 | Chamber of Commerce (3 attendees) |
| Thursday 21st August | 1130-1300 | Goose Green | Camp, East Falkland (7 attendees) |
| | 1430-1630 | Hope Cottage Farm | Camp, East Falkland (8 attendees) |
| Friday 22nd August | 0830-0900 | Falklands Conservation | Argos House |
| | 1000-1200 | South Atlantic Environmental Research Institute | Chamber of Commerce (6 attendees) |
| | 1300-1400 | Department of Mineral Resources, Environmental Planning Department | Argos House |

8.16 Issues raised during the general meetings were no different in nature to those presented above in Table 8.2. More pertinent issues raised by government agencies and other key stakeholders, which include DMR, EPD, FIG Policy Unit, SAMS, Falklands Conservation, the Fisheries Department, RSPB and DECC have been addressed in the formal response to comments received during the consultation period, and in this re-written EIS document.

# 9 Conclusion

9.1 Noble is proposing to conduct exploration drilling activities offshore of the Falkland Islands. Noble will ensure that operations throughout the exploration drilling programme will follow applicable laws, regulations, standards; and environmental, socio-economic, health and safety best practices (such as effective waste management, staff awareness of environmental issues and training in pollution prevention procedures and emergency response).

9.2 Although there will be some environmental impacts during each phase of the project life cycle, adverse long-term environmental impacts from the exploration drilling programme have been assessed as **low**, and incremental cumulative impacts of the development will be minimal. Furthermore, due to the implementation of control and mitigation measures, the majority of residual impacts are considered to be **low**.

9.3 There is the potential for disturbance from planned exploration drilling operations to significantly affect the two existing shipwrecks lying within the southern region of FISA12. It is thought that an anomaly seen on the bathymetry is highly likely to be the wreck of the Atlantic Conveyor in FINA13 but the survey was unable to obtain seabed photographs so a positive identification was not possible. However, Noble has proposed the following mitigation measures to ensure these important wreck sites remain unaffected:

1. Placing an exclusion zone around the best known 'as reported' wreck locations;
2. Choosing well locations that avoid existing wrecks; and
3. Re-locating the wellhead should the location of the wrecks be found during pre-drilling surveys.

9.4 With the implementation of the above measures residual impacts to wreck sites form the proposed drilling activity will be reduced to **low**.

9.5 Underwater noise during Vertical Seismic Profiling (VSP) operations has the potential to cause injury and behavioural disturbance to marine mammals and fish. The injury and behavioural noise levels for cetaceans will be exceeded during the potential VSP operations, although only within three metres (permanent threshold shift [PTS] criteria) and six metres (temporary threshold shift [TTS] criteria) of the VSP equipment noise source.

9.6 Without mitigation, there is the potential for these impacts to be considerable to marine mammals that may be in the location during VSP operations. JNCC guidelines for minimising risk to marine mammals from VSP noise emissions and the employment of soft-start procedures will be implemented to reduce potential impacts. However, due to the uncertainty related to the distribution and abundance of marine mammals in the area the residual impact will remain **medium**. Monitoring of marine mammal populations during VSP operations will be utilised to ensure that the measures employed reduce the impact as much as possible and to ensure (as far as possible) that firing of seismic equipment occurs when marine mammals are not in the vicinity of the seismic source.

9.7 For fish species, there is potential for injury within very close proximity to the VSP energy source, although this is significantly reduced beyond 300 metres. Through the use of soft start procedures any fish that are present will be alerted to the sound and will gradually move further away from the source as the sound increases. As a result, the likelihood and severity of the impact is reduced although the residual impact is **medium**. However, it should be noted that this is a precautionary assessment and that the main fish species likely to be present (e.g., Patagonian toothfish, *Dissostichus eleginoides*) are hearing generalists and are less affected by sound and the assessment was undertaken on a precautionary basis.

9.8 Accidental events involving unintentional releases of hydrocarbons or chemicals are of **medium** impact. They require control measures to reduce the potential impacts as much as possible, including:

- Stringent well control procedures;
- Oil spill response procedures, including:

    a. the provision of Tier 1 response capability; and

    b. development of an Oil Spill Response Plan (OSRP),

- Membership with a reputable international oil spill response organisation; and
- Emergency response procedures (including the production of an Emergency Response Plan [ERP]).

9.9 Noble operates under a Global Environmental, Health and Safety (EHS) Management System (GMS). Noble is committed to conducting its business in a manner that protects the environment, health and safety of employees and communities. To achieve this, Noble strives to comply with EHS laws and minimize injuries and incidents whilst protecting the environment. Noble's GMS is a consistent framework for the management of EHS issues and is instrumental in protecting the environment and the health and safety of our employees and communities.

9.10 For the Falklands Exploration drilling programme, the main method for converting the GMS policies and principles into action will be the EMPA presented in Section 7. These commitments are captured through the Noble tracking system and carried through to detailed design and operations. The plan identifies monitoring, management measures and responsibilities to be implemented.

9.11 In turn the EMPA will be transposed into the contractual obligations of contractors employed by Noble to deliver the project. The Environmental Management Systems (EMS) of each contractor will be audited to ensure compliance with the Noble GMS and as necessary bridging documents will be put in place to ensure compatibility between systems. In cases where the Noble GMS and a contractor EMS differ, the more stringent measure will apply.

9.12 Moving forward, the creation and implementation of the procedures and documents outlined in Section 7 will ensure that mitigation measures identified in the Environmental Management Plan (EMPA) and proposed within this EIS are adhered to throughout the lifetime of the exploration drilling project and will ensure that any potential impacts to the environment are minimised.

# 10 References

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