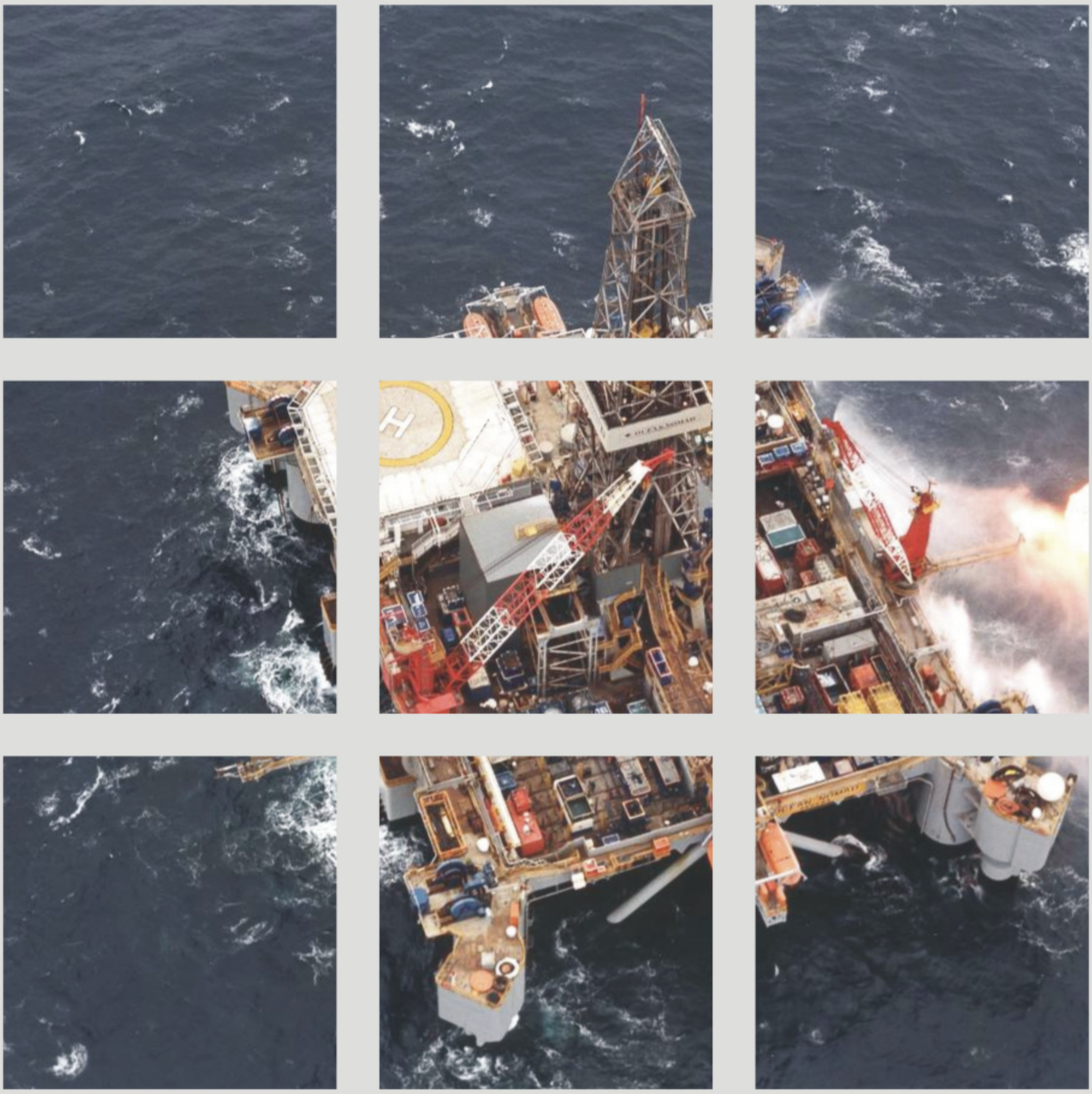
BHP Billiton Petroleum (Falklands) Corporation

OFFSHORE FALKLAND ISLANDS EXPLORATION DRILLING
EIS OPERATIONAL ADDENDUM

Toroa Exploration Well (Licence PL015)

January 2010



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Toroa Exploration Well (Licence PL015)

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January 2010

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Table of Contents

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Abbreviations

ADCP	Acoustic Doppler Current Profiler
APF	Antarctic Polar Front
API	American Petroleum Industry
BHPBP(F)C	BHP Billiton Petroleum (Falklands) Corporation
BIH	British International Helicopters
BML	Below Mud Line
BOP	Blow out Preventor
CEFAS	Centre for Environment Fisheries and Aquaculture Science
CHARM	Chemical Hazard Assessment and Risk Management
COLREGs	The Convention on the International Regulations for Preventing Collisions at Sea, 1972
CO_2	Carbon Dioxide
CPI	Carbon Preference Index
dB	Decibels
DO	Dissolved Oxygen
DP	Dynamically Positioned
E&P	Exploration and Production
EEM's	Environmental Emissions Monitoring System
EIS	Environmental Impact Statement
EMP	Emergency Management Plan
EROD	Ethoxyresorufin *O*-Deethylase
ERP	Emergency Response Plan
EVOS	*Exxon Valdez* oil spill
FACs	Fluorescent Aromatic Compounds
FC	Falkland Conservation
FCO	Foreign and Commonwealth Office
FICZ	Falkland Interim Conservation and Management Zone
FIG	Falkland Islands Government
FIPASS	Falklands Interim Port and Storage System
FOCZ	Falkland Outer Conservation and Management Zone
FICZ	Falklands Interim Conservation and Management Zone
FOC	Fractionated Organic Carbon
FOGL	Falkland Oil and Gas Limited
GMT	Greenwich Mean Time
HMCS	Harmonised Mandatory Control Scheme
HOCNF	Harmonised Offshore Chemical Notification Format
HQ	Hazard Quotients

HSE	Health, Safety and Environment
IBAs	Important Bird Areas
ICP-MS	Inductively coupled plasma mass spectroscopy
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LTOBM	Low Toxicity Oil Based Mud
MARPOL	Marine Pollution
MIME	Managing Impacts on the Marine Environment
mm	Millimetres
MMO	Marine Mammal Observer
MMOS	Marine Mammal Observers
MoD	Ministry of Defence
NOx	Oxides of Nitrogen
NO_2	Nitrogen Dioxide
NNR	National Nature Reserves
OCNS	Offshore Chemical Notification Scheme
OCR	Offshore Chemicals Regulations
OGP	The International Association of Oil & Gas producers
OSPAR	Oslo / Paris Convention
OSCP	Oil Spill Contingency Plan
OSR	Oil Spill Response
OSIS	Oil Spill Information System
PAHs	Polycyclic aromatic hydrocarbons
PLONOR	Pose Little or No Risk to the environment
PROTEUS	The Pollution Risk Offshore Technical Evaluation System
ROV	Remotely Operated Vehicle
RQ's	Risk Assessments
SMRU	The UK Sea Mammals Research Unit
TD	Target Depth
THC	Total hydrocarbon concentrations
TOM	Total Organic Matter
TVD	Total Vertical Depth
UKOOA	United Kingdom Offshore Operators Association
UKCS	United Kingdom Continental Shelf
WBM	Water Based Mud

Non Technical Summary

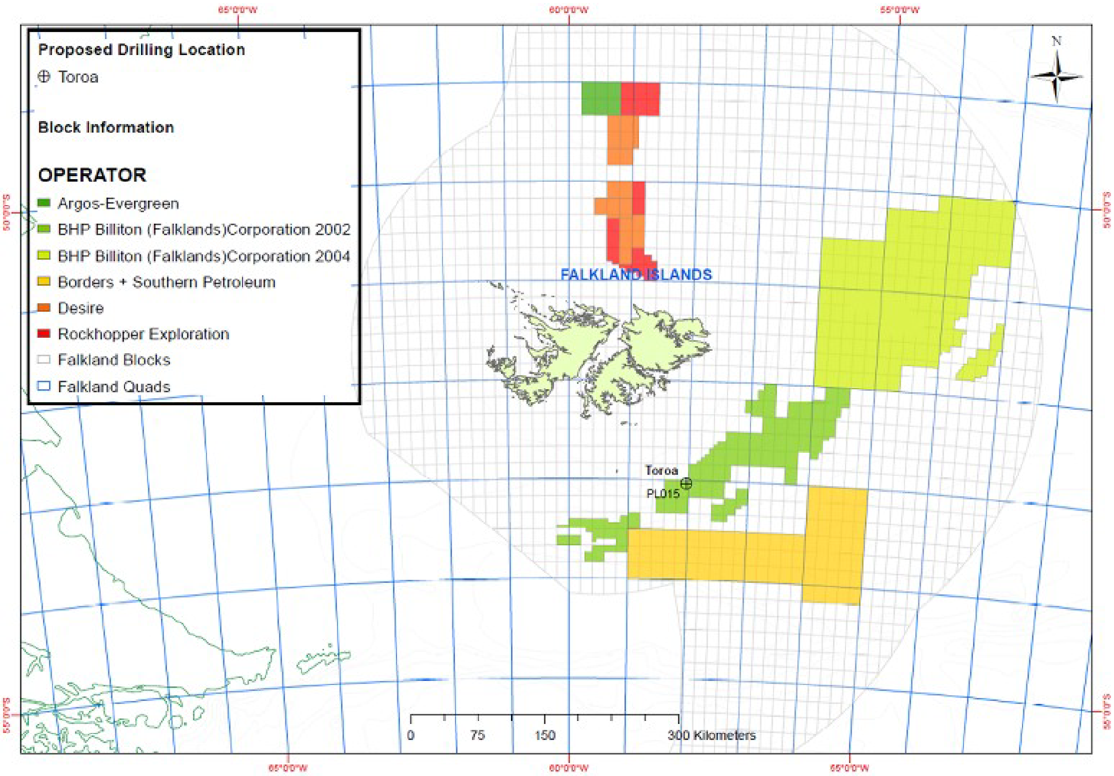
Background

BHP Billiton Petroleum (Falklands) Corporation (hereafter referred to as 'BHPBP(F)C') holds 14 exploration and production licences offshore the Falkland Islands in the South Atlantic after signing contracts with Falkland Oil and Gas Limited (FOGL). BHPBP(F)C holds a 51% interest in the acreage and is the designated operator. The remaining 49% is held by FOGL.

In September 2009, BHPBP(F)C submitted an Environmental Impact Statement (EIS) to the Falkland Islands' Government (FIG) in order to drill two exploration wells (Toroa and Loligo) in Licence Areas PL028 and PL015. At this time, a drilling contractor and rig had not been commissioned and the timing of the exploration drilling programme was unknown. Given this, BHPBP(F)C made a commitment to FIG to produce an Operational Addendum to the EIS in order to provide further details on the drilling campaign once known.

This document, therefore, constitutes the Operational Addendum to the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS. It specifically relates to the Toroa exploration well, which is located in Licence Area PL015, approximately 160 kilometres to the south of Stanley on East Falkland (refer to Figure 1). A rig has yet to be contracted for the proposed Loligo exploration well in Licence Area PL028. When a drill rig has been contracted and the spud date confirmed, a separate Operational Addendum will be produced for the Loligo well and submitted to FIG for comment and approval.

Figure 1: Toroa Exploration Well Location Map



Proposed Drilling Operations

BHPBP(F)C has contracted Diamond Offshore's Ocean Guardian semi-submersible drilling rig to drill the proposed Toroa exploration well. The spud date for the well is scheduled for April 2010, with the rig expected to be on site for 30 to 40 days.

A number of other operators are also working with the Ocean Guardian rig as part of a wider drilling campaign offshore the Falkland Islands. There is a possibility, therefore, that the precise timing of the Toroa drilling programme could change due to reasons beyond BHPBP(F)C's control (e.g. due to timings of preceding rig moves). As such, it is has been assumed within this Operational Addendum that drilling operations for Toroa could occur at anytime between April and June 2010.

It is proposed to use water based mud to drill the well. All chemicals to be used have been selected to minimise the potential environmental impacts as much as possible. The vast majority (by volume) of planned chemicals are naturally occurring products (e.g. barite) that are either biologically inert or readily dispersible or biodegradable. Other chemicals are selected based on drilling performance and environmental acceptability to ensure low toxicity and high biodegradability.

Following drilling, the well will be logged and evaluated. On completion it will be plugged and abandoned in accordance with Oil & Gas UK guidelines. No equipment will be left on the seabed and there will be no evidence of drilling operations having been undertaken.

Existing Environment

The Patagonian Shelf, on which the Falkland Islands sit, is of regional and global significance for marine resources. It comprises rich assemblages of seabirds, marine mammals, fish, squid and plankton populations.

There has previously been little information available on the benthic environment of this area, therefore in order to obtain more detailed baseline information, BHPBP(F)C conducted environmental site surveys in December 2008 to January 2009 to provide current data, water column profiles, sediment analysis and identification of benthic species.

The maximum current speed observed at Toroa was 0.39 metres per second at 682 metres below the sea surface (10 metres above the seabed) with a corresponding direction of 233 degrees (true).

The geophysical data collected during the Toroa site survey suggested that surficial sediments were extremely homogeneous, with seafloor materials consisting of silt / clay throughout the site. Total hydrocarbon concentrations were low compared to North Sea Oil and Gas UK data, though considered moderate for the remote nature of the survey area, ranging from 7.0 µg.g-1 to 10.1 µg.g-1 (stations T8 and T5, respectively). These concentrations are presumed to originate from local natural oil seeps and are considered to be typical background concentrations for the area. The concentrations of heavy and trace metals appeared consistent across the survey area, being found at levels typical for unimpacted silt / clay sediments.

The benthic survey results at Toroa appear to show a single benthic community dominating, which is considered to be homogenous across the drilling location, although it is recognised that only a limited number of samples were collected.

Fish species known to spawn in the area of the proposed drilling activity for Toroa include hake, southern blue whiting and cod, although none are expected to spawn during the drilling period (April to June). Cephalopod spawning is also unlikely to occur in the vicinity of the Toroa well during the drilling period.

The main fisheries resources in the Falkland Islands are the squid species, *Illex argentinus* and *Loligo gahi*. Other types of fisheries include finfish, ray and longline. The Falkland Islands' Government annual Fisheries Statistics volume 11 (1997–2006) show that the area in the vicinity of the Toroa well has no fishing interests for the key commercial target species. There are some significant fisheries interests on the landward side of Licence Area PL015, which may be impacted by vessel movements to and from the proposed drilling operations. It should be noted, however, that nearshore Loligo fishery close to the eastern coast of East Falklands is most intense in the second half of the year between July and December, outside of the proposed drilling period for Toroa.

Between February 1998 and January 2001 the Joint Nature Conservation Committee (JNCC) and Falklands Conservation (FC) conducted a 'Seabirds at Sea Survey' in the waters surrounding the Falkland Islands. Based on the results from this survey work (White et al., 2002), the following species of cetacean were recorded within the vicinity of the proposed Toroa drilling location: long-finned pilot whale, hourglass dolphin and Peale's dolphin, although during the months of the proposed drilling period (April to June) only long-finned pilot whale and Peale's dolphin were recorded in significant numbers. Species specifically recorded offshore the Falkland Islands, but not within the vicinity of the Toroa well, during the proposed drilling period (April to June) include sei whale, sperm whale, minke whale and Commerson's dolphin. Additional marine mammal data in the vicinity of the proposed drilling location has also been compiled based on the reports provided by Marine Mammal Observers (MMOs) on seismic vessels during acquisition programmes. This includes surveys undertaken in BHPBP(F)C's licence area when it was under the Operatorship of FOGL. This data indicates that the southern right whale, fin whale, hourgalss dolphin and Peale's dolphin may be present within the general vicinity of the proposed Toroa drilling location. Given the migratory nature of cetaceans and the fact that effort during the JNCC/FC 'Seabirds at Sea Survey' was lower to the south and east of the Falkland Islands, the possibility that other species are present in the exploration area cannot be discounted. It is considered, however, that the Toroa well is not located within an area of high sensitivity for cetaceans.

Little is known of the at-sea distribution of Falkland Islands pinnipeds, and it is possible that South American sea lions, south American fur seals and southern elephant seals may be present within the vicinity of the proposed Toroa location during the drilling period in low numbers. It should be noted, however, that the Toroa well is located some distance from the know seal haul-out sites.

The Falkland Islands are an area of global importance for birdlife, particularly seabird species. The avifauna of the region is well studied and documented, and seabird distribution, breeding and foraging patterns have been studied extensively.

Of the penguin species recorded in the Falkland Islands, only rockhopper penguins and magellanic penguins have been observed at significant distance from the Falkland Islands and may therefore be present during the proposed drilling period for the Toroa exploration well.

It is possible that the southern royal albatross will be present in the vicinity of the proposed Toroa well during the months of March to June and the northern royal albatross will be present in the vicinity of the proposed well during the months of March to July, thereby overlapping with the proposed drilling period. It is also likely that the black-browed albatross will be present in the vicinity of the exploration well between February and June.

Petrels and shearwaters known to be present in the vicinity of the Toroa exploration well during the drilling period include blue petrel, kerguelen petrel, atlantic petrel, prion species, sooty shearwater and diving petrel; although none of these species are considered to be present in significant numbers.

The proposed Toroa exploration well is located away from the identified areas of highest seabird vulnerability. Highest vulnerability tends to be associated with the inshore waters around the Falklands Islands, largely due to the presence of resident species with a predominantly coastal distribution such as the endemic Falklands Steamer duck, imperial shag and gentoo penguin. The Patagonian Shelf waters to the north and west of the Falklands, which support high densities of black-browed albatrosses and royal albatrosses year-round are also associated with high vulnerability areas, but again these are remote from the proposed drilling location.

Impacts and Management Measures

The results of the impact assessment indicate that the majority of impacts from the Toroa drilling operation will be minor to negligible and probably undetectable shortly after drilling is completed. There are environmental risks associated with drill cuttings disposal, the risk of large offshore and near-shore oil spills, waste disposal and use of resources (i.e. fuel and potable water). However, these risks can be controlled using standard drilling practices and good planning.

The potential impacts of the proposed drilling activity will be mitigated in a number of ways, including:

- Maintaining a spirit of openness and ongoing consultation with the Falkland Islands Government (FIG), the public and key stakeholders;
- Applying established UK standards to operations, particularly in offshore chemical use and emissions reporting;
- Using water based drilling muds and low toxicity chemicals approved under the UK Offshore Chemical Notification Scheme.
- Implementing a high level of environmental management offshore and applying environmental procedures for potentially impacting operations (chemical storage, bunkering, waste handling, maintenance programmes, seafloor surveys etc);
- Establishing and implementing a project specific Oil Spill Contingency Plan and carrying out training of key personnel in spill response. BHPBP(F)C are members of Oil Spill Response which provide outside assistance in the case of a major spill. The Oil Spill Contingency Plan will be submitted to FIG for approval prior to commencement of the drilling operations.
- Implementing a Waste Management Plan to minimise the quantity of waste going to landfill, prevent unsuitable disposal of waste, maximise the re-use of materials and establish procedures for the storage, treatment, transfer and disposal of waste materials. It is envisaged that normal waste will be disposed of on the Falkland Islands with hazardous waste likely to be exported to the UK, Chile or Uruguay. Specific waste handling/disposal routes and procedures will be detailed in the Waste Management Plan, to be submitted to FIG for approval prior to commencement of the proposed drilling operations.
- Collecting and sharing environmental data wherever possible, for example in offshore sightings, seabed surveys and meteorological and oceanographic conditions.

Conclusions

In conclusion, despite the high sensitivity and international importance of the Falkland Islands' waters, there is clear dedication to carrying out these operations to a high environmental standard. Given the current operational commitments and proposed mitigation measures, it is considered that the proposed operations can be undertaken without significant impacts to the Falkland Islands' environment.

1 Introduction

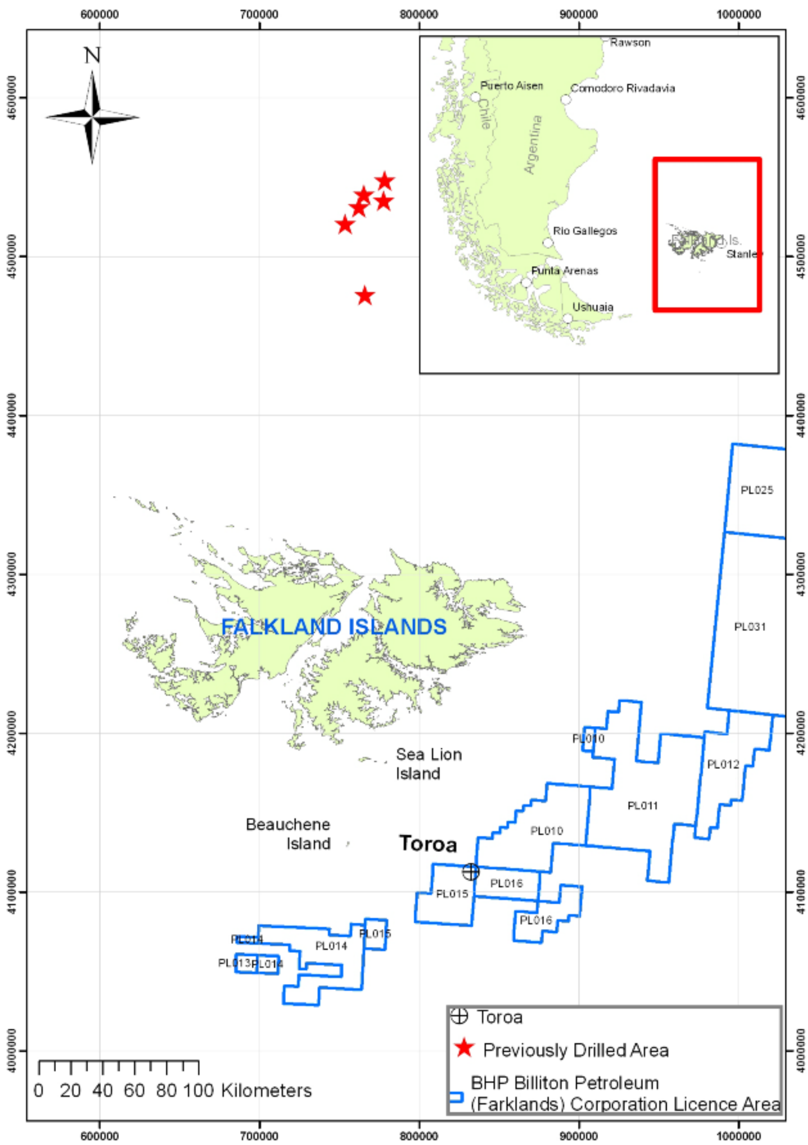
1.1 Document Objective

This document constitutes the Operational Addendum to the BHP Billiton Petroleum (Falklands) Corporation Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) Environmental Impact Statement (EIS).

The EIS was submitted to the Falkland Islands' Government (FIG) for approval in September 2009 and has since undergone a review process by The Scottish Association for Marine Science on behalf of FIG. On submission of the EIS, BHP Billiton Petroleum (Falklands) Corporation (hereafter refer to as 'BHPBP(F)C') committed to producing an EIS Operational Addendum to provide further details on the drilling programme, which were unknown at the time the EIS was produced.

BHPBP(F)C has now finalised their drilling programme for the Toroa exploration well (Licence Area PL015 – refer to Figure 1.1) and contracted Diamond Offshore's Ocean Guardian semi-submersible drilling rig. Drilling operations are anticipated to commence in April 2010, at the earliest, with the rig expected to be on location for a maximum of 30 to 40 days.

Figure 1.1: Location Map Showing BHPBP(F)C Licence Areas and Proposed Toroa Exploration Well



Given the above, this Operational Addendum has been produced by RPS Energy on behalf of BHPBP(F)C to meet their commitment to FIG. It aims to:

- Provide details of the drilling contractor and drilling rig for the Toroa well, outline any changes to the Toroa well design and confirm the proposed dates for the drilling operation;
- Assess seasonal sensitivities within the vicinity of the Toroa exploration well during the proposed drilling operations;
- Review and update the impact assessment to identify the environmental hazards, effects and mitigation measures;
- Detail the project Environmental Management Plan (EMP), with particular emphasise on waste management and resource use.

Of note is that a rig has yet to be contracted for the proposed Loligo exploration well in Licence Area PL028. When a drill rig has been contracted and the spud date confirmed, a separate Operational Addendum will be produced for the Loligo well and submitted to FIG for comment and approval.

1.2 The Applicant

In 2007 BHPBP(F)C acquired an interest in 14 exploration and production licences offshore the Falkland Islands in the South Atlantic after signing contracts with Falkland Oil and Gas Limited (FOGL) (an AIM-listed oil and gas exploration company operating in the undrilled South and East Falklands' Basins). The licences give BHPBP(F)C the rights to explore and, if successful, eventually produce oil and gas from the East Falklands Basin located off the southern and eastern coast of the Falkland Islands.

BHPBP(F)C holds a 51 percent interest in the acreage and is the designated operator. The remaining 49 percent is held by Falkland Oil and Gas Limited (FOGL). The exploration and production licences cover approximately 18 million acres and are located in water depths ranging from approximately 200 to 2,000 metres (refer to Figure 1.1).

1.3 Contact Address

Any questions, comments or requests for additional information regarding this EIS Addendum should be addressed to:

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2 The Proposed Toroa Drilling Programme

2.1 Overview

BHPBP(F)C is planning to drill the Toroa exploration well in the East Falklands Basin to explore for hydrocarbons and appraise reservoir characteristics. A full description of the proposed operations associated with the Toroa well are provided in Section 4 of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

Since submission of the EIS, BHPBP(F)C has contracted Diamond Offshore's Ocean Guardian semi-submersible drilling rig to drill the proposed Toroa exploration well. The spud date has now been scheduled for April 2010, with the rig expected to be on site for 30 to 40 days.

A number of other operators are also working with the Ocean Guardian rig as part of a wider drilling campaign offshore the Falkland Islands. There is a possibility, therefore, that the precise timing of the Toroa drilling programme could change due to reasons beyond BHPBP(F)C's control (e.g. due to timings of preceding rig moves). As such, it is has been assumed within this Operational Addendum that drilling operations for Toroa could occur at anytime between April and June 2010.

The key characteristics of the Toroa well are summarised in Table 2.1. Following drilling, the well will be logged and evaluated. On completion it will be plugged and abandoned in accordance with Oil & Gas UK guidelines (refer to Section 2.7 for further details). No equipment will be left on the seabed and there will be no evidence of drilling operations having been undertaken.

The remainder of this section provides a summary of the proposed drilling operations for the Toroa exploration well. Extensive reference has been made to Section 4 of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

Table 2.1: Proposed Toroa Well Characteristics

Aspect	Toroa
FIDA Block	61/05
Anticipated Drilling Location	53° 01' 45.236'' S 58° 02' 21.740" W
Anticipated Drill Rig	Ocean Guardian Semi-submersible
Support Location	Stanley
Water Depth (m)	626
Depth of Well (m) (TVD)	2,726
Depth of Well (m) (BML)	2,094
Anticipated Spud date	April 2010
Estimated time to reach Total Depth	30 - 40 days
Clean up and well testing	None planned
Hydrocarbons Anticipated	Oil and Gas, Av. 31°API
Anticipated Weight of Cuttings	635 tonnes

2.2 The Drilling Rig

The proposed Toroa exploration well will be drilled from the Diamond Offshore Drilling (UK) Limited's third generation semi-submersible drilling rig: the Ocean Guardian. The rig has an 8 line mooring anchor pattern. A copy of the indicative anchor pattern for the Ocean Guardian rig deployed at the Toroa well location is provided in Appendix A.

The specifications for the Ocean Guardian rig are summarised in Table 2.2.

Table 2.2: Ocean Guardian Rig Specifications

Rig Type	Semi-submersible	**Drill Water**	1,103 ST
Rig Design	Earl & Wright Sedco 713 Series	**Brine**	3,154 bbls
Year Built	1985	**Base Oil**	3,154 bbls
Yard Built	Scott Lithgow, Glasgow, Scotland	**Potable Water**	224 ST
Class	ABS AI Column Stabilized Drilling Unit	**Sack Storage**	13,000 sacks
Registry	Marshall Islands	**Drawworks**	Oilwell E-3000 w/1-1/2" drill line
Water Depth	2,000 feet	**Derrick**	Dreco 50' x 40' x 185', 1,333 kips static hook load
Drilling Depth	25,000 feet	**Top Drive**	Varco TDS-4S
Quarters	100 + 2 bed hospital	**Pipe Handling System**	Victoria RJT-336 Racking Arm, Varco AR 3200 Iron Roughneck
Dimensions	227.5' x 197'	**Rotary**	Oilwell A-495, 49-1/2"
Helideck	89' x 83' for Chinook 22T	**Top of Rotary Table to Bottom of Barge**	170 feet
Drilling Draft	83.5'	**Mud Pumps**	(3) Oilwell A1700-PT
Variable Deckload - Operating	3,125 LT	**Main Engines**	(3) Ruston 12 RKCM, 3320 BHP ea., (1) Bergen KVG12, 3044 HP
Variable Deckload - Transit	1,800 LT	**Annular BOP**	(2) Cameron "D" 18-3/4"10K
Number of Columns	8	**Ram BOP**	(2) Cameron Type U-II (double) 18-3/4" 15K
Max Combined Structure Load	758 kips	**Diverter**	Regan KFDS 24" 500 psi
Moonpool Dimensions	19.25' x 20.75'	**Riser**	Mannesmann 24" w/21" Shaffer DT-1 connections
Operating Displacement	25,406 LT	**Riser Tensioning**	Brown Brothers 10 x 80K
Bulk Mud & Cement	18,166 cu ft	**Solids Control**	(4) Thule VSM-300 Cascade system
Liquid Mud	1,893 bbls	**Cranes**	(1) Clarke Chapman NEI w/128' boom, 45 MT; (1) SeaTrax 9036 w/140' boom, 55 T
Fuel Oil	1,108 ST	**Mooring System**	(8) Vicinay K4 stud link chains w/Bruce 12 MT MK4 anchors

2.3 Well Profile

Details on well construction are provided within Section 4.4.3 of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS (pages 4-3 to 4-4). Since submissions of the EIS, the well design for Toroa has now been finalised resulting in some minor alterations to the section lengths and casing sizes. The new well profile for Toroa is outlined below.

The proposed Toroa well will be drilled to a total vertical depth of 2,700 metres (8,858 feet) or 2,073 metres (6802 feet) below mud line (Table 2.3 and Figure 2.1).

42" Hole with 36" Casing

Once the rig has been installed at the proposed location, a 42" hole will be drilled to about 70 metres (228 feet) below mud line. This section will be drilled with seawater. Occasional pills of viscosified water (using bentonite as a gelling agent) will be circulated to help cleaning the hole. A 36" by 30" casing will then be run and cemented in place to provide structural integrity for the well.

17 ½" Hole and 13 3/8" Casing

A 17 1/2" hole will be drilled to approximately 710 metres (2,329 feet) below mud line, using seawater and gel sweeps. A 13 3/8" casing will be run and cemented in place for this entire section.

12 ¼" Hole and 9 5/8" Casing

A 12 ¼" hole will be drilled to approximately 1,500 metres (4,921 feet) below mud line, using WBM with density ranging from 9.0–10 ppg. . A 9 5/8" casing will be run and cemented in place for this entire section.

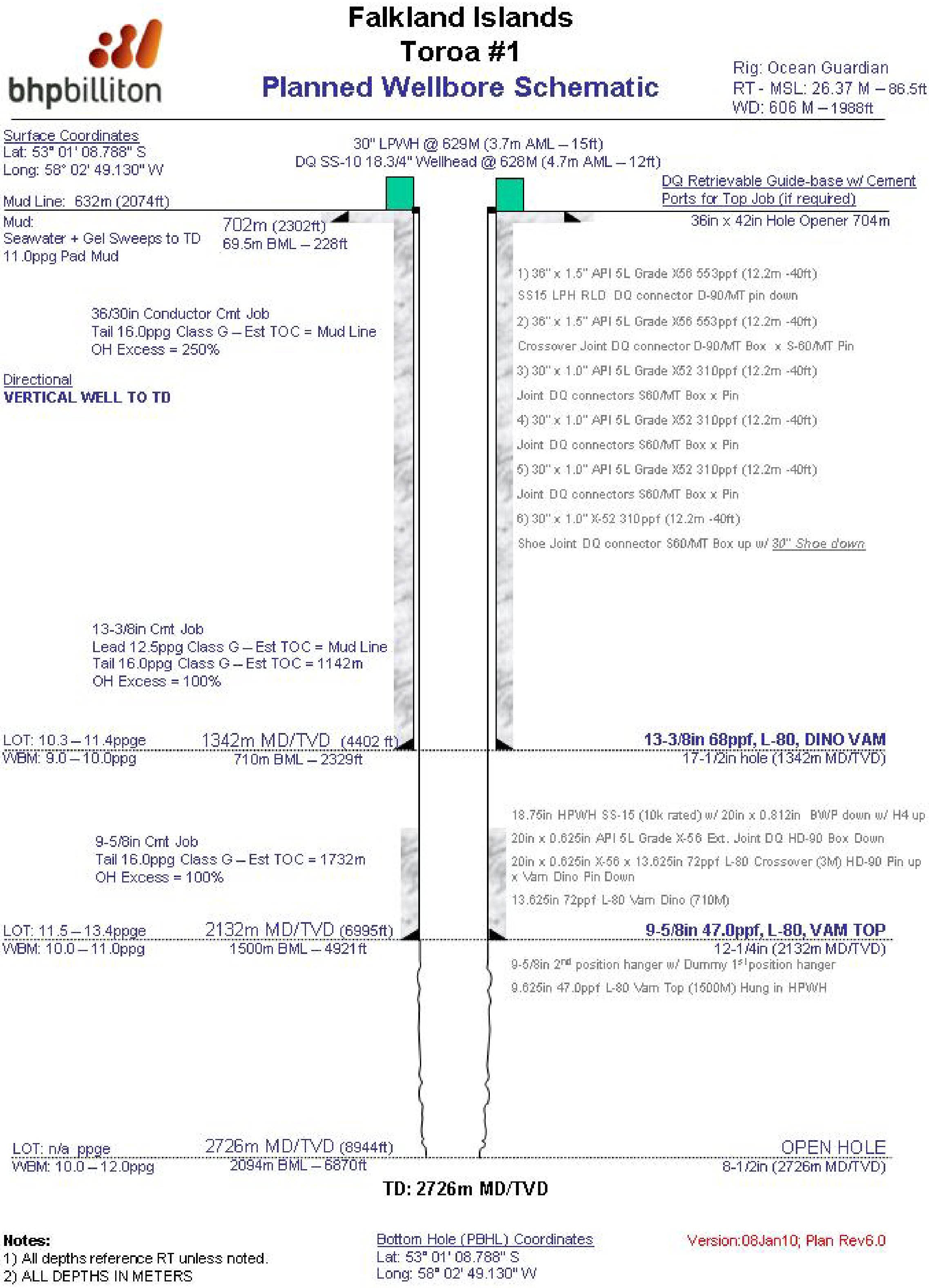
8 ½" Hole to TD

An 8 ½" hole will be drilled to total depth of 2,094 metres (6,870 feet) below mud line, using WBM with density ranging from 10 to 12.0 ppg. The higher density will be required to provide sufficient over-balance on the formation and prevent influx of reservoir fluids.

Table 2.3: Proposed Toroa Well Profile

Hole Size		Casing Size		Section Length (Measured Depth) (metres)	Proposed Mud Use
Millimetres	Inches	Millimetres	Inches		
1066.8	42	914.4	36 x 30	70 (cased)	Seawater
444.5	17 $^1/_2$	508	13 3/8	710 (cased)	Seawater + Gel Sweeps
311	12 ¼	244	9 $^5/_8$	1,500 (cased)	WBM
216	8 $^1/_2$	-	-	594 (open hole)	WBM

Figure 2.1: Proposed Toroa Well Schematic



2.4 Drilling Mud and Casing Cement

A background to the use of drilling muds is given in Appendix A of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS. As stated within Section 4.4.5 of the EIS, the Toroa exploration well will be drilled using water based mud (WBM). On the rig, the composition of the cleaned mud will be monitored and its contents adjusted to ensure that its properties remains as specified and it will be recycled through the well. No low toxicity oil based mud (LTOBM) will be used for the proposed well.

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 Chemical Regulations 2002, which apply the provisions of the Decision by the Convention for the Protection of the Marine Environment of the North-East 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. The Offshore Chemical Notification Scheme (OCNS) ranks chemical products according to Hazard Quotient (HQ), calculated using the CHARM (Chemical Hazard and Risk Management) model (refer to Appendix B of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS for further details).

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 practical.

All of the planned chemicals, which BHPBP(F)C propose to use for the wells, appear on this Ranked Lists of Products approved under the OCNS. They all have an OCNS category of 'E' or have 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.

The preliminary mud programme for the proposed exploration well was originally provided in Section 4.4.8 of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS. Since the submission of the EIS, the mud programme for the Toroa well has now been finalised. The mud components which BHPBP(F)C now propose to use are listed in Table 2.4, below, with contingency chemicals listed in Table 2.5.

