SCOPING AND ENVIRONMENTAL IMPACT ASSESSMENT FOR PROPOSED EXPLORATION ACTIVITIES IN OFFSHORE LICENCE BLOCKS 3617 AND 3717 OFF THE SOUTH-WEST COAST OF SOUTH AFRICA

ENVIRONMENTAL IMPACT REPORT

Prepared for:
Petroleum Agency of South Africa

On behalf of:
Rhino Oil & Gas Exploration South Africa (Pty) Ltd

Prepared by:
CCA Environmental (Pty) Ltd

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PROJECT INFORMATION

TITLE	Scoping and Environmental Impact Assessment for proposed exploration activities in offshore Licence Blocks 3617 and 3717 off the South-West Coast of South Africa: Environmental Impact Report
APPLICANT	Rhino Oil & Gas Exploration South Africa (Pty) Ltd
ENVIRONMENTAL CONSULTANT	CCA Environmental (Pty) Ltd
REPORT REFERENCE	RO01OS/EIR/Rev.0
REPORT DATE	15 January 2016

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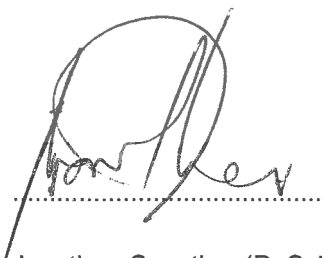

Jonathan Crowther (Pr.Sci.Nat.; CEAPSA)
Managing Director

EXPERTISE OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

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RESPONSIBILITY ON PROJECT	Project leader and quality control
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NAME	Jeremy Blood
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NAME	Nicholas Arnott
RESPONSIBILITY ON PROJECT	Project consultant and report writing.
DEGREE	B.Sc. Hons (Earth and Geographical Science)
PROFESSIONAL REGISTRATION	-
EXPERIENCE IN YEARS	10
EXPERIENCE	Nicholas Arnott has worked as an environmental assessment practitioner since 2006 and has been involved in a number of projects covering a range of environmental disciplines, including Basic Assessments, Environmental Impact Assessments and Environmental Management Programmes. He has gained experience in a wide range of projects relating to mining, infrastructure projects (e.g. roads), housing and industrial developments.

EXECUTIVE SUMMARY

1. INTRODUCTION

This Executive Summary provides a comprehensive synopsis of the Environmental Impact Report (EIR) prepared as part of the Scoping and Environmental Impact Assessment (hereafter collectively referred to as "EIA") process being undertaken for the proposal by Rhino Oil & Gas Exploration South Africa (Pty) Ltd (hereafter referred to as "Rhino") to undertake offshore exploration activities for oil and gas in Licence Blocks 3617 and 3717 off the South-West Coast of South Africa.

1.1 OPPORTUNITY TO COMMENT

The EIR has been distributed for a 30-day comment period from **20 January to 19 February 2016** in order to provide Interested and Affected Parties (I&APs) with an opportunity to comment on any aspect of the proposed project and the findings of the EIA process. Copies of the full report have been made available on the CCA Environmental (Pty) Ltd (CCA) website (www.ccaenvironmental.co.za) and at the Cape Town Central Library (Drill Hall, Darling Street, Cape Town).

Any comments on the EIR should be forwarded to CCA at the address, telephone/fax numbers or e-mail address shown below. For comments to be included in the updated EIR, comments should reach CCA **no later than 19 February 2016**.

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1.2 PROJECT BACKGROUND

In April 2015, Rhino lodged an application with the Petroleum Agency of South Africa (PASA) for an Exploration Right in terms of Section 79 of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) (MPRDA), as amended. PASA accepted the application on 22 May 2015.

The exploration licence area is approximately 13 279 km^2 in extent. The eastern border of the exploration licence area is located between approximately 190 km and 385 km off the South-West Coast of South Africa in water depths greater than 3 500 m (see Figure 1).

The proposed exploration programme in Blocks 3617 and 3717 would commence with the acquisition and collation of existing data. Thereafter, multi-beam bathymetry and two- / three-dimensional (2D/3D) seismic surveys would be conducted to identify potential oil or gas target areas for future exploration.

1.3 AUTHORISATION REQUIREMENTS

The proposed exploration programme requires statutory approval in terms of both the MPRDA and the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), as amended. These two regulatory processes are summarised below and presented in more detail in Chapter 2.

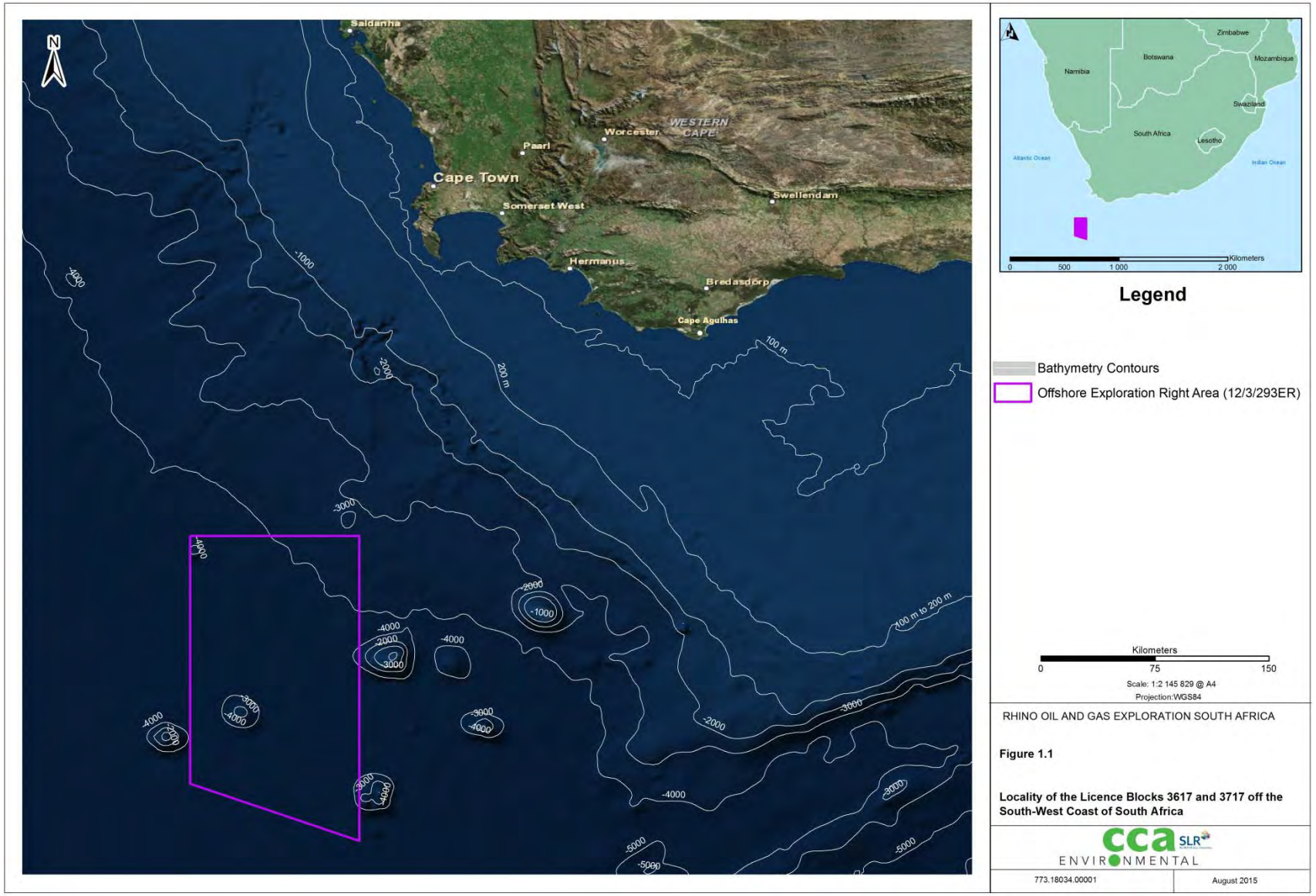

Figure 1.1: Locality of the Licence Blocks 3617 and 3717 off the South-West Coast of South Africa.

In terms of the MPRDA an Exploration Right must be issued by the Minister of Mineral Resources (or delegated authority) prior to the commencement of any exploration activities. A requirement for obtaining an Exploration Right is that an applicant must comply with Chapter 5 of NEMA with regards to consultation and reporting.

In terms of the Environmental Impact Assessment (EIA) Regulations 2014, promulgated in terms of Chapter 5 of NEMA, an application for an Exploration Right requires Environmental Authorisation from the competent authority, the Minister of Mineral Resources (or delegated authority), to carry out the proposed exploration programme. In order for PASA to consider an application for Environmental Authorisation and make a recommendation to the Minister of Mineral Resources, an EIA process must be undertaken.

CCA has been appointed by Rhino to undertake the EIA process to meet the relevant requirements of the MPRDA, NEMA and Regulations thereto.

2. EIA PROCESS

2.1 SCOPING PHASE

The Scoping Phase complied with the requirements of NEMA and the EIA Regulations 2014, as set out in GN No. R982. This involved a process of notifying I&APs of the proposed project and EIA process in order to ensure that all potential key environmental impacts, including those requiring further investigation, were identified.

The Scoping Phase also included a pre-application public participation process. Although this is not a legislated requirement of the EIA Regulations 2014, it provided an opportunity to notify I&APs of the proposed project and to raise any initial issues or concerns regarding the proposed exploration activities.

The Scoping Report, which was prepared in compliance with Appendix 2 of the EIA Regulations 2014, was accepted by PASA on 3 November 2015. PASA's acceptance of the Scoping Report stated that the next phase of the EIA may proceed as outlined in the Plan of Study for EIA, which was appended to the Scoping Report.

2.2 EIA PHASE

2.2.1 Specialist studies

Two specialist studies were undertaken to address the key issues that required further investigation, namely the impact on fishing and marine fauna. The specialist studies involved the gathering of data relevant to identifying and assessing environmental impacts that may occur as a result of the proposed project. These impacts were then assessed according to pre-defined rating scales. Specialists also recommended appropriate mitigation / control or optimisation measures to minimise potential negative impacts or enhance potential benefits, respectively.

2.2.2 Integration and Assessment

The specialist assessments and other relevant information have been integrated into the EIR. The EIR presents all information in a clear and understandable format suitable for easy interpretation by I&APs and authorities and provides an opportunity for them to comment on the proposed project and findings of the EIA process (see Section 1.1 for details of the comment period).

The following steps are envisaged for the remainder of the EIA process:

- After closure of the EIR comment period, all comments received will be incorporated and responded to in a Comments and Responses Report. The EIR will then be updated into a final report, to which the Comments and Responses Report will be appended;
- The revised EIR will be submitted to PASA for consideration and decision-making by the Minister of Mineral Resources (or delegated authority);
- After the Minister of Mineral Resources (or delegated authority) has reached a decision, all I&APs on the project database will be notified of the outcome of the application and the reasons for the decision; and
- A statutory appeal period in terms of the National Appeal Regulations (GN No. R993) will follow the issuing of the decision.

3. PROJECT DESCRIPTION

The proposed exploration programme in offshore Licence Blocks 3617 and 3717 would commence with acquisition and collation of existing data. Thereafter multi-beam bathymetry and 2D/3D seismic surveys would be conducted to identify potential target areas for future exploration (see Figure 2 and 3). The proposed activities associated with the exploration programme are described further below.

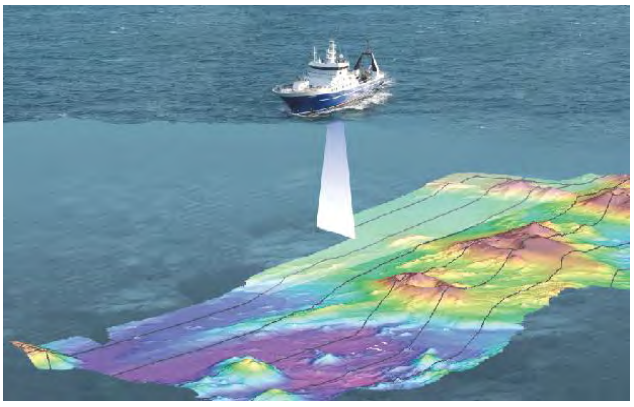

Figure 2: Illustration of a vessel using multi-beam depth/echo sounders.

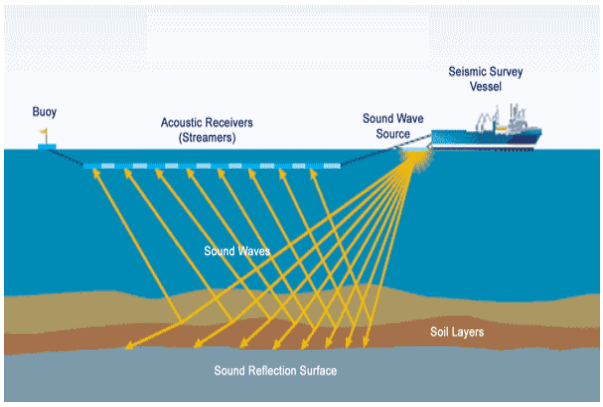

Figure 3: Principles of offshore 2D/3D seismic surveys.

3.1 MULTI-BEAM BATHYMETRY

3.1.1 Introduction

There are a number of different sonar surveying tools for investigating the structure of the ocean bed sediment layers (including multi-beam echo/depth sounders, depth sounders, side scan sonar and bottom profilers). The operator proposes to undertake a multi-beam bathymetry survey to produce a digital terrain model of the seafloor (see Figure 2).

3.1.2 Methodology

The survey vessel would be equipped with a multi-beam echo sounder to obtain swath bathymetry and a sub-bottom profiler to image the seabed and the near surface geology within the proposed exploration licence area. The multi-beam system provides depth sounding information on either side of the vessel's track across a swath width of approximately two times the water depth.

The multi-beam echo sounder emits a fan of acoustic beams from a transducer at frequencies ranging from 10 kHz to 200 kHz and typically produces sound levels in the order of 207 db re 1µPa at 1m. The sub-bottom profiler emits an acoustic pulse from a transducer at frequencies ranging from 3 kHz to 40 kHz and typically produces sound levels in the order of 206 db re 1µPa at 1m.

3.1.3 Extent and duration

The multi-beam bathymetry survey would be undertaken over the majority of the proposed exploration licence area. It is anticipated that data acquisition would take in the order of 15 to 20 productive days to complete at a vessel speed of 4 knots.

3.2 SEISMIC SURVEYS

3.2.1 Introduction

Seismic surveys are carried out during oil and gas exploration activities in order to investigate subsea geological formations. During seismic surveys, high-level, low frequency acoustics are directed towards the seabed from near-surface sound sources towed by a seismic vessel. Signals reflected from geological interfaces below the seafloor are recorded by multiple receivers (or hydrophones) towed in a single or multiple streamers (see Figure 3). Analyses of the returned signals allow for interpretation of subsea geological formations.

Seismic surveys are undertaken to collect either 2D or 3D data. For this investigation Rhino is proposing to undertake acquisition of a 2D seismic survey. However, if it is determined by subsequent analysis of existing data, that acquisition of a seismic dataset utilising 3D seismic techniques might be a more advantageous approach for data collection, then a 3D seismic survey might be substituted for the 2D survey or may be undertaken in addition to the 2D seismic survey.

3.2.2 Survey methodology and airgun array

The seismic survey would involve a towed airgun array, which provides the seismic source energy for the profiling process, and a seismic wave detector system, usually known as a hydrophone streamer. The anticipated airgun and hydrophone array would be dependent on whether a 2D or 3D seismic survey is undertaken. The sound source or airgun array (one for 2D and two for 3D) would be situated some 80 m to 150 m behind the vessel at a depth of 5 m to 25 m below the surface. A 2D survey typically involves a single streamer, whereas 3D surveys use multiple streamers (up to 12 streamers spaced 100 m apart). The array can be up to 12 000 m long. The streamer/s would be towed at a depth of between 6 m and 30 m and would not be visible, except for the tail-buoy at the far end of the cable.

A single airgun could typically produce sound levels in the order of 220-230 dB re 1 mPa @ 1m, while arrays produce sounds typically in the region of 250 dB re 1 mPa @ 1m. The majority of energy produced is in the 0 to 120 Hz bandwidth, although energy at much higher frequencies is also recorded. High-resolution surveys and shallow penetration surveys require relatively high frequencies of 100-1000 Hz, while the optimum wavelength for deep seismic work is in the 10-80 Hz range.

3.2.3 Extent, duration and timing

It is anticipated that the proposed 2D seismic survey would be up to a maximum of 1 000 km in length comprising a number of low density spaced survey lines within the proposed exploration licence area. Rhino is considering two alternative seismic survey plans in the proposed exploration licence area (see Figure 4).

Although survey commencement would ultimately depend on the Exploration Right award date, availability of seismic contractors and other factors, it is anticipated that the survey would be undertaken during the summer of 2017 (Q1/Q2) and would take in the order of 15 to 20 productive days to complete. The summer period has specifically been selected in order to avoid the main cetacean migration / breeding period from June to December, as well as ensuring optimal sea state and weather conditions.

Once the initial 2D survey has been undertaken (or replaced by an initial 3D survey) the data will be analysed. After data analysis further possible target areas may be identified for further 3D surveying, which would take a further 15 to 20 productive days to complete.

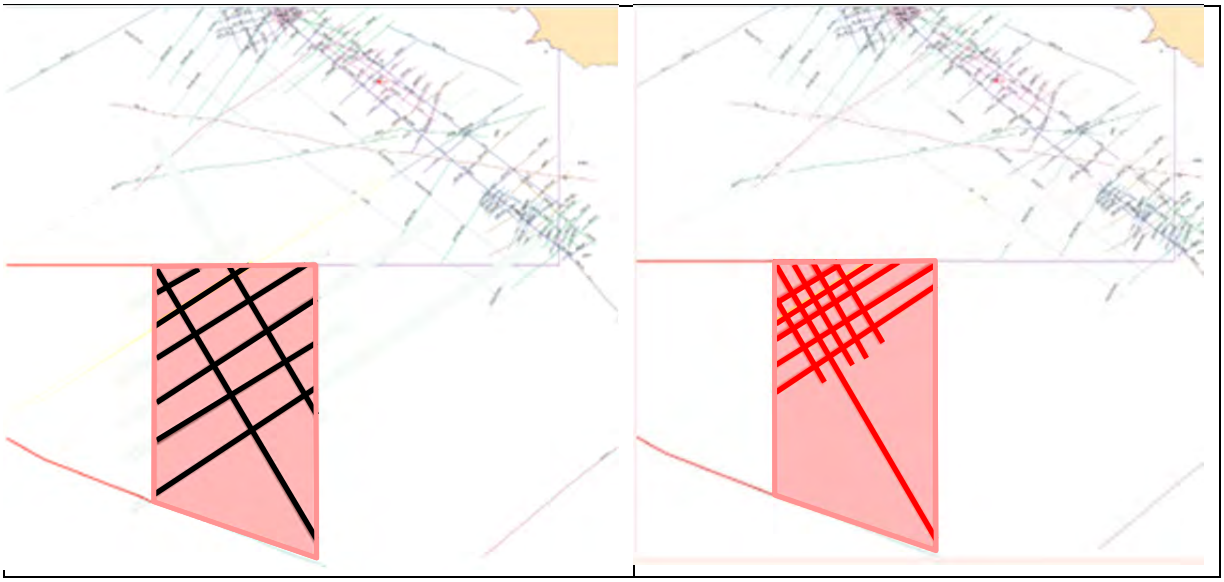

Figure 4: Indicative seismic survey plan alternatives.

3.3 EXCLUSION ZONES

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part B, Rule 18), survey vessels that are engaged in surveying or towing operations are defined as “vessel restricted in its ability to manoeuvre” which requires that power-driven and sailing vessels give way to a vessel restricted in its ability to manoeuvre. Vessels engaged in fishing shall, so far as possible, keep out of the way of the seismic survey operation. Furthermore, under the Marine Traffic Act, 1981 (No. 2 of 1981), a vessel (including array of airguns and hydrophones) used for the purpose of exploiting the seabed falls under the definition of an “offshore installation” and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone. In addition to a statutory 500 m safety zone, a seismic contractor would typically request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond.

At least a 500 m exclusion zone would need to be enforced around all survey vessels (including its array of airguns and hydrophones) at all times. A chase boat with appropriate radar and communications would be used during the seismic survey to warn vessels that are in danger of breaching the exclusion zone.

3.4 SUPPORT SERVICES

A support vessel may be required to perform logistics support to the seismic vessel.

Bunkering of the survey vessels is expected to be undertaken at port of operation (Cape Town or Saldanha) or at sea during the survey. Standard operating procedures for refuelling would be adhered to at all times.

4. DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 PHYSICAL ENVIRONMENT

Licence Blocks 3616 and 3717 lie within the southern zone of the Benguela Current region, which is characterised by the cool Benguela upwelling system.

Wind and weather patterns along the South-West Coast are primarily due to the South Atlantic high-pressure cell and the eastward movement of mid-latitude cyclones, south of the subcontinent. The majority of swells are generated by mid-latitude cyclones and originate from the south-west. Wave height decreases with both distance north along the West Coast and with distance offshore. Tides along the South-West Coast are subject to a simple semi-diurnal tidal regime.

The continental shelf along the West to South-West Coast is generally both wide and deep, although large variations in both depth and width occur. The shelf maintains a general north-north-west trend north of Cape Point, being narrowest in the south between Cape Columbine and Cape Point (40 km), widening to the north of Cape Columbine and widening south of Cape Point due to the presence of the Agulhas Bank. Major bathymetric features in the region include Protea Seamount (36.8°S, 18.1°E), Simpson Seamounts (37.2°S, 16.9°E), Argentina Seamount (37.6°S, 18.1°E) and the Cape Canyon (~33.5°S, 17.5°E).

The most important current is the Benguela current, which constitutes a broad, shallow and slow north-west flow along the west of the South African coast between the cool coastal upwelled waters and warmer Central Atlantic surface waters further offshore. The current is driven by the moderate to strong south to south-east winds which are characteristic of the region and is most prevalent at the surface, although it does follow the major seafloor topographic features. Current velocities in continental shelf areas generally range between 10–30 cm/s.

The Benguela region is one of the world's major coastal upwelling systems. Upwelling is characterised by pulsed input of cold, nutrient rich water into the euphotic zone, and in the Benguela region results from the wind-driven offshore movement of surface waters. The surface waters are replaced by cold nutrient-rich water that upwells from depth. Once upwelled, this water warms and stabilises, and moves offshore where a thermocline usually develops. Nutrient rich upwelled water enhances primary production, and the West Coast region consequently supports substantial pelagic fisheries. The proposed exploration licence area lies well offshore of the Cape Peninsula and Cape Columbine upwelling cells.

4.2 BIOLOGICAL OCEANOGRAPHY

Licence Blocks 3616 and 3717 are located in the Atlantic Offshore bioregion. Communities within marine habitats are largely ubiquitous throughout the southern African South-West Coast region, being particular only to substrate type or depth zone. These biological communities consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales). The deep-water marine

ecosystems comprise a limited range of habitats, namely unconsolidated seabed sediments and the water column.

The offshore water in the proposed exploration licence area are characterised by diminished phytoplankton biomass due to the predominance of nutrient-poor oceanic waters. A deficiency of phytoplankton results in poor feeding conditions for zooplankton and ichthyoplankton. Key spawning areas and northward egg and larval drift also occur well inshore of the proposed exploration licence area. Thus plankton abundance in these offshore oceanic waters is expected to be extremely low.

Three seamounts occur adjacent to the proposed exploration licence area, namely Protea, Argentina and Simpson seamounts. A further smaller, unnamed seamount occurs within the proposed exploration licence area. The effects of such seabed features on the surrounding water masses can include the upwelling of relatively cool, nutrient-rich water into nutrient-poor surface water thereby resulting in higher productivity, which can in turn strongly influence the distribution of organisms on and around seamounts. Evidence of enrichment of bottom-associated communities and high abundances of demersal fishes has been regularly reported over such seabed features.

Species diversity, abundance and biomass of benthic invertebrate macrofauna increases from the shore to a water depth of approximately 80 m. Further offshore to 120 m depth, the midshelf is a particularly rich benthic habitat, which acts as an important source of food for carnivores, such as cephalopods, mantis shrimp and demersal fish species. Outside of this rich zone biomass declines.

Pelagic invertebrates that may be encountered in the proposed exploration licence area include the colossal squid and the giant squid, although the likelihood of encounter is extremely low.

As many as 110 species of bony and cartilaginous fish have been identified in the demersal communities on the continental shelf of the South-West Coast. Changes in fish communities occur with increasing depth, with the most substantial change in species composition occurring in the shelf break region between 300 m and 400 m depth. The shelf community (<380 m) is dominated by Cape hake. Small pelagic fish species, including the sardine/pilchard, anchovy, chub mackerel, horse mackerel and round herring, typically occur in mixed shoals of various sizes within the 200 m contour. The fish most likely to be encountered in the proposed exploration licence area are the large pelagic species such as tunas, billfish and pelagic sharks, which migrate throughout the southern oceans, between the surface and deep waters (>300 m).

Three species of turtles, the green, leatherback and loggerhead, are found along the South-West Coast. However, only the Leatherback turtle is likely to be encountered within the proposed exploration licence area, but their abundance is expected to be low.

There are a total of 49 species of seabirds occurring within the southern Benguela area, of which 14 are residents species, 25 are migrants from the southern ocean and 10 are visitors from the northern hemisphere. Most of the species in the region reach highest densities offshore of the shelf break (200 to 5 00 m depth) with highest population levels during their non-breeding season (winter). The availability of breeding sites is an extremely important determinant in the distribution of resident seabirds. Although breeding areas are distributed along the whole coast, islands are especially important. Most of the breeding seabird species forage at sea with most birds being found relatively close inshore (10-30 km). Cape Gannets, however, are known to forage up to 140 km offshore, and African Penguins have also been recorded as far as 60 km offshore. The closest nesting grounds are at the Saldanha Bay islands (over 300 km north of the proposed exploration licence area), Dassen Island (±285 km north), Seal Island (±210 km north-north-east), Boulders Beach (200 km) and Dyer Island (±195 km north-east).

The Cape fur seal is the only species of seal resident along the West and South-West Coast, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs. There are a number of Cape fur seal colonies within the broader study area, including Paternoster Rocks and Jacobs Reef at Cape Columbine, Robbesteen near Koeberg and Seal Island in False Bay. Non-breeding colonies occur at Paternoster Point at Cape Columbine and Duikerklip in Hout Bay. These colonies all fall well outside of the proposed exploration licence area. The nearest breeding colony is at Seal Island in False Bay, approximately 210 km to the north-east of the proposed exploration licence area. As seals are known to forage up to 120 nm (approximately 220 km) offshore, it is unlikely that seals would be encountered in the proposed exploration licence area.

A wide diversity of cetaceans (between 28 and 32 species) may be encountered within the proposed exploration license area, including year round resident species and those migrating through the area to mate and breed. The majority of baleen whales migrate to the southern African subcontinent to breed during winter months. Depending on the ultimate location of these feeding and breeding grounds, seasonality off South Africa can be either unimodal (usually in June-August, e.g. minke and blue whales) or bimodal (usually May-July and October-November, e.g. fin whales), reflecting a northward and southward migration through the area. As whales follow geographic or oceanographic features, the northward and southward migrations may take place at difference distances from the coast, thereby influencing the seasonality of occurrence at different locations. The proposed exploration licence area lies within the migration paths of humpback and southern right whales, but offshore of areas frequented by southern right whales for mating and breeding.

4.3 HUMAN UTILISATION

Eight fishing sectors operate off the South-West Coast including demersal trawl, hake-directed demersal long-line, shark-directed demersal long-line, large pelagic long-line, small pelagic purse seine, tuna pole, traditional line-fish and West Coast rock lobster. With the exception of the large pelagic long-line and tuna pole fishery, all other fishing effort is generally directed inshore of the 1 000 m bathycontour and thus well inshore of the proposed exploration licence area.

The majority of shipping traffic is located on the outer edge of the continental shelf (between 12 and 24 nm offshore) with traffic inshore of the continental shelf along the South-West Coast largely comprising fishing vessels. Therefore, vessel traffic is not expected to pass through the exploration licence area.

Exploration for oil and gas is currently undertaken in a number of adjacent licence blocks off the West and South coasts. There is no current development or production activities off the South-West Coast.

A number of proposed prospecting areas for glauconite and phosphorite / phosphate are located off the South-West Coast, all of which are located inshore of the proposed exploration licence area. There are also no known mining rights off the South-West Coast.

No seafloor telecommunications cables pass through the proposed exploration licence area and no disused explosives or ammunition dumping grounds are located within Licence Block 3616 and 3717. All known shipwrecks off the coast of South Africa occur in waters shallower than 100 m within 50 km of the coast, well inshore of the proposed exploration licence area.

Numerous conservation areas and a Marine Protected Area (MPA) exist along the coastline of the South-Western Cape, however, Licence Blocks 3617 and 3717 do not overlap with any of these areas. Through systematic biodiversity planning to identify a potential offshore MPA network, a number of priority areas have been identified off the South African coastline for the protection of benthic and pelagic habitats. The proposed exploration licence area overlaps with the proposed Southeast Atlantic protection area.

5. IMPACT ASSESSMENT CONCLUSIONS

5.1 GENERAL CONCLUSIONS

A summary of the assessment of potential environmental impacts associated with the proposed exploration activities and No-Go Alternative is provided in Table 6.1.

In summary, the majority of the impacts associated with the proposed exploration activities (namely multi-beam bathymetry and 2D / 3D seismic surveys) would be of short-term duration (15 – 20 days per survey) and limited to the immediate survey area. As a result, the majority of the impacts associated with the multi-beam bathymetry and seismic surveys are considered to range from **INSIGNIFICANT** to **LOW** significance after mitigation.

The two key issues associated with the proposed exploration activities relate to:

- The potential impact on cetaceans (physiological injury and behavioural avoidance) as a result of seismic and sonar noise; and
- The potential impact on the fishing industry (vessel interaction, disruption to fishing operations and reduced catch) due to the presence of the survey vessel with its associated safety zone, potential fish avoidance of the survey area and changes in feeding behaviour.

Although most of the impacts on cetaceans are assessed to have **VERY LOW to LOW** significance with mitigation, the impact could be of much higher significance due to the limited understanding of how short-term effects of seismic surveys relate to longer term impacts. For example, if a sound source displaces a species from an important feeding or breeding area for a prolonged period, impacts at the population level could be more significant. This said, the proposed exploration licence area is located well offshore of important southern right mating, calving and nursery grounds off the West and South coasts, as well as summer feeding grounds around Cape Columbine utilised by resident populations of humpback and southern right whales. In order to mitigate the potential impact on migrating cetaceans it is strongly recommended that the proposed seismic survey programme be planned to avoid they key cetacean migration and breeding period from the beginning of June to the end of November, as well as December when whales (with calves) are on their return journey, which potentially passes through the proposed exploration licence area. Thus the recommended survey period extends from the beginning of January to the end of May. Various other measures are recommended to further mitigate the potential impact on cetaceans, including a 60-minute pre-watch period, 20-minute “soft-start” procedure, temporary termination of survey, etc.

The proposed exploration activities would only potentially have an impact on the large pelagic long-line and tuna pole sectors. The proposed exploration licence area occurs well offshore of, and thus does not overlap with, the demersal trawl, hake-directed demersal long-line, shark-directed demersal long-line, small pelagic purse seine, traditional line-fish and West Coat rock lobster fishing grounds. Thus **NO IMPACT** is anticipated on these fishing sectors. The potential impacts on the large pelagic long-line and tuna pole sectors are considered to be of **VERY LOW** significance and **INSIGNIFICANT**, respectively. This assessment is based primarily on the short-term duration of the survey (15 – 20 days) and the minor catch recorded from the proposed exploration licence area (namely 0.1% and 0.01% of the national catch recorded within the proposed exploration area for the large pelagic long-line and tuna pole sectors, respectively). However, if fish avoid the survey area and / or change their feeding behaviour it could have a more significant impact on the fishing industry. Research has, however, shown that behavioural effects are generally short-term with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound. However, there have been recent concerns that seismic survey activities in southern Namibia and the Australian Bight are responsible for substantially reduced catches of tuna. According to other sources, it is probable that fluctuating tuna catches are caused by a number of variables (e.g. fluctuation of fishing effort,

general decline in longfin tuna abundance and changes in fishing strategy) and that a simple correlation between seismic survey acquisition and reduced tuna catches cannot be inferred and more in-depth research is required.

Any interaction between the survey vessels and fishing vessels could also increase the significance of the impact on the large pelagic long-line and tuna pole sectors. Thus it is important that the operator engage timeously with the fishing industry prior to and during the surveys in order to minimise any interaction. Thus prior to survey commencement it is recommended that key stakeholders (including fishing industry associations) are informed of the proposed survey details (including navigational co-ordinates of the survey areas, and timing and duration of proposed activities) and the likely implications thereof (500 m safety zone and proposed safe operational limits). In addition, it is recommended that Radio Navigation Warnings and Notices to Mariners are distributed throughout the seismic survey periods. The placement of an on-board Fisheries Liaison Officer (FLO) would also help ensure that ongoing communication (via daily reports) is maintained between the survey vessels and the fishing industry and other users of the sea. This proposed regular communication with fishing vessels in the vicinity of the proposed surveys would minimise the potential disruption to fishing operations and risk of gear entanglements.

Table 6.1: Summary of the significance of potential impacts related to the proposed exploration activities in Licence Block 3617 and 371 off the South-West Coast of South Africa. (Note: * indicates that no mitigation is possible and / or considered necessary, thus significance rating remains).

Potential impact		Probability (with mitigation)	Significance	
			Without mitigation	With mitigation
Normal vessels and helicopter operation:				
Emissions to the atmosphere		Definite	VL	**VL**
Deck drainage into the sea		Highly probable	VL	**VL**
Machinery space drainage into the sea		Highly probable	VL	**VL**
Sewage effluent into the sea		Definite	VL	**VL**
Galley waste disposal into the sea		Highly probable	VL	**VL**
Solid waste disposal into the sea		Improbable	Insig.	**INSIG.**
Accidental oil spill during bunkering / refuelling	Within port limits	Improbable	Insig.	**INSIG.**
	Offshore	Improbable	L	**VL**
Noise from seismic and support vessel operations		Probable	VL	**VL***
Noise from helicopter operation		Probable	L-M	**VL**
Impact of seismic noise on marine fauna:				
Plankton		Probable	Insig.	**INSIG.***
Invertebrates	Physiological injury	Improbable - Probable	Insig. - VL	**INSIG. - VL***
	Behavioural avoidance	Probable	VL	**VL***
Fish	Physiological injury	Improbable	Insig. - L	**INSIG. - VL**
	Behavioural avoidance	Improbable	M	**L**
	Spawning and recruitment	Improbable	Insig.	**INSIG.**
	Masking sound and communication	Improbable	VL	**VL**
	Indirect impacts on food sources	Improbable	VL	**VL**
Diving seabirds	Physiological injury	Improbable	L	**VL**
	Behavioural avoidance	Improbable	L	**VL**
	Indirect impacts on food sources	Improbable	VL	**VL**
Non-diving seabirds	Physiological injury	Improbable	Insig.	**INSIG.**
	Behavioural avoidance	Improbable	Insig.	**INSIG.**

Potential impact		Probability (with mitigation)	Significance	
			Without mitigation	With mitigation
Turtles	Physiological injury	Improbable	L	**VL**
	Behavioural avoidance	Probable	L	**VL**
	Masking sound and communication	Improbable	Insig.	**INSIG.**
	Indirect impacts on food sources	Improbable	VL	**VL**
Seals	Physiological injury	Improbable	VL	**VL**
	Behavioural avoidance	Improbable	VL	**VL**
	Masking sound and communication	Improbable	Insig.	**INSIG.**
	Indirect impacts on food sources	Improbable	VL	**VL**
Mysticetes Cetaceans	Physiological injury	Probable	M	**L**
	Behavioural avoidance	Probable	M	**L**
	Masking sound and communication	Probable	L	**VL**
	Indirect impacts on food sources	Improbable	Insig.	**INSIG.**
Odontocetes Cetaceans	Physiological injury	Probable	L	**VL**
	Behavioural avoidance	Probable	VL - L	**VL**
	Masking sound and communication	Probable	M	**L**
	Indirect impacts on food sources	Probable	VL	**VL**
Impact of multi-beam bathymetry survey:				
Impact on marine fauna		Improbable	VL	**VL**
Impact on other users of the sea:				
Fishing industry	Demersal trawl	Improbable	**NO IMPACT**	
	Hake demersal long-line	Improbable	**NO IMPACT**	
	Shark demersal long-line	Improbable	**NO IMPACT**	
	Large pelagic long-line	Improbable	VL	**VL**
	Small pelagic purse-seine	Improbable	**NO IMPACT**	
	Tuna pole	Improbable	Insig.	**INSIG.**
	Traditional line-fish	Improbable	**NO IMPACT**	
	West Coast rock lobster	Improbable	**NO IMPACT**	
	Fisheries research	Improbable	**NO IMPACT**	
Marine transport routes		Probable	VL	**VL**
Marine prospecting, mining, exploration and production	Prospecting, mining and production	Improbable	**NO IMPACT**	
	Exploration	Improbable	VL	**VL**
Socio-economic impact:				
Impact of job creation and the generation of direct revenues		Probable	Insig. (+ve)	**INSIG. (+VE)**
No-Go Alternative:				
Lost opportunity to further explore on the South-West Coast and to maximise the use of South Africa's own reserves. Also lost economic opportunities related to sunken costs		Improbable	L	**-**
VH=Very High - H=High - M=Medium - L=Low - VL=Very Low - Insig = insignificant - All impacts are negative				

5.2 COMPARATIVE ASSESSMENT OF PROJECTS ALTERNATIVES

5.2.1 Site and survey area alternatives

The location of the proposed exploration activities is ultimately determined by Rhino's application for an Exploration Right in Licence Blocks 3617 and 3717. Thus the proposed exploration activities would be limited to these blocks and no further site alternatives can be considered.

Although Rhino is considering two indicative alternative seismic survey plans in the proposed exploration licence area, there are no additional impacts or differences in impact significance between the two alternative survey areas. There would also be no change to the assessment if the final survey plan differed slightly from that assessed, as the EIA has considered a seismic survey located anywhere within the proposed exploration licence area.

5.2.2 Survey timing alternatives

Although survey commencement would ultimately depend on the Exploration Right award date, availability of seismic contractors and other factors, Rhino is proposing to commence the seismic surveys in a fair weather period in 2017 (Q1/Q2). The summer period has specifically been selected in order to avoid the main cetacean migration / breeding period from June to December, as well as ensuring optimal sea state and weather conditions.

In order to avoid whales (with calves) on their return journey potentially passing through the proposed exploration licence area, it is recommended that the exclusion period also include December. Thus the recommended survey period extends from the beginning of January to the end of May.

5.2.3 Sonar survey technologies

In order to further investigate the structure of the ocean floor sediment layers, there are several possible alternative technologies available, including:

- Depth sounders;
- Side scan sonar;
- Bottom profilers; and
- Multi-beam bathymetry.

Rhino is, however, only proposing to undertake a multi-beam bathymetry survey, as it produces high quality bathymetric data along a wider track beam compared to the other alternatives. Although no other sonar survey technology alternatives are being considered in the EIA process, it should be noted that the potential impacts associated with the other sonar survey technology alternatives would be no more significant than that associated with the proposed multi-beam bathymetry survey.

5.2.4 Seismic survey technologies

For this investigation Rhino is proposing to undertake acquisition of a 2D seismic survey. However, if it is determined by subsequent analysis of existing data, that acquisition of a seismic dataset utilising 3D seismic techniques might be a more advantageous approach for data collection, then a 3D seismic survey might be substituted for the 2D survey or may be done in addition to the 2D seismic survey.

This EIA thus assesses the potential impacts related to undertaking both a 2D and 3D seismic survey. Since the airgun and streamer type, array configurations, etc. would ultimately be limited to what equipment is available on the contacted survey vessel, this assessment is based, to a large extent, on a generic description of seismic surveys, specifically airgun and hydrophone array specifications.

There are no additional impacts or differences in impact significance associated with either the 2D or 3D seismic survey, or the equipment that would ultimately be used during the survey.

5.2.5 No-go alternative

The no-go alternative is the option of not undertaking the proposed exploration activities. Thus there would be no acquisition of bathymetry and seismic data for the proposed exploration licence area as proposed. The negative implications of not going ahead with the proposed exploration are as follows:

- South Africa would lose the opportunity to further establish the extent of indigenous oil or gas reserves off the South-West Coast;
- Lost economic opportunities related to sunken costs (i.e. costs already incurred) of initial desktop investigations in the proposed exploration licence area; and
- If economic oil and gas reserves do exist and are not developed, South Africa / Rhino would lose the opportunity to maximise the use of its own indigenous oil and gas reserves.

This potential impact associated with the no-go alternative is considered to be of **LOW** significance.

5.3 RECOMMENDATION / OPINION OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

The key principles of sustainability, including ecological integrity, economic efficiency, and equity and social justice, are integrated below as part of the supporting rationale for recommending an opinion on whether the proposed project should be approved.

- Ecological integrity[1]

  The proposed exploration licence area lies well offshore of the Cape Peninsula and Cape Columbine upwelling cells. These offshore areas are characterised by diminished phytoplankton biomass due to the predominance of nutrient-poor oceanic waters. A deficiency of phytoplankton results in poor feeding conditions for zooplankton and ichthyoplankton. Key spawning areas and northward egg and larval drift also occur well inshore of the proposed exploration licence area. Thus plankton abundance in these offshore oceanic waters is expected to be extremely low.

  Three seamounts occur adjacent to the proposed exploration licence area, namely Protea, Argentina and Simpson seamounts. A further smaller, unnamed seamount occurs within the proposed exploration licence area. These seamounts could potentially host sensitive and potentially vulnerable benthic communities. However, as the survey would be conducted in water depths in excess of 3 000 m, the received noise at the seabed would be within the far-field range and outside of distances at which physiological injury of benthic invertebrates and demersal fish species would be expected. There is a likelihood of encountering feeding aggregations of large pelagic fish species, which are attached to seamount communities. However, given the high mobility of most large pelagic species, it is assumed that the majority of fish species would avoid seismic noise at levels below those where physiological injury or mortality would result.

  The proposed exploration licence area, which is approximately 190 km offshore at its closest point, is located beyond the normal foraging range of animals from seabird and seal colonies located off the South-West Coast. Thus there is a low likelihood of encountering seabirds (except pelagic seabird such as albatrosses, petrels, shearwaters, etc.) and seals in the proposed exploration licence area.

  A wide diversity of cetaceans (between 28 and 32 species) may be encountered within the proposed exploration license area, including year round resident species and those migrating through the area to mate and breed. Available information suggests that an animal would need to be in close proximity to operating airguns to suffer physiological injury, and being highly mobile it is assumed that they

[1] Ecological integrity is the abundance and diversity of organisms at all levels, and the ecological patterns, processes and structural attributes responsible for that biological diversity and for ecosystem resilience.

would avoid sound sources at distances well beyond those at which injury is likely to occur. A key concern would be the displacement of animals from critical feeding or breeding habitats. However, the proposed exploration licence is located well offshore of important southern right mating, calving and nursery grounds off the West and South coasts, as well as summer feeding grounds around Cape Columbine utilised by localised resident populations of humpback and southern right whales.

In summary, the proposed project with the implementation of the proposed mitigation measures would not result in a significant loss of or impact on ecological integrity within the proposed exploration licence area.

- Economic efficiency

  Operation Phakisa aims to, *inter alia*, unlock the economic potential of South Africa's oceans, and in terms of offshore oil and gas exploration, the goal is to further enhance the enabling environment for exploration of oil and gas while simultaneously maximising the value captured for South Africa. The proposed exploration programme provides an opportunity to further explore oil and gas reserves off the coast of South Africa, thereby meeting one of the aims of Operation Phakisa.

  During survey operations the 500 m safety zone and proposed safe operational limits around the survey vessel would essentially exclude other maritime and fishing vessels from portions of the survey area for a very short period of time (15 to 20 days per survey). Since the majority of shipping traffic is located on the outer edge of the continental shelf (between 12 and 24 nm offshore), it passes well inshore of the proposed exploration licence area. Only two fishing sectors operate in the vicinity of the proposed exploration licence area, namely the pelagic long-line and tuna pole sectors. These sectors could thus potentially be affected by the proposed exploration activities. This is, however, considered unlikely based on the minor catch and effort recorded in the proposed exploration licence area.

  Although offshore exploration is highly technical and requires specialised survey vessels and crews, there would be a few opportunities for local companies to provide support services during the proposed surveys, e.g. vessel supplies, support vessels, etc.

  The proposed project is considered to be economically efficient, as it provides an opportunity to meet one of the aims of Operation Phakisa and establish the extent of indigenous oil / gas reserves in the Orange Basin, while not significantly impacting any other party/ies.

- Equity and social justice

  Due to the extent, duration and offshore location of the proposed project, it would not unfairly discriminate, directly or indirectly, against any one party nor result in an unequal distribution of negative impacts.

It is the opinion of CCA in terms of the sustainability criteria described above, the nature and extent of the proposed exploration programme (all alternatives), and the findings of the specialist studies, that the generally **VERY LOW** to **LOW** significance, with the implementation of the proposed mitigation measures, should support a positive decision being made by the Minister of Mineral Resources (or delegated authority) in this regard.

Since the proposed exploration activities are associated with Rhino's initial three-year exploration work programme, Rhino requests that that environmental authorisation (should it be granted) be issued and remain valid for a period of three years or more.

6. RECOMMENDATIONS

6.1 GENERAL RECOMMENDATIONS FOR BOTH SEISMIC AND MULTI-BEAM BATHYMETRY SURVEYS

6.1.1 Compliance with EMP and MARPOL standards

- All phases of the proposed project (including pre-establishment phase, establishment phase, operational phase, and decommissioning and closure phase) must comply with the Environmental Management Programme (EMP) presented in Chapter 7 of the EIR. In addition, the seismic and support vessels must ensure compliance with the MARPOL 73/78 standards.

6.1.2 Permit / exemption requirements

- In terms of the Marine Living Resources Act, 1998 (No. 18 of 1998) it is illegal for any vessel to approach to or remain within 300 m of whales within South African waters without a permit or exemption. Thus if the operator or seismic contractor are not able to comply with this restriction, an application should be made to the Department of Environmental Affairs (DEA) for a permit or exemption.

6.1.3 Communication with key stakeholders

- Prior to survey commencement the following key stakeholders should be consulted and informed of the proposed survey activity (including navigational co-ordinates of the survey area, timing and duration of proposed activities) and the likely implications thereof:
  - > Fishing industry / associations:
    - South African Tuna Association;
    - South African Tuna Long-Line Association; and
    - Fresh Tuna Exporters Association.
  - > Other:
    - PASA;
    - Department of Agriculture, Forestry and Fisheries (DAFF);
    - Transnet National Ports Authority (ports of Cape Town and Saldanha Bay);
    - South African Maritime Safety Authority (SAMSA);
    - South African Navy Hydrographic office; and
    - Overlapping and neighbouring right holders.

  These stakeholders should again be notified at the completion of surveying when the survey vessel and support vessels are off location.
- The operator must request, in writing, that the South African Navy Hydrographic office release Radio Navigation Warnings and Notices to Mariners throughout the survey periods. The Notice to Mariners should give notice of (1) the co-ordinates of the proposed survey area, (2) an indication of the proposed survey timeframes and day-to-day location of the survey vessel, and (3) an indication of the 500 m safety zones and the proposed safe operational limits of the survey vessel. These Notices to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible;
- An independent on-board FLO who is familiar with fisheries operational in the area must be appointed for the duration of each survey. The FLO should provide a fisheries facilitation role to identify and communicate with fishing vessels in the area to reduce the risk of gear interaction between fishing and survey activities. The FLO should:

  - > report on vessel activity daily;
  - > advise on actions to be taken in the event of encountering fishing gear;
  - > provide back-up on-board facilitation with the fishing industry and other users of the sea; and
  - > set up a daily electronic reporting routine to keep key stakeholders informed of survey activity and progress and fisheries and environmental issues.
- Any fishing vessel targets at a radar range of 12 nm from the survey vessel should be called via radio and informed of the navigational safety requirements around the survey vessel;
- Ongoing notification is to be undertaken throughout the duration of survey with the submission of daily reports (via email) indicating the vessel's location to key stakeholders, as appropriate;
- Any dispute arising with other right holders should be referred to the Department of Mineral Resources (DMR) or PASA for resolution; and
- Marine mammal incidence data and seismic source output data arising from the survey should be made available, if requested, to the Marine Mammal Institute, DEA, DAFF and PASA for analyses of survey impacts in local waters.

6.1.4 Vessel safety

- All vessels must be certified for seaworthiness through an appropriate internationally recognised marine certification programme (e.g. Lloyds Register, Det Norske Veritas). The certification, as well as existing safety standards, requires that safety precautions would be taken to minimise the possibility of an offshore accident;
- Collision prevention equipment should include radar, multi-frequency radio, foghorns, etc. Additional precautions include:
  - > A support / chase vessel with an on-board FLO familiar with the fisheries expected in the area;
  - > The existence of an internationally agreed 500 m safety zone around the survey vessel;
  - > Cautionary notices to mariners; and
  - > Access to current weather service information.
- The vessels are required to fly standard flags, lights (three all-round lights in a vertical line, with the highest and lowest lights being red and the middle light being white) or shapes (three shapes in a vertical line, with the highest and lowest lights being balls and the middle light being a diamond) to indicate that they are engaged in towing surveys and are restricted in manoeuvrability, and must be fully illuminated during twilight and night; and
- Report any emergency situation to SAMSA.

6.1.5 Emissions, discharges into the sea and solid waste

- Ensure adequate maintenance of diesel motors and generators to minimise the volume of soot and unburned diesel released to the atmosphere;
- Route deck and machinery space drainage to a separate drainage system (oily water catchment system) for treatment to ensure compliance with MARPOL (15 ppm);
- Ensure all process areas are bunded to ensure drainage water flows into the closed drainage system;
- Use drip trays to collect run-off from equipment that is not contained within a bunded area and route contents to the closed drainage system;
- Use of low toxicity, biodegradable detergents during deck cleaning to further minimise the potential impact of deck drainage on the marine environment;
- Ensure adequate maintenance of all hydraulic systems and frequent inspection of hydraulic hoses;
- Undertake spill management training and awareness of crew members of the need for thorough clean-up of any spillages immediately after they occur, as this would minimise the volume of contaminants washing off decks;

- Initiate an on-board waste minimisation system;
- Ensure on-board solid waste storage is secure;
- Ensure that waste (solid and hazardous) disposal onshore is carried out in accordance with the appropriate laws and ordinances; and
- Prepare a project specific Emergency Response Plan and Shipboard Oil Pollution Emergency Plan for the proposed seismic survey, which defines the organisational structure and protocols that would be implemented to respond to any incident (including accidental oil / fuel spills) in a safe, rapid, effective and efficient manner.

6.1.6 Offshore bunkering

- Offshore bunkering should not be undertaken in the following circumstances:
  - > Wind force and sea state conditions of 6 or above on the Beaufort Wind Scale;
  - > During any workboat or mobilisation boat operations;
  - > During helicopter operations;
  - > During the transfer of in-sea equipment; and
  - > At night or times of low visibility.
- Support vessels must have the necessary spill response capability to deal with accidental spills in a safe, rapid, effective and efficient manner; and
- Crew must be trained in spill management.

6.1.7 Job creation and the generation of direct revenues

- The use of local companies for support services should be promoted as far as possible.

6.1.8 Vessel lighting

- Lighting on-board survey vessels should be reduced to the minimum safety levels to minimise stranding of pelagic seabirds on the survey vessels at night. All stranded seabirds must be retrieved and released during daylight hours.

6.2 RECOMMENDATIONS SPECIFIC TO SEISMIC SURVEYS

6.2.1 Survey timing and scheduling

- The seismic survey should be planned to avoid the key cetacean migration and breeding period, which occurs from the beginning of June to the end of November. However, in order to avoid whales (with calves) on their return journey potentially through the proposed exploration licence area, it is recommended that the exclusion period also include December. Thus the recommended survey period extends from the beginning of January to the end of May.

6.2.2 Equipment

- ‘Turtle-friendly’ tail buoys should be used by the survey contractor or existing tail buoys should be fitted with either exclusion or deflector 'turtle guards'.

6.2.3 Seismic survey procedures

- Passive Acoustic technology (PAM) technology
  - > The survey vessel must be fitted with PAM technology, which detects animals through their vocalisations. As the proposed surveys would take place in waters deeper than 1 000 m depth where deep-diving sperm whales are likely to be encountered, it is recommended that PAM technology is used during both the pre-watch period and when the airguns are active (including "soft-starts", airgun tests and surveying).
  - > The PAM hydrophone streamer should ideally be towed behind the airgun array to minimise the interference of vessel noise, and should be fitted with two hydrophones to allow directional detection of cetaceans.
  - > In order to avoid unnecessary delays to the survey programme, it is recommended that a spare PAM cable and sensor are kept onboard should there be any technical problems with the system. However, if there is a technical problem with PAM during surveying, visual watches must be maintained by the Marine mammal Observer (MMO) during the day and night-vision/infra-red binoculars must be used at night while PAM is being repaired.
- "Soft-start" procedure, pre-watch period and airgun firing
  - > A "soft-start" procedure of a minimum of 20 minutes' duration must be implemented when initiating airgun tests (a single or a number of airguns at full power)[2] and / or seismic surveying. This requires that the sound source be ramped from low to full power rather than initiated at full power, thus allowing a flight response by marine fauna to outside the zone of injury or avoidance.
  - > "Soft-start" procedures must only commence once it has been confirmed for at least a 60-minute[3] period (visually and using PAM technology during the day and using only PAM technology at night or during periods of poor visibility) that there is no cetacean activity within 500 m of the vessel. Similarly, it must also be confirmed (visually during the day and using night-vision/infra-red binoculars at night) that there is no seabird (significant diving activity), turtle or seal activity within 500 m of the vessel just prior to initiating the "soft-start" procedure.
  - > "Soft-starts" should be delayed until such time as this area is clear of seabirds (diving), turtles, seals or cetaceans. In the case of turtles and cetaceans the "soft-start" procedure should not begin until after the animals depart the 500 m exclusion zone or 30 minutes after they are last seen. In the case of seals, which are often attracted to survey vessels, the normal "soft-start" procedures should be allowed to commence, if after a period of 30 minutes seals are still within 500 m of the airguns.
  - > All breaks in airgun firing of longer than 20 minutes must be followed by a 60-minute pre-shoot watch and a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing. In order to facilitate a more effective timing of proposed operations when surveying in deeper waters, the 60-minute pre-shoot watch can commence before the end of the survey line (whilst the airguns are still firing). Breaks of shorter than 20 minutes should be followed by a visual assessment for marine mammals and turtles within the 500 m mitigation zone (not a 60-minute pre-shoot watch) and a "soft-start" of similar duration.
  - > The use of the lowest practicable airgun volume, as defined by the operator, should be defined and enforced.
  - > During surveying, airgun firing should be terminated when:
    - obvious negative changes to turtle, seal and cetacean behaviour is observed;
    - turtles or cetaceans are observed within 500 m of the operating airgun and appear to be approaching the firing airgun; or

[2] Note: If the intention is to test a single airgun on low power then a "soft-start" is not required.

[3] The JNCC Guidelines state that the pre-watch period should be extended from 30 minutes to 60 minutes for deep-diving species when surveying in deeper water (>200 m).

- there is mass mortality of fish or mortality / injuries to seabirds, turtles, seals or cetaceans as a direct result of the survey.

> The survey should remain terminated until such time the time MMO / PAM operator confirms that:

- turtles or cetaceans have moved to a point that is more than 500 m from the source;
- despite continuous observation, 30 minutes has elapsed since the last sighting of the turtles or cetaceans within 500 m of the source; and
- risks to seabirds, turtles, seals or cetaceans have been significantly reduced.

> A log of all termination decisions must be kept (for inclusion in both daily and "close-out" reports).

- MMO and PAM operator

> An independent on-board MMO and a PAM operator must be appointed for the duration of the seismic survey. The MMO and PAM operator must have experience in seabird, turtle and marine mammal identification and observation techniques.

> The duties of the MMO would be to:

<u>Marine fauna:</u>

- Confirm that there is no marine faunal activity within 500 m of the seismic source array prior to commencing with the "soft-start" procedures;
- Record pre-shoot observation regime;
- Record survey activities, including sound levels, "soft-start" procedures and survey periods (duration);
- Monitor marine faunal activity during daytime surveying. Observe and record responses of marine fauna to the seismic survey, including seabird, turtle, seal and cetacean incidence and behaviour and any mortality or injuries of marine fauna as a result of the seismic survey. Data captured should include species identification, position (latitude/longitude), distance from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the survey activities; and
- Request the temporary termination of the seismic survey, as appropriate. It is important that the MMOs' decisions to terminate firing are made confidently and expediently;

<u>Other:</u>

- Record meteorological conditions;
- Monitor compliance with international marine pollution regulations (MARPOL 73/78 standards); and
- Prepare daily reports of all observations. These reports should be forwarded to the key stakeholders, as appropriate.

> The duties of the PAM operator would be to:

- Ensure that hydrophone streamers are optimally placed within the towed array;
- Confirm that there is no cetaceans activity within 500 m of the vessel prior to commencing with the "soft-start" procedures;
- Record survey activities, including sound levels, "soft-start" procedures and survey periods (duration);
- Record pre-shoot observation regime;
- Monitor cetacean activity during daytime and night time surveying. Record species identification, position (latitude/longitude) and distance from the vessel, where possible; and
- Request the temporary termination of the seismic survey, as appropriate.

> All data recorded by the MMO and PAM operator should form part of the survey "close-out" report.

6.3 RECOMMENDATIONS SPECIFIC TO MULTI-BEAM BATHYMETRY SURVEYS

- MMO and PAM operator:
  - > Appoint an MMO for the duration of the survey.
  - > The MMO should conduct visual scans for the presence of diving birds, marine mammals and/or turtles around the survey vessel prior to the initiation of any acoustic impulses.
  - > PAM technology, which detects animals through their vocalisations, must be used for a source level greater than 190 dB re 1 µPa at 1 m when surveying at night or during adverse weather conditions and thick fog. If there is a technical problem with PAM during nighttime surveying, night-vision/infra-red binoculars must be used;
  - > The duties of the MMO and PAM operator would be to:
    - Monitor the survey pre-watch period;
    - Record sound levels, pre-watch sightings and "soft-start" procedures (where required);
    - Observe and record responses of diving birds, marine mammals and/or turtles to the multi-beam bathymetry survey. Data captured should include species identification, position (latitude/longitude), distance from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the survey activities; and
    - Request the temporary termination of survey, as appropriate. A log of all termination decisions must be kept for inclusion in both daily and "close-out" reports.
- For a source level less than 190 dB re 1 µPa at 1 m the following is recommended:
  - > Surveying must only commence (subject to the need for a "soft-start") once it has been confirmed (visually during the day) that there is no diving bird, marine mammal and/or turtle activity within 500 m of the vessel. For cetaceans the period of confirmation should be at least 30 minutes. However, if after a period of 30 minutes cetaceans smaller than 3 m, seals and/or diving seabirds are still within 500 m of the vessel, the survey may commence; and
  - > Terminate the survey if diving birds, marine mammals and/or turtles show obvious negative behavioural changes within 500 m of the survey vessel or equipment. The survey should be terminated until such time it is confirmed that the identified animal(s) has moved to a point that is more than 500 m from the source or despite continuous observation or 30 minutes has elapsed since the last sighting of the identified animal(s) within 500 m of the source.
- For a source level greater than 190 dB re 1 µPa at 1 m the following is recommended, in addition to the above:
  - > A "soft-start" procedure shall be implemented for a period of 20 minutes. Where the equipment does not provide for a "soft-start", the equipment should be turned on and off over a 20 minute period to act as a warning signal and allow the above-mentioned animals to move away from the sound source;
  - > "Soft-starts" should, as far as possible, be planned to commence within daylight hours;
  - > "Soft-start" procedures must only commence once it has been confirmed by the MMO (visually during the day and in favourable weather conditions) or the PAM operator (at night or during poor daytime visibility), where applicable, that there is no diving bird, marine mammal and/or turtle activity within 500 m of the vessel for a 30-minute period. However, if after a period of 30 minutes diving birds, marine mammals smaller than 3 m and/or turtles are still within 500 m of the vessel, the normal "soft-start" procedure should be allowed to commence; and
  - > "Soft-start" procedures must also be implemented after breaks in surveying (for whatever reason) of longer than 20 minutes. Breaks of shorter than 20 minutes should be followed by a "soft-start" of similar duration.

6.4 RECOMMENDATIONS SPECIFIC TO HELICOPTER OPERATIONS

- Flight paths must be pre-planned to ensure that no flying occurs over seal and seabird colonies or marine islands. Important areas between Cape Town and the proposed exploration area include: Seal Island and Boulders Beach in False Bay, and Duikerklip in Hout Bay;
- Extensive coastal flights (parallel to the coast within 1 nm of the shore) should be avoided. There is a restriction of coastal flights (parallel to the coast within 1 nm of the shore) on the South Coast between the months of June and November to avoid Southern Right whale breeding areas;
- The contractor should comply fully with aviation and authority guidelines and rules; and
- All pilots must be briefed on ecological risks associated with flying at a low level parallel to the coast.

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LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

2D	Two Dimensional
3D	Three Dimensional
ACE	African Coast to Europe
BID	Background Information Document
CCA	CCA Environmental (Pty) Ltd
CITES	Convention on International Trade in Endangered Species
cm	centimetres
cm/s	centimetres per second
CMS	Convention on Migratory Species
CO	Carbon monoxide
CO_2	Carbon dioxide
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
DAFF	Department of Agriculture, Forestry and Fisheries
db	decibels
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
E	East
EAP	Environmental Assessment Practitioner
EASSy	Eastern Africa Submarine Cable System
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMP	Environmental Management Programme
g/m^2	grams per square metre
g/m^3	grams per cubic metre
GN	Government Notice
HSE	Health, Safety and Environmental
HWS	high water spring
I&APs	Interested & Affected Parties
IEM	Integrated Environmental Management
IEP	Integrated Energy Plan
IUCN	International Union for Conservation of Nature
km	kilometres
km^2	Square kilometres
m	Metres
m^2	Square metres
m^3	Cubic metre
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973/1978
mg/l	Milligrams per litre
mm	Millimetres
MPA	Marine Protected Area
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002)
mR/hr	Milliroentgens per hour
m/s	Metres per second
N	North

NDP	National Development Plan
NEMA	National Environmental Management Act, 1998 (No. 107 of 1998)
NEM:PAA	National Environmental Management: Protected Areas Act, 2003 (No. 57 of 2003)
NEM:WA	National Environmental Management: Waste Act, 2008 (No. 59 of 2008)
NNW	North-north-west
NO_2	Nitrogen dioxide
NW	North-west
PASA	Petroleum Agency of South Africa
PIM	Particulate Inorganic Matter
POM	Particulate Organic Matter
RSA	Republic of South Africa
S	South
EIA	Scoping and Environmental Impact Assessment
SAFE	South Africa Far East
SAHRA	South African Heritage Resources Agency
SAN	South African Navy
SAT3	South Atlantic Telecommunications cable no.3
SO_2	Sulphur dioxide
SSW	South-south-west
SW	South-west
t	Tons
TAC	Total Allowable Catch
TSPM	Total Suspended Particulate Matter
UNCLOS	United Nations Convention on Law of the Sea, 1982
VMEs	Vulnerable Marine Ecosystems
VOS	Voluntary Observing Ships
W	West
WACS	West Africa Cable System
WASC	West African Submarine Cable
WSW	West-south-west
µg	Micrograms
µm	Micrometre
µg/l	Micrograms per litre
µPa	Micro Pascal
°C	Degrees Centigrade
%	Percent
‰	Parts per thousand
<	Less than
>	Greater than

1. INTRODUCTION

This chapter describes the purpose of this report, provides a brief description of the project background, summarises the legislative authorisation requirements and terms of reference, describes the structure of the report and outlines the opportunity for comment on the report.

1.1 PURPOSE OF THIS REPORT AND OPPORTUNITY TO COMMENT

This Environmental Impact Report (EIR) has been compiled and distributed for review and comment as part of the Scoping and Environmental Impact Assessment (hereafter collectively referred to as "EIA") process that is being undertaken for the proposal by Rhino Oil & Gas Exploration South Africa (Pty) Ltd (hereafter referred to as "Rhino") to apply for a right to undertake offshore exploration activities for oil and gas in Licence Blocks 3617 and 3717 off the South-West Coast of South Africa.

This report summarises the process followed to date and provides an overview of the proposed project and affected environment. It also presents the findings of the specialist studies and provides an assessment of the impacts of the proposed project.

Interested and Affected Parties (I&APs) are asked to comment on the EIR (see Section 1.6). The document will then be updated to a final report, giving due consideration to the comments received, and submitted to the Petroleum Agency of South Africa (PASA)[1] for decision-making.

1.2 PROJECT BACKGROUND

In April 2015, Rhino lodged an application with PASA for an Exploration Right with PASA in terms of Section 79 of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) (MPRDA), as amended. PASA accepted the application on 22 May 2015.

The exploration licence area is approximately 13 279 km^2 in extent. The eastern border of the exploration licence area is located between approximately 190 km and 385 km off the South-West Coast of South Africa in water depths greater than 3 500 m (see Figure 1.1).

The proposed exploration programme in Blocks 3617 and 3717 would commence with the acquisition and collation of existing data. Thereafter, multi-beam bathymetry and two- / three-dimensional (2D/3D) seismic surveys would be conducted to identify potential oil or gas target areas for future exploration.

1.3 AUTHORISATION REQUIREMENTS

The proposed exploration programme requires statutory approval in terms of both the MPRDA and the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), as amended. These two regulatory processes are summarised below and presented in more detail in Chapter 2.

In terms of the MPRDA an Exploration Right must be issued by the Minister of Mineral Resources (or delegated authority) prior to the commencement of any exploration activities. A requirement for obtaining an Exploration Right is that an applicant must comply with Chapter 5 of NEMA with regards to consultation and reporting.

[1] PASA is the designated agency, in terms of Section 70 of the MPRDA, responsible for the regulation and administration of exploration and production applications and activities.

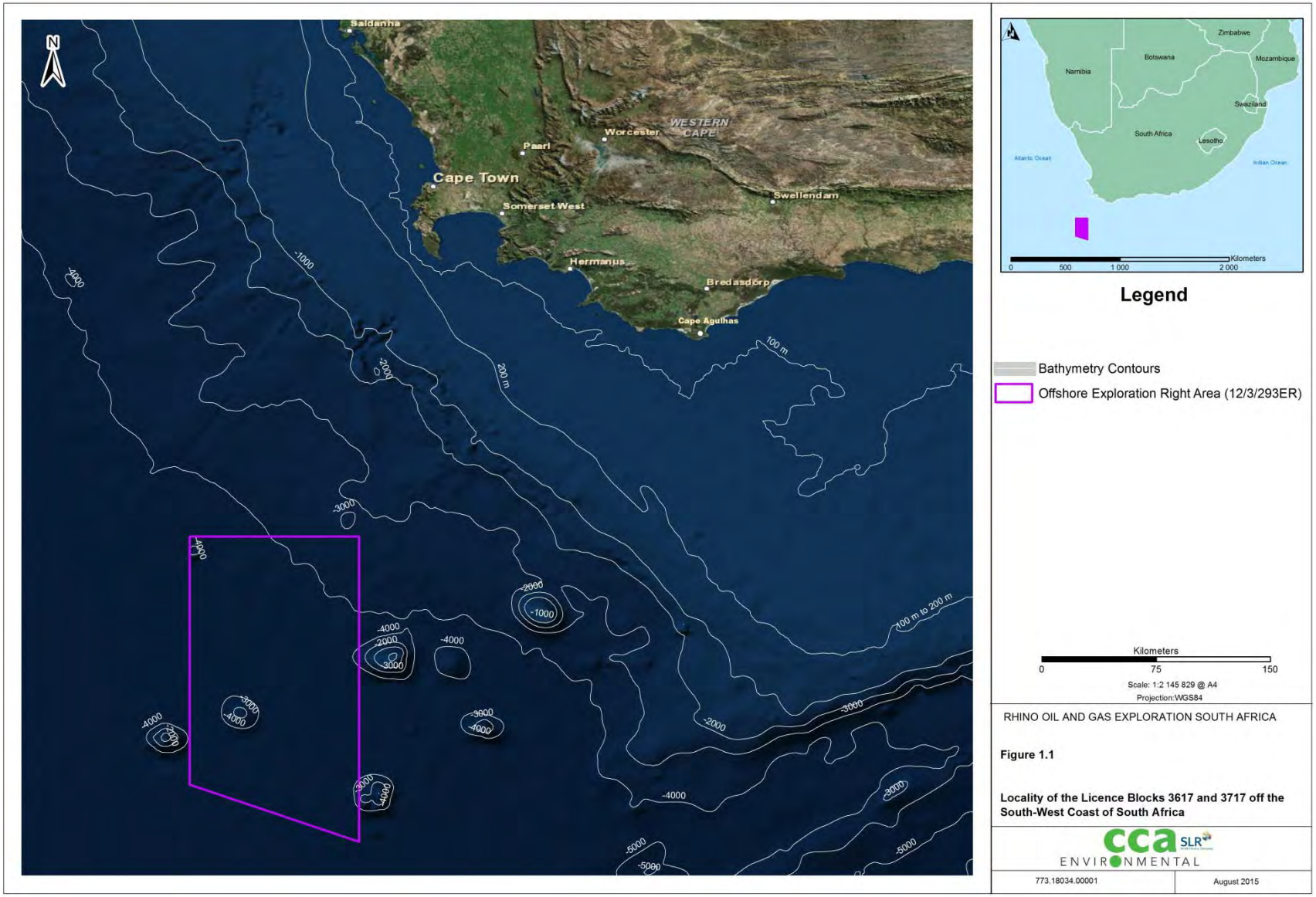


Figure 1.1: Locality of the Licence Blocks 3617 and 3717 off the South-West Coast of South Africa.

In terms of the EIA Regulations 2014, promulgated in terms of Chapter 5 of NEMA, an application for an Exploration Right requires Environmental Authorisation from the competent authority, the Minister of Mineral Resources (or delegated authority), to carry out the proposed exploration programme. In order for PASA, as the delegated authority, to consider an application for Environmental Authorisation and make a recommendation to the Minister of Mineral Resources (or delegated authority), an EIA process must be undertaken.

CCA Environmental (Pty) Ltd (CCA) has been appointed by Rhino to undertake the EIA process to meet the relevant requirements of the MPRDA, NEMA and Regulations thereto.

1.4 TERMS OF REFERENCE

The terms of reference for the EIA are as follows:

1. Ensure the EIA is undertaken in accordance with the requirements of NEMA and the EIA Regulations 2014;
2. Ensure the EIA is undertaken in an open, participatory manner to ensure that all potential impacts are identified;
3. Undertake a formal public participation process, which specifically addresses the distribution of information to I&APs and provides the opportunity for I&APs to raise any concerns/issues, as well as an opportunity to comment on all EIA documentation;
4. Commission specialists to undertake studies, identified during the scoping process, to assess key issues and concerns; and
5. Integrate all the information, including the findings of the specialist studies and other relevant information, into an EIR to allow an informed decision to be taken concerning the proposed project.

1.5 STRUCTURE OF THIS REPORT

This report consists of eight chapters and five appendices, the contents of which are outlined below.

Section	Contents
Executive Summary	Provides a summary of the EIR.
Chapter 1	**Introduction** Describes the purpose of this report, provides a brief description of the project background, summarises the legislative authorisation requirements, presents the terms of reference of the EIA, and describes the structure of the report and the opportunity for comment.
Chapter 2	**Legislative requirements and study process** Outlines the key legislative requirements applicable to the proposed exploration activities and outlines the methodology and consultation process followed in the EIA process.
Chapter 3	**Project overview** Describes the need and desirability for the proposed project, provides general project information, an overview of the proposed exploration activities and a description of the project alternatives.
Chapter 4	**Description of the affected environment** Describes the existing biophysical and social environment that could potentially be affected by the proposed project.
Chapter 5	**Impact description and assessment** Describes and assesses the potential impacts of the proposed project on the affected environment. It also presents mitigation or optimisation measures that could be used to reduce the significance of any negative impacts or enhance any benefits, respectively.

Section	Contents
Chapter 6	**Conclusion and recommendations** Provides conclusions to the EIA and summarises the recommendations for the proposed project.
Chapter 7	**Environmental Management Programme** Provides an Environmental Management Programme for the proposed exploration activities.
Chapter 8	**References** Provides a list of the references used in compiling this report.
Appendices	Appendix 1: PASA acceptance of the Scoping Report Appendix 2: I&AP database Appendix 3: Specialist studies Appendix 3.1: Convention for assigning significance ratings to impacts Appendix 3.2: Fisheries Assessment Appendix 3.3: Marine Faunal Assessment Appendix 4: Undertaking by the Applicant Appendix 5: EAP declaration Appendix 6: Financial Provision

1.6 OPPORTUNITY TO COMMENT

This EIR has been distributed for a 30-day comment period from **20 January to 19 February 2016** in order to provide I&APs with an opportunity to comment on any aspect of the proposed project and the findings of the EIA process. Copies of the full report have been made available on the CCA website (www.ccaenvironmental.co.za) and at the Cape Town Central Library (Drill Hall, Darling Street, Cape Town).

Any comments on the EIR should be forwarded to CCA at the address, telephone/fax numbers or e-mail address shown below. For comments to be included in the updated EIR, comments should reach CCA **no later than 20 January 2016**.

CCA Environmental (Pty) Ltd
Attention: Jeremy Blood

Unit 39 Roeland Square, 30 Drury Lane, Cape Town, 8001
PO Box 10145, Caledon Square, 7905

Tel: (021) 461 1118/9; Fax: (021) 461 1120
E-mail: jeremy@ccaenvironmental.co.za

2. LEGISLATIVE REQUIREMENTS AND EIA PROCESS

This chapter outlines the key legislative requirements applicable to the proposed exploration activities and outlines the methodology and I&AP consultation process followed in the EIA process.

2.1 LEGISLATIVE REQUIREMENTS

2.1.1 OVERVIEW OF THE "ONE ENVIRONMENTAL SYSTEM"

The "One Environmental System" commenced on 8 December 2014 removing the environmental regulation of prospecting, mining, exploration and production and related activities from the MPRDA and transferring it to NEMA. Under the "One Environmental System", the Minister of Mineral Resources (or delegated authority) is the competent authority responsible for issuing Environmental Authorisations in terms of NEMA for mining and petroleum related activities. The Minister of Environmental Affairs, however, remains the appeal authority for these authorisations.

2.1.2 MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002

In terms of the MPRDA, an Exploration Right must be obtained prior to the commencement of any exploration activities.

A requirement for obtaining an Exploration Right is that an applicant must submit an application in terms to Section 79(1) of the MPRDA to the designated agency, and they must accept the application within 14 days if, *inter alia*, no other person holds a Technical Co-operation Permit, Exploration Right or Production Right for petroleum over any part of the proposed licence area. If the application for an Exploration Right is accepted, the designated agency must request that the applicant comply with Chapter 5 of NEMA with regards to consultation and reporting (see Section 2.1.3 below).

As mentioned previously, in April 2015, Rhino lodged an application for an Exploration Right with PASA, the designated agency in terms of Section 70 of the MPRDA. PASA accepted the application on 22 May 2015 and requested that an application for Environmental Authorisation be submitted to them in terms of Regulation 16 of the EIA Regulations 2014.

2.1.3 NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998

Section 2 of NEMA sets out a range of environmental principles that are to be applied by all organs of state when taking decisions that significantly affect the environment. Included amongst the key principles is that all development must be socially, economically and environmentally sustainable and that environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably. NEMA also provides for the participation of I&APs and stipulates that decisions must take into account the interests, needs and values of all I&APs.

Chapter 5 of NEMA outlines the general objectives and implementation of Integrated Environmental Management (IEM), which provides a framework for the integration of environmental issues into the planning, design, decision-making and implementation of plans and development proposals. Section 24 provides a framework for granting of Environmental Authorisations. In order to give effect to the general objectives of IEM, the potential impacts on the environment of listed activities must be considered,

investigated, assessed and reported on to the competent authority. Section 24(4) provides the minimum requirements for procedures for the investigation, assessment and communication of the potential impact of activities.

The EIA Regulations 2014 promulgated in terms of Chapter 5 of NEMA, and published in Government Notice (GN) No. R982, provides for the control of certain listed activities. These activities are listed in GN No. R983 (Listing Notice 1), R984 (Listing Notice 2) and R985 (Listing Notice 3) of 4 December 2014, and are prohibited until environmental authorisation has been obtained from the competent authority. Although the administration of applications for Environmental Authorisations has been delegated to PASA, the Minister of Mineral Resources remains responsible the granting of Environmental Authorisation in term of NEMA. Such Environmental Authorisation, which may be granted subject to conditions, will only be considered once there has been compliance with GN No. R982.

GN No. R982 sets out the procedures and documentation that need to be complied with when applying for Environmental Authorisation. A *Basic Assessment* process must be applied to an application if the authorisation applied for is in respect of an activity(ies) listed in Listing Notice 1 and / or 3 and an EIA process must be applied to an application if the authorisation applied for is in respect of an activity(ies) listed in Listing Notice 2.

The proposed project triggers Activity 18 contained in Listing Notice 2 (see Table 2.1), thus a full EIA process must be undertaken in order for PASA to consider the application in terms of NEMA and make a recommendation to the Minister of Mineral Resources.

Table 2.1: List of applicable activities in terms of Listing Notice 2 (GN No. R984).

Activity No.	Activity Description	Description of activity in relation to the proposed project
18	*Any activity including the operation of that activity which requires an Exploration Right as contemplated in Section 79 of the MPRDA, including associated infrastructure, structures and earthworks.*	The proposed exploration activities require an Exploration Right and an application has been submit to PASA. The proposed exploration activities associated with the Exploration Right are described in Chapter 3.

2.1.4 NATIONAL ENVIRONMENTAL MANAGEMENT: AIR QUALITY ACT, 2004

The National Environmental Management: Air Quality Act, 2004 (No. 39 of 2004) (NEM:AQA) regulates all aspects of air quality, including prevention of pollution, providing for national norms and standards and including a requirement for an Atmospheric Emissions Licence for listed activities, which result in atmospheric emissions and have or may have a significant detrimental effect on the environment. Activities that require an Atmospheric Emission Licence are listed in GN No. 893 (22 November 2013), published in terms of Section 21(1)((b) of the NEM:AQA. In terms of Section 22 of NEM:AQA no person may conduct a listed activity without an Atmospheric Emission Licence.

Although the Department of Environmental Affairs (DEA): Air Quality Management Services has indicated that the offshore incineration of waste is a listed activity (Category 8.1) and requires an Atmospheric Emission Licence, Rhino has indicated that they would bring all waste to shore for disposal. Thus no offshore incineration of waste would be undertaken as part of the proposed project.

2.1.5 NATIONAL ENVIRONMENTAL MANAGEMENT: WASTE ACT, 2008

The National Environmental Management: Waste Act, 2008 (No. 59 of 2008) (NEM:WA) regulates all aspects of waste management and has an emphasis on waste avoidance and minimisation. NEM:WA creates a system for listing and licensing waste management activities. Listed waste management activities above certain thresholds are subject to a process of impact assessment and licensing. Activities listed in Category A require a Basic Assessment, while activities listed in Category B require an EIA.

As there has been uncertainty as to the applicability of NEM:WA with regards to operations offshore this issue was previously raised with DEA. They subsequently responded that NEM:WA is not applicable to offshore oil and gas operations. Thus a Waste Management Licence would not be required for offshore waste management activities, such as those related to the treatment and discharge sewage. These aspects will be managed in terms of and comply with the requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78).

2.1.6 OTHER RELEVANT LEGISLATION

In addition to the foregoing, Rhino must also comply with the provisions of other relevant conventions and legislation, which includes, amongst other, the following:

International Marine Pollution Conventions

- International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL);
- Amendment of the International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL) (Bulletin 567 – 2/08);
- International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990 (OPRC Convention);
- United Nations Convention on Law of the Sea, 1982 (UNCLOS);
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 (the London Convention) and the 1996 Protocol (the Protocol);
- International Convention relating to Intervention on the High Seas in case of Oil Pollution Casualties (1969) and Protocol on the Intervention on the High Seas in Cases of Marine Pollution by substances other than oil (1973);
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal (1989); and
- Convention on Biological Diversity (1992).

Other International Legislation

- International Commission on Radiological Protection (ICRC); and
- International Atomic Energy Agency (IAEA) Regulations for the Safe Transport of Radioactive Material, 1984.

Other South African legislation

- Carriage of Goods by Sea Act, 1986 (No. 1 of 1986);
- Dumping at Sea Control Act, 1980(No. 73 of 1980);
- Hazardous Substances Act, 1983 and Regulations (No. 85 of 1983);
- Marine Living Resources Act, 1998 (No. 18 of 1998);
- Marine Traffic Act, 1981 (No. 2 of 1981);
- Marine Pollution (Control and Civil Liability) Act, 1981 (No. 6 of 1981);
- Marine Pollution (Prevention of Pollution from Ships) Act, 1986 (No. 2 of 1986);
- Marine Pollution (Intervention) Act, 1987 (No. 65 of 1987);
- Maritime Safety Authority Act, 1998 (No. 5 of 1998);

- Maritime Safety Authority Levies Act, 1998 (No. 6 of 1998);
- Maritime Zones Act 1994 (No. 15 of 1994);
- Merchant Shipping Act, 1951 (No. 57 of 1951);
- Mine Health and Safety Act, 1996 (No. 29 of 1996);
- National Environmental Management: Biodiversity Act, 2004 (No. 10 of 2004);
- National Environmental Management: Integrated Coastal Management Act, 2008 (No. 24 of 2008);
- National Environmental Management: Protected Areas Act, 2003 (No. 57 of 2003)
- National Heritage Resources Act, 1999 (No. 25 of 1999);
- National Nuclear Energy Regulator Act, 1999 (No. 47 of 1999);
- National Ports Act, 2005 (No. 12 of 2005);
- National Water Act, 1998 (No. 36 of 1998);
- Nuclear Energy Act, 1999 (No. 46 of 1999);
- Occupational Health and Safety Act, 1993 (No. 85 of 1993) and Major Hazard Installation Regulations;
- Sea-Shore Act, 1935 (No. 21 of 1935);
- Sea Birds and Seals Protection Act, 1973 (No. 46 of 1973);
- Ship Registration Act, 1998 (No. 58 of 1998);
- South African Maritime Safety Authority Act, 1998 (No. 5 of 1998);
- South African Maritime Safety Authority Levies Act, 1998 (No. 6 of 1998); and
- Wreck and Salvage Act, 1995 (No. 94 of 1995).

2.1.7 GUIDELINES AND POLICIES

The guidelines and policies listed in Table 2.2 have been / or will be taken into account during the EIA.

Table 2.2: Guidelines and policies relevant to the proposed project.

Guideline	Governing body	Applicability
Scoping, Integrated Environmental Management, Information Series 2 (2002)	DEA	This guideline was consulted to obtain guidance on how to implement scoping.
IEM Guideline Series (Guideline 9): Draft guideline on need and desirability in terms of the EIA Regulations 2010 (October 2012)	DEA	This guideline was consulted to inform the need and desirability of the proposed project.
Stakeholder Engagement, Integrated Environmental Management, Information Series 3 (2002)	DEA	These public participation guidelines were consulted to ensure that an adequate public participation process is undertaken.
IEM Guideline Series (Guideline 7): Public participation in the EIA process (October 2012)		
Guidelines – Consultation with I&APs (December 2011)	PASA	
Specialist Studies, Integrated Environmental Management, Information Series 4 (2002)	DEA	This guideline was consulted to ensure adequate development of terms of reference for specialist studies.
Impact significance, Integrated Environmental Management, Information Series 5 (2002)	DEA	This guideline was consulted to inform the assessment of significance of impacts of the proposed project.
Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7 (2004)	DEA	This guideline was consulted to inform the consideration of potential cumulative effects of the proposed project.
Criteria for determining Alternatives in EIA, Integrated Environmental Management, Information Series 11 (2004)	DEA	This guideline was consulted to inform the consideration of alternatives.

Guideline	Governing body	Applicability
Environmental Management Plans, Integrated Environmental Management, Information Series 12 (2004)	DEA	This guideline was consulted to ensure that the Environmental Management Programme (EMP) has been adequately compiled.
Environmental Impact Reporting, Integrated Environmental Management, Information Series 15 (2004)	DEA	This guideline was consulted to inform the approach to impact reporting.

2.2 EIA PROCESS

2.2.1 OBJECTIVES

In accordance with Appendix 2 of GN No. R982, the objectives of the EIA are:

- To identify the relevant policies and legislation relevant to the activity;
- To present the need and desirability of the proposed activity and its preferred location;
- To identify feasible alternatives related to the project proposal;
- To ensure that all potential key environmental issues and impacts that would result from the proposed project are identified;
- To provide a reasonable opportunity for I&APs to be involved in the EIA process;
- To assess potential impacts of the proposed project alternatives during the different phases of project development;
- To present appropriate mitigation or optimisation measures to minimise potential impacts or enhance potential benefits, respectively; and
- Through the above, to ensure informed, transparent and accountable decision-making by the relevant authorities.

The EIA process consists of a series of steps to ensure compliance with these objectives and the EIA Regulations 2014 as set out in GN No. R982. The process involves an open, participatory approach to ensure to ensure that all impacts are identified and that decision-making takes place in an informed, transparent and accountable manner. A flowchart indicating the EIA process is presented in Figure 2.1.

2.2.2 ASSUMPTIONS AND LIMITATIONS

The EIA assumptions and limitations are listed below:

- The EIA assumes that CCA has been provided with all relevant project information and that it was correct and valid at the time it was provided;
- Specialists were provided with all the relevant project information in order to produce accurate and unbiased assessments;
- There will be no significant changes to the project description or surrounding environment between the completion of the EIR and implementation of the proposed project that could substantially influence findings, recommendations with respect to mitigation and management, etc.; and
- The assessment is based, to a large extent, on a generic description of the proposed exploration activities (including multi-beam bathymetry and seismic surveys) and an indicative survey plan, as the specific details were not available at the time of writing this report (e.g. survey vessels, exact timing and duration, airgun and hydrophone array specifications, sound levels, etc.).

These assumptions and limitations, however, are not considered to have any negative implications in terms of the credibility of the results of the EIA process.

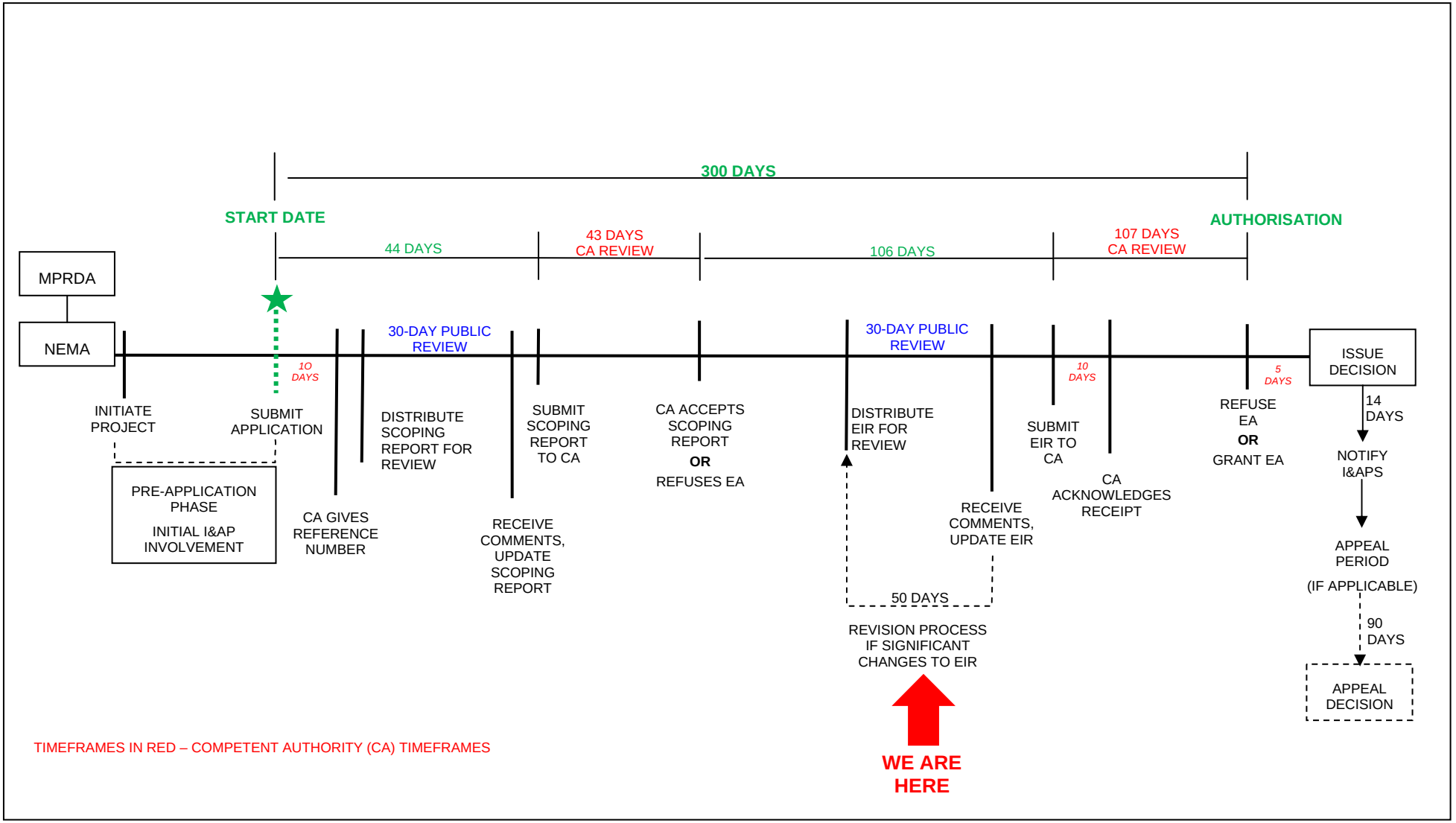


Figure 2.1: Flow diagram showing the EIA process.

2.2.3 SCOPING PHASE

The Scoping Phase complied with the requirements of NEMA and the EIA Regulations 2014, as set out in GN No. R982. This involved a process of notifying I&APs of the proposed project and EIA process in order to ensure that all potential key environmental impacts, including those requiring further investigation, were identified.

The Scoping Phase also included a pre-application public participation process. Although this is not a legislated requirement of the EIA Regulations 2014, it provided an opportunity to notify I&APs of the proposed project and to raise any initial issues or concerns regarding the proposed exploration activities.

The steps / tasks undertaken during the Scoping Phase are summarised in Box 2.1.

The key issues and concerns identified by the project team, with I&AP input, during the Scoping Phase are summarised in Box 2.2. This information provided the basis on which the specialist studies and associated terms of references were determined.

The Scoping Report, which was prepared in compliance with Appendix 2 of the EIA Regulations 2014, was accepted by PASA on 3 November 2015 (see Appendix 1). PASA's acceptance of the Scoping Report stated that the next phase of the EIA may proceed as outlined in the Plan of Study for EIA, which was appended to the Scoping Report.

Box: 2.1: Tasks undertaken during the Scoping Phase.

1. Pre-application public participation process

The initial public participation process involved the following:

- PASA meeting: A meeting was held with PASA on 31 July 2015. The purpose of the meeting was to discuss the legislative requirements and the approach to the EIA process to ensure agreement and compliance.
- Identification of I&APs: A preliminary I&AP database of authorities, Non-Governmental Organisations, Community-based Organisations and other key stakeholders was compiled using other databases of previous studies undertaken in the South-West Coast offshore region. Additional I&APs were added to the database based on responses to the advertisements and notification letter, and attendees at the Information-sharing Meeting. To date 203 I&APs have been registered on the project database (see Appendix 2).
- Distribution of Background Information Document (BID): A notification letter and BID were distributed for a 30-day registration and comment period from 5 August to 7 September 2015, which made provision for the two public holidays in August 2015. The purpose of the letter and BID was to convey information on the proposed project and to invite I&APs to register on the project database and provide initial comment. To simplify the registration process, a Registration and Comment Form was distributed with the BID.
- Advertisements: Advertisements announcing the proposed project, the availability of the BID and the I&AP registration / comment period were placed in regional (Cape Times and Die Burger) and local (Weslander, Hermanus Times and Suidernuus) newspapers.
- Information-sharing Meeting: An Information-sharing Meeting was held in Cape Town (Two Oceans Aquarium) on 20 August 2015. At the meeting Rhino and CCA provided a basic overview of the project proposal and EIA process, respectively. Attendees (13 in total) were then provided the opportunity to raise any issues or concerns regarding the proposed project.

2. Project registration

An "Application Form for Environmental Authorisation" was submitted to PASA on 31 August 2015. The application was acknowledged by PASA on 1 September 2015 (PASA reference number: 12/3/293).

3. Compilation and review of Scoping Report

A Scoping Report was prepared in compliance with Appendix 2 of the EIA Regulations 2014 and was informed by comments received during the initial pre-application public participation process. A total of nineteen written submissions were received during the pre-application public participation process. These related to registration on the project database and the impact of exploration activities on marine fauna and the fishing industry.

Box 2.1 cont.

The DSR was distributed for a 30-day review and comment period from 11 September to 12 October 2015. Tasks undertaken included:

- DSR availability: Copies of the Scoping Report were made available on the CCA website and at the Cape Town Central Library (Drill Hall, Darling Street, Cape Town) for the duration of the review and comment period.
- I&AP notification: A notification letter was sent to all I&APs registered on the project database. The letter informed them of the release of the Scoping Report and where the report could be reviewed. To facilitate the commenting process, a copy of the Scoping Report Executive Summary and a Comment Form were enclosed with each letter. The South African Oil and Gas Alliance (SAOGA) forwarded this correspondence to registered members (approximately 1 300 organisations).
- DSR availability: Copies of the Scoping Report were made available on the CCA website and at the Cape Town Central Library (Drill Hall, Darling Street, Cape Town) for the duration of the review and comment period. Copies of the Scoping Report were sent directly to a number of key stakeholders, including Department of Agriculture, Forestry and Fisheries, South African National Parks, CapeNature, Western Cape Government: Department of Environmental Affairs & Development Planning and PASA.

4. Revise Scoping Report and submission to PASA for acceptance

The preparation of the revised Scoping Report was informed by comments received on the draft report. A total of six written submissions were received during this period, relating to the impact of exploration activities on Marine Protected Areas (MPAs) and the fishing industry. All comments were collated and responded to in an updated Comments and Responses Report, which was appended to the Scoping Report.

As indicated in Section 2.2.3, the Scoping Report was accepted by PASA on 3 November 2015 (see Appendix 1).

Box 2.2: Key issues identified by the project team, with I&APs input, during the Scoping Phase.

Potential impact on marine fauna:

- Normal discharges to the marine environment from a variety of sources, including deck drainage, machinery space drainage, sewage and galley wastes from survey and support vessels;
- Localised disturbance of marine fauna due to noise and lighting from survey and support vessels; and
- Potential impacts of seismic and multi-beam bathymetry noise / pulses on marine fauna. Potential impacts could include physiological injury, behavioural avoidance of the survey area, masking of environmental sounds and communication, and indirect impacts due to effects on prey.

Potential impact on fishing:

- Disruption to fishing operations;
- Loss of access to fishing grounds in the proposed survey area over the survey period; and
- Fish avoidance (flight response) of the seismic survey area and changes in feeding behaviour.

Potential impact on other marine mining and exploration operations:

- Disruption of activities as a result of statutory safety zone around the survey vessel.

Potential impact on marine transport routes:

- Interference with shipping routes as a result of statutory safety zone around the survey vessel.

Potential socio-economic impacts:

- Employment and business opportunities; and
- Generation of direct revenues.

2.2.4 EIA PHASE

2.2.4.1 Specialist studies

Two specialist studies were undertaken to address the key issues that required further investigation, namely the impact on fishing and marine fauna. A list of the specialists and their details are provided in Table 2.3.

The specialist studies involved the gathering of data relevant to identifying and assessing environmental impacts that may occur as a result of the proposed project. These impacts were then assessed according to pre-defined rating scales (see Appendix 3.1). Specialists also recommended appropriate mitigation / control or optimisation measures to minimise potential negative impacts or enhance potential benefits, respectively.

Table 2.3: List of specialist studies and specialists.

No.	Specialit study	Specialist/s	Qualifications	Company	Appendix
1	Fishing	Mr Dave Japp	MSc (Ichthyology and Fisheries Science), Rhodes University	Capricorn Marine Environmental (Pty) Ltd	3.2
		Ms Sarah Wilkinson	BSc (Hons) (Botany), University of Cape Town		
2	Marine fauna	Dr Andrea Pulfrich	PhD (Fisheries Biology), Christian-Albrechts University, Kiel, Germany	Pisces Environmental Services (Pty) Ltd	3.3

2.2.4.2 Integration and Assessment

Compilation of EIR

This EIR has been prepared in compliance with Appendix 3 of the EIA Regulations 2014 (see Table 2.4). The specialist studies and other relevant information / assessments have been integrated into this report. This report has also been informed by PASA's acceptance of the Scoping Report.

This report aim to present all information in a clear and understandable format, suitable for easy interpretation by I&APs and authorities, and to provide an opportunity for I&APs to comment on the proposed project and findings of the EIA process (see Section 1.6 for details of the comment period).

Completion of the EIA Phase

The following steps are envisaged for the remainder of the EIA process (see Figure 2.1):

- After closure of the EIR comment period, all comments received will be incorporated and responded to in a Comments and Responses Report. The EIR will then be updated into a final report, to which the Comments and Responses Report will be appended;
- The revised EIR will be submitted to PASA for consideration and decision-making by the Minister of Mineral Resources (or delegated authority);
- After the Minister of Mineral Resources (or delegated authority) has reached a decision, all I&APs on the project database will be notified of the outcome of the application and the reasons for the decision; and
- A statutory appeal period in terms of the National Appeal Regulations (GN No. R993) will follow the issuing of the decision.

Table 2.4: Requirements of an EIR in terms of the EIA Regulations 2014.