Table 2.4: Planned Drilling Mud Components

Chemical Name	Function	Estimated Use (tonnes)	Estimated Discharge (tonnes)	HQ Band / OCNS group
42 inch section				
Soda Ash	Water Based Drilling Fluid Additive	0.1	0.1	E
Caustic Soda	Acidity Control Chemical	0.0875	0.0875	E
M-I GEL	Viscosifier	14	14	E
M-I BAR	Weighting Chemical	61	61	E
Guar Gum	Viscosifier	0.3	0.3	E
17 ½ inch section				
Soda Ash	Water Based Drilling Fluid Additive	0.25	0.25	E
Caustic Soda	Acidity Control Chemical	0.25	0.25	E
M-I GEL	Viscosifier	44	44	E

Chemical Name	Function	Estimated Use (tonnes)	Estimated Discharge (tonnes)	HQ Band / OCNS group
M-I BAR	Weighting Chemical	110	110	E
Guar Gum	Viscosifier	2.2	2.2	E
12 ¼ inch section				
M-I BAR	Weighting Chemical	109	109	E
SAFECIDE	Biocide	0.3	0.3	GOLD
Magnesium Oxide	Acidity Control Chemical	0.375	0.375	E
DEFOAM NS	Defoamer (Drilling)	0.3	0.3	E
ULTRAHIB	Shale Inhibitor / Encapsulator	14.8	14.8	GOLD
ULTRACAP	Shale Inhibitor / Encapsulator	2.2	2.2	GOLD
ULTRAFREE NS	Drilling Lubricant	14.4	14.4	GOLD
FLOTROL	Fluid Loss Control Chemical	2.95	2.95	E
POLYPAC UL	Viscosifier	2.95	2.95	E
DUO-TEC	Viscosifier	1.775	1.775	GOLD
8 ½ inch section				
M-I BAR	Weighting Chemical	137	137	E
SAFECIDE	Biocide	0.15	0.15	GOLD
Magnesium Oxide	Acidity Control Chemical	0.175	0.175	E
DEFOAM NS	Defoamer (Drilling)	0.15	0.15	E
ULTRAHIB	Shale Inhibitor / Encapsulator	7.4	7.4	GOLD
ULTRACAP	Shale Inhibitor / Encapsulator	1.1	1.1	GOLD
ULTRAFREE NS	Drilling Lubricant	7.2	7.2	GOLD
FLOTROL	Fluid Loss Control Chemical	1.475	1.475	E
POLYPAC UL	Viscosifier	1.475	1.475	E
DUO-TEC	Viscosifier	0.875	0.875	GOLD

Table 2.5: Contingency Drilling Mud Components

Chemical Name	Function	HQ Band / OCNS group
42 inch section		
Lime	OPF Additive	E
DUO-VIS	Viscosifier	GOLD
DUO-TEC	Viscosifier	GOLD
Nutshells Fine / Medium	Lost Circulation Material	E
Mica Fine / Medium	Lost Circulation Material	E

Chemical Name	Function	HQ Band / OCNS group
Citric Acid	Water based Drilling Fluid Additive	E
SAPP	OPF Oil based Drilling fluid	E
Sodium Bicarbonate	Water Based Drilling Fluid Additive	E
SAFE-SURF E	Detergent / Cleaning Fluid	GOLD
17 ½ inch section		
Lime	OPF Additive	E
DUO-VIS	Viscosifier	GOLD
DUO-TEC	Viscosifier	GOLD
Nutshells Fine / Medium	Lost Circulation Material	E
Mica Fine / Medium	Lost Circulation Material	E
Citric Acid	Water based Drilling Fluid Additive	E
SAPP	OPF Oil based Drilling fluid	E
Sodium Bicarbonate	Water Based Drilling Fluid Additive	E
SAFE-SURF E	Detergent / Cleaning Fluid	GOLD
12 ¼ inch section		
Dynared Course / Fine	Fluid Loss Control Chemical	E
Mica Fine / Medium	Lost Circulation Material	E
Nutshells Fine / Medium	Lost Circulation Material	E
Kwikseal Fine / Medium	Lost Circulation Material	E
FORM-A-SQUEEZE	Fluid Loss Control Chemical	E
SAFE-CARB 40	Weighting Chemical	E
SAFE-CARB 250	Weighting Chemical	E
SAFE-CARB 500	Weighting Chemical	E
Citric Acid	Water based Drilling Fluid Additive	E
Sodium Bicarbonate	Water Based Drilling Fluid Additive	E
SAPP	Water Based Drilling Fluid Additive	E
NaCl PVD Salt	Water based Drilling Fluid Additive	E
MEG	Gas Hydrate Inhibitor	E
8 ½ inch section		
Dynared Course / Fine	Fluid Loss Control Chemical	E
Mica Fine / Medium	Lost Circulation Material	E
Nutshells Fine / Medium	Lost Circulation Material	E
Kwikseal Fine / Medium	Lost Circulation Material	E
FORM-A-SQUEEZE	Fluid Loss Control Chemical	E
SAFE-CARB 40	Weighting Chemical	E
SAFE-CARB 250	Weighting Chemical	E
SAFE-CARB 500	Weighting Chemical	E

Chemical Name	Function	HQ Band / OCNS group
Citric Acid	Water based Drilling Fluid Additive	E
Sodium Bicarbonate	Water Based Drilling Fluid Additive	E
SAPP	Water Based Drilling Fluid Additive	E

Once each section of the well has been drilled, the drill string is lifted and the casing is lowered into the hole and cemented into place. The cement is formulated specifically for each section of the well and contains small volumes of additives that are required to improve its performance.

The preliminary cement chemicals for the proposed exploration well were originally provided in Section 4.4.8 of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS. Since the submission of the EIS, the cement programme for the Toroa well has now been finalised. The proposed cement chemicals which BHPBP(F)C now propose to use are listed in Table 2.6, below, with contingency chemicals listed in Table 2.7..

Table 2.6: Proposed Cement Chemicals and Ratings

Chemical Name	Function	Estimated Use (tonnes)	Estimated Discharge (tonnes)	HQ Band / OCNS group
Cement Class G D907	Cement or Cement Additive	303	60.6	E
UNIFLAC* L D168	Fluid Loss Control Chemical	3.045	0.609	GOLD
TROS SEADYE	Dye	0.09	0.018	GOLD
MUDPUSH II Spacer B174	Viscosifier	0.288	0.058	E
Liquid Antifoam B143	Cement or Cement Additive	0.522	0.104	E
Environmentally Friendly Dispersant B165	Dispersant	1.204	0.241	E
AccuSET D197	Cement or Cement Additive	2.091	0.418	GOLD
Liquid Accelerator D77	Cement or Cement Additive	2.046	0.409	E
Silicate Additive D75	Cement or Cement Additive	1.841	0.368	E

Table 2.7: Contingency Cement Chemicals

Chemical Name	Function	HQ Band / OCNS group
D095 Cement Additive	Lost Circulation Material	E
Antifoam Agent D175A	Cement or Cement Additive	GOLD
D600G GASBLOK*Gas-Migration Control Additive	Cement or Cement Additive	GOLD

2.5 Disposal of Drill Cuttings

The top-hole section for Toroa well will be drilled open to the seabed and the cuttings generated whilst doing so will be will be swept out of the hole using seawater. These will be deposited around the well bore. For subsequent sections the wells will be cased and drilled using a riser whilst circulating drilling mud to remove cuttings, to condition the well bore and provide weight down the hole (refer to Appendix A of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS for further details).

Estimated amounts of cuttings that will be generated for the proposed Toroa exploration well are detailed in Table 2.8. Given the detailed well design work undertaken for Toroa these have increased slightly (by approximately 3%) compared to the volumes provided within the EIS, however, the increase is considered to be insignificant (refer to Section 4.5.2).

Table 2.8: Estimate of Cuttings Generated for the Proposed Toroa Exploration Well

Hole Size (in)	Hole size diameter (m)	Length (m)	Volume (cu m)	Weight (tonnes)
42	1.067	70	63	164
17 $^{1}/_{2}$	0.444	640	99	258
12 ¼	0.311	790	60	156
8 $^{1}/_{2}$	0.216	594	22	57
Total Cuttings			**244**	**635**
Discharged at Seabed			63	164
Discharged at Surface			181	471

Note: Weight of cuttings calculated assuming density of 2.6 tonnes per cubic metre

2.6 Rig Chemicals

Certain chemicals will be required for specific purposes on the drilling rig for example lubricant for the drill string threads and detergent to periodically wash rig equipment. The chemicals to be used onboard the Ocean Guardian rig are listed in Table 2.9. These chemicals have been selected to minimise any environmental impact that they might otherwise have.

Table 2.9: Planned Rig Chemicals

Chemical Name	Chemical Function	Estimated Use (tonnes)	Estimated Discharged (tonnes)	HQ Band / OCNS group
Primary				
Aqueous Degreaser 4000	Detergent / Cleaning Fluid	3	3	GOLD
ECO-F	BOP Fluid	2	2	D
MEG	Gas Hydrate Inhibitor	3	3	E
Bestolife 3010 NM special.	Pipe Dope	0.6	0.06	E
Jet-Lube API-MODIFIED®	Pipe Dope	0.2	0	C
JET-LUBE®SEALGAURD™ ECF	Pipe Dope	0.2	0.1	E
JET-LUBE® RUN N SEAL™ECF	Pipe Dope	0.2	0.1	E
Sodium Chloride	Other	140	7	E
Contingency				
Methanol	Gas Hydrate Inhibitor	-	-	E

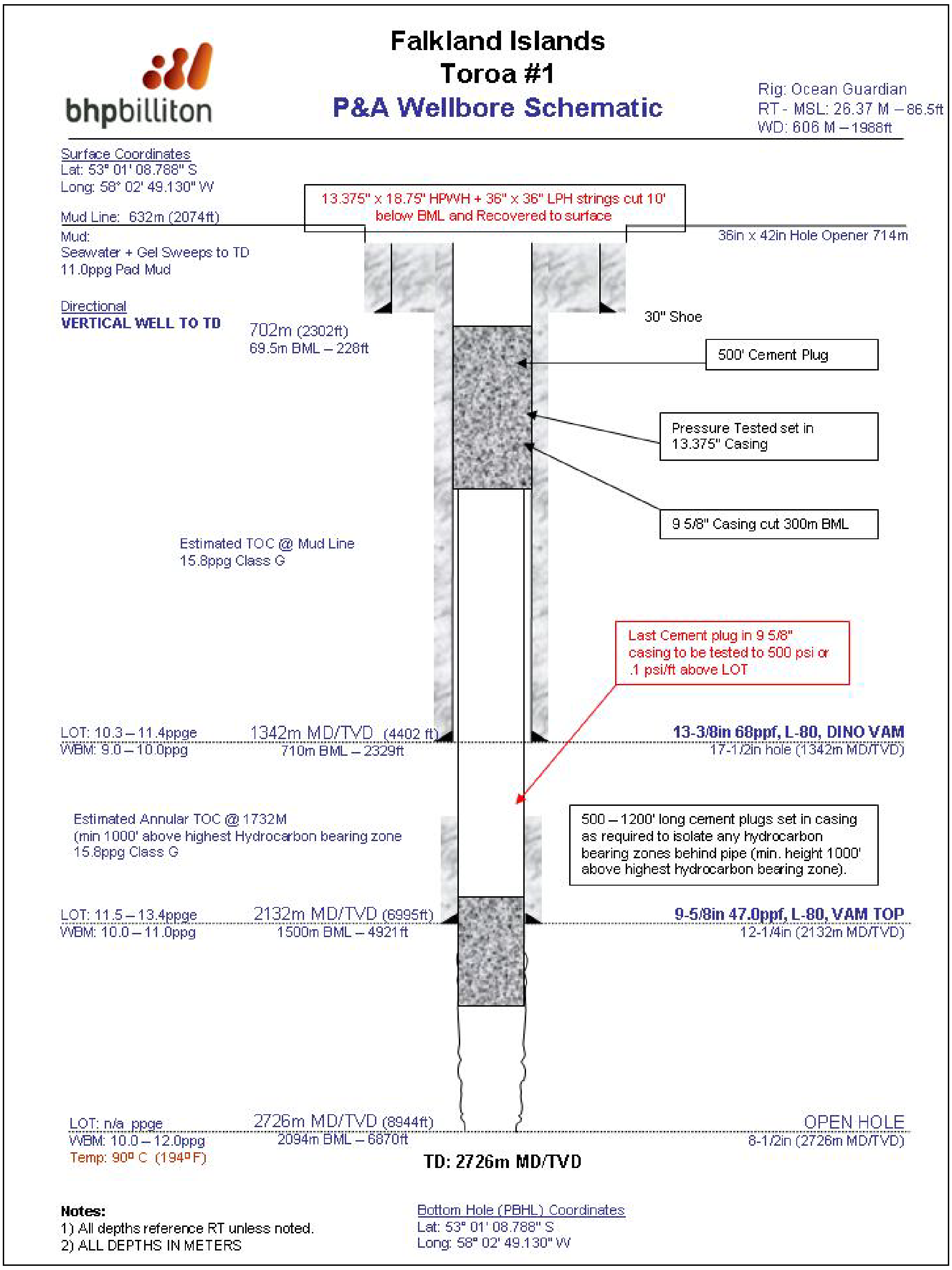
2.7 Well Clean-up, Testing and Completion

Once drilling operations have been completed, BHPBP(F)C proposes to run electric logs to provide information on the potential type and quantities of hydrocarbons present in the target formation. Logging instruments will be attached to the bottom of a wireline and lowered to the bottom of the well. They are then slowly brought back up, the devices reading different data as they pass each formation and recording it on graphs, which can be interpreted by the geologist, geophysist and drilling engineer.

In the event that hydrocarbons are encountered in sufficient quantities, as determined by the electric wireline logs, attempts to recover reservoir fluid samples may be undertaken by wireline. There are no plans to test any well fluids to the surface and therefore no flaring will be undertaken.

After evaluation, the well will be plugged and abandoned. Plugging will be in accordance with UK Guidelines, however a notional description of the plugging procedure follows. The open hole will be cemented to seal off any hydrocarbon bearing formation. Further cement plugs will then be put inside the last casing string. Details of the exact plugging design are dependent upon the formations encountered during drilling, and the evaluation of hydrocarbon potential at the site. Figure 2.2 is an example of an appropriate plugging design for the Toroa well, and will be revised as further details are received during evaluation and logging.

Figure 2.2: An Example of Possible Plugging Design at Toroa



2.8 Resource Use

2.8.1 Equipment and Chemicals

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 and most likely outside of the Falkland Islands.

2.8.2 Fuel

The Ocean Guardian drilling rig is likely to consume 15 tonnes of diesel fuel a day during drilling operations. Four support vessels will be used throughout the Toroa drilling campaign, each of which is estimated to consume 5 tonnes of diesel fuel a day. In total, therefore, it is estimated that the Toroa drilling campaign will use between 1,050 and 1,400 tonnes of diesel fuel, given that the rig will be on site for 30 to 40 day. The fuel will be sourced from the Falkland Islands.

Helicopter trips for crew changes will occur 25 times (round trips) throughout the drilling programme, and are estimated to have a fuel consumption of 5 tonnes per 1,000 kilometre (Mt Pleasant Airport to rig round trip estimated distance of 256 kilometres). Each flight is estimated to take 1hr15 plus deck time. Total aviation fuel use is estimated at 32 tonnes for the drilling period.

2.8.3 Water

Water will be needed for operational and domestic use onboard the rig, and it is estimated that approximately 51,000 litres of drilling water per day and 200 litres of potable water per person per day is required for a typical drilling operation.

For the Toroa drilling campaign, it is estimated, therefore, that between 1,530,000 and 2,040,000 litres of drilling water will be required. This will be sourced from the ocean.

In addition, approximately 600,000 – 800,000 litres of potable water will be required during the drilling campaign (assuming 100 people are onboard the rig during the 30 to 40 day operations). Potable water will be obtained from the water maker onboard the Ocean Guardian, but small amounts could also be sourced from FIPASS.

2.8.4 Waste

Waste will be disposed of on the Falkland Island with hazardous waste likely to be exported to the UK, Chile or Uruguay. Specific waste handling/disposal routes and procedures will be detailed in a Waste Management Plan, to be submitted for approval.

2.9 Support Operations

The drilling rig will be supported by four vessels. One vessel will serve as a stand-by vessel and will at all times be within proximity of the drilling rig for safety purposes. It will be in close liaison with the drilling rig and will continuously monitor other vessel movement in the area. It will warn off vessels on a course that is likely to bring them into or near the safety exclusion zone around the rig, by using a prearranged series of signals of increasing intensity, to ensure that the vessel becomes aware of the obstacle and takes action to avoid it.

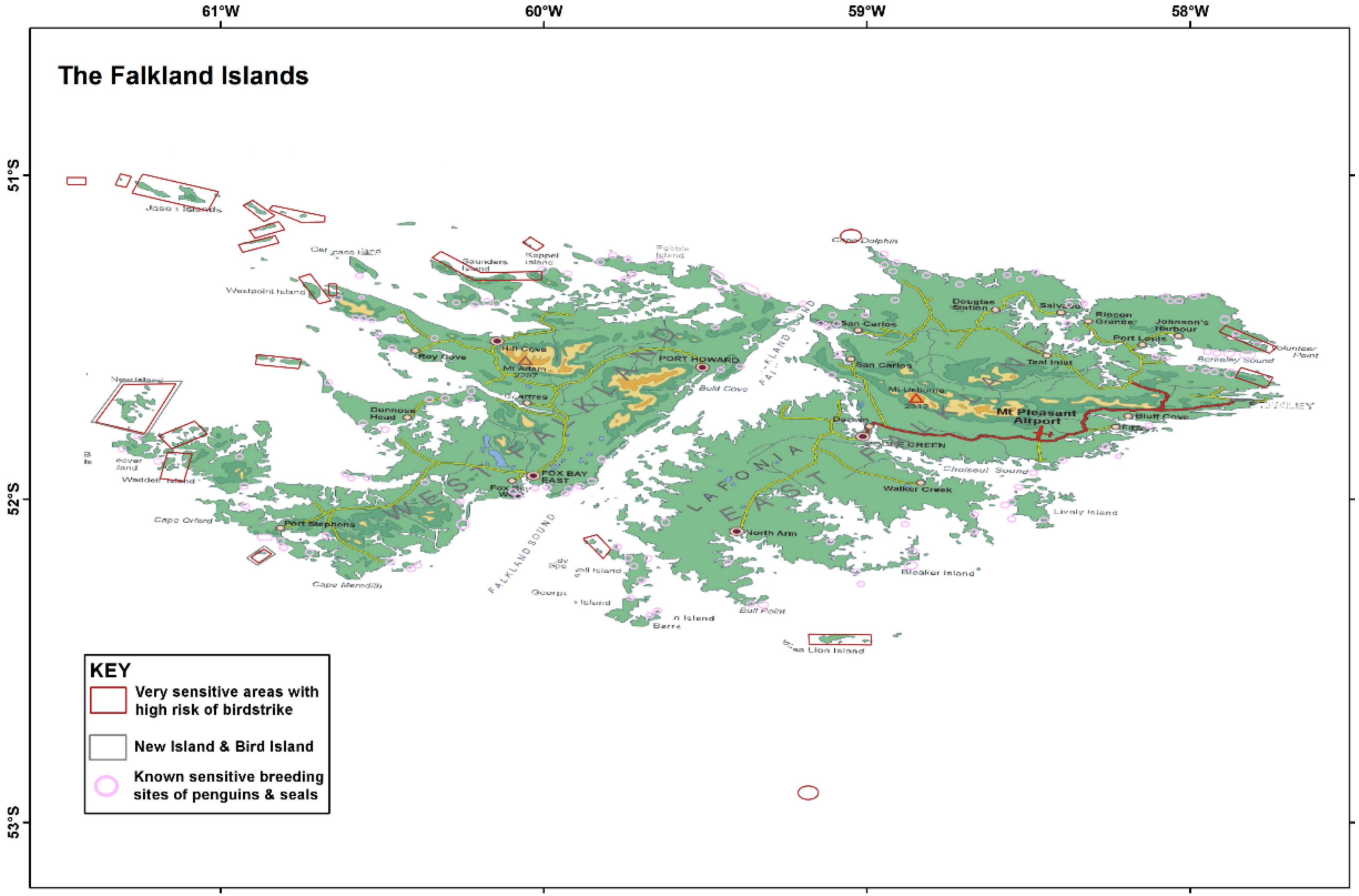
The other three support vessels will serve as supply vessels and will provide the bulk logistics, transporting material required for drilling and well construction to the rig from port and transferring unwanted material and material generated by the drilling operations from the rig to the port.

Rig crews will be transferred to and from the rig by helicopter. A Sikorsky s 61N helicopter, dedicated to BHPBP(F)C will be available from British International Helicopters (BIH) throughout the drilling programme. Helicopter flights for crew changes will take place three to five times a week and will fly out of into Mt Pleasant Airport, although on rare occasions the airport in Stanley may be utilised. Each flight will involve a crew change of up to 18 people.

All the routes used by vessels and aircraft will be pre-planned to avoid creating unnecessary disturbance to sensitive elements along their routes. Figure 2.3 illustrates the 'no-go' zones for areas identified to be ecologically sensitive from aircraft and helicopter activities. These areas will be avoided.

During routine crew changes, the inbound crew will need to be temporarily accommodated on the Islands as they wait for their flights. Inbound crews will be bussed to Stanley and accommodated in the Malvinas House or other rental accommodation. The outbound crews may also have to spend one night in Stanley prior to leaving from the Mt. Pleasant airport. The impacts from increased demand will not be significant as the crew changes will not be in large numbers.

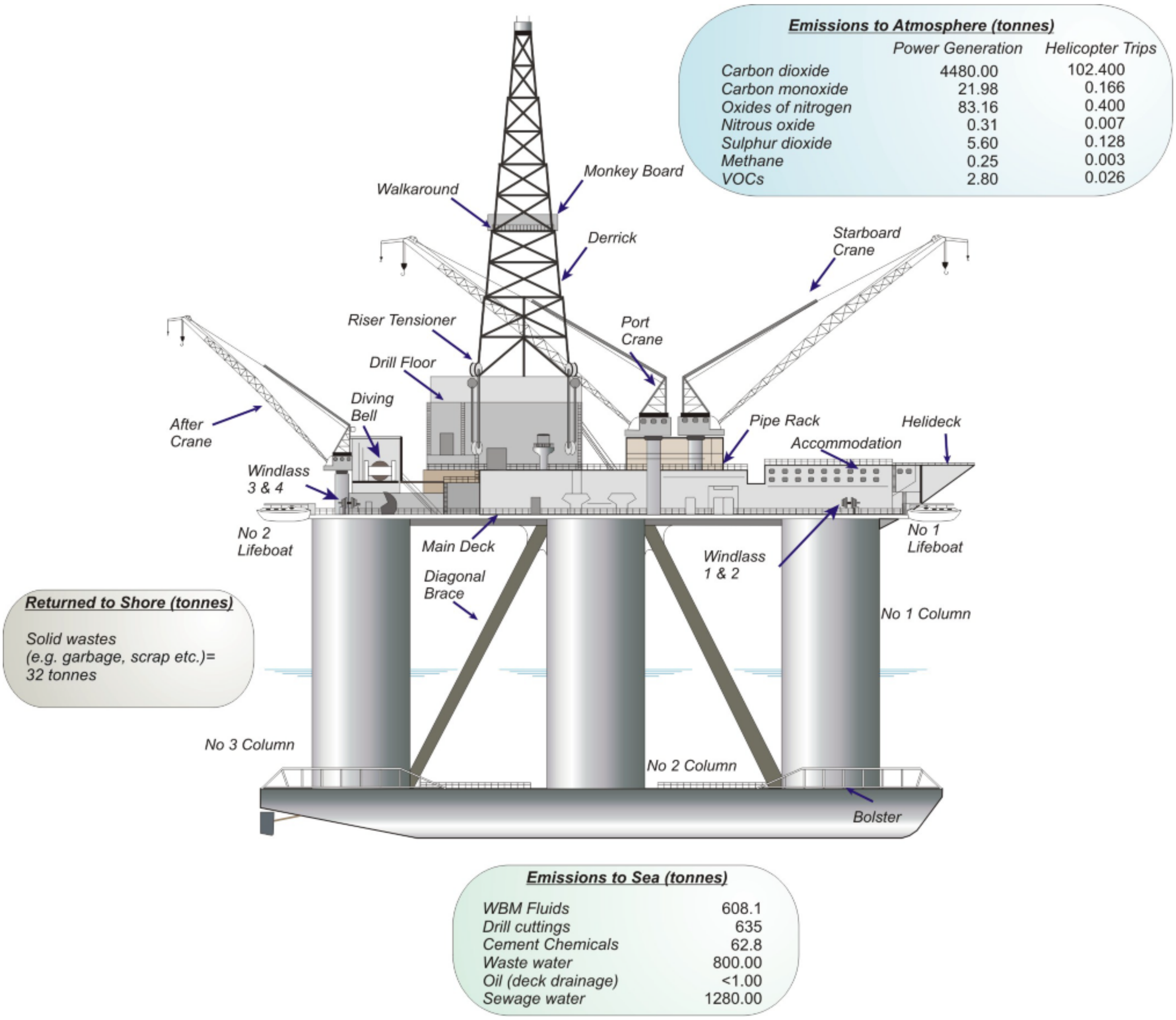
Figure 2.3: Identified Ecologically Sensitive Areas to Impacts from Aircraft and Helicopter Activity



2.10 Total Emissions Summary

Figure 2.4 provides a summary of estimated worst case totals (assuming rig is on-site for a maximum of 40 days) of the main emissions and discharges directly arising from routine operations associated with the drilling of the Toroa exploration well.

Figure 2.4: Emissions Summary for the Proposed Toroa Exploration Well (worst case 40 day operational period)



Note: Atmospheric emissions for power generation assume rig consumes @ 15 tonnes fuel/day and support vessels (4 total) @ 5 tonnes fuel/day each for 40 days duration. Atmospheric emissions for helicopter trips assumes flights for crew changes will occur 25 times (round trip) throughout the drilling programme. Fuel consumption is estimated at 5 tonnes per 1,000km with a return trip from Mt Pleasant Airport to the rig estimated at 256 kilometres.

Waste water discharges calculated assuming 200 l/man/day with 100 personnel onboard the rig.

Sewage water discharge based on 0.22m^3 of grey water and 0.1m^3 of black water /man/day, assuming 100 personnel onboard the rig for a maximum of 40 days.

Solid waste production based on an estimated average of 24 tonnes per month during drilling operations.

3 Key Seasonal Sensitivities

This section describes the key physical, biological and socio-economic values of the marine environment within and adjacent to the proposed drilling Toroa exploration well during the proposed drilling period. Drilling operations are currently schedule to occur sometime between April and June 2010, with the rig anticipated to be on site for a total of 30 to 40 days.

Extensive reference has been made to Section 5 (Existing Environment) and Appendix D (Rig Site Survey – FIDA 61/05 TOROA) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

3.1 Physical Environment

3.1.1 Geography

Refer to Section 5.2.1 (pages 5-3) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

The Falkland Islands are an archipelago of approximately 700 islands in the South Atlantic, the largest of which are East Falkland and West Falkland. Situated some 770 kilometres (480 miles) north-east of Cape Horn and 480 km (300 miles) from the nearest point on the South American mainland, the Falkland Islands have a total land area of 12,173 km^2 (4700 square miles) and a permanent population of 2,913 (*FCO, 2007*).

The proposed Toroa exploration well is situated approximately 160 kilometres to the south of Stanley on East Falkland, approximately 96 kilometres south-east of Sea Lion Island and approximately 78 kilometres east-south-east of Beauchene Island (refer to Figure 1.1).

3.1.2 Bathymetry and Seabed Morphology

Refer to Section 5.2.2 (pages 5-3 to 5-5) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

Water depths in the Toroa survey area ranged from approximately 552 metres in the northern corner to approximately 728 metres in the south. Within the vicinity of the proposed Toroa exploration well water depths are approximately 606 metres LAT (*FSLTD, 2009b*).

The seafloor dipped regionally down to the south-east with slopes ranging from approximately 0.6 degrees in the north-western portion of the survey area, and increasing gradually to about 1.8 degrees in the south-east. There is no indication of past or incipient seafloor slope instability within the survey area (*FSLTD, 2009b*). Further assessment has shown that, no further investigation related to slope stabilities is warranted.

The only seafloor topographic or geologic features identified within the survey area were a series of west-south-west to east-north-east trending curvilinear features in the extreme north-west of the site and one similar south-west to north-east trending feature in the central part of the study area. These features were characterised either by a slight local flattening of the seafloor or a shallow seafloor trough and are probably the result of differential erosion of variable seafloor sediments by marine currents. It is possible that the erosional processes responsible for generating these features are active (*FSLTD, 2009b*).

3.1.3 Seabed Sediments

Refer to Section 5.2.3 (pages 5-6 and 5-7) and Section 5.2.4 (pages 5-8 to 5-10) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

The geophysical data collected during the Toroa site survey suggested that surficial sediments were extremely homogeneous and this was supported by the evidence of the box corer and gravity corer sampling, drilling and ROV programs, all of which showed that seafloor materials consisted of silt / clay throughout the site (*FSLTD, 2009b*).

Granulometry

Particle size analysis of the samples collected during the site survey suggested that sediments across the Toroa survey area were extremely homogeneous, the graphical means of the samples' distributions ranging from 4.87 phi units (34.1 µm) to 5.08 phi units (29.5 µm). The Wentworth classification of the graphical means categorise the sediments in two separate classes (poorly sorted medium silt or poorly sorted coarse silt), however all graphical means fall only marginally above or below the threshold between the two classes (5 phi units) (*FSLTD, 2009b*).

Both sand and fines content of the samples are consistent across the stations, the former ranging between approximately 20% and 25% and the latter between approximately 75% and 80%. No coarse material was identified from the analysis, although occasional shell and coral fragments were seen from the Remotely Operated Vehicle (ROV) footage and in the sieved fauna samples.

Organic Carbon, Hydrocarbon and Heavy/Trace Metal Analysis

Both fractionated organic carbon (FOC) and total organic matter (TOM) were consistent across the sampling stations from Toroa, the former ranging from 0.62% to 0.77% (stations T10 and T9, respectively) and the latter from 4.7% to 6.8% (stations T10 and T4, respectively). The lowest proportions of both FOC and TOM were identified from the deepest of the station samples (station T10). The higher values for TOM may be due to carbonates present in the samples.

Total hydrocarbon concentrations (THC) were low compared to North Sea Oil and Gas UK data, though considered moderate for the remote nature of the survey area, ranging from 7.0 µg.g-1 to 10.1 µg.g-1 (stations T8 and T5, respectively). These concentrations are presumed to originate from local natural oil seeps and are considered to be typical background concentrations for the area.

Total n-alkane concentration was low, ranging from 0.505 µg.g-1 to 0.749 µg.g-1 (stations T8 and T5, respectively), this trend (and those seen in concentrations of individual aliphatics) generally reflected that seen in THC. The lack of odd or even-carbon number preference in the n-alkanes, the carbon preference index (CPI) being close to unity, may have been the result of diffuse inputs from natural seeps to the survey area.

Total PAH concentrations were low, but higher than expected for this region, again suggesting a local presence of natural oil seeps. They showed little correspondence with the patterns identified in other hydrocarbon concentrations and instead appeared to show a spatial (or depth-related) trend, being measured at their lowest (195 ng.g-1) at the shallowest station (station T9) and at their highest (243 ng.g-1) at the deepest station (station T10). No clear causal mechanism for this trend (e.g. sedimentary gradient) was apparent.

The concentrations of heavy and trace metals were measured using inductively coupled plasma mass spectrometry following extraction by separate aqua regia and hydrofluoric acid (HF) digests. The former technique is the less stringent of the two measures and provides a partial estimate of metals, indicative of bioavailable concentrations, while the more stringent HF digestion releases matrix locked metals to provide a 'near total' estimate of both bioavailable and unavailable concentrations.

The aqua regia digestion technique was applied to provide an indication of metal concentrations that may have been available to uptake by the biota associated with the sediments. This occurs due to aqua regia's high level of acidity and therefore it breaks down matrices releasing elements that would not generally be available. To achieve this breakdown, aqua regia samples were subjected to oxidative acid digestion using nitric acid and heating. Hydrochloric acid was added at the end of the digestion for element stability prior to analysis. Elements were identified and quantified by ICP-MS. The quantity of sample and digest taken was adjusted according to the concentrations of metals within the samples.

The more stringent HF extraction technique was employed as to provide a 'near total' estimate of metal concentration; HF is capable of breaking down silicate structures that bind metals within sediments. Neither the aqua regia or HF methods provide an accurate estimate of bioavailable heavy and trace metal concentration (i.e. the concentration available to the food chain).

Calculating bioavailable metal concentrations is notoriously difficult as metals take different forms (with varying degrees of bioavailability) under different physico-chemical conditions (*Tack and Verloo, 1995*).

As would be expected given the differing stringency of the two extraction procedures, the concentrations measured by aqua regia digestion were generally much lower than those measured by HF digestion. The concentrations of heavy and trace metals appeared consistent across the site, being found at levels typical for unimpacted silt / clay sediments (*FSLTD, 2009b).*

3.1.4 Oceanography

Refer to Section 5.2.6 (pages 5-12 to 5-17) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

Water Circulation and Tidal Currents

Average current speeds are less than 25 cm/s (0.5 knots) to the west and 25–50 cm/s (0.5–1 knots) to the east of the Falkland Islands (*Hydrographer of the Navy, 1993*). Tidal cycles around the Falkland Islands are semi-diurnal (twice daily), with tides ranging from 0.3–3.5 metres above local datum (*Brown & Root, 1997*).

From 6th December 2008 to the 26th April 2009, a metocean buoy was deployed at the Toroa well location by Fugro Survey Limited on behalf of BHPBP(F)C. The aim of the deployments was to gather data on current speed and direction throughout the water profile between these times. The metocean buoy, deployed in a water depth of 692 metres, was equipped with a Long Ranger RDI 75kHz ADCP and two RCM7's. Unfortunately, the ADCP unit at Toroa became flooded shortly after deployment due to failure of the unit casing and, as such, current profile data was not recorded from this unit.

Table 3.1 lists the maximum observed current speeds at each of the metocean buoys. The maximum current speed observed at Toroa was 0.39 ms^{-1} at 682 metres below the sea surface (10 metres above the seabed) with a corresponding direction of 233^{o} (true).

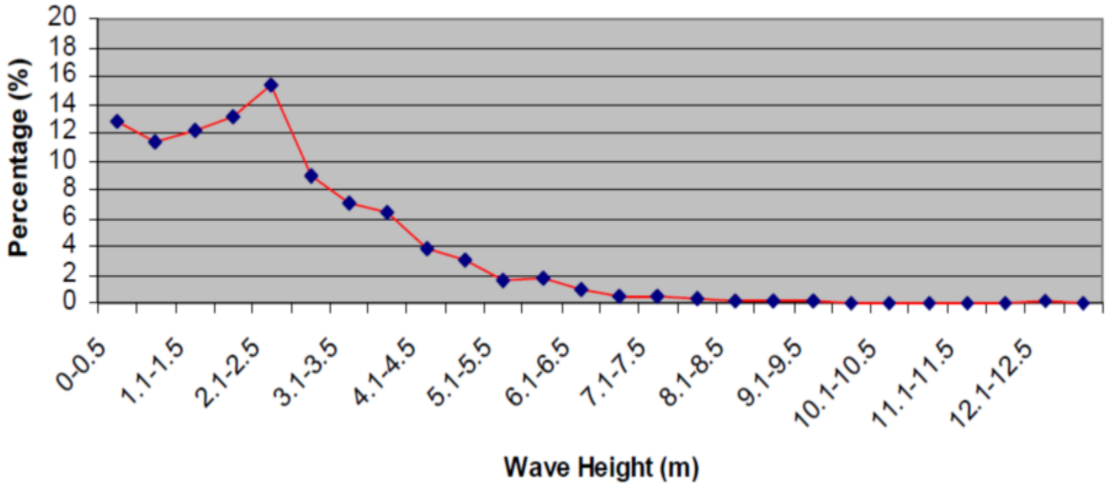
Table 3.1: Maximum Observed Current Speeds and Directions from the Instruments at the Metocean Buoy (FSLTD, 2009c)

Data Bin No.	Depth Below MSL	Current Speed (ms^{-1})		Direction of Current Max.	Date and Time of Maximum
	metres	Maximum	Mean	(^{o} True)	GMT
Toroa RCM1	422	0.32	0.10	012	13-APR-2009 0700
Toroa RCM2	682	0.39	0.11	233	13-APR-2009 1640

Waves

Maximum wave heights in the vicinity of the proposed drilling location are in the region of 2 to 3 metres (Figure 3.1). Seasonality in wave height showed a more energetic wave environment between June (towards the end of the proposed drilling period) and September, corresponding to the Southern Hemisphere winter. The direction of wave approach was predominantly west to south-west.

Figure 3.1: Annual Wave Exceedance



Water Column Characteristics

Two water profiling attempts were made at Toroa during the site survey. The first deployment returned erroneous data so a second attempt was made using a different water profiler which acquired good data for all parameters except pH (as no functioning sensor was available).

The surface temperature was approximately 9.7°C and this remained relatively constant in the upper layers of the water column to approximately 14 metres depth. Below this there was a distinct thermocline over which the water temperature descended fairly rapidly to 5.3°C at approximately 140 metres depth before declining gradually to a temperature of 4.4°C at the seabed (*FSLTD, 2009b*).

Although salinity showed minimal variation throughout the water column, ranging from a minimum of 34.1 ppt at the surface to 34.2 ppt at the seabed, it appeared to have a strong negative relationship with temperature (*FSLTD, 2009b*).

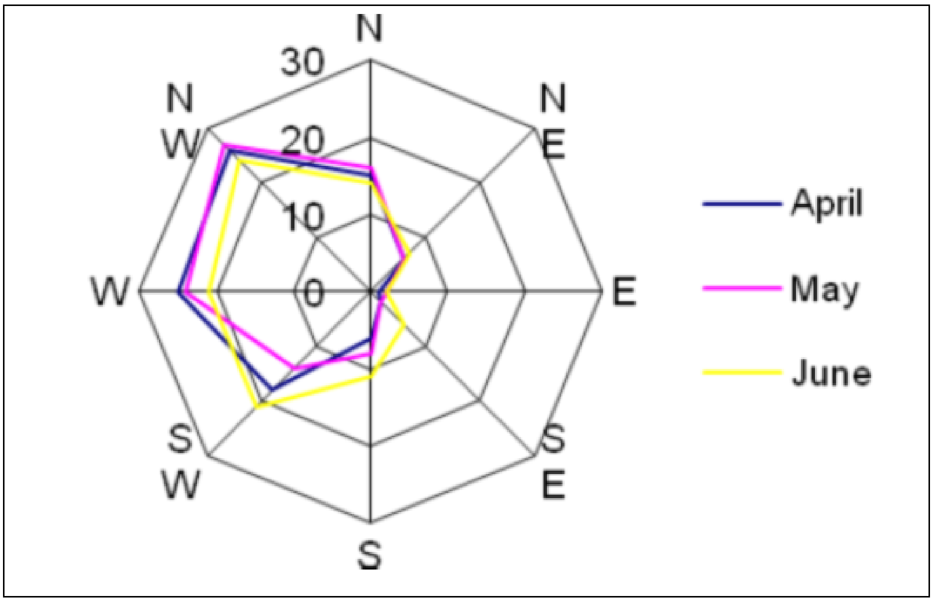
Dissolved oxygen (DO) declined rapidly from a surface concentration of approximately 85%sat. to 72%sat. at around 130 m depth. DO then decreased steadily to the seabed (minimum concentration of 66%sat.) (*FSLTD, 2009b*).

3.1.5 Winds

Refer to Section 5.2.7 (page 5-18) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

The prevailing wind direction is an annual broad arc spanning south-west to north-west constantly. Winds predominantly range between 11 to 21 knots (Beaufort scale 4 to 5) or below. Strong gales and storms (Beaufort scale 7+) are rare in the area, but may occur in winter or from a westerly direction. Figure 3.2 provides the wind rose for the months of April to June, during the proposed drilling period.

Figure 3.2: April to June Wind Rose for Stanley Harbour (51° 42'S, 57° 52'W - 2m above MSL) measured in knots (data taken from 1874 to 1982; Admiralty Sailing Directions: South American Pilot Volume II (2008)



3.2 Biological Environment

The Patagonian Shelf, on which the Falkland Islands sit, is of regional and global significance for marine resources (*Croxall & Wood, 2002*). It comprises rich assemblages of seabirds, marine mammals, fish, squid and plankton populations.

3.2.1 Benthic Fauna

Refer to Section 5.3.3 (pages 5-23 to 5-28) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

Epifauna / Pelagic Fauna

During the environmental baseline survey for Toroa, the most frequently occurring epifaunal taxa encountered were tubicolous (tube-dwelling) onuphid worms, the majority of which were *Onuphis pseudoiridescens*, a dominant component of the community sampled. Brittle-stars, which appeared from their gross morphology to largely comprise members of the family *Amphiuridae*, were also frequently seen (refer to Section 5.3.3 of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS for further details).