Appendix 3	Content of an EIR	Completed (Y/N or N/A)	Location in report
2(a)	*(i & ii) Details and expertise of the Environmental Assessment Practitioner (EAP) who prepared the report.*	Y	page ii
(b)	*The location of the activity, including:*	Y	Section 3.2.2
	(i) The 21 digit Surveyor General code of each cadastral land parcel;	N/A	
	(ii) Where available, the physical address and farm name; and	N/A	
	(iii) Where the required information in items (i) and (ii) is not available, the co-ordinates of the boundary of the property or properties.	Y	

Appendix 3	Content of an EIR	Completed (Y/N or N/A)	Location in report
(c)	*A plan which locates the proposed activity or activities applied for at an appropriate scale, or, if it is:*	Y	Figure 1.1
	(i) A linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or	N/A	
	(ii) On land where the property has not been defined, the coordinates within which the activity is to be undertaken.	N/A	
(d)	*A description of the scope of the proposed activity, including:*		
	(i) All listed and specified activities triggered and being applied for;	Y	Section 2.1
	(ii) A description of the associated structures and infrastructure related to the development.	Y	Section 3.3
(e)	*A description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context.*	Y	Section 2.1
(f)	*A motivation for the need and desirability for the proposed development, including the need and desirability of the activity in the context of the preferred location.*	Y	Section 3.1
(g)	*A motivation for the preferred development footprint within the approved site.*	Y	Section 3.4 & Table 3.2
(h)	*A full description of the process followed to reach the proposed development footprint within the approved site, including:*		
	(i) Details of the development footprint alternatives considered;	Y	Section 3.2.2
	(ii) Details of the public participation process undertaken in terms of Regulation 41 of the Regulations, including copies of the supporting documents and inputs;	Y	Section 2.2.3 & 2.2.4
	(iii) A summary of the issues raised by I&APs, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;	Y	Box 2.2 * Note: Comments on this report will be summarised and responded to in the revised EIR
	(iv) The environmental attributes associated with the development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Y	Chapter 4
	(v) The impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts: *(aa) can be reversed;* *(bb) may cause irreplaceable loss of resources; and* *(cc) can be avoided, managed or mitigated.*	Y	Chapter 5
	(vi) The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks;	Y	Appendix 3.1
	(vii) Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Y	Chapter 5
	(viii) The possible mitigation measures that could be applied and level of residual risk;	Y	Chapter 5

Appendix 3	Content of an EIR	Completed (Y/N or N/A)	Location in report
	(ix) If no alternative development locations for the activity were investigated, the motivation for not considering such;	Y	Section 3.4 & Table 3.2
	(x) A concluding statement indicating the preferred alternative development location within the approved site;	Y	Section 6.1.3
(i)	*A full description of the process undertaken to identify, assess and rank the impacts the activity and associated infrastructure will impose on the preferred location through the life of the activity, including:*		
	(i) A description of all environmental issues and risks that were identified during the EIA process; and	Y	Box 2.2 & Chapter 5
	(ii) An assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.	Y	Chapter 5 & Appendix 3.1
(i)	*An assessment of each identified significant impact and risk, including:* *(i) Cumulative impacts;* *(ii) The nature, significance and consequence of the impact and risk;* *(iii) The extent and duration of the impact and risk;* *(iv) The probability of the impact occurring;* *(v) The degree to which the impact and risk can be reversed;* *(vi) The degree to which the impact and risk may cause irreplaceable loss of resources; and* *(vii) The degree to which the impact and risk can be mitigated.*	Y	Chapter 5 & Appendix 3.1
(k)	*Where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report.*	Y	Chapter 5
(l)	*An environmental impact statement which contains:*		
	(i) A summary of the key findings of the EIA;	Y	Section 6.1
	(ii) A map at an appropriate scale which superimposes the activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and	Y	Figures 1.1 & 3.5
	(iii) A summary of the positive and negative impacts of the proposed activity and identified alternatives.	Y	Sections 6.1.1 & 6.1.2
(m)	*Based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMP as well as for inclusion as conditions of authorisation.*	Y	Section 6.2
(n)	*The final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment.*	Y	Section 6.1.2
(o)	*Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation.*	Y	Section 6.2
(p)	*A description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed.*	Y	Section 2.2.2
(q)	*A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation.*	Y	Section 6.1.3

Appendix 3	Content of an EIR	Completed (Y/N or N/A)	Location in report
(r)	*Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised.*	Y	Section 6.1.3
(s)	*An undertaking under oath or affirmation by the EAP in relation:* *(i) The correctness of the information provided in the report;* *(ii) The inclusion of comments and inputs from stakeholders and I&APs;* *(iii) The inclusion of inputs and recommendations from the specialist reports where relevant; and* *(iv) Any information provided by the EAP to I&APs and any responses by the EAP to comments or inputs made by I&APs.*	Y	Appendix 5
(t)	*Where applicable, details of any financial provisions for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts.*	Y	Section 3.2.3 & Appendix 6
(u)	*An indication of any deviation from the approved Scoping Report, including the plan of study, including:* *(i) Any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and* *(ii) A motivation for the deviation.*	N/A	-
(v)	*Any specific information that may be required by the competent authority.* *PASA listed information requirements in their Letter of Acceptance of the Scoping Report. Information included:*		
	1. Proposed exploration programme: Indicate risks, positive and negative impacts associated with each activity, the planned duration of each activity and include measures to avoid, reverse, mitigate or manage the identified issues. Determine the extent of residual impacts that need to be managed and monitored.	Y	Chapter 5
	2. Consultation with stakeholders: comments raised by CapeNature about considering of alternative survey line and existing technology need to be taken into consideration.	Y	Sections 3.4 & 6.1.2; Table 3.2
	3. Project alternatives: Provide a detailed description of the alternatives in accordance with Appendix 2 of the EIA Regulations 2014.	Y	Section 3.4 & 6.1.2; Table 3.2
	4. Key project issues: Provide a detailed indication of how the identified key project issues were incorporated.	Y	Chapter 5
	5. Aspects to be assessed: Provide a description of aspects to be assessed in the EIR.	Y	Chapter 5
	6. Financial provision: In terms of Section 24P of NEMA, an applicant for an environmental authorisation relating to …, exploration, … must, before the minister responsible for the mineral resource issues the environmental authorisation, comply with the prescribed financial provision for the rehabilitation, closure and ongoing post decommissioning management of negative environmental impacts. Assess and quantify the potential liability associated with the proposed activities.	Y	Section 3.2.3 & Appendix 6
(m)	*Any other matter required in terms of section 24(4)(a) and (b) of the Act.*	N/A	-

3. PROJECT DESCRIPTION

This chapter describes the need and desirability for the proposed project, provides general project information, an overview of the proposed exploration drilling programme and a description of the project alternatives.

3.1 NEED AND DESIRABILITY

Fossil fuels (including gas) play a central role in the socio-economic development of South Africa, while simultaneously providing the necessary infrastructural economic base for the country to become an attractive host for foreign investments in the energy sector (Ministerial foreword of the White Paper on the Energy Policy 1998). The White Paper on the Energy Policy (1998) is the overarching policy document which guides future policy and planning in the energy sector. It states that the government will, *inter alia*, "promote the development of South Africa's oil and gas resources…" and "ensure private sector investment and expertise in the exploitation and development of the country's oil and gas resources". The successful exploitation of these natural resources would contribute to the growth of the economy and relieve pressure on the balance of payments.

The National Development Plan (NDP) (2012) provides the context for all development in South Africa, with the overarching aim of eradicating poverty and inequality between people in South Africa. The NDP identifies the need to diversify the current energy mix and to reduce carbon emissions. There is a clear intention for gas to play a more significant role in the energy mix and the exploration of gas as an alternative to coal for energy production has been recognised as a planning priority.

The position of the NDP is reiterated in the Draft Integrated Energy Plan (IEP) (2013), which seeks to determine how current and future energy needs can be addressed efficiently. Key objectives outlined in the plan include security of supply, increased access to energy, diversity in supply sources and primary sources of energy and minimising emissions. The plan indicates that projected demand for natural gas between 2010 and 2050 would be second only to petroleum products, primarily due to increased growth in the industrial sector. It also identifies significant potential for natural gas in terms of power generation and direct thermal uses.

An increase in domestic natural gas reserves would also contribute to security of supply in the gas-to-liquids industry, which relies on feedstock from coal, oil and gas reserves. The Draft IEP points out the vulnerability of the liquid fuels industry and its economy to fluctuations in the global oil market, given that South Africa is a net importer of oil. Furthermore, existing gas stocks in the domestic offshore are declining, and new sources of feedstock are required to support and increase production in the gas-to-liquids industry (NDP, 2012).

As such, exploration for additional domestic hydrocarbon reserves is considered important and any discoveries would be well received by the local market. The Department of Energy's Integrated Resource Plan (2010-2030) supports this view, stating that regional and domestic gas options should be pursued. In essence, the government's official position is that exploration and development of oil and gas fields should be encouraged.

In July 2014 the South African Government launched Operation Phakisa[1], which is an innovative, pioneering and inspiring approach that will enable South Africa to implement its policies and programmes better, faster and more effectively. Operation Phakisa aims to, *inter alia*, unlock the economic potential of South Africa's oceans. In this regard four priority sectors have been selected as new growth areas in the ocean economy, including:

[1] Address by President Jacob Zuma at the launch of Operation Phakisa, 19 July 2014; http://www.thepresidency.gov.za/pebble.asp?relid=17739)

(a) Marine transport and manufacturing activities, such as coastal shipping, trans-shipment, boat building, repair and refurbishment;
(b) Offshore oil and gas exploration;
(c) Aquaculture; and
(d) Marine protection services and ocean governance.

In terms of offshore oil and gas exploration, the goal is to further enhance the enabling environment for exploration of oil and gas while simultaneously maximising the value captured for South Africa. The proposal by Rhino provides an opportunity to meet one of the aims of Operation Phakisa.

The identification of potential geological structures or "prospects" within the proposed exploration licence area for future exploration and possible well-drilling provides an opportunity to develop a South African oil and gas industry resulting in long-term benefits consisting of access to new energy sources, improved security of supply, major in-country investments in a development project and reduced dependence on the importation of hydrocarbons. There is also potential in the long-term for local economic stimulation through direct employment, future business opportunities, royalties and tax revenues.

In summary, exploration success would result in long-term benefits for South Africa consisting of access to new energy sources, improved security of supply, major in-country investments in a development project and reduced dependence on the importation of hydrocarbons.

3.2 GENERAL PROJECT INFORMATION

3.2.1 EXPLORATION RIGHT HOLDER

Rhino as the applicant for an Exploration Right will also be the operator for the proposed project.

Address:	Rhino Oil and Gas Exploration South Africa (Pty) Ltd Icon Building, Suite 300 Corner of Long Street & Hans Strijdom Avenue CAPE TOWN, 8000
Vice President and COO:	Phillip Steyn
Cell:	+27 (0)79 716 1030
E-mail:	psteyn@rhinoresourcesltd.com

3.2.2 LICENCE AREA DETAILS

Licence Blocks 3617 and 3717 are located off the South-West Coast of South Africa and cover an area of approximately 13 279 km^2. The eastern border of the proposed exploration licence area is located between approximately 190 km and 385 km off the South-West Coast of South Africa in water depths greater than 3 500 m (see Figure 1.1). The co-ordinates of the proposed exploration licence area are provided Table 3.1.

Table 3.1: Co-ordinates of License Blocks 3617 and 3717.

Point	Latitude (S)			Longitude (E)		
1	37°	48'	15.3236"	18°	00'	00.0000"
2	36°	00'	00.0000"	18°	00'	00.0000"
3	36°	00'	00.0000"	17°	00'	00.0000"
4	37°	27'	53.2011"	17°	00'	00.0000"

Co-ordinate system: WGS 84

3.2.3 FINANCIAL PROVISION

In terms of Section 24P of NEMA and associated regulations pertaining to the financial provision (GN No. R1147), an applicant for Environmental Authorisation relating to exploration must, before the Minister of Mineral Resources issues the Environmental Authorisation, comply with the prescribed financial provision for the rehabilitation, closure and ongoing post decommissioning management of negative environmental impacts.

Rhino would put in place the required financial provision for the proposed exploration activities. Rhino would obtain and maintain appropriate insurance against operational risks. Such insurance would be held for and in relation to operations, against (*inter alia*) pollution damage, damage to property, the cost of removing wrecks or clean-up operations pursuant to an operational accident, injury to employees and other persons, in accord with good oilfield practice.

The estimated cost for management and / or rehabilitation of potential negative environmental impacts that might be incurred during the proposed exploration activities is USD 940 500. A breakdown of cost is provided in Appendix 6.

3.3 PROPOSED EXPLORATION PROGRAMME

The proposed exploration programme in Licence Blocks 3617 and 3717 would commence with the acquisition and collation of existing data. Thereafter multi-beam bathymetry and 2D/3D seismic surveys would be conducted to identify potential target areas for future exploration. The proposed activities associated with the exploration programme are described further below.

3.3.1 MULTI-BEAM BATHYMETRY

3.3.1.1 Introduction

There are a number of different sonar surveying tools for investigating the structure of the ocean floor sediment layers (including depth sounders, side scan sonar, bottom profilers and multi-beam echo/depth sounders). The operator proposes to undertake a multi-beam bathymetry survey to produce a digital terrain model of the seafloor (see Figure 3.1).

3.3.1.2 Methodology

The survey vessel would be equipped with a multi-beam echo sounder to obtain swath bathymetry and a sub-bottom profiler to image the seabed and the near surface geology within the proposed exploration licence area. The multi-beam system provides depth sounding information on either side of the vessel's track across a swath width of approximately two times the water depth.

The multi-beam echo sounder emits a fan of acoustic beams from a transducer at frequencies ranging from 10 kHz to 200 kHz and typically produces sound levels in the order of 207 db re 1µPa at 1m. The sub-bottom profiler emits an acoustic pulse from a transducer at frequencies ranging from 3 kHz to 40 kHz and typically produces sound levels in the order of 206 db re 1µPa at 1m.

3.3.1.3 Extent and duration

The multi-beam bathymetry survey would be undertaken over the majority of the proposed exploration licence area. It is anticipated that data acquisition would take in the order of 15 to 20 productive days to complete at a vessel speed of 4 knots.

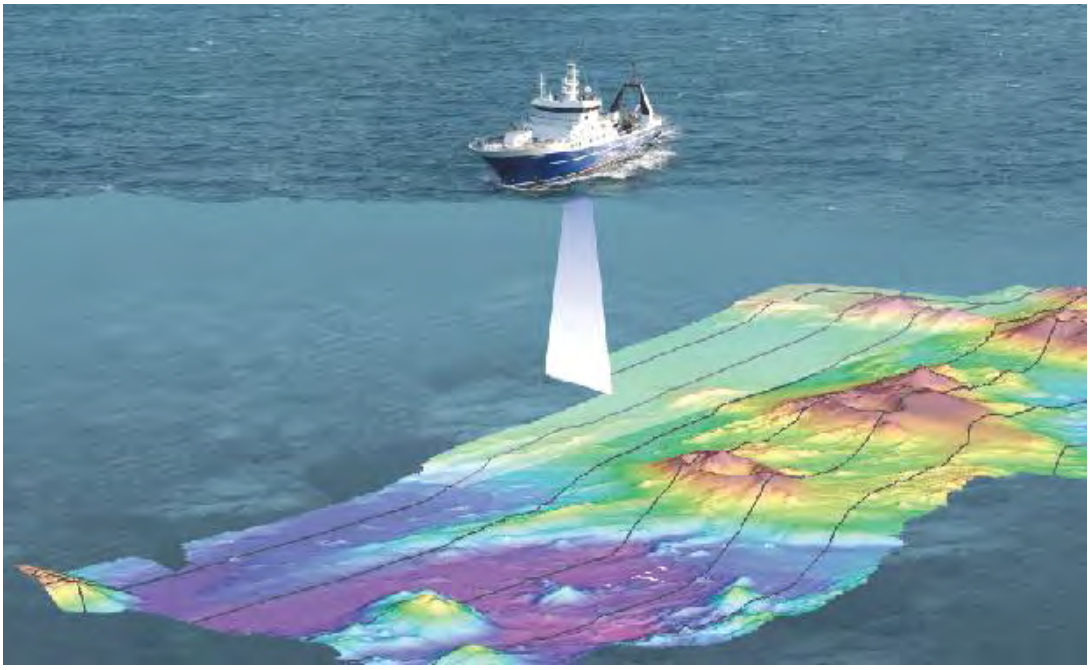


Figure 3.1: Illustration of a vessel using multi-beam depth/echo sounders (http://www.gns.cri.nz/).

3.3.2 SEISMIC SURVEYS

3.3.2.1 Introduction

Seismic surveys are carried out during oil and gas exploration activities in order to investigate subsea geological formations. During seismic surveys, high-level, low frequency acoustics are directed towards the seabed from near-surface sound sources towed by a seismic vessel. Signals reflected from geological interfaces below the seafloor are recorded by multiple receivers (or hydrophones) towed in a single or multiple streamers (see Figure 3.2). Analyses of the returned signals allow for interpretation of subsea geological formations.

Seismic surveys are undertaken to collect either 2D or 3D data. 2D surveys are typically applied to obtain regional data from widely spaced survey grids (tens of kilometres) and infill surveys on closer grids (down to a 1 km spacing) are applied to provide more detail over specific areas of interest such as potentially drillable petroleum prospects. A 2D survey provides a vertical slice through the earth's crust along the survey track-line. The vertical scales on displays of such profiles are generally in two-way sonic time, which can be converted to depth displays by using sound velocity data.

3D seismic surveys are typically applied to promising petroleum prospects to assist in fault interpretation, distribution of sand bodies, estimates of oil and gas in place and the location of exploration wells. A 3D survey operation requires multiple traverses of the survey area over the region of interest. Typically the surface sail line tracks of the vessel are separated by half the streamer array width.

For this investigation Rhino is proposing to undertake acquisition of a 2D seismic survey. However, if it is determined by subsequent analysis of existing data, that acquisition of a seismic dataset utilising 3D seismic techniques might be a more advantageous approach for data collection, then a 3D seismic survey might be substituted for the 2D survey or may be done in addition to the 2D seismic survey.

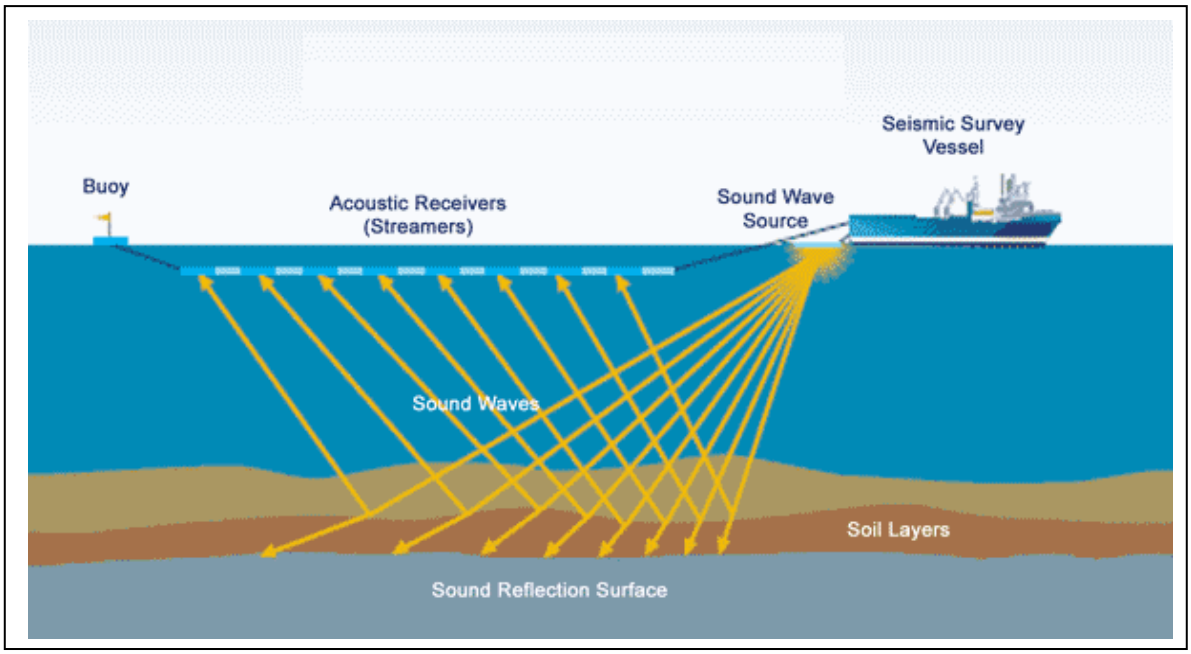


Figure 3.2: Principles of offshore 2D / 3D seismic surveys (from fishsafe.eu).

3.3.2.2 Survey methodology and airgun array

The seismic survey would be conducted using a purpose-built seismic vessel. The seismic vessel would travel along transects of a prescribed grid within the survey area that have been carefully chosen to cross any known or suspected geological structure. During surveying, the seismic vessel would travel at a speed of between four and six knots (i.e. 2 to 3 metres per second).

The seismic survey would involve a towed airgun array, which provides the seismic source energy for the profiling process, and a seismic wave detector system, usually known as a hydrophone streamer. The anticipated airgun and hydrophone array would be dependent on whether a 2D or 3D seismic survey is undertaken. The sound source or airgun array (one for 2D and two for 3D) would be situated some 80 m to 150 m behind the vessel at a depth of 5 m to 25 m below the surface. A 2D survey typically involves a single streamer, whereas 3D surveys use multiple streamers (up to 12 streamers spaced 100 m apart). The array can be up to 12 000 m long. The streamer/s would be towed at a depth of between 6 m and 30 m and would not be visible, except for the tail-buoy at the far end of the cable. A typical 3D seismic survey configuration and safe operational limits are illustrated in Figure 3.3.

Airguns, which are the most common sound source used in modern seismic surveys, would be used for the proposed survey. The airgun is an underwater pneumatic device from which high-pressure air is released suddenly into the surrounding water. On release of pressure the resulting bubble pulsates rapidly producing an acoustic signal that is proportional to the rate of change of the volume of the bubble. The frequency of the signal depends on the energy of the compressed air prior to discharge. Airguns are used on an individual basis (usually for shallow water surveys) or in arrays. Arrays of airguns are made up of towed parallel strings, usually comprised of between 12 and 70 airguns in total. The airguns are commonly towed some 80 m to 150 m behind the vessel at a depth of 5 m to 25 m below the surface. The airgun would be fired at approximately 10 to 20 second intervals.

The sound waves are reflected by boundaries between sediments of different densities and returned signals are recorded by hydrophones mounted inside streamer cables and transmitted to the seismic vessel for electronic processing. Analyses of the returned signals allow for interpretation of subsea geological formations.

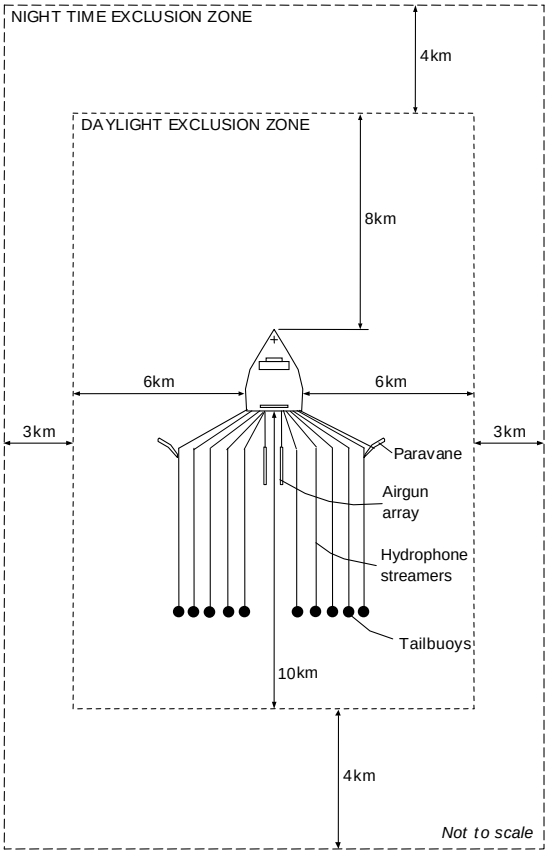


Figure 3.3: Typical configuration for a 3D seismic survey operation. Safe operational limits applicable to both 2D and 3D surveys are also shown.

3.3.2.3 Sound pressure emission levels

A single airgun could typically produce sound levels in the order of 220-230 dB re 1 mPa @ 1m, while arrays produce sounds typically in the region of 250 dB re 1 mPa @ 1m. The majority of energy produced is in the 0 to 120 Hz bandwidth, although energy at much higher frequencies is also recorded. High-resolution surveys and shallow penetration surveys require relatively high frequencies of 100 to 1000 Hz, while the optimum wavelength for deep seismic work is in the 10 to 80 Hz range.

One of the required characteristics of a seismic shot is that it is of short duration (the main pulse is usually between 5 and 30 milliseconds). The main pulse is followed by a negative pressure reflection from the sea surface of several lower magnitude bubble pulses (see Figure 3.4). Although the peak levels during the shot may be high, the overall energy is limited by the duration of the shot.

3.3.2.4 Extent, duration and timing

It is anticipated that the proposed 2D seismic survey would be up to a maximum of 1 000 km in length comprising a number of low density spaced survey lines within the proposed exploration licence area. Rhino is considering two alternative seismic survey plans in the proposed exploration licence area (see Figure 3.5).

Although survey commencement would ultimately depend on the Exploration Right award date, availability of seismic contractors and other factors, it is anticipated that the survey would be undertaken during the summer of 2017 (Q1/Q2) and would take in the order of 15 to 20 productive days to complete. The summer period has specifically been selected in order to avoid the main cetacean migration / breeding period from June to December, as well as ensuring optimal sea state and weather conditions.

Once the initial 2D survey has been undertaken (or replaced by an initial 3D survey) the data will be analysed. After data analysis further possible target areas may be identified for further 3D surveying, which would take a further 15 to 20 productive days to complete.

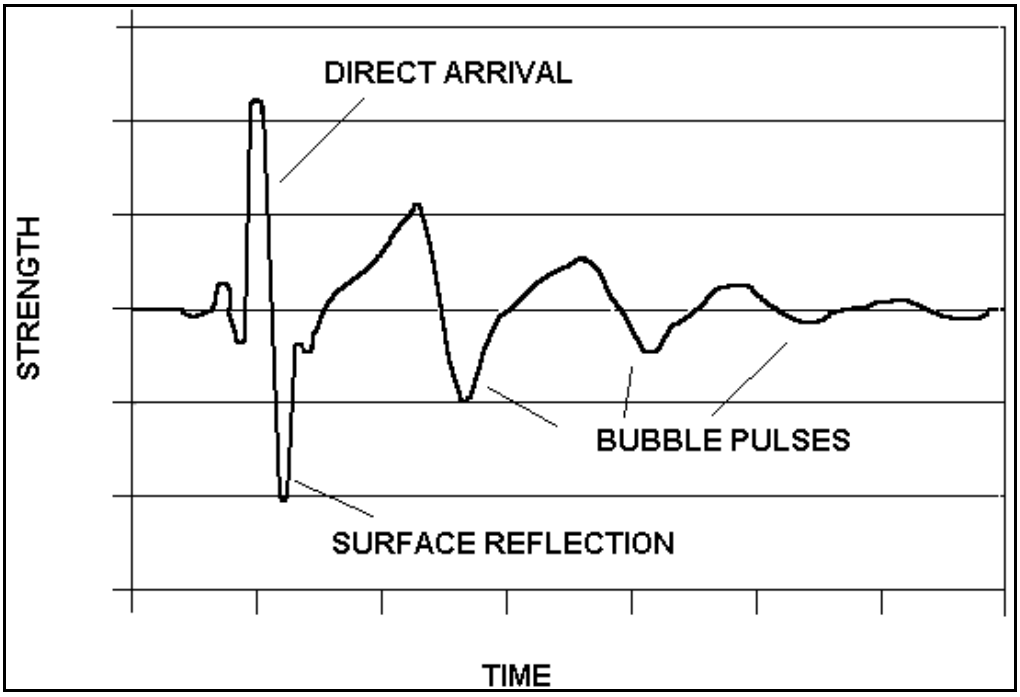


Figure 3.4: A typical pressure signature produced on firing of an airgun.

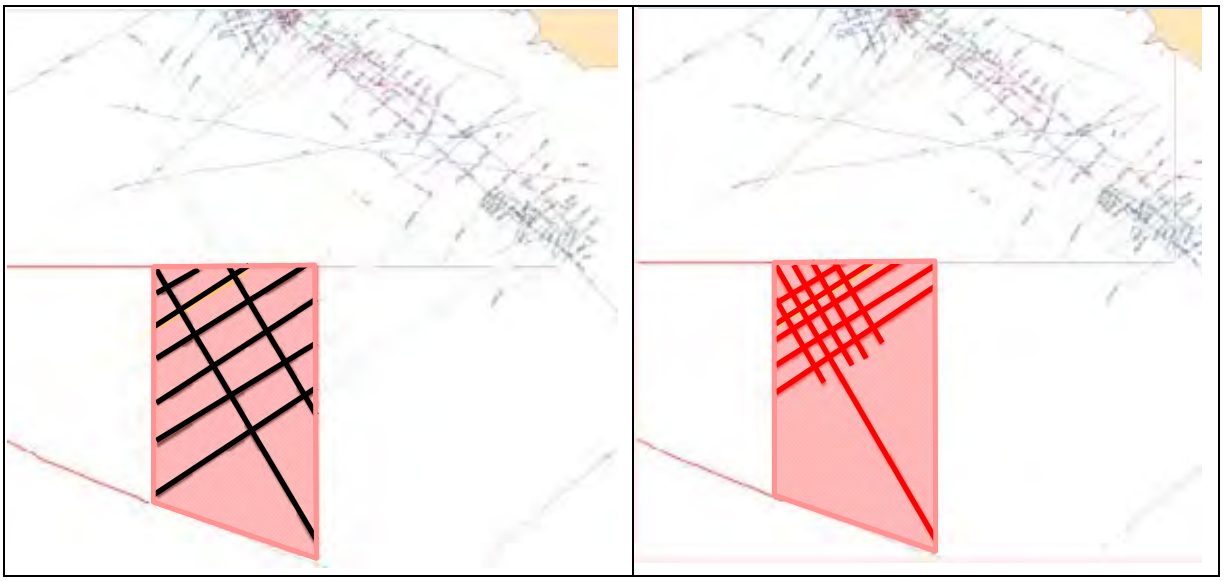


Figure 3.5: Indicative seismic survey plan alternatives.

3.3.3 EXCLUSION ZONES

The acquisition of high quality seismic data requires that the position of the survey vessel and the array be accurately known. Seismic surveys consequently require accurate navigation of the sound source over pre-determined survey transects. This, and the fact that the array and the hydrophone streamers need to be towed in a set configuration behind the tow-ship, means that the survey operation has little manoeuvrability while operating.

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part B, Rule 18), survey vessels that are engaged in surveying or towing operations are defined as "vessel restricted in its ability to manoeuvre[2]" which requires that power-driven and sailing vessels give way to a vessel restricted in its ability to manoeuvre. Vessels engaged in fishing shall, so far as possible, keep out of the way to a vessel restricted in its ability to manoeuvre. Furthermore, under the Marine Traffic Act, 1981 (No. 2 of 1981), a vessel (including array of airguns and hydrophones) used for the purpose of exploiting the seabed falls under the definition of an "offshore installation" and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone. In addition to a statutory 500 m safety zone, a seismic contractor would typically request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond. Typical safe operational limits for a 2D and 3D survey are illustrated in Figure 3.3.

At least a 500 m exclusion zone would need to be enforced around all survey vessels (including its array of airguns and hydrophones) at all times. A chase boat with appropriate radar and communications would be used during the seismic survey to warn vessels that are in danger of breaching the exclusion zone.

The 500 m safety zone and proposed safe operational limits would be communicated to key stakeholders well in advance of the proposed exploration programme. Notices to Mariners will also be communicated through the proper channels.

3.3.4 SUPPORT SERVICES

A support vessel may be required to perform logistics support to the seismic vessel.

Bunkering of the survey vessels is expected to be undertaken at port of operation (Cape Town or Saldanha) or at sea during the survey. Standard operating procedures for refuelling would be adhered to at all times.

3.3.5 ENVIRONMENTAL NOTIFICATION

At this stage no vessels have been contracted for the various exploration activities. Thus specific detail would only be available when the operator has appointed a contractor/s and contracted vessel/s. The specific details of the contractor/s and vessel/s would be compiled into an Environmental Notification that would be prepared per exploration activity and submitted to PASA for information purposes prior to the commencement thereof. The Environmental Notification may include, depending on the activity, the following:

[2] Definition: The term "vessel restricted in her ability to manoeuvre" means a vessel which from the nature of her work is restricted in her ability to manoeuvre as required by these Rules and is therefore unable to keep out of the way of another vessel. The term "vessels restricted in their ability to manoeuvre" shall include but not be limited to:

- (i) a vessel engaged in laying, servicing, or picking up a navigation mark, submarine cable or pipeline;
- (ii) a vessel engaged in dredging, surveying or underwater operations;
- (iii) a vessel engaged in replenishment or transferring persons, provisions or cargo while underway;
- (iv) a vessel engaged in the launching or recovery of aircraft;
- (v) a vessel engaged in mine clearance operations; and
- (vi) a vessel engaged in a towing operation such as severely restricts the towing vessel and her tow in their ability to deviate from their course.

- Survey lines / target area;
- Survey timing and duration;
- Contractor details;
- Vessel specifications (including relevant certification and insurance);
- Emergency Response Plan and Shipboard Oil Pollution Emergency Plan (SOPEP); and
- Details of Marine Mammal Observer, Passive Acoustic Operator and Fisheries Liaison Officer, where applicable.

3.4 PROJECT ALTERNATIVES

NEMA prescribes that every application for Environmental Authorisation must include, *inter alia*, an investigation of the potential consequences or impacts of the alternatives to the activity on the environment and assessment of the significance of those potential consequences or impacts, including the option of not implementing the activity (i.e. No-Go Alternative).

"Alternatives", in relation to a proposed activity, are different ways of meeting the general purposes and requirements of the proposed activity, which may include alternatives to:

- the location where it is proposed to undertake the activity;
- the type of activity to be undertaken;
- the design or layout of the activity;
- the technology to be used in the activity; and
- the option of not implementing the activity.

A summary of the project alternatives that have been considered during the scoping process is provided in Table 3.2 below.

Table 3.2: Summary of project alternatives.

No.	Alternatives	Description
1. Site / location alternatives		
1.1	Exploration Right area / Survey area	The location of the proposed exploration activities is ultimately determined by Rhino's application for an Exploration Right in Licence Blocks 3617 and 3717. Thus the proposed exploration activities would be limited to these blocks and no further site alternatives can be considered. This EIA assesses the potential impacts of the proposed exploration activities over the entire extent of the proposed exploration licence area in order for Rhino to be able to get a full understanding of the geology of the area.
2. Activity alternatives		
2.1	Exploration activities	Rhino has assessed the petroleum potential of the proposed exploration licence area using existing data available from PASA and public sources (seismic surveys and data from existing exploration wells). This assessment has indicated there may be a possibility of a hydrocarbon discovery (oil or gas) within the area. In order to better understand the potential of discovering oil or gas within the proposed exploration licence area, Rhino is proposing to undertake both multi-beam bathymetry and seismic surveys. Both these surveying methods are primary tools for locating hydrocarbon deposits and thus the first step in determining whether there are likely to be any oil or gas reserves in the proposed exploration licence area. The proposed activities are also in line with Rhino's proposed Work Programme. Thus no other exploration activity alternatives are being considered in the EIA process. Any future proposed well drilling or development would be subject to a separate EIA process.

No.	Alternatives	Description
3. Design or layout alternatives		
3.1	Seismic survey lines	Rhino is considering two alternative seismic survey programmes in the proposed exploration licence area (see Figure 3.5). In order to cater for any potential deviations to the proposed alternative seismic survey plans, the EIA assess the potential impacts of the proposed seismic survey anywhere within the proposed exploration licence area.
3.2	Survey timing	Although Rhino is proposing to commence the seismic surveys in a fair weather period in 2017 (Q1/Q2) (see Section 3.3.2.4), the EIA assesses the potential impacts of the proposed exploration activities during both the summer and winter.
4. Technology alternatives		
4.1	Sonar survey technologies	In order to further investigate the structure of the ocean floor sediment layers, there are several possible alternative technologies available, including: • Depth sounders; • Side scan sonar; • Bottom profilers; and • Multi-beam bathymetry. Rhino is, however, only proposing to undertake a multi-beam bathymetry survey, as it produces high quality bathymetric data along a wider track beam compared to the other alternatives. Although no other sonar survey technology alternatives are being considered in the EIA process, it should be noted that the potential impacts associated with the other sonar survey technology alternatives would be no more significant than that associated with the proposed multi-beam bathymetry survey.
4.2	Seismic survey technologies	For this investigation Rhino is proposing to undertake acquisition of a 2D seismic survey. However, if it is determined by subsequent analysis of existing data, that acquisition of a seismic dataset utilising 3D seismic techniques might be a more advantageous approach for data collection, then a 3D seismic survey might be substituted for the 2D survey or may be done in addition to the 2D seismic survey. This EIA thus assesses the potential impacts related to undertaking both 2D and 3D seismic surveys. Since the airgun and streamer type, array configurations, etc. would ultimately be limited to what equipment is available on the contacted survey vessel, the assessment is based, to a large extent, on a generic description of seismic surveys, specifically airgun and hydrophone array specifications.
5. No-go alternative		
5.1	No-go alternative	The no-go alternative is the non-occurrence of the proposed exploration activities. Thus there would be no acquisition of bathymetry and seismic data for the proposed exploration licence area as proposed. The negative implications of not going ahead with the proposed exploration are as follows: • South Africa would lose the opportunity to further establish the extent of indigenous oil or gas reserves off the South-West Coast; • Lost economic opportunities related to sunken costs (i.e. costs already incurred) of initial desktop investigations in the proposed exploration licence area; and • If economic oil and gas reserves do exist and are not developed, South Africa / Rhino would lose the opportunity to maximise the use of its own indigenous oil and gas reserves. The no-go alternative is assessed in this EIA.

4. THE AFFECTED ENVIRONMENT

This chapter provides a description of the biophysical and socio-economic environment that is likely to be affected by the proposed exploration activities in Licence Blocks 3617 and 3717 off the South-West Coast of South Africa. In certain descriptions in this literature review, the South-West Coast is included in the West Coast (West of Cape Agulhas).

4.1 METEOROLOGY AND PHYSICAL OCEANOGRAPHY

The proposed exploration licence area lies within the southern zone of the Benguela Current region, which is characterised by the cool Benguela upwelling system (Shillington 1998; Shannon 1985). A conceptual model of the Benguela system (see Figure 4.1) summarises much of the physical oceanography of the region.

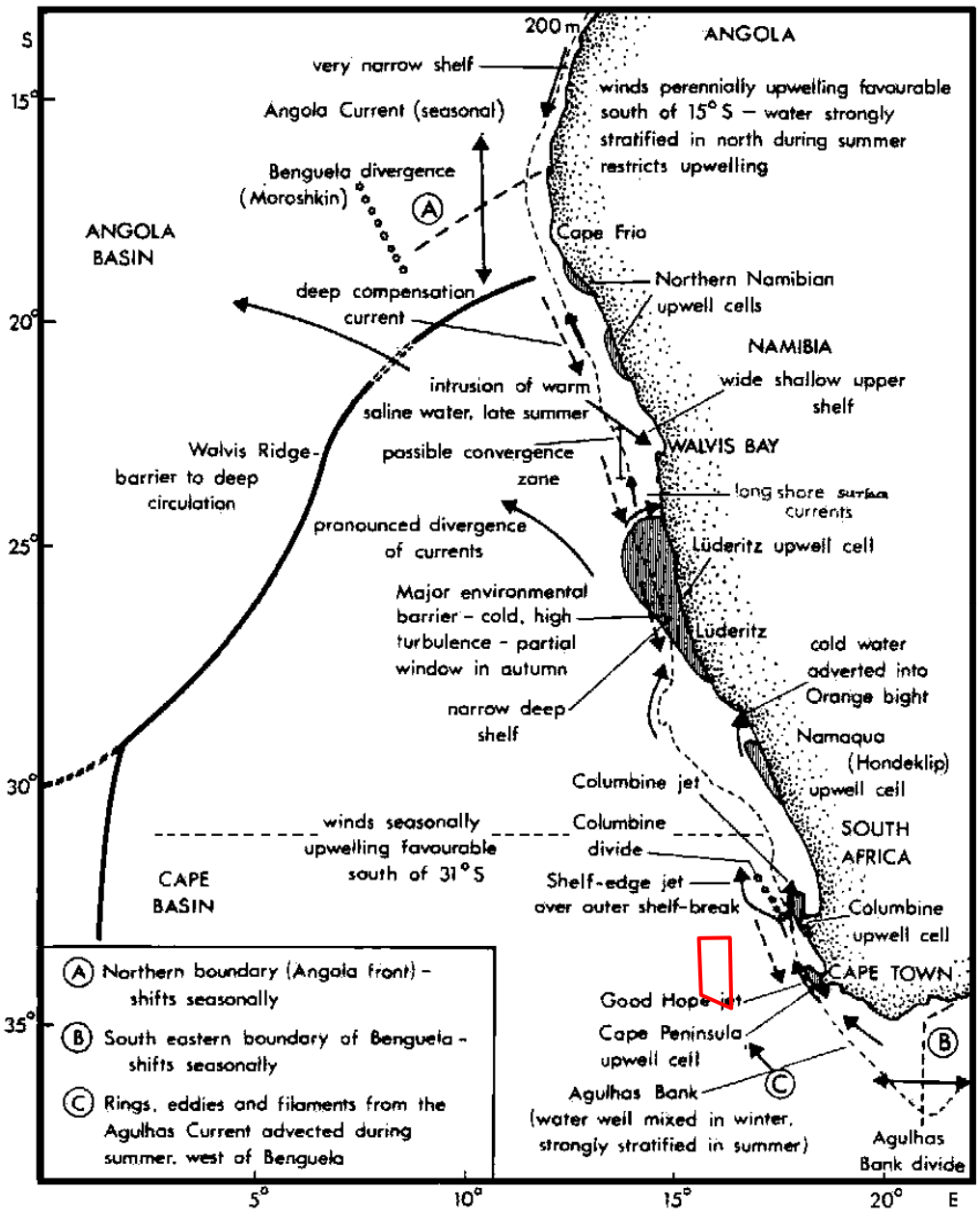


Figure 4.1: A conceptual model of the Benguela system (after Shannon 1985). Approximate location of Licence Blocks 3617 and 3717 is also indicated.

4.1.1 METEOROLOGY

The meteorological processes of the South African South-West Coast have been described by numerous authors, including Andrews and Hutchings (1980), Heydorn and Tinley (1980), Nelson and Hutchings (1983), Shannon (1985), Shannon and Nelson (1996), and Shillington (1998).

Wind and weather patterns along the South-West Coast are primarily due to the South Atlantic high-pressure cell and the eastward movement of mid-latitude cyclones (which originate within the westerly wind belt between 35° to 45°S), south of the subcontinent.

The South Atlantic high-pressure cell is perennial, but strongest during austral summer when it attains its southernmost extension to the south and south-west (approximately 30°S, 05°E) of the subcontinent. Linked to this high-pressure in summer is a low-pressure cell that forms over the subcontinent due to strong heating over land. The pressure differential of these two systems induces moderate to strong south-easterly (SE) winds near the shore during summer. Furthermore, the southern location of the South Atlantic high-pressure cell limits the impact that mid-latitude cyclones have on summer weather patterns so that, at best, the mid-latitude cyclones cause a slackening of the SE winds. During the austral winter both the weakening and north-ward migration of the South Atlantic high-pressure cell (to approximately 26°S, 10°E) and the increase in atmospheric pressure over the subcontinent result in the eastward moving mid-latitude cyclones advancing closer to the coast.

Strong north-westerly (NW) to south-westerly (SW) winds result from mid-latitude cyclones passing the southern Cape at a frequency of 3 to 6 days. Associated with the approach of mid-latitude cyclones is the appearance of low-pressure cells, which originate from near Lüderitz on the Namibian coast and quickly travel around the subcontinent (Reason and Jury 1990; Jury, Macarthur and Reason 1990). Mid-latitude cyclones can generate cut-off lows during winter. Cut-off lows are associated with extreme weather patterns, such as powerful convection updrafts and very strong atmospheric instability, resulting in a range of severe types of weather. Extreme weather conditions along the South-West Coast include very strong gale forces winds, rough seas (> 5 m) and torrential rain, leading to flooding and associated damages. No hurricanes are likely to occur off the South-West Coast.

A second important wind type that occurs along the South-West Coast are katabatic ‘berg’ winds during the formation of a high-pressure system (lasting a few days) over, or just south of, the south-eastern part of the subcontinent. This results in the movement of dry adiabatically heated air offshore (typically at 15 m/s). At times, such winds may blow along a large proportion of the West Coast north of Cape Point and can be intensified by local topography. Aeolian transport of fine sand and dust may occur up to 150 km offshore.

4.1.2 PHYSICAL OCEANOGRAPHY

4.1.2.1 Waves

The direction and size of waves present at different sites along the South-West Coast have been reported by Heydorn and Tinley (1980), Bickerton (1981a and b, 1982) and Morant (1984).

Wave patterns along the South-West Coast are strongly influenced by the seasonal meteorology. The majority of swells are generated by mid-latitude cyclones to the south of the country, and thus originate from the SW. Wave period is similar and unimodal along the West Coast to the north of Cape Point. Peak energy periods range from 9.7 to 15.5 seconds.

Typical seasonal swell-height rose-plots, compiled from Voluntary Observing Ship (VOS) data off Cape Columbine and Cape Point, are shown in Figure 4.2a and b.

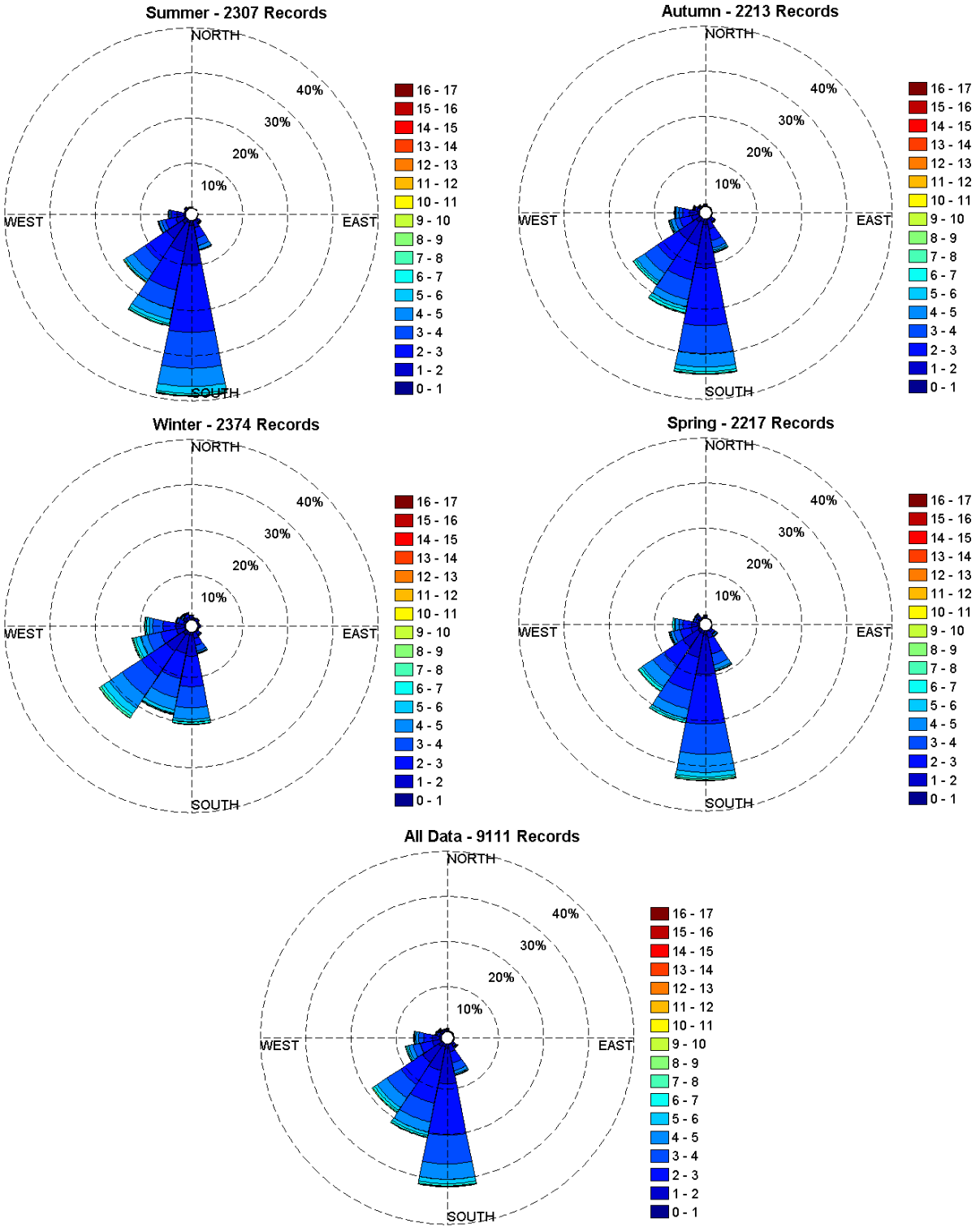


Figure 4.2a: Voluntary Observing Ship (VOS) Wave Height vs Wave Direction data for the Cape Columbine area 32.0° to 32.9° S and 17.0° to 17.9° E (1903/11/01 to 2011/05/24; 9 111 records) (from CSIR).

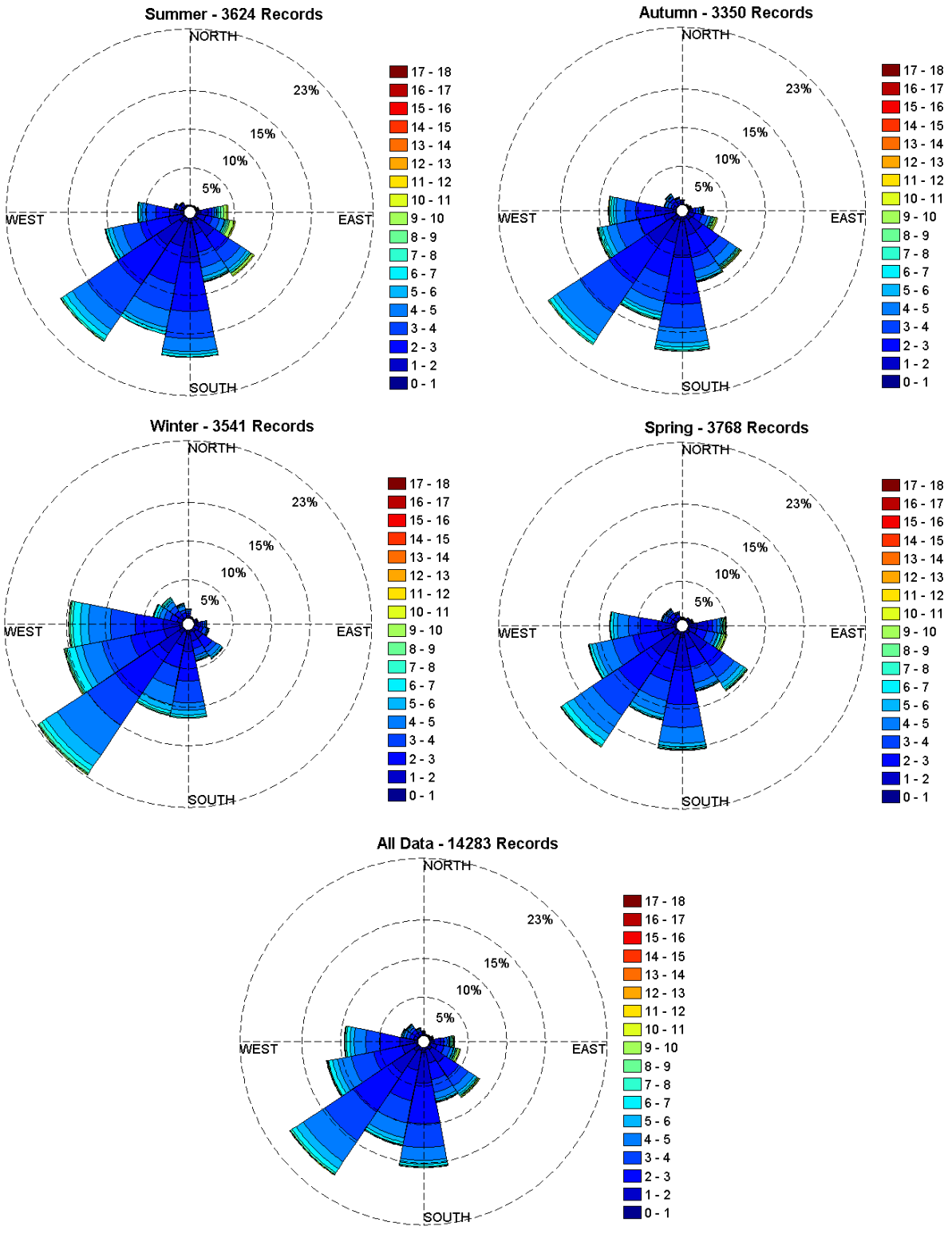


Figure 4.2b: VOS Wave Height vs Wave Direction data for the Cape Point area 34.0° to 34.9° S and 18.0° to 18.9° E (1900/01/01 to 2011/05/24; 14 283 records) (from CSIR).