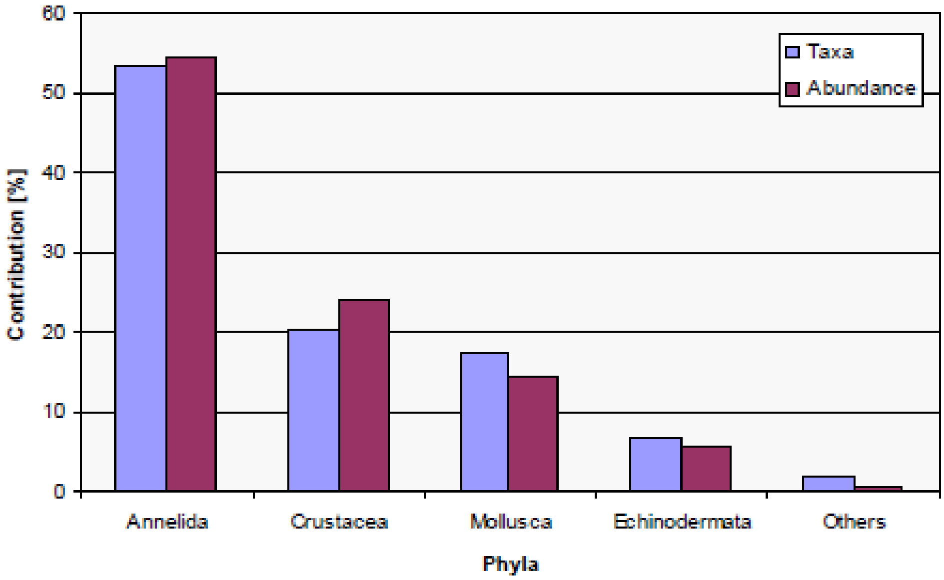
Infauna

During the environmental baseline survey for Toroa, two 0.1 m^2 macrofaunal grab samples were analysed from each of the six stations sampled. Macrofaunal data were derived from the taxonomic analysis of all of these samples, with individuals of macrofaunal taxa being identified, enumerated and expressed as abundance per sample (0.1 m^2) and per station (0.2 m^2).

A total of 103 discrete macrofaunal taxa were found during the course of the Toroa survey, excluding the six juvenile and three indeterminate taxa, records which were not included in the analysis.

Of the taxa recorded 53.4% were annelid, 20.4% were crustacean, 17.5% were molluscan and 6.8% were echinoderm (Figure 3.3). In terms of abundance the Annelida were dominant, representing 54.5% of the 488 individuals recorded in total from the samples.

Figure 3.3: Abundance of Taxonomic Groups (FSLTD, 2009b)



The dominant taxa recorded from the survey area are shown in Table 3.2. Of the dominant infaunal taxa identified the majority were polychaetous annelids, although the most abundant species overall was the amphipod crustacean *Haustoriidae sp*. 1.

Abundance / dominance and univariate analyses of the infaunal data suggested that a single community occurred throughout the survey area. These findings were corroborated by the multivariate CLUSTER and SIMPROF analyses, which showed that all station data could be grouped within a single statistically undifferentiated cluster. This cluster was shown to be characterised by the amphipod *Haustoriidae sp. 1* and polychaete *O. pseudoiridescens*, species that were consistently abundant at all stations (*FSLTD, 2009b*).

Values for primary and univariate parameters calculated for station data (0.2 m^2) collected during the Toroa environmental baseline survey are presented in Table 3.3. Unsurprisingly most of the parameters increased and the variability within them was reduced in comparison to the sample data, this was attributed to species accumulation (the detection of an increased number of rare species) when the samples were aggregated at station level. The station data for Toroa suggested that its benthic community is marginally more species rich and less highly dominated than that of deeper sites (such as the Loligo site, found to the east of the Falkland Islands) (refer to Appendix D – Section 2.9 – of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS).

Table 3.2: Dominant Taxa by Abundance and Dominance Rank for Samples [0.1m^2] (FSLTD, 2009b)

Taxon	Rank Abundance	Mean Abundance	Frequency (%)	Rank Dominance
Haustoriidae sp. 1	1	5.6	83.3	1
Onuphis pseudoiridescens	2	5.3	100.0	2
Ampharete sp. 1	3	2.7	75.0	3
Stemaspis sp. 1	4	1.7	50.0	4
Ctenodiscus australis	5	1.1	50.0	6
Nucula falklandica	6	0.9	66.7	8
Thyasira subovata	6	0.9	41.7	9
Axinulus of croulinensis	6	0.9	41.7	6
Harpinia sp. 2	9	0.8	41.7	11
Chaetozone ander	10	0.8	50.0	13
Pulsellum falklandicum	11	0.7	25.0	5
Myriochele riojai	14	0.6	25.0	10

Table 3.3: Toroa Primary and Univariate Parameters by Station (0.2 m^2)

Station		No of Taxa [s]	Abundance [N]	Richness [DMO]	Evenness [J']	Dominance [1-λ]	Shannon Wiener[H']
T1		29	101	6.07	0.821	0.910	3.99
T4		39	78	8.72	0.915	0.963	4.84
T5		39	94	8.36	0.865	0.942	4.57
T8		25	48	6.20	0.896	0.940	4.16
T9		47	108	9.84	0.901	0.963	5.00
T10		33	00	7.82	0.955	0.975	4.82
Comparison Results							
Current Survey	Mean	35.3	81.3	7.84	0.892	0.949	4.56
	SD	7.9	23.6	1.48	0.046	0.023	0.41
	V	22.5	29.0	18.8	5.1	2.5	8.9
Loligo	Mean	29.3	76.0	6.53	0.828	0.895	3.98
	SD	9.0	39.2	1.36	0.079	0.044	0.30
	V	30.6	50.3	20.8	9.5	4.9	7.6
Endeavour	Mean	36.0	80.0	8.00	0.873	0.935	4.51
	SD	2.9	11.1	0.56	0.054	0.031	0.30
	V	8.1	13.9	7.0	6.2	3.3	6.7
Nimrod	Mean	32.4	61.7	7.62	0.897	0.942	4.49
	SD	5.7	12.3	1.12	0.042	0.031	0.41
	V	17.6	20.0	14.7	4.7	3.3	9.1

3.2.2 Fish

Refer to Sections 5.3.4 to 5.3.7 (pages 5-28 to 5-31) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

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*). Coggan et al, (2006) 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 (depth range of approximately 500-1,000 metres). Forty-one species of teleost fish were recorded, 10 species of elasmobranch and one species of agnathan. Different assemblages of fish were found to characterize 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. Four species, namely the grenadiers *Macrourus carinutus* and *Coelorhynchus fasciatus*, the southern blue whiting *Micromesistius australis*, and the Patagonian toothfish *Dissostichus eleginoides*, accounted for 85 percent by weight of all fish caught.

Cephalopods

Argentine shortfin squid (*Illex argentinus*) is a demersal, schooling species caught in The Falklands Interim Conservation and Management Zone (FICZ) between late February and June, at depths of 80–800 metres (*FIFD, 2001; Rodhouse & Hatfield, 1990*). Fishing catch peaks between April and May with principal catch areas to the north and north-west of the Falklands, away from the proposed location of the Toroa exploration well, although they can vary annually.

Pantagonian squid (*Loligo gahi*) is a demersal, schooling species found in shallower water around the coast to a depth of about 400 metres (*Boyle, 1983*). They have two main spawning periods; the spring (September-October) spawning group is larger than the autumn (March-April) group. It is possible therefore that the proposed drilling period for Toroa will overlap with the end of the autumn spawning for the species. Historically, however, fishing activity for *Loligo gahi* has not occurred within the vicinity of the Toroa exploration area.

A third squid species, red squid (*Martialia hyadesi*) is not widely fished. It is larger in size than *Illex argentinus* or *Loligo gahi* and is thought to be abundant in the waters of the Antarctic Convergence Zone, near South Georgia. This species forms at least 90% of the squid intake of the grey-headed albatross population during the chick rearing period resulting in approximately 1,400 tonnes of squid consumed each breeding season (*Brunetti & Ivanovic, 1992*). Due to the known distribution of this species, it is unlikely that the proposed drilling operations at Toroa will impact on *Martialia hyadesi*.

Finfish

Eleven species of finfish are caught throughout the Falkland Islands' waters in significant quantities. Southern blue whiting catch is found to the south-west and north-east of the Falkland Islands. Hoki, rays, red cod and Patagonian toothfish are caught widely around the Falkland Islands in the FICZ, except in the south-east. Within the Falkland Islands Outer Conservation Zone (FOCZ) all are caught to the north of the Falkland Islands. Patagonian toothfish and rays are also caught to the south-east within the FOCZ (*Munro, 2004*).

The distribution of migratory species such as hake may be affected by fluctuations in spawning success and external environmental affects. Many of the commercially caught demersal species are likely to spawn in deep water and have planktonic eggs and larvae. Immature stages of some species may occur inshore; however, there is little information on specific nursery areas.

Fish and larval stages can be particularly vulnerable to the effects of hydrocarbon pollutants, such as PAHs (*Stagg and McIntosh, 1996*). Spawning of most species begins in autumn and progresses through winter, when the southern blue whiting and grenadier fish contribute to more than half of all eggs present in samples from around the Falkland Islands (*Ehrlich et al., 1999*). Sampling has shown that the greatest number of unidentified eggs (indicating early life stages) are found in the slope waters and deeper parts of the continental shelf (<400 metres), shallower than the water depth at Toroa. Fifty percent of all larvae collected during surveys over four years (1992-1995) were found in the 800-1000 metre depth range, deeper than the water depth found at the Toroa exploration well location.

The Toroa drilling period falls into the autumn (April and May) and winter (June) seasons. Autumn data show a very low density of eggs (64.63 eggs per $10m^2$) in samples collected throughout the Falkland waters and the Patagonian shelf; winter levels are slightly elevated (142.85 eggs per $10m^2$). Peak levels are seen during the spring months (September – November) (3864.32 eggs per $10m^2$) outside of the proposed drilling period for Toroa.

In summary, finfish species potentially found in the vicinity of the Toroa exploration well include hake (*Merluccius sp.*), southern blue whiting (*Micromesistius australis*) and cod (*Notothenia spp.*). Spawning and nursery periods for these species are, however, not expected to coincide with the proposed drilling period for the well (April to June).

Shellfish

Data on shellfish found in the shallow and offshore waters of the Falkland Islands are scarce. Lobster krill is abundant in Falkland Islands' waters. Crabs found in the shallow inshore waters of the Falkland Islands include red crab (*Paralomis granulosa*) and, to a lesser extent, the king crab (*Lithodes antarcticus*). Trawling to the south of the Falkland Islands has also shown there to be a probable significant population of sub-Antarctic stone crab (*Neolithodes* sp.).

It is unlikely that shellfish species will be found in the direct vicinity of the Toroa exploration well, due to the distance offshore and water depth.

3.2.3 Marine Mammals

Refer to Section 5.3.8 (Pages 5-31 to 5-41) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

Little is known about the populations, distribution and habits of marine mammals in the waters surrounding the Falkland Islands, particularly in the deeper waters to the south and east. There may be more than 20 species which occur in Falkland Islands' waters, but it is estimated that only 2 to 3 of these species would be resident to the area (*Munro, 2004*).

After the award of the initial round of hydrocarbon exploration licenses in 1996, six wells were subsequently drilled to the north. The threat to seabird and marine mammal populations was recognized, and in view of the lack of published data available 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*). To date, the findings from these surveys are still the major body of work regarding the frequency and distribution of marine mammals, particularly cetaceans, in the region.

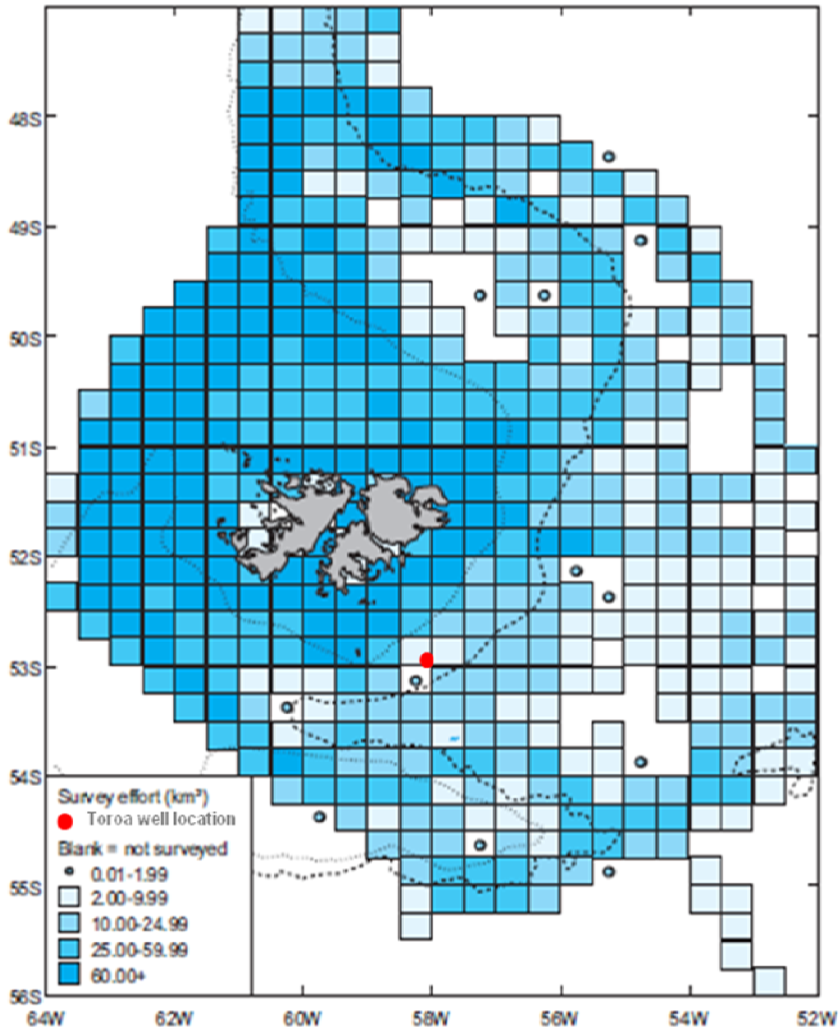
These at-sea surveys were carried out in every month between February 1998 and January 2001. Surveys were conducted throughout the south-west Atlantic – as far north as 35° S (*Black, 1999*), south to 65° S (*White and Gillon, 2000*), east to 28° W (*White and Gillon, 2000*) and west to 70° W (*Gillon et al., 2000*). The majority, over 82 percent, of survey effort was conducted within Falkland Islands waters. Analysis of the data within the White et al., 2002 report includes all survey effort within a rectangle defined by south-west co-ordinates 56° S 64° W and northeast co-ordinates 47° S 52° W.

In total, 91 survey cruises were conducted during the three years. In most cases single observers were on board, with the remainder 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 (methods as per *Tasker et al., 1984; Webb and Durinck, 1992*).

A total of 20,907 km² of survey effort was conducted within the study area in the period under consideration. Monthly survey effort ranged from a low of 262.2 km² in November 2000 to a high of 1,546.7 km² in November 1998, with an average monthly survey effort of 676.5 km² (*White et al., 2002*).

The distribution of all the survey effort achieved from February 1998 to January 2001 is shown in Figure 3.4, below.

Figure 3.4: Total Survey Effort in All Months (White et al., 2002)



Highest levels of effort were concentrated over Patagonian Shelf waters, particularly waters around Stanley and in the west of the survey area. Although it can be seen from this that survey effort was lower in the vicinity of the proposed Toroa exploration well, particularly compared to the north and west of the Falklands Islands, surveys were conducted within the area of the BHPBP(F)C license blocks. It is recognised, however, that a decrease in survey effort may decrease the number of species recorded. White et al., 2002 noted that the rate of increase in sightings was greatest between zero and 20 km² of survey effort, although for levels of survey effort above 20 km² per month there was little increase in the number of species recorded.

Cetaceans

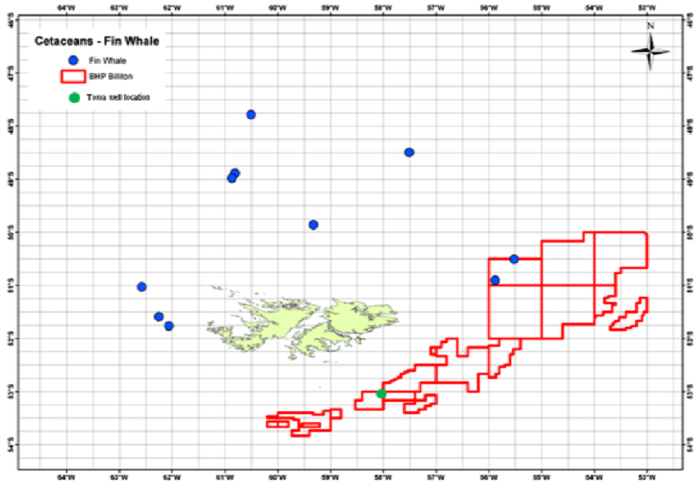
Prior to the JNCC survey (*White et al., 2002*), knowledge of the cetacean fauna of the Falkland Islands was based largely on coastal observations and records of stranded animals. Hamilton (1952) recorded a total of 16 species within Falkland Islands waters, while Strange (1992) recorded a total of 23 species. More recently, observations from FIG Air Service pilots and fisheries observers of the FIG Fisheries Department (FIGFD) give an indication of some of the species present in offshore areas, but interpretation of these casual observations is difficult (*White et al., 2002*).

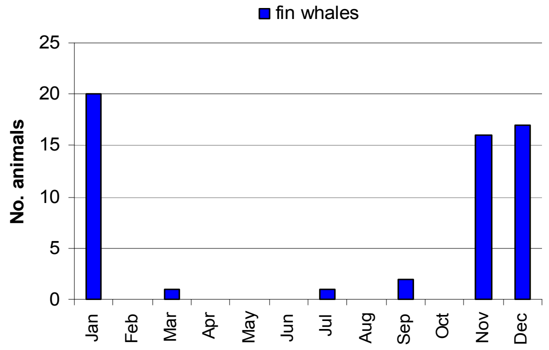
The following results, unless stated otherwise, have been extracted from the Distribution of Seabirds and Marine Mammals in Falkland Islands' Waters report (White et al., 2002) and represent the findings of those surveys between 1998 and 2001.

Figure 3.5 and Table 3.4 below, show the distribution and species of cetaceans sightings recorded during all the surveys month.

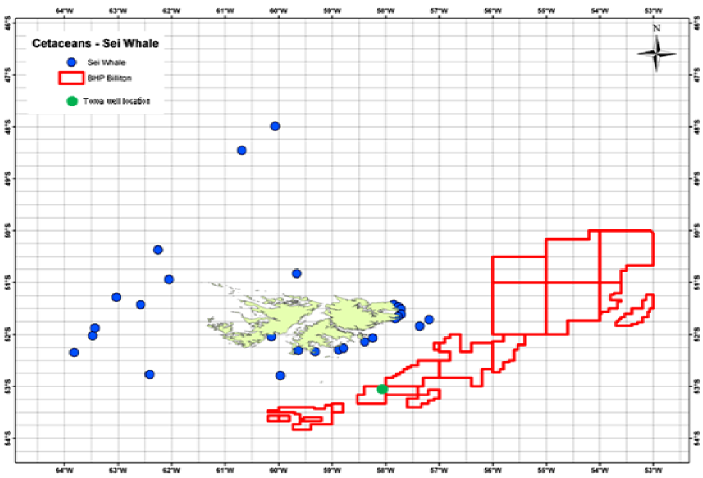
Figure 3.5: Cetacean Species Distribution (all months) (1998-2001) (White et al., 2002)

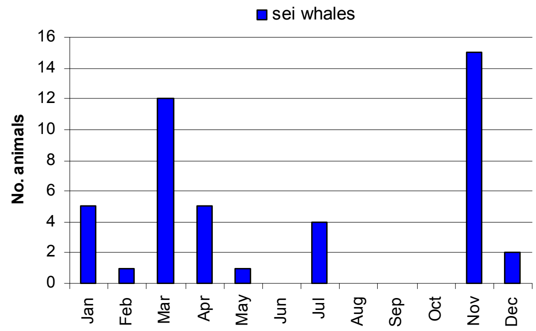
Fin Whale



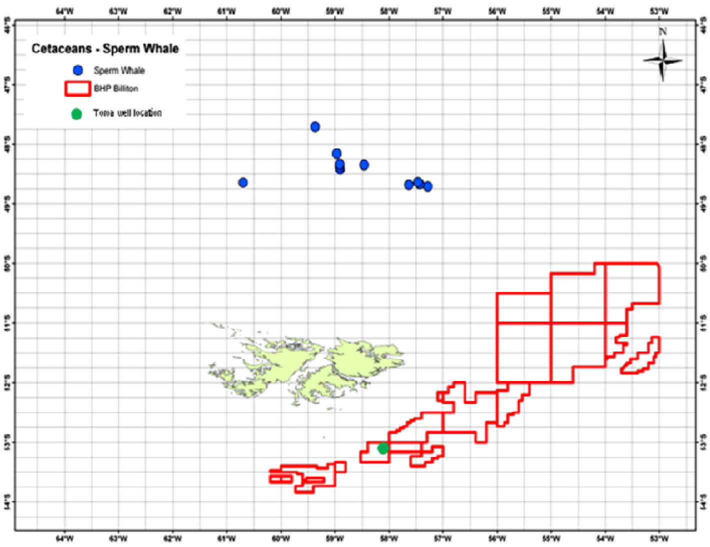


Sei Whale





Sperm Whale



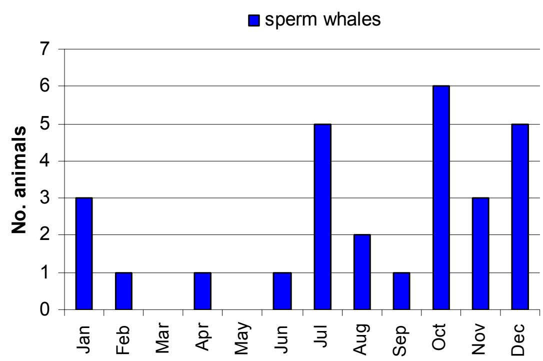
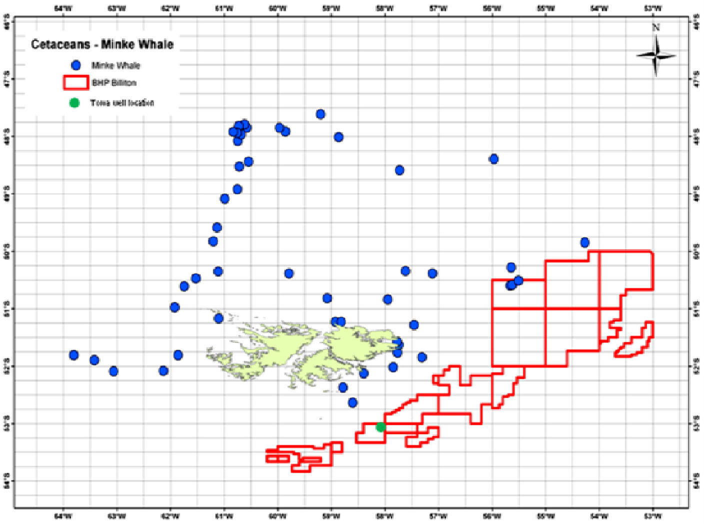
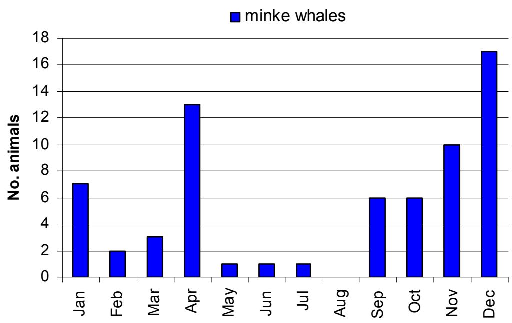


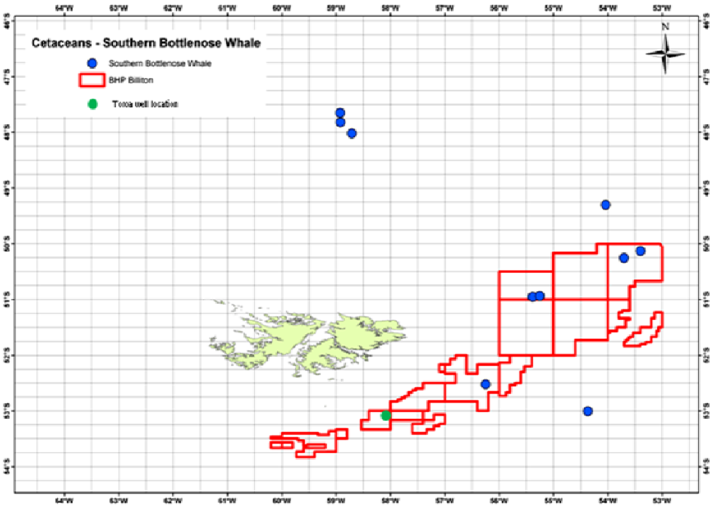
Figure 3.5 (continued): Cetacean Species Distribution (all months) (1998-2001) (White et al., 2002)

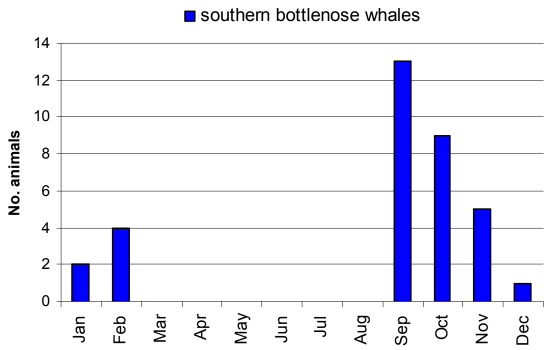
Minke Whale



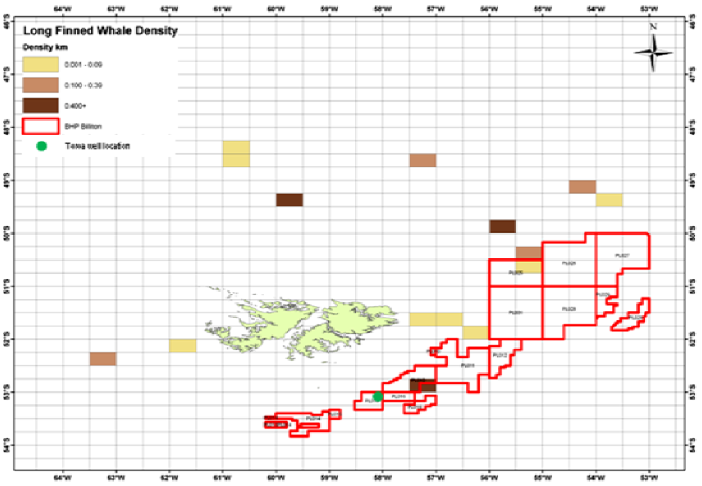


Southern Bottlenose Whale





Long-finned Pilot Whale



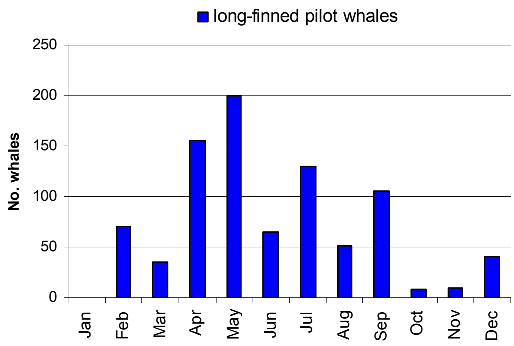
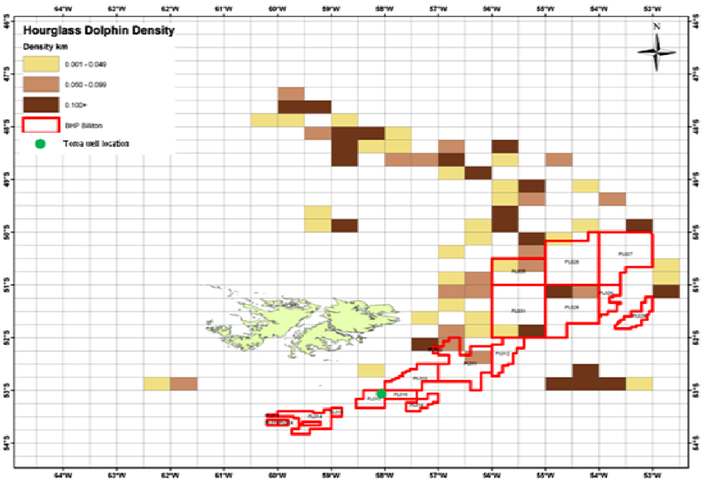
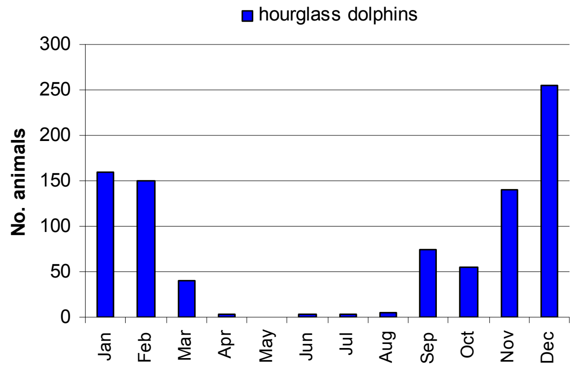


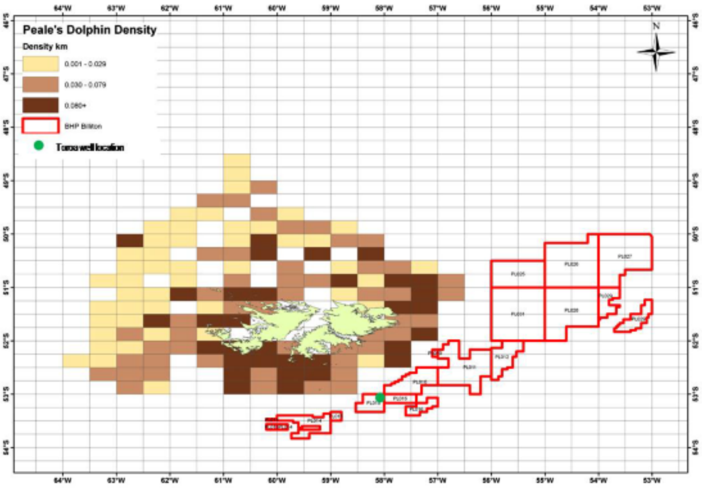
Figure 3.5 (continued): Cetacean Species Distribution (all months) (1998-2001) (White et al., 2002)

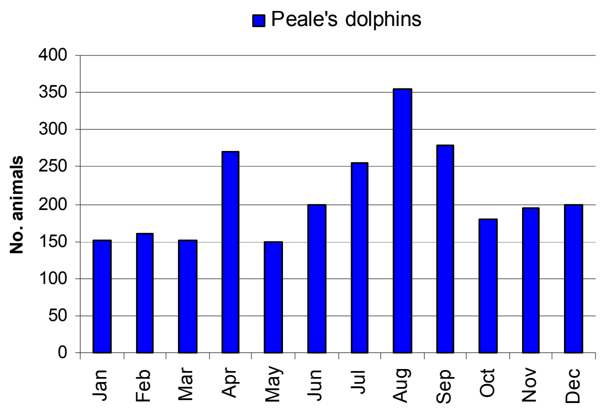
Hourglass Dolphin



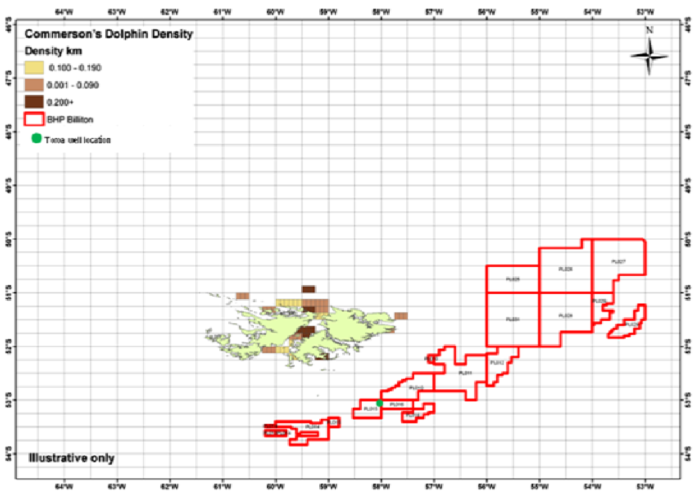


Peale's Dolphin





Commerson's Dolphin



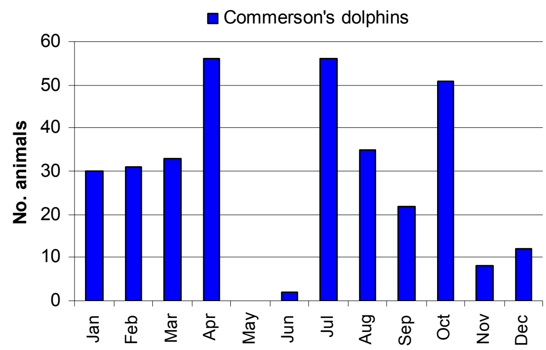


Table 3.4: Cetacean Species Distribution (all months) (1998-2001) (White et al., 2002)

Fin whale (*Balaenoptera physalus*)	The majority of fin whales were recorded between November and January, with 57 recorded in total on 27 separate occasions over the survey area. Sightings were generally in water depths >200 m. No sightings were made in the block of interest.
Sei whale *(Balaenoptera borealis)*	Most sei whale sightings were between November and April, with 45 individuals recorded on 31 occasions. Most records were from Patagonian Shelf waters, with others in relatively shallow waters. No sightings were made in the block of interest.
Sperm whale *(Physeter macrocephalus)*	A total of 28 sperm whales were recorded on 21 occasions, mainly in July, October and December, but also throughout most months. All sperm whale sightings occurred in deeper waters (>200 m), with records clustered to primarily to the north of the Falkland Islands. No sightings were made in the block of interest.
Minke whale *(Balaenoptera acutorostrata)*	Minke whale sightings peaked in April and December, with a total of 68 whales recorded on 60 occasions. The majority of records were from Patagonian Shelf waters around East Falkland Islands and in the north-west of the survey area. No sightings were made in the block of interest.
Southern bottlenose whale *(Hyperoodon planifrons)*	Southern bottlenose whales were recorded between September and February, with a total of 34 records on 18 occasions. All sightings were made in waters >1000 metres, generally to the north, east and south. Sightings were made close to the exploration location.
Long-finned pilot whale *(Globicephala melas)*	Large numbers of long-finned pilot whale were recorded (872 over 27 occasions), with group sizes of up to 200. Although these whales were recorded in all months except January, they were predominantly recorded between April and September in waters deeper than 200 metres. Density of sightings close to the exploration location was high.
Hourglass dolphin (*Lagenorhynchus cruciger*)	Hourglass dolphins were recorded in large numbers, with 866 sightings over 177 occasions, mainly between September and March and in water depths of greater than 200 metres. Density of sightings close to the exploration location was high.
Peale's dolphin (*Lagenorhynchus australis*)	Peale's dolphins were the most numerous and frequently recorded cetacean with a total of 2617 animals recorded on 864 occasions. They were recorded in all months with a maximum of 358 animals in August. They were generally found in waters less than 200 metres deep. Density of sightings close to the exploration location was medium.
Commerson's dolphin (*Cephalorhynchus commersonii*)	A total of 336 Commerson's dolphin was recorded on 100 occasions, covering all months except May. Dip in records over May and June may be due to variation in the level of survey effort rather than seasonal variations. No observations were made over 25 kilometres offshore. Density of sightings close to the exploration location was low

Of note is that some inter-annual variation in the occurrence of cetaceans was recorded. There was a marked decrease in baleen whales, mainly fin, sei and minke whales, recorded in summer 2000/01 when compared with 1998/99 and 1999/2000. This can be explained in part by the reduction in survey effort in 2000/01, but this alone does not explain the size of the decrease. The distribution of survey effort is unlikely to be a factor, since species such as minke whales were recorded throughout the survey area while fin and sei whales were typically either deep water (fin) or shallow water (sei) species. It seems more likely that the occurrence of these species is linked to the local availability of food, which was perhaps relatively less in 2000/01 than in preceding years (*White et al., 2002*).

In addition to the sightings described above, several species of marine mammals were recorded on fewer than 10 occasions and are therefore described as rare in *White et al. (2002)*. Descriptions of these sightings are provided in Table 3.5.

Table 3.5: Rare Species identified in the Falkland Islands waters (White et al., 2002)

Southern right whale (*Eubalaena australis*)	Two records, of two separate individuals, were recorded in 1998. A further record was made in June 2000 and two additional records of single animals in January 2001. Although the majority of sightings were to the north of the Falkland Islands, the low number sightings make geographic or seasonal modelling inaccurate.
Humpback whale (*Megaptera novaeangliae*)	Seven records were made over five occasions, all between October and March in Patagonian Shelf waters. Most records were made to the north-west of the Falkland Islands.
Unidentified beaked whale species (*Mesoplodon spp.)*	There were 15 animals sighted in seven occasions, none were specifically identified. All records were in waters deeper than 1,000 metres to the east of the Falkland Islands.
Killer whale (*Orcinus orca*)	A total of 18 animals were recorded in seven occasions, mainly in coastal and Patagonian Shelf waters. These sightings took place throughout the year in groups of between one and four animals. Longline fishing vessels have also reported interaction with killer whales in deep waters to the north and east, where they remove fish from the lines (*Munro, 2004*).
Southern right whale dolphin (*Lissodelphis peronii*)	Southern right whale dolphins were recorded on five occasions totaling 231 animals, all in deep waters to the east of the Falkland Islands.

Munro (2004) states that records of sightings in Falkland Islands waters of dusky dolphins (*Lagenorhynchus obscurus*), bottlenose dolphin (*Tursiops truncatus*) and spectacled porpoise (*Phococena dioptica*) have also been made. The lack of any sighting over the three year survey period, however, also indicates that these animals may be considered rare.

Based on the JNCC survey results (*White et al., 2002*), the following species of cetacean were recorded within the vicinity of the proposed Toroa drilling location: long-finned pilot whale, hourglass dolphin and Peale's dolphin, although during the months of the proposed drilling period (April – June) only long-finned pilot whale and Peale's dolphin were recorded in significant numbers. Due to the migratory nature of cetaceans, and the lower survey effort to the south and east of the Falkland Islands the possibility of other species in the exploration area cannot be discounted. Species specifically recorded offshore the Falkland Islands during the proposed drilling period (April to June) include sei whale, sperm whale, minke whale and Commerson's dolphin.

Additional marine mammal data in the vicinity of the proposed Toroa well has also been compiled based on the reports provided by Marine Mammal Observers (MMOs) on seismic vessels during acquisition programmes. This includes surveys undertaken in BHPBP(F)C's licence area when it was under the Operatorship of FOGL.

Figures 3.6 and 3.7 provide marine mammal records from the seismic surveys carried out in BHPBP(F)C's licence areas (June 2007), where a Marine Mammal Observer (MMO) was stationed on board the seismic vessel. Marine mammal observations and mitigation measures were employed in accordance with guidance published by the JNCC and accepted as best practice in UK waters and elsewhere. This data indicates that the southern right whale, fin whale, hourgalss dolphin and Peale's dolphin may be present within the general vicinity of the proposed Toroa drilling location.

Figure 3.6: Numbers of Whales recorded by MMOs during the Seismic Surveys undertaken in BHPBP(F)C's licence areas during June 2007

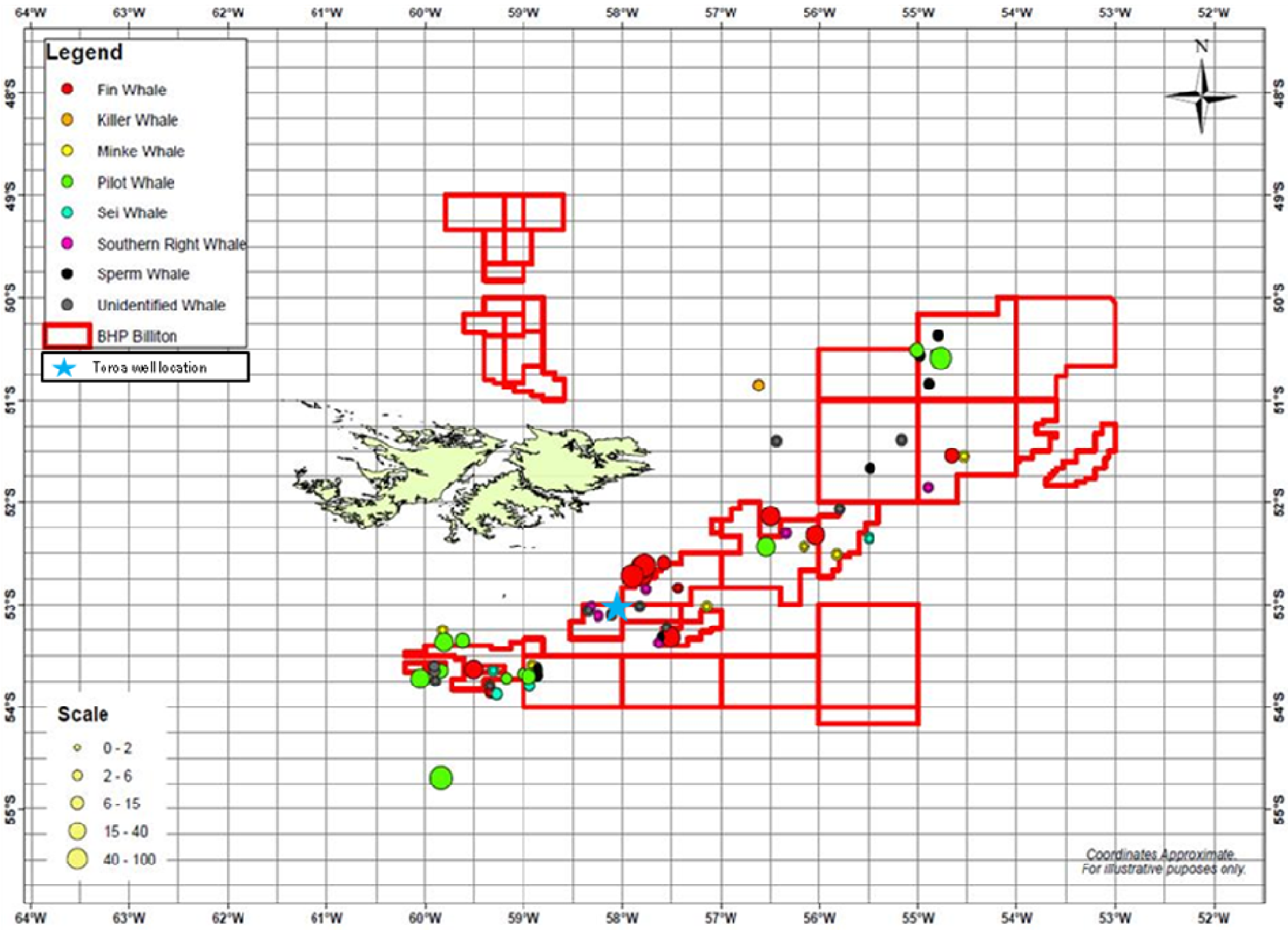
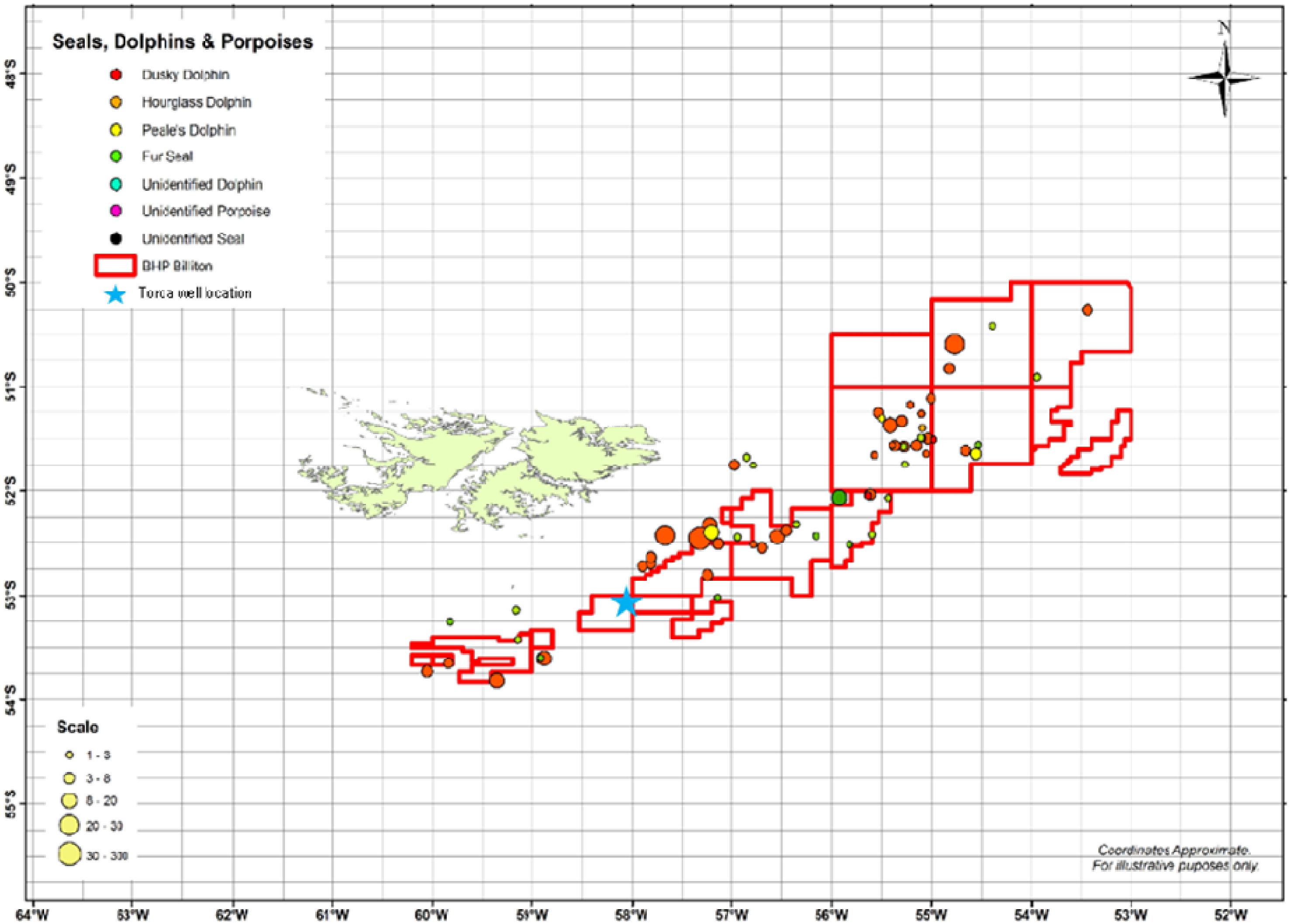


Figure 3.7: Numbers of Seal, Dolphin and Porpoise recorded by MMOs during the Seismic Surveys undertaken in BHPBP(F)C's licence areas during June 2007



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Pinnipeds

Three species of pinniped, South American sea lion, South American fur seal and southern elephant seal, breed in the Falkland Islands (*Strange 1992*). A further two species, Antarctic and subantarctic fur seals, have been recorded breeding (*D. Thompson pers. comm*., in *White et al., 2002*) and a further species, leopard seal, is recorded annually as a non-breeding visitor to the islands.

Knowledge of the distribution and size of breeding pinniped populations indicates that the three species that regularly breed in the islands are currently at very low levels compared to historical populations (*Strange 1992; Thompson et al. 1995*). While these declines were probably linked with exploitation for skins and oil, which continued until the early 1960s, the populations have failed to recover since the cessation of hunting (*Strange 1992; Thompson et al. 1995*).

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 and Moss 2001*), the only previous work was a satellite tracking study of South American sea lions (*Thompson et al. 1995*). In addition, satellite tracking of southern elephant seals from Patagonia (*Campagna et al. 1995*) and Antarctic fur seals from South Georgia (*I. Boyd pers. comm*. in *White et al., 2002*) have both tracked animals into Falkland Islands waters, but, in common with satellite tracking studies of seabirds, sample sizes are small.

South American Sea Lion (Otaria flavescens - formally Otaria byronia)

The southern sea lion (*Otario flavescens*) is widely distributed along the coast of South America. Within the Falkland Islands, sea lions breed in small colonies at around one hundred sites, mainly on remote sandy beaches with adjacent tussac grass.

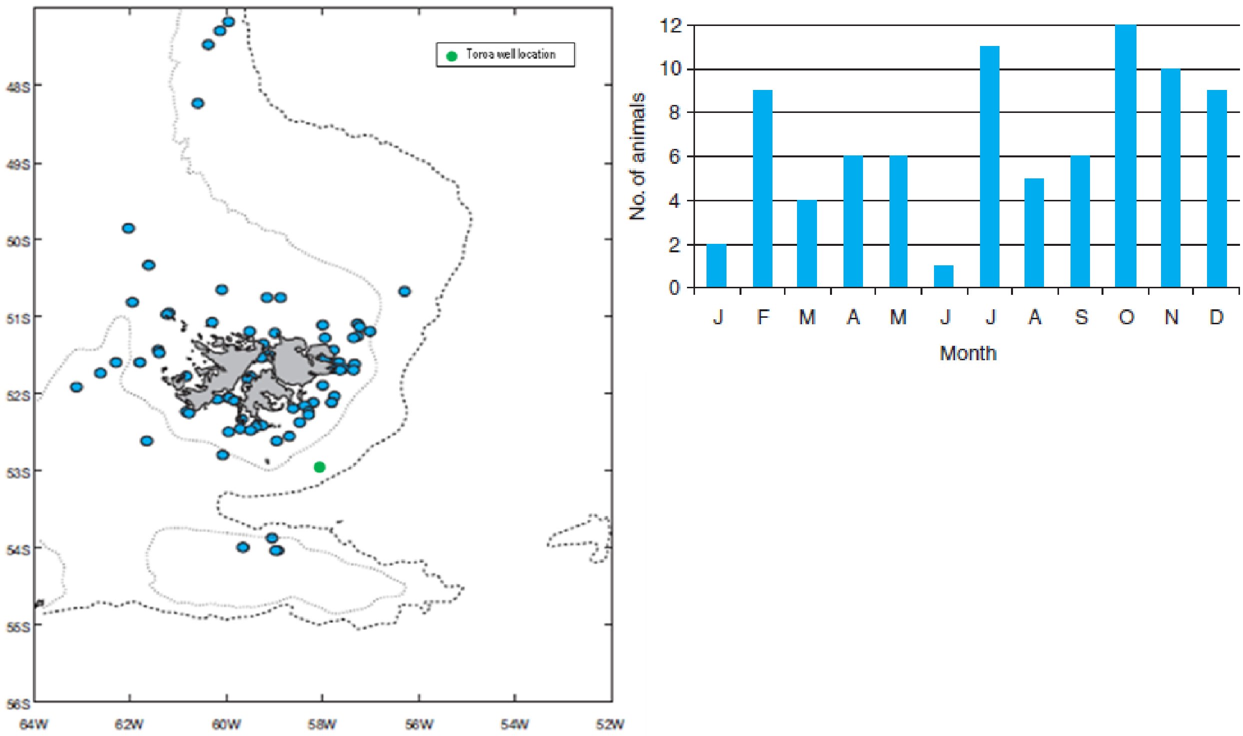
Both males and females are an orange-colour with upturned snouts. The manes on males are lighter than females, but female fur on the head and neck is lighter than that of males. Size varies with males having an average length of 2.6 metres and an average weight of about 300 kg. Females are slightly smaller, having an average length of 1.8 to 2 metres and usually weighing approximately half the weight of the males, around 150 kg. Breeding begins in December when bulls establish territories, with the females arriving during late December and January to pup. This will, therefore, not coincide with the proposed drilling period for Toroa. Females mate shortly after pupping, but continue to rear the pups for up to 12 months or more (*Munro, 2004*)

The UK Sea Mammals Research Unit (SMRU) conducted the most complete census of southern sea lions on the Falkland Islands in 1995 and repeated it in 2003 to monitor population trends. The two censuses update partial surveys conducted between 1934 and 1937 by Hamilton and aerial surveys conducted by Strange in 1990 (*Strange, 1992*). Population estimates have varied with the JNCC at-sea surveys estimating a Falkland Islands resident population of 3,385. Thompson (2003) estimates a current Falkland Islands population of approximately 7,047 animals, with an estimated 2,744 pups born annually. The census trends concluded that while the overall population is increasing, it is still well below the peak populations recorded in the 1930's, due to heavy exploitation during the twentieth century.

During winter, non-breeding individuals appear to remain in the Falkland Islands, hauling out at breeding sites and at other localities (*Otley, 2008*).

The distribution of South American sea lions recorded during the JNCC Seabirds and Marine Mammals at Sea Survey between February 1998 and January 2001 (White et al., 2002) are illustrated in Figure 3.8. A total of 81 South American sea lions were recorded, on 77 occasions, with the majority recorded from coastal waters or Patagonian Shelf waters. Given the distribution pattern, it is possible that they might be present within the vicinity of the proposed Toroa drilling location.

Figure 3.8: Distribution of South American Sea Lion Sightings (All Months) (White et al., 2002)



South American Fur Seal (Arctocephalus australis)

The South American fur seal is the smallest of the pinnipeds to breed in the Falkland Islands. It breeds at 15 known sites within the Falkland Islands, where it tends to concentrate in fairly large numbers on elevated rocky shores. Fur seals appear to prefer to inhabit rocky coastal strips above the reach of storms (*Laws, 1981*) and undercut cliff edges, with access to both offshore reefs or kelp beds and coastal tussac grass habitat (*Bonner, 1968*).

Males of the species have a dark grey coat of fur with the females and sub-adults having lighter grey or tan colouring on the chest and muzzle. On average, adult males measure up to 2 metres long and weigh 150–200 kg and females measure up to 1.5 metres long and weigh 30–60 kg. Mating commences in early November with the establishment of territories by the dominant bulls. Cubs are generally born around 6–8 weeks later in mid-December. This will, therefore, not coincide with the proposed drilling period for Toroa.

It is estimated that the current Falkland Islands population stands at over 10,000 adults, however no dedicated population census has been conducted in recent years. It is probable that there may have been a steady increase this century following its near extermination by the fur trade during the last century (*Munro, 2004*).

In the Falkland Islands, the species is known to breed at about ten sites, including Jason Cays West, Elephant Jason Island, Seal Rocks, North Fur Island, North Island, New Island, Beaver Island, Bird Island, Volunteer Rocks and Eddystone Rock. Bird Island has two colonies, with 100 individuals in one (perhaps non-breeding males) and approximately 10,000 in another, a few hundred breed on Beaver Island and 150 animals breed on Volunteer Rocks (*Falklands*

Conservation, 2006) and 2,000 adults and sub-adults on New Island (*New Island Conservation Trust, 2007*).

During the JNCC Seabirds and Marine Mammals at Sea Survey between February 1998 and January 2001 (*White et al., 2002*) a total of 937 fur seals was recorded, on 442 occasions. Fur seals were recorded in all months with a distinct midwinter 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 islands. Outside these months, fur seals were encountered in lower numbers throughout the survey area.

During winter, non-breeding individuals appear to remain in the Falkland Islands, hauling out at breeding sites and at other localities (*Strange, 1992*).

Fur seals were also recorded by MMOs during the seismic surveys undertaken in BHPBP(F)C's licence areas during June 2007 (refer to Figure 3.7). Given the distribution pattern, it is possible that they might be present within the vicinity of the proposed Toroa drilling location.

Southern Elephant Seal (Mirounga leonine)

The southern elephant seal is the largest of all the pinniped species. Found in most sub-Antarctic waters, the Falkland Islands hold only a very small percentage of the world population. Only one major breeding colony exists on Sea Lion Island and it is estimated to represent around 90% or more of the breeding population of the Falkland Islands.

The elephant seal gets its name from both its massive size and from the large proboscis which males have. Males are much bigger than the females with bulls weighing around 2000—3000 kg and 3 metres in length compared to about 600–800 kg for females. Southern elephant seals breed from August to November with the bulls arriving weeks before the females to claim territories. Pups are born 0–10 days after the females come to shore.

Falkland Islands' elephant seals were almost hunted to extinction by sealers in the past. A population peak of around 3,500 was recorded in the 1950's, but there are indications that the Falkland Islands population has declined over the last few years. Elephant seals feed on fish and squid and impacts to the food source and environmental changes are key factors in population decline.

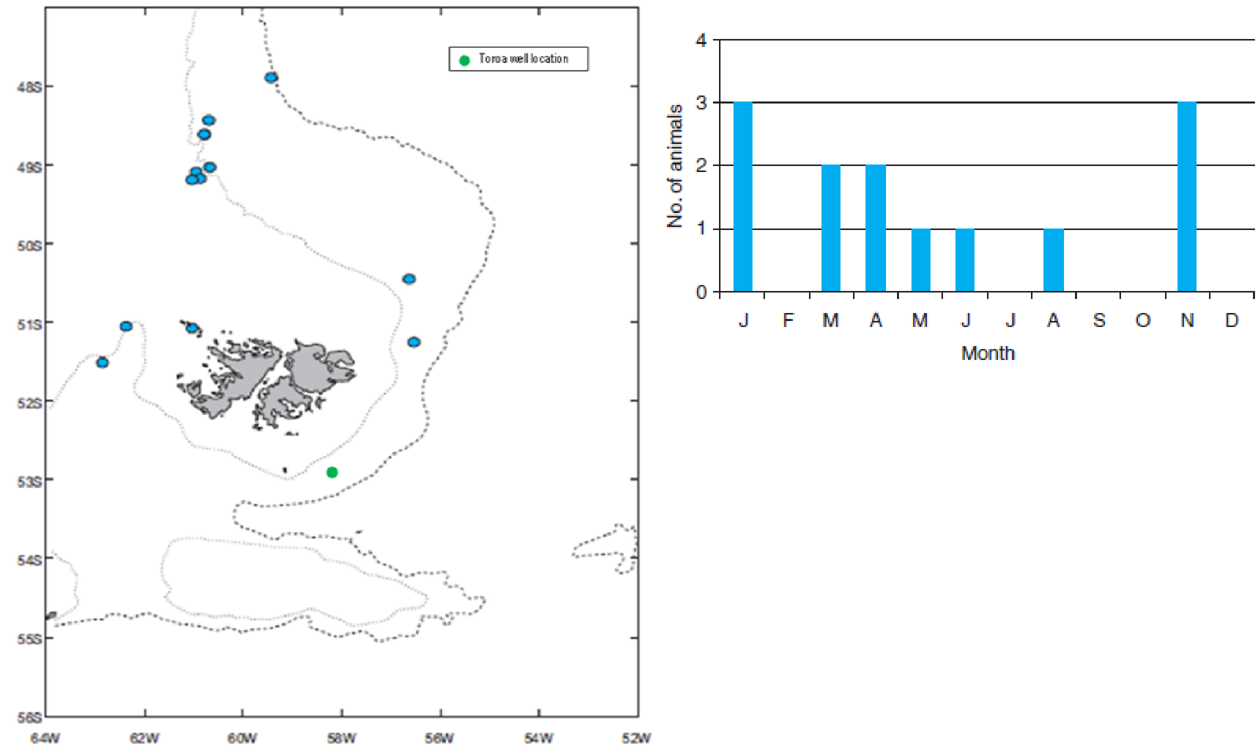
Little is know about where elephant seals that breed in the Falkland Islands feed during the non-breeding season and pre-moult period. Most re-sights of female elephant seals that breed on Sea Lion Island are at South Shetland Islands and the Antarctic Peninsula (*F. Galimberti and S. Simona, personal communication, in Otley, 2008*). Only five elephant seals were sighted over two years of Falkland Islands at-sea survey effort (*White et al. 2002*).

During February and March 2007, approximately 10 female elephant seals hauled ashore on Livingston Island, South Shetlands were equipped with satellite transmitters (*D. Costa, personal communication, in Otley, 2008*). Although most of these animals head back to South Georgia to breed by September, one tracked female swam up to the Falkland Islands, arriving to Sea Lion Easterly, where it most likely bred.

This data suggests that elephant seals that breed at sites to the south of the Falkland Islands are most likely foraging to the south, including the Drake Passage and Antarctic waters. Thus conservation efforts in the Falkland Islands may ultimately play only a small part in achieving the international goal of securing long term survival of the Falkland Islands population (*Otley, 2008*).

The distribution of southern elephant seals recorded during the JNCC Seabirds and Marine Mammals at Sea Survey between February 1998 and January 2001 (*White et al., 2002*) are illustrated in Figure 3.9. A total of 13 southern elephant seals were recorded, with animals recorded in every season. All records north of 50°S occurred between January and May whereas all those south of 50°S were in June, August and November. None were observed within the vicinity of the proposed Toroa drilling location.

Figure 3.9: Distribution of Southern Elephant Seal Sightings (All Months) (White et al., 2002)



Leopard Seal (Hydrurga leptonyx)

The leopard seal is a winter visitor to the Falkland Islands, with only occasional sightings reported to Falklands Conservation. They are known to breed on sub-Antarctic pack ice and are highly unlikely to be impacted by normal offshore operations.

Leopard seals have dark grey backs and light grey stomachs. They get their name from their spotted throats. Females are generally larger than the males. The males are usually about 2.8 meters long and weigh up to 320 kg, while females are around 3 to 3.5 metres in length and weigh up to 370–400 kg.

3.2.4 Seabirds

Refer to Section 5.3.9 (pages 5-41 to 5-50) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

The Falkland Islands are an area of global importance for birdlife, particularly seabird species of international significance. The North Falklands 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.

The avifauna of the region is well studied and documented, and seabird distribution, breeding and foraging patterns have been studied extensively. A number of publications outlining survey efforts by those such as Croxall et al. (1984), Woods (1988; 1997), Strange (1992) have recently been supplemented by ongoing seabird monitoring and survey programmes conducted by FC/JNCC.

Between 1998 and 2001 a total of 218 species were recorded along with some unconfirmed sightings. There were 21 resident landbirds, 18 waterbirds, 22 breeding seabirds, 18 annual non-breeding migrants and at least 139 occasional visitors (*Woods et al., 2004*). Between 2001 and 2005 a total of 547 sightings of 291 banded wandering albatross *Diomedea exulans* and 21 sightings of 14 banded giant petrels *Macronectes* spp. were made (*Otley, 2005*).

There are five different species of breeding penguin in the Falkland Islands (rockhopper, Magellanic, gentoo, king and macaroni). The Falkland Islands are the most important world site for the endangered rockhopper penguin and are also home to 80% of the world's breeding population of black-browed albatross. Several rare and threatened species of petrel nest on offshore islands.

Penguins

Nine penguin species have been recorded in the Falkland Islands, although only the following six species were identified during the JNCC at-sea surveys (1998–2001): King penguin (*Aptenodytes patagonicus*); Gentoo penguin (*Pygoscelis papua*); Rockhopper penguin (*Eudyptes chrysocome*); Macaroni penguin (*Eudyptes chrysolophus*); Magellanic penguin (*Speniscus magellanicus*); Chinstrap penguin (*P. antarctica*).

In a review by Putz (2002), king penguins from breeding islands (including the Falkland Islands) were equipped with global location sensors to compare their foraging patterns during different times of year. It was found that during the summer months, all birds travelled toward the Antarctic Polar Front (APF), where most remain north of the APF and forage in waters of the Antarctic Polar Frontal Zone. Some penguins travelled south of the APF and foraged in Antarctic waters. It is suggested by Putz that food resources in the area are sufficiently predictable to warrant travel of several hundred kilometres for foraging. During the winter months, birds originating from the Falkland Islands were seen to relay on the resources provided by the diverse and productive slope of the Patagonian Shelf. In most cases, a minimum of 10,000 kilometres distance was travelled over the year.

Putz and Cherel (2005) studied the diving behaviour of the king penguin in the Falkland Island, where the population found there are considered to exist at the limit of their breeding range. During the investigation over 20,000 dives of greater than 3 metres were recorded from 12 birds during 15 foraging trips, with a mean duration of 5.7 days. The majority of the trips were directed up to 500 kilometres to the northeast of the breeding colony in slope waters of, and oceanic waters beyond, the Patagonian shelf.

Dive depth was seen to correlate positively with: (1) light intensity, (2) dive duration and (3) vertical velocities. However, separation of dives according to their profile—V-, U-, or W-shaped—revealed significant differences between certain dive parameters. It is suggested that foraging is more effective during W-dives than U-dives, and during twilight. These findings imply that king penguins have to make more complex decisions, individually and socially, on the performance of the subsequent dive than previously thought.

Of the species recorded in the Falkland Islands, only rockhopper penguins and magellanic penguin have been observed at significant distance from the Falkland Islands during the proposed drilling period for the Toroa exploration well. King penguin are, however, present during the southern hemisphere winter months.

Further investigations have looked into the foraging and breeding behaviours of other penguin species, including the Rockhopper penguin (*Eudyptes chrysocome*) (*Putz, 2006*). Individuals were satellite tracked in 2002 and 2003 during the onset of their winter migration. Birds were seen to travel at a mean velocity of 3.1 km/hr, with the mean minimum distance travelled being 1,640 kilometres and the maximum distance to the colony was generally less than 1,000 kilometres.

The penguins dispersed over an area totalling about 1.3 million km², ranging from 50 to 62°S and from 49°W in the Atlantic to 92°W in the Pacific, and covering polar, sub-polar and temperate waters in oceanic regions as well as shelf waters. Despite the very wide dispersal, both temporally and spatially, two important wintering grounds for rockhopper penguins from Staten Island could be identified, both located over shelf regions: one extended from Staten Island to the north along the coast of Tierra del Fuego up to the Magellan Strait; the other was located over the Burdwood Bank, an isolated extension of the Patagonian Shelf to the south of the Falkland Islands. The Drake Passage also appeared to be an important area for wintering penguins, although dispersal was far more widely spread. Comparison with data obtained during winter from rockhopper penguins originating from the Falkland Islands showed that the area off the coast of Tierra del Fuego was used more or less exclusively by birds from Staten Island, whereas the Burdwood Bank was shared with penguins coming from southern colonies in the Falkland Islands.

Between December and March the majority of recorded rockhopper sightings are from near-shore areas and to the west of the Falkland Islands, with very few scattered sightings within the vicinity of the proposed drilling operations.

Between April and August there are fewer sightings and these are primarily to the north and west of the Falkland Islands, with only occasional records within the vicinity of the proposed drilling operation. It is therefore unlikely that rockhopper penguins will be present in the vicinity of the well for any significant time during the proposed drilling months (April to June).

Magellanic penguin populations in the Falkland Islands have decreased over the past decade. The post-breeding migration (November to April) may be the period in which the birds are most vulnerable (*Putz et al, 2000)*. It is therefore possible that magellanic penguin may be present over the well locations in low number towards the beginning of the drilling campaign when the birds venture offshore post-breeding. The highest densities of magellanic penguin have, however, been recorded between December and February (outside of the proposed drilling period), primarily in inshore waters.

Albatrosses

Albatross species are globally declining with populations in the Falkland Islands reported to have dropped by 28% in the last 20 years (*Woods, 1988*). Eleven species of albatross have been recorded in the Falkland Islands, although only the black-browed albatross is a resident breeding species.

Ten of the 11 species of albatross recorded in the Falkland Islands are afforded conservation status. Of these, southern royal albatross and black-browed albatross can be expected to be found within the vicinity of the proposed Toroa exploration well during the proposed drilling period (refer to Table 3.4).

Table 3.6: Likely distribution of Albatross in the vicinity of the proposed Toroa exploration well during the proposed drilling period (April to June) (White et al., 2002)

Species	Notes
Royal albatrosses	The royal albatrosses are a visiting species, breeding in New Zealand and using South Pacific and Patagonian feeding grounds. The southern royal albatross is classified as 'Vulnerable' where as the Northern is 'Endangered'. Of the 4,114 royal albatrosses recorded (1998–2001), 3252 were identified as southern and 447 as northern (with 415 not determined). Highest numbers of southern royal albatross were seen between March and June, particularly to the north-west of the Falkland Islands. Highest numbers of northern royal albatross were seen between March and July, generally in the same areas as the southern. It is therefore possible that the southern royal albatross will be present in the vicinity of the proposed Toroa well during the months of March to June and the northern royal albatross will be present in the vicinity of the proposed well during the months of March to July, thereby overlapping with the proposed drilling period.

Species	Notes
Black-browed albatross	Huin (2006) studied the foraging distribution of the black-browed albatross, based on two different stages of the breeding season and two separate breeding sites. He identified that during the incubation period, birds from the north travel northwards from the Falkland Islands. During this period foraging trips were longest, both in terms of distance travelled and duration. Albatrosses foraged mainly over the Patagonian Shelf or along its edge. During the post-guard period, foraging areas were much restricted with many birds staying close to the coast. Each group had a clear foraging area, and this use of mutually exclusive foraging is thought to be part of a strategy to minimise intra-specific competition (*Huin, 2006*). Black-browed albatross were recorded in all months (1998–2001), with a total of 84,614 birds recorded, reaching a peak in March. Between November and January the highest densities occurred in inshore waters to the west of the Falkland Islands. Between February and June high densities occurred throughout Patagonian Shelf waters to the north-west of the Falkland Islands and between July and October high densities shifted to the south-west of the Falkland Islands. Given the recorded distribution of black-browed albatross in the Falkland Islands it is likely that the species will be present in the vicinity of the Toroa exploration well during the proposed drilling period (April to June).

Petrels and Shearwater

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 is the southern giant petrel (*Macronectes giganteus*) (*Otley et al., 2008*). As many as 26 species have previously been recorded in the Falkland Islands with nine species breeding on the Islands themselves.

Distributions of petrels and shearwaters are predominantly to the North and East of the Falkland Islands, however, it is possible that several of these species may be present in the vicinity of the proposed Toroa well given the timing of the proposed drilling operations (refer to Table 3.5).

Table 3.7: Likely distribution of Petrel and Shearwater in the vicinity of the proposed Toroa exploration well during the proposed drilling period (April to June)

Species	Notes
Southern giant petrel	Southern giant petrels were recorded in all months during the at-sea survey, peaking in June and with highest densities between March and June over Patagonian Shelf waters to the west and south of the Falklands. The southern giant petrel breeds at 38 locations around the Falklands, in colony sizes ranging between one and 110,000 breeding pairs (*Reid & Huin, 2005*). Most colonies concentrate around the south of South Falklands and to the west of West Falklands. Nearly 20,000 breeding pairs were counted in 2004/2005, which account for 40% of the global population (*Reid & Huin, 2005*). Although sightings within the licence blocks are possible, distribution is concentrated away from this area and occurrence within the vicinity of the Toroa exploration well is not considered significant.
Antarctic fulmar	A total of 18,061 Antarctic fulmars were recorded, all between April and December. Highest densities were recorded between April and June, dropping between July and October with only occasional sightings for the rest of the year. Only occasional records were made within the licence area and, as such, occurrence of this species within the vicinity of the proposed drilling activity for Toroa is not considered significant.
Blue petrel	Blue petrels, a non-breeding visitor to the Falkland Islands, were recorded in the period May to October. A total of 573 blue petrels were recorded, the majority in deep waters to the east and south-east of the Falklands. Occurrence within the licence area is considered likely between May and

Species	Notes
	November and, therefore they may be present within the vicinity of the Toroa drilling operations during the later half of the proposed drilling period.
Kerguelen petrel	A total of 152 Kerguelen petrels were recorded, almost wholly between May and November and mainly in the deep waters to the north, east and south of the Falklands. Peak numbers were recorded in August, outside of the proposed drilling period for Toroa. Distribution of Kerguelen petrel sightings was widespread and an occasional occurrence within the vicinity of the Toroa well is likely, although the lack of any concentration of sightings makes this species less vulnerable to impacts.
Atlantic petrel	A total of 252 Atlantic petrels were recorded, primarily between October and March but with records in all months. Most sightings were to the north-east and south-east of the Falklands in deep waters. As such this species may be present within the vicinity of the Toroa well during the proposed drilling period.
Prion species	Due to the difficulty in identifying prions (small petrels) to species level at sea, most records from the survey were for 'prion species'. A total of 119,610 records make prions the most numerous seabirds encountered during the survey, with the highest numbers recorded between September and January, outside of the proposed drilling period for Toroa. Highest densities were recorded to the west, north and south of the Falklands. Although occasional sightings within the vicinity of the Toroa well may be possible, due to the concentration of prion sightings outside of this area occurrence is not considered to be significant.
Fairy prion	The fairy prion was identifiable at sea and has been recorded separately. In total 228 fairy prions were recorded, in all months except February, with peaks in April, August and October. This species was recorded primarily in continental shelf slope and oceanic waters. Distribution of the fairy prion is widely scattered and sensitivity in the vicinity of the Toroa well is not considered to be significant.
Sooty shearwater	Sooty shearwaters breed on the Falkland Islands, with a population estimated at 10,000 to 20,000 pairs (*Woods & Woods, 1997*). A total of 37,109 sooty shearwaters were recorded, mainly between September and March, peaking in October. Most records occurred throughout inshore waters of the Falklands and shelf to the east and south. It is possible they may be present within the vicinity of the Toroa well, but drilling operations do not coincide with peak densities. The population is not considered to be globally significant as the world population is estimated to be in the millions.
Grey-backed storm-petrels	The Falkland Islands support between 1000 and 5000 breeding pairs of grey-backed storm-petrels (*Woods & Woods, 1997*). A total of 2758 grey-backed storm-petrels were recorded, mainly between September and March. Records occurred on all sides of the Falklands, with high densities recorded to the north of the Falklands from November to March. A few recordings were made within the licence area to the south-east, however occurrence is not considered to be significant within the vicinity of the Toroa exploration well.
Black bellied storm-petrel White bellied storm-petrel	Black bellied and white bellied storm-petrels were both recorded, primarily between December and February and in the deep waters to the north-east of the Falklands, outside of the licence areas. There were 205 records of black bellied storm-petrels and 23 of white bellied storm-petrels. Numbers of both species peaked in January, outside of the proposed drilling period for Toroa. Occasional sightings of black bellied storm-petrels are likely to the south of the Islands, although the number of sightings within the vicinity of the proposed Toroa well is not considered significant.
Diving petrel	A total of 6,078 diving petrels were recorded during the at-sea survey, incorporating both the Magellan (133 confirmed) and common (753 confirmed) diving-petrel. The remainder were not specifically identified, but have been combined with common diving-petrel numbers for the purposes of

Species	Notes
	the report. Most diving petrels were recorded between September and February, with greatest densities to the west and south of the Falklands. Occasional sightings of the common diving petrel are possible in the licence area throughout all months of the year, particularly between March and August, although the number within the vicinity of the Toroa exploration well is not considered to be significant.

Terns

Three species of tern were recorded during the at-sea survey (listed below), although eight species have been previously recorded in Falkland Islands' waters (*Otley et al., 2008*) of which only one species is known to breed in the Falkland Islands:

- South American tern (*Sterna hirundinacea*);
- Arctic tern (*Sterna paradisea*);
- Unidentified sterna tern (*Sterna spp*).

A total of 1894 South American terns were recorded during the at-sea survey for all months and peaking March to April. The South American tern is the only species known to breed in the Falkland Islands. Distribution was mainly in coastal waters.

Arctic terns are a summer visitor to the Falklands. A total of 21 Arctic terns was recorded during the at-sea survey, all between October and March. They were observed widely distributed throughout the at-sea survey area, mostly in offshore areas. A number of unidentified sterna terns were also recorded during the at-sea survey. Of the 160 unidentified terns recorded in offshore waters, the majority were between April and November. Distribution was widely scattered although very few sightings were made to the south-east of the Falkland Islands. No tern species have significant abundance or distribution within the vicinity of the proposed Toroa exploration well, although occasional sightings are possible during the proposed drilling period (April to June).

Falkland Skua

Philips et. al. (2007) is the first published study of the wintering ranges and activity patterns of skuas from any colony. The study combines tracking (geolocator) and stable isotope analysis in a comparison of migration behaviour of brown skuas (*Catharacta lonnbergi*) and Falkland skuas (*C. Antarctica*) from South Georgia and the Falkland Islands, respectively.

The study found that Falkland skuas performed a pre-laying exodus and that they wintered mainly in subantarctic waters around the central Patagonian shelf-break (40 to 52° S). Both species of skua spent far more time on the water than foraging albatrosses.

Although the sample sizes were relatively small (4 to 6 individuals from each site), the similarity in feather isotope signatures of the tracked birds indicate that all of these birds almost certainly used the same water masses in the non-breeding period. Comprehensive at-sea surveys over several years in Falkland Islands waters concluded that the only Falkland skuas to remain in the area during the winter months were far to the north (*White et al. 2001*), in agreement with the results from Philips et. al. (2007). It is unlikely, therefore that Falkland skuas would be present in the vicinity of the proposed Toroa well during the April to June drilling period.

3.2.5 Seabird Vulnerability

Refer to Section 5.3.10 (pages 5-53 to 60) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

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. Within Falkland Islands' waters, negative impacts on seabird productivity through competition for food with commercial fisheries have not yet been identified (*White, 2001*).

Death from entanglement and snagging with longline hooks is considered to be of low risk due to a well managed fishery and a relatively low amount of longlining.

To date, reports of adverse effects to seabirds from surface pollution such as oil is low in the Falkland Islands. Hence, the increasing oil and gas exploration activities in the area are a potential threat to seabird populations.

Seabird vulnerability has been assessed with regard to species-specific aspects of their feeding, breeding and population ecology (*White et al., 2001*). Maps produced in the JNCC 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 and well documented (*White et al., 2001*).

A summary of the seabird vulnerability survey results for the proposed Toroa exploration campaign period (April to June) is shown in Figure 3.10. It can be seen from Figure 3.10 that the proposed Toroa exploration well is located away from the identified areas of highest seabird vulnerability. Highest vulnerability tends to be associated with the inshore waters around the Falklands Islands, largely due to the presence of resident species with a predominantly coastal distribution such as the endemic Falklands Steamer duck, imperial shag and gentoo penguin. The Patagonian Shelf waters to the north and west of the Falklands, which support high densities of black-browed albatrosses and royal albatrosses year-round are also associated with high vulnerability areas, but again these are remote from the proposed drilling location.