The wave regime along the West Coast shows only moderate seasonal variation in direction, with virtually all swells throughout the year coming from the SW - S direction. Winter swells, however, are strongly dominated by those from the SW – south-south-west (SSW), which occur almost 80% of the time, and typically exceed 2 m in height, averaging about 3 m, and often attaining over 5 m. With wind speeds capable of reaching 100 km/h during heavy winter south-westerly storms, winter swell heights can exceed 10 m.

In comparison, summer swells tend to be smaller on average, typically around 2 m, not reaching the maximum swell heights of winter. There is also a more pronounced southerly swell component in summer. These southerly swells tend to be wind-induced, with shorter wave periods (approximately 8 seconds) and are generally steeper than swell waves (CSIR 1996). These wind-induced southerly waves are relatively local and, although less powerful, tend to work together with the strong southerly winds of summer to cause the northward-flowing nearshore surface currents, and result in substantial nearshore sediment mobilisation, and northwards transport, by the combined action of currents, wind and waves.

4.1.2.2 Tides

Tides along the South-West Coast are subject to a simple semi-diurnal tidal regime with a mean tidal range of about 1.57 m (at least 50% of the time in the nearshore area), with spring tides as much as 2.24 m and neap tides in the order of 1 m. Tides arrive almost simultaneously (within 5 to 10 minutes) along the whole of the West Coast. Other than in the presence of constrictive topography, e.g. an entrance to enclosed bay or estuary, tidal currents are weak.

4.1.2.3 Bathymetry and topography

The bathymetry and topography of the South-West Coast offshore region has been described by Nelson and Hutchings 1983; Shannon 1985; Shannon and Nelson 1996 and Dingle *et al.* 1987.

The continental shelf along the West to South-West Coast is generally both wide and deep, although large variations in both depth and width occur (see Figure 4.3). The shelf maintains a general north-north-west (NNW) trend north of Cape Point, being narrowest in the south between Cape Columbine and Cape Point (40 km) and widening to the north of Cape Columbine to its widest off the Orange River (180 km), and widening south of Cape Point due to the presence of the Agulhas Bank.

The immediate nearshore area consists mainly of a narrow (to about 8 km wide) rugged rocky zone which initially slopes steeply seawards to a depth of about 30 m and then gradually to about 80 m. The middle and outer shelf normally lacks relief and slope gently seawards reaching the shelf break (where the slope becomes significantly steeper) at a depth of approximately 300 m. A number of submarine canyons cut into the shelf between 31° and 35°S, the most prominent being the Cape Canyon and the Cape Point Valley.

Major bathymetric features in the region include Protea Seamount (36.8°S, 18.1°E), Simpson Seamounts (37.2°S, 16.9°E), Argentina Seamount (37.6°S, 18.1°E) and the Cape Canyon (~33.5°S, 17.5°E) (Birch & Rogers 1973; CCA & CSIR 1998).

Outside the shelf break, depth increases rapidly to more than 1 000 m (Hutchings 1994). Licence Blocks 3617 and 3717 extend beyond the continental shelf with depths beyond 3 500 m.

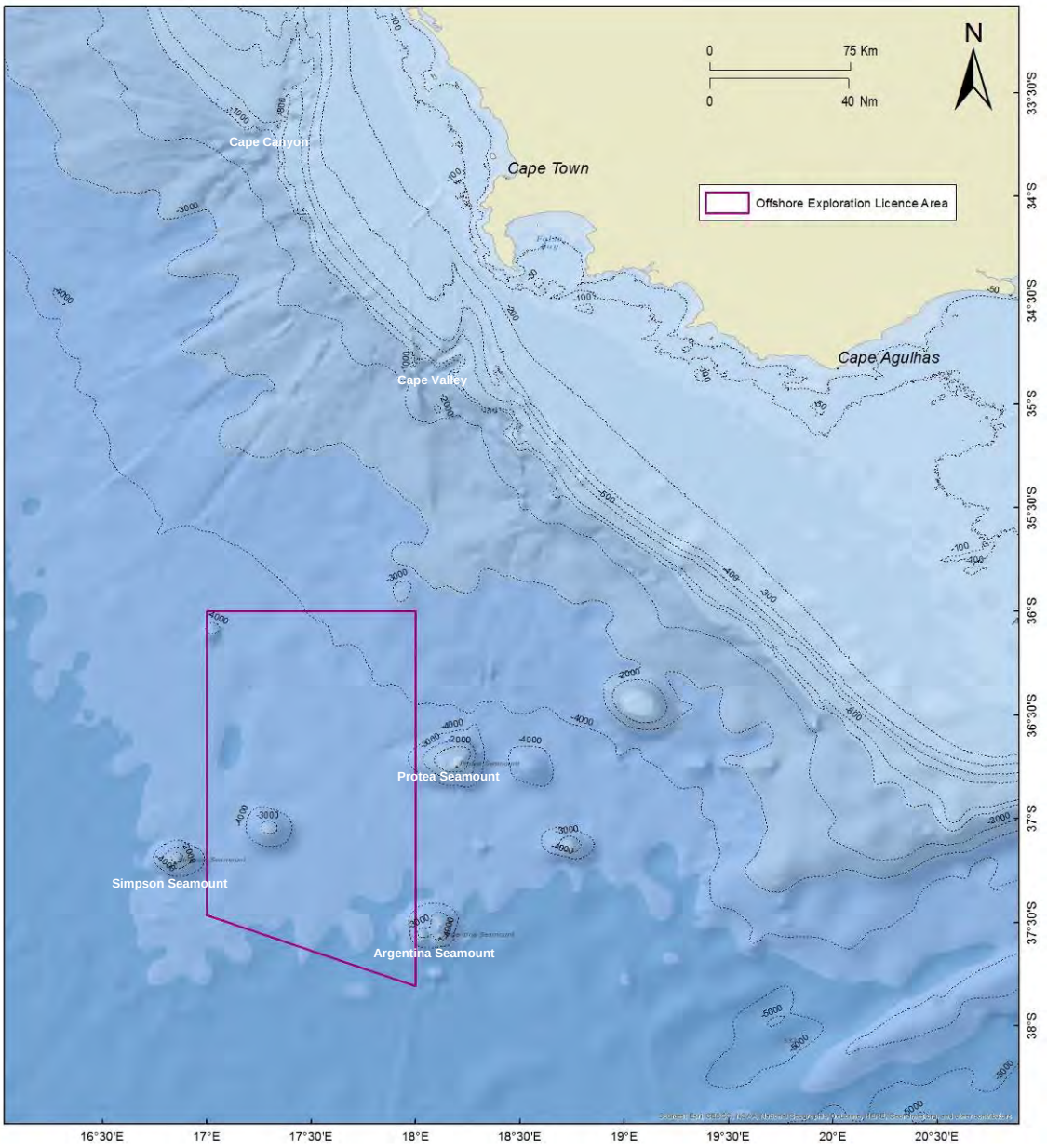


Figure 4.3: Bathymetry of the continental shelf off the West Coast of southern Africa. Approximate location of Licence Blocks 3617 & 3717 is also indicated.

4.1.2.4 Sediments

The inner shelf is underlain by Precambrian bedrock (also referred to as Pre-Mesozoic basement), whilst the middle and outer shelf areas are composed of Cretaceous and Tertiary sediments (Dingle 1973; Birch *et al*. 1976; Rogers 1977; Rogers & Bremner 1991).

As a result of erosion on the continental shelf, the unconsolidated sediment cover is generally thin, often less than 1 m. Sediments are finer seawards, changing from sand on the inner and outer shelves to muddy sand and sandy mud in deeper water. However, this general pattern has been modified considerably by biological deposition (large areas of shelf sediments contain high levels of calcium carbonate) and localised river input. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze. Isolated areas of seabed associated with the Cape Valley and Cape Canyon are characterised by hard outer shelf and shelf edge sediments (Sink et al. 2012).

4.1.2.5 Water masses and sea surface temperatures

Licence Blocks 3617 and 3717 comprises mostly of South Atlantic Central Water (SACW), either in its pure form in the deeper regions, or mixed with previously upwelled water of the same origin on the continental shelf (Nelson and Hutchings 1983). Salinities range between 34.5% and 35.5% (Shannon 1985).

The deeper waters (thermocline water) comprise of South Indian and tropical Atlantic Central Water, Antarctic Intermediate Water (AAIW), North Atlantic Deep Water (NADW) and Antarctic Bottom Water (AABW). The thermocline water mass (6°C, 34.5 Practical Salinity Units (psu) – 16°C, 35.5 psu) is that which upwells along the coast and which constitutes the shelf waters of the Benguela, although in highly modified forms. Thermocline water overlies AAIW (34.2-34.5 psu with potential temperature 4-5°C). NADW has a potential temperature less than 3°C and salinity greater than 34.8 psu, and lies below the AAIW stratum. In the Cape Basin, it lies above the AABW, which is located deeper than about 3 800 m. AABW is cooler than 1.4°C and has a salinity of 34.82 psu. South and east of Cape Agulhas, the Agulhas retroflection area is a global “hot spot” in terms of temperature variability and water movements.

Off the south-western Cape the upwelling of cool water occurs during the summer months stabilising the seawater temperature along this coastline to some extent so that the average sea surface temperature changes little throughout the year (13 to 15 °C). Over the continental margin, progressively colder waters encroach onto the continental shelf between the Orange River and the Cape Peninsula (Shannon and Nelson 1996).

4.1.2.6 Water Circulation

Water circulation off the West Coast is dominated by upwelling (see Section 4.1.2.7).

The ocean currents occurring off the West Coast are complex and are summarised in Figure 4.4. Data suggests that currents north of Cape Columbine are weaker and more variable than the currents to the south (Boyd *et al*. 1992). The most important is the Benguela current, which constitutes a broad, shallow and slow NW flow along the West Coast between the cool coastal upwelled waters and warmer Central Atlantic surface waters further offshore. The current is driven by the moderate to strong S to SE winds which are characteristic of the region and is most prevalent at the surface, although it does follow the major seafloor topographic features (Nelson and Hutchings 1983). Current velocities in continental shelf areas generally range between 10–30 cm/s (Boyd & Oberholster 1994). Shelf edge jet currents exist off both Cape Columbine (Nelson and Hutchings 1983) and the Cape Peninsula (Bang 1970; Shillington 1998), where flow is locally more intense (up to 50 cm/s off Cape Columbine and 70 cm/s off the Cape Peninsula). In the south the Benguela current has a width of 200 km, widening rapidly northwards to 750 km.

The flows are predominantly wind-forced, barotropic and fluctuate between poleward and equatorward flow (Shillington *et al.* 1990; Nelson & Hutchings 1983). Near bottom shelf flow is mainly poleward with low velocities of typically 5 cm/s. The poleward flow becomes more consistent in the southern Benguela (Pulfrich, 2011). A southward flow of surface water occurs close inshore during periods of barotropic reversals and during winter when upwelling is not taking place.

Agulhas Current water does occasionally enter the south-east Atlantic in summer as warm water filaments (<50 m deep) or eddies (several 100 m wide and deep). These warm water tongues are usually at least 180 km offshore and seldom move further north than 33°S and do not appear to impact the Benguela shelf region.

4.1.2.7 Upwelling

The Benguela region is one of the world's major coastal upwelling systems, the majority of which are found off the west coasts of continents (e.g. off Chile and Peru, California and West Africa). This upwelling dominates the oceanography of the West Coast of South Africa (Andrews and Hutchings 1980; Nelson and Hutchings 1983). Upwelling is characterised by pulsed input of cold, nutrient-rich water into the euphotic zone, and in the Benguela region results from the wind-driven offshore movement of surface waters. The surface waters are replaced by cold nutrient-rich water that upwells from depth through Ekman transport. Once upwelled, this water warms and stabilises, and moves offshore where a thermocline usually develops. Nutrient-rich upwelled water enhances primary production, and the West Coast region consequently supports substantial pelagic fisheries (Heydorn and Tinley 1980; Shillington 1998).

Upwelling occurs along the South-West and West Coasts from Cape Agulhas to northern Namibia (see Figure 4.4). The principle upwelling centre on the West Coast lies off Lüderitz and the Lüderitz upwelling cell effectively divides the Benguela Upwelling system into a northern and southern region, which are meteorologically distinct (Pitcher *et al.* 1992). In the south upwelling-favourable SE winds are most prevalent during spring and summer, and upwelling occurs mostly between September and March. Upwelling in the southern Benguela area is highly variable on macro, meso and micro scales. Both continental shelf bathymetry and upwelling winds drive upwelling in the southern Benguela which is further influenced by local topography and meteorology (Shannon 1985), resulting in centres of enhanced upwelling off Namaqualand (30°S), Cape Columbine (33°S) and Cape Peninsula (34°S) (see Figure 4.5).

Both bathymetry and orography control upwelling at Cape Columbine. Two fronts separate a divergence zone off the Columbine Peninsula, an oceanic front at the shelf edge and a shallower inshore front. Upwelling off the Cape Peninsula is among the most marked in the world with upwelling rates estimated to average 21 m/day (maximum of 32 m/day). A well-defined front exists over the shelf break off the Cape Peninsula, outside of which is a well-developed equatorward jet reaching speeds of 60 cm/s on the surface and 120 cm/s at 150 m (Andrews and Hutchings 1980).

Although the upwelling process is active within 10 to 20 km of the shore, the influence of cold upwelled water extends approximately 150 km (Shannon and Nelson 1996). However, distinctive cold water filaments can extend 200 km offshore perpendicular to the coast, some being more than 1 000 km long (Shannon and Nelson 1996, Shillington *et al.* 1992).

4.1.2.8 Nutrient distribution

Above thermoclines (that develop as water movement stabilises) phytoplankton production consumes nutrients, thus depleting the nutrients in the surface layer. Below the thermocline, nutrient re-enrichment occurs as biological decay occurs. As upwelled water is nutrient enriched compared to surface water, nutrient distribution on the West Coast are closely linked to upwelling (Chapman and Shannon 1985). Highest nutrient concentrations are thus located at the upwelling sites (Andrews and Hutchings 1980), offshore of which it decreases (Chapman and Shannon 1985).

Phosphate levels are low at the surface and offshore, but high (up to 3.0 μM) in bottom waters of the shelf and in newly upwelled waters. Upwelled waters can at times be enriched in phosphate as they pass over phosphorus rich shelf sediments. Phosphate is unlikely to ever become a limiting nutrient in the Benguela region.

Nitrate normally occurs in greater concentrations at the bottom than in upwelling source water, and decreases in availability at the surface (to less than 1 μM). Nitrate appears to be the limiting nutrient in the Benguela region.

Silicate levels range between 5-15 μM within the Benguela system, although these may at times be enhanced considerably over the shelf. It is not likely to be limiting in the southern Benguela.

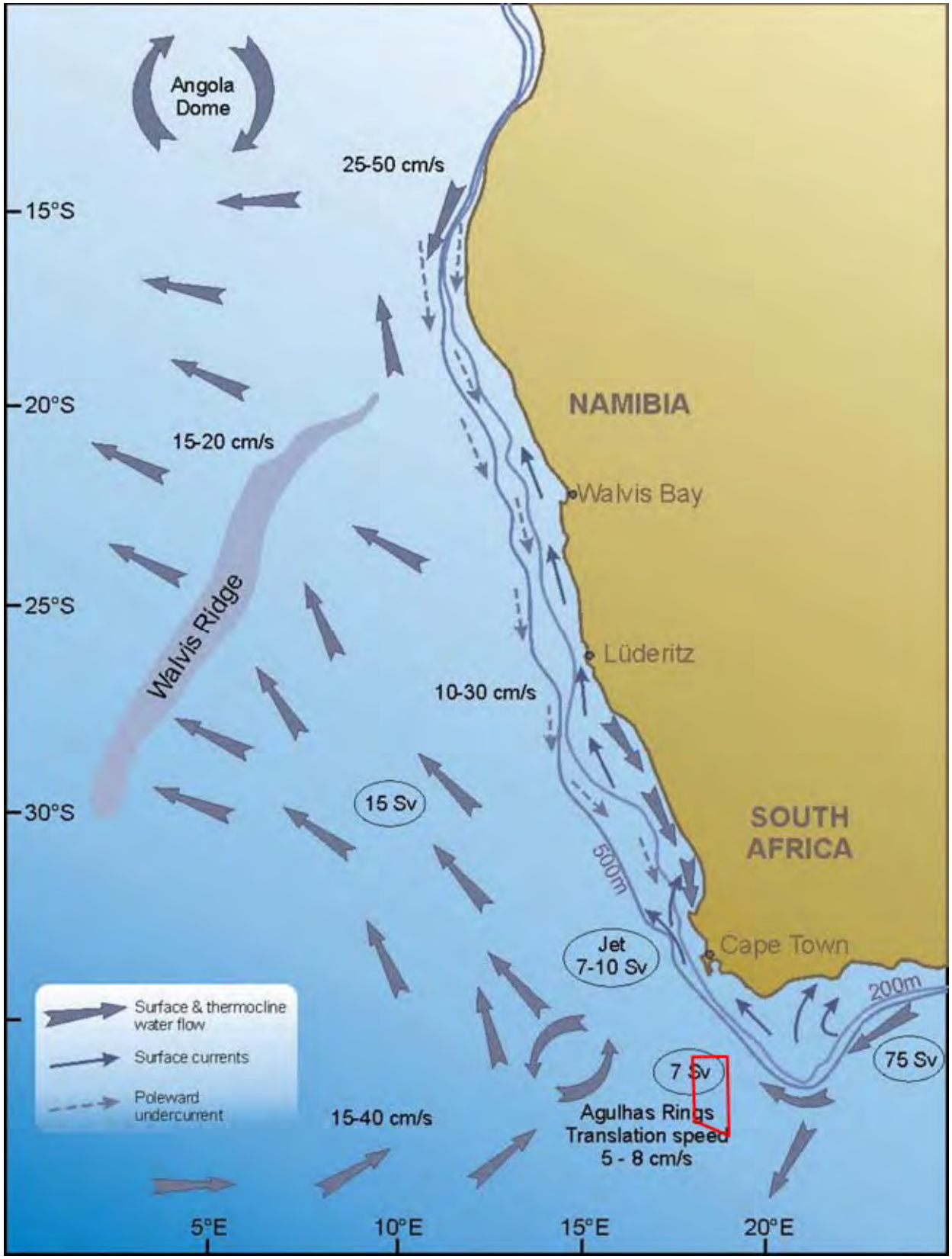


Figure 4.4: Major features of the predominant circulation patterns and volume flows in the Benguela System, along the southern Namibian and South African west coasts (re-drawn from Shannon & Nelson 1996). Approximate location of Licence Blocks 3616 & 3717 is also indicated.

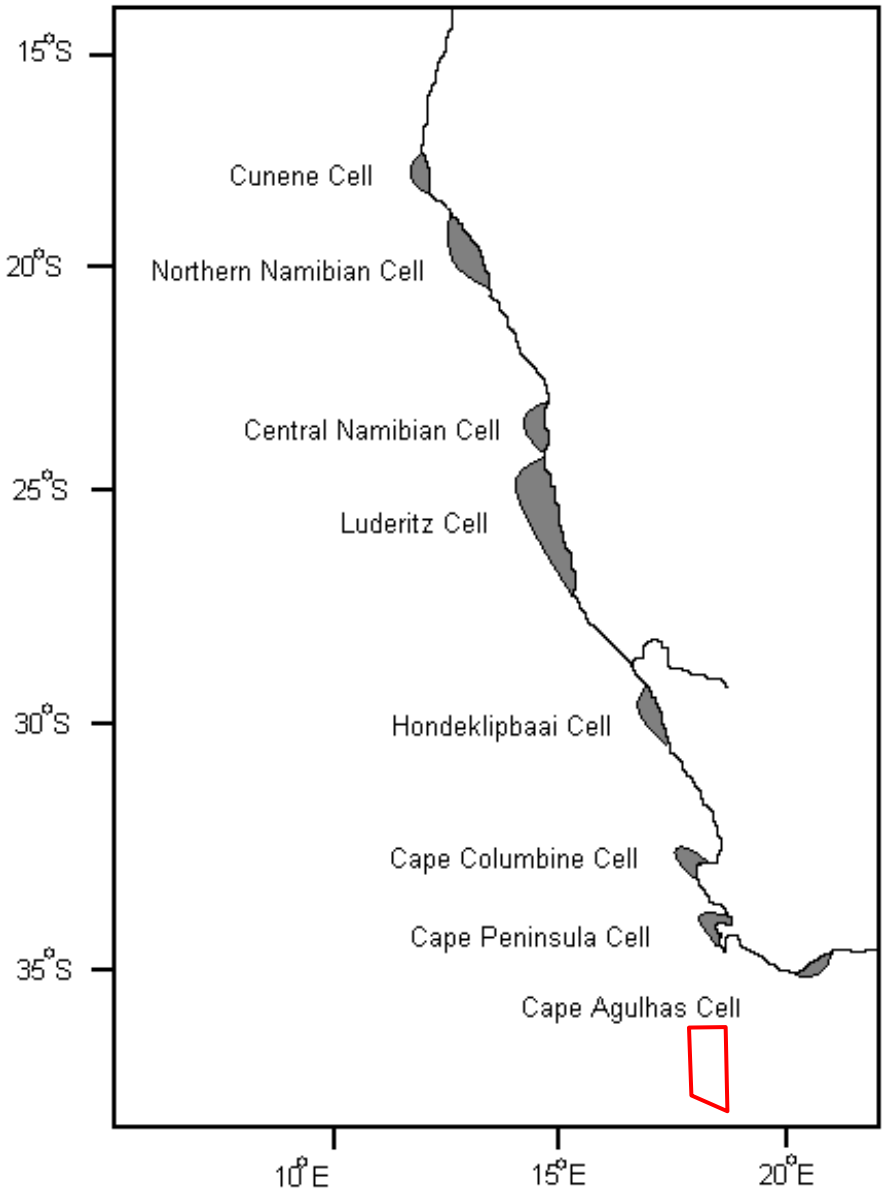


Figure 4.5: The location of three major upwelling cells along the West Coast (Shannon and Nelson, 1996). Approximate location of Licence Blocks 3616 & 3717 is also indicated.

4.1.2.9 Oxygen concentration

The Benguela system is characterised by large areas of very low oxygen concentrations with less than 40% saturation occurring frequently (Visser 1969; Bailey *et al*. 1985). The low oxygen concentrations are attributed to nutrient remineralisation in the bottom waters of the system (Chapman & Shannon 1985). The absolute rate of this is dependent upon the net organic material build-up in the sediments, with the carbon rich mud deposits playing an important role. As the mud on the shelf is distributed in discrete patches, there are corresponding preferential areas for the formation of oxygen-poor water.

Generally, oxygen concentrations appear to increase from the Orange River region southward. Surface oxygen levels are higher than bottom waters (water is regularly supersaturated) due to phytoplankton production, especially during less intense upwelling. Upwelling processes can move low-oxygen water up onto the inner shelf and into nearshore waters, often with devastating effects on marine communities.

Oxygen deficient water can affect the marine biota at two levels. It can have sub-lethal effects, such as reduced growth and feeding, and increased inter-moult period in the rock-lobster population (Beyers *et al*. 1994). Low-oxygen events associated with massive algal blooms can lead to large-scale stranding of rock lobsters, and mass mortalities of marine biota and fish (Newman & Pollock 1971; Matthews & Pitcher 1996; Pitcher 1998; Cockcroft *et al*. 2000). The development of anoxic conditions as a result of the decomposition of huge amounts of organic matter generated by algal blooms is the main cause for these mortalities and walkouts. Algal blooms usually occur during summer-autumn (February to April) but can also develop in winter during the 'berg' wind periods, when similar warm windless conditions occur for extended periods.

4.1.2.10 Turbidity

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulate matter. Total Suspended Particulate Matter (TSPM) can be divided into Particulate Organic Matter (POM) and Particulate Inorganic Matter (PIM), the ratios between them varying considerably. The POM usually consists of detritus, bacteria, phytoplankton and zooplankton and serves as a source of food for filter-feeders. PIM, on the other hand, is primarily of geological origin consisting of fine sands, silts and clays. Off the southern African West Coast, the PIM loading in nearshore waters is strongly related to natural riverine inputs. 'Berg' wind events can potentially contribute the same order of magnitude of sediment input as the annual estimated input of sediment by the Orange River (Shannon & Anderson 1982; Shannon & O'Toole 1998; Lane & Carter 1999).

Concentrations of suspended particulate matter in shallow coastal waters can vary both spatially and temporally, typically ranging from a few mg/l to several tens of mg/l (Bricelj & Malouf 1984; Berg & Newell 1986; Fegley *et al*. 1992). Field measurements of TSPM and PIM concentrations in the Benguela current system have indicated that outside of major flood events, background concentrations of coastal and continental shelf suspended sediments are generally <12 mg/l, showing significant long-shore variation (Zoutendyk 1995). Considerably higher concentrations of PIM have, however, been reported from southern African West Coast waters under stronger wave conditions associated with high tides and storms, or under flood conditions. Field measurements of TSPM and PIM concentrations in the southern Benguela are summarised in Table 4.1.

Table 4.1: Mean concentrations of total suspended particulate matter (TSPM) and particulate inorganic matter (PIM) expresses as mg/ℓ from coastal waters in the Benguela.

Region	TSPM	PIM	Source
Dalebrook (RSA)	1.5		Cliff (1982)
Olifantsbos (RSA)		1	Zoutendyk (1995)
Oudekraal (RSA)	1.6		Stuart (1982), Stuart *et al.* (1982)
Melkbosstrand (RSA)		~4.5	Zoutendyk (1995)
Saldanha Bay (RSA)		<4	Carter & Coles (1998)
Groenrivier (RSA)		8.8 2	Bustamante (1994) Zoutendyk (1995)
Port Nolloth (RSA)		~2.75	Zoutendyk (1995)
Alexander Bay (RSA)		14.3	Zoutendyk (1995)
Orange River	9		Emery *et al*. (1973)
Orange River 1988 flood		7 400	Bremner *et al.* (1990)

Superimposed on the suspended fine fraction, is the northward littoral drift of coarser bedload sediments, parallel to the coastline. This northward, nearshore transport is generated by the predominantly south-westerly swell and wind-induced waves. Longshore sediment transport varies considerably in the shore-

perpendicular dimension, being substantially higher in the surf-zone than at depth, due to high turbulence and convective flows associated with breaking waves, which suspend and mobilise sediment (Smith & Mocke 2002).

On the inner and middle continental shelf, the ambient currents are insufficient to transport coarse sediments, and resuspension and shoreward movement of these by wave-induced currents occur primarily under storm conditions (see also Drake *et al*. 1985; Ward 1985).

4.2 BIOLOGICAL OCEANOGRAPHY

South Africa is divided into nine bioregions (see Figure 4.6). Licence Blocks 3616 and 3717 are located in one of these bioregions, namely the Atlantic Offshore bioregion (Emanuel *et al.* 1992; Lombard et al. 2004).

The South African National Biodiversity Institute (SANBI) has initiated a process to identify potential priority areas for spatial management in the offshore environment that require protection (Sink, *et. al.,* 2012). Priority areas for protection are presented in Section 4.1.4.6e. Licence Blocks 3616 and 3717 overlap with the proposed Southeast Atlantic Seamount protection area (see Figure 4.13). Sink, *et. al.* (2012) also mapped the ecosystem threat status of offshore benthic and pelagic habitats. Licence Blocks 3616 and 3717 coincide with areas mapped as Least Threatened (see Figure 4.7 and 4.8).

Communities within marine habitats are largely ubiquitous throughout the southern African South-West Coast region, being particular only to substrate type or depth zone. These biological communities consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales). Licence Blocks 3616 and 3717 are located well beyond the 3 000 m depth contour, the closest point to shore being approximately 190 km offshore of Cape Point. The deep-water marine ecosystems comprise a limited range of habitats, namely unconsolidated seabed sediments and the water column. The biological communities 'typical' of these habitats are described briefly below, focussing both on dominant, commercially important and conspicuous species, as well as potentially threatened species.

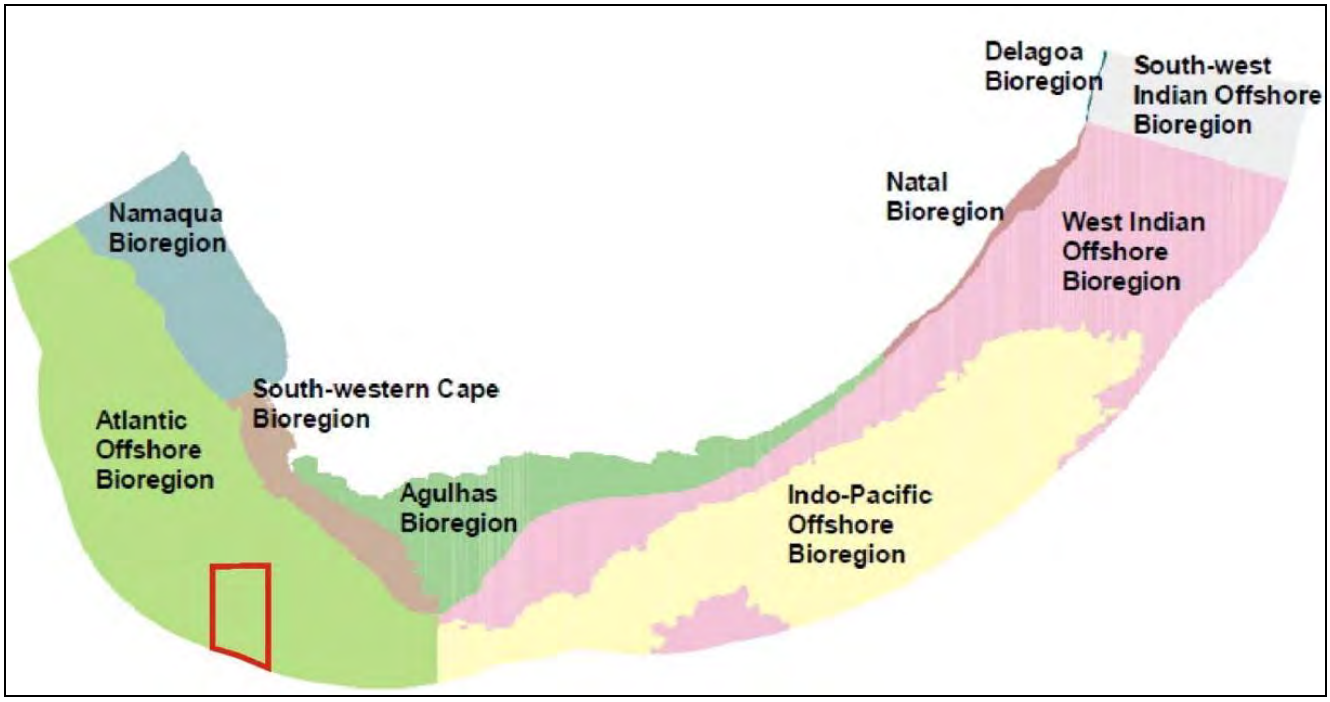


Figure 4.6: The nine bioregions defined by the NBSA study (Lombard and Strauss 2004). The approximate location of Licence Blocks 3616 & 3717 is also shown.

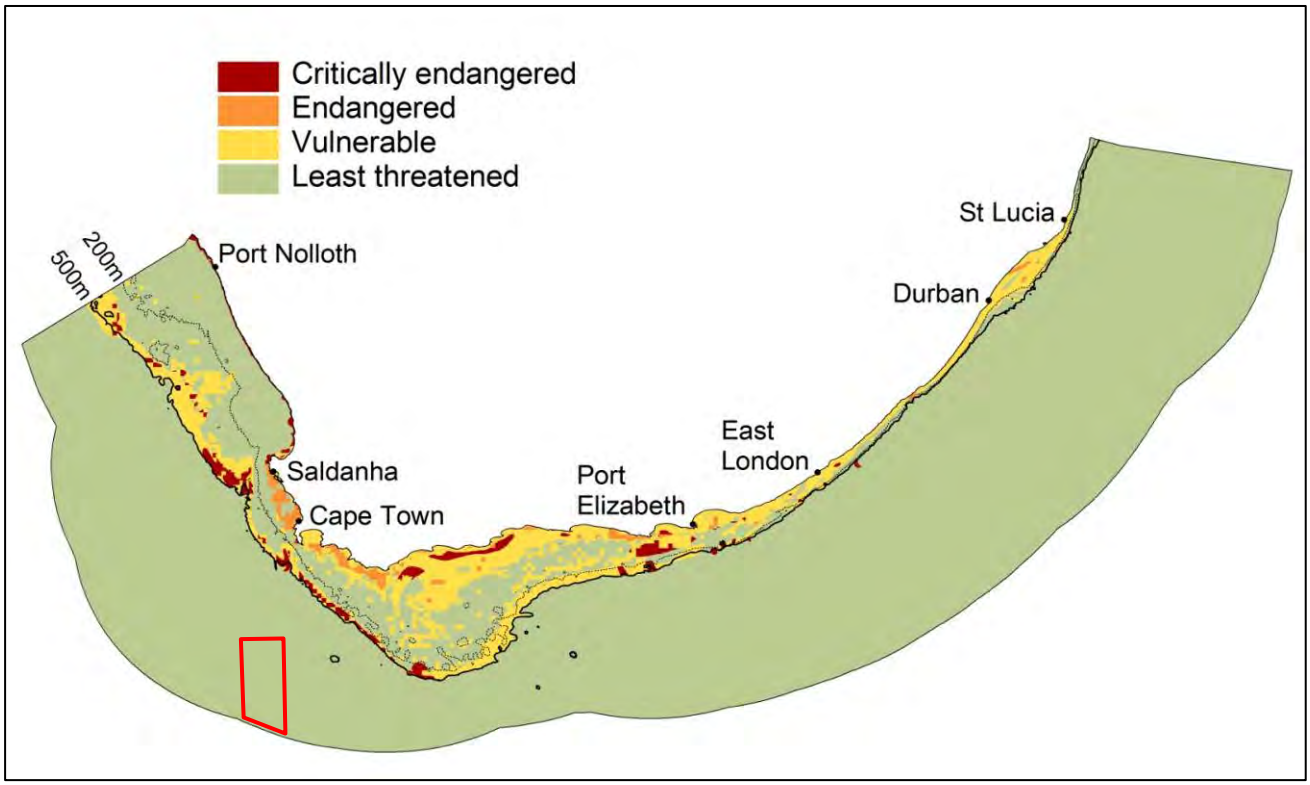


Figure 4.7: **Ecosystem threat status for coastal and offshore benthic habitat types in South Africa (Sink, et. al., 2012). The approximate location of Licence Blocks 3616 & 3717 is also shown.**

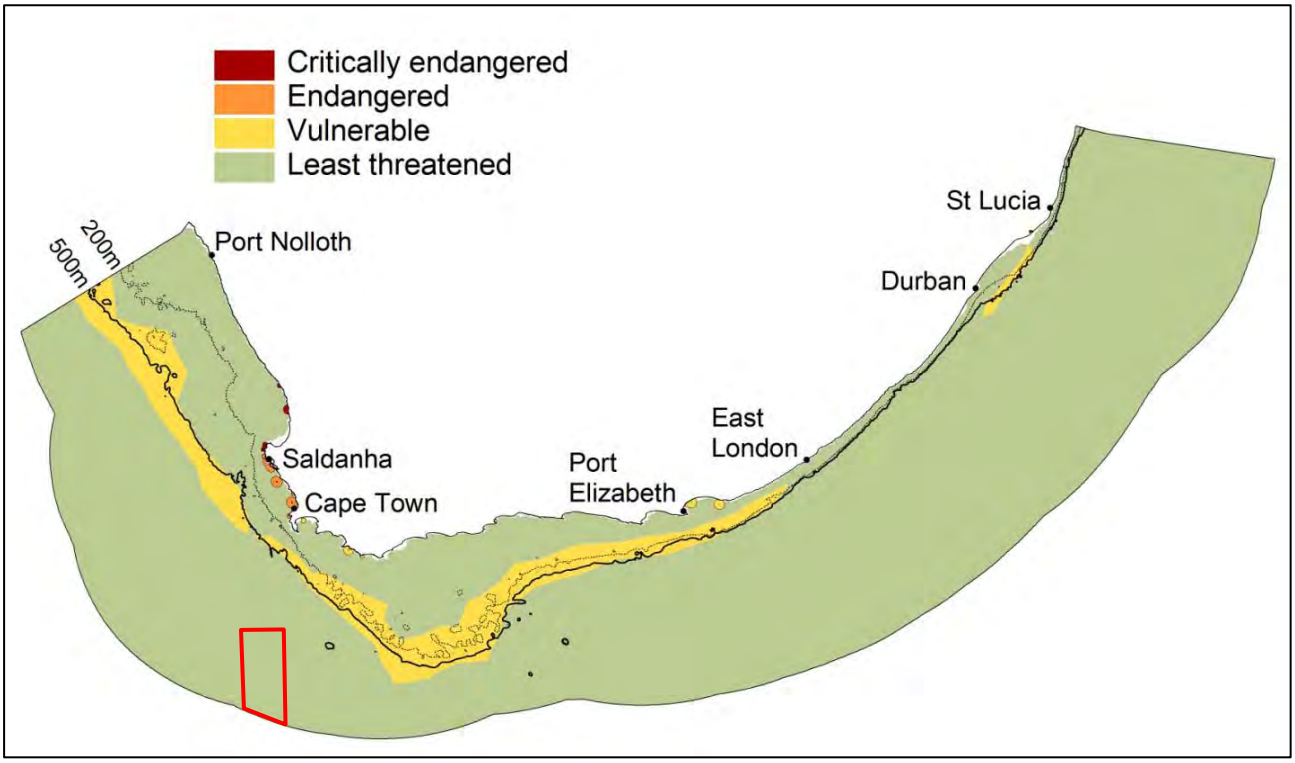


Figure 4.8: **Ecosystem threat status for offshore pelagic habitat types in South Africa (Sink, et. al., 2012). The approximate location of Licence Blocks 3616 & 3717 is also shown.**

4.2.1 PLANKTON

Plankton comprises of three components:

4.2.1.1 Phytoplankton

Features of phytoplankton distribution in the Benguela system are summarised in Figure 4.9. Phytoplankton and "*chlorophyll a*" concentrations vary seasonally along the West Coast, being minimal in winter and summer (<1-2 mg/m³) and maximal (2-4 mg/m³) in spring and autumn. Brown (1992) divided the shelf areas of the West and South Coasts into three regions; West Coast (north of Cape Columbine), the Cape Coast from Cape Columbine to Cape Agulhas and the South Coast (to the east of Cape Agulhas). Mean "*chlorophyll a"* concentrations measured in the surface 30 m of the water column in each of inshore (<200 m depth) and offshore (200 m – 500 m depth) areas in the West Coast region are shown in Table 4.2.

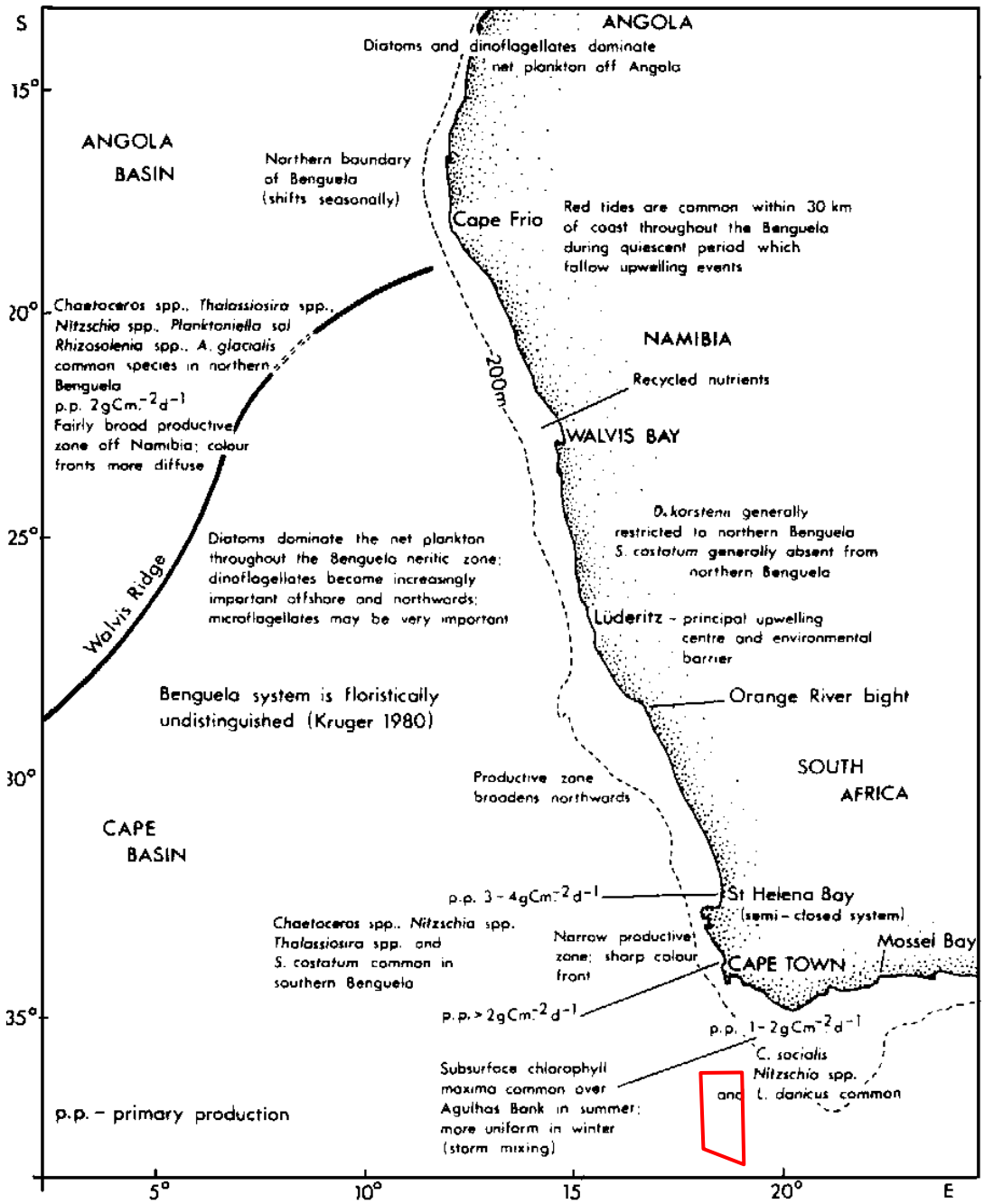


Figure 4.9: Features of phytoplankton distribution in the Benguela System (after Shannon and Pillar 1986). Approximate location of Licence Blocks 3616 & 3717 is also indicated.

Phytoplankton cells are greatest during upwelling. However, as phytoplankton production is related to nutrient supply, seeding and water column stability, production at the upwelling site *per se* is low (chlorophyll a levels range from 0.4 to 0.9 $mg.m^{-3}$), but increases offshore and 'downstream' (northward) from upwelling sites, where the water column is more stable.

Although diatoms are reported to contribute the bulk of the phytoplankton in the Benguela current (Andrews and Hutchings 1980; Olivieri 1983), dinoflagellates are also important (Chapman and Shannon 1985). An estimated 36% of the phytoplankton is lost to the seabed annually. This natural annual input of millions of tons of organic material onto the seabed off the West Coast has a substantial effect on the ecosystems of the Benguela region. It provides most of the food requirements of the particulate and filter-feeding benthic communities that inhabit the sandy-muds and results in the high organic content of the muds in the area.

Red tides (dinoflagellate and/or ciliate blooms or harmful algal blooms) may occur inshore along the coast north of Cape Point (especially in the Lamberts Bay to St Helena Bay region), usually during relaxation of upwelling cells in late summer to autumn. Such red tides (which can range in colour) may be toxic and animals, particularly filter feeding species, may accumulate toxins in their tissues. Furthermore, decomposition of red tides may strip the remaining oxygen from the water and turn it anoxic (known as a "black tide"), having catastrophic consequences on the inshore fauna of the affected area. The massive mortality of fish, lobsters and other inter- and subtidal invertebrates between Cape Columbine and the Berg River mouth during 1994 serves as an example of a black tide.

There is considerable variation in phytoplankton abundance off the West Coast (Pitcher *et al.* 1992), in terms of both the longshore and offshore scales (productivity levels between Cape Point and the Orange River mouth range from 0.3 to 11 $gC.m^{-2}.day^{-1}$).

Table 4.2: Mean concentrations of chlorophyll a in the southern Benguela system over the period 1971 to 1989 (after Brown 1992).

Season	Coast	Mean *"chlorophyll a"* concentrations ($mg.m^{-3}$)		
		Total shelf	Inshore shelf	Offshore shelf
All year	Whole area	1.82	2.28	1.00
	West Coast	2.11	3.32	0.78
	Cape Coast	2.50	3.58	1.43
	South Coast	1.35	1.46	1.00
Spring	Whole area	2.28	2.50	1.61
	West Coast	4.98	5.41	
	Cape Coast	2.93	3.61	2.03
	South Coast	1.43	1.50	1.16
Summer	Whole area	2.09	2.83	0.93
	West Coast	2.28	3.62	0.79
	Cape Coast	3.30	4.96	1.44
	South Coast	1.06	1.19	0.57
Autumn	Whole area	2.14	2.50	1.12
	West Coast	2.68	3.94	0.52
	Cape Coast	2.84	3.98	1.56
	South Coast	1.63	1.70	1.16
Winter	Whole area	1.54	1.84	0.96
	West Coast	1.88	2.75	0.88
	Cape Coast	1.55	1.96	1.14
	South Coast	1.25	1.32	0.92

4.2.1.2 Zooplankton

Features of the zooplankton distribution in the Benguela system are summarised in Figure 4.10. Zooplankton biomass is related to that of phytoplankton, and is thus seasonal, being minimal during winter when the rate of upwelling is lower (Andrews and Hutchings 1980). Zooplankton biomass is low in newly upwelled waters, but increases as these waters age and develops substantial phytoplankton. However, zooplankton blooms lag phytoplankton blooms and thus are found even further offshore, with zooplankton biomass being maximal 40 to 100 km offshore in summer. During winter (when no upwelling occurs in the southern Benguela region) maximal zooplankton biomass is observed close inshore, values being low offshore. An estimated 5 % of the zooplankton is lost to the seabed annually.

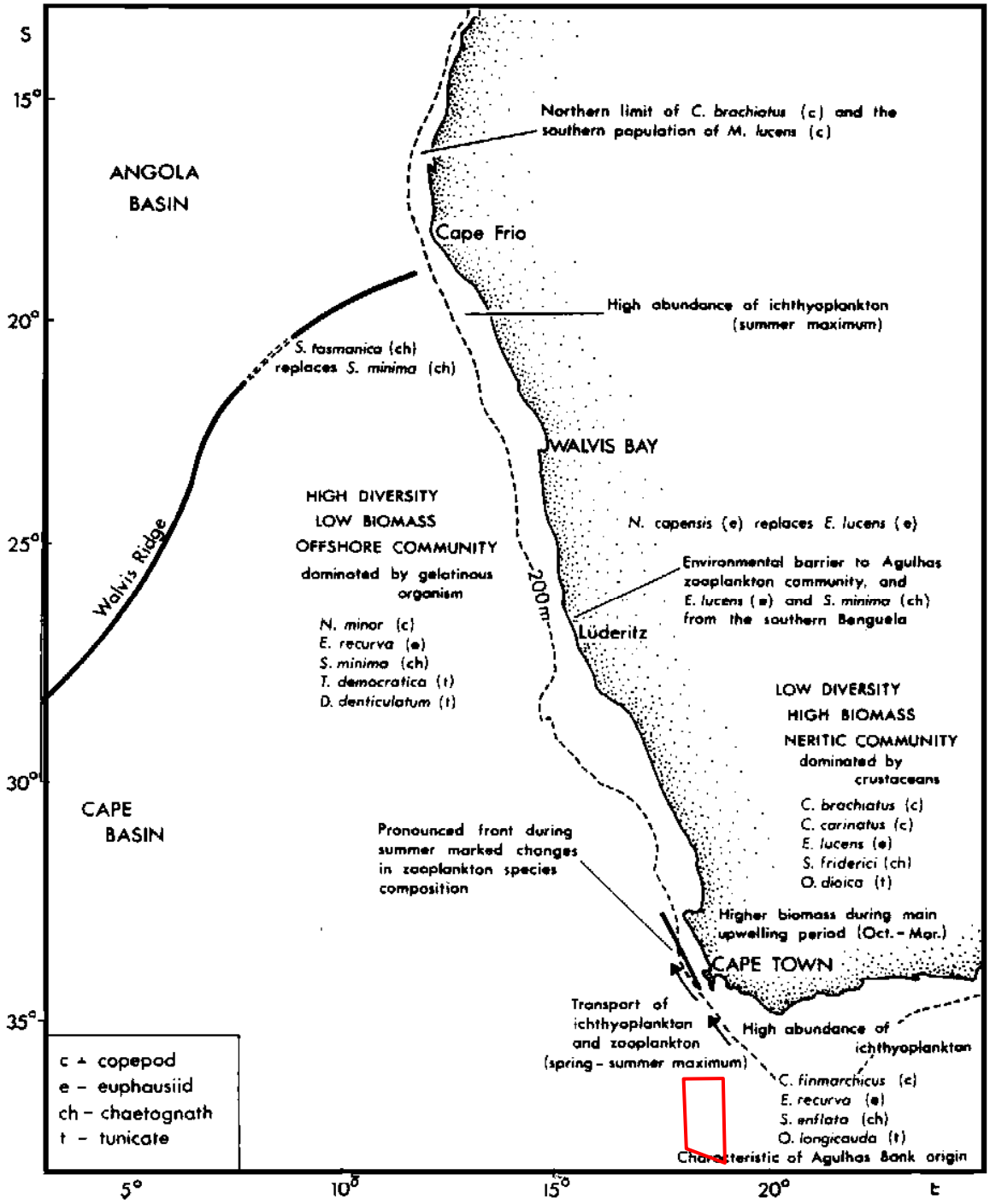


Figure 4.10: Features of zooplankton and ichtyoplankton distribution in the Benguela system (after Shannon and Pillar 1986). Approximate location of Licence Blocks 3616 & 3717 is also indicated.

Zooplankton is best described divided into mesozooplankton (>200 µm) and macrozooplankton (>1 600 µm). Copepods dominate the mesozooplankton (Andrews and Hutchings 1980; Hutchings *et al.* 1991; Verheye *et al.* 1994), and most are found in the phytoplankton-rich upper mixed layer of the water column. Mesozooplankton standing stock estimates in the southern Benguela range from 0.237 to 2.520 $gC.m^{-2}$ and generally increase from south (~0.5 to ~1.0 $gC.m^{-2}$ between Cape Point and Cape Columbine) to north (~0.5 to ~2.5 $gC.m^{-2}$ to the north of Cape Columbine); the higher northern biomass attributed to the region being downstream of two major upwelling cells.