Figure 3.10: Monthly Vulnerability of Seabird Concentrations to Surface Pollution (1998-2000)

April

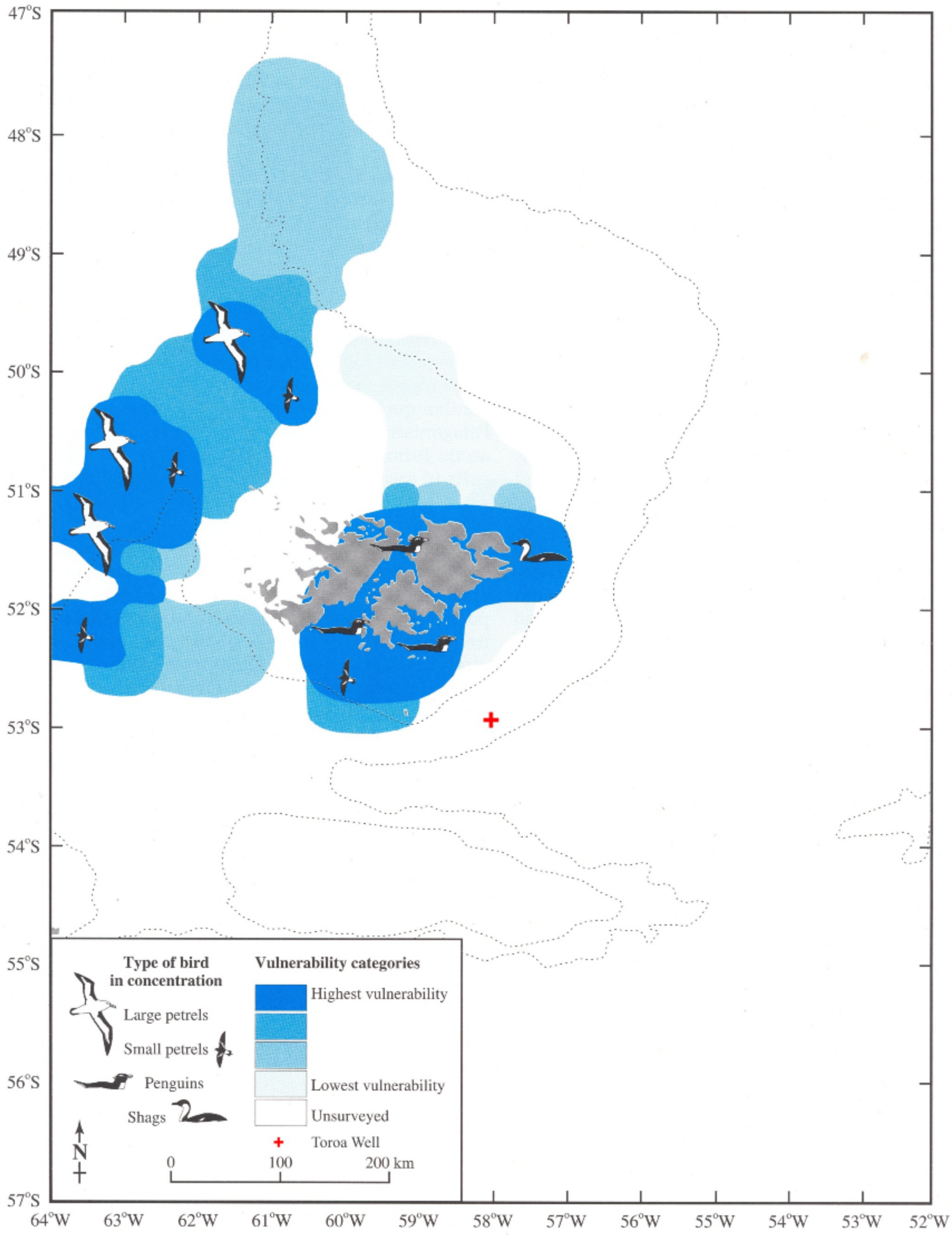


Figure 3.10 (continued) Monthly Vulnerability of Seabird Concentrations to Surface Pollution (1998-2000)

May

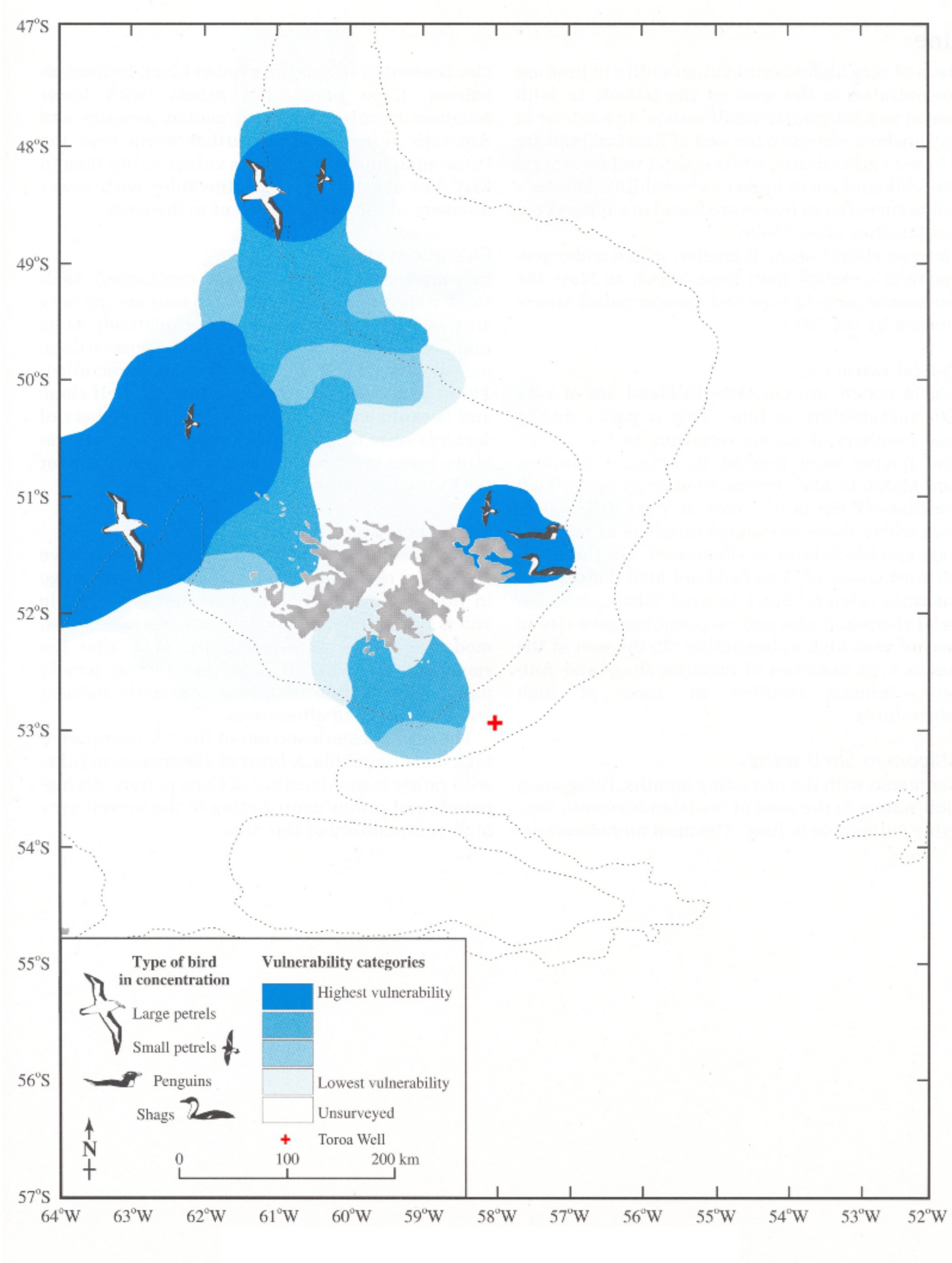
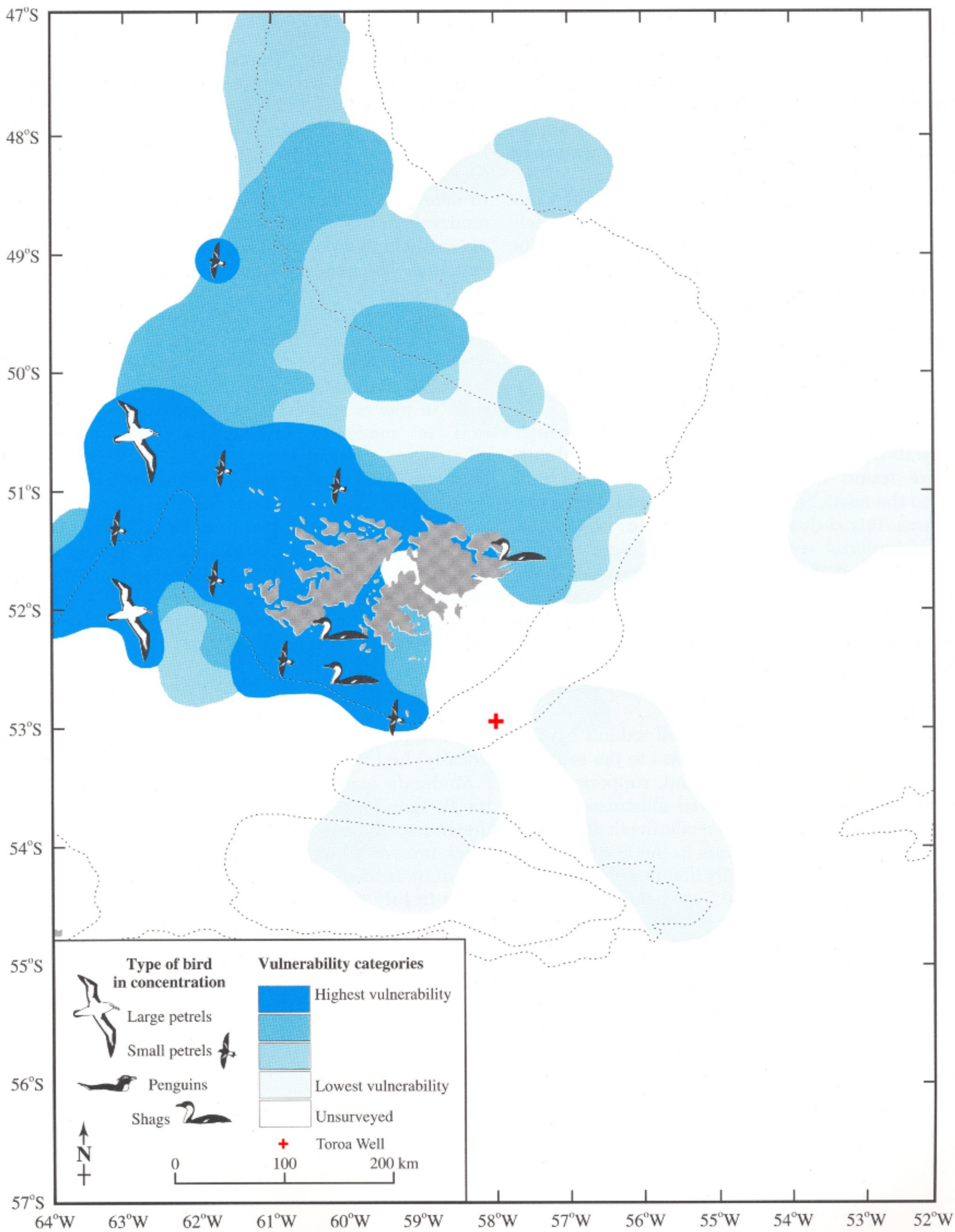


Figure 3.10 (continued) Monthly Vulnerability of Seabird Concentrations to Surface Pollution (1998-2000)

June



3.2.6 Threatened Species

The IUCN Red List is a comprehensive listing of all species within the Falklands marine environment which are characterised as 'endangered', 'threatened' or 'vulnerable' to 'extinction'.

A search of the Red List found 43 species recorded as threatened, and 31 classified as 'Least Concern'. Most pinnipeds are of the latter category. There were seven species (two cetaceans and five birds) listed as endangered – the highest level of conservation status.

Overall the Red List results included:

- 17 species of cetaceans;
- 2 species of fish;
- 24 species of birds.

The list of species identified as under threat by IUCN is given in Appendix F of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS. It should be noted that many species in the list are classified as 'data deficient'. This is not a category of threat instead it indicates that not enough data on the species is available to make an assessment of the risk of extinction. More information is required in such areas, and including them in the list acknowledges the need for additional research to show that the classification given is appropriate.

Species classified as 'data deficient' which potentially could be found in the vicinity of the Toroa exploration well during the drilling period include: Commerson's dolphin and Peale's dolphin.

3.2.7 Protected Habitats and Areas

Refer to Section 5.3.12 (pages 5-60 to 62) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

The following three types of formally protected areas are located in the Falkland Islands:

- National Nature Reserves (NNR) (designated under the Conservation of Wildlife & Nature Ordinance (1999));
- National Parks (designated under the National Parks Ordinance); and
- Ramsar sites.

These protected areas are illustrated in Figure 3.11. Although FIG can designate marine reserves, to-date no marine NNR has been created in the Falkland Islands.

Important Bird Areas (IBAs) have been defined 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 Falklands Conservation responsible for the cataloguing and description of IBA's within the Falklands. 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.

Currently, 22 sites of international conservation importance for birds (IBA) have been identified in the Falkland Islands. These are illustrated on Figure 3.12. The closest of these to the proposed Toroa exploration well are Beauchêne Island, located approximately 78 kilometres to the east-north-east and Sea Lion Islands, located approximately 96 kilometres to the north-east.

Beauchene Island

Forming the southernmost land in the Falklands archipelago, Beauchene Island is located approximately 54 kilometres south of the mainland, and 78 kilometres from the proposed drilling location.

More than 30 bird species have been recorded on the Island, the majority being migratory seabirds that are present in very large numbers during the breeding season. The site is significant for the second largest populations in the world of black-browed albatrosses and Rockhopper penguins. Beauchene Island is also important for Wilson's storm-petrels, grey-backed storm-petrels and common diving petrels. It is the only confirmed breeding site for fairy prions in the Falkland Islands. Southern giant petrels and Magellanic penguins are present, but populations are too small to qualify. The total congregation of seabirds far exceeds 10,000 breeding pairs, making this site classifiable under the A4iii criterion (A4iii criterion is modelled on criterion 5 of the Ramsar Convention for identifying wetlands of international importance) (*BirdLife International, 2009a*).

Sea Lion Island

Sea Lion Island is 8 kilometres from east to west and 2 kilometres at its widest point. The island is a slightly inclined plateau with steep cliffs of about 30 metres at the south-western point and long sandy bays to the east. Habitat inland is largely open heath and grassland. There are permanent ponds and boggy ground, which are attractive to a variety of waterbirds (*BirdLife International, 2009b*).

Between 1983 and 1993, 53 bird species were recorded on Sea Lion Island during fieldwork for the Breeding Birds Survey. Of these, 43 were breeding or probably breeding, including eight of the nine resident songbirds and five species of penguins. The macaroni penguin occasionally breeds among the Rockhoppers but not in sufficient numbers to warrant site qualification. The predator-free status Sea Lion Island makes it important for small passerines and burrowing petrels. It is noticeable that Tussacbirds and Cobb's Wrens are very numerous, particularly on the beaches of the islands. Endemic sub-species present include the White-tufted/ Rolland's Grebe, Black-crowned Night-heron, Upland Goose, Short-eared Owl, Dark-faced Ground-tyrant, Falkland Pipit, Falkland Grass Wren and the Falkland Thrush (*BirdLife International, 2009b*).

Sea Lion Island is an important wildlife tourism destination within the Falklands archipelago, with an estimated 2,000 visitors per year.

Figure 3.11: Protected National Nature Reserves of the Falkland Islands (World Database on Protected Areas, 2009)

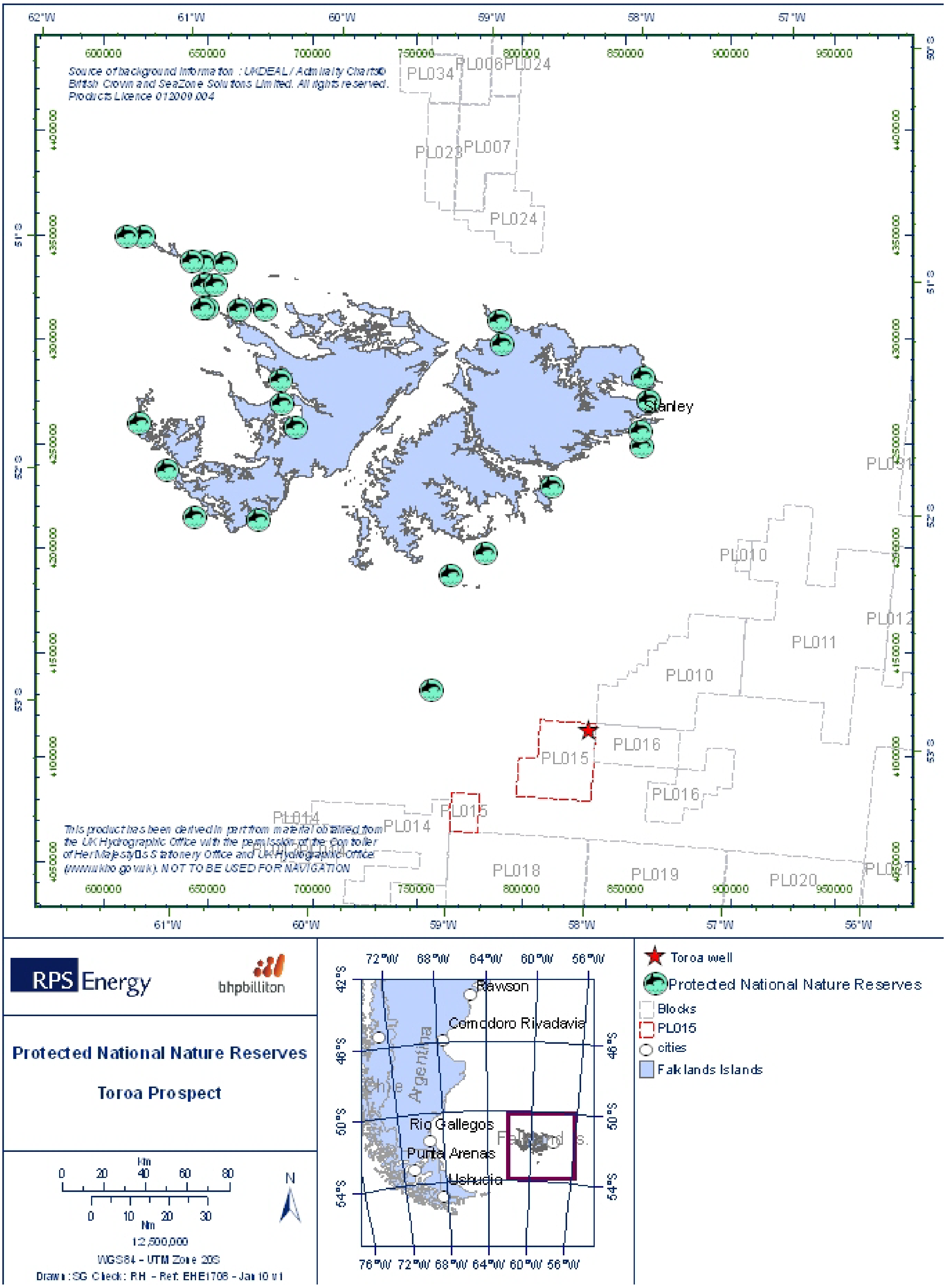


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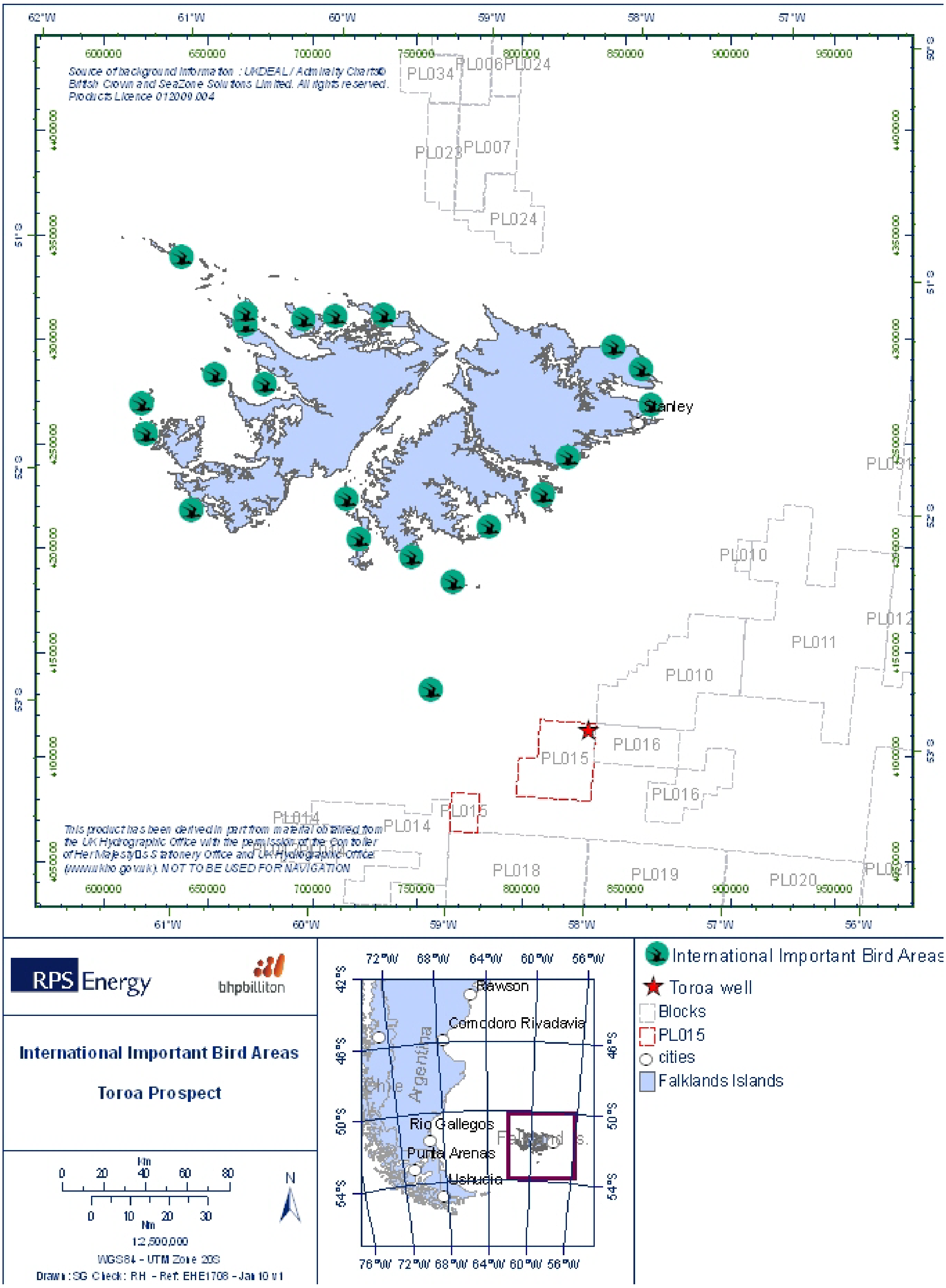
Figure 3.12: International Important Bird Areas (Birdlife International, 2009)



3.3 Social and Economic Environment

Refer to Section 5.4 (pages 5-63 to 5-73) of the BHPBP(F)COffshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

3.3.1 Fisheries

Commercial fisheries are the largest source of income for the Falkland Islands. All fishing within 200 nautical miles of the Falkland Islands is subject to licensing by the FIG. The fisheries generate over £21 million per annum in licence fees, roughly half the government revenue. Since 1990 Britain and Argentina have worked together to conserve fish stocks under the auspices of a UK/Argentine South Atlantic Fisheries Commission (*FCO, 2005*). Approximately £6 million of fisheries income is spent each year on catch and conservation monitoring, research and administration.

The key catches are the squid species: *Illex argentinus* and *Loligo gahi*, followed by the southern blue whiting. Approximately 2.4 MT of Illex, 1.2 MT of Loligo, and 20,500 tonnes of southern blue whiting were caught in 2006.

Figures 3.13 to 3.15 show the catch distribution for these three species during January to June, which covers the proposed drilling period for Toroa.

It can be seen from Figure 3.13 that there are no recorded Illex catch within the vicinity of the proposed Toroa exploration well. There is, however, a low level of catch close to the eastern shore of East Falklands, which may have minor significance for vessel movements to and from the proposed drilling operations.

Figure 3.14 shows that there is a recorded Loligo catch immediately to the north of the Toroa exploration well. This may be impacted by vessel movements to and from the proposed drilling operations. It should be noted, however, that nearshore Loligo fishery close to the eastern coast of East Falklands is most intense in the second half of the year between July and December, outside of the proposed drilling period for Toroa.

Figure 3.15 illustrates that there is also a recorded catch of southern blue whiting immediately to north-east of the proposed Toroa exploration between January and July, however, this is very low.

From Figures 3.13 to 3.15 a clear 'catch-boundary' can be seen running along the southwestern-northeastern axis adjacent to the license area, within which the Toroa well is located. The reasons for this apparent 'catch-boundary' are discussed below.

Loligo gahi is fished in the eastern and southern parts of the Falkland Shelf in the region called the '*Loligo* box'. Two main cohorts of *Loligo* are usually exploited; the autumn-spawning cohort in February-April and spring-spawning cohort in July- September. The abundance of both cohorts of *Loligo* has been quite stable in the last five years.

Loligo catch is constrained to the '*Loligo* box' by restrictions made by FIG, which is evident from the clear boundary along a south-western-north-eastern axis adjacent to the licence area. The '*Loligo* Box' was setup in 1989 and restricts fishing effort for *Loligo* to a certain area. From 1989 the '*Loligo* Box' has served two purposes: it has kept *Loligo* vessels from fishing elsewhere unless they have a finfish license and used a minimum mesh size of 90 millimetres; and has also protected the *Loligo* from being caught incidentally in other fishery areas. The efficiency of the '*Loligo* Box' as conservation measure is greatly increased by a stable geographical distribution of *Loligo* feeding migrations across the 200 metre depth contour on the edge of the Falkland Islands (*Milner-Gulland and Mace, 1998*).

The proposed Toroa well is located in water depths of 606 metres LAT and is outside of the *Loligo* nursery areas, which in general do not exceed 400 metres in depth (*Laptikhovsky, 2008*) and are deeper than the spawning ground of the *Loligo* which occur at depths of less than 20 metres (*Laptikhovsky, 2008*). Hatfield et al. (*1990*) also supports this notion that the well is located in depths too great for *Loligo* catch stating that *Loligo* catch is made using both pelagic and bottom trawls during two fishing seasons, February to June and August to September, usually within a depth range 140 to 200 metres. It can therefore be concluded that the boundary along a south-western-north-eastern axis adjacent to the licence area for *Loligo* catch is due to water depth, although also influenced by the '*Loligo* Box' fishing restriction.

Micromesistius australis, known as the southern blue whiting occur in depth range of 50 to 900 metres however most spawning *Micromesistius australis* are found between depths of 250 and 600 metres (*Nabis, 2009*). Given the known spawning depths of *Micromesistius australis* it is highly likely that the boundary along a south-western-north-eastern axis adjacent to the licence area for their catch is due to a function water depth, although also influenced by FIG fishing restriction.

Figure 3.13: Illex argentinus catches (tonnes) by grid for Season 1 (Jan–Jun 2006)

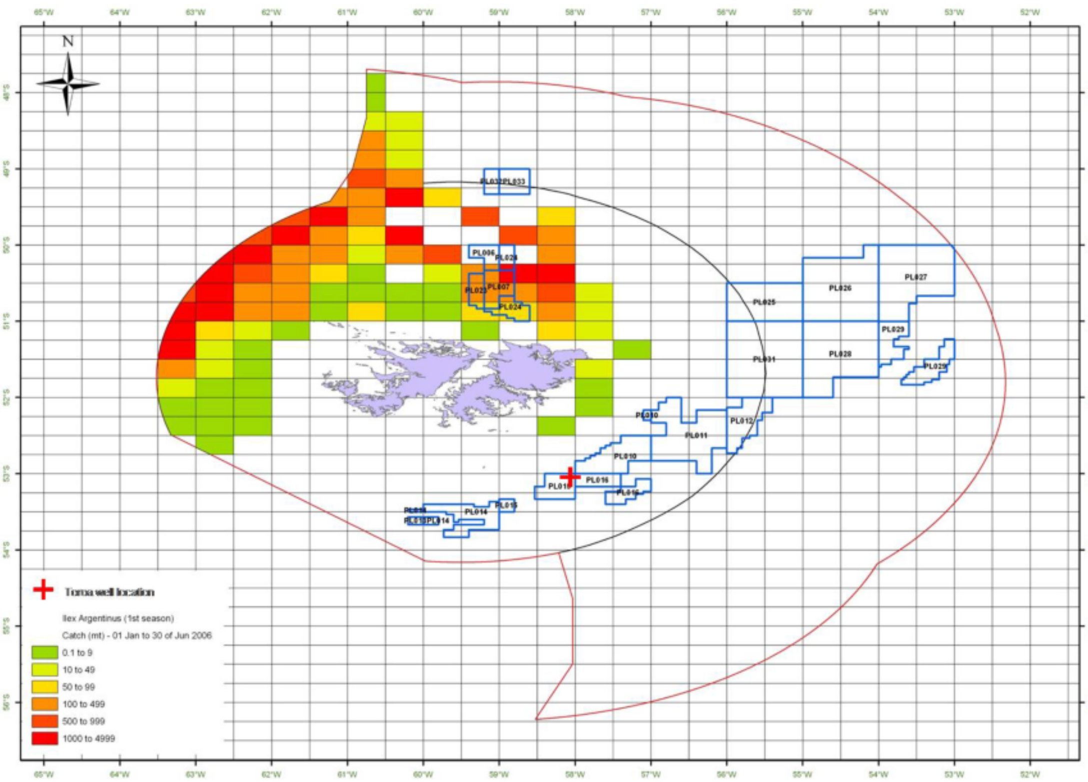


Figure 3.14: Loligo gahi catches (tonnes) by grid square for Season 1 (Jan–Jun 2006)

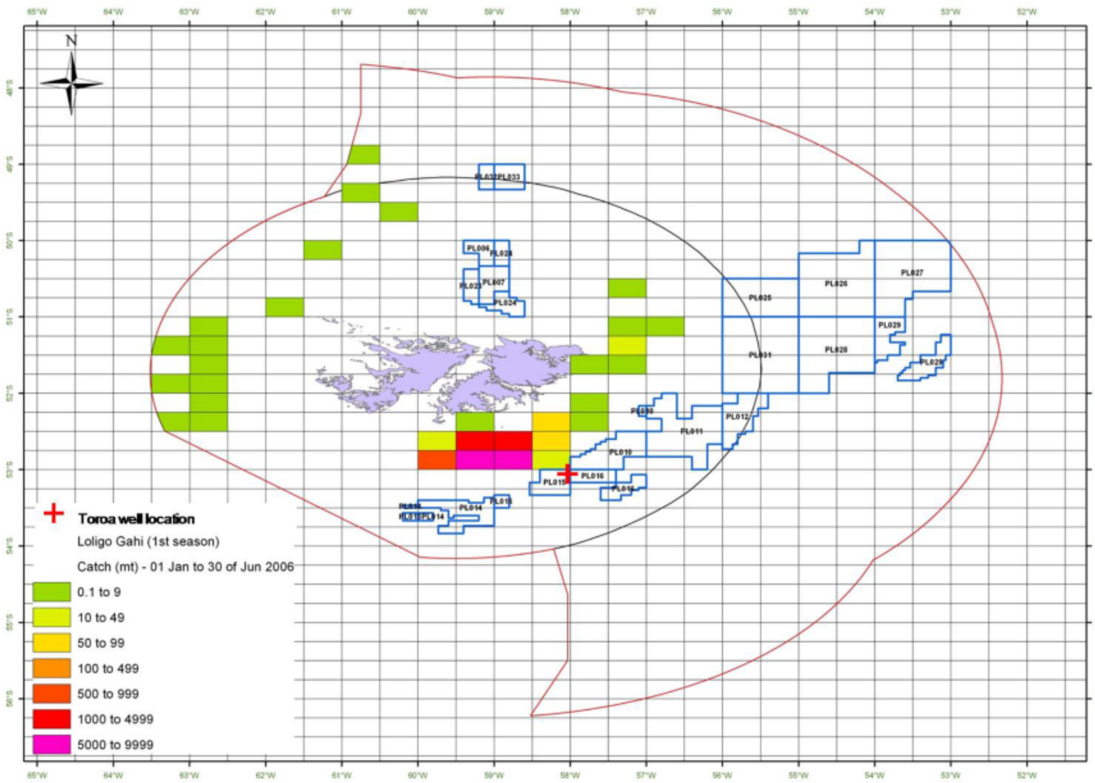
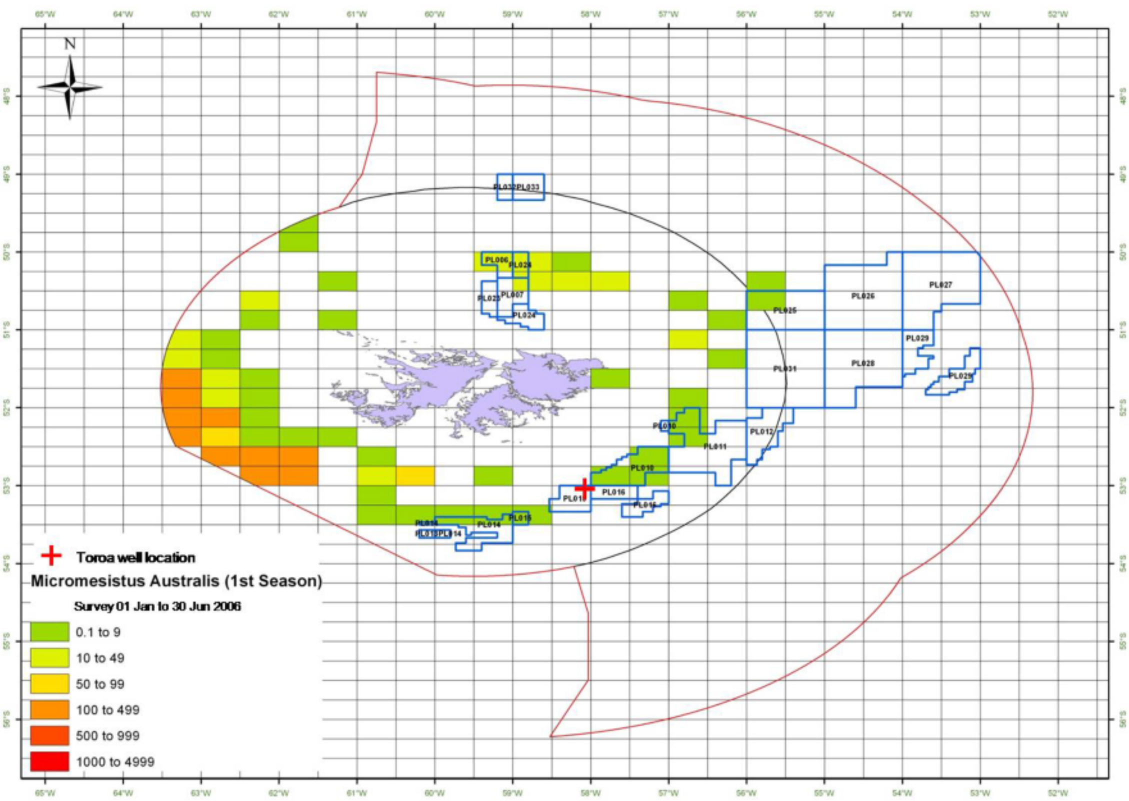


Figure 3.15: Micromesistius australis catches (tonnes) by grid square for Season 1 (Jan–Jun 2006)



3.3.2 Marine Archaeology

Refer to Section 5.4.2 (pages 5-68 to 5-69) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

Numerous ships wrecks lie in the Falklands' waters including 19 registered shipwrecks (six from the World War One battle of the Falkland Islands) and other designated war graves which cannot be disturbed.

No identified wrecks or significant marine artefacts were identified in the site survey area for the proposed well, which was one of the primary purposes for conducting the survey (*FSLTD, 2009b*). It is therefore very unlikely that a wreck would be discovered during the exploration drilling programme. In the very unlikely instance a ship wreck was found FIG would be immediately informed and every attempt would be made to ensure that the wreck is left undisturbed on the seabed for the duration of the exploration programme.

3.4 Summary of Seasonal Sensitivities

Table 3.8 presents an overview of some of the key seasonal environmental sensitivities for the Falkland Islands, and surrounding waters, where known monthly distribution data is available.

Table 3.8: Overview of Some of the Key Seasonal Sensitivities for the Falkland Islands 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												
Hake (*Merlucius sp.)*												
Southern Blue Whiting (*Micromesistius australis*)												
Whiptail Hake (*Macruronus magellanicus*)												
Cod (*Notothenia sp.*)												
Key	*Peak spawning*			*Spawning*								

Species	J	F	M	A	M	J	J	A	S	O	N	D
Cephalopods												
Illex argentinus												
Loligo gahi												
Key	*Peak spawning*			*Spawning*								

Species	J	F	M	A	M	J	J	A	S	O	N	D
Seabirds												
Southern giant petrel												
Antarctic fulmar												
Blue petrel												
Kerguelen petrel												
Atlantic petrel												

Species	J	F	M	A	M	J	J	A	S	O	N	D
Prion sp.												
Fairy prion												
Sooty shearwater												
Grey-backed storm petrel												
Black-bellied storm petrel												
White-bellied storm petrel												
Diving petrel												
Arctic tern												
Key	*Peak occurrence*						*Known occurrence*					

Species	J	F	M	A	M	J	J	A	S	O	N	D
Penguins												
King penguin												
Gentoo penguin												
Chinstrap penguin												
Rockhopper penguin												
Macarooni penguin												
Megellanic penguin												
Key (Penguin numbers recorded per month (White et al., 2002))												
High (>100)	*Medium (10-99)*			*Low (4-9)*			*V. low (1-3)*			*No animals*		

Species	J	F	M	A	M	J	J	A	S	O	N	D
Albatross												
Southern Royal albatross												
Northern Royal albatross												
Black-browed albatross												
Key	*Peak occurrence*						*Known occurrence*					

Species	J	F	M	A	M	J	J	A	S	O	N	D
Pinnipeds												
South American Sea Lion												
Southern Elephant Seal												
Key (Numbers recorded per month (White et al., 2002))												
High (<10)	*Medium (6-10)*			*Low (3-5)*			*V. low (1-2)*			*No animals*		

Species	J	F	M	A	M	J	J	A	S	O	N	D
Cetaceans												
Fin whale												
Sei whale												

Species	J	F	M	A	M	J	J	A	S	O	N	D
Sperm whale	V. low	V. low	No animals	V. low	No animals	V. low	Low	V. low	V. low	Low	V. low	Low
Minke whale	Low	V. low	V. low	Medium	V. low	V. low	V. low	No animals	Low	Low	Medium	Medium
Bottlenose whale	V. low	Low	No animals	No animals	No animals	No animals	No animals	No animals	Medium	Low	Low	V. low
Long-finned pilot whale	No animals	High	High	High	High	High	High	High	High	Low	Low	Medium
Hourglass dolphin	High	High	Medium	V. low	No animals	V. low	V. low	Low	High	High	High	High
Peale's dolphin	High	High	High	High	High	High	High	High	High	High	High	High
Commerson's dolphin	High	High	High	High	No animals	V. low	High	High	High	High	Medium	High

Key (Cetacean numbers recorded per month (White et al., 2002))

High (<50) | *Medium (10-49)* | *Low (4-9)* | *V. low (1-3)* | *No animals*

Solid Red Line = Proposed April to June Drilling Period

The table above demonstrates the range of environmental sensitivities present in the Falklands and surrounding waters for each month. Seasonal vulnerabilities likely to be present in the vicinity of the Toroa exploration well location have been assessed throughout this section of the Operational Addendum, and are summarised below:

- Fish species known to spawn in the area include hake, southern blue whiting and cod, although none are expected to spawn during the drilling period;
- Cephalopod spawning is unlikely to occur in the vicinity of the Toroa well during the drilling period;
- Based on the JNCC survey results (*White et al., 2002*), the following species of cetacean were recorded within the vicinity of the proposed Toroa drilling location: long-finned pilot whale, hourglass dolphin and Peale's dolphin, although during the months of the proposed drilling period (April to June) only long-finned pilot whale and Peale's dolphin were recorded in significant numbers. Species specifically recorded offshore the Falkland Islands during the proposed drilling period (April to June) include sei whale, sperm whale, minke whale and Commerson's dolphin. Additional marine mammal data in the vicinity of the proposed Toroa well has also been compiled based on the reports provided by Marine Mammal Observers (MMOs) on seismic vessels during acquisition programmes. This includes surveys undertaken in BHPBP(F)C's licence area when it was under the Operatorship of FOGL. This data indicates that the southern right whale, fin whale, hourgalss dolphin and Peale's dolphin may be present within the general vicinity of the proposed Toroa drilling location.
- Little is known of the at-sea distribution of Falkland Islands pinnipeds, and it is possible that South American sea lions, south American fur seals and southern elephant seals may be present within the vicinity of the proposed Toroa location during the drilling period in low numbers;
- Of the penguin species recorded in the Falkland Islands, only rockhopper penguins and magellanic penguins have been observed at significant distance from the Falkland Islands and may therefore be present during the proposed drilling period for the Toroa exploration well;
- It is possible that the southern royal albatross will be present in the vicinity of the proposed Toroa well during the months of March to June and the northern royal albatross will be present in the vicinity of the proposed well during the months of March to July, thereby overlapping with the proposed drilling period. It is also likely that the black-browed albatross will be present in the vicinity of the exploration well between February and June;

- Petrels and shearwaters known to be present in the vicinity of the Toroa exploration well during the drilling period include blue petrel, kerguelen petrel, atlantic petrel, prion species, sooty shearwater and diving petrel. None of these species are considered to be present in significant numbers;
- The proposed Toroa exploration well is located away from the identified areas of highest seabird vulnerability. Highest vulnerability tends to be associated with the inshore waters around the Falklands Islands, largely due to the presence of resident species with a predominantly coastal distribution such as the endemic Falklands Steamer duck, imperial shag and gentoo penguin. The Patagonian Shelf waters to the north and west of the Falklands, which support high densities of black-browed albatrosses and royal albatrosses year-round are also associated with high vulnerability areas, but again these are remote from the proposed drilling location.