Euphausiids (18 species) dominate the macrozooplankton (Pillar 1986), of which *Euphausia lucens* and *Nyctiphanes capensis* are the most abundant in the shelf region with *E. lucens* dominating the region between Lüderitz and Cape Agulhas (Pillar *et al.* 1992). Other important groups contributing to the southern Benguela macrozooplankton community are chaetognaths (24 species), hyperiid amphipods (over 70 species within the southern and northern Benguela) and tunicates (42 species) (see Gibbons *et al.* 1992). Macrozooplankton standing stocks are greatest north of Cape Columbine (0.5 $gC.m^{-2}$) and decline southwards and eastwards to 0.1 $gC.m^{-2}$ at the eastern boundary of the West Coast.

4.2.1.3 Ichthyoplankton

Ichthyoplankton comprises both fish eggs and larvae, and despite comprising a small component of the overall plankton, is important due to commercial fisheries. Various pelagic and demersal fish species are known to spawn in the southern Benguela, including pilchard, round herring, chub mackerel and hakes (Crawford et al. 1987) (see Figure 4.11), and their eggs and larvae form an important contribution to the ichthyoplankton in the region.

The spawning areas of the major pelagic species are distributed on the continental shelf and along the shelf edge extending from south of St Helena Bay to Mossel Bay on the South Coast (Shannon & Pillar 1986) (see Figure 4.11). They spawn inshore of the shelf edge and downstream of major upwelling centres (particularly on the Agulhas Bank), in spring and summer and their eggs and larvae are subsequently carried around Cape Point and up the coast in northward flowing surface waters. The spawning areas and northward egg and larval drift thus occurs well inshore of the proposed exploration licence area, and ichthyoplankton abundance in these offshore oceanic waters is expected to be extremely low.

4.2.2 BENTHIC INVERTEBRATE MACROFAUNA

The benthic biota of soft-bottom substrates constitutes invertebrates that live on (epifauna) or burrow within (infauna) the sediments and are generally divided into macrofauna (animals >1 mm) and meiofauna (<1 mm). The structure and composition of benthic soft bottom communities is primarily a function of water depth and sediment composition (Steffani & Pulfrich 2004a, 2004b; 2007; Steffani 2007a; 2007b), but other factors such as current velocity, organic content and food abundance also play a role (Flach & Thomsen 1998; Ellingsen 2002).

Species diversity, abundance and biomass increase from the shore to a water depth of approximately 80 m, with communities being characterised equally by polychaetes, crustaceans and molluscs. Further offshore to 120 m depth, the midshelf is a particularly rich benthic habitat where biomass can attain 60 g/m^2 dry weight (Christie 1974; Steffani 2007b). This rich benthic habitat acts as an important source of food for carnivores, such as cephalopods, mantis shrimp and demersal fish species (Lane & Carter 1999). Outside of this rich zone biomass declines to 4.9 g/m^2 at 200 m depth and then is consistently low (<3 g/m^2) on the outer shelf (Christie 1974).

Typical species occurring at depths of up to 60 m included the snail *Nassarius* spp., the polychaetes *Orbinia angrapequensis, Nepthys sphaerocirrata*, several members of the spionid genera *Prionospio*, and the amphipods *Urothoe grimaldi* and *Ampelisca brevicornis*. The bivalves *Tellina gilchristi* and *Dosinia lupinus*

orbignyi are also common in certain areas (Pulfrich, 2011). Offshore communities are dominated by polychaetes (e.g. *Diopatra dubia, D. monroi, D. cuprea cuprea*, *Lumbrineris albidentata, Laonice cirrata*), echinoderms (e.g. *Amphiura* sp., *Ophiura* sp.) and crustaceans (e.g. *Ampelisca brevicornis, Hippomedon onconotus, Tanais philetaerus*) (Atkinson 2009). The benthic fauna of the continental shelf and continental slope beyond approximately 450 m depth are poorly known. With little seafloor topography and hard substrate, such areas are likely to offer minimal habitat diversity or niches for animals to occupy. Detritus-feeding crustaceans, holothurians and echinoderms tend to be the dominant epi-benthic organisms of such habitats.

Soft-bottom substrates are also associated with demersal communities that comprise bottom-dwelling invertebrate and vertebrate species, many of which are dependent on the invertebrate benthic macrofauna as a food source. Atkinson (2009) reported numerous species of urchins and burrowing anemones beyond 300 m water depth off the West Coast.

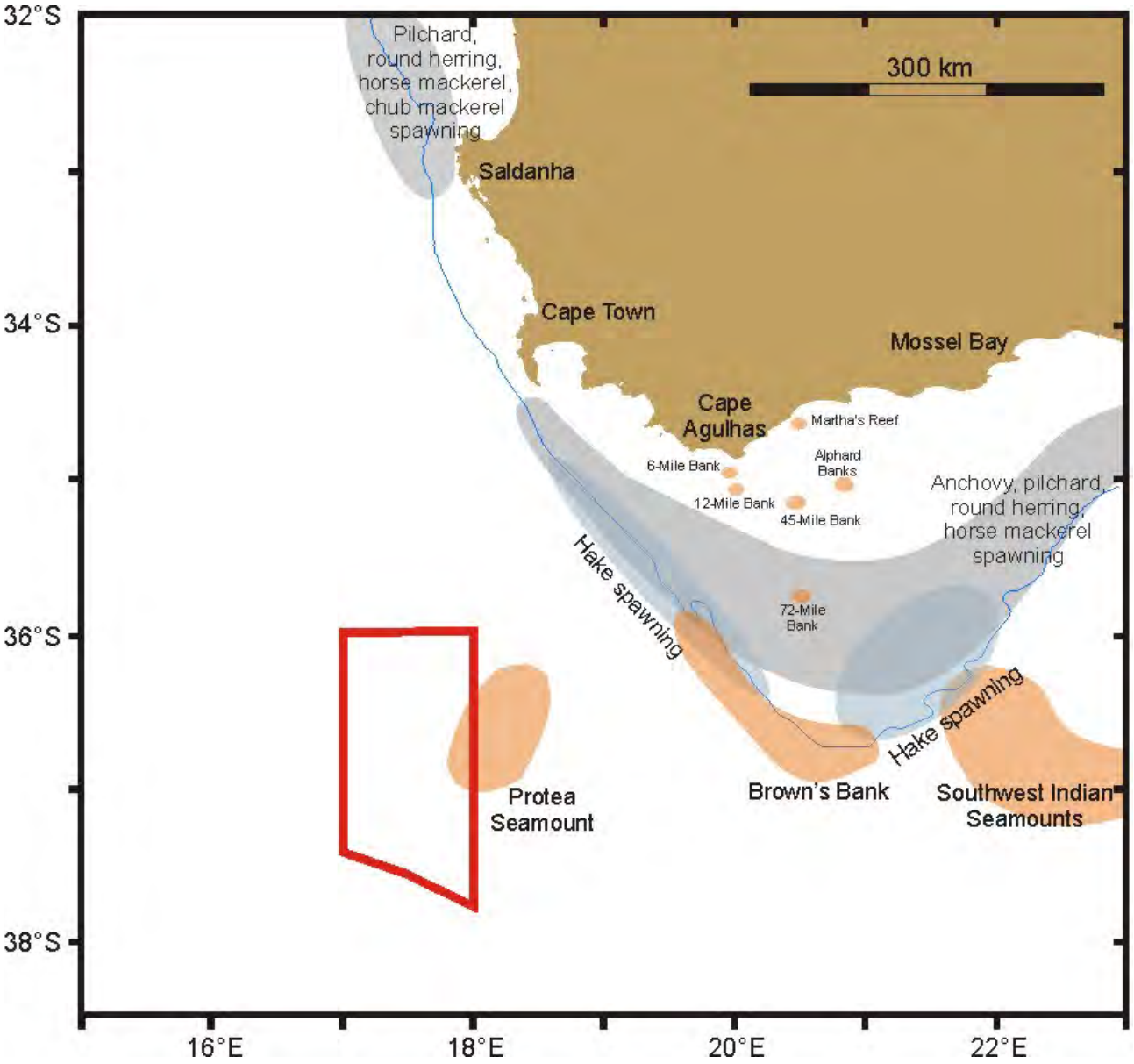


Figure 4.11: Location of Licence Blocks 3616 & 3717 in relation to major spawning areas for different pelagic species and seamounts in the southern Benguela region. Adapted from Anders (1975), Crawford et al. (1987) and Hutchings (1994).

4.2.3 INVERTEBRATES

The West Coast supports important commercial stocks of West Coast rock lobster (*Jasus lalandii*) between Cape Agulhas and about 25º S. While larvae normally move in offshore ocean currents before settling in the shallow kelp beds of the West Coast, the adults are generally found in water depths of between 10 and about 70 m. Female West Coast rock lobsters have a well-defined moulting and spawning cycle, with moulting between May and June and the berry season between May/June and October/November. Peak hatching in October/November is synchronised with strong wind upwelling especially in the southern Benguela. Newly hatched larvae drift northwards and offshore. The return of late stage larvae is believed to be controlled by large-scale ocean circulation systems.

Studies have shown that the majority of seabed species recorded from similar areas have short life spans (a few years or less) and relatively high reproductive rates, indicating the potential for rapid recovery after natural or anthropogenic disturbance of the soft sediment environment. The only species associated with these environments that are slow growing, slow to mature, long-lived and therefore slow to recover and consequently are regarded as vulnerable are the seapens - a list of species recorded by Lopez-Gonzales *et al.* (2001) is given in Table 4.3.

Table 4.3: List of seapen species sampled by Lopez-Gonzales *et al.* (2001) during cruises in the Benguela Region.

Species	Zoogeographic Region	Depth Range (m)*
Anthoptillum grandiflorum	Widespread	238-2 500
Amphibelemnon namibiensis	Benguela	91-304
Crassophyllum cristatum	Benguela	40-650
Distichoptilum gracile	Widespread	650-4 300
Funiculina quadriangularis	Widespread	60-2 600
Halipteris africana	Benguela	459-659
Kopholobelemnon stelliferum	Widespread	400-1 180
Pennatula inflata	Widespread	457-741
Scleroptilum grandiflorum	Widespread	500-4 200
Stylatula macpheersoni	Benguela	245-318
Umbellula thomsoni	Widespread	1300-6 200
Virgularia mirabilis	Widespread	9-400
Virgularia tuberculata	Benguela	75-1 050

*Recorded to date, but these areas are not well sampled or studied.

4.2.4 SEAMOUNT COMMUNITIES

Geological features of note in the study area include various banks (e.g. Brown's Banks), knolls and seamounts (e.g. Protea, Simpson and Argentina Seamounts) (referred to collectively here as "seamounts"). These seabed features protrude into the water column, and are subject to, and interact with, the water currents surrounding them. The effects of such seabed features on the surrounding water masses can include the upwelling of relatively cool, nutrient-rich water into nutrient-poor surface water thereby resulting in higher productivity (Clark *et al.* 1999), which can in turn strongly influences the distribution of organisms on and around seamounts. Evidence of enrichment of bottom-associated communities and high abundances of demersal fishes has been regularly reported over such seabed features.

The enhanced fluxes of detritus and plankton that develop in response to the complex current regimes around such seabed features lead to the development of detritivore-based food-webs, which in turn lead to the presence of seamount scavengers and predators. Seamounts provide an important habitat for

commercial deep water fish stocks such as orange roughy, oreos, alfonsino and Patagonian toothfish, which aggregate around these features for either spawning or feeding (Koslow 1996).

Such complex benthic ecosystems in turn enhance foraging opportunities for many other predators, serving as mid-ocean focal points for a variety of pelagic species with large ranges (turtles, tunas and billfish, pelagic sharks, cetaceans and pelagic seabirds) that may migrate large distances in search of food or may only congregate on seamounts at certain times (Hui 1985; Haney et al. 1995). Seamounts thus serve as feeding grounds, spawning and nursery grounds and possibly navigational markers for a large number of species (SPRFMA 2007).

Deep- and cold-water corals (including stony corals, black corals and soft corals) are a prominent component of the suspension-feeding fauna of many seamounts, accompanied by barnacles, bryozoans, polychaetes, molluscs, sponges, sea squirts, basket stars, brittle stars and crinoids (reviewed in Rogers 2004). Compared to the surrounding deep-sea environment, seamounts typically form biological hotspots with a distinct, abundant and diverse fauna, many species of which remain unidentified. Consequently, the fauna of seamounts is usually highly unique and may have a limited distribution restricted to a single geographic region, a seamount chain or even a single seamount location (Rogers *et al.* 2008). Levels of endemism on seamounts are also relatively high compared to the deep sea. As a result of conservative life histories (*i.e*. very slow growing, slow to mature, high longevity, low levels of recruitment) and sensitivity to changes in environmental conditions, such biological communities have been identified as Vulnerable Marine Ecosystems (VMEs). They are recognised as being particularly sensitive to anthropogenic disturbance (primarily deep-water trawl fisheries and mining), and once damaged are very slow to recover, or may never recover (FAO 2008).

It is not always the case that seamount habitats are VMEs, as some seamounts may not host communities of fragile animals or be associated with high levels of endemism. South Africa's seamounts and their associated benthic communities have not been sampled by either geologists or biologists (Sink & Samaai 2009). Three seamounts occur adjacent to the proposed exploration licence area, namely Protea Seamount and Argentina Seamount (on the eastern boundary), and Simpson Seamount (on the western boundary) (see Figure 4.3). A further smaller, unnamed seamount occurs within the proposed exploration licence area.

4.2.5 CEPHALOPODS

On the basis of abundance and trophic links with other species, eight species of cephalopod are important and a further five species have potential importance within the Benguela system (Table 4.4). The main cephalopod species that occurs within the southern Benguela system are the sepiods / cuttlefish (Lipinski 1992; Augustyn *et al.* 1995). Most of the cephalopod resource is distributed on the mid-shelf with *Sepia australis* being most abundant at depths between 60-190 m, whereas *S. hieronis* densities were higher at depths between 110-250 m. *Rossia enigmatica* occurs more commonly on the edge of the shelf to depths of 500 m. Biomass of these species is generally higher in the summer than in winter.

Cuttlefish are largely epi-benthic and occur on mud and fine sediments in association with their major prey item; mantis shrimps (Augustyn *et al.* 1995). They form an important food item for demersal fish.

Pelagic invertebrates that may be encountered in the proposed exploration licence area are the colossal squid (*Mesonychoteuthis hamiltoni*) and the giant squid (*Architeuthis sp*.). Both are deep dwelling species, with the colossal squid's distribution confined to the entire circum-Antarctic Southern Ocean (see Figure 4.12), while the giant squid is usually found near continental and island slopes all around the world's oceans (see Figure 4.12). Both species could thus potentially occur in the proposed exploration licence area, although the likelihood of encounter is extremely low. Growing to in excess of 10 m in length, they are the principal prey of the sperm whale, and are also taken by beaked whaled, pilot whales, elephant

seals and sleeper sharks. Nothing is known of their vertical distribution, but data from trawled specimens and sperm whale diving behaviour suggest they may span a depth range of 300 – 1 000 m. They lack gas-filled swim bladders and maintain neutral buoyancy through an ammonium chloride solution occurring throughout their bodies.

Table 4.4: Cephalopod species of importance or potential importance within the Benguela System (after Lipinski 1992).

Scientific Name	Importance
Important species:	
Sepia australis	Very abundant in survey catches, prey of many fish species. Potential for fishery.
Sepia hieronis	Densities higher at depths between 110-250 m
Loligo vulgaris reynaudii	Fisheries exist, predator of anchovy and hake, prey of seals and fish.
Todarodes angolensis	Fisheries exist (mainly by-catch), predator of lightfish, lanternfish and hake, prey of seals.
Todaropsis eblanae	Some by-catch fishery, predator of lightfish and lanternfish, prey of seals and fish. Potential for fishery.
Lycoteuthis lorigera	Unconfirmed by-catch, prey of many fish species. Potential for fishery.
Octopus spp.	Bait and artinisal fishery, prey of seals and sharks.
Argonauta spp.	No fisheries, prey of seals.
Rossia enigmata	No fisheries, common in survey catches.
Potentially important species:	
Ommastrephes bartramii	No fisheries.
Abraliopsis gilchristi	No fisheries.
Todarodes filippovae	No fisheries.
Lolliguncula mercatoris	No fisheries.
Histioteuthis miranda	No fisheries.

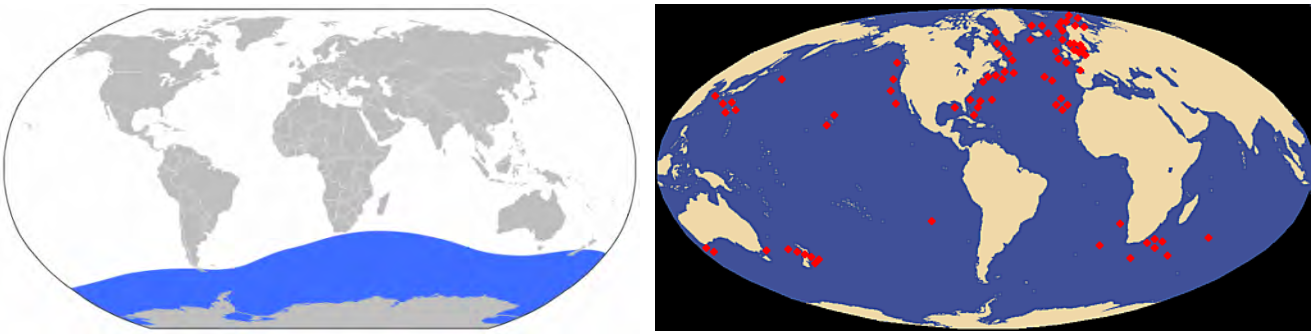


Figure 4.12: Distribution of the colossal squid (left) and the giant squid (right) (www.wikipedia.org).

4.2.6 FISHES

Marine fish can generally be divided in three different groups, namely demersal (those associated with the substratum), pelagic (those species associated with water column) or meso-pelagic (fish found generally in deeper water and may be associated with both the seafloor and the pelagic environment). Pelagic species include two major groups, the planktivorous clupeid-like fishes such as anchovy or pilchard and piscivorous predatory fish. Demersal fish can be grouped according to the substratum with which they are associated, for example rocky reef or soft substrata. It must be noted that such divisions are generally simplistic, as certain species associate with more than one community.

4.2.6.1 Demersal species

As many as 110 species of bony and cartilaginous fish have been identified in the demersal communities on the continental shelf of the West Coast (Roel 1987), inshore of the proposed exploration licence area. Changes in fish communities occur with increasing depth (Roel 1987; Smale *et al*. 1993; Macpherson & Gordoa 1992; Bianchi *et al*. 2001; Atkinson 2009), with the most substantial change in species composition occurring in the shelf break region between 300 m and 400 m depth (Roel 1987; Atkinson 2009). The shelf community (<380 m) is dominated by the Cape hake *Merluccius capensis*, and includes jacopever *Helicolenus dactylopterus*, Izak catshark *Holohalaelurus regain*, soupfin shark *Galeorhinus galeus* and whitespotted houndshark *Mustelus palumbes*. The more diverse deeper water community is dominated by the deepwater hake *M. paradoxus*, monkfish *Lophius vomerinus*, kingklip *Genypterus capensis*, bronze whiptail *Lucigadus ori* and hairy conger *Bassanago albescens* and various squalid shark species. There is some degree of species overlap between the depth zones.

Roel (1987) showed seasonal variations in the distribution ranges of shelf communities, with species such as the pelagic goby *Sufflogobius bibarbatus*, and West Coast sole *Austroglossus microlepis* occurring in shallow water north of Cape Point during summer only. The deep-sea community was found to be homogenous both spatially and temporally. However, Atkinson (2009) identified two long-term community shifts in demersal fish communities; the first (early to mid-1990s) being associated with an overall increase in density of many species, whilst many species decreased in density during the second shift (mid-2000s). These community shifts correspond temporally with regime shifts detected in environmental forcing variables (Sea Surface Temperatures and upwelling anomalies) (Howard *et al*. 2007) and with the eastward shifts observed in small pelagic fish species and rock lobster populations (Coetzee *et al*. 2008, Cockcroft *et al*. 2000).

4.2.6.2 Pelagic species

Small pelagic species include sardine/pilchard (*Sadinops ocellatus*), anchovy (*Engraulis capensis*), chub mackerel (*Scomber japonicus*), horse mackerel (*Trachurus capensis*) and round herring (*Etrumeus whiteheadi*). These species typically occur in mixed shoals of various sizes, and generally occur within the 200 m contour.

Most of the pelagic species exhibit similar life history patterns involving seasonal migrations between the west and south coasts. Apart from round herring which spawn offshore of the shelf break on the West Coast, the spawning areas of the major pelagic species are distributed on the continental shelf extending from south of St Helena Bay to Mossel Bay on the South Coast (Shannon & Pillar 1986). They spawn downstream of major upwelling centres in spring and summer, and their eggs and larvae are subsequently carried around Cape Point and up the coast in northward flowing surface waters (see Figure 4.11).

At the start of winter every year, juveniles of most small pelagic shoaling species recruit into coastal waters in large numbers between the Orange River and Cape Columbine. They utilise the shallow shelf region as nursery grounds before gradually moving southwards in the inshore southerly flowing surface current,

towards the major spawning grounds east of Cape Point. Recruitment success relies on the interaction of oceanographic events, and is thus subject to spatial and temporal variability. Consequently, the abundance of adults and juveniles of these small, short-lived (1-3 years) pelagic fish is highly variable both within and between species.

Two species that migrate along the West Coast following the shoals of anchovy and pilchards are snoek (*Thyrsites atun)* and chub mackerel (*Scomber japonicas)*. Their appearance along the West and South-West coasts are highly seasonal. Snoek migrating along the southern African West Coast reach the area between St Helena Bay and the Cape Peninsula between May and August. They spawn in these waters between July and October before moving offshore and commencing their return northward migration (Payne & Crawford 1989). Chub mackerel similarly migrate along the southern African West Coast reaching South-Western Cape waters between April and August. They move inshore in June and July to spawn before starting the return northwards offshore migration later in the year. Their abundance and seasonal migrations are thought to be related to the availability of their shoaling prey species (Payne & Crawford 1989).

The fish most likely to be encountered in the proposed exploration licence area are the large pelagic species such as tunas, billfish and pelagic sharks, which migrate throughout the southern oceans, between the surface and deep waters (>300 m). Species occurring off western southern Africa include the albacore/longfin tuna (*Thunnus alalunga)*, yellowfin (*T. albacares)*, bigeye (*T. obesus)* and skipjack (*Katsuwonus pelamis)* tunas, as well as the Atlantic blue marlin (*Makaira nigricans)*, the white marlin (*Tetrapturus albidus)* and the broadbill swordfish (*Xiphias gladius)* (Payne & Crawford 1989). The distribution of these species is dependent on food availability in the mixed boundary layer between the Benguela and warm central Atlantic waters. These species have a highly seasonal abundance in the Benguela and show seasonal associations with underwater feature such as canyons and seamounts as well as meteorologically induced oceanic fronts (Penney et al. 1992). The closest underwater features to the proposed exploration licence area are Brown's Bank (~150 km east), Protea Seamount and Argentina Seamount (on the eastern boundary), and Simpson Seamount (on the western boundary) (see Section 4.1.3.4; Figure 4.3).

A number of species of pelagic sharks are also known to occur on the West Coast, including blue (*Prionace glauca)*, short-fin mako (*Isurus oxyrinchus)* and oceanic whitetip sharks (*Carcharhinus longimanus)*. Great whites (*Carcharodon carcharias)* and whale sharks (*Rhincodon typus)* may also be encountered in coastal and offshore areas, although the latter occurs more frequently along the South and East coasts. Of these the blue shark is listed as "Near threatened", and the short-fin mako, whitetip, great white and whale sharks as "Vulnerable" by the International Union for Conservation of Nature (IUCN).

4.2.7 TURTLES

Three species of turtles, namely the green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*) and loggerhead (*Caretta caretta*) are found along the West and South-West coasts. The Leatherback turtle is the only turtle likely to be encountered in the offshore waters of west South Africa. However, their abundance is expected to be low. Loggerhead and green turtles are expected to occur only as occasional visitors along the South-West Coast.

Leatherback turtles inhabit deeper waters and are considered a pelagic species, travelling the ocean currents in search of their prey (primarily jellyfish). The Benguela ecosystem, especially the northern Benguela where jelly fish numbers are high, is increasingly being recognised as a potentially important feeding area for leatherback turtles from several globally significant nesting populations in the south Atlantic (Gabon, Brazil) and south east Indian Ocean (South Africa) (Lambardi *et al*. 2008, Elwen & Leeney 2011, SASTN 2011). While hunting they may dive to over 600 m and remain submerged for up to 54 minutes (Hays *et al*. 2004).

Leatherback turtles breed on the northern KwaZulu-Natal coastline of the East Coast and in the Republic of Congo and Gabon on the West Coast. Leatherback turtles from the east South Africa population have been satellite tracked swimming around the west coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (Lambardi *et al*. 2008) (see Figure 4.13).

Leatherback turtles are listed as Critically Endangered worldwide by the IUCN and are in the highest categories in terms of need for conservation in CITES (Convention on International Trade in Endangered Species) and CMS (Convention on Migratory Species). Loggerhead and green turtles are listed as "Endangered". As a signatory of CMS, South Africa has endorsed and signed a CMS International Memorandum of Understanding specific to the conservation of marine turtles.

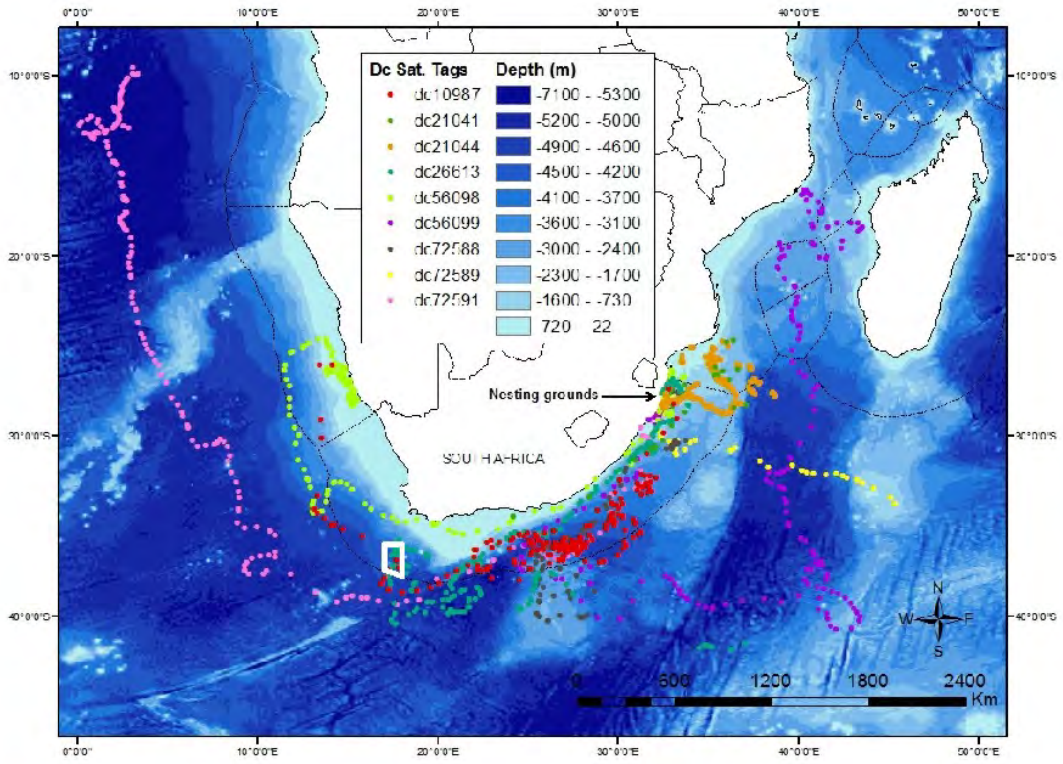


Figure 4.13: The post-nesting distribution of nine satellite tagged leatherback females (1996 – 2006; Oceans and Coast, unpublished data). The approximate location of Licence Blocks 3616 & 3717 are also shown.

4.2.8 BIRDS

There are a total of 49 species of seabirds occurring within the southern Benguela area, of which 14 are resident species, 25 are migrants from the southern ocean and 10 are visitors from the northern hemisphere. Table 4.5 provides a list of the common species occurring within the study area.

The area between Cape Point and the Orange River supports 38% and 33% of the overall population of pelagic seabirds in winter and summer, respectively. Most of the species in the region reach highest densities offshore of the shelf break (200 to 500 m depth), well inshore of the proposed exploration licence area, with highest population levels during their non-breeding season (winter).

The availability of breeding sites is an extremely important determinant in the distribution of resident seabirds. Although breeding areas are distributed along the whole coast, islands are especially important.

The number of successfully breeding birds at the particular breeding sites varies with food abundance. Fourteen resident species breed along the West Coast, including Cape Gannet, African Penguin, four species of Cormorant, White Pelican, three Gull and four Tern species (see Table 4.6). The closest nesting grounds are at the Saldanha Bay islands (over 300 km north of the proposed exploration licence area), Dassen Island (±285 km north), Seal Island (±210 km north-north-east), Boulders Beach (200 km) and Dyer Island (±195 km north-east).

African penguin colonies occur at 27 localities around the coast of South Africa and Namibia (see Figure 4.14). Cape Gannets breed only on islands and Lamberts Bay and Malgas Island are important colonies. Cape cormorants breed mainly on offshore islands (Dyer, Jutten, Seal, Dassen, Bird (Lamberts Bay), Malgas and Vondeling Islands), although the large colonies may associate with estuaries, lagoons or sewerage works. The bank and crowned cormorants are endemic to the Benguela system and both breed between Namibia and just to the west of Cape Agulhas. Although white-breasted cormorants occur between northern Namibia and the Eastern Cape in southern Africa, the majority of the population is concentrated between Swakopmund and Cape Agulhas.

Most of these resident species feed on fish (with the exception of the gulls, which scavenge, and feed on molluscs and crustaceans). Feeding strategies can be grouped into surface plunging (gannets and terns), pursuit diving (cormorants and penguins) and scavenging and surface seizing (gulls and pelicans). Most of the breeding seabird species forage at sea with most birds being found relatively close inshore (10 to 30 km). Cape Gannets, however, are known to forage up to 140 km offshore (Dundee 2006; Ludynia 2007), and African Penguins have also been recorded as far as 60 km offshore. However, due to the extreme offshore location of the proposed exploration licence area, penguins and gannets are unlikely to be encountered during exploration activities.

Table 4.5: Pelagic seabirds common in the southern Benguela region (Crawford *et al*. 1991).

Common Name	Species name	Global IUCN Status
Shy albatross	*Thalassarche cauta*	Near Threatened
Black browed albatross	*Thalassarche melanophrys*	Endangered
Yellow nosed albatross	*Thalassarche chlororhynchos*	Endangered
Giant petrel sp.	*Macronectes halli/giganteus*	Near Threatened
Pintado petrel	*Daption capense*	Least concern
Greatwinged petrel	*Pterodroma macroptera*	Least concern
Soft plumaged petrel	*Pterodroma mollis*	Least concern
Prion spp	*Pachyptila* spp.	Least concern
White chinned petrel	*Procellaria aequinoctialis*	Vulnerable
Cory's shearwater	*Calonectris diomedea*	Least concern
Great shearwater	*Puffinus gravis*	Least concern
Sooty shearwater	*Puffinus griseus*	Near Threatened
European Storm petrel	*Hydrobates pelagicus*	Least concern
Leach's storm petrel	*Oceanodroma leucorhoa*	Least concern
Wilson's storm petrel	*Oceanites oceanicus*	Least concern
Blackbellied storm petrel	*Fregetta tropica*	Least concern
Skua spp.	*Catharacta*/*Stercorarius* spp.	Least concern
Sabine's gull	*Larus sabini*	Least concern

Table 4.6: Breeding resident seabirds present along the West Coast (CCA & CMS 2001).

Common name	Species name	Global IUCN Status
African Penguin	*Spheniscus demersus*	Endangered
Great Cormorant	*Phalacrocorax carbo*	Least Concern
Cape Cormorant	*Phalacrocorax capensis*	Near Threatened
Bank Cormorant	*Phalacrocorax neglectus*	Endangered
Crowned Cormorant	*Phalacrocorax coronatus*	Least Concern
White Pelican	*Pelecanus onocrotalus*	Least Concern
Cape Gannet	*Morus capensis*	Vulnerable
Kelp Gull	*Larus dominicanus*	Least Concern
Greyheaded Gull	*Larus cirrocephalus*	Least Concern
Hartlaub's Gull	*Larus hartlaubii*	Least Concern
Caspian Tern	*Hydroprogne caspia*	Vulnerable
Swift Tern	*Sterna bergii*	Least Concern
Roseate Tern	*Sterna dougallii*	Least Concern
Damara Tern	*Sterna balaenarum*	Near Threatened

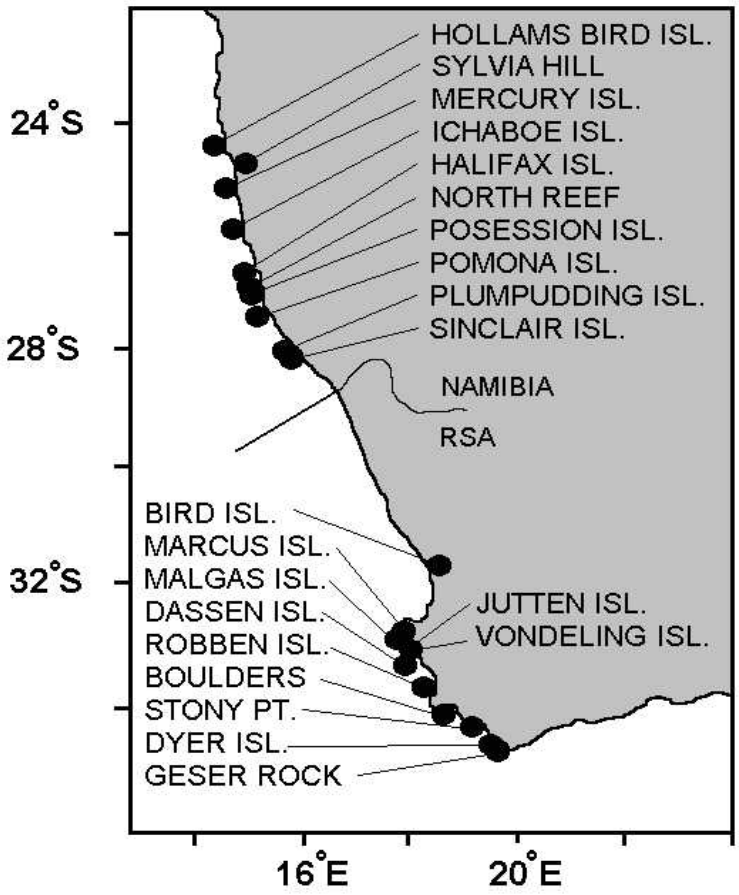


Figure 4.14: The distribution of breeding colonies of African penguins on the South African West Coast.

4.2.9 MARINE MAMMALS

The marine mammal fauna of the West and South West coasts comprises between 28 and 32 species of cetaceans (whales and dolphins) and four seal species, of which the Cape fur seal (*Arctocephalus pusillus*) is the most common. The range of cetacean species reflects largely taxonomic uncertainty at species and sub-species level, rather than uncertainty of occurrence or distribution patterns (Findlay *et al.* 1992*).*

4.2.9.1 Cetaceans

Cetaceans comprised two basic taxonomic groups: the mysticetes (filter-feeding baleen whales), which are largely migratory, and the odontocetes (toothed predatory whales and dolphins), which may be resident or migratory. More than 20 species of whales and dolphins are known or likely to occur in the offshore environment (>200 m depth) off the South-West coast of South Africa (see Table 4.7). The offshore areas have been particularly poorly studied with almost all available information from deeper waters (>200 m) arising from historic whaling records. Information on smaller cetaceans in deeper waters is particularly poor.

Mysticete cetaceans occurring in the study area include the blue, fin, sei, Antarctic minke, dwarf minke, humpback, southern right, pygmy right and Bryde's whales. The southern right whale and pygmy right whale are from taxonomically separate groups. Most of these species occur in pelagic waters, with only occasional visits into shelf waters. All of these species show some degree of migration either to, or through, the latitudes encompassed by the broader study area when *en route* between higher-latitude feeding grounds (Antarctic or Subantarctic) and lower-latitude breeding grounds. Depending on the ultimate location of these feeding and breeding grounds, seasonality off South Africa can be either unimodal (usually in June-August, e.g. minke and blue whales) or bimodal (usually May-July and October-November, e.g. fin whales), reflecting a northward and southward migration through the area. As whales follow geographic or oceanographic features, the northward and southward migrations may take place at difference distances from the coast, thereby influencing the seasonality of occurrence at different locations. Due to the complexities of the migration patterns, each species is discussed in further detail below.

- Bryde's whales: Two types of Bryde's whales are recorded from South African waters - a larger pelagic form described as *Balaenoptera brydei* and a smaller neritic form (of which the taxonomic status is uncertain) but included by Best (2007) with *B. brydei* for the subregion. The migration patterns of Bryde's whales differ from those of all other baleen whales in the region. The inshore population is unique in that it is resident year round on the Agulhas Bank ranging from Durban in the east to at least St Helena Bay off the West Coast, and does not migrate at all, although some movement up the West Coast in winter has been reported (Best 2007, 2001; Best *et al*. 1984). The offshore population of Bryde's whale lives off the continental shelf (>200 m depth) and migrates between wintering grounds off equatorial West Africa (Gabon) and summering grounds off the South African West Coast (Best 2001). Its seasonality within South African waters is thus opposite to the majority of the other migratory cetaceans, with abundance in the broader study area likely to be highest in January-February. The Exploration Area lies to the south and offshore of the known distributions of both these populations, so encounters are likely to be low. The proposed exploration licence area lies to the south and offshore of the known distributions of both these populations, so encounters are likely to be low.

- Sei whales: Sei whales (listed as Endangered) spend time at high latitudes (40-50˚S) during summer months and migrate through South African waters to unknown breeding grounds further north. Their migration pattern shows a bimodal peak with numbers west of Cape Columbine highest in May and June, and again in August, September and October. Based on whaling records, all whales were caught in waters deeper than 200 m with most deeper than 1 000 m (Best & Lockyer 2002). Sei whales are likely to be one of the more commonly seen baleen whales in the proposed exploration licence area.

Table 4.7: Cetaceans occurrence offshore of the South-West Coast, their seasonality and likely encounter frequency.

Common Nam	Scientific Name	Occurrence on Shelf	Occurrence offshore	IUCN Conservation Status (2008)	Seasonality in impact zone	Likely encounter frequency
Delphinids						
Dusky dolphin	*Lagenorhynchus obscurus*	Yes 0-800 m	No	Data Deficient	Year round	Unlikely
Common bottlenose dolphin (Offshore)	*Tursiops truncatus*	Yes	Yes	Least Concern	Year round	Weekly
Indo-Pacific bottlenose dolphin (Inshore)	*Tursiops aduncus*	Yes 0-50 m	No	Data Deficient		Unlikely
Common dolphin - Short-beaked	*Delphinus delphis*	Occasional	Yes	Least Concern	Year round	Weekly
Common dolphin - Long-beaked	*Delphinis capensis*	Yes	No	Data Deficient		Weekly
Southern right whale dolphin	*Lissodelphis peronii*	Yes	Yes	Data Deficient	Year round	Rare
Long-finned pilot whale	*Globicephala melas*	Edge	Yes	Data Deficient	Year round	Weekly
Short-finned pilot whale	*Globicephala macrorhynchus*	?	?	Data Deficient	Year round	Unlikely
Killer whale	*Orcinus orca*	Occasional	Yes	Data Deficient	Year round	Weekly
False killer whale	*Pseudorca crassidens*	Occasional	Yes	Data Deficient	Year round	Weekly
Pygmy killer whale	*Feresa attenuata*	?	Yes	Data Deficient	Year round	Unlikely
Risso's dolphin	*Grampus griseus*	Edge	Yes	Least Concern	Year round	Monthly
Sperm whales						
Pygmy sperm whale	*Kogia breviceps*	Edge	Yes	Data Deficient	Year round	Weekly
Dwarf sperm whale	*Kogia sima*	Edge	?	Data Deficient	Year round	Weekly
Sperm whale	*Physeter macrocephalus*	Edge	Yes	Vulnerable A1d	Year round	Weekly

Common Nam	Scientific Name	Occurrence on Shelf	Occurrence offshore	IUCN Conservation Status (2008)	Seasonality in impact zone	Likely encounter frequency
Beaked whales						
Cuvier's	*Ziphius cavirostris*	No	Yes	Least Concern	Year round	Rare
Arnoux's	*Beradius arnuxii*	No	Yes	Data Deficient	Year round	Rare
Southern bottlenose	*Hyperoodon planifrons*	No	Yes	Least Concern	Year round	Rare
Layard's	*Mesoplodon layardii*	No	Yes	Data Deficient	Year round	Rare
True's	*M. mirus*	No	Yes	Data Deficient	Year round	Rare
Gray's	*M. grayi*	No	Yes	Data Deficient	Year round	Rare
Blainville's	*M. densirostris*	No	Yes	Data Deficient	Year round	Rare
Baleen whales						
Antarctic minke	*Balaenoptera bonaerensis*	Yes	Yes	Data Deficient	Higher in winter	Weekly
Dwarf minke	*B. acutorostrata*	Yes	Yes	Not assessed	Year round	Weekly
Fin whale	*B. physalus*	Yes	Yes	Endangered	May-Jul, Oct-Nov	Occasional
Blue	*B. musculus*	No	Yes	Endangered	May-Aug	Unlikely
"Pygmy" Blue	*B. musculus brevicauda*	No	Yes	Endangered	May-Aug	Unlikely
Sei	*B. borealis*	Edge	Yes	Endangered	May-Jun, Aug-Oct	Weekly
Bryde's (both forms)	*B. brydei*	Yes	Yes	Data Deficient	Higher in summer	Monthly
Humpback	*Megaptera novaeangliae*	Yes	Yes	Least Concern	Year round, higher in Jun-Nov	Weekly
Pygmy right	*Caperea marginata*	Yes	?	Data Deficient	Year round	Unlikely
Southern right	*Eubalaena australis*	Yes	No	Least Concern	Year round, higher in Jul-Nov	Monthly

- Fin whales: Fin whales (listed as Vulnerable) have a bimodal peak in the catch data suggesting animals were migrating further north during May-June to breed, before returning during August-October *en route* to Antarctic feeding grounds. Some juvenile animals may feed year round in deeper waters off the shelf (Best 2007). There are no recent data on the abundance or distribution of fin whales off the West Coast, although a sighting of a live animal in St Helena Bay in 2011 (MRI unpubl. data) and off Lüderitz in southern Namibia in March-May (Sea Search unpubl. Data) confirm their contemporary occurrence in the region.

- Blue whales: Antarctic blue whales were historically caught in high numbers during commercial whaling activities, with a single peak in catch rates during July in Walvis Bay, Namibia and at Namibe, Angola suggesting that in the eastern South Atlantic these latitudes are close to the northern migration limit for the species (Best 2007). Very few confirmed sightings of blue whales have occurred off the west coast of South Africa since 1973 (Branch *et al.* 2007), although new reports from pelagic waters have confirmed their current presence in the area, although at very low densities. Note: "Pygmy" blue whales may also occur in the proposed exploration licence area, but it is unlikely that the species can be distinguished visually at sea.

- Minke whales: Two forms of minke whale occur in the southern Hemisphere, the Antarctic minke whale and the dwarf minke whale, both of which are likely to occur in the exploration licence area (Best 2007, NDP unpublished data). Antarctic minke whales range from Antarctica to tropical waters and are usually seen more than approximately 50 km offshore. Although adults of the species do migrate from the Southern Ocean (summer) to tropical/temperate waters (winter) where they are thought to breed, some animals, especially juveniles, are known to stay in tropical/temperate waters year round. The dwarf minke whale has a more temperate distribution than the Antarctic minke and they do not range further south than 60-65°S. Dwarf minkes have a similar migration pattern to Antarctic minkes with at least some animals migrating to the Southern Ocean during summer. Dwarf minke whales occur closer to shore than Antarctic minkes. Both species may be encountered in the proposed exploration licence area.

- Southern right whales: Southern right whales migrate from Southern Ocean feeding grounds at approximately 60°S to the coastline of southern Africa where they were historically found from southern Mozambique (Maputo Bay) to southern Angola (Baie dos Tigres). Southern right whales also feed during spring and summer months on the West Coast of South Africa between St Helena and Saldanha Bays, and possibly further north and now have an almost year round presence along the South African coast (Mate et al. 2011; Peters et al. 2011; Barendse & Best 2014). Southern right whales tend to remain within a few kilometres of shore except when migrating to and from sub-Antarctic feeding grounds when it is possible they will pass through the proposed exploration licence area.

- Humpback whales: The majority of humpback whales on the West Coast are migrating past the southern African continent to breeding grounds off Angola and the Gulf of Guinea (Rosenbaum *et al.* 2009, Barendse *et al*. 2010), while those migrating up the East Coast of heading to breeding grounds of Mozambique and Madagascar (Findlay et al. 2011). The proposed exploration licence area is located outside the known migration corridors of either population, but given that it is situated to the west of Cape Agulhas, it is considered likely that 'west coast' whales are more likely to be encountered.

  A large number of humpback whales can be found feeding within the Benguela ecosystem (especially between Saldanha Bay and St Helena Bay) in the spring and summer months (Barendse et al. 2011). Individuals using this West Coast feeding ground may migrate through the exploration licence area *en route* to or from the Antarctic. The exact relationship between whales using this feeding ground and those breeding further north is not fully understood at the moment, but there is some overlap of

individuals (Carvalho et al. 2009; Barendse et al. 2011). Recent abundance estimates put the number of animals in the west African breeding population to be in excess of 9 000 individuals in 2005 (IWC 2012) and it is likely to have increased since this time at about 5% per annum (IWC 2012). Humpback whales are thus likely to be one of the most frequently encountered baleen whales in in the proposed exploration licence area.

The Odontoceti are a varied group of animals including the dolphins, porpoises, beaked whales and sperm whales. Species occurring within the broader project area display a diversity of features, for example their ranging patterns vary from extremely coastal and highly site specific to oceanic and wide ranging.

- Sperm whales: Sperm whales are the largest of the toothed whales and have a complex, well-structured social system with adult males behaving differently from younger males and female groups. They live in deep ocean waters, usually greater than 1 000 m depth, occasionally coming into depths of 500-200 m on the shelf (Best 2007). Seasonality of catches off the West Coast suggest that medium- and large-sized males are more abundant during winter, while female groups are more abundant in autumn (March-April), although animals occur year round (Best 2007). Sperm whales feed at great depth, during dives in excess of 30 minutes, making them difficult to detect visually. Very little data is available on the abundance, distribution or seasonality of the smaller odontocetes known to occur in oceanic waters (greater than 200 m) off the shelf of southern Africa. Beaked whales are all considered to be true deep-water species usually being seen in waters in excess of 1 000 - 2 000 m deep. The presence of sperm whales in the proposed exploration licence area may fluctuate seasonally, but insufficient data exist to define this clearly.

- Pygmy and dwarf sperm whales: Dwarf sperm whales are associated with the warmer waters south and east of St Helena Bay. Abundance in the project area is likely to be low with the seasonality unknown. Pygmy sperm whales are recorded from both the Benguela and Agulhas ecosystem (Best 2007) and are likely to occur in the proposed exploration licence area at low levels in waters deeper than 1 000 m.

- Killer whales: Killer whales have a circum-global distribution being found in all oceans from the equator to the ice edge (Best 2007). Killer whales occur year round in low densities off western South Africa (Best *et al.* 2010), Namibia (Elwen & Leeney 2011) and in the Eastern Tropical Atlantic (Weir *et al.* 2010). Killer whales are found in all depths from the coast to deep open ocean environments and may thus be encountered in the proposed exploration licence area at low levels.

- False killer whales: The species has a tropical to temperate distribution and most sightings off southern Africa have occurred in water deeper than 1 000 m but with a few close to shore as well (Findlay *et al*. 1992). False killer whales usually occur in groups ranging in size from 1 - 100 animals (mean 20.2) (Best 2007), and are thus likely to be fairly easily seen in most weather conditions. There is no information on population numbers of conservation status and no evidence of seasonality in the region (Best 2007) but they are likely to be encountered regularly in the proposed exploration licence area.

- Pygmy killer whale: The species is found worldwide in tropical and subtropical waters. Within the sub region it has been recorded from Gabon, Namibia, South Africa, Comoro Islands and the Seychelles, typically occurring offshore in oceanic waters. Information on population numbers, conservation status and seasonality in the region is lacking (Best 2007).

- Long-finned pilot whales: Long finned pilot whales display a preference for temperate waters and are usually associated with the continental shelf or deep water adjacent to it (Mate *et al.* 2005; Findlay *et al.* 1992; Weir 2011). They are regularly seen associated with the shelf edge by marine mammal observers and fisheries observers and researchers (NDP unpubl. data). The distinction between long-

finned and short finned pilot whales is difficult to make at sea. As the latter are regarded as more tropical species (Best 2007), it is likely that the vast majority of pilot whales encountered in the proposed exploration licence area will be long-finned. Pilot whales are likely to be among the most commonly encountered odontocetes in vicinity of the proposed exploration licence area.

- Common bottlenose dolphins: Two species of bottlenose dolphins occur around southern Africa, the smaller Indo-Pacific bottlenose dolphin, which occurs exclusively to the east of Cape Point in water usually less than 30 m deep, and the larger common bottlenose dolphin forms. The larger common bottlenose dolphin species occur in two forms. The inshore form occurs as a small and apparently isolated population that occupies the very coastal (usually <15 m deep) waters of the central Namibian coast as far south as Lüderitz and is considered a conservation concern. Members of this population are unlikely to be encountered in the project area. Little is known about the offshore form in terms of their population size or conservation status. They sometimes occur in association with other species such as pilot whales (NDP unpublished data) or false killer whales (Best 2007) and are likely to be present year round in waters deeper than 200 m.

- Common dolphin: Two species of common dolphin are known to occur in warm temperate waters around Southern Africa, although distinguishing them at sea is challenging so they have been combined here. The short-beaked (*D. delphis*) has a worldwide distribution in offshore waters and confirmed sightings within southern Africa occur primarily off the continental shelf. The long-beaked common dolphin (*D. capensis*) is primarily associated with the waters of the continental shelf to the east of the Cape Peninsula although sightings regularly occur as far north as St Helena Bay (Findlay *et al.* 1992). Both species generally form large groups of hundreds to thousands of animals and are easily spotted at sea. Encounter rate in oceanic waters is not known but animals of either species might be encountered occasionally.

- Risso's dolphin: A medium sized dolphin with a distinctively high level of scarring and a proportionally large dorsal fin and blunt head. Risso's dolphins are distributed worldwide in tropical and temperate seas and show a general preference for shelf edge waters <1 500 m deep (Best 2007). Although sightings have occurred beyond this, encounters are likely to be rare in the proposed exploration licence area.

- Southern right whale dolphins: The cold waters of the Benguela provide a northwards extension of the normally subantarctic habitat of this species (Best 2007). Most records in the region originate in a relatively restricted region between 26˚S and 28˚S off Lüderitz (Rose & Payne 1991) in water 100 – 2 000 m deep (Best, 2007), where they are seen several times per year (Findlay et al. 1992; JP Roux[1] pers comm.). Encounters are likely to be rare in the proposed exploration licence area.

- Beaked Whales (Various Species): Beaked whales were never targeted commercially and their pelagic distribution makes them largely inaccessible to most researchers making them the most poorly studied group of cetaceans. Beaked whales appear to be particularly vulnerable to certain types of man-made noise. All the beaked whales that may be encountered in the exploration licence area are pelagic species that tend to occur in small groups usually less than five, although larger aggregations of some species are known (MacLeod & D'Amico 2006; Best 2007).

4.2.9.2 Seals

The Cape fur seal (*Arctocephalus pusillus pusillus*) is the only species of seal resident along the West and South-West Coast, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs (see Figure 4.15). Vagrant records from four other species of seal more usually

[1] Ministry of Fisheries and Marine Resources (Namibia).

associated with the subantarctic environment have also been recorded: southern elephant seal (*Mirounga leoninas*), subantarctic fur seal (*Arctocephalus tropicalis*), crabeater (*Lobodon carcinophagus*) and leopard seals (*Hydrurga leptonyx*) (David 1989).

There are a number of Cape fur seal colonies within the broader study area, including Paternoster Rocks and Jacobs Reef at Cape Columbine, Robbesteen near Koeberg and Seal Island in False Bay. Non-breeding colonies occur at Paternoster Point at Cape Columbine and Duikerklip in Hout Bay. These colonies all fall well outside of the proposed exploration licence area. The nearest breeding colony is at Seal Island in False Bay, approximately 210 km to the north-east of the proposed exploration licence area.

Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nm (approximately 220 km) offshore (Shaughnessy 1979), with bulls ranging further out to sea than females. They are, therefore, unlikely to be encountered during exploration activities in Licence Blocks 3617 and 3717.

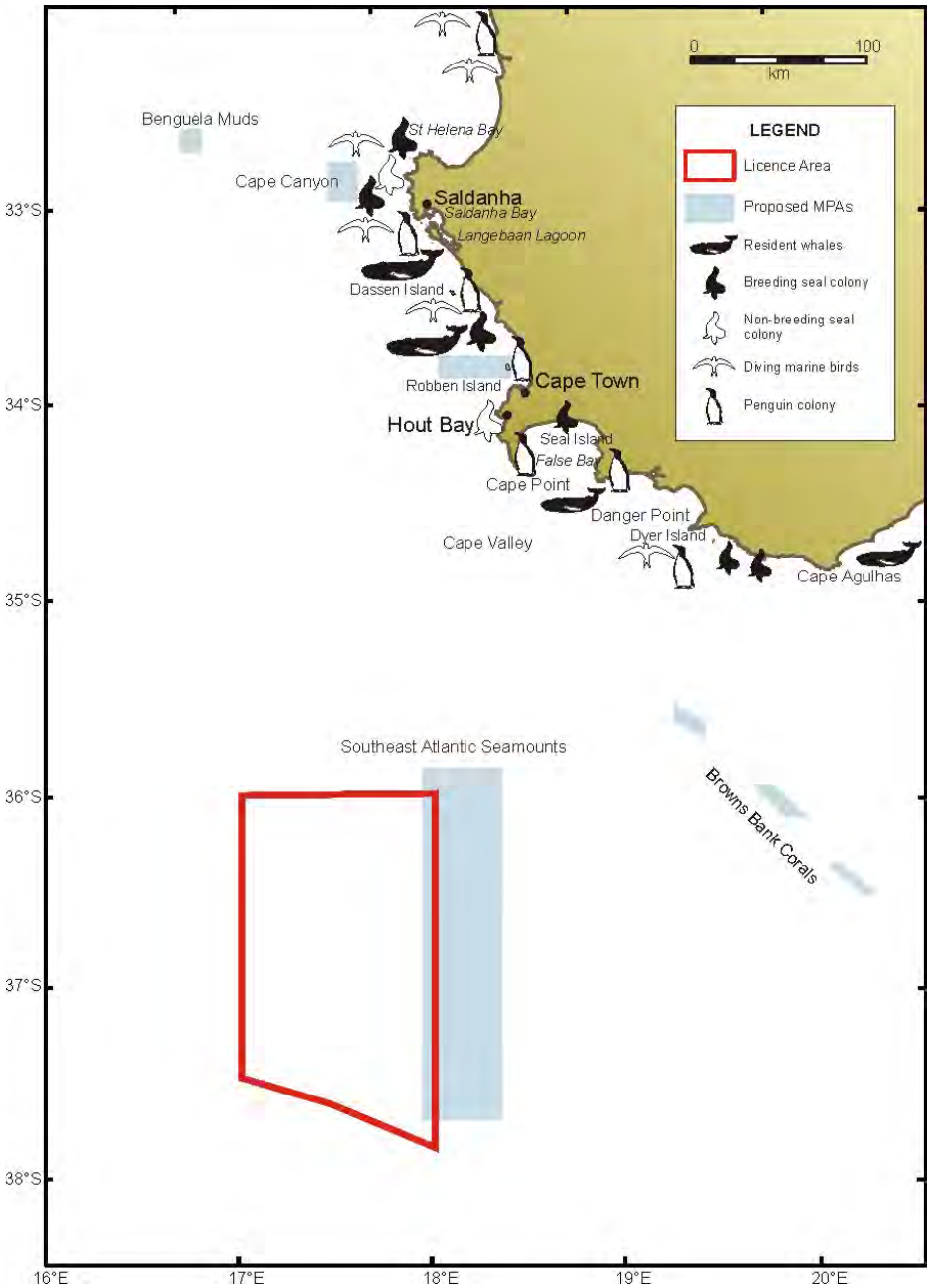


Figure 4.15: Location of Licence Blocks 3616 and 3717 in relation to seabird and seal colonies and resident whale populations. The location of areas identified potential offshore Marine Protected Areas by Operation Phakisa (shaded blue) are also shown.

4.3 HUMAN UTILISATION

4.3.1 FISHERIES

The South African fishing industry consists of approximately 14 commercial sectors operating within the country's 200 nautical mile Exclusive Economic Zone (EEZ)[2] (see Table 4.8). Fisheries can be categorised by the species targeted and the different types of fishing gear they deploy. The different fisheries active off the South-West Coast are discussed below, along with their catch composition and their target areas.

Table 4.8: South African offshore commercial fishing sectors (Source: DAFF).

Sector	Areas of Operation	Main Ports in Priority	Number of Vessels (2015)	Rights Holders (2015)	Landed Catch (2013)
Tuna pole	West Coast, South Coast	Cape Town, Saldanha	128	170	4 418 t
Pelagic long-line	West Coast, South Coast, East Coast	Cape Town, Durban, Richards Bay, Port Elizabeth	31	30	3 576 t
Mid-water trawl	South Coast	Cape Town, Port Elizabeth	6	19	16 298 t
Small pelagics	West Coast, South Coast	St Helena Bay, Saldanha, Hout Bay, Gansbaai, Mossel Bay	101	111	202 478 t
Hake long-line	West Coast, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth, Gansbaai	64	146	9 807 t
Hake hand-line	West Coast, South Coast	All ports, harbours and beaches around the coast	100	86	non-operational
Traditional line fish	West Coast, South Coast, East Coast	All ports, harbours and beaches around the coast	450	422	9 142 t
Demersal shark long-line	South Coast	Cape Town, Hout Bay, Mossel Bay, Plettenberg Bay, Cape St Francis, Saldanha Bay, St Helena Bay, Gansbaai, Port Elizabeth	6	7	834 t (2012)
Hake deep sea trawl	West Coast, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth	45	49	140 346 t
Hake/ sole inshore trawl	South Coast	Cape Town, Saldanha, Mossel Bay	31	18	6 100 t
West Coast rock lobster	West Coast	Hout Bay, Kalk Bay, St. Helena	105	240	1 854 t
South coast rock lobster	South Coast	Cape Town, Port Elizabeth	12	15	652 t
Crustacean trawl	East Coast	Durban, Richards Bay	5	8	218 t
Squid jig	South Coast	Port Elizabeth, Port St Francis	138	121	2 526 t

4.3.1.1 Demersal trawl fishery

Demersal trawl is South Africa's most valuable fishery accounting for approximately half of the income generated from commercial fisheries. Demersal trawlers operate extensively around the coast primarily targeting the bottom-dwelling (demersal) species of hake (*Merluccius paradoxus* and *M. capensis*). Other commercially valuable trawl catch species are kingklip, monk, mackerel, panga, ribbonfish, chokka, gurnards, jacopever, octopus, pilchards and skates. The hake-directed trawl fishery is split into two sub-sectors: a small inshore trawling sector active off the South Coast and a large deep-sea trawl sector

[2] The Exclusive Economic Zone is the 200 nm zone from the South African coastline out to sea over which it holds exclusive economic rights.

operating on both the South and West coasts. There are currently 45 trawlers operating within the offshore sector. The current (2015) annual hake Total Allowable Catch (TAC) of hake across all sectors targeting hake is 147 500 tons, of which the majority is landed by the demersal trawl sector.

The towed gear typically consists of trawl warps, bridles and trawl doors, a footrope, headrope, net and codend (see Figure 4.16). The monk-directed trawlers use slightly heavier trawl gear, trawl at slower speeds and for longer periods (up to eight hours) compared to the hake-directed trawlers (60 minutes to four hours). Monk gear includes the use of "tickler" chains positioned ahead of the footrope to chase the monk off the substrate and into the net.

The total trawl footprint within the South African EEZ is approximately 70 400 km^2 of which offshore grounds amount to 57 420 km^2 and inshore grounds 12 983 km^2. The deep-sea trawl sector on the West / South-West Coast operates mainly in a continuous band along the shelf edge between the 300 m and 1 000 m bathymetric contours, approximately 90 km inshore of the proposed exploration licence area (see Figure 4.17). Trawl nets are generally towed along depth contours (thereby maintaining a relatively constant depth) running parallel to the depth contours in a north-westerly or south-easterly direction. Trawlers also target fish aggregations around bathymetric features, in particular seamounts and canyons (i.e. Child's Bank, Cape Columbine and Cape Canyon), where there is an increase in seafloor slope and in these cases the direction of trawls follow the depth contours. Trawlers are prohibited from operating within 5 nm of the coastline.

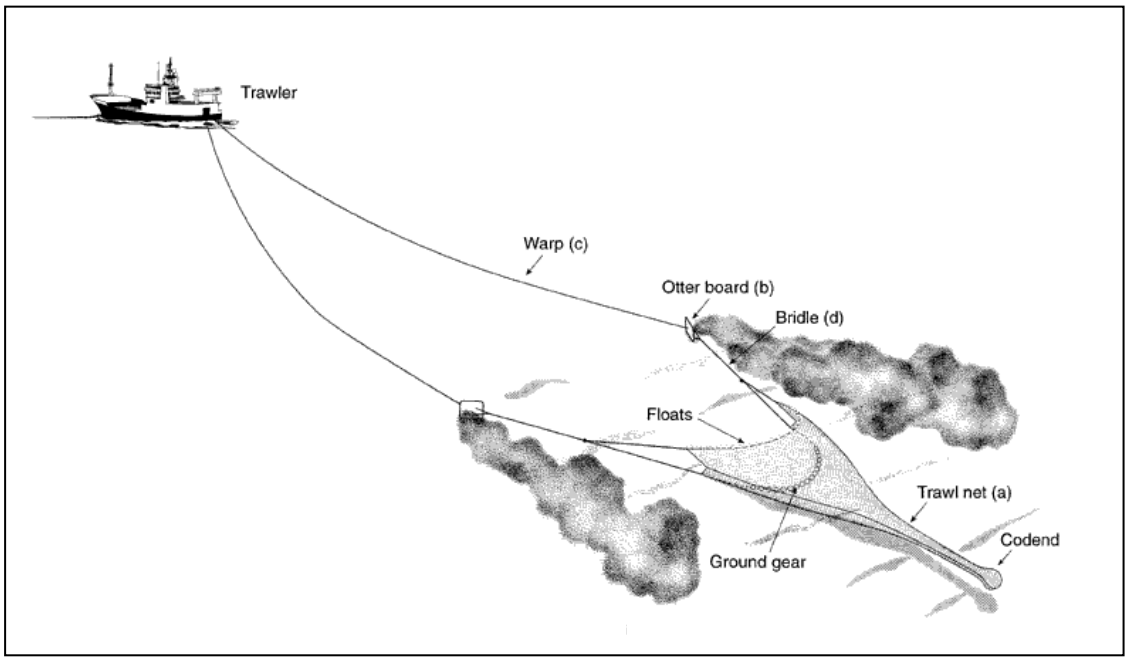


Figure 4.16: Schematic diagram of trawl gear typically used by demersal trawlers.

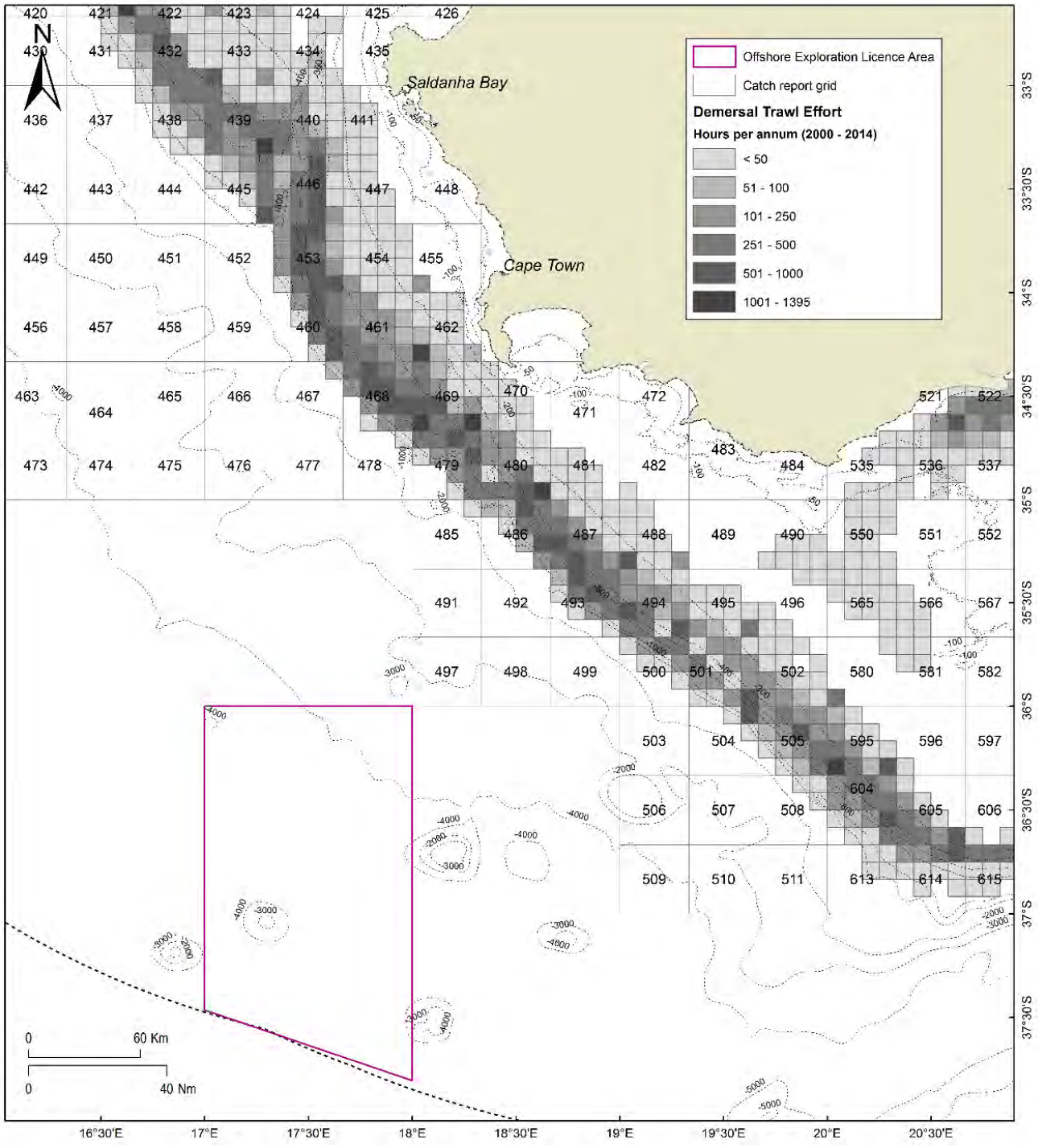


Figure 4.17: Location of Licence Blocks 3616 and 3717 in relation to demersal trawl effort by the sector targeting hake (2000 to 2014).

4.3.1.2 Demersal long-line fishery

In South Africa the demersal long-line fishery operates in well-defined areas extending along the shelf break from Port Nolloth to Cape Agulhas and is comprised of the hake-directed, with a small non-targeted commercial by-catch that includes kingklip, and shark-directed demersal long-line sectors.

Bottom-set long-line gear is robust and comprises two lines as well as dropper lines with subsurface floats attached (see Figure 4.18). Lines are typically between 10 km and 20 km in length, carrying between 6 900 and 15 600 hooks each. Baited hooks are attached to the bottom line at regular intervals (1 to 1.5 m) by means of a snood. Gear is usually set at night at a speed of between five and nine knots. Once deployed the line is left for up to eight hours before it is retrieved. A line hauler is used to retrieve gear (at a speed of approximately one knot) and can take six to ten hours to complete. During hauling operations a demersal long-line vessel would be severely restricted in manoeuvrability.

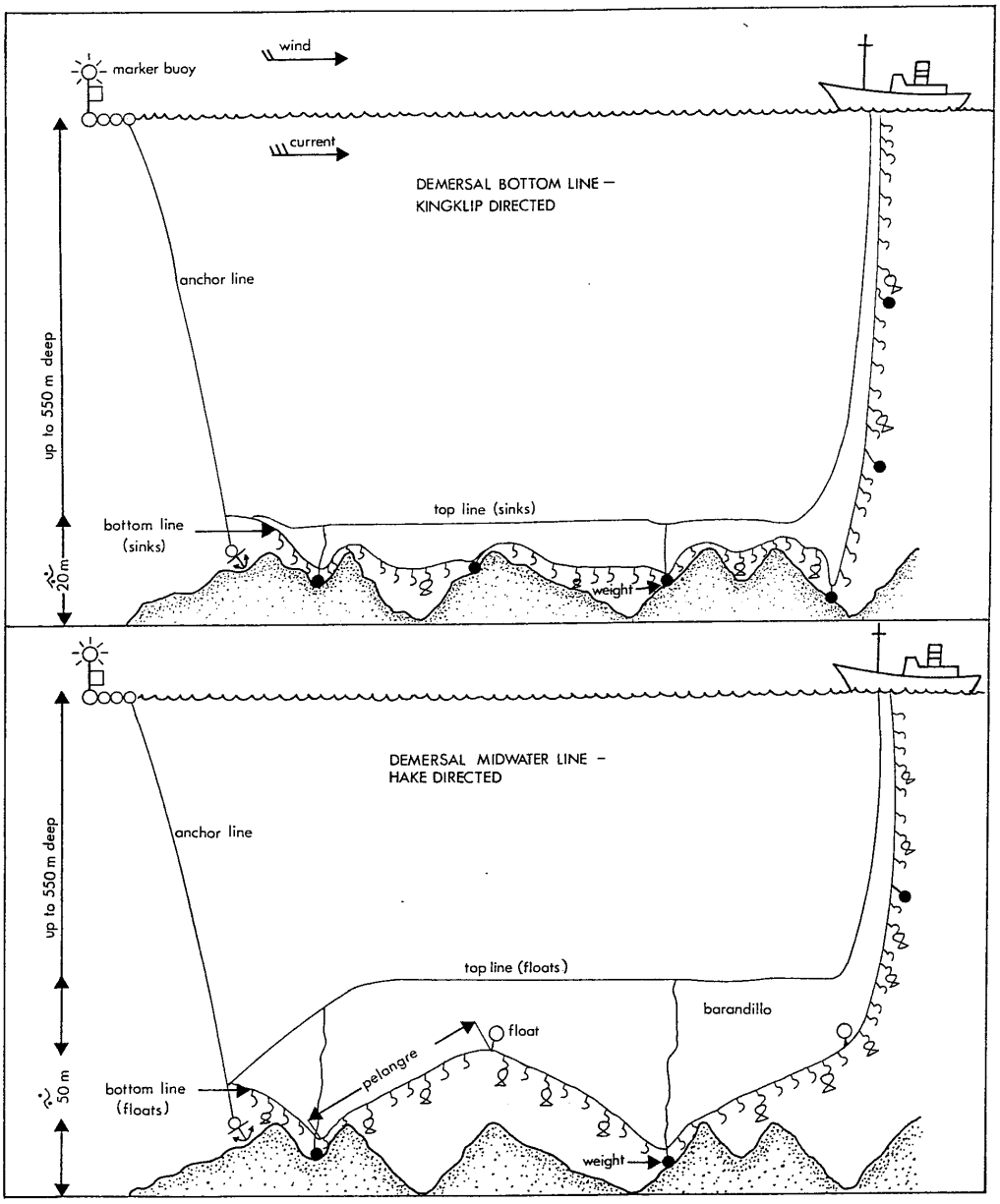


Figure 4.18: Typical configuration of demersal (bottom-set) hake long-line gear used in South African waters.

(a) Hake-directed demersal long-line sector

Currently 64 hake-directed vessels are operational within the South African fishery, most of which are based at the harbours of Cape Town and Hout Bay. Operations are *ad hoc* and intermittent, subject to market demand. The catch taken by the long-line fleet in 2014 amounted to 9 798 tons.

Demersal long-lining is expected to occur in similar areas used by the hake-directed trawling, i.e. along the shelf edge up to the 1 000 m isobaths with lines usually set parallel to bathymetric contours. The fishing grounds do not coincide with the proposed exploration licence area. The main fishing grounds are situated approximately 90 km inshore of the proposed exploration licence area (see Figure 4.19).

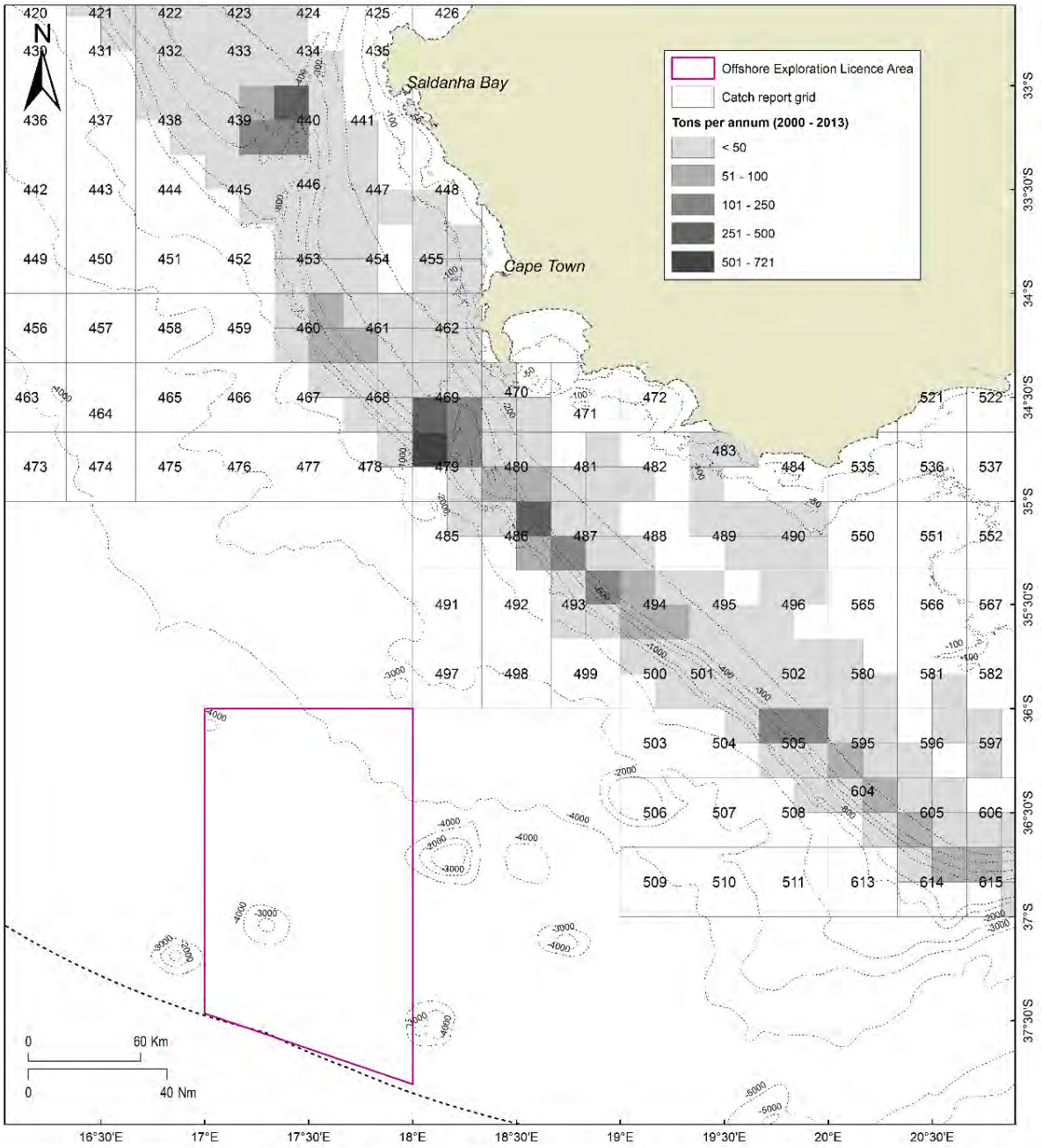


Figure 4.19: Location of Blocks 3616 and 3717 in relation to hake-directed demersal long-line catch (2000 - 2013).

(b) Shark-directed demersal long-line sector

The demersal shark fishery targets soupfin shark, smooth-hound shark, spiny dogfish, St Joseph shark, *Charcharhinus* spp., rays and skates. Other species which are not targeted but may be landed include cape gurnards, jacopever and smooth hammerhead shark. Catches are landed at the harbours of Cape Town, Hout Bay, Mossel Bay, Plettenberg Bay, Cape St Francis, Saldanha Bay, St Helena Bay, Gansbaai and Port Elizabeth and currently six permit holders have been issued with long-term rights to operate within the fishery.

The fishery operates in coastal waters, predominantly inshore of the 150 m isobaths. Spatial records of effort show that fishing grounds occurs at least 150 km inshore of the proposed exploration licence area (see Figure 4.20). Over the period 2007 to 2012, the fishery reported an annual average of 430 500 hooks set and 175 tons landed annually. Effort is continuous throughout the year with a relative increase between May and October.

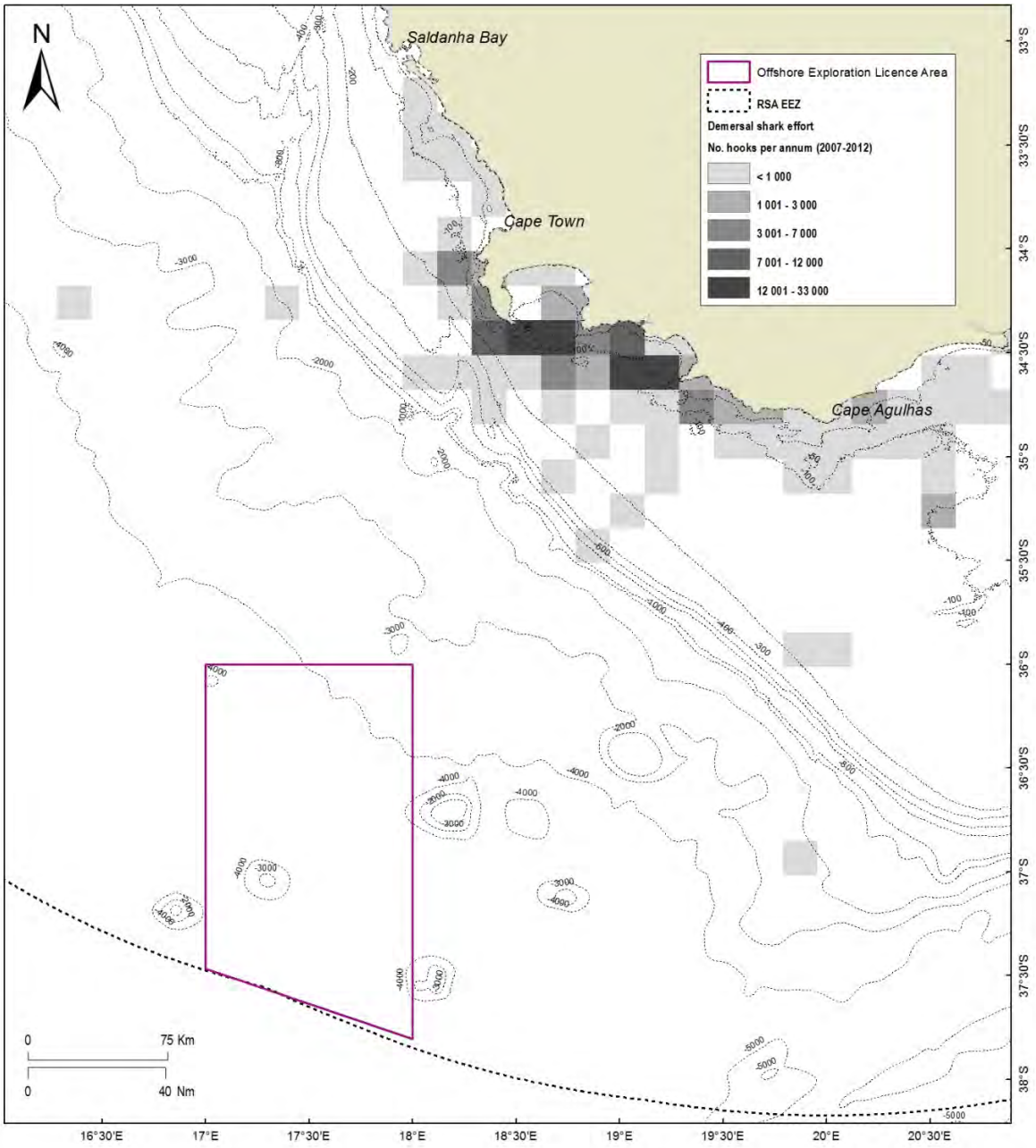


Figure 4.20: Location of Blocks 3616 and 3717 in relation to shark-directed demersal long-line effort (2007 - 2012).

4.3.1.3 Large pelagic long-line fishery

The large pelagic long-line fishery operates year-round, extensively within the South African EEZ targeting primarily tuna and swordfish. Due to the highly migratory nature of these species, stocks straddle the EEZ of a number of countries and international waters. As such they are managed as a "shared resource" amongst various countries. There are currently 30 commercial large pelagic fishing rights issued for South African waters and there are 31 vessels active in the fishery.

The fishery operates extensively from the continental shelf break into deeper waters, year-round. Pelagic long-line vessels are primarily concentrated seawards of the 500 m depth contour where the continental slope is steepest (see Figure 4.21). During the period 2000 to 2014, an average of 2.6 tons and 4 100 hooks per annum was recorded within the proposed exploration licence area. This amounts to approximately 0.1% of both the national catch and the national effort. These figures comprise the combined catch and effort of both the domestic and the foreign-flagged vessels fishing under joint ventures.

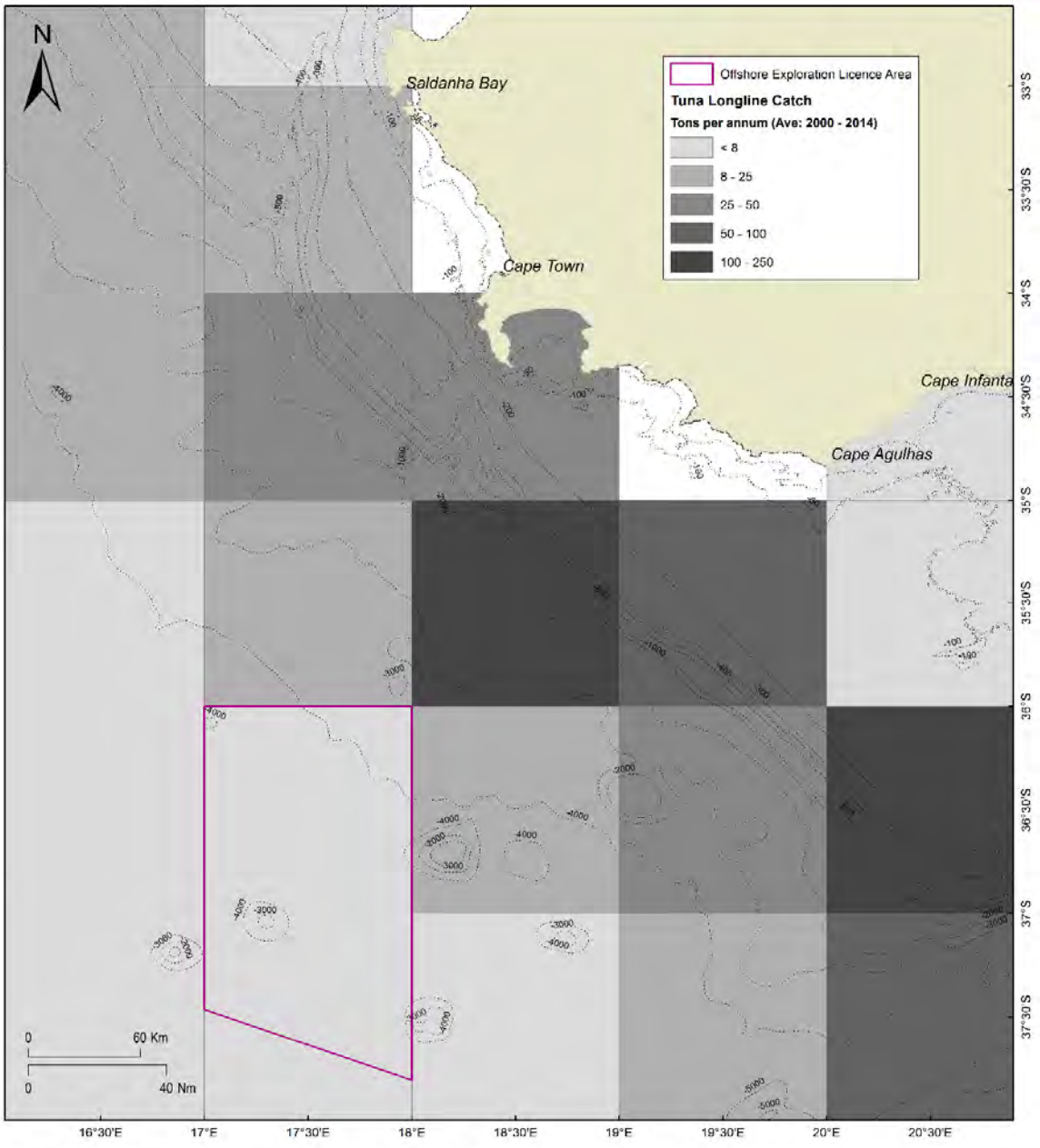


Figure 4.21: Location of Licence Blocks 3616 and 3717 in relation to large pelagic long-line catch (2000 - 2014).

Pelagic long-line vessels set a drifting mainline, which can be up to 100 km in length. The mainline is kept near the surface or at a certain depth (20 m below) by means of buoys connected via "buoy-lines", which are spaced approximately 500 m apart along the length of the mainline (see Figure 4.22). Hooks are attached to the mainline via 20 m long trace lines, which are clipped to the mainline at intervals of approximately 50 m. There can be up to 3 500 hooks per line. A single main line consists of twisted rope (6 to 8 mm diameter) or a thick nylon monofilament (5 to 7.5 mm diameter). Various types of buoys are used in combinations to keep the mainline near the surface and locate it should the line be cut or break for any reason. Each end of the line is marked by a Dahn Buoy and Radar reflector, which marks its position for later retrieval by the fishing vessel. Lines are usually set at night, with hauling commencing the next morning. During hauling a vessel's manoeuvrability is severely restricted and, in the event of an emergency, the line may be dropped to be hauled in at a later stage.

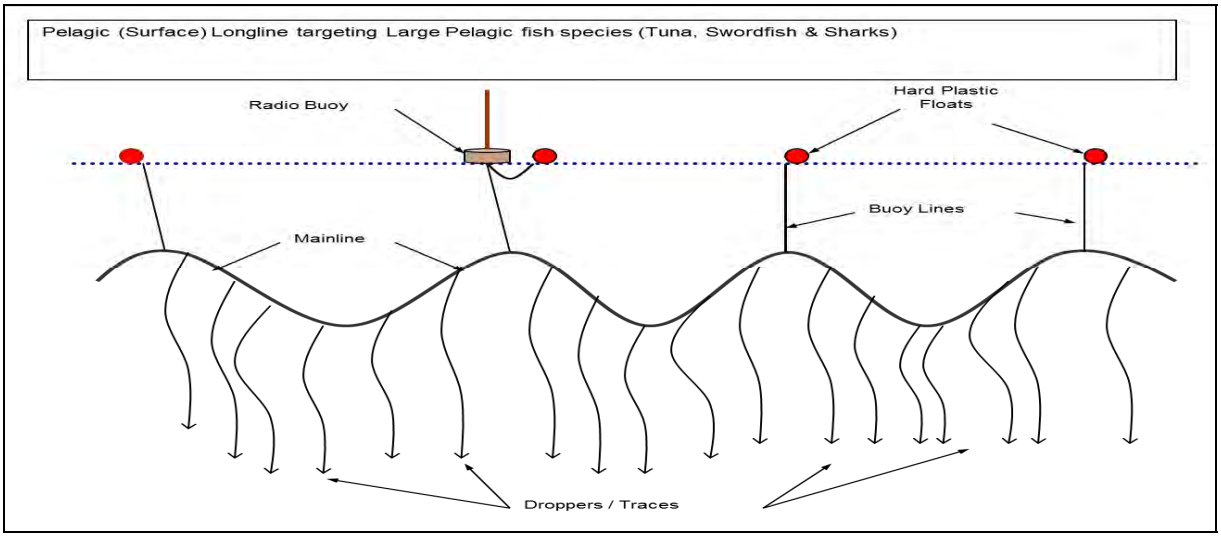


Figure 4.22: Typical pelagic long-line configuration targeting tuna, swordfish and shark species.

4.3.1.4 Small pelagic purse seine fishery

The South African small pelagic purse seine fishery is the largest fishery by volume and the second most important in terms of value. The pelagic purse-seine fishery targets small mid-water and surface-shoaling species such as sardine, anchovy, juvenile horse mackerel and round herring using purse-seine fishing techniques. Annual landings have fluctuated between 300 000 and 600 000 tons over the last decade, with average landings of 444 000 tons (all species) recorded per annum between 2000 and 2014. During 2014 the fishery landed 375 000 tons.

The South African fishery, consisting of approximately 101 vessels, is active all year round with a short break from mid-December to mid-January (to reduce impact on juvenile sardine), with seasonal trends in the specific species targeted. The geographical distribution and intensity of the fishery is largely dependent on the seasonal fluctuation and geographical distribution of the targeted species. Fishing grounds occur primarily along the Western Cape and Eastern Cape coast up to a distance of 100 km offshore, but usually closer inshore. The sardine-directed fishery tends to concentrate effort in a broad area extending from Lambert's Bay, southwards past Cape Town towards Cape Point and then eastwards along the coast to Mossel Bay and Port Elizabeth. The anchovy-directed fishery takes place predominantly on the South-West Coast from Lambert's Bay to Cape Point and is most active in the period from March to September. Round herring is targeted when available and specifically in the early part of the year (January to March) and is distributed from Lambert's Bay to south of Cape Point.

Figure 4.23 shows the spatial distribution of the average annual effort expended by the small pelagic purse-seine fishery from 2000 to 2014. Records of fishing events during this period indicate that the main fishing grounds are located approximately 150 km inshore of the proposed exploration licence area.

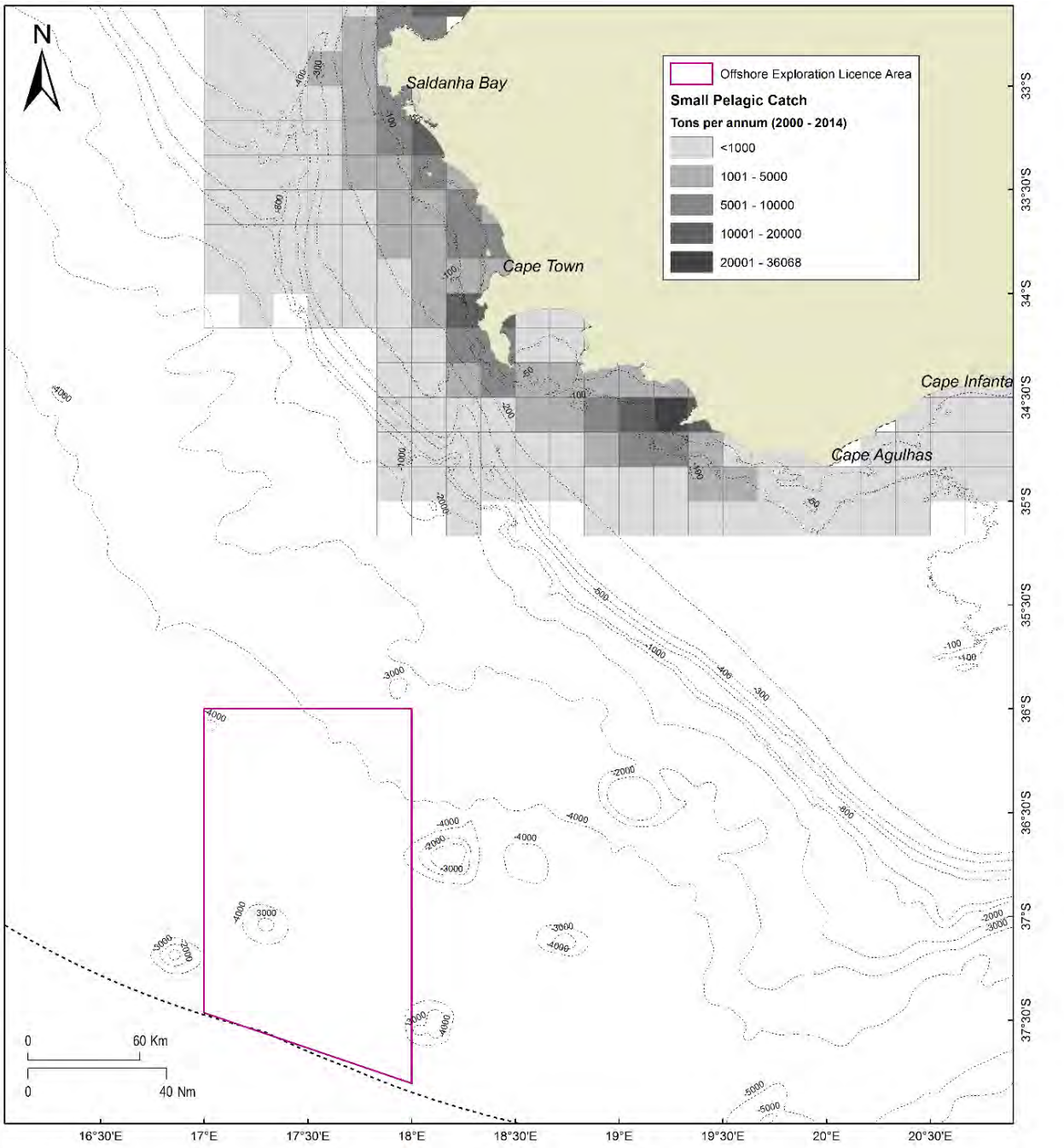


Figure 4.23: Location of Licence Blocks 3616 and 3717 in relation to pelagic purse-seine effort (2000 - 2014).

Once a shoal has been located the vessel steams around it and encircle it with a large net. The depth of the net is usually between 60 m and 90 m. Netting walls surround aggregated fish both from the sides and from underneath, thus preventing them from escaping by diving downwards. These are surface nets framed by lines: a float line on top and lead line at the bottom (see Figure 4.24). Once the shoal has been encircled the net is pursed and hauled in and the fish are pumped onboard into the hold of the vessel. After the net is deployed the vessel has no ability to manoeuvre until the net has been fully recovered onboard, which may take up to 1.5 hours. Vessels usually operate overnight and return to offload their catch the following day.

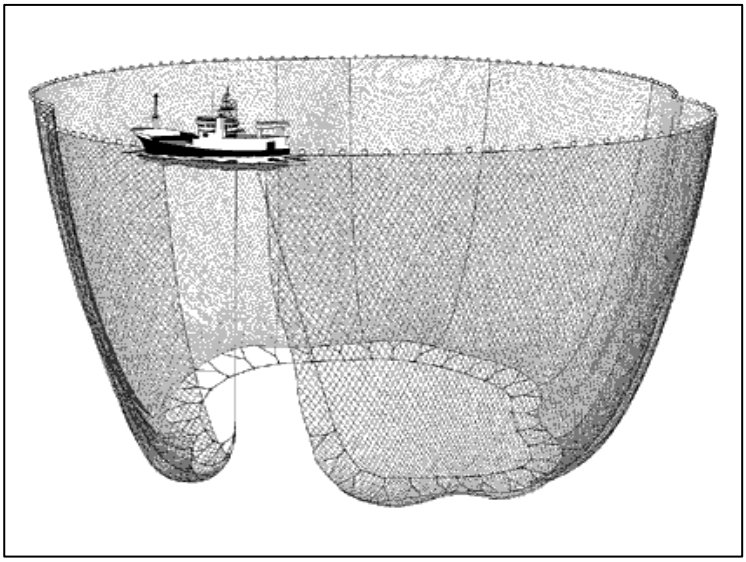


Figure 4.24: Schematic of typical purse-seine gear deployed in the "small" pelagic fishery.

4.3.1.5 Tuna pole fishery

The tuna pole fishery is based on migratory species of tuna, predominantly Atlantic longfin tuna stock and a very small amount of skipjack tuna, yellowfin tuna and bigeye tuna. The South African fleet consists of approximately 128 pole-and-line vessels, which are based at the ports of Cape Town, Hout Bay and Saldanha Bay. The fishery is seasonal with vessel activity mostly between December and May and with peak catches recorded from November to February. The 2014 TAC for the South African tuna pole fishery (albacore) was set at 4 400 tons, of which 3 620 tons (approximately 82%) was landed.

Fishing activity occurs along the entire West Coast, with effort being directed mainly inshore of the 500 m bathycontour. Fishing activity occurs along the shelf break with favoured fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore from Saldanha Bay. Incidental fishing activity has been recorded in the vicinity of the proposed exploration licence area around Protea Seamount situated adjacent to the boundary of the licence area (see Figure 4.25). Catch taken from the area during 2013 amounted to 2.3 tons, which is less than 0.01% of the overall catch reported by the sector.

Vessels drift whilst attracting and catching shoals of pelagic tunas. Sonars and echo sounders are used to locate schools of tuna. Once a school is located, water is sprayed outwards from high-pressure nozzles to simulate small baitfish aggregating near the water surface. Live bait is then used to entice the tuna to the surface (chumming). Tuna swimming near the surface are caught with hand-held fishing poles. The ends of the 2 to 3 m poles are fitted with a short length of fishing line leading to a hook. In order to land heavier fish, lines may be strung from the ends of the poles to overhead blocks to increase lifting power (see Figure 4.26). Vessels are relatively small (less than 25 m in length) and store catch on ice, thus staying at sea for short periods (approximately five days).

The nature of the fishery and communication between vessels often results in a large number of vessels operating in close proximity to each other at a time. The vessels fish predominantly during daylight hours and are highly manoeuvrable. However, at night in fair weather conditions the fleet of vessels may drift or deploy drogues to remain within an area and would be less responsive during these periods.

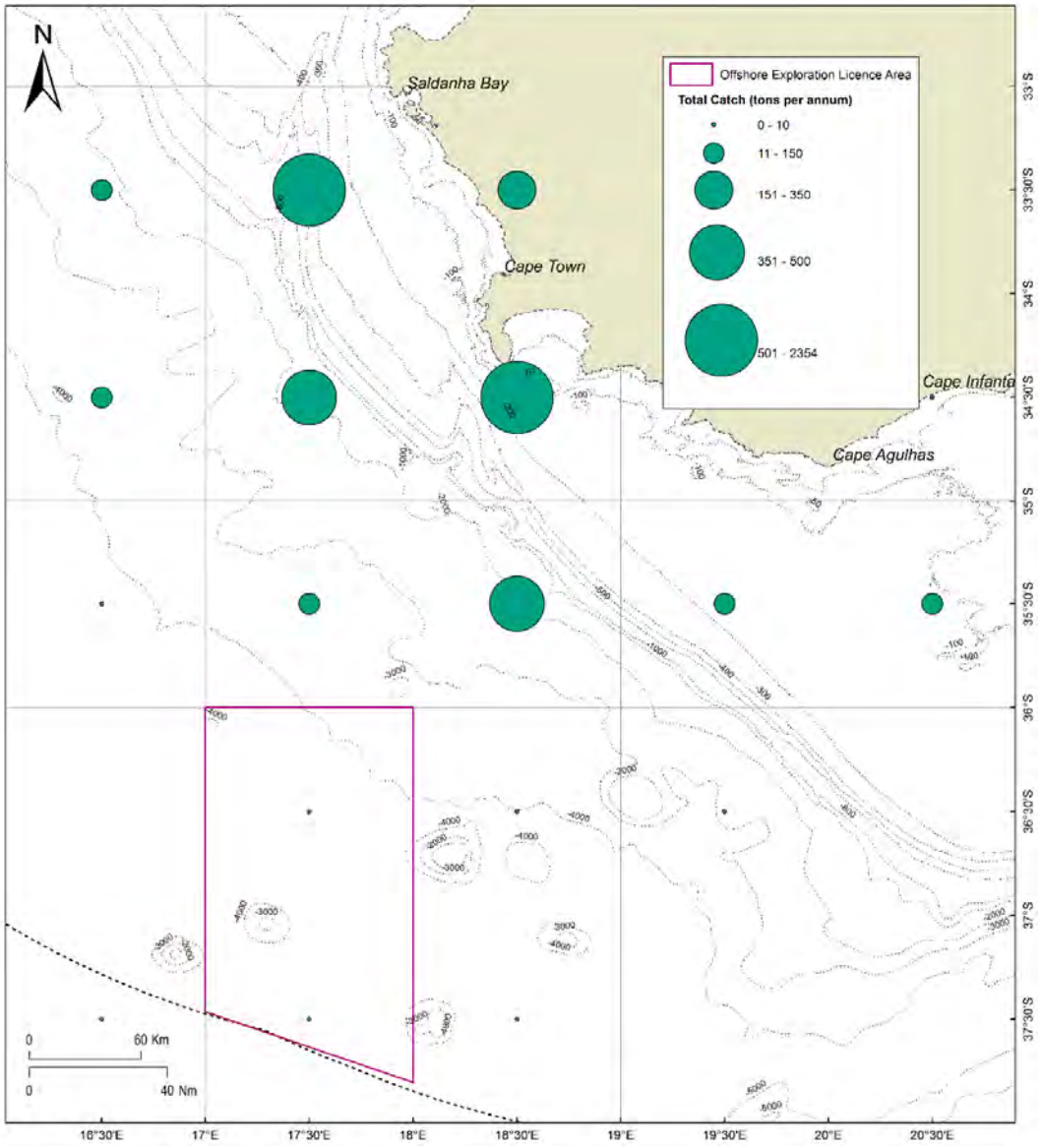


Figure 4.25: Location of Licence Blocks 3616 and 3717 in relation to tuna pole catch (2003 - 2014).