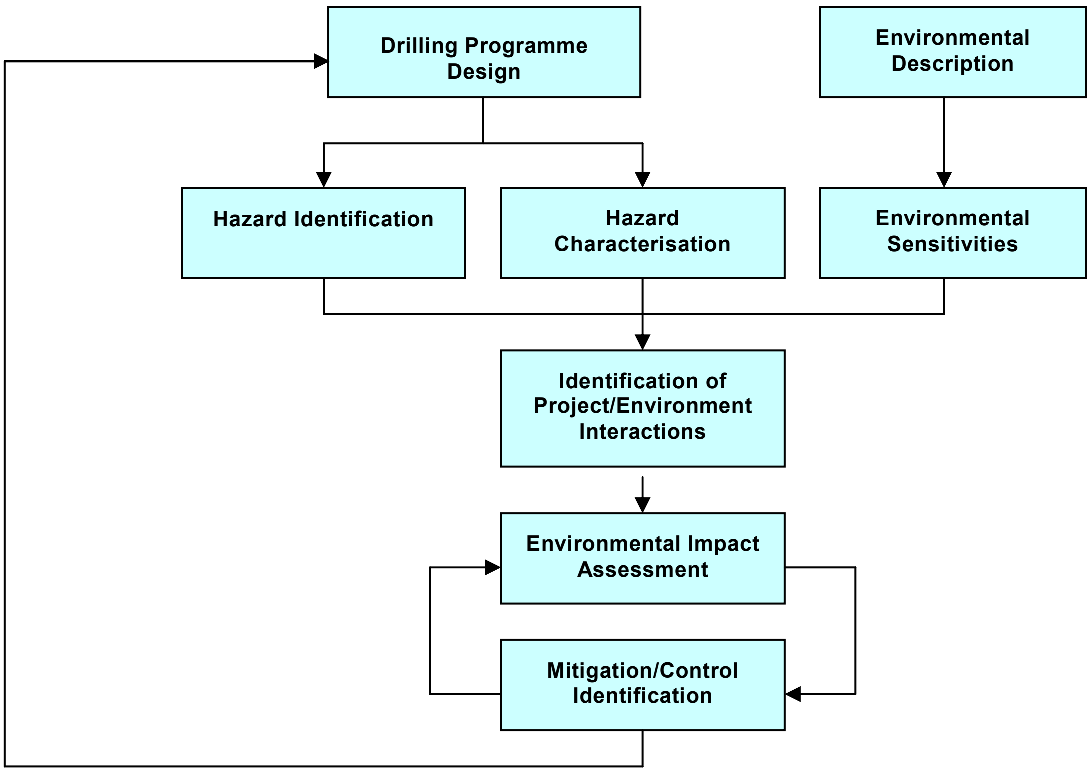
4 Environmental Hazards, Effects and Mitigation Measures

4.1 Introduction

This section aims to assess the environmental hazards and effects resulting from the Toroa exploration well during the proposed April to June drilling period and, where necessary, identify any mitigation measures that may be required to eliminate or lessen the severity of the impacts. Where appropriate, the impacts have been considered in context with those previously identified within Section 6 of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

The methodology used for environmental impact assessment follows the sequence summarised in Figure 4.1, with consultations incorporated into every phase.

Figure 4.1: Methodology for Environmental Impact Assessment



The main supporting information required for an assessment includes a description of both the project (refer to Section 2 of this report) and the environment (refer to Section 3 of this report) in which it will take place. In this section, the interactions between the Toroa exploration well and the environment during the proposed drilling period (April to June) are identified and an environmental impact assessment is undertaken by establishing a matrix of hazards against environmental sensitivities.

The results of this qualitative risk assessment exercise are presented in the form of a matrix that highlights areas where some interaction is expected and provides a measure of the expected significance based on the criteria provided in Table 4.1. This qualitative scale helps to rank issues on a relative basis and identify areas where additional control measures may be required.

Table 4.1: Assessment of Significance of Effect or Hazard (from UKOOA, 1998)

1	**Severe** Change in ecosystem leading to long term (>10 years) damage and poor potential for recovery to a normal state. Likely to effect human health. Long term loss or change to users or public finance.
2	**Major** Change in ecosystem or activity over a wide area leading to medium term (>2 years) damage but with a likelihood of recovery within 10 years. Possible effect on human health. Financial loss to users or public.
3	**Moderate** Change in ecosystem or activity in a localised area for a short time, with good recovery potential. Similar scale of effect to existing variability but may have cumulative implications. Potential effect on health but unlikely, may cause nuisance to some users.
4	**Minor** Change which is within scope of existing variability but can be monitored and/or noticed. May affect behaviour but not a nuisance to users or public.
5	**Negligible** Changes which are unlikely to be noticed or measurable against background activities. Negligible effects in terms of health or standard of living.
	None No interaction and hence no change expected.
B	**Beneficial** Likely to cause some enhancement to ecosystem or activity within existing structure. May help local population.

4.2 Identification of Interactions

Table 4.2 summarises the interactions between the proposed Toroa exploration well and the sensitivities of the local and regional environment during the proposed drilling period (April to June). A measure of the expected significance for each of the interactions has been derived based on the criteria provided in Table 4.1, above. The significance level assumes that the mitigation measures, identified for each of the hazards in the following sections, have been implemented.

Table 4.2: Potential Hazards and Associated Impacts from Drilling Operations Associated with the Proposed Toroa Exploration Well

Hazard	Water & Air		Flora & Fauna							Socio-economic								Other		
	Water Quality	Air Quality	Plankton	Seabed Fauna	Fish Spawning	Offshore Sea Birds	Coastal Birds	Marine Mammals	Sensitive Coastal Sites	Fishing	Shipping	Military Activity	Pipelines, Wells & Cables	Drilling & Support Crews	Dredging	Archaeology	Tourism / Leisure	Land Use	Sediments	Resource Use
Physical Presence										5	5									5
Seabed Disturbance				4															4	
Noise & Vibration					5			5												
Atmospheric Emissions		5																		
Marine Discharges	5		5	5	5															
Solid Waste																		3		
Minor Loss of Containment	4		4		5	4		5		5										
Major Loss of Containment	3		3		4	3		5		3	4									

Key to Significance of Effect (see Table 4.1 for definitions)

1	Severe	2	Major	3	Moderate	4	Minor	5	Negligible		None	B	Beneficial

4.3 Design Control Measures

As discussed in Section 6.3 of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS, environmental performance has been a key consideration in option selection and through the design process. Environmental studies and controls, implemented during the design stage of the project, ensure that additional control and mitigation measures required during the operational phases of the project are limited.

The major design controls for the Toroa drilling campaign have included:

- Extensive planning prior to commencing operations to ensure that no strains are placed on current onshore capacities;
- Mud selection: use of WBM as the preferred option for the well sections with careful selection of components to reduce potential environmental effects;
- Waste: currently, any solid waste, excluding drill cuttings and hazardous waste, that can be returned to shore for appropriate disposal will be skipped and shipped to the Falkland Islands. All hazardous waste is likely to be exported to the UK, Chile or Uruguay. Specific

waste handling/disposal routes and procedures will be detailed in a Waste Management Plan, to be submitted to FIG for approval prior to commencement of the drilling operations.

- Management procedures will be in place to ensure environmental controls are operating effectively and efficiently. These are detailed in Section 5 of this Addendum.
- Oil Spill Contingency Plan (OSCP) and emergency response procedures will be in place. These will be submitted to FIG for approval prior to commencement of the drilling operations.

4.4 Physical Presence

There is no subsea infrastructure, such as cables or pipelines, in the areas of proposed Toroa well, and so no interference is expected.

Drilling the proposed exploration well will not result in any significant obstruction to other marine activities (e.g. fishing and/or shipping operations) whilst the drilling rig is operational, as the proposed drilling location is outside of the key fishing areas and there are no known shipping lanes passing through the proposed well sites. However there is some fishing activity between the proposed exploration well and the coast (refer to Section 3.3.1). Vessel collision risk is minor and the following mitigation measures will be implemented:

- A safety exclusion zone will be established during the drilling operation and the presence of the four project related vessels (one of which will serve as a stand-by vessel and will at all times be within proximity of the drilling rig for safety purposes) will minimise the risk of vessel collision;
- The planned activities will be promulgated in advance through Notice to Mariners, Navtex and VHF broadcast for the duration of the operations;
- The British Military will also be continually informed of BHPBP(F)C's proposed activities;
- The Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs) will be complied with.

Resource consumption from acquisition of drilling consumables and equipment (casing, cement, mud, and chemicals) is assessed to be of low importance to the Falkland Islands as it is unlikely that these resources will be sourced in the Falkland Islands, and are more likely to be sourced from elsewhere. The remote drilling location will require sufficient materials, equipment, spares and contingency supplies to be ordered in advance and shipped prior to rig mobilisation. Reordering and transporting replacement parts or additional materials during drilling will be financially and logistically impractical.

Fuel consumption throughout the drilling campaign is considered to be of medium importance to the Falkland Islands as it is likely that the fuel will be sourced from the Islands (refer to Section 2.8.2). The consumption of heli-fuel, aviation fuel for flights, diesel and marine fuel oil is an operational necessity, although fuel consumption can be minimised by a regular programme of maintenance and servicing. Advanced planning will be undertaken and should help to ensure flights and transfers are kept to a minimum, however regular crew changes are a necessity both for operational and health and safety reasons.

Water required for operational use onboard the rig will be sourced from the sea. Potable water will be obtained from the water maker onboard the Ocean Guardian, but small amounts could also be sourced from Falklands Interim Port and Storage System (FIPASS). As such, it is considered water for drilling and domestic use is of low importance to the Falkland Islands. If potable water has to be sourced from FIPASS, it can be loaded outside peak times to minimise any impacts to the local community. In addition, water needs have been discussed with local authorities, and with adequate advance planning can be provided without effect to local needs.

Increased vessel traffic around the port will be created due to regular visits by the rig supply vessel to collect water, fuel and supplies. Three support vessels will provide the bulk logistics, transporting material/waste between the rig and port (refer to Section 2.9).

The majority of fish (by weight) caught in the Falklands Interim Conservation and Management Zone (FICZ) is not landed. Transhipping operations take place at sea or in sheltered waters (either Port William or Berkeley Sound) from the fishing vessel on to reefer (freezer) vessels which transport the catch direct to market without it ever hitting land in the Falkland Islands. A small proportion of fish is landed onshore at FIPASS in Stanley and most of this is backloaded into freezer containers for shipment out to Uruguay.

The only fish species where the complete catch is landed in the Falkland Islands is the small Toothfish catch from the Falklands and South Georgia fisheries. This is very tightly controlled for conservation reasons (all catches which are landed in the Falkland Islands are weighed and checked by the authorities prior to export).

Given the above, it is envisaged that the increased vessel traffic around the port will not impact on the majority of the fishing vessels operating around the Falklands, many of which never call at FIPASS. The effect on the remainder of vessels will be manageable.

4.5 Seabed Disturbance

4.5.1 Anchoring

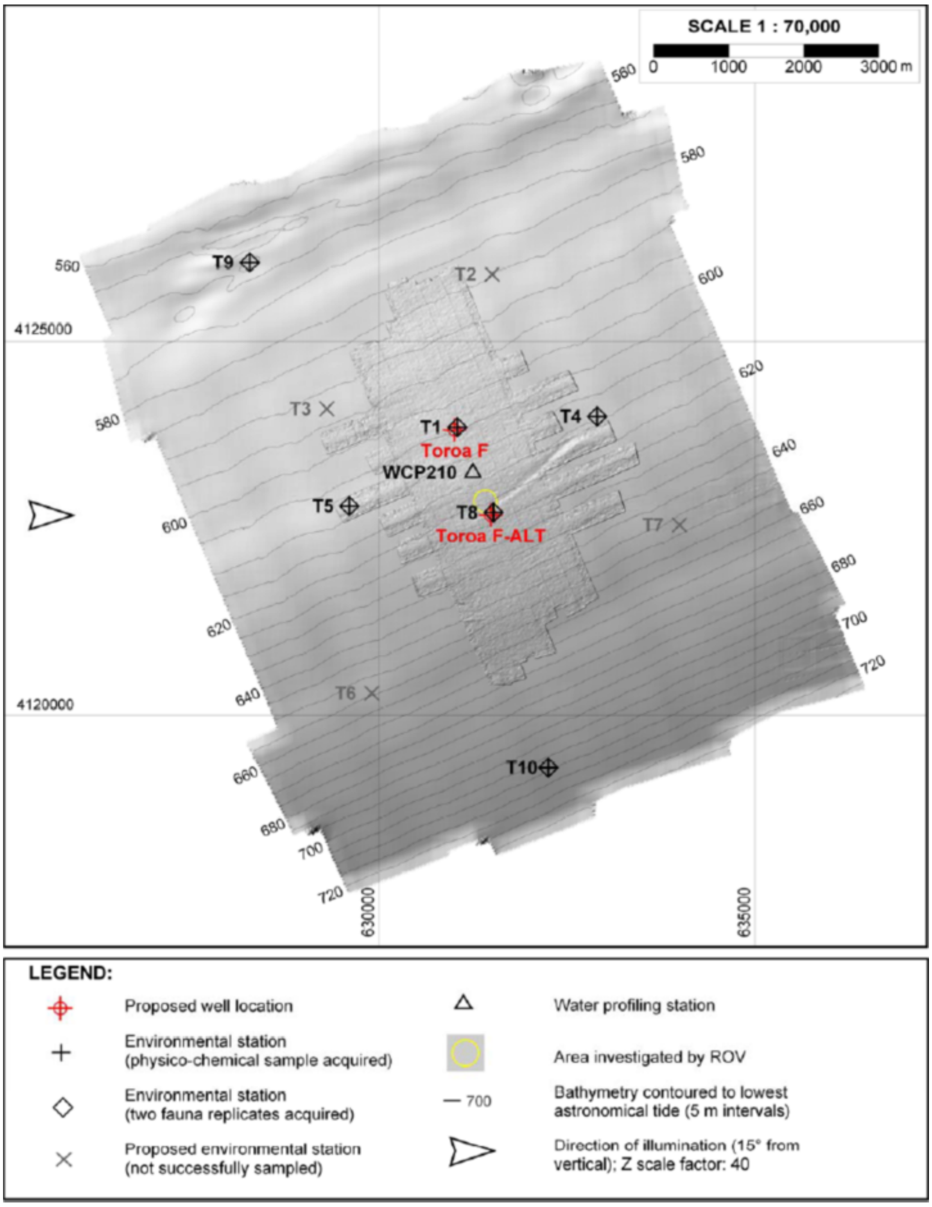
The Ocean Guardian rig has an 8 line mooring anchor pattern, the anchors and chains of which will directly impact the seabed. A copy of the indicative anchor pattern for the rig when deployed at the Toroa well location is provided in Appendix A. Of note, is that the anchors are likely to be deployed out to a distance of ca. 1,160 metres around the drill rig.

The study area for the Toroa site survey comprised of an 8.7 kilometre by 7.4 kilometre bathymetric survey. A plot showing the shaded relief rendering of the survey area is provided in Figure 4.2, and covers the area of seabed which will be impacted by the proposed anchor pattern. The geophysical data suggested that the surface sediments within the survey area were extremely homogeneous. During the survey, no seabed features of concern for anchoring were discovered.

The benthic survey results at Toroa appear to show a single benthic community dominating, which is considered to be homogenous across the drilling location, although it is recognised that only a limited number of samples were collected (refer to Section 3.2.1). While limited differentiation of the community was identified by multivariate analyses of sample data (CLUSTER and SIMPROF), this was thought to result from patchiness in community, rather than to indicate clear community differentiation due to differing habitat; there was no spatial pattern evident in the analyses, the smaller of the two clusters comprising single replicates from three different stations. Station level multivariate analysis failed to identify any significant differentiation in the infaunal dataset, all stations being grouped within a single cluster characterised by the numerically dominant *Haustoriide sp.* 1 and *Onuphis pseudoiridescens* (refer to Appendix D of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS for further detail).

The footprint of seabed which will be impacted by the rig anchors is relatively small. Given this, the relatively short duration of the drilling period (a maximum of 40 days) and the fact that crude abundance / dominance and univariate analyses of the macrofaunal data indicates a single community throughout the survey area, it is anticipated that once the rig moves off location seabed communities will recover relatively quickly.

Figure 4.2: Shaded Relief Rendering Showing Seabed Morphology (FSLTD, 2009b)



4.5.2 Deposition of Drill Cuttings

As discussed within Section 6.5.2 (pages 6-4 to 6-14) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS, the main potential source of seabed disturbance from the Toroa well will be caused by the deposition of drill cuttings on the seabed in the vicinity of the drilling location. The major physical waste product of a drilling operation is the generation of rock cuttings together with fine solids from the centrifuges. Other waste products include the discharge of drilling muds with the cuttings and the discharge of excess cement during cementing of well casings.

It is estimated that drilling the Toroa exploration well will generate a maximum total of 635 tonnes of cuttings associated with WBM (refer to Section 2.6). These cuttings will be discharged to the sea, where the mud and cuttings will sink to the seabed and be deposited there in a pattern that reflects the nature of the cuttings' particle size distribution, the water depth and the water movements at the time of discharge.

The deposition of the cuttings and mud on the seabed from the Toroa well was previously modelled for the EIS to gauge the potential pattern of deposition and to allow an estimation of the effect this could have on the benthic fauna. The Pollution Risk Offshore Technical Evaluation System (PROTEUS) model (version 1.5), developed by BMT Cordah, a UK based environmental consultancy and information systems company, was used to carry out the modelling. Details on the model set up and the way in which the model works are provided in Appendix G of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

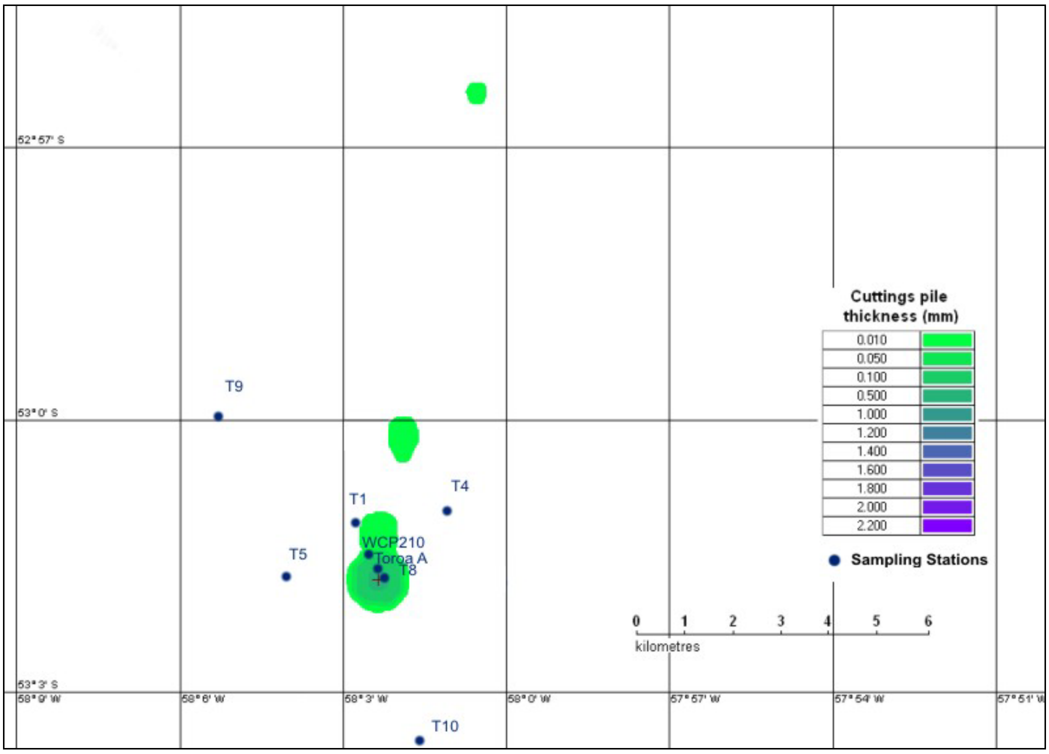
It should be noted that since the model was run further detailed well design work has resulted in a slight increase (by approximately 3%) in the amount of cuttings that will be generated from Toroa; from 615 tonnes to 635 tonnes. In the context of the model this increase is considered insignificant and will not alter the area of seabed, which is predicted to be disturbed.

A summary of the modelling results for Toroa has been provided for reference below.

Modelling Results

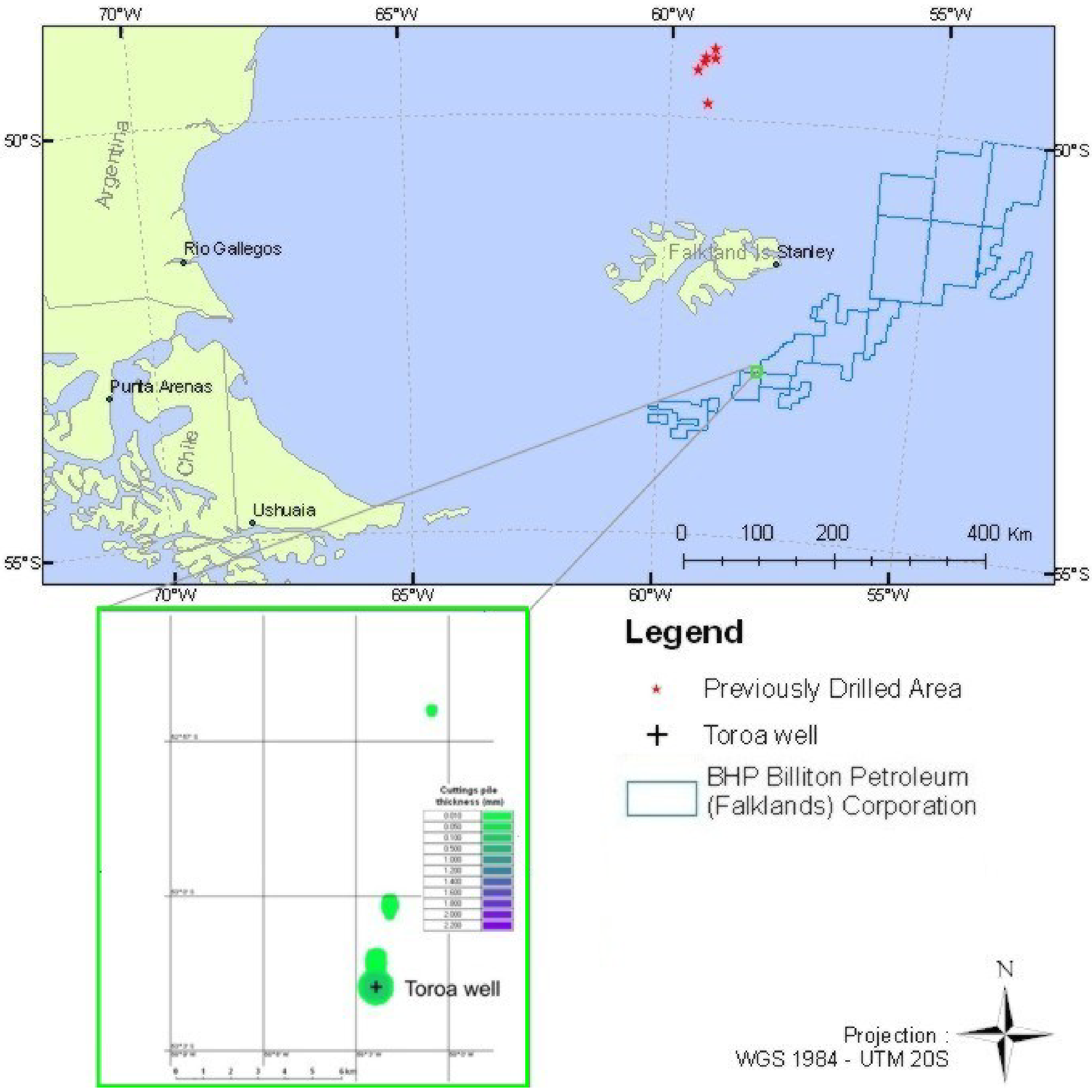
Figure 4.3 shows the output from the PROTEUS model run for the Toroa well. It displays cuttings pile thickness contour plots with a thickness range from 0.01 to 2.2 millimetres (mm). This close-up image has been plotted onto an overview map to show the extent of the area impacted in relation to the Falkland Islands (refer to Figure 4.4).

Figure 4.3: Predicted Maximum Extent of Cuttings Deposition on the Seabed around the Proposed Toroa Drilling Location and Environmental Baseline Survey Sampling Stations



Note: Two replicates from Stations T1, T4, T5, T8, T9 and T10 were completely screened over a 0.5mm mesh and fixed for macrofaunal analysis, and one physicochemical sample was retained and sub-sampled for hydrocarbon, heavy metal, organic carbon and particle size analysis.
ROV video footage was taken from Station Toroa A.
Water profile data were collected at WCP210.

Figure 4.4: Predicted maximum extents of cuttings deposition on the seabed around the proposed Toroa drilling location in relation to the Falkland Islands



It can be seen from Figure 4.3 that the cuttings from the Toroa well are deposited along a north north-easterly to south south-westerly orientated axis. This is the result of the current characteristics input into the model (current in direction of bearing 012°). The distance covered along this axis is approximately 11 kilometres and the maximum width of the pile is around 1.3 kilometres (when measured to the 0.01 mm thickness contour). It should be noted that Figures 4.3 and 4.4 do not denote the impact area from the cuttings pile, but simply displays the area where cuttings are deposited in a layer greater than or equal to 0.01mm thick.

Three distinct piles are shown in Figure 4.2, which are formed as a result of the particle size distribution of the cuttings. The majority of cuttings are located in a circular-shaped pile centred on the drilling location. This circular-shaped pile has a diameter of approximately 1.3 kilometres when measured to the 0.01 mm thickness contour. The maximum cuttings pile thickness found was 0.86 mm, which occurred at the drilling location itself. This is likely to be the result of the top-hole 42" well section being discharged directly to the seabed. Cuttings from this section have a limited chance to move through the water column and become dispersed by the localised currents and, as such, result in a thicker deposition of cuttings at this point.

The two other distinct cuttings pile areas are likely to be formed as a result of the finer cuttings discharged from a few meters below the sea surface from the 17½", 12¼" and 8 ½" well sections. When cuttings are discharged overboard, they can remain suspended in the water column for a significant period of time under the influence of the water column currents during settling, before finally being deposited on the seabed. This often results in more widespread deposition of the cuttings and a much less thick deposition of cuttings in general. In the case of the Toroa well, the water depths in the area are fairly deep (606 metres at the drilling location), which increases the time over which the particles would settle to the seabed. As such, it is likely that the majority of cuttings, particularly smaller particles that require less energy to be entrained, would be dispersed over a very great distance, and after settling on the seabed, their thickness would be so small that it would be undetectable against the normal background sediment.

The sampling stations for Toroa have also been plotted onto Figure 4.2 in order to relate where baseline environmental data has been collected in relation to the area where cuttings are deposited in a layer greater than or equal to 0.01mm thick. It can be seen that baseline data has been collected from the area where the majority of cuttings are located, namely in the circular-shaped pile centred on the drilling location. No samples have been collected from the third outlining pile, situated approximately 11 kilometres to the north-north-east of the Toroa well. It should be noted, however, that the thickness of the cuttings pile in this area does not exceed 0.01 mm. Studies have shown that impacts from smothering can occur where the depth of cuttings is one millimetre or more (*Bakke et al., 1986*). As such, no significant smothering effects on the flora and fauna are expected in this area.

Conclusions

The deposition of cuttings and fine solids described above has the potential to directly affect the seabed fauna. Smothering effects and changes in the sediment grain size and chemistry combine to favour certain species over others. As a result, the population of seabed fauna within the area influenced by cuttings deposition may differ from that of the surrounding unaffected sediments. Such effects have been well studied and indicate an effect broadly mirroring the area of deposition of the cuttings. As stated above, studies have shown that impacts from smothering can occur where the depth of cuttings is one millimetre or more (*Bakke et al., 1986*).

The maximum predicted cuttings thickness was 0.86 mm at the Toroa drilling location. Although the cuttings piles from the Toroa well in general potentially cover large areas, 11 x 1.3 kilometres at the Toroa location (at their longest and widest points, respectively, measured to the 0.01mm thickness contours), at no point did the cuttings pile thickness exceed 1 mm. Significant smothering effects on the flora and fauna are, therefore, not expected at the Toroa location.

As there are no toxic components within the discharge of the vast majority of cuttings, the impacted area will begin to recover soon after drilling operations have ceased. Recolonisation of the impacted area 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.

A study of the development drilling in the Pompano field in deep water in the Gulf of Mexico (*Fechelm et al, 1998*) has assessed the dispersion of Synthetic-based Drilling Muds (SBM) cuttings from two platforms in water depths of 393 metres and 565 metres. The cuttings from these multi-well developments totalled 7,659 bbl (ca. 980 tonnes) of SBM Petrofree LE (90% LAO, 10% Ester), although mud weight discharged has not been estimated. The dispersion of these cuttings was surveyed, and results indicated that no cuttings pile was observed at either location. Instead there was a thin 'veneer' of cuttings dispersed over a large area in a patchy fashion, the thickest patches were 20-25cm deep. Chemical analyses indicated that most of the fluid was observed along transects in the direction of the surface and mid-level currents rather than in the direction of bottom currents. Maximum measured SBM concentrations were recorded close to the platform (100m) and were in the order of 30-50,000µg/g in the top 2cm of sediment. Benthic abundance was highest in sediment along the same transect that had high SBM concentrations. ROV video was used to count demersal megafauna (primarily fish). Neither benthic fauna nor demersal fish abundance appeared to have been adversely affected by the SBM cuttings discharge.

Other evidence of cuttings dispersion exists from the UKCS. In 1987 a benthic environmental survey was undertaken at a single well site, located within a water depth of around 140 metres, 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*).

Given this evidence, the shallowness of the predicted cuttings deposition and the action of movement of the bottom currents, it is likely that any cuttings will soon become mixed with the natural sediments and will eventually be dispersed.

4.6 Noise and Vibration

As discussed within Section 6.6 (pages 6-14 to 6-16) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS, operational activities at the proposed well site will generate noise, both above and below the sea surface, mainly during drilling activities. Typical subsea noise levels have been provided again for reference in Table 4.3, below.

Table 4.3: Typical Noise Levels Associated with Offshore Operations

Source	Noise Level (dB)	Dominant Frequency(s) (Hz)
Pile driving	135-145 * 225-236***	50-200 130-150
5 metre Zodiac with an out-board motor	152 *	6,300
Jack Up Drilling Rig	140-160*	100
Semi submersible Drilling Rig	170****	10-2000
Typical Fishing Vessel	150-160 **	-
Tug/barge traveling at 10 knots (18 kilometres per hour)	162 *	630
Large Tanker	177 *	100
Seismic Air Gun	210 (average array)* 259 (large array)*	10-1,000

** Richardson* et al *(1995) ** Gulland and Walker (1998) *** Ward and Healy (2002) **** Davis et al. (1991)*

(dB) The magnitude of the sound manifests itself as pressure, i.e. a force acting over a given area. It is expressed in terms of 'sound levels', which use a logarithmic scale of the ratio of the measured pressure to a reference pressure (Decibels (dB)). In this report all dB reported are re 1µPa @ one metre in water. Source: *Richardson et al 1995.*

Available measurements indicate that drilling activities produce mainly low-frequency continuous noise from several separate sources on the drilling unit (*Richardson et al. 1995, Lawson et al. 2001*). The primary sources of noise are various types of rotating machinery, with noise transmitted from a semi-submersible rig to the water column through submerged parts of the drilling unit hull, risers and mooring cables, and (to a much smaller extent) across the air-water interface.

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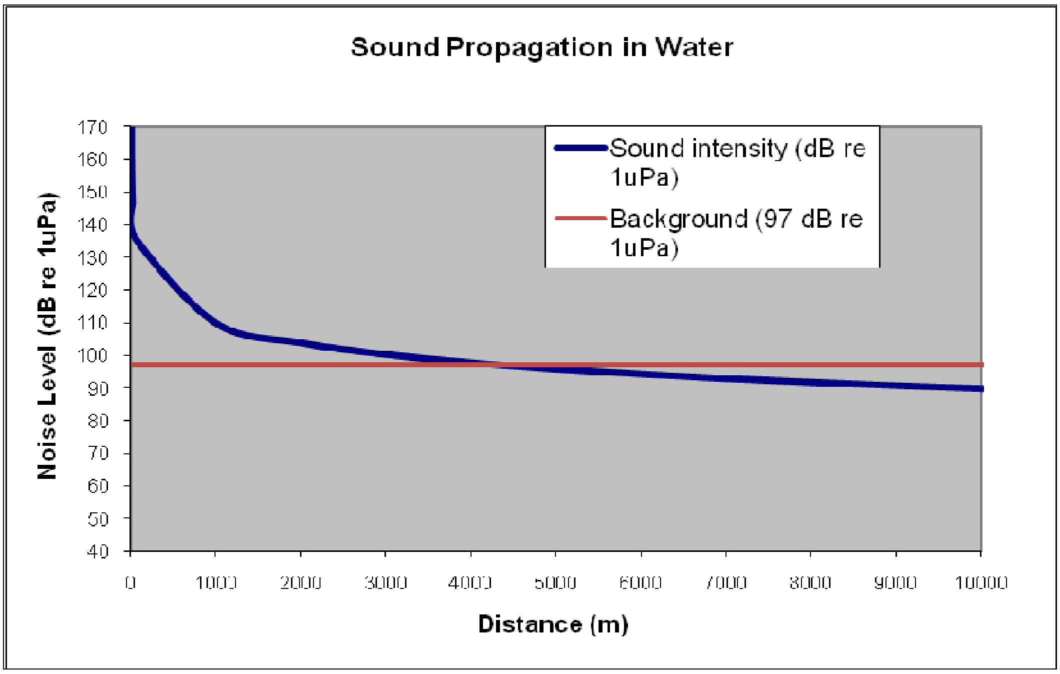
Measured farfield sound pressure of around 170dB re 1µPa, in the frequency range 10-2000Hz (*Davis et al. 1991*) is probably typical of drilling from a semi-submersible rig and is of the same order and dominant frequency range as that from large merchant vessels (e.g. *McCauley 1994*).

Taking 170dB as an example of the typical noise level generated from drilling operations using a semi-submersible drilling rig and assuming a spherical propagation of noise from the source, it can be seen from Figure 4.5 that background noise levels will be reached within approximately 4 kilometres of the source. Of note, is that an anchored semi-submersible will generate less noise than a dynamically positioned semi-submersible, which is dependent on its thrusters for maintaining position.

Figure 4.5: Propagation of Sound in Water (from Richardson et al., 1995)



4.6.1 Potential Impacts on Fish

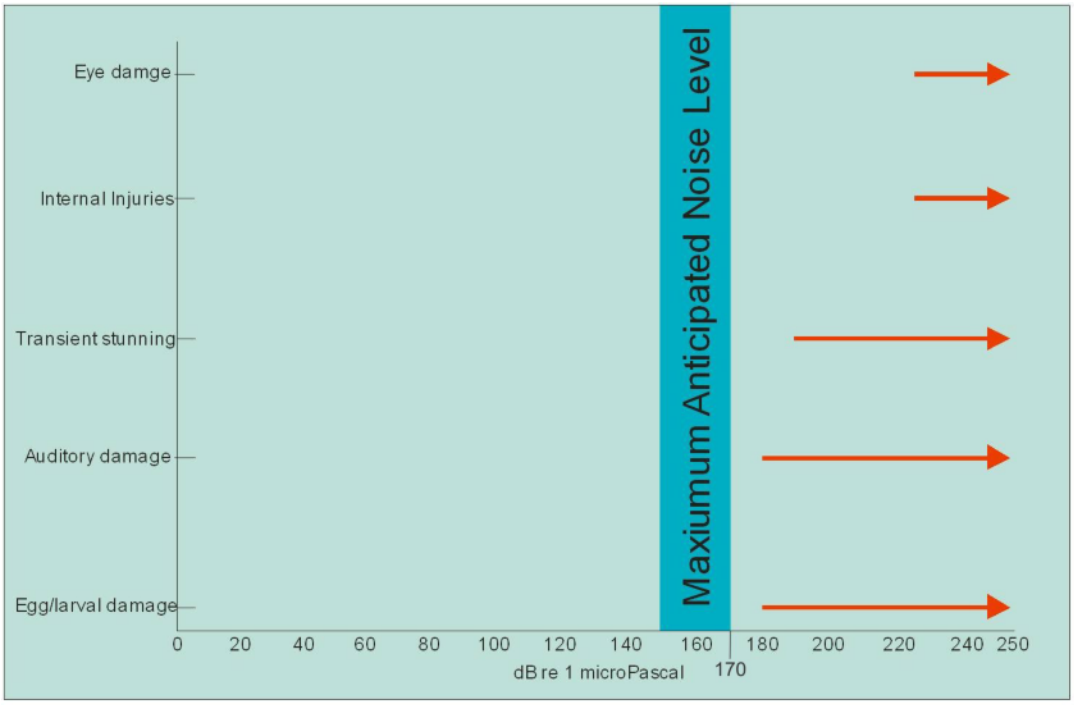
Fish species known to spawn in the area include hake, southern blue whiting and cod, although none of these species are expected to spawn during the proposed April to June drilling period (refer to Section 3.2.2).

Cephalopod spawning is also unlikely to occur in the vicinity of the Toroa well during the drilling period. Given the water depth at Toroa (around 600 metres) the proposed drilling activity is considered to be located outside of the *Loligo* nursery areas, which in general do not exceed 400 metres in depth (*Laptikhovsky, 2008*), and is certainly deeper than the spawning ground of the *Loligo,* which occur at depths of less than 20 metres (*Laptikhovsky, 2008)*

As discussed in Section 6.6.1 of the EIS (pg 6-15) fish are generally sensitive to noises within the frequency range of less than 1 Hertz to 3,000 Hertz, however, it has been reported that they will respond consistently to very low, or very high frequency noises (*Knudsen et al. 1992, 1994*). Sounds in the range of 50 to 2,000 Hertz, such as the peak sound levels produced by many anthropogenic activities, only produce short-term startle response at the outset of sound production with subsequent habituation to noise (*Knudsen et al. 1992, 1994; Westerberg, 1999*).

Given the magnitude of sounds expected to be produced by the proposed Toroa drilling activities, there are not expected to be any physical impacts on fish or physical damage to fish egg/larval (Figure 4.6).

Figure 4.6: Sound Pressure Level Thresholds for the Onset of Fish Injuries (after Turnpenny & Nedwell, 1994)



4.6.2 Potential Impacts on Cetaceans

Based on the JNCC survey results (*White et al., 2002*), the following species of cetacean have been recorded within the vicinity of the proposed Toroa drilling location: long-finned pilot whale, hourglass dolphin and peale's dolphin, although during the months of the proposed drilling period (April to June) only long-finned pilot whale and peale's dolphin were recorded in significant numbers. In addition, species specifically recorded offshore the Falkland Islands during the proposed drilling period (April to June) include sei whale, sperm whale, minke whale and Commerson's dolphin. Additional marine mammal data in the vicinity of the proposed Toroa well has also been compiled based on the reports provided by Marine Mammal Observers (MMOs) on seismic vessels during acquisition programmes. This includes surveys undertaken in BHPBP(F)C's licence area when it was under the Operatorship of FOGL. This data indicates that the southern right whale, fin whale, hourglass dolphin and peale's dolphin may be present within the general vicinity of the proposed Toroa drilling location (refer to Section 3.2.3 for further details).

As discussed within Section 6.6.2 of the EIS (pg6-16), cetaceans are unlikely to be significantly affected by the magnitude and frequency of noise produced during the planned offshore drilling operations (*Richardson et al., 1995*). The sound produced by drilling rigs and associated support shipping are all well below the injury thresholds for the functional hearing groups (i.e. low-, mid- and high-frequency cetaceans) for non-pulse sounds as established by Southall et al (2007). Sounds produced might, however, evoke certain levels of behavioural response.

While there are clearly major areas of uncertainty remaining, there has been relatively extensive behavioural observation of 'low-frequency cetaceans' exposed to non-pulse sources. The combined information from these generally indicates no (or very limited) responses at received sound levels of 90 to 120 dB re: 1 µPa and an increasing probability of avoidance and other behavioural effects in the 120 to 160 dB re: 1 µPa range (*Southall et al, 2007*). Assuming a 120 dB re: 1 μPa threshold, behavioural avoidance by 'low frequency cetaceans' is expected to extend to approximately 350 metres from a semi-submersible drilling rig.

Evidence suggests that dolphins and other toothed whales show considerable tolerance of drill rigs and support vessels (*Richardson et al, 1995*). Baleen whales have been reported within visual distance of drill ships off West Greenland (*LGL, 2000*) and bowhead whales have been observed to avoid an area with radius 10 kilometres around a drill-ship, corresponding to received sound levels of 115 dB re 1 **μ**Pa (*Richardson et al, 1995*). Sound levels produced from the Ocean Guardian semi-submersible rig will be approximately 170 dB, this will be annulated to background levels within 4 kilometres of the source (assuming spherical spreading – see Figure 4.5) limiting behavioral reactions to a small area in the vicinity of the proposed drilling activity.

A recent study by Todd et al (2009) recorded the harbour porpoise activity around offshore gas installations in the North Sea and concluded that harbour porpoises actually frequented the 500 metres safety zone surrounding offshore installations, possibly to feed, with surprising regularity, particularly at night.

Given the above, although there may be cetaceans present in the vicinity of the drilling activity, impacts from noise associated with drilling the Toroa exploration well will be within a localised area and are expected to be negligible.

4.6.3 Potential Impacts on Pinnipeds

Little is known of the at-sea distribution of Falkland Islands pinnipeds, and it is possible that both South American sea lions, south American fur seals and southern elephant seals may be present within the vicinity of the proposed Toroa location during the drilling period in low numbers.

Information on the effect of noise on pinnipeds is scarce (*Davis et al., 1990*). Noise can interfere with the ability of pinnipeds to explore their environment and communicate with each other (*Reijnders et al., 1993)*. Furthermore, heavy noise generated from seismic operations, icebreakers and drilling operations might cause serious discomfort (*Richardson et al., 1998*).

Most pinniped species have peak sensitivities between 1 and 20 kHz. Some species, like the harbour seal, have best sensitivities over 10 kHz. Only the northern elephant seal has been shown to have good to moderate hearing below 1 kHz (*Kastak and Schusterman, 1999*). Some pinniped species are considered to be effectively double-eared in that they hear moderately well in two domains, air and water, but are not particularly acute in either. Others, however, are clearly best adapted for underwater hearing alone.

Responses of pinnipeds to noise disturbance vary depending on where the individual is when they encounter a novel noise source. Pinnipeds generally show reduced reaction distances to ships when the animals are in the water compared to when they are hauled out (*Hammond et al., 2006*). As the proposed Toroa well is located some distance from the know haul-out sites and only low numbers of pinnipeds may be present in the water around the drilling rig (refer to Section 3.2.3), impacts from noise associated with drilling the Toroa exploration well are expected to be negligible.

4.6.4 Potential Impacts on Protected Birds

The majority of seabird species in the Falkland are observed in coastal and nearshore areas. Few seabirds have been recorded in the vicinity of the proposed exploration well during the proposed drilling period (April to June) (refer to Section 3.2.4). Of the penguin species recorded in the Falkland Islands, only rockhopper penguins and magellanic penguins have been observed at significant distance from the Falkland Islands and may therefore be present during the proposed drilling period for the Toroa exploration well. It is possible that the southern royal albatross will be present in the vicinity of the proposed Toroa well during the months of March to June and the northern royal albatross will be present in the vicinity of the proposed well during the months of March to July, thereby overlapping with the proposed drilling period. It is also likely that the black-browed albatross will be present in the vicinity of the exploration well between February and June. Petrels and shearwaters known to be present in the vicinity of the Toroa exploration well during the drilling period include blue petrel, kerguelen petrel, Atlantic petrel, prion species, sooty shearwater and diving petrel, however, none of these species are considered to be present in significant numbers.

Anticipated airborne noise from drilling activities is likely to be rapidly attenuated and, as a result, any impact to seabirds (i.e. displacement from the area) is likely to be very localized within the immediate vicinity of the drilling and will be temporary in nature (the rig is anticipated to be on site for a maximum of 40 days).

Given the above, and the fact that the area in the vicinity of the Toroa well is not considered to be of particularly high sensitivity for seabirds, the impact of the proposed drilling activity on any birds which may be present in the area is considered to be negligible.

4.7 Atmospheric Emissions

The main sources of atmospheric emissions during drilling operations will result from diesel burnt for power generation for the drill rig and three associated standby vessels, and from aviation fuel burnt during helicopter trips.

Diesel burnt for power generation will give rise to minor emissions of carbon dioxide (CO_2), oxides of nitrogen (NOx), nitrogen dioxide (NO_2), sulphur dioxide (SOx) and unburned hydrocarbons (refer to Table 4.4). These types of emissions are anticipated to disperse rapidly under most conditions to levels approaching background within a few tens of metres of their source. Although all such emissions will contribute in a small way to the overall pool of greenhouse and acidic gases in the atmosphere, local environmental and transboundary effects will be negligible.

Practical steps to limit atmospheric emissions that will be adopted during the drilling programme include advanced planning to ensure efficient operations, well maintained and operated power generation equipment and regular monitoring of fuel consumption.

Table 4.4: Predicted Atmospheric Emissions from Power Generation from Drilling Toroa (assumes rig is on location for a maximum of 40 days)

Gas[1]	Drill Rig [2]	Standby Vessels[3]	Helicopters[4]	Total
Carbon dioxide	1,920.000	2,560.000	102.400	4,582.400
Carbon monoxide	9.420	12.560	0.166	22.146
Oxides of nitrogen	35.640	47.520	0.400	83.560
Nitrous oxide	0.132	0.176	0.007	0.315
Sulphur dioxide	2.400	3.200	0.128	5.728
Methane	0.108	0.144	0.003	0.255
Volatile organic chemicals	1.200	1.600	0.026	2.826

Note 1: Emission factors used from UKOOA 2002a based on methodology proposed by OGP

Note 2: Rig is estimated to consume @ 15 tonnes fuel/day for 40 days duration.

Note 3: 4 Standby vessels, each estimated to consume @ 5 tonnes fuel/day for 40 days duration.

Note 4: Atmospheric emissions for helicopter trips assumes flights for crew changes will occur 25 times (round trip) throughout the drilling programme. Fuel consumption is estimated at 5 tonnes per 1,000km with a return trip from Mt Pleasant Airport to the rig estimated at 256 kilometres.

4.8 Marine Discharges

As discussed in Section 6.8 (pages 6-17 to 6-18) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS, marine discharges from the exploration drilling programme will include discharge of WBM, drill cuttings, cement, drainage water and sewage.

BHPBP(F)C have employed several measure to reduce impacts to the marine environment from these discharges as detailed below:

- Planned use of water based mud (WBM) for all sections of the well with the selection of most environmentally benign mud and cement chemicals.
- Good housekeeping standards to be maintained on the rig to control the amount of hydrocarbons and other contaminants entering the drainage system. Appropriate drainage and sewage treatment systems will be on all rig/vessels. All discharges from the rig/supporting vessels will be treated and discharged according to the MARPOL Convention.
- All drilling chemicals to be assessed using the HOCNS methodology where appropriate, in accordance with the UK's Offshore Chemicals Regulations (OCR) 2002. Any chemicals with substitution warnings will be substituted where practicable.

Due to the low toxicity of the majority of the discharges and the anticipated dilution and dispersion, all impacts are predicted to be short-term and localised and assessed to be negligible.

4.8.1 Water Based Mud (WBM)

WBM will be discharged as mud on cuttings and fine solids and, upon the completion of drilling each section of each well, the spent WBM will be discharged to sea. The drilling mud composition is essentially a brine solution, with naturally occurring barite and bentonite clay. Small amounts of chemicals are added to this to maintain the properties of the mud and to prevent damage to the well bore and the reservoir.

The main components of WBM will comprise natural products (for example, brine, bentonite and barite), which are biologically inert. The muds typically have a very low toxicity, with an LC_{50} of more than 50,000 parts per million (*Jones et al., 1986; Leuterman et al., 1989*). In fact, the WBM comprises approximately 90 percent water and the vast majority of WBM discharged for the well are classified under Annex 6 of the OSPAR convention (*OSPAR, 1999*) as substances, which are considered to Pose Little Or No Risk to the environment (PLONOR chemicals) (refer to Tables 2.4 and 2.5 in Section 2.4).

Of the limited quantity of chemicals not classified as PLONOR and anticipated to be discharged along with the WBM, all are categorised as Category E or Gold (the lowest environmental risk category) under the UK Harmonised Offshore Chemical Notification Scheme.

Studies of the discharge of WBM into the water column in areas where currents are weak have found dilutions of 500 to 1,000 times within one to three metres of discharge *(Ray and Meek, 1980)*. Dilution will therefore be rapid and this, together with the low toxicity, indicates that any impacts within the water column will be undetectable shortly after discharge. Discharge of the WBM will not contribute to any impacts on the local seabed communities through toxicity, bioaccumulation, low biodegradability or other aspects such as the endocrine disruption.

In some cases drilling muds may be associated with elevated levels of heavy metals. However, a wide range of studies have shown that these are not bio-available and do not therefore result in any direct affects on marine fauna and flora (*Neff et al., 1989*).

4.8.2 Cement Chemicals

During drilling of the wells, some surface returns of cement and associated chemicals will be lost to the seabed in the immediate vicinity of the well. Only a small volume of cement will be lost from the well. The cement is comprised mostly of PLONOR chemicals (refer to Tables 2.6 and 2.7 in Section 2.4). All chemicals to be discharged which are non-PLONOR have a HQ band of GOLD or E (lowest environmental risk category) for the purposes of CHARM assessment. Any impacts will be very close to the wells in the same area affected by cuttings deposition (refer to Section 4.5.2 above).

4.8.3 Drainage Water and Sewage

Water generated from rig washdown and rainfall from the open deck areas may contain trace amounts of mud, lubricants and residual chemicals from small onboard leaks derived from activities such as re-fuelling of power packs or the laying down of dirty hoses or dope brushes etc. It should be stressed, however, that these would be relatively low volume discharges containing small residual quantities of contaminant. BHPBP(F)C will ensure that the rig is equipped with suitable containment, treatment and monitoring systems as part of the contract specification.

In addition, the BHPBP(F)C Drilling Representative will also ensure good housekeeping standards are maintained onboard the rig to minimise the amount of hydrocarbons and other contaminants entering the drainage systems. Liquid storage areas and areas that might otherwise be contaminated with oil are generally segregated from other deck areas to ensure that any contaminated drainage water can be treated or accidental spills contained. All the drains from the rig floor will be directed to a containment tank and the fluids processed/filtered to remove hydrocarbons (<15 parts per million hydrocarbons in water) as required under the MARPOL Convention and discharged to sea. Residual hydrocarbons will be routed to transit tanks for processing onshore.

An estimated 0.22 m^3/day of grey water and 0.10 m^3/day of black water will be generated by each person on board the drilling rig and support vessels (based on previous modelling and assumptions for offshore drilling operations (*BP, 2002*). Table 4.5 show the estimated volumes of grey and black water produced per day from the drilling of the exploration wells (assuming 100 persons onboard).

Table 4.5: Estimated daily quantities of grey and black water discharge

Type of water	Volume(m^3)
Grey water produced (m^3)	22
Black water produced (m^3)	10

A Marine Sanitation Device will be available on the drilling rig for treatment of sewage effluent. Sanitary wastes such as black (sewerage) and grey water (showers and washing facilities) will contain detergents and cleaning agents from toilets and showers, together with human waste. All black water is routed via sewage treatment systems before being discharged to sea.

Of note is that all discharges from the rig/supporting vessels will be treated and discharged according to the MARPOL Convention. In addition, all vessels, including the rig, will implement appropriate waste management plans.

4.9 Solid Wastes

Careful consideration is given to minimising the amount of waste generated and controlling its eventual disposal. It is acknowledged that waste disposal and treatment options in the Falklands are limited, and a tailored project waste management plan is currently being developed for the project by BHPBP(F)C.

Typically, 24 tonnes of general waste are generated per month from a single well drilling programme. Bulk wastes (e.g. garbage, scrap, etc.) generated on the drilling rig will be segregated by type, stored in covered, four tonne capacity skips. Periodically these will be transported to shore (waste will be disposed of on the Falkland Island with hazardous waste likely to be exported to the UK, Chile or Uruguay) and the waste recycled or disposed of in a controlled manner through authorised waste contractors.

BHPBP(F)C will ensure that a waste management programme is implemented to minimise the amounts generated and to ensure material such as scrap metal, waste oil and surplus chemicals are sent for re-cycle or re-use as far as practicable. Other waste will be sent to authorised landfills or incineration facilities, depending on its precise nature, to the Falklands, if practicable, or an alternate location.

All discharges from the supporting vessels will be treated and discharged according to the MARPOL Convention, which prohibits discharge of any garbage or solid wastes into the marine environment.

All vessels, including the rig, will implement appropriate waste management plans and store and dispose of all solid wastes onshore accordingly. Procedures for dealing with hazardous waste will be implemented in accordance with UK regulatory guidelines and the Toroa drilling waste management plan.

4.10 Loss of Containment

4.10.1 Potential Spill Scenarios

Potential spills risks from drilling operations are discussed within Section 6.10.1 (pg 6-19 to 6-20) of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS and have remained unchanged.

4.10.2 Oil Spill Modelling

For oil spill planning purposes, the spill modelling originally provided within the EIS has been re-run for this Operational Addendum using the BMT (BMT Cordah is a UK based environmental consultancy and information systems company) OSIS 4.2 spill model. As the rig is now known, modelling has been included to simulate the loss of the entire inventory of diesel from the Ocean Guardian rig located at Toroa. In addition, as a result of comments received on the EIS, trajectory modelling has been run to estimate a worst case beaching time to Beauchene Island and Sea Lion Island, both of which are closer to the proposed exploration well than the East Falklands coastline. The predicted maximum volumes of crude, which may be released during a worst-case blow out scenario, have also been re-calculated and a 31°API crude oil has been used rather than an 18°API crude oil, as this is the predicted API type for Toroa.

In the absence of tidal cycle data, the residual surface current speed and direction observed in the vicinity of the Toroa was input into the OSIS model. This data was obtained from current meter installed at the proposed Toroa well location (refer to Section 3.1.4). A blanket current of 0.3 knots in the direction of bearing 041 degrees was input into the model. This prevailing current speed and direction is in general agreement with the prevailing currents observed in the area of the well at the time of year, according to the Admiralty pilot for the Falkland Islands area.

For the stochastic modelling scenarios, wind rose data for the month of April was selected from the relevant Admiralty pilot for the area. The wind rose data was also analysed for the subsequent months and it was noted that the wind rose data for the months of April, May and June were very similar, with winds from the south-west, west and north-west slightly increasing in speed in May and June. Therefore, in the unlikely event that the spud date of the well slips into preceding months of either May or June, the stochastic modelling results will not be significantly affected. Further, the increased wind speeds indicated above in May and June will have the effect of encouraging the oil to disperse further offshore, and therefore using the April wind rose data presents a worst case scenario in terms of possible beaching.

For the trajectory modelling, a 30 knot wind was chosen to represent a worst case scenario, as outlined in the UK's guidance notes relating to The Merchant Shipping (Oil Pollution Preparedness, Response Co-operation Convention) Regulations 1998, produced by the Department of Energy and Climate Change.

Given the above, the following scenarios have been modelled:

1. The weathering of the full rig inventory (1,108 tonnes) instantaneous diesel spill with a 30 knot onshore wind towards Sea Lion Island (Figure 4.7);
2. The weathering of the full rig inventory (1,108 tonnes) instantaneous diesel spill with a 30 knot onshore wind towards Beauchene Island (Figure 4.8);
3. The weathering of well blow out of 31° API crude oil (115.2 tonnes per hour for 48 hours) with a 30 knot onshore wind towards Sea Lion Island (Figure 4.9);
4. The weathering of well blow out of 31° API crude oil (115.2 tonnes per hour for 48 hours) with a 30 knot onshore wind towards Beauchene Island (Figure 4.10);
5. The weathering of a spill plume of diesel (1,108 tonnes instantaneous) from the loss of a full rig inventory under 'prevailing' currents and 'typical' weather conditions (stochastic) from the Toroa well location (Figure 4.11).
6. The weathering of a spill plume of 31° API crude oil (115.2 tonnes per hour released over 48 hours) derived from a well blowout event lasting two days under 'prevailing' currents and 'typical' weather conditions (stochastic) from the Toroa well location (Figure 4.12).

The results of the modelling are summarised in Table 4.6, below. Note that for oil spill planning purposes a radius of 30 kilometres was drawn around Beauchene Island and Sea Lion Island to represent the possible extent of wildlife foraging areas.

Table 4.6: Toroa Exploration Wells OSIS Modelling Results

Oil Type	Spill Size	Scenario	Met-ocean Conditions	Fate of Spill	Figure
Diesel	1,108 tonnes (instantaneous release)	Full rig inventory instantaneous spill from Toroa	Trajectory 30 knot onshore wind towards Sea Lion Island (119°)	Diesel disperses within 9 hours, 38 kilometres south-east of the Sea Lion Island foraging area boundary and 68 kilometres from the closest landfall (Sea Lion Island). No beaching occurs.	4.7
Diesel	1,108 tonnes (instantaneous release)	Full rig inventory instantaneous spill from Toroa	Trajectory 30 knot onshore wind towards Beauchene Island (87°)	Diesel disperses within 9 hours, 29 kilometres east of the Beauchene Island foraging area boundary and 59 kilometres from the closest landfall (Beauchene Island). No beaching occurs.	4.8
31° API Crude	115.2 t / hour (48 hours)	Well blowout from the Toroa well	Trajectory 30 knot onshore wind towards Sea Lion Island (119°)	Slick enters the foraging area surrounding Sea Lion Island after 30 hours at sea, and beaches on the south-eastern shores 44 hours after the spill.	4.9
31° API Crude	115.2 t / hour (48 hours)	Well blowout from the Toroa well	Trajectory 30 knot onshore wind towards Beauchene Island (87°)	Slick enters the foraging area surrounding Beauchene Island after 25 hours at sea, and beaches on the eastern shore 41 hours after the spill.	4.10
Diesel	1,108 tonnes (instantaneous spill)	Full rig inventory spill from Toroa	Stochastic Typical weather conditions with 'prevailing' currents	Predominant movement to the east-north-east, away from Sea Lion Island and Beauchene Island. No beaching occurs.	4.11
31° API Crude	115.2 t / hour (released over 48 hours)	Well blowout from the Toroa well	Stochastic Typical weather conditions with 'prevailing' currents	Predominant movement to the east-north-east, away from Sea Lion Island and Beauchene Island. 2% probability of beaching on the east Island; beached volume 253m^3.	4.12

The red line shown in Figures 4.7 to 4.10 below, represents the main path of the leading edge of the oil slick. The black dots represent the general path of the dispersion of the oil slick as the oil spreads out on the sea surface. The general movement and dispersion of the oil is influenced by both the currents in the water and the winds acting on the surface of the oil. The general effect on the movement of the oil is the resultant of the two forces. In the modelling results presented in the figures below, it can be seen that the movement of the oil is predominantly wind driven, due to the weak current applied (0.3 knots in direction 041^o). However, the current still has a small effect on the movement. This can most clearly be seen in Figure 4.7, where the path of the oil is predominantly wind driven (30 knots towards Sea Lion Island), but it can also be seen that the oil slick also disperses slowly towards the north-east due to the effect of the current, as the black dots indicate.

Figure 4.7: Trajectory model run of total fuel inventory loss from the rig (1,108 tonnes) released instantaneously at the Toroa exploration well location under worst case 30 knot onshore wind conditions towards Sea Lion Island

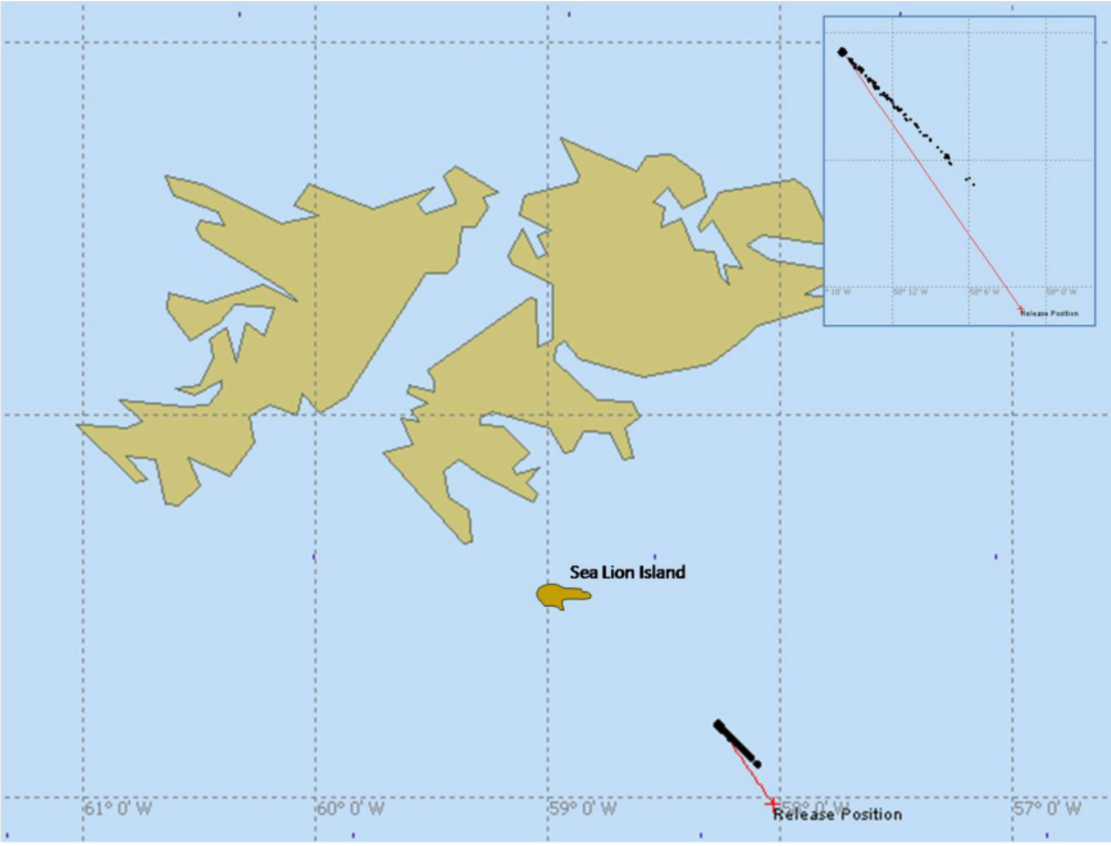


Figure 4.8: Trajectory model run of total fuel inventory loss from the rig (1,108 tonnes) released instantaneously at the Toroa exploration well location under worst case 30 knot onshore wind conditions towards Beauchene Island

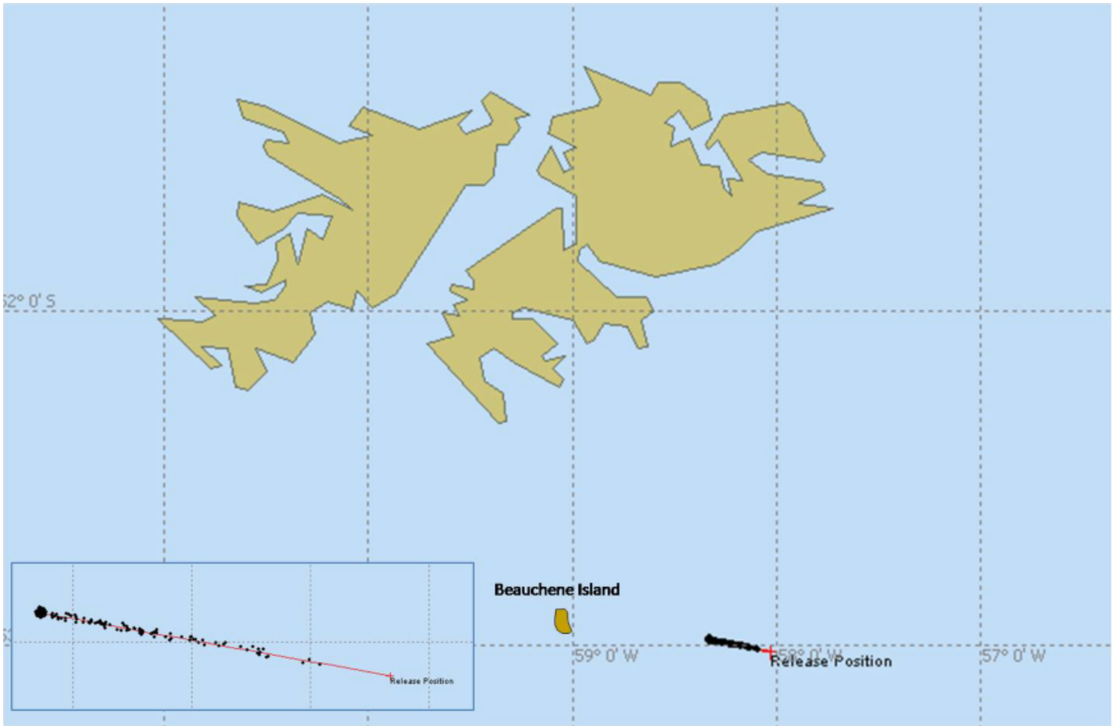


Figure 4.9: Trajectory model run of well blowout (115.2 tonnes per hour for 48 hours) of 31° API crude oil released at the Toroa exploration well location under worst case 30 knot onshore wind conditions towards Sea Lion Island

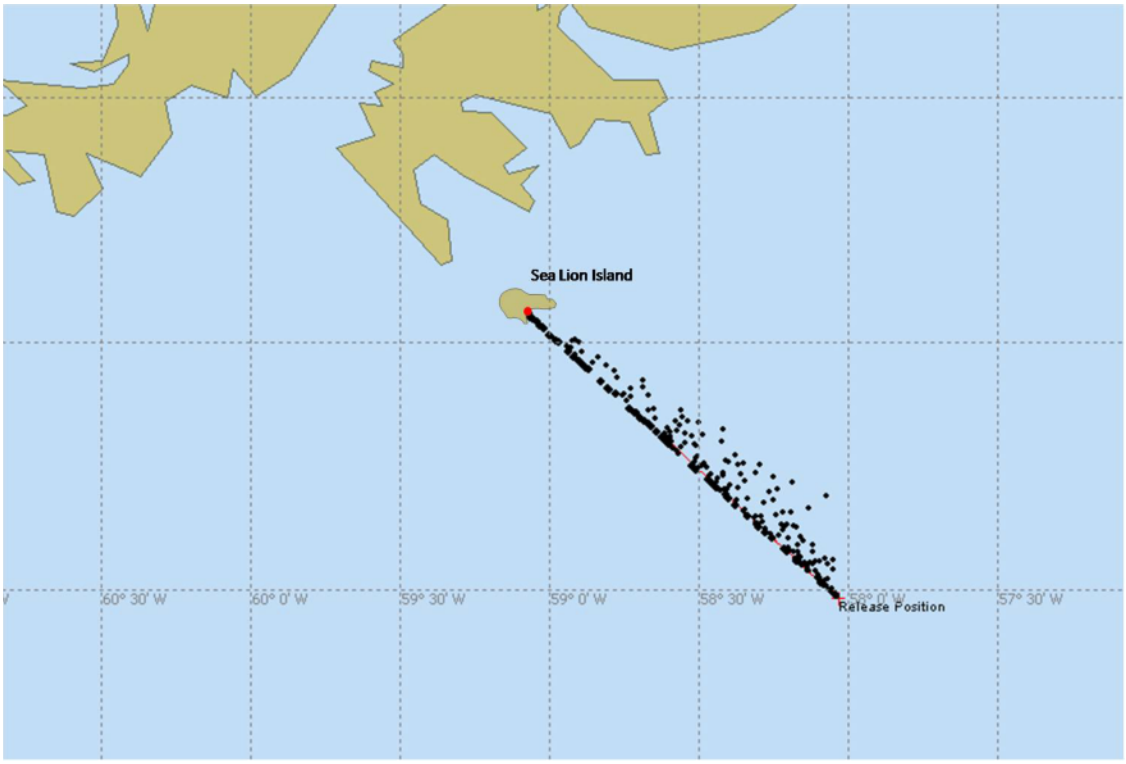


Figure 4.10: Trajectory model run of well blowout (115.2 tonnes per hour for 48 hours) of 31° API crude oil released at the Toroa exploration well location under worst case 30 knot onshore wind conditions towards Beauchene Island

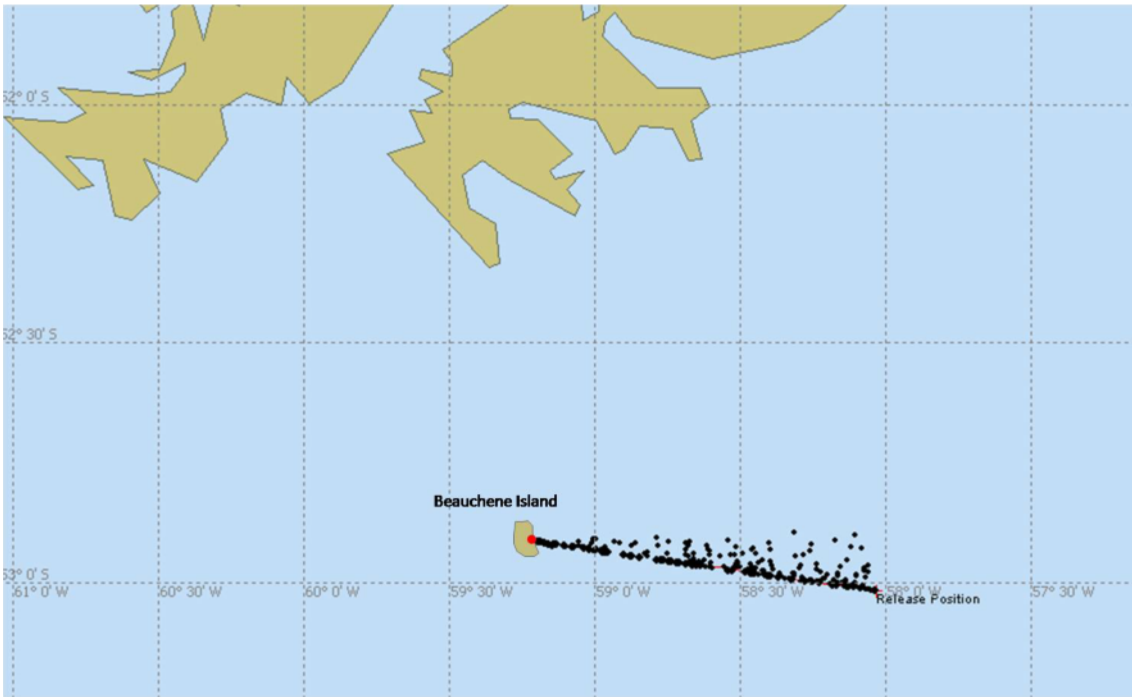


Figure 4.11: Stochastic model run of total fuel inventory loss from the rig (1,108 tonnes) released instantaneously at the Toroa well location under typical wind conditions

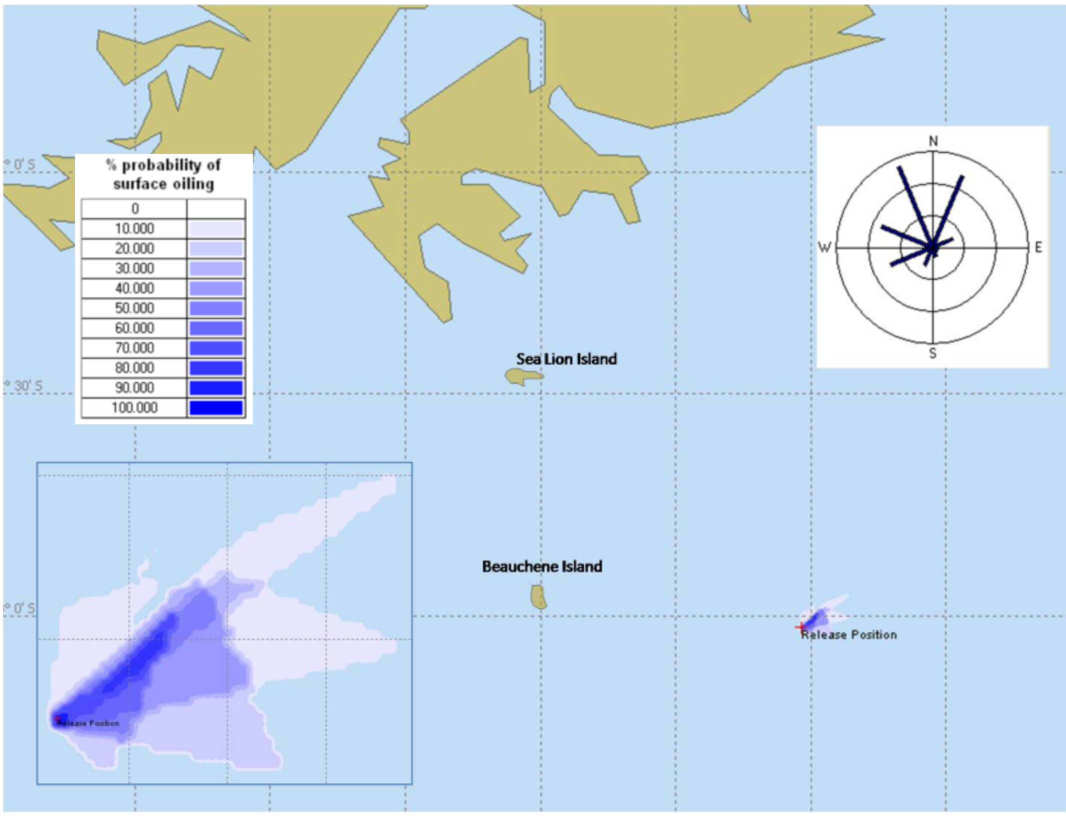
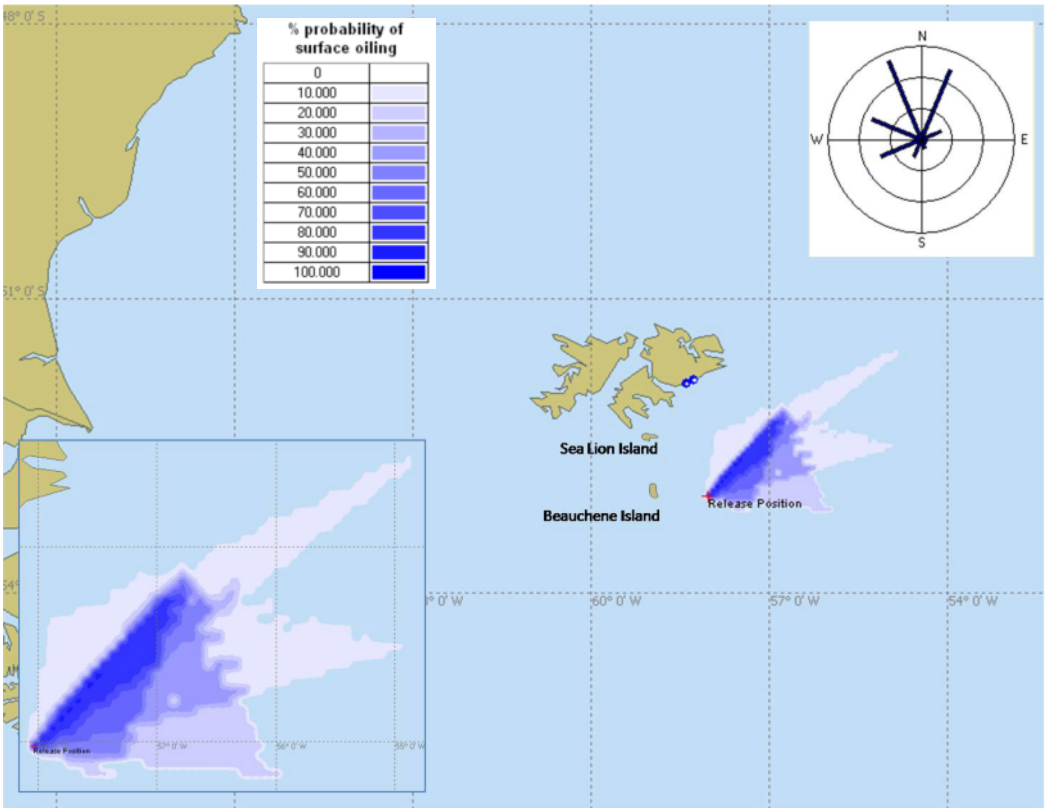


Figure 4.12: Stochastic model run of well blowout (115.2 tonnes per hour for 48 hours) of 31° API crude oil released at the Toroa well location under typical wind conditions



Summary of Modelling Results

Trajectory modelling of the entire diesel inventory of the rig released instantaneously from the Toroa well location with a worst case 30 knot onshore wind showed that the oil dispersed offshore within 9 hours, without beaching on Sea Lion Island or Beauchene Island or crossing into the 30 kilometre foraging area radii (Figures 4.7 and 4.8).