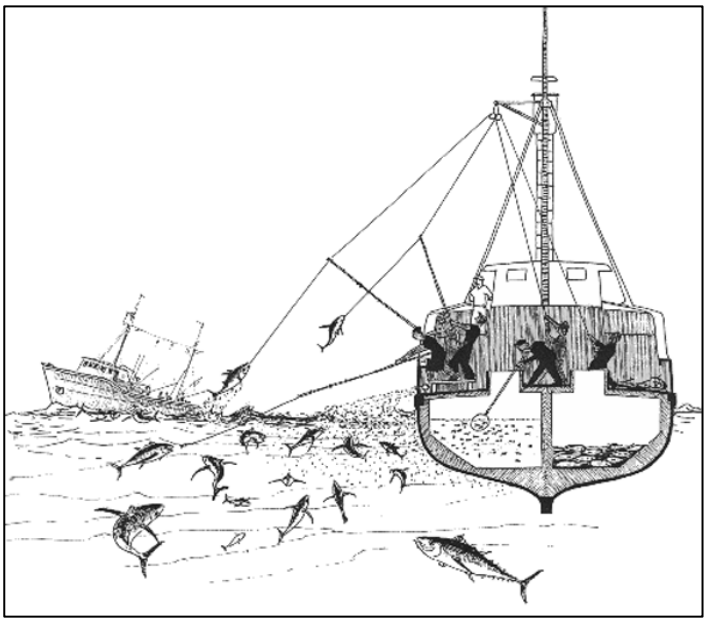


Figure 4.26: Schematic diagram of pole and line operation (www.fao.org/fishery).

4.3.1.6 Traditional line fishery

This fishery includes commercial, subsistence and recreational sectors. The South African commercial line fishery is the country's third most important fishery in terms of total tons landed and economic value. The bulk of the fishery catch is made up of approximately 35 species. Different assemblages of species are targeted according to the region in which they are being fished and include tuna species, sparidae, serranidae, caragidae, scombridae and sciaenidae. In South Africa effort is managed geographically with the spatial effort of the fishery divided into three zones. The majority of the catch (up to 97%) is landed by the Cape commercial fishery, which operates on the continental shelf mostly up to a depth of 200 m from the Namibian border on the West Coast to the Kei River in the Eastern Cape. Up to 3 000 boats are involved in the fishery on the national level, 450 of which are involved in the commercial fishery.

Records of fishing activity off the South-West Coast are predominantly coastal, up to the 200 m isobaths, with fishing vessels generally ranging up to a maximum of 40 nm offshore, although fishing at the outer limit of this range is sporadic (see Figure 4. 30). Thus fishing grounds do not coincide with the proposed exploration licence area. The fishery operates year-round and reported landings of 6 445 tons during 2014.

Line fishing techniques consist of hook and line deployments (up to 10 hooks per line) and differ from the pelagic long-line fishing technique in that the use of set long-lines is not permitted.

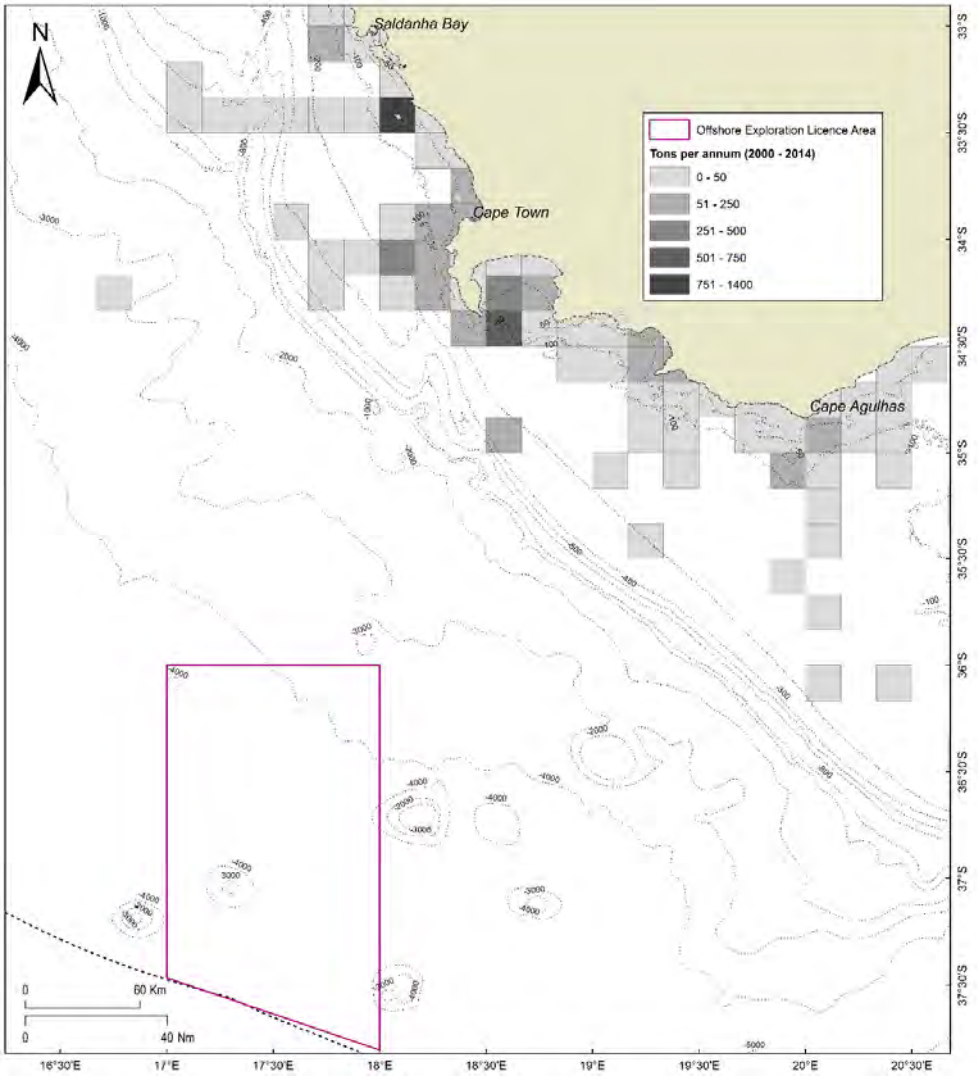


Figure 4.27: Location of Licence Blocks 3616 and 3717 in relation to traditional line-fish catch (2000 - 2014).

4.3.1.7 West Coast rock lobster fishery

The West Coast rock lobster occurs inside the 200 m depth contour along the West Coast from Namibia to East London on the East Coast of South Africa. In South Africa the fishery is divided into the offshore fishery and the near-shore fishery, both directed inshore of the 100 m bathymetric contour. The offshore sector operates in a water depth range of 30 m to 100 m whilst the inshore fishery is restricted by the type of gear used to waters shallower than 30 m in depth.

Fishing grounds are divided into Zones stretching from the Orange River mouth to east of Cape Hangklip in the South-Eastern Cape. Effort is seasonal with boats operating from the shore and coastal harbours. Catch is managed using a TAC, 80% and 20% of which is allocated to the offshore and inshore fisheries respectively. The overall TAC for the 2015/16 fishing season has been set at 1 924 tons, with 1 243 tons and 235 tons apportioned to the commercial offshore and near-shore subsectors, respectively.

Figure 4.31 shows the West Coast rock lobster catch between 1969 and 2012 in the various management zones in relation to the proposed exploration licence area. Since the fishery operates in waters shallower than 100 m, most fishing grounds are situated within 10 km of the coastline, well inshore of the proposed exploration licence area.

The offshore sector makes use of traps consisting of rectangular metal frames covered by netting, which are deployed from trap boats, whilst the inshore fishery makes use of hoop nets deployed from small dinghy's. Traps are set at dusk and retrieved during the early morning. Vessels using traps will leave up to 30 traps per vessel in the fishing grounds overnight during the week.

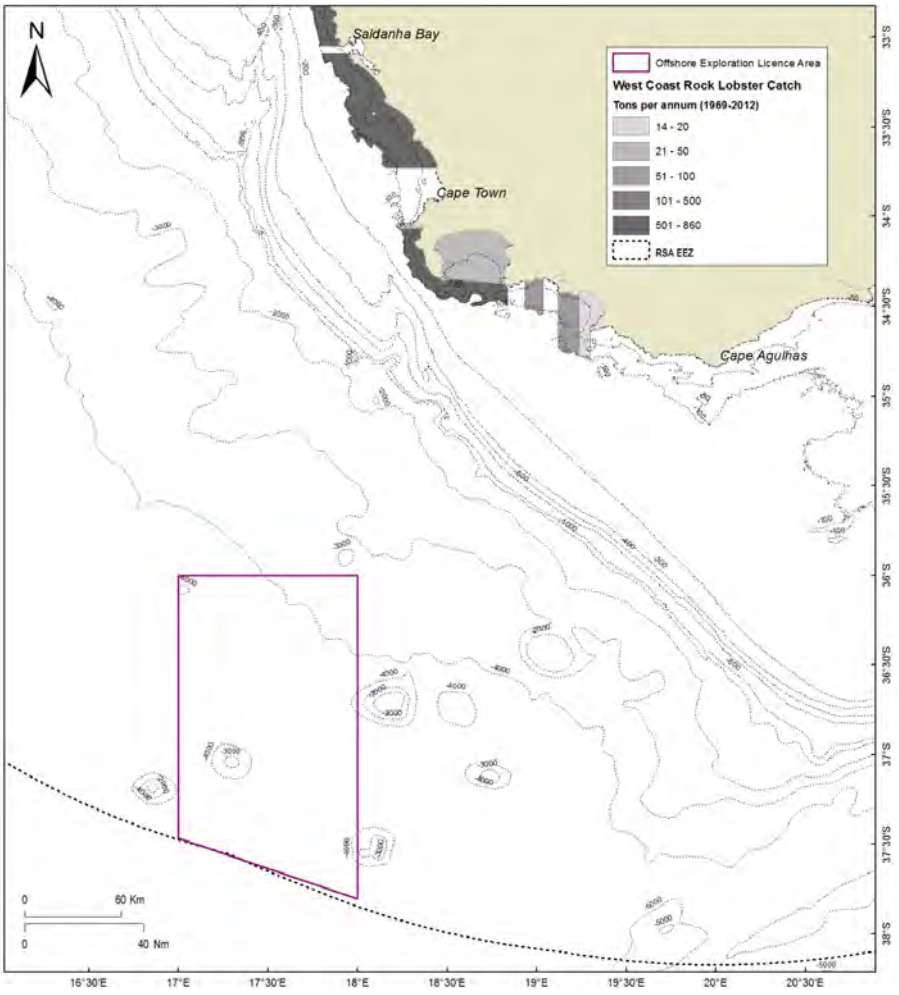


Figure 4.28: Location of Licence Blocks 3616 & 3717 in relation to the West Coast Rock Lobster fishery (1969 and 2012).

4.3.1.8 Fisheries research

Surveys of demersal fish resources are carried out in January (West Coast survey) and May (South Coast survey) each year by the Department of Agriculture, Forestry and Fisheries (DAFF) in order to set the annual TACs for demersal fisheries. Stratified, bottom trawls are conducted to assess the biomass, abundance and distribution of hake, horse mackerel, squid and other demersal trawl species on the shelf and upper slope of the South African coast. The gear configuration is similar to that of commercial demersal trawlers, however, nets are towed for a shorter duration of generally 30 minutes per tow. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000 m bathymetric contour (see Figure 4.26), thus inshore of the proposed exploration licence area. Approximately 120 trawls are conducted during each survey over a period of approximately one month.

The biomass of small pelagic species is also assessed bi-annually by an acoustic survey. The first of these surveys is timed to commence mid-May and runs until mid-June while the second starts in mid-October and runs until mid-December. During these surveys the survey vessel travels pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200 m bathymetric contour (see Figure 4.27), thus inshore of the proposed exploration licence area. The surveys are designed to cover an extensive area from the Orange River (West Coast) to Port Alfred (East Coast).

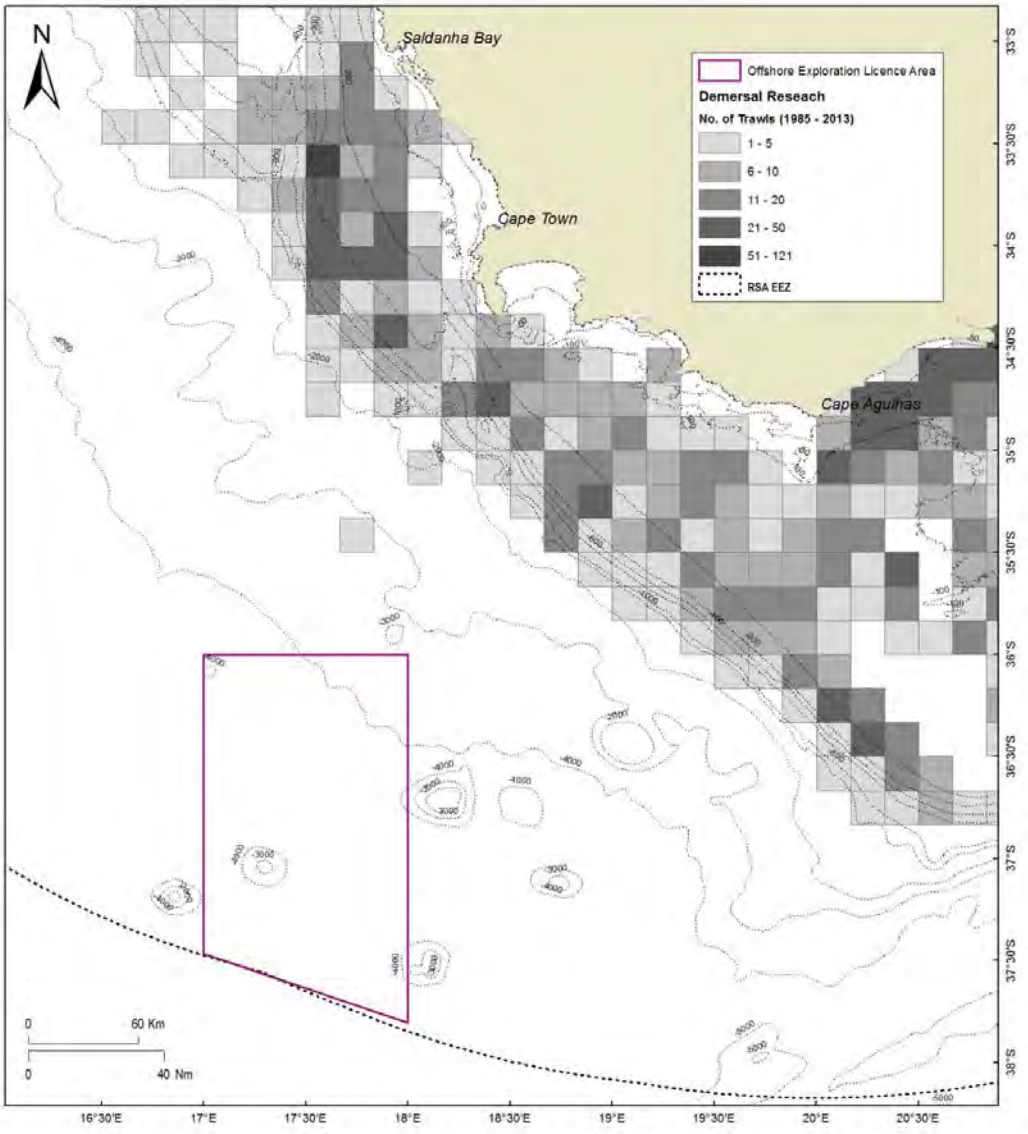


Figure 4.29: Location of Licence Blocks 3616 & 3717 in relation to the spatial distribution of research trawls undertaken by DAFF between 1985 and 2013.

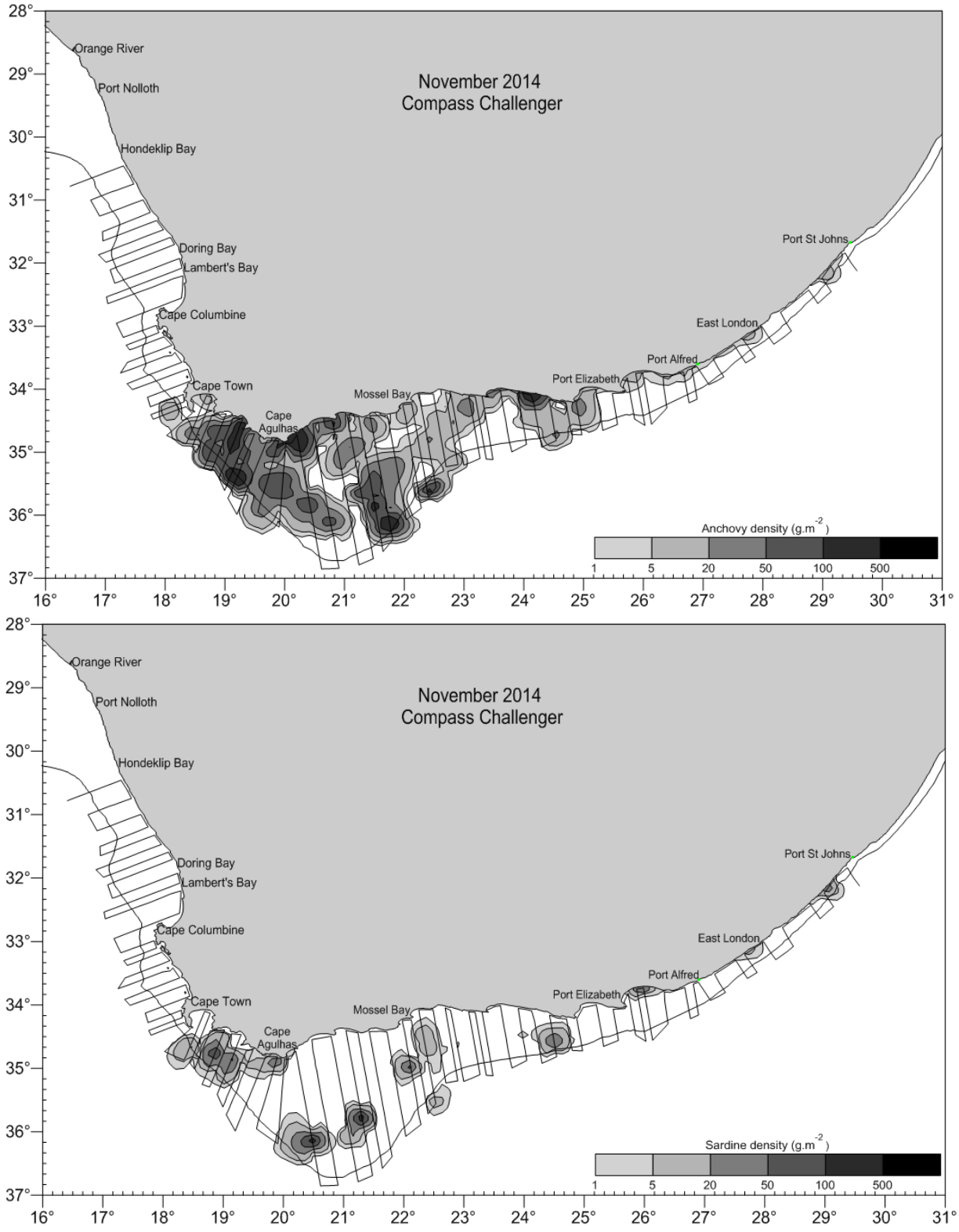


Figure 4.30: Spatial distribution of survey tracks undertaken during the acoustic biomass survey by DAFF during November 2014. Density of anchovy (above) and sardine (below) is also shown.

4.3.2 SHIPPING TRANSPORT

A large number of vessels navigate along the West, South and East coasts on their way around the southern African subcontinent. The majority of shipping traffic is located on the outer edge of the continental shelf (between 12 and 24 nm offshore) with traffic inshore of the continental shelf along the South-West Coast largely comprising fishing vessels. Figure 4.28 shows that the majority of the shipping traffic would pass inshore of the proposed exploration licence area.

Important harbours along the South-West Coast include St Helena Bay, Saldanha Bay, Cape Town, Hout Bay, Hermanus, Gansbaai, Struis Bay, Arniston and Still Bay.

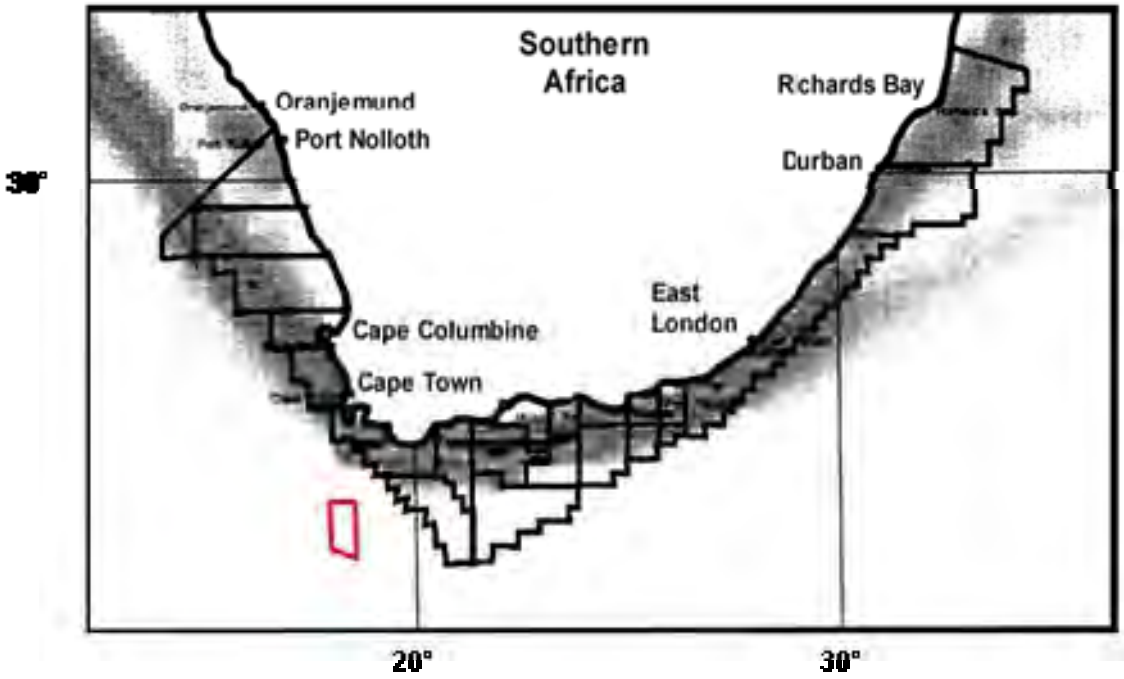


Figure 4.31: The major shipping routes along the West Coast of South Africa showing petroleum licence blocks (Data from the South African Centre for Oceanography). Approximate location of Licence Blocks 3616 & 3717 is also shown.

4.3.3 OIL AND GAS EXPLORATION

4.3.3.1 Exploration

Exploration for oil and gas is currently undertaken in a number of licence blocks off the West, South and East coasts of South Africa (see Figure 4.29).

4.3.3.2 Production

There are no current development or production activities off the South-West coast. The Ibhubesi Gas Field (Block 2A) and Kudu Gas Field (off southern Namibia) have been identified for development.

Off the South Coast PetroSA operates the F-A production platform, which was brought into production in 1992. The F-A platform is located 85 kilometres south of Mossel Bay in a water depth of 102 m.

Gas and associated condensate from the associated gas fields (F-A, E-M, South Coast Gas and F-O) are processed through the platform. The produced gas and condensate are exported through two separate 93 km pipelines to the PetroSA Gas-to-Liquid (GTL) plant in Mossel Bay.

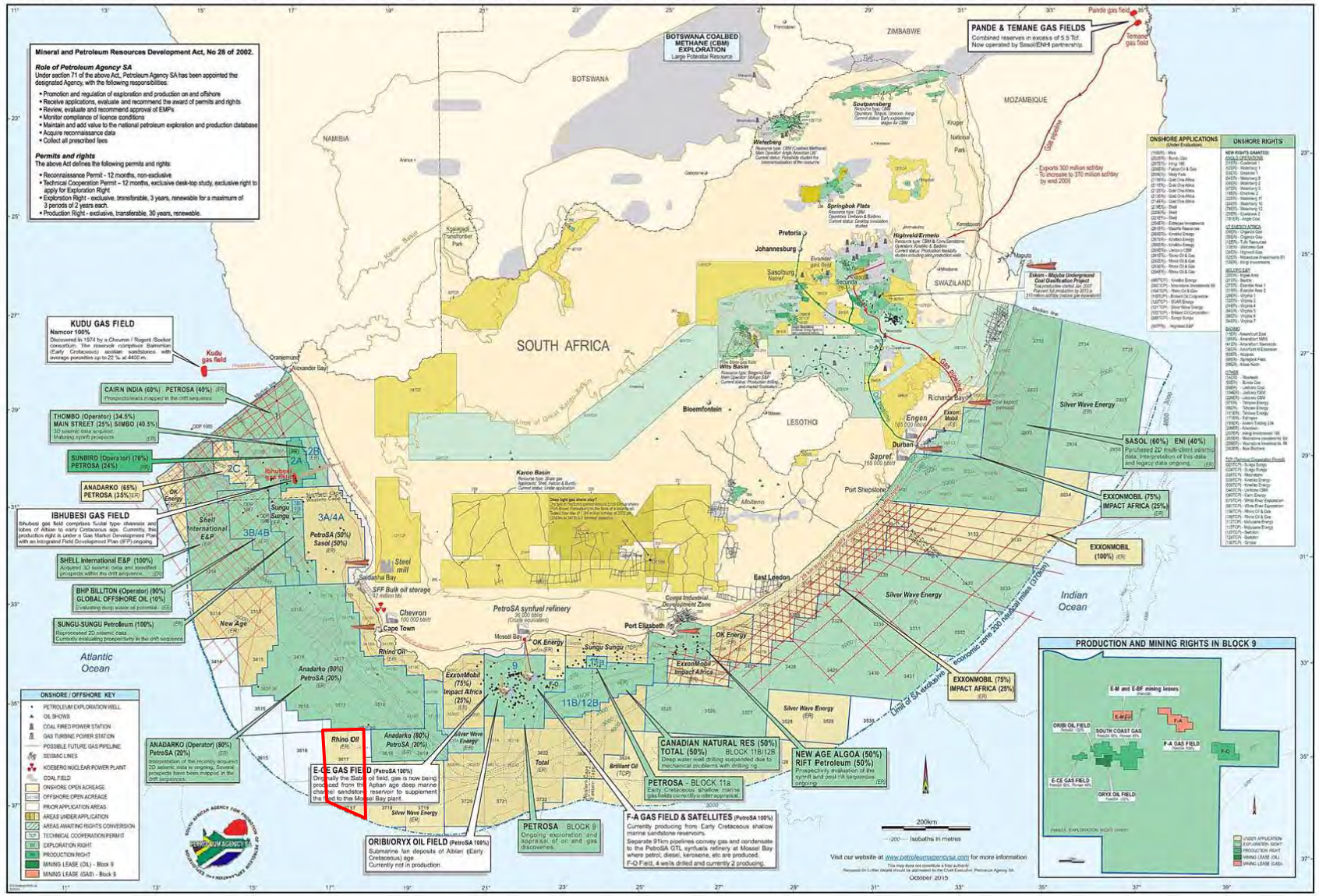


Figure 4.32: Petroleum licence blocks off the West, South and East coasts of South Africa (after PASA, Nov 2015). Licence Blocks 3616 & 3717 are highlighted in red.

PetroSA is currently producing oil from the Oryx/Oribi oil fields (E-AR and E-BT fields). These fields are tied back to the ORCA floating production platform. The ORCA lies approximately 130 km south-west of Mossel Bay. The gas and oil are separated on the ORCA and the gas is flared (burned off). The stabilised (degassed) oil is exported through a calm buoy to a shuttle tanker.

PetroSA brought the Sable Oil Field into production in 2003. The Sable Field consists of the E-BD and E-CE reservoirs, which lie 17 km to the west of the Oryx/Oribi Oil Field and 85 km south-west of the F-A Platform. Sable is currently not producing.

A 500 m statutory exclusion zone around any floating production storage and offloading unit and sea structures prohibits entry of all unauthorized vessels and aircraft. Larger safety zones around the E-M, F-A, South Coast Gas and Oryx/Oribi developments, established by the SA Navy Hydrographic Office, prohibit any activities that impact on the seafloor, i.e. anchoring, deploying of trawling gear, etc. to take place in these areas.

4.3.4 PROSPECTING AND MINING OF OTHER MINERALS

4.3.4.1 Glauconite and phosphate

Glauconite pellets (an iron and magnesium rich clay mineral) and bedded and peletal phosphorite occur on the seafloor over large areas of the continental shelf on the West and South-West Coasts. These represent potentially commercial resources that could be considered for mining as a source of agricultural phosphate and potassium (Birch 1979a & b; Dingle *et al*. 1987; Rogers and Bremner 1991).

A number of prospecting areas for glauconite and phosphorite / phosphate are located off the West Coast (see Figure 4.30), although none overlap with the proposed exploration licence area. Green Flash Trading received their prospecting rights for Areas 251 and 257 in 2012/2013. The prospecting rights for Agrimin1, Agrimin2 and SOM1 have expired (Jan Briers, DMR *pers. comm*., December 2013).

4.3.4.2 Manganese nodules in ultra-deep water

Rogers (1995) and Rogers and Bremner (1991) report that manganese nodules enriched in valuable metals occur in deep water areas (>3 000 m) off the West Coast (see Figure 4.31). These identified manganese nodules overlap with the proposed exploration licence area.

The nickel, copper and cobalt contents of the nodules fall below the current mining economic cut-off grade of 2% over most of the area, but the possibility exists for mineral grade nodules in the areas north of 33°S in the Cape Basin and off northern Namaqualand.

4.3.5 OTHER

4.3.5.1 Anthropogenic marine hazards

Human use of the marine environment has resulted in the addition of numerous hazards on the seafloor. The Annual Summary of South African Notices to Mariners No. 5 and charts from the South African Navy or Hydrographic Office provide detailed information on the location of different underwater hazards along the South-West Coast.

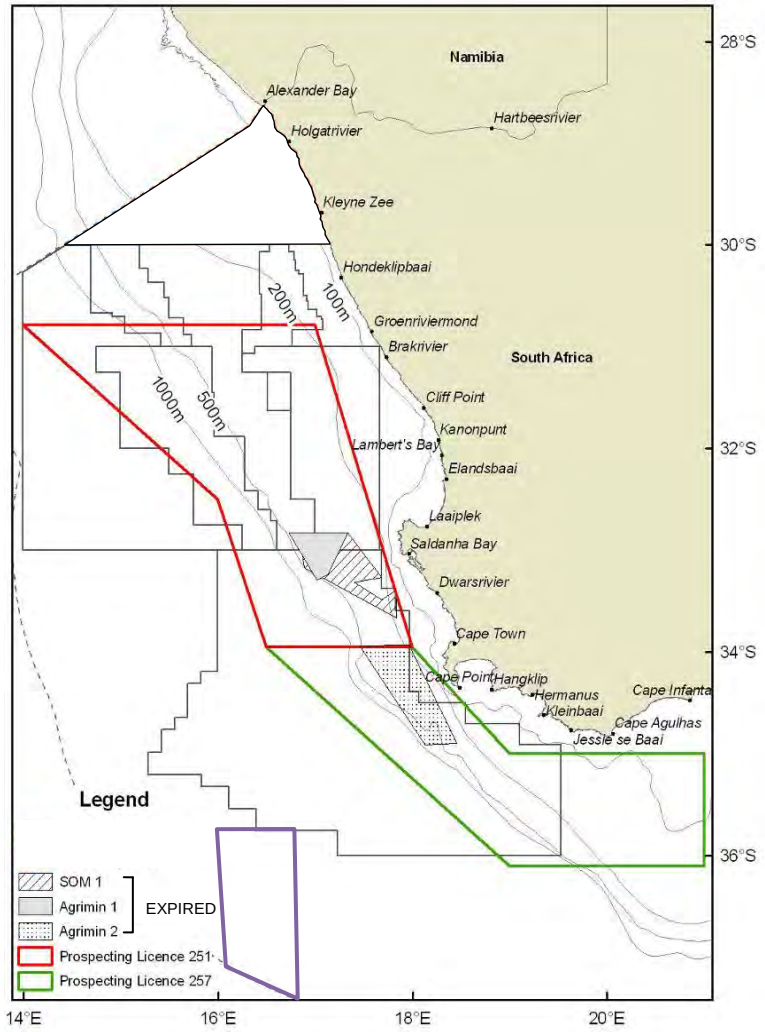


Figure 4.33: Location of Licence Blocks 3616 & 3717 in relation to glauconite and phosphorite / phosphate prospecting areas.

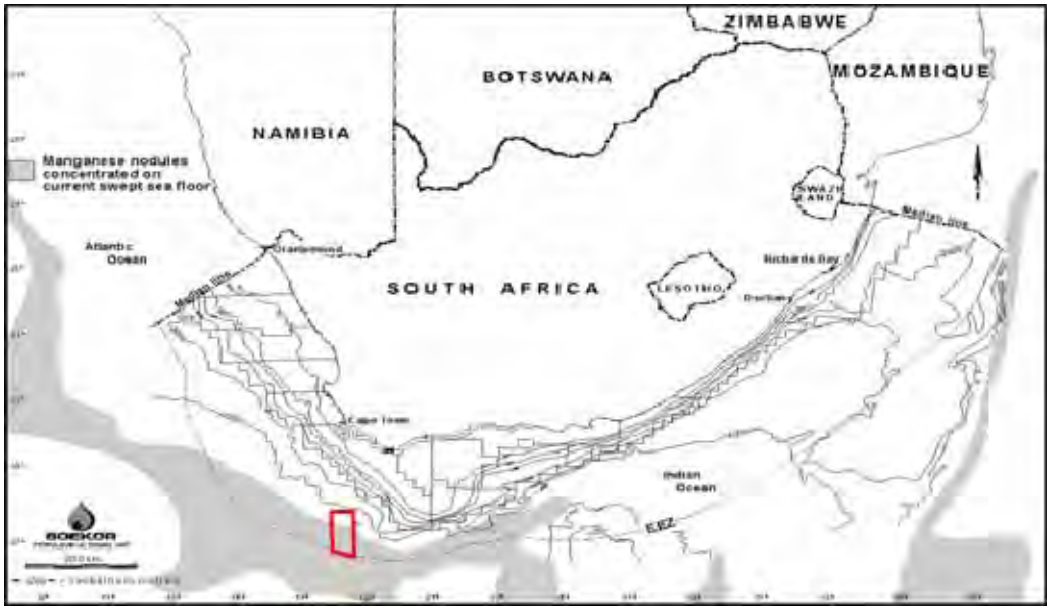


Figure 4.34: Schematic of location of manganese nodules off Southern Africa (modified from Rogers 1995). Approximate location of Licence Blocks 3616 & 3717 is also indicated.

4.3.5.2 Undersea cables

There are a number of submarine telecommunications cable systems across the Atlantic and the Indian Ocean (see Figure 4.32), including *inter alia*:

- South Atlantic Telecommunications cable No.3 / West African Submarine Cable / South Africa Far East (SAT3/WASC/SAFE): This cable system is divided into two sub-systems, SAT3/WASC in the Atlantic Ocean and SAFE in the Indian Ocean. The SAT3/WASC sub-system connects Portugal (Sesimbra) with South Africa (Melkbosstrand). From Melkbosstrand the SAT-3/WASC sub-system is extended via the SAFE sub-system to Malaysia (Penang) and has intermediate landing points at Mtunzini South Africa, Saint Paul Reunion, Bale Jacot Mauritius and Cochin India (www.safe-sat3.co.za).
- Eastern Africa Submarine Cable System (EASSy): This is a high bandwidth fibre optic cable system, which connects countries of eastern Africa to the rest of the world. EASSy runs from Mtunzini (off the East Coast) in South Africa to Port Sudan in Sudan, with landing points in nine countries, and connected to at least ten landlocked countries.
- West Africa Cable System (WACS): WACS is 14 530 km in length, linking South Africa (Yzerfontein) and the United Kingdom (London). It has 14 landing points, 12 along the western coast of Africa (including Cape Verde and Canary Islands) and 2 in Europe (Portugal and England) completed on land by a cable termination station in London.
- African Coast to Europe (ACE): The ACE submarine communications cable is a 17 000 km cable system along the West Coast of Africa between France and South Africa (Yzerfontein).

There is an exclusion zone applicable to the telecommunication cables 1 nm (approximately 1.9 km) each side of the cable in which no anchoring is permitted. None of the submarine cables are located within the proposed exploration licence area.

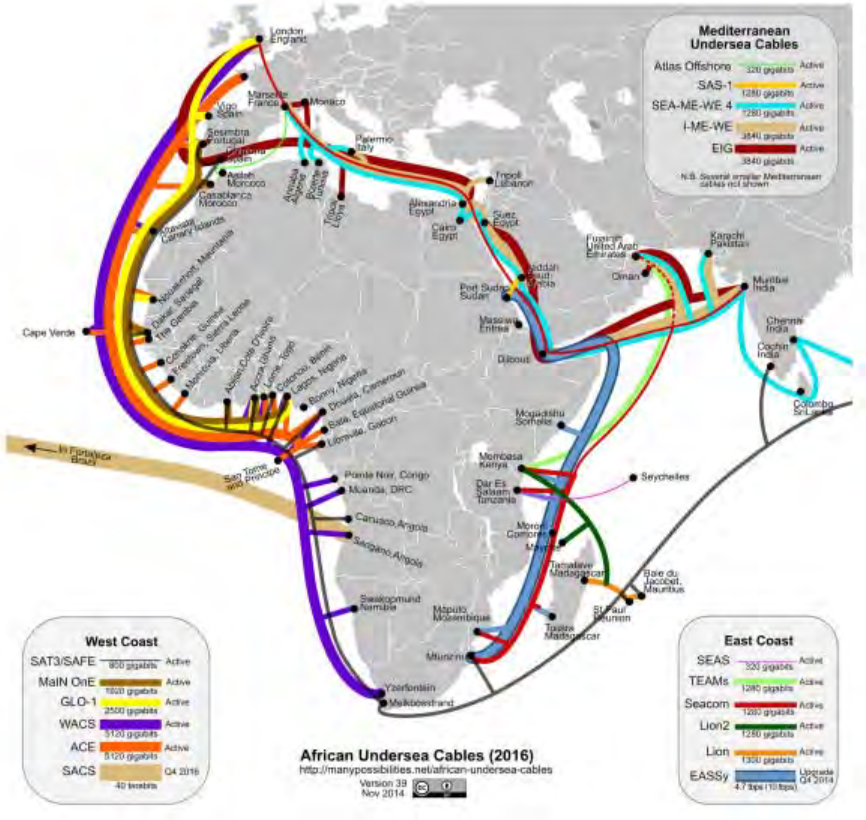


Figure 4.35: Configuration of the current African undersea cable systems, November 2014 (From http://www.manypossibilities.net).

4.3.5.3 Marine archaeological sites

In terms of the National Heritage Resources Act (No. 25 of 1999), any wreck, being any vessel, aircraft or any part thereof, older than 60 years lying in South Africa's territorial waters or maritime cultural zone is protected. The majority of known shipwrecks off the coast of South Africa occur in waters shallower than 100 m within 50 km of the coast, well inshore of the proposed exploration licence area. According to the South African Heritage Resources Agency (SAHRA) there are between 45 and 50 shipwrecks located around Robben Island, approximately 20 shipwrecks between Cape Town and Milnerton and approximately 20 shipwrecks between Milnerton and Saldanha Bay. There are no known shipwrecks in the proposed exploration licence area.

4.3.5.4 Ammunition dump sites

Ammunition and explosive dumpsites off the South-West Coast are presented on SAN Chart 56. There are four disused explosives dumping grounds and one active ammunition dumping ground, none of which occur within proposed exploration licence area (see Figure 4.33).

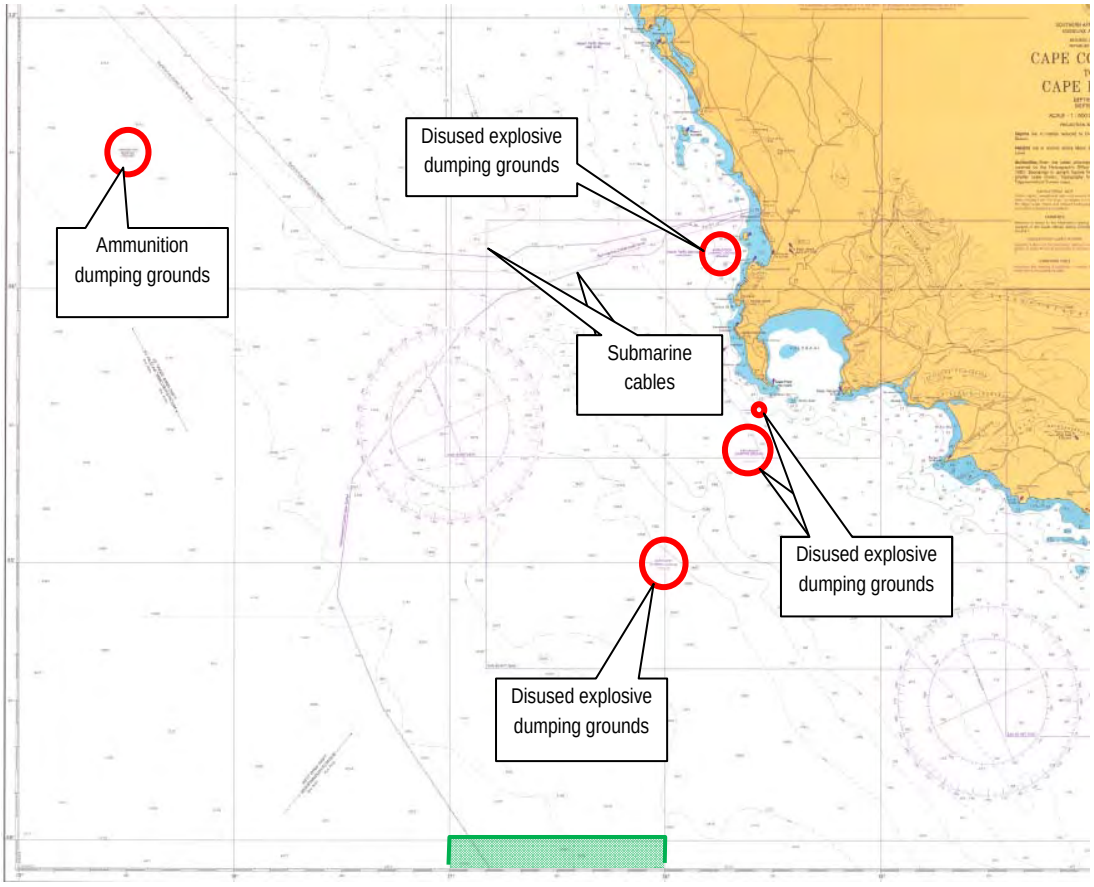


Figure 4.36: The location of Licence Blocks 3617 and 3717 (shown in green) in relation to ammunition and explosive dumping grounds and subsea cable off the West Coast (from SAN Chart 56).

4.3.5.5 Conservation areas and Marine Protected Areas

Numerous conservation areas and a Marine Protected Area (MPA) exist along the coastline of the South-Western Cape, however, Licence Blocks 3617 and 3717 do not overlap with any of these areas (see Figure 4.34).

A systematic biodiversity plan has been developed for the West Coast (Majiedt *et al.* 2013) with the objective of identifying both coastal and offshore priority areas for MPA expansion. To this end, nine focus areas have been identified for protection on the West Coast between Cape Agulhas and the South African – Namibian border. These focus areas have been carried forward through Operation Phakisa for the proposed development of offshore MPAs. Those within the broad project area are shown in Figure 4.15. The eastern border of the proposed exploration licence area falls within the proposed Southeast Atlantic Seamounts MPA, although the seamount itself is located approximately 7 km east. Before formal declaration of these proposed MPAs, a full public participation process with other stakeholders, including Rhino, needs to be undertaken.

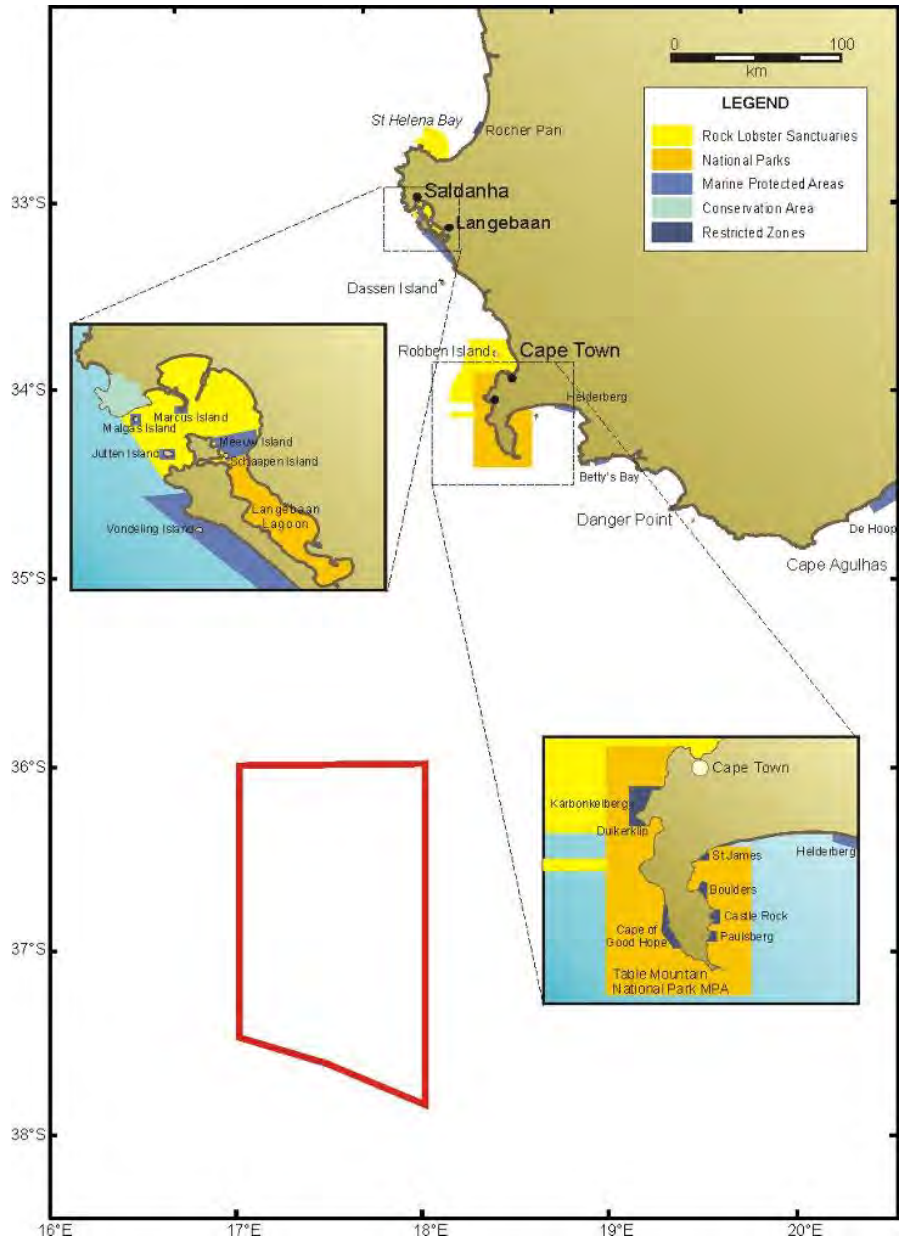


Figure 4.37: Location of Licence Blocks 3616 and 3717 in relation reserves and Marine Protected Areas on the South-West Coast.

5. IMPACT DESCRIPTION AND ASSESSMENT

This chapter describes and assesses the significance of potential impacts related to the proposed exploration activities in Licence Blocks 3617 and 3717 off the South-West Coast of South Africa. The potential impacts of the proposed exploration activities are addressed in four categories, namely:

1. Seismic and support vessels (incl. helicopter) operation (see Section 5.1);
2. Impacts of seismic noise on marine fauna (see Section 5.2);
3. Impacts of multi-beam bathymetry noise on marine fauna (see Section 5.3);
4. Impacts of proposed exploration activities on other users of the sea (see Section 5.4); and
5. Impact related to local employment and business opportunities (see Section 5.5).

The implications of not going ahead with the proposed project (i.e. the No-Go Alternative) are assessed in Section 5.6.

All impacts are systematically assessed and presented according to predefined rating scales (see Appendix 3.1). Mitigation or optimisation measures are proposed which could ameliorate the negative impacts or enhance potential benefits, respectively. The status of all impacts should be considered to be negative unless otherwise indicated. The significance of impacts with and without mitigation is also assessed.

Two specialist studies were undertaken to address the key issues that required further investigation, namely (1) the impact on fishing (see Appendix 3.2) and (2) the impact on marine fauna (see Appendix 3.3). In addition, this assessment used as a basis the issues identified in the Generic EMP Report prepared for seismic surveys off the coast of South Africa (CCA and CMS 2001) and similar studies. The project team have assessed the relevance of these issues to this project.

Unless otherwise indicated, all potential impacts discussed below would be for the duration of the survey only, i.e. 15 to 20 days per survey activity (namely multi-beam bathymetry, 2D seismic and 3D seismic), due to the transient nature of survey activities.

5.1 IMPACT OF NORMAL SEISMIC / SUPPORT VESSELS AND HELICOPTER OPERATION

5.1.1 EMISSIONS TO THE ATMOSPHERE

Description of impact

Emissions to the atmosphere during the seismic survey may include exhaust gases from the use of diesel as fuel for generators and motors.