Stochastic modelling of the entire diesel inventory of the rig, using typical wind conditions for the area obtained from Admiralty pilots, indicated that the diesel would weather offshore with the oil drifting and dispersing in a north-easterly direction (Figure 4.11). The modelling indicated a zero percent chance of the oil beaching.

It should be noted that the stochastic modelling scenario is more likely to reflect the actual fate of any oil that is spilt, as it is based upon the prevailing meteorological conditions for the area. The trajectory modelling scenarios, as illustrated in Figures 4.7 and 4.8 represent a worst case scenario whereby the spill is forced towards the coastline with a 30 knot wind. In reality such strong onshore winds are highly unlikely to occur for any significant length of time.

In the event of a well blowout from Toroa, it is estimated that 115.2 tonnes of 31° API crude per hour would be released for a maximum period of 48 hours. Trajectory modelling of this worst case scenario, using a 30 knot onshore winds towards Sea Lion Island, shows the slick entering the foraging area after 30 hours and beaching after 44 hours (Figure 4.9). Trajectory modelling of the same scenario, using a 30 knot onshore wind towards Beauchene Island, indicates that the slick enters the foraging area after 25 hours and beaches after 41 hours (Figure 4.10).

Stochastic modelling, using typical wind conditions for the area obtained from Admiralty pilots, indicated that a well blowout of 31° API crude (115.2 tonnes per hour for 48 hours) is likely to weather offshore with the oil drifting and dispersing in a north-easterly direction (Figure 4.12). As discussed above, this scenario is more likely to reflect the actual fate of any oil that is spilt, as it is based upon the prevailing meteorological conditions for the area.

The stochastic modelling indicates a two percent probability of the oil beaching on the coastline of the East Falklands, but predicts that no oil would beach on either Sea Lion Island or Beauchene Island (Figure 4.12). A two percent probability of oil beaching on the mainland is considered to be a very small probability and therefore is unlikely to occur. In addition, it should be noted that historically, the worldwide frequency of blow outs is approximately 0.0063 per well, or 1 in every 159 wells (*Holand, 1997*). Statistics from the World Offshore Accident Data Bank (WOAD) indicate that worldwide the frequency of occurrence of blowouts from mobile drilling units is only of the order of 10 per 1000 unit years (*WOAD, 1998*). This is supported by data from the UK, where over 3500 exploration, appraisal and development wells have been drilled from 1997 to 2008 (includes mechanical sidetracks) with no major blow outs. The probability of a blow out during drilling of the Toroa exploration well is therefore very low.

4.10.3 Seabird Vulnerability

Seabird vulnerability maps for the Falkland Islands are available within the report 'Vulnerable Concentrations of Seabirds in Falkland Islands Waters' (1998–2000), produced by the JNCC under contract to Falklands Conservation, with funding support from the FIG. 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 and well documented (White et al., 2001) and are not expanded upon further here.

Vulnerability of seabird species to oiling varies throughout the year, depending upon breeding, migratory patterns and at-sea conditions. The proposed Toroa exploration well is located away from the identified areas of highest seabird vulnerability. Highest vulnerability tends to be associated with the inshore waters around the Falklands Islands, largely due to the presence of resident species with a predominantly coastal distribution such as the endemic Falklands Steamer duck, imperial shag and gentoo penguin. The Patagonian Shelf waters to the north and west of the Falklands, which support high densities of black-browed albatrosses and royal albatrosses year-round are also associated with high vulnerability areas, but again these are remote from the proposed drilling location (refer to Section 3.2.5).

The results of the stochastic model run for a well blow-out (115.2 tonnes per hour for 48 hours) of 31° API crude oil released at the Toroa well location under typical wind conditions have been overlain onto the seabird vulnerability maps for April, May and June. It can be seen from this that a major spill from Toroa is likely to interact only with areas of lowest seabird vulnerability.

Figure 4.14: Seabird Vulnerability to Oiling Overlain with Stochastic model run of well blowout (115.2 tonnes per hour for 48 hours) of 31° API crude oil released at the Toroa well location under typical wind conditions

April

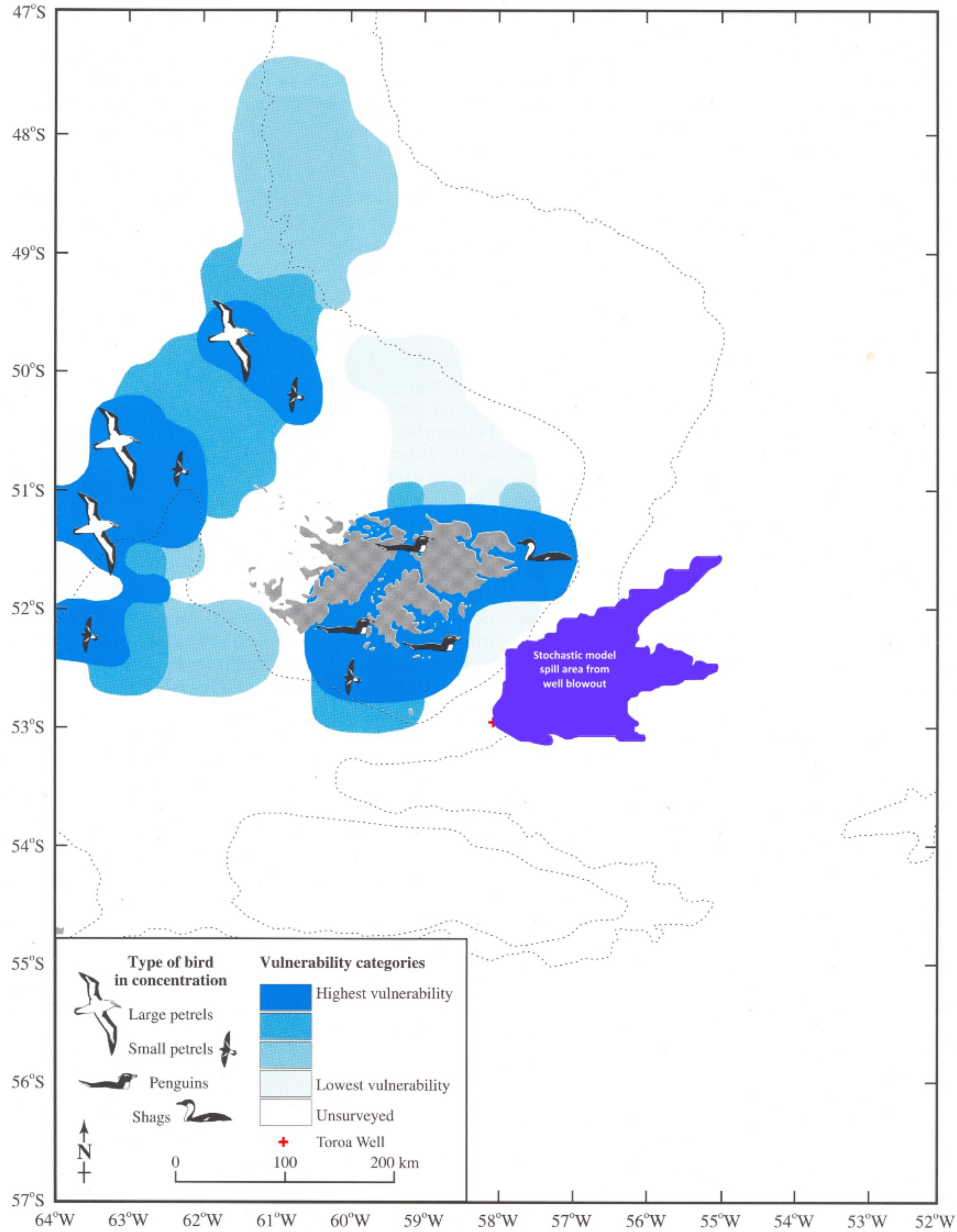


Figure 4.14 (continued): Seabird Vulnerability to Oiling Overlain with Stochastic model run of well blowout (115.2 tonnes per hour for 48 hours) of 31° API crude oil released at the Toroa well location under typical wind conditions

May

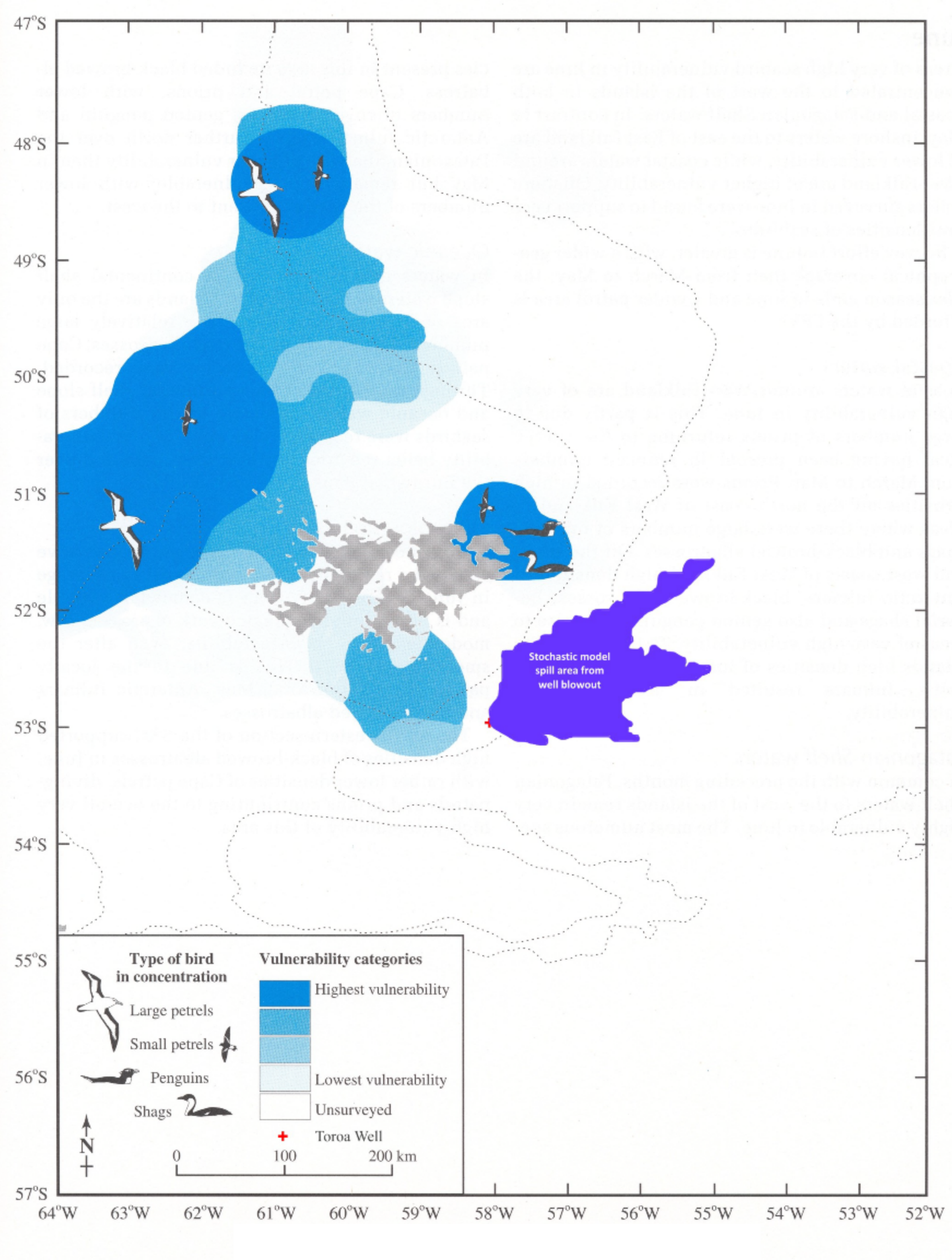
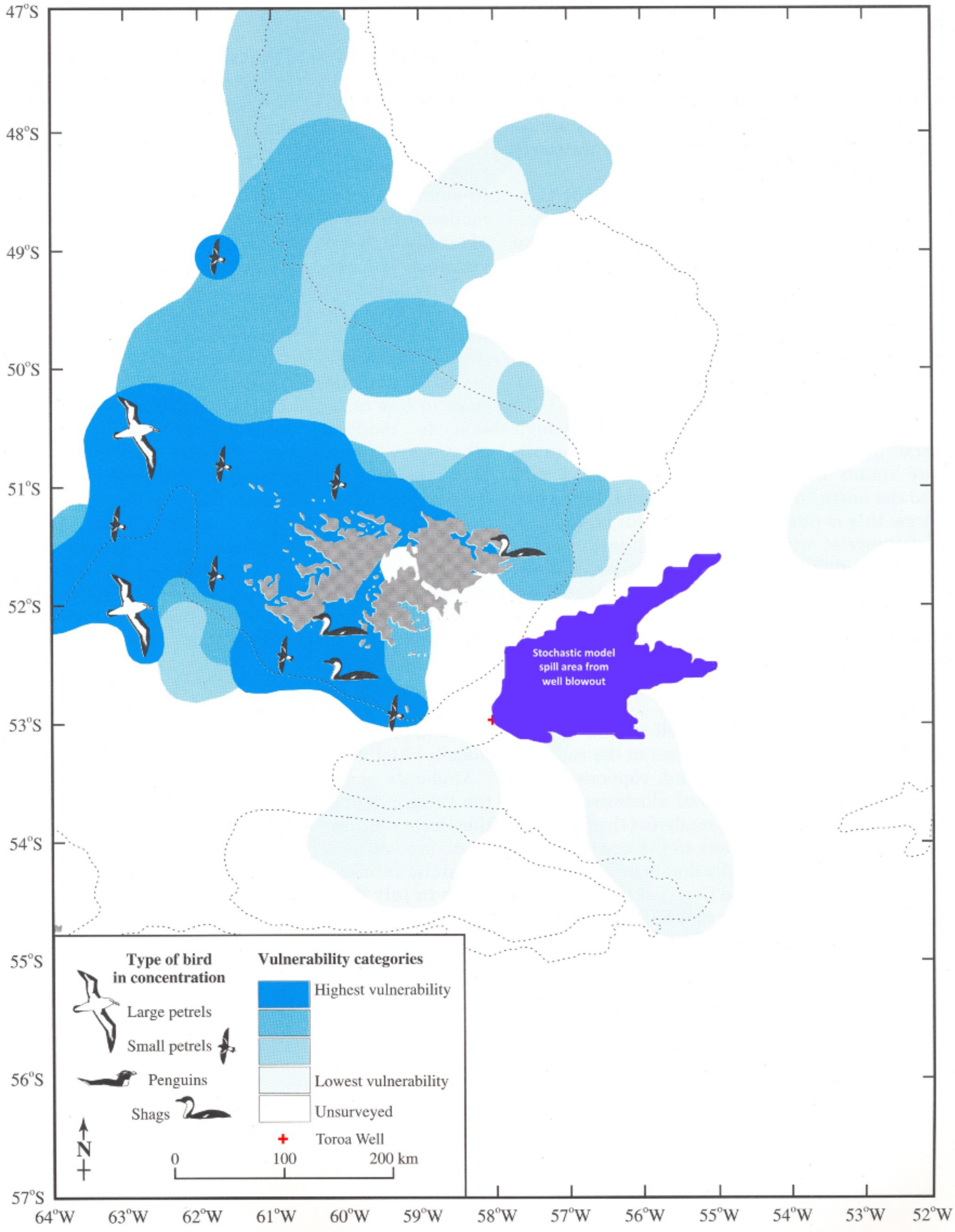


Figure 4.14 (continued): Seabird Vulnerability to Oiling Overlain with Stochastic model run of well blowout (115.2 tonnes per hour for 48 hours) of 31° API crude oil released at the Toroa well location under typical wind conditions

June



4.10.4 Potential Offshore Impacts

Offshore, the groups of animals that are most obviously distressed by a marine oil spill are the plankton, fish, seabirds and mammals.

Plankton occupies the upper layers of the water column and may be exposed to toxic water soluble components from spills. The most serious consequence of this is seen where the water body is relatively small, i.e. in shallow, inshore water. However plankton show great variability in time and space and therefore the direct effects of oil are difficult to measure.

Spill events offshore may cause lethal effects in adult fish with hydrocarbon levels of above one part per million. Fish larvae tend to be more susceptible and lethal effects may occur above 0.1 parts per million. Sub-lethal effects may be observed at low parts per billion concentrations; this can result in behavioural changes or narcosis (*Baker et al, 1990*).

There has been some research into the lethal and sub-lethal effects of exposure of fish embryos and larvae to hydrocarbon pollutants. Crude oil or its water soluble components are known to induce histopathological effects in fish following chronic exposure (*Khan and Kiceniuk 1984*). Fish tend to harbour a variety of parasites, most of which under natural conditions cause little or no apparent harm. However, after chronic exposure to petroleum hydrocarbons, the prevalence and intensity of parasitism increases substantially (*Skinner 1982; Khan 1987; Khan and Kiceniuk 1988*).

Interpretations of the biological impact of different oil spills have varied tremendously. For instance, little damage to subtidal marine organisms which could be attributed to oil were recorded following the Torrey Canyon spill (*Smith, 1968*) or the Santa Barbara spill (*Straughan, 1971*). However, substantial and long lasting damage to the subtidal marine biota was recorded following the wreck of the Tampico Maru (*North et al., 1965*) and the West Falmouth oil spill (*Blumer et al., 1970*). These differences can be attributed in part to differences in the environmental and geographic conditions at the spill sites and to differences in the nature of the oils spilled.

Three biomarkers of hydrocarbon exposure, CYP1A in liver vascular endothelium, liver ethoxyresorufin *O*-deethylase (EROD), and biliary fluorescent aromatic compounds (FACs), were examined in the nearshore fishes, masked greenling (*Hexagrammos octogrammus*) and crescent gunnel (*Pholis laeta*), collected in Prince William Sound, Alaska, 7–10 years after the *Exxon Valdez* oil spill (EVOS). All three biomarkers were elevated in fish collected from sites originally oiled, in comparison to fish from unoiled sites. Evidence shows that 10 years after the spill, nearshore fishes within the original spill zone were still exposed to residual EVOS hydrocarbons (*Jeweet et al, 2001*).

BHPBP(F)C are also aware that fish egg and larval stages may be particularly vulnerable to the effects of hydrocarbon pollutants such as PAHs. Two surveys were carried out in 1993 and 1994 to measure the concentrations of oil in water and the associated effects on fish larvae along two north-south sections (between latitude 57.00°N and 62.00°N and between longitude 0.0°E and 1.5°E) through the northern North Sea by Stagg and McIntosh *(1996).* A distinct north-south gradient in hydrocarbon concentration peaking around installations associated with oil and gas exploration and production was found. The hydrocarbon levels in the top 50 metres of water between 56.00 and 59.00°N were elevated compared to those in deeper water. 7-Ethoxyresorufin *O*-deethylase (EROD) activity was measured in pooled samples of both sandeel and gadoid larvae. For both species the range of EROD activities was large and variable, thought most likely due to damage to larvae associated with capture and subsequent denaturation of the enzyme. However elevated EROD activity in samples taken where hydrocarbon fluorescence in the water was clearly high, showing significant regression of EROD activity with hydrocarbon concentration. The results presented by Stagg and McIntosh *(1996)* suggest a significant elevation of hydrocarbons in a large area of the northern North Sea and that these concentrations are capable of inducing biological responses associated with deleterious effects in fish larvae.

As discussed in Section 3.2.2, however, sampling throughout the Falkland waters and the Patagonian shelf has shown that the greatest number of unidentified fish eggs (indicating early life stages) are found in the slope waters and deeper parts of the continental shelf (<400 metres), shallower than the water depth at Toroa. In addition, fifty percent of all larvae collected during surveys over four years (1992-1995) were found in the 800-1,000 metre depth range, deeper than the water depth found at the Toroa exploration well location.

The effect on bird mortality following an oil spill depends on the size of the local bird populations, their foraging behaviours, whether populations are aggregated or dispersed at the time of the spill, and on the quantity of oil spilled and its persistence. After contact oil can kill birds by removing the insulative property of their feathers and through toxilogical effects after ingestion (Piatt*, J.F et al.* 1996).

Piatt, J.F et al (1996) studied the immediate impact of the 'Exxon Valdez' oil spill on marine birds. They found that most birds retrieved 7 months after the spill were un-oiled species that apparently died of starvation. The observed mortality was similar to that which occurred in the Gulf of Alaska following a spill in 1983 (Nysewander and Trapp 1984). In that event tens of thousalnds of adult shearwater, kittiwake and other seabirds died of starvation several months after the initial spill due to losing their food supply from reduced fish levels in the water (*Piatt, J.F et al 1996).*

It should be noted, however, that the likelihood a spill during the exploration programme is highly unlikely. In planning its activities, BHPBP(F)C endeavour to ensure that all practicable measures are taken to prevent the loss of hydrocarbon containment (refer to Table 4.7). In the event of a release of hydrocarbons to the marine environment, BHPBP(F)C will enact both an appropriate and proportionate spill response. With respect to the exploration programme, the main spill risks are associated with accidental fuel spills from vessels during bunkering or as a result of vessel impacts. The risks related to the initial exploration drilling operations will be minimised through the employment of various controls and procedures such as the auditing of all vessels, implementation of bunkering and fuel transfer procedures, development of an oil pollution emergency plan (OPEP), vessel management and co-ordination plans.

Table 4.7: Planned Control Measures for Potential Sources of Oil Spills

Potential Source of Spill	Risk and Control Measures Taken
Fuel or other utility fluids (e.g. diesel, lubricants)	When refuelling is undertaken at sea, a refuelling procedure will be implemented, and will contain measures such as the following: • Where practicable, re-fuelling and transfer of lubricants and other utility fluids will only be undertaken during daylight and in good weather conditions. Non-return valves will be installed on fuel transfer hoses, hoses will be tested and inspected as a part of a regular maintenance programme and operations will be supervised at all times from both the supply boat and drill rig. • Bunding is integral to the fuel, oil and liquid storage areas. • The rig will be equipped with sorbent clean-up materials and storage capacity for recovered oil and sorbent. The crew are trained in oil spill response actions. An oil spill contingency plan will be in place and will compliment the Falkland Islands national oil spill plan.
Loss of well control	Precautions to prevent loss of well control include: • shallow gas survey • appropriate well design and engineering, such as using a blowout preventer • well monitoring programme • conducting well control training and emergency drills.

4.11 Cumulative Impacts

The potential for cumulative impacts will arise from the drilling operation itself during which time the rig and support vessels will pose an additional shipping hazard in the area and from the legacy it will leave in terms of atmospheric greenhouse gases and the cuttings and mud discharged. However it is not anticipated that the short-term exploratory drilling campaign will significantly, or permanently, add to these existing cumulative impacts.

The rig will be shared by a number of operators, each drilling their respective wells in a programmed sequence, therefore there is unlikely to be any temporal overlap in operations. In addition, the wells being planned by other operators are located a considerable distance from each other, so the likelihood of any spatial overlap of impacts from different drilling operations must be considered to be remote.

Cumulative solid waste generation from the drilling campaign will be minimised and managed through the implementation of a Waste Management Plan, a separate document which will define specific waste handling/disposal routes and procedures.

Modelling has shown that cuttings from the Toroa well will be deposited along a north north-easterly to south south-westerly orientated axis. The distance covered along this axis is approximately 11 kilometres and the maximum width of the pile is around 1.3 kilometres (when measured to the 0.01 mm thickness contour). Given the distance of the closest other well to be drilled, the proposed Loligo well located approximately 310 kilometres to the north-east, it is very unlikely that the two cuttings pile would overlap. As such no cumulative impacts are anticipated from the discharged cuttings and mud.

In summary, cumulative environmental effects from the planned exploration programme offshore the Falkland Islands are unlikely given the short term nature of the wells, the fact that they will be plugged and abandoned and that exploration activities are planned over a wide area. Over time, impacts from drilling will be undetectable so there is no cumulative impact. Positive socio-economic effects are possible over time as they will be concentrated in a single location (Stanley) for all drilling operations both to the north and south of the island.

5 Management Framework

5.1 Introduction

Environmental management of the Toroa drilling programme will be conducted within a comprehensive framework comprising:

- BHP Billiton's Charter;
- BHP Billiton's Sustainable Development Policy;
- BHP Billiton Petroleum's Health, Safety and Environment Management System;
- Contractor HSE Policy Statements;
- Contractor HSE Management Systems;
- Management System Interface Documents;
- Contractor operational controls and specific environmental procedures for the drilling Environmental Management Plans (EMPs).

A detailed description of this framework, including BHP Billiton Petroleum's Health, Safety and Environment (HSE) Management System (August 2009), BHP Billiton's Sustainability Policy Statement (which includes environmental commitments and goals and aspires to zero harm to the environment) and BHP Billiton's Charter was previously provided within Section 7 of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS and therefore has not be repeated within this Operational Addendum.

The application of the HSE MS during the drilling of the proposed Toroa exploration well will ensure that BHP Billiton's Sustainability Policy Statement and Charter is followed and that the Company's responsibilities under all relevant regulations are met.

5.2 Environmental Management Plan (EMP)

In order to ensure that appropriate mitigation measures, identified following the EIS process, are implemented during the planning and drilling of the proposed Toroa exploration well, an Environmental Management Plan (EMP) has been prepared.

The EMP identifies actions required, assigns responsibilities and sets target dates for completion. The register will act as a 'live' document to track progress through to cessation of drilling activities. It will provide guidance for the drilling contractor and can also be used by BHPBP(F)C to monitor contractor performance with regard to environmental issues. Should monitoring indicate unacceptable environmental performance, the EMP provides a mechanism to initiate remedial action.

An EMP was previously provided within Section 7.7 of the BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS. This EMP has been reviewed and revised, where appropriate, for this Operational Addendum (refer to Table 5.1).

Table 5.1: Environmental Management Plan

Project Phase & Activities	Aspect / Objective	Management and Mitigation Measures	Responsible Parties	Monitoring
1.0 PRE-ESTABLISHMENT PHASE				
1.1. Pre-drilling planning	Accommodation of needs for environmental monitoring and liaison with fishing industries	In order to minimise disruption to the drilling and other users of the sea: • Determine the extent of local fishing activities. • Establish contact with Fisheries Department. • Verify procedures for notifying local interests (including tourism industry.	BHPBP(F)C	
1.2. Emergency preparedness	Preparation for any emergency that could result in an environmental impact	Have the following emergency plans, equipment and personnel in place to deal with all emergencies: • Company (or representative) Emergency Response Plan; • Drilling Contractor Emergency Response Plan; • Oil Spill Contingency Plan	BHPBP(F)C & Diamond Offshore	Management Audit
1.3. Permitting & approvals	Compliance with legislative requirements	Licensing of contractor and pre-notification with FIG.	BHPBP(F)C & Diamond Offshore	Legal Register
2.0 ESTABLISHMENT PHASE				
2.1 Compliance with EMP	Operator and contractor to commit to adherence to EMP Establish necessary bridging documents to BHP Billiton Petroleum HSEC MS	Ensure that a copy of the approved EMP is on the drill rig and support vessels during the drilling programme. Appropriately inform the rig and shipboard personnel of the purpose and requirements of the EMP. Ensure correct equipment and personnel are available to meet the requirements of the EMP. Operator to commit organisation and contractor to meet the requirements of the EMP.	BHPBP(F)C & Diamond Offshore	Audit results Training records
2.2 Notifying other users	Ensure that other users are aware of the forthcoming drilling operation	Liaise with Fisheries Department at FIG, local fisheries interests, tourism industry, as well as the British Military. Issue Radio Navigation Warnings and Notices to Mariners as	BHPBP(F)C & Diamond Offshore	Records of communications Copies of notices issued

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Project Phase & Activities	Aspect / Objective	Management and Mitigation Measures	Responsible Parties	Monitoring
		appropriate.		
3.0 OPERATIONAL PHASE				
3.1 Use of Resources				
Adherence to EMP Implementation of mitigation measures	Fuel consumption Drilling muds Sea water abstraction	• Extensive planning to ensure that no strains are placed on current capacities. • Appropriate and well-maintained equipment. • Accurate monitoring and recording of consumption figures. • Minimisation of water use. Appropriate use of water resources.	Party Chief Chief Mechanic Drilling Manager Project Manager	Record of fuel used. Maintenance records External HSE audits Internal HSE audits Incident reporting
3.2 Emissions to water				
	Grey water discharge Sewage discharge Food waste OWS discharge Cooling water Deck drainage	• Materials handling, operating and maintenance procedure. • Strict bunkering procedures to be implemented and monitored. • No contaminated and/or solid wastes to be discharged overboard. • Suitable contained storage of hydrocarbons and chemicals. • No release of chemical spills on deck overboard. • Contaminated water directed to the oil water separator (OWS). • Implement suitable waste segregation and storage. • Biodegradable cleaning agents used wherever possible. • Utilise IMO compliant sewage treatment plant.	Party Chief Chief Mechanic Drilling Manager Project Manager	Oil record log Maintenance records External HSE audits Internal HSE audits Incident reporting Survey Report

Project Phase & Activities	Aspect / Objective	Management and Mitigation Measures	Responsible Parties	Monitoring
	Oil/chemical spills Fugitive release of waste Ballast water exchange	• No discharge of 'high risk' ballast water in Falklands' waters. • Ballast water exchange to take place in open waters. • Use of ballast water management plan.		Ballast exchange records
3.3 Emissions to Air				
	Engine / generator emissions Incinerator emissions Fugitive emissions Fire fighting chemicals	• Regular maintenance of engines, compressors and generators. • Internal 'housekeeping audits' to check for leaks and spills. • Use of non ozone depleting fire fighting foam. • Batch processing waste to minimise operational time of incinerator, if one is available onboard the rig. • Incineration of non-hazardous combustible waste only. • Using designated personnel to carry out incineration. • Reduction of waste at source. • Recycling of waste where possible.	Party Chief Chief Mechanic Drilling Manager Project Manager	Monitor fuel consumption. Maintenance records Garbage record log Incinerator records External HSE audits Internal HSE audits Chemical inventory
3.4 Waste disposal				
	Onshore burial of waste Onshore incineration of waste	• Reduction of waste production and recycling of materials where possible. • No onshore disposal of hazardous wastes to landfill in the Falkland Islands.	Party Chief Drilling Manager	Garbage record log Waste disposal transmittals

Project Phase & Activities	Aspect / Objective	Management and Mitigation Measures	Responsible Parties	Monitoring
		• Correct segregation and appropriate containment of wastes prior to disposal. • Removing metal and hazardous wastes to appropriate disposal facilities. • Containment/netting of skips to prevent fugitive release during transport. • Where onshore incineration in an approved incinerator is a viable option, emissions abatement equipment should be used where available. • Proper disposal of ashes. • Correct segregation of wastes prior to disposal. • Disposal of waste at approved sites.	Project Manager	Survey Final Report
3.5 Underwater sound				
	Engine and propeller noise Drilling equipment	• Regular maintenance of vehicles and equipment. • Selection of appropriate drilling equipment and materials.	Party Chief Chief Surveyor	Maintenance records Internal HSE audits

Project Phase & Activities	Aspect / Objective	Management and Mitigation Measures	Responsible Parties	Monitoring
3.6 Physical Impacts				
	Vessel presence Emergency anchoring Lost equipment	• Use of water based bentonite mud. • Advanced consultation with FIG, Fisheries and the British Military. • Reasonable efforts made to retrieve lost equipment.	Party Chief Chief Surveyor Client Representative	External HSE audits Internal HSE audits Incident reporting HSE Statistics Drilling Final Report
4.0 POST-DRILLING PHASE				
4.1 Post-drilling area	Leave drilling area in an acceptable state	Ensure that all deployed equipment is retrieved.	Diamond Offshore	Equipment logs Incident reports
4.2 Inform relevant parties of drill completion	Ensure that relevant parties are aware that drilling work is complete	Inform the FIG of the drill completion.	BHPBP(F)C & Survey Contractors	Records of communications
4.3 Final waste disposal	Minimise pollution and ensure correct disposal of waste	Refer to Operational Aspects above.	BHPBP(F)C & Survey Contractors	Garbage book Waste transfer notes

6 Conclusions

This EIS Operation Addendum makes a thorough assessment of the potential impacts that may arise from drilling the proposed Toroa exploration well offshore the Falkland Islands. It has assessed seasonal sensitivities within the vicinity of the well during the proposed drilling period (April to June) with reference to the previously submitted BHPBP(F)C Offshore Falkland Islands Exploration Drilling (Licences 028 and 015) EIS.

The Addendum has also re-assessed the potential impacts from the proposed drilling campaign in light of the seasonal sensitivities and the further detailed project information, which is now available. Mitigation measures have been proposed for all potential impacts with extra attention given to those deemed to be of high to medium significance, in particular waste management and the accidental loss of containment. This will allow operations to proceed without any significant long lasting impacts to the marine or coastal environment of the Falkland Islands.

In conclusion, given the current operational commitments and proposed mitigation measures as detailed in Sections 4 and 5 of this Addendum, it is considered that the proposed Toroa drilling campaign can be undertaken without significant impacts to the Falkland Islands' environment.

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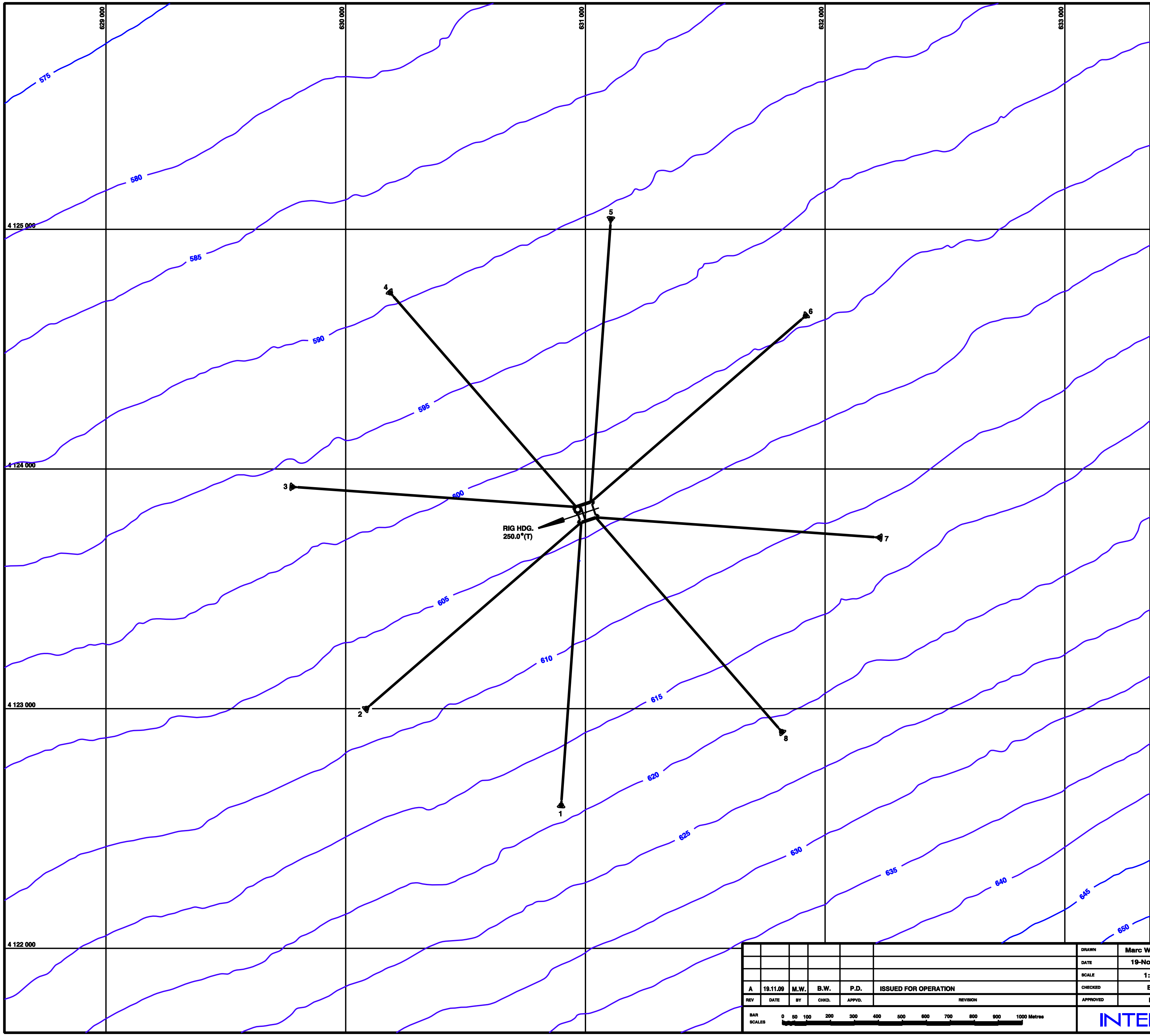
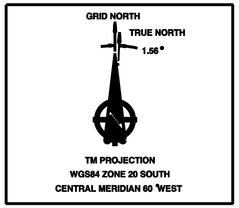
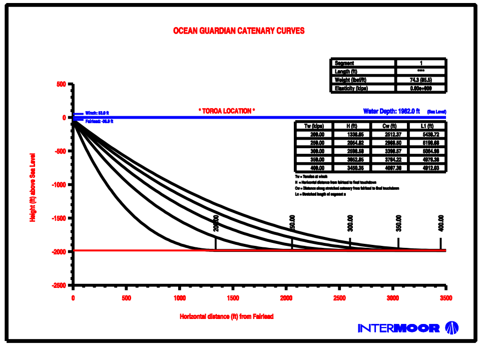
Appendix A – Indicative Anchor Pattern for the Ocean Guardian Rig Deployed at the Toroa Well Location







ANCHOR POSITIONS

ANCHOR NUMBER	RANGE(Ft)	BRG.(T)	EASTING	NORTHING
1	3806	182.5°	630 901	4 122 619
2	3806	227.5°	630 103	4 123 015
3	3806	272.5°	629 800	4 123 924
4	3806	317.5°	630 200	4 124 719
5	3806	002.5°	631 104	4 125 021
6	3806	047.5°	631 902	4 124 625
7	3806	092.5°	632 205	4 123 716
8	3806	137.5°	631 804	4 122 921

NOTE: ALL BEARINGS (TRUE) AND DISTANCES (FEET)
FROM RIG FAIRLEADS.
LOCATION CENTRE CO-ORDS 53° 01' 08.788" SOUTH
58° 02' 49.130" WEST
4 123 820.0 NORTHING
631 003.0 EASTING

615 —— BATHYMETRY AT 5m INTERVALS

PROPOSED

REV	DATE	BY	CHKD.	APPVD.	REVISION
A	19.11.09	M.W.	B.W.	P.D.	ISSUED FOR OPERATION

BAR SCALES 0 50 100 200 300 400 500 600 700 800 900 1000 Metres

DRAWN	Marc Winpenny
DATE	19-Nov-2009
SCALE	1:7500
CHECKED	B.W.
APPROVED	P.D.

ANCHOR PATTERN FOR OCEAN GUARDIAN (HDG. 250° T) AT TOROA LOCATION - FALKLAND ISLANDS

CLIENT AGR

INTERMOOR

DRAWING No	SHEET No	REV
IP200900201	1 of 1	A