Diesel exhaust comprises mainly carbon dioxide (CO_2) as well as several toxic gases such as nitrogen oxides (NO_X), sulphur oxides (SO_X) and carbon monoxide (CO). In addition, diesel combustion can produce hydrocarbons (Total Hydrocarbons and Volatile Organic Compounds). Smoke and particulate matter (soot) are also produced during diesel combustion.

Incineration of waste on board the survey vessel would also release soot as well as CO, CO_2 and dioxins (depending on the composition of the waste). However, Rhino has indicated that no offshore incineration of waste would be undertaken as part of the proposed project, as this would require an Atmospheric Emission Licence in terms of the National Environmental Management: Air Quality Act, 2004. Thus general waste would be stored on board for later onshore disposal.

Assessment

The atmospheric emissions from the seismic and support vessels are expected to be similar to those from similar diesel-powered vessels of comparable tonnage (approximately 3 000 – 5 000 tonnes), with the addition of the emissions from the airgun compressors.

Based on the location of the proposed exploration licence area (approximately 190 km offshore at its closest point) it is not expected that such emissions would have a direct effect on any other activity. The potential impact of emissions to the atmosphere during survey operations would be limited to the survey area, of low intensity and is considered to be of **VERY LOW** significance with or without the implementation of mitigation measures (see Table 5.1).

Mitigation

No mitigation is deemed necessary, but it is recommended that all diesel motors and generators receive adequate maintenance to minimise soot and un-burnt diesel released to the atmosphere.

Table 5.1: Impact of atmospheric emissions from the survey and support vessels.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the marine environment include other mining, exploration and production projects, other fishing and maritime activities, etc. Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

5.1.2 DISCHARGES/DISPOSAL TO THE SEA

Discharges from the seismic and support vessel to the marine environment include deck drainage, machinery space drainage, sewage, galley wastes, solid wastes and accidental hydrocarbon spills.

5.1.2.1 Deck drainage

Description of impact

Drainage of deck areas from precipitation, sea spray or routine operations (e.g. deck and equipment cleaning and fire drills) may result in small volumes of oils, solvents or cleaners being introduced into the marine environment.

Assessment

The discharge into the sea of any oil or oily mixture that may originate from the seismic and support vessels is prohibited in terms of Regulation 21 of MARPOL (Annex I), except when the oil content of the discharge

without dilution does not exceed 15 ppm. To ensure MARPOL compliance all deck drainage from work spaces should be collected and piped into an on-board sump tank for treatment prior to discharge. Oily waste substances would be shipped to land for treatment and disposal. If no such equipment is available oily water would be retained on-board and disposed of at an appropriate facility at port.

Based on the small volumes, distance offshore and high energy sea conditions, the potential impact of deck drainage from vessels on the marine environment would be of low intensity across the proposed exploration licence area (considering all the survey alternatives) over the short-term, and is considered to be of **VERY LOW** significance with or without mitigation (see Table 5.2).

Mitigation

The following measures are recommended for mitigation of deck drainage discharges from vessels:

- A Shipboard Oil Pollution Emergency Plan (SOPEP) must be prepared for all vessels and be in place at all times during operation;
- Deck drainage should be routed to a separate drainage system (oily water catchment system) for treatment to ensure compliance with MARPOL 73/78[1] standards (i.e. 15 ppm before discharge);
- All process areas should be bunded to ensure drainage water flows into the closed drainage system;
- Drip trays should be used to collect run-off from equipment that is not contained within a bunded area and the contents routed to the closed drainage system;
- Low-toxicity biodegradable detergents should be used in cleaning of all deck spillage;
- All hydraulic systems should be adequately maintained and hydraulic hoses should be frequently inspected; and
- Spill management training and awareness should be provided to crew members of the need for thorough cleaning-up of any spillages immediately after they occur in order to minimise the volume of contaminants washing off decks.

Table 5.2: Impact of deck drainage from the survey and support vessels.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the marine environment include other mining, exploration and production projects, other fishing and maritime activities, etc. Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

[1] MARPOL 73/78 is an International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 relating thereto. All vessels operating within the South African EEZ are required to conform to legal requirements for waste management and pollution control, including the Marine Pollution Act (No. 2 of 1986 – which incorporate MARPOL 73/78 standards) and the Dumping at Sea Control Act, 1965 (No. 73 of 1965). These Acts make provision for the discharge of various types of waste.

5.1.2.2 Machinery space drainage

Description of impact

Small volumes of oil such as diesel fuel, lubricants, grease, etc. used within the machinery space of the seismic and support vessels could enter the marine environment.

Assessment

All operations would comply fully with international agreed standards regulated under MARPOL 73/78. All machinery space drainage would pass through an oil/water filter to reduce the oil in water concentration to less than 15 ppm, in accordance with Regulation 21 of MARPOL (Annex 1). If no such equipment is available oily water would be retained on board and disposed of at an appropriate facility at port.

Concentrations of oil reaching the marine environment through drainage of machinery spaces are, therefore, expected to be low. Based on the distance offshore, small volumes and high energy sea conditions, the potential impact of such low concentrations would be of low intensity and limited to the proposed exploration licence area (considering all the survey alternatives) over the short-term. The potential impact of machinery space drainage on the marine environment is therefore considered to be of **VERY LOW** significance with or without mitigation (see Table 5.3).

Mitigation

Mitigation is as for deck drainage (see Section 5.1.2.1).

Table 5.3: Impact of machinery space drainage from the survey and support vessels.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the marine environment include other mining, exploration and production projects, other fishing and maritime activities, etc. Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

5.1.2.3 Sewage

Description of impact

Sewage poses an organic and bacterial loading on the natural degradation processes of the sea, resulting in an increased biological oxygen demand (BOD). This could result in anaerobic conditions in the marine environment. Although treated sewage would also increase BOD, it does not pose a bacterial load.

Assessment

The proposed seismic survey is expected to take in the order of 15 - 20 days per survey. The volumes of sewage wastes released from the seismic and support vessels would be small and comparable to volumes produced by vessels of similar crew compliment (up to 50 people).

All sewage would be treated to the required MARPOL 73/78 standard prior to release into the marine environment, where the high wind and wave energy is expected to result in rapid dispersal. Discharges of sewage, according to MARPOL 73/78 standards, would be comminuted and disinfected prior to disposal to the marine environment if between 4 nm (± 7.5 km) and 12 nm (± 22 km) from the coast, and no disposal would occur within 4 nm (± 7.5 km) of the coast. Disposal beyond 12 nm requires no treatment. Sewage would not be discharged instantaneously but at a moderate rate when the vessel is *en route* and travelling at no less than 4 knots.

Based on the small volumes, distance offshore and high energy sea conditions, the potential impact of sewage effluent from vessels on the marine environment is expected to be limited to the survey area over the short-term, and is therefore considered to be of **VERY LOW** significance with or without mitigation (see Table 5.4).

Mitigation

Ensure compliance with the MARPOL 73/78 standards.

Table 5.4: Impact of sewage effluent discharge from the survey and support vessels.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the marine environment include other mining, exploration and production projects, other fishing and maritime activities, etc. Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

5.1.2.4 Galley waste

Description of impact

Galley wastes, comprising mostly of biodegradable food waste, would place a small organic and bacterial loading on the marine environment.

Assessment

The volume of galley waste from a survey and support vessel would be small and comparable to wastes from any vessel of a similar crew compliment (up to 50 people). Discharges of galley wastes, according to MARPOL 73/78 standards, would be comminuted to particle sizes smaller than 25 mm prior to disposal to the marine environment if less than 12 nm (± 22 km) from the coast and with no disposal within 3 nm (± 5.5 km) of the coast.

Based on the small volumes, distance offshore and high energy sea conditions, the potential impact of galley waste disposal on the marine environment would be of low intensity and limited to the proposed exploration licence area (considering all the survey alternatives) over the short-term. The potential impact of galley waste on the marine environment is therefore considered to be of **VERY LOW** significance with or without mitigation (see Table 5.5).

Mitigation

Ensure compliance with the MARPOL 73/78 standards.

Table 5.5: Impact of galley waste disposal from the survey and support vessels.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the marine environment include other mining, exploration and production projects, other fishing and maritime activities, etc. Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

5.1.2.5 Solid waste

Description of impact

The accidental release of solid waste comprising non-biodegradable domestic waste, packaging and operational industrial waste into the sea could pose a hazard to marine fauna, may contain contaminant chemicals and could end up as visual pollution at sea, on the seashore or on the seabed.

Assessment

Solid waste generated during the exploration activities (excluding galley waste) would be transported to shore for disposal at a licensed landfill facility or an alternative approved facility. Consequently there would be no impact on the marine environment. However, there could be incidents (e.g. blown by wind) which could result in a small amount of waste entering the marine environment.

The potential impact of the disposal of solid waste from vessels on the marine environment is therefore considered to be **INSIGNIFICANT** (see Table 5.6).

Mitigation

The following measures are recommended for the mitigation of waste:

- Initiate an on-board waste minimisation system;
- On-board solid waste storage is to be secure; and
- The disposal of waste (solid and hazardous) onshore must be in accordance with the appropriate laws and ordinances.

Table 5.6: Impact of solid waste disposal from the survey and support vessels.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Zero	Zero
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the marine environment include other mining, exploration and production projects, other fishing and maritime activities, etc. Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

5.1.2.6 Accidental oil spill during bunkering / refuelling

Description of impact

Accidental hydrocarbon spills of varying sizes could result from related operations, for example the bunkering of fuel oil at sea. This scenario assumes that an accidental spillage of fuel oil would occur.

Assessment

Spillages and leakages during bunkering operations are a primary source of oil pollution from ships. Many of the spillages that occur can be attributed to human error. Thus all bunkering operations should be carefully planned and executed in accordance with MARPOL 73/78 standards and the necessary approval from the South African Maritime Safety Authority (SAMSA).

Spillages and leakages during bunkering operations are generally relatively small (< 1 000 litres). Bunkering operations are expected to take place either in port (Cape Town or Saldanha) or at sea during the survey. Bunkering within the port limits would be less likely to be affected by environmental factors (e.g. sea state and wind) and any accidental spills would be easier to contain and remediate. Any spill within the port limits would be managed in accordance with the port's local oil spill contingency plan. The impact associated with an oil spill within the port limits is considered to be **INSIGNIFICANT**.

Accidental spillages from offshore bunkering operations would be more difficult to contain. However, since the proposed exploration licence area is located approximately 190 km offshore at the closest point, a small spill would disappear before reaching the shore due to evaporative processes and the high energy marine environment off the South-West coast. In addition, the dominant winds originate from the south-east during the summer and thus do not blow directly towards the coast. Any spills would be managed in accordance with procedures specified in the project specific Emergency Response Plan and Shipboard Oil Pollution Emergency Plan. Since a small spill would not reach the coast, the potential impact on the biophysical environment is expected to be localised, of medium to high intensity over the short-term, and is therefore considered to be of **LOW** significance without mitigation and **VERY LOW** with mitigation (see Table 5.7).

Mitigation

- Rhino and the appointed survey contractor must prepare a project specific Emergency Response Plan and Shipboard Oil Pollution Emergency Plan for the each of the proposed survey activities, which defines their organisational structure and protocols that would be implemented to respond to any incident (including accidental oil / fuel spills) in a safe, rapid, effective and efficient manner;
- Offshore bunkering should not be undertaken in the following circumstances:
  - > Wind force and sea state conditions of 6 or above on the Beaufort Wind Scale;
  - > During any workboat or mobilisation boat operations;
  - > During helicopter operations;
  - > During the transfer of in-sea equipment; and
  - > At night or times of low visibility.
- Support vessels must have the necessary spill response capability to deal with accidental spills in a safe, rapid, effective and efficient manner; and
- Crew must be trained in spill management.

Table 5.7: Impact of an accidental oil spill during bunkering operations.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Accidental spillages related to bunkering operations in port		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Zero	Zero
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Accidental spillages related to offshore bunkering operations		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Medium to High	Medium
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the marine environment include other mining, exploration and production projects, other fishing and maritime activities, etc. Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Low	

5.1.3 NOISE FROM VESSEL AND HELICOPTER OPERATIONS

5.1.3.1 Noise from seismic and support vessel operations

Impact description

The noise from seismic and support vessels could result in localised disturbance of marine fauna.

Impact assessment

Noise from seismic and support vessels is likely to be no higher than those from other small shipping vessels in the region. Underwater noise from vessels is not considered to be of sufficient amplitude to cause direct harm to marine life.

The potential impact of noise from seismic and support vessel operations on marine fauna is considered to be localised and of low intensity in the short-term. The significance of this impact is therefore assessed to be **VERY LOW** with and without mitigation (Table 5.8).

Mitigation measures

No measures are deemed necessary to mitigate noise impacts from seismic and support vessel operations.

Table 5.8: Impact of noise from survey and support vessel operations.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	No mitigation is considered necessary.
Duration	Short-term	
Intensity	Low	
Significance	**Very Low**	
Status	Negative	
Probability	Probable	
Confidence	Medium	
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the marine fauna include other mining, exploration and production projects, other fishing and maritime activities, etc. Cumulative impact is considered to be of MEDIUM significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

5.1.3.2 Noise from helicopter operations

Impact description

Although no crew changes are anticipated during the proposed surveys, helicopters could be utilised in an emergency situation to transfer crew between the seismic vessel and the mainland, which could result in localised disturbance of marine fauna.

Impact assessment

Low altitude flight paths over bird breeding colonies could result in temporary abandonment of nests and exposure of eggs and chicks leading to increased predation risk. Fourteen resident species breed along the West Coast, including Cape Gannet, African Penguin, four species of Cormorant, White Pelican, three Gull and four Tern species. The closest nesting grounds to the proposed exploration licence area are at the Saldanha Bay islands (over 300 km north), Dassen Island (±285 km north), Seal Island (±210 km north-north-east), Boulders Beach (200 km) and Dyer Island (±195 km north-east). Nesting grounds that could potentially be impact by a flight path between Cape Town and the proposed exploration licence area include Seal Island and Boulders Beach.

Low altitude flight paths over seal colonies can also cause stampedes of animals to sea resulting in trampling of pups and nesting seabirds within seal colonies. There are a number of Cape fur seal colonies within the broader study area, including Paternoster Rocks and Jacobs Reef at Cape Columbine,

Robbesteen near Koeberg and Seal Island in False Bay. Non-breeding colonies occur at Paternoster Point at Cape Columbine and Duikerklip in Hout Bay. Colonies that could be potentially affected by a flight path between Cape Town and the proposed exploration licence area include Seal Island (±210 km north-north-east of licence area) and Duikerklip (190 km north). The timing of the annual breeding cycle is very regular occurring between November and January. It is an offence in terms of the Sea Birds and Seals Protection Act, 1973 (No. 46 of 1973) to wilfully disturb seals on the coast or on offshore islands.

In terms of the Marine Living Resources Act, 1998 (No 18 of 1998) it is illegal for any vessel, including aircraft, to approach to within 300 m of whales within South African waters without a permit or exemption. Disturbance of cetaceans by helicopter would depend on the distance and altitude of the aircraft from the animals (particularly the angle of incidence of helicopter noise to the water surface) and the prevailing sea conditions.

Indiscriminate or direct flying over seabird or seal colonies (or flying low level parallel to the coast) and cetaceans could have a significant disturbance impact on breeding success or mortalities of juveniles. Although such impacts would be local in the area of the colony, they may have wider ramifications over the range of affected species and are deemed to range from low to high intensity. The significance of the potential impact is considered to range from **low to medium** significance (see Table 5.9), if helicopter flight paths cross any of these areas at an altitude of less than 500 m.

Mitigation measures

- Flight paths must be pre-planned to ensure that no flying occurs over seal and seabird colonies or marine islands. Important areas between Cape Town and the proposed exploration area include: Seal Island and Boulders Beach in False Bay, and Duikerklip in Hout Bay;
- Extensive coastal flights (parallel to the coast within 1 nm of the shore) should be avoided. There is a restriction of coastal flights (parallel to the coast within 1 nm of the shore) on the South Coast between the months of June and November to avoid Southern Right whale breeding areas;
- The contractor should comply fully with aviation and authority guidelines and rules; and
- All pilots must be briefed on ecological risks associated with flying at a low level parallel to the coast.

If the suggested mitigation measures are implemented, this impact is expected to be **VERY LOW** (see Table 5.9).

Table 5.9: Impact of noise from helicopter operations.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low to High	Low
Significance	**Low to Medium**	**VERY LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the marine fauna include other aviation activities around the Cape Peninsula related to tourism, recreation, police, etc. Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

5.2 IMPACTS OF SEISMIC NOISE ON MARINE FAUNA

This section assesses the potential impacts related to both 2D and 3D seismic survey noise on marine fauna.

5.2.1 POTENTIAL IMPACTS ON PLANKTON

Plankton, which are species that are unable to determine their direction of travel within the water column, comprise bacterioplankton (bacterial component of plankton), phytoplankton (floral plankton) and zooplankton (faunal plankton). Zooplankton includes ichthyoplankton (planktonic larval stages of fish and invertebrates and eggs) as well as holoplankton (species that spend their entire life-cycle as plankton).

Description of impact

Potential impacts of seismic pulses on plankton could include physiological injury and/or mortality. No behavioural avoidance of the seismic survey area by plankton or invertebrates would occur. Limited indirect impacts may arise from effects on predators or prey.

Assessment

Review of the literature suggests that mortality or injury to plankton would occur in the immediate vicinity of the airgun sound source within metres of the firing airguns. Impacts would thus be of high intensity at very close range (< 5 m from the airguns), but this would be no more significant than the effect of the wash from ships propellers and bow waves.

The spawning areas of the major pelagic species are distributed on the continental shelf and along the shelf edge extending from south of St Helena Bay to Mossel Bay on the South Coast (see Figure 4.11). They spawn inshore of the shelf edge and downstream of major upwelling centres (particularly on the Agulhas Bank), in spring and summer (main spawning season typically extending from October to early December) and their eggs and larvae are subsequently carried around Cape Point and up the coast in northward flowing surface waters. Key spawning areas and northward egg and larval drift thus occur well inshore of the proposed exploration licence area, and ichthyoplankton abundance in these offshore oceanic waters is expected to be extremely low. It should, however, be noted that a survey commencing in the summer of 2017 (Q1/Q2) would fall outside the main spawning season).

The proposed exploration licence area lies well offshore of the Cape Peninsula and Cape Columbine upwelling cells. These offshore areas are characterised by diminished phytoplankton biomass due to the predominance of nutrient-poor oceanic waters. A deficiency of phytoplankton results in poor feeding conditions for micro-, meso- and macrozooplankton, and for ichthyoplankton. Phytoplankton, zooplankton and ichthyoplankton abundances in the proposed exploration licence area are thus expected to be low. In addition, as plankton distribution is naturally temporally and spatially variable and natural mortality rates are high, any impacts would be of low to negligible intensity across the proposed exploration licence area and for the duration of the survey (short-term).

Considering the spatial extent of the spawning areas and the anticipated timing of the proposed survey, the overall potential impact of seismic noise on plankton (for both seismic survey plan alternatives) is considered to be localised and of very low intensity in the short-term. Thus this potential impact is considered to be **INSIGNIFICANT** with and without mitigation (see Table 5.10).

Mitigation

No mitigation measures are deemed necessary.

Table 5.10: Impact of seismic noise on plankton.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	No mitigation is considered necessary.
Duration	Short-term	
Intensity	Very Low	
Significance	**Insignificant**	
Status	Negative	
Probability	Probable	
Confidence	Medium	
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on plankton include other multi-beam bathymetry and seismic survey activities off the South-West Coast (e.g. the proposed multi-beam bathymetry survey in the proposed exploration licence area, as well as Rhino's proposed seismic and multi-beam bathymetry surveys in various licence blocks adjacent to the coast). Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

5.2.2 POTENTIAL IMPACTS TO MARINE INVERTEBRATES

Description of impact

Most marine invertebrates do not possess hearing organs that perceive sound pressure, although many have mechanoreceptors or statocyst organs that are sensitive to hydroacoustic disturbances. Potential impacts of seismic pulses on invertebrates could include physiological injury and behavioural avoidance of the seismic survey area. Masking of environmental sounds and indirect impacts due to effects on predators or prey have not been documented and are highly unlikely.

Assessment

Physiological injury and mortality

Although there is little published information on the effects of seismic surveys on invertebrate fauna, lethal and sub-lethal effects have been observed under experimental conditions. It has been postulated, however, that shellfish, crustaceans and most other invertebrates can only hear seismic survey sounds at very close range (< 15 m away). This implies that only surveys conducted in very shallow water would have any detrimental effects on invertebrates associated with the seabed. However, as the survey would be conducted in excess of 3 000 m depth, the received noise at the seabed would be within the far-field range and outside of distances at which physiological injury of these invertebrates would be expected. The potential impact of seismic noise on physiological injury or mortality of benthic invertebrates is deemed to be of zero to very low intensity across the survey area and for the survey duration. Thus this potential impact is considered to be **INSIGNIFICANT** with and without mitigation (see Table 5.11).

Pelagic invertebrates that may be encountered in the proposed exploration licence area include the colossal squid and the giant squid, although the likelihood of encounter is extremely low. Both are deep dwelling species, with the colossal squid's distribution confined to the entire circum-Antarctic Southern Ocean, while the giant squid is usually found near continental and island slopes all around the world's oceans. Although a causative link to seismic surveys has not been established with certainty, giant squid strandings coincident with seismic surveys have been reported, the animals all having severe internal injuries indicative of having ascended from depth too quickly. The potential impact of seismic noise on physiological injury or mortality of

pelagic invertebrates is consequently deemed of high intensity across the survey area (both alternatives) and for the survey duration. However, based on the low numbers expected in the proposed exploration licence area and low probability of encounter, the impact is considered to be of **VERY LOW** significance with and without mitigation (see Table 5.11).

Behavioural avoidance of seismic survey areas

There is also little published information on the effects of seismic surveys on the response of invertebrate fauna to seismic impulses. Limited avoidance of airgun sounds may occur in mobile neritic and pelagic invertebrates and is deemed to be of low intensity. Of the marine invertebrates only cephalopods are receptive to the far-field sounds of seismic airgun arrays. Although consistent avoidance has not been reported, behavioural changes have been observed at 2 to 5 km from an approaching seismic source, so avoidance of the survey area by squid may occur for the duration of the survey. As the survey would be conducted in excess of 3 000 m depth, the received noise at the seabed would be within the far-field range and outside of distances at which avoidance by benthic invertebrates would be expected.

The potential impact of seismic noise on invertebrate behaviour (mainly cephalopods) is consequently deemed of low intensity across the survey area (both alternatives) for the survey duration. Thus this potential impact is considered to be **VERY LOW** with and without mitigation (see Table 5.11).

Mitigation

No mitigation measures are deemed necessary.

Table 5.11: Impact of seismic noise on marine invertebrates.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Physiological injury		
Extent	Local	No mitigation is considered necessary.
Duration	Short-term	
Intensity	Very Low (benthic) to High (pelagic)	
Significance	**Insignificant (benthic) to Very Low (pelagic)**	
Status	Negative	
Probability	Improbable (benthic) to Probable (pelagic)	
Confidence	Medium	
Behavioural avoidance		
Extent	Local	No mitigation is considered necessary.
Duration	Short-term	
Intensity	Low	
Significance	**Very Low**	
Status	Negative	
Probability	Probable	
Confidence	Medium	
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on the marine invertebrates include other multi-beam bathymetry and seismic survey activities off the South-West Coast (e.g. the proposed multi-beam bathymetry survey in the proposed exploration licence area, as well as Rhino's proposed seismic and multi-beam bathymetry surveys in various licence blocks adjacent to the coast). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause	Low	

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
irreplaceable loss of resources		
Degree to which impact can be mitigated	None	

5.2.3 POTENTIAL IMPACTS ON FISH

The potential impact of seismic noise on fish larvae is discussed under Section 5.2.1 above and this section discusses the impact on adult fish only.

Description of impact

A review of the available literature suggests that potential impacts of seismic pulses to fish species (including sharks) could include physiological injury / mortality, behavioural avoidance of seismic survey area, masking of environmental sounds and communication, and indirect impacts due to effects on predators or prey.

Assessment

Impacts on fish are summarised in Table 5.12.

Physiological injury and mortality

The greatest risk of physiological injury or mortality from seismic sound sources is for species that establish home ranges on shallow-water reefs or congregate in inshore waters to spawn, and those displaying an instinctive alarm response to hide on the seabed or in the reef rather than flee. Large demersal or reef-fish species with swim-bladders are also more susceptible than those without this organ. Such species may suffer severe hearing damage and the adverse effect may intensify and last for a considerable time after the termination of the sound source. However, as the proposed exploration licence area is located more than 190 km offshore in water depths in excess of 3 000 m, the received noise by demersal species at the seabed would be within the far-field range, and outside of distances at which physiological injury or avoidance would be expected. Thus the potential physiological impact on demersal and nearshore reef species would be **INSIGNIFICANT**, as they would only be affected in the far-field range, if at all.

The most likely fish species to be encountered in the proposed exploration licence area are the large pelagic species (e.g. the highly migratory tuna and billfish), which occur offshore of the 200 m isobath. As the survey is scheduled during the summer of 2017 (Q1/Q2) there is a high likelihood that the survey vessel would encounter tuna and billfish *en route* to their seasonal aggregation around the seamounts (specifically Child's Bank off Namaqualand and Tripp Seamount off southern Namibia). However, given the high mobility of most large pelagic species, it is assumed that the majority of fish species would avoid seismic noise at levels below those where physiological injury or mortality would result. Furthermore, in many of the large pelagic species, the swim-bladders are either underdeveloped or absent, and the risk of physiological injury through damage of this organ is therefore lower.

Possible injury or mortality in pelagic species could occur on initiation of a sound source at full pressure in the immediate vicinity of fish, or where reproductive or feeding behaviour override a flight response to seismic survey sounds. As there are various banks (e.g. Brown's Banks) and seamounts (e.g. Protea, Simpson and Argentina Seamounts) in the vicinity of the proposed exploration licence area (see Figure 4.3), there is a likelihood of encountering feeding aggregations of large pelagic species. The potential physiological impact on pelagic species is consequently deemed of high intensity across the survey area (both alternatives) for the survey duration. The impact is, therefore, considered to be of **low** significance without mitigation and of **VERY LOW** significance with mitigation measures (see Table 5.12).

Behavioural avoidance of seismic survey areas

Behavioural responses to seismic sounds have been documented at received levels of about 160 dB re 1 μPa @ 1m. Responses are varied and include avoidance of seismic survey areas, changes in depth distribution and schooling behaviour, startle response and changes in feeding behaviours of some fish. Behavioural effects are generally short-term with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound. However, there have been recent concerns that seismic survey activities in southern Namibia and the Australian Bight are responsible for substantially reduced catches of albacore and southern bluefin tuna. According to other sources, it is probable that fluctuating tuna catches are caused by a number of variables (e.g. fluctuation of fishing effort, general decline in longfin tuna abundance and changes in fishing strategy) (Attwood 2014). This is supported by the briefing paper prepared by Dr Gabi Schneider of the GSN (Schneider & Muyongo 2013) which states that a simple correlation between seismic survey acquisition in Namibian waters and reduced tuna catches cannot be inferred and more in-depth research is required.

The potential impact on fish behaviour could therefore be of high intensity (particularly in the near-field of the airgun array), but limited to the survey area in the short-term, with any effects unlikely to persist for more than a few days after termination of the seismic source. Consequently it is considered to be of **medium** significance without mitigation and of **LOW** significance with mitigation.

Spawning and reproductive success

Fish populations could be further impacted if behavioural responses result in deflection from migration paths or disturbance of spawning. If fish on their migration paths or spawning grounds are exposed to powerful external forces, they may be disturbed or even cease spawning altogether thereby affecting recruitment to fish stocks. The magnitude of effect in these cases would depend on the biology of the species and the extent of the dispersion or deflection. Studies undertaken experimentally exposing the eggs and larvae of various fish species to airgun sources, however, identified mortalities and physiological injuries at very close range (< 5 m) only.

The proposed exploration licence area is located well offshore of key spawning areas (see Figure 4.11). In addition, it is anticipated that the survey would commence in the summer of 2017 (Q1/Q2) and thus outside of the main spawning season, which typically extends from October to early December. Considering the wide range over which the potentially affected species occur, the spatial extent of spawning relative to the survey area, survey timing, the relatively short duration of the seismic survey and that migration routes do not constitute narrow restricted paths, the impact is considered to be of **INSIGNIFICANT** significance both with and without mitigation.

Masking of environmental sounds and communication

Fish deliberately produce sounds by three processes, including by stridulation (caused by friction of adjacent skeletal components), by vibration of the swimbladder, or by rapid head movement. Chorus sounds range across frequencies higher than the majority of produced seismic survey energy, but some frequency overlap may occur.

Communication and the use of environmental sounds by fish in the offshore environment off the South-West Coast of South Africa are unknown. However, impacts arising from masking of sounds are expected to be of low intensity due to the duty cycle of seismic surveys (one firing every 10 to 15 seconds) in relation to the more continuous biological noise. Furthermore, as the proposed survey would be conducted at depths in excess of 3 000 m, any effects on demersal fish species would be in the far field. Such impacts would occur across the survey area (both alternatives) in the short-term, and are consequently considered of **VERY LOW** significance with and without mitigation.

Indirect impacts due to effects on predators or prey

The assessment of indirect effects of seismic surveys on fish is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine and would depend on the diet make-up of the fish species concerned and the effect of seismic surveys on the diet species. Indirect impacts of seismic surveying could include attraction of predatory species such as sharks to small pelagic fish species stunned by seismic noise. In such cases where feeding behaviour overrides a flight response to seismic survey sounds, injury or mortality could result if the seismic sound source is initiated at full power in the immediate vicinity of the feeding predators. Little information is available on the feeding success of large migratory species in association with seismic survey noise.

There are a couple of deep water reefs, around which large pelagic species are known to aggregate to feed, that occur in the vicinity of the proposed exploration licence area, including Protea Seamount and Argentina Seamount (on the eastern boundary), and Simpson Seamount (on the western boundary) (see Figure 4.3). However, considering the extensive range over which large pelagic fish species feed in relation to the survey area (both alternatives) and the low abundance of pelagic shoaling species that constitute their main prey, the impact is likely to be of low intensity in the short-term. The significance of impact is consequently deemed **VERY LOW** with or without mitigation.

Mitigation

- Implement a "soft-start" procedure of a minimum of 20 minutes' duration when initiating airgun tests (a single or a number of airguns at full power)[2] and / or seismic surveying. This requires that the sound source be ramped from low to full power rather than initiated at full power, thus allowing a flight response to outside the zone of injury or avoidance. Such a "soft-start" procedure would allow fish to move out of the survey areas and thus avoid potential physiological injury as a result of seismic noise;
- All breaks in airgun firing of longer than 20 minutes must be followed by a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing. Breaks of shorter than 20 minutes should be followed by a "soft-start" of similar duration; and
- Airgun firing should be terminated if mass mortalities of fish as a direct result of shooting are observed.

Table 5.12: Impact of seismic noise on fish.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Physiological injury		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Very Low (benthic) to High (pelagic)	Very Low (benthic) to Low - Medium (pelagic)
Significance	**Insignificant (benthic) to Low (pelagic)**	**INSIGNIFICANT (benthic) to VERY LOW (pelagic)**
Status	Negative	Negative
Probability	Improbable (benthic) to Probable (pelagic)	Improbable (benthic and pelagic)
Confidence	Medium	Medium
Behavioural avoidance		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	High	Low
Significance	**Medium**	**LOW**
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium

[2] Note: If the intention is to test a single airgun on low power then a "soft-start" is not required.

Spawning and reproductive success		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Very Low	Very Low
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Masking of environmental sounds and communication		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Very Low
Significance	**Very Low**	**Very LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low
Indirect impacts		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Very Low
Significance	**Very Low**	**Very LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on fish include other multi-beam bathymetry and seismic survey activities off the South-West Coast (e.g. the proposed multi-beam bathymetry survey in the proposed exploration licence area, as well as Rhino's proposed seismic and multi-beam bathymetry surveys in various licence blocks adjacent to the coast). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None to Low	

5.2.4 POTENTIAL IMPACTS ON SEABIRDS

Description of effect

Among the marine avifauna occurring along the South-West Coast of South Africa, it is only the species that feed by plunge-diving or that rest on the sea surface (non-diving), which may be affected by the underwater noise of seismic surveys. Potential impacts of seismic pulses to seabirds could include physiological injury, behavioural avoidance of seismic survey areas and indirect impacts due to effects on predators or prey.

Assessment

Impacts on seabirds are summarised in Table 5.13 (diving seabirds) and 5.14 (non-diving seabirds).

Physiological injury and mortality

Diving seabirds are all highly mobile and would be expected to flee from approaching sound sources at distances well beyond those that could cause physiological injury, although initiation of a sound source at full

power in the vicinity of diving seabirds could result in injury or mortality where feeding behaviour override a flight response to seismic survey sounds.

Of the plunge diving species that occur along the South- West Coast, only the Cape gannet regularly feeds as far offshore as 100 km. African penguins are known to forage as far as 60 km offshore, with the rest foraging in nearshore areas up to 40 km from the coast. The closest nesting grounds to the proposed exploration licence area are at the Saldanha Bay islands (over 300 km north), Dassen Island (±285 km north), Seal Island (±210 km north-north-east), Boulders Beach (200 km) and Dyer Island (±195 km north-east). There is, therefore, a low likelihood of encountering the majority of seabirds in the proposed exploration licence area. Other pelagic seabirds (e.g. albatrosses, petrels, shearwaters, etc.) that dive for their prey may, however, still be encountered.

The potential for physiological impact of seismic noise on diving bird species is considered to be of high intensity and would be limited to the survey area (both alternatives) and survey duration. The potential physiological impact on diving species is considered to be of **low** significance without mitigation and of **VERY LOW** significance with mitigation.

No physiological injury or mortalities impacts would occur in non-diving seabirds, as flying seabirds are highly mobile and would be expected to flee from approaching seismic noise sources at distances well outside of that that could cause physiological injury. The potential physiological impact on non-diving species is considered to be **INSIGNIFICANT**.

Behavioural avoidance of seismic survey areas

There is a very low likelihood of the survey encountering foraging gannets and penguins. However, other pelagic seabirds are likely to be encountered. Diving seabirds would be expected to hear seismic sounds at considerable distances as they have good hearing at low frequencies (which coincide with seismic shots). Avoidance behaviour by diving seabirds would only last for as long as the seismic survey continues and would be limited to the vicinity of the operating airgun within the survey area.

The impact is likely to be of medium to high intensity in the short-term, as avoidance behaviour would only last for as long as the seismic survey continues. The potential impact on the behaviour of diving seabirds is considered to be of **low** significance without mitigation and of **VERY LOW** significance with mitigation.

The behavioural impact of seismic noise on non-diving seabirds is considered to be **INSIGNIFICANT**.

Indirect impacts due to effects on predators or prey

The assessment of indirect effects of seismic surveys on diving seabirds is limited by the complexity of trophic pathways in the marine environment and depends on the diet make-up of the bird species concerned and the effect of seismic surveys on the diet species. No information is available on the feeding success of seabirds in association with seismic survey noise. With few exceptions, most plunge-diving birds forage on small shoaling fish prey species relatively close to the shore and are unlikely to feed extensively in offshore waters that would be targeted during the seismic survey. The broad ranges of potential fish prey species (in relation to potential avoidance patterns of seismic surveys of such prey species) and extensive ranges over which most seabirds feed suggest that indirect impacts would be **VERY LOW** with and without mitigation.

Mitigation

Recommendations to mitigate the potential impacts on seabirds are the same as recommended for fish (refer to Section 5.2.3). In addition, the following is recommended:

- It is recommended that an area with a radius of 500 m be scanned for the presence of diving seabirds prior to the commencement of “soft-starts”. “Soft-start” procedures must only commence once it has been confirmed (visually during the day and using night-vision/infra-red binoculars at night) that there is no significant diving seabird activity within 500 m of the vessel;

- Daylight observations of the survey area should be carried out by an independent onboard Marine Mammal Observer (MMO). Seabird incidence and behaviour should be recorded. Any attraction of predatory seabirds by mass disorientation and stunning of fish as a result of seismic survey activities, and incidents of feeding behaviour near the hydrophone streamer, should be recorded;
- If obvious mortality or injuries to seabirds are observed, the survey should be terminated temporarily until such time as the MMO confirms that the risk to diving seabirds has been significantly reduced. It is important that the MMO's decisions to terminate firing are made confidently and expediently. In this light it is suggested that MMOs advise when the survey is to be terminated and a log of all termination decisions is kept (for inclusion in both daily and close out reports);
- Lighting on board the survey vessel should be reduced to minimum safety levels to minimise stranding of pelagic seabirds on the survey vessel at night. All stranded seabirds must be retrieved and released during daylight hours; and
- All data recorded by the MMO should form part of a survey close-out report. Furthermore, daily reports should be forwarded to the necessary stakeholders to ensure compliance with the mitigation measures.

Table 5.13: Impact of seismic noise on diving seabirds.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Physiological injury		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	High	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium
Behavioural avoidance		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Medium to High	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium
Indirect impacts		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on diving seabirds include other multi-beam bathymetry and seismic survey activities off the South-West Coast (e.g. the proposed multi-beam bathymetry survey in the proposed exploration licence area, as well as Rhino's proposed seismic and multi-beam bathymetry surveys in various licence blocks adjacent to the coast). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None to Low	

Table 5.14: Impact of seismic noise on non-diving seabirds.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Physiological injury		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Zero	Zero
Significance	**Insignificant**	**Insignificant**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
Behavioural avoidance		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Zero	Zero
Significance	**Insignificant**	**Insignificant**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on non-diving seabirds include other multi-beam bathymetry and seismic survey activities off the South-West Coast (e.g. the proposed multi-beam bathymetry survey in the proposed exploration licence area, as well as Rhino's proposed seismic and multi-beam bathymetry surveys in various licence blocks adjacent to the coast). Cumulative impact is considered to be of INSIGNIFICANT.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None	

5.2.5 POTENTIAL IMPACTS ON TURTLES

Description of impact

The most likely impacts on turtles from seismic survey operations include physiological injury (including disorientation) or mortality from seismic noise and collision with or entanglement in towed seismic apparatus, behavioural avoidance of seismic survey areas and indirect effects due to the effects of seismic sounds on prey species.

Assessment

Although three species of turtles potentially occur it the study area, it is only the Leatherback turtle that is likely to be encountered in deeper waters. However, abundances are likely to be extremely low comprising occasional migrants. Impacts on turtles are summarised in Table 5.15.

Physiological injury and mortality

The overlap of turtle hearing sensitivity with the higher frequencies produced by airguns suggest that turtles may be considerably affected by seismic noise. Recent evidence, however, suggests that turtles only detect airguns at close range (<10 m) or are not sufficiently mobile to move away from approaching airgun arrays (particularly if basking). Initiation of a sound source at full power in the immediate vicinity of a swimming or basking turtle would be expected to result in physiological injury. The potential impact could therefore be of high intensity, but remain within the short-term.

There is also the potential for collision between adult turtles and the seismic vessel or entanglement of turtles in the towed seismic equipment and surface floats. The potential impact on turtles is highly dependent on the abundance and behaviour of turtles in the survey area at the time of the survey. As the breeding areas for Leatherback turtles occur over 3 000 km to north-west of the survey area (in Republic of Congo and Gabon) and over 1 500 km north-east of the survey area (in northern KwaZulu-Natal), turtles encountered during the survey are likely to be migrating vagrants and impacts through collision or entanglement would be of low intensity and short-term.

The potential physiological impact on turtles and the potential for mortality through collision or entanglement is considered to be of **low** significance without mitigation and **VERY LOW** significance with mitigation.

Behavioural avoidance of seismic survey areas

Behavioural changes by turtles in response to seismic sounds range from startle response and avoidance by fleeing an operating sound source, through to apparent lack of movement away from active airgun arrays. The impact of seismic sounds on turtle behaviour is of high intensity, but would persist only for the duration of the survey, and be restricted to the survey areas.

Given the general extent of turtle migrations relative to seismic survey target grid and the low abundance of turtles in the area, the impact of seismic noise on turtle migrations is deemed to be of **low** significance without mitigation and **VERY LOW** with mitigation.

Masking of environmental sounds and communication

Breeding adults of sea turtles undertake large migrations between distant foraging areas and their nesting sites (which on the African West coast are >3 000 km north-west of survey area in Republic of Congo and Gabon, and over 1 500 km north-east of the survey area in northern KwaZulu-Natal on the East Coast). Although it is speculated that turtles may use acoustic cues for navigation during migrations, information on turtle communication and the effect of seismic noise is lacking. However, their low abundance in the survey area would suggest that the significance of this potential impact (should it occur) would be **INSIGNIFICANT**.

Indirect impacts due to effects on predators or prey

Leatherback turtles feed on jellyfish, which are pelagic and, therefore, have a naturally temporally and spatially variable distribution. Adverse modification of such pelagic food sources would thus be insignificant, and the effects of seismic surveys on the feeding behaviour of turtles is thus expected to be **VERY LOW** both with and without mitigation.

Mitigation

Recommendations to mitigate the potential impacts on turtles are the same as recommended for seabirds (refer to Section 5.2.4). In addition, the following is recommended:

- The MMO should record incidence of turtles and their responses to seismic shooting, including position, distance from the vessel, swimming speed and direction and obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns, etc.). It is important that the identification and behaviour of the animals are recorded accurately along with sound levels. MMOs should therefore have experience in identification and differentiation of marine species,

as well as observation techniques. The observer should also record (1) all "soft-starts" and pre-firing observation regimes, (2) incidence of feeding behaviour of predators within the hydrophone streamers, and (3) sightings of any injured or dead protected species, regardless of whether the injury or death was caused by the seismic vessel itself. If the injury or death was caused by a collision with the seismic vessel, the date and location (coordinates) of the strike and the species or a description of the animal should be recorded;

- If turtles are observed within 500 m of the airguns during the pre-watch period, the "soft-start" procedure should be delayed until such time as this area is clear of turtles or 30 minutes after they are last seen;
- Seismic shooting must be temporarily terminated when obvious negative changes to turtle behaviour is observed, if animals are observed within 500 m of the operating airgun and appear to be approaching the firing airgun or there is mortality or injuries to turtles as a direct result of the survey; and
- 'Turtle-friendly' tail buoys should be used by the survey contractor or existing tail buoys should be fitted with either exclusion or deflector 'turtle guards'.

Table 5.15: Impact of seismic noise on turtles.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Physiological injury		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	High	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium
Behavioural avoidance		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	High	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High
Masking of environmental sounds and communication		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Very Low	Very Low
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low
Indirect impacts		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Very Low
Significance	**Very Low**	**Very LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on turtles include other multi-beam bathymetry and seismic survey activities off the South-West Coast (e.g. the proposed multi-beam bathymetry survey in the proposed exploration licence area, as well as Rhino's proposed seismic and multi-beam bathymetry surveys in various licence blocks adjacent to the coast). Cumulative impact is considered to be of VERY LOW to LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None to Low	

5.2.6 POTENTIAL IMPACTS ON SEALS

Description of impact

Review of the available literature suggests that potential impacts of seismic pulses on Cape fur seals could include physiological injury, behavioural avoidance of seismic survey areas, masking of environmental sounds and underwater communication and indirect impacts due to effects on predators or prey.

Assessment

The Cape fur seal is the only species of seal resident along the West and South-West Coast, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs (see Figure 4.15). There are a number of Cape fur seal colonies within the broader study area, including Paternoster Rocks and Jacobs Reef at Cape Columbine, Robbesteen near Koeberg and Seal Island in False Bay. Non-breeding colonies occur at Paternoster Point at Cape Columbine and Duikerklip in Hout Bay. These colonies all fall well outside of the proposed exploration licence area. The nearest breeding colony is at Seal Island in False Bay, approximately 210 km to the north-east of the proposed exploration licence area. As seals are known to forage up to 120 nm (approximately 220 km) offshore, it is unlikely that seals would be encountered in the proposed exploration licence area. Impacts on seals are summarised in Table 5.16.

Physiological injury and mortality

The potential for physiological injury to seals from seismic noise is expected to be low as it is assumed that highly mobile creatures such as fur seals would avoid severe sound sources at levels below those at which discomfort occurs, although Cape fur seals have been recorded to approach operational seismic survey gear. Their tendency to swim at or near the surface would expose them to reduced sound levels when in close proximity to an operating airgun array.

The potential impact of physiological injury to seals as a result of seismic noise is therefore deemed to be of medium intensity and would be limited to the survey area, although injury could extend beyond the survey duration. However, as the survey area is located offshore of the foraging range of seals, encounters are highly unlikely and the significance of the impact is thus rated as **VERY LOW** with and without mitigation.

Behavioural avoidance of seismic survey areas

Although partial avoidance (to less than 250 m) of operating airguns has been recorded for some seal species, Cape fur seals appear to be relatively tolerant to loud noise pulses and, despite an initial startle reaction, individuals quickly revert back to normal behaviour.

The potential avoidance of seismic survey areas is thus considered to be of low to medium intensity and limited to the survey area (both alternatives) and duration. The potential impact of seal behaviour in response to seismic surveys is considered to be of **VERY LOW** significance with or without mitigation.

Masking of environmental sounds and communication

The fact that seals have acute underwater directional hearing suggests that sound is used in orientating underwater. True seals have been shown to use underwater vocalisation in both orientation and communication. The use of underwater sounds for environmental interpretation and communication by Cape fur seals is unknown, although masking is likely to be limited by the low duty cycle of seismic pulses (one pulse every 10 to 15 seconds). As encounters with seals in the offshore area are highly unlikely, the impact of masking is considered **INSIGNIFICANT** with and without mitigation.

Indirect impacts due to effects on predators or prey.

The assessment of indirect effects of seismic surveys on Cape fur seals is limited by the complexity of trophic pathways in the marine environment and depends on the diet make-up of the species (and the flexibility of the diet) and the effect of seismic surveys on the diet species. The broad ranges of fish prey species (in relation to the avoidance patterns of seismic surveys of such prey species) and the extended foraging ranges of Cape fur seals suggest that indirect impacts due to effects on predators or prey in the proposed exploration licence area would be **INSIGNIFICANT** with and without mitigation.

Mitigation

Recommendations to mitigate the potential impacts on seals are similar to that recommended for turtles (refer to Section 5.2.5), except that:

- "Soft-start" procedures should be allowed to commence for at least a 20-minute duration, if after a period of 30 minutes seals are still within 500 m of the airguns;
- Airgun firing should be terminated temporarily if any obvious negative changes to seal behaviour is observed in close proximity to firing airguns or there is any obvious mortality or injuries to seals as a direct result of the survey; and
- The MMO's daily report should record general seal activity, numbers and any noticeable change in behaviour.

Table 5.16: Impact of seismic noise on seals.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Physiological injury		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Medium	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Behavioural avoidance		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low to Medium	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Masking of environmental sounds and communication		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Indirect impacts		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**Very LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on seals include other multi-beam bathymetry and seismic survey activities off the South-West Coast (e.g. the proposed multi-beam bathymetry survey in the proposed exploration licence area, as well as Rhino's proposed seismic and multi-beam bathymetry surveys in various licence blocks adjacent to the coast). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None to Very Low	

5.2.7 Potential impact on cetaceans (whales and dolphins)

Description of impact

Review of the available literature suggests that potential impacts of seismic pulses on cetaceans (whales and dolphins) could include physiological injury, behavioural avoidance of seismic survey areas, masking of environmental sounds and communication, and indirect impacts due to effects on predators or prey.

Assessment

A wide diversity of cetaceans (between 28 and 32 species) may be encountered within the proposed exploration license area, with varying likelihood of being encountered (see Section 4.2.9.1). The terms "whales" and "dolphins" relate to the size of cetacean species, but the group can best be divided into odontocete (toothed whales and dolphins) that are resident or migratory and mysticete (filter-feeding baleen whales) that are largely migratory. Marked differences occur in the hearing of odontocete cetaceans and mysticete cetaceans, with mysticete hearing centred at below 1 kHz, while odontocete hearing is centred at frequencies of between 10 and 100 kHz. These species may react to seismic shots at long ranges, but hearing damage from seismic shots is only likely to occur at close range.

Impacts on mysticete cetaceans and odontocete cetaceans are summarised in Tables 5.17 and 5.18, respectively.

Physiological injury

Physiological injury to cetaceans can result from exposure to high sound levels through a number of avenues, including trauma to both auditory and non-auditory tissues as shifts of hearing threshold (as permanent (PTS) or temporary threshold shifts (TTS)), direct tissue damage, acoustically induced decompression sickness or other non-auditory physiological effects.

There is little information available on the levels of noise that would result in physiological injury to whales and dolphins. No PTS have been recorded in cetaceans. TTS have been induced in captive dolphin species at received levels higher than 190 dB, although it should be noted that the limited duration of seismic survey pulses would limit the onset of TTS to far higher levels. Available information suggests that an animal would need to be in close proximity to operating airguns to suffer physiological injury, and being highly mobile it is assumed that they would avoid sound sources at distances well beyond those at which injury is likely to occur. Deep-diving cetacean species (e.g. sperm whale) may, however, be more susceptible to acoustic injury, particularly in the case of seafloor-focussed seismic surveys, where the downward focussed impulses could trap deep diving cetaceans within the survey pulse, as escaping towards the surface would result in exposure to higher sound level pulses.

Available information also suggests that baleen whales and the larger toothed whales would be very receptive to the sound produced by seismic airgun arrays and consequently these groups may be more affected by this type of disturbance than smaller toothed whales. There is a wide diversity of cetaceans that may be encountered within the proposed exploration license area, including year round resident species and those migrating through the area to mate and breed. The proposed exploration licence area lies within the migration paths of humpback and southern right whales, but offshore of areas frequented by southern right whales for mating and breeding. The majority of humpback whales on the West Coast are migrating past the southern African continent to breeding grounds off Angola and the Gulf of Guinea, while those migrating up the East Coast of heading to breeding grounds of Mozambique and Madagascar. As the survey would be undertaken during a period that avoids the main cetacean migration / breeding period (beginning of December to end of May) encounters with migrating whales should be minimal, although some whales on their return journey in December may still be encountered.

The potential impact of physiological injury to both mysticetes and resident odontocetes as a result of high-amplitude seismic sounds is deemed to be of high intensity, but would be limited to the immediate vicinity of operating airguns within the survey area (both alternatives). The potential impact on mysticetes is, however, considered to be slightly higher than that on odontocetes due to offshore population of Bryde's whales whose seasonality on the West Coast is opposite to the majority of the balaenopterids with abundance likely to be highest in the broader study area from January to March and the possibility of encountering migrating baleen whales in the proposed exploration licence area. The potential impact on mysticetes is considered to be of **medium** significance before mitigation and **LOW** significance with mitigation, while the impact on odontocetes is considered to be of **low** significance before mitigation and **VERY LOW** significance with mitigation.

Behavioural avoidance of seismic survey areas

Mysticete cetaceans appear to avoid impulsive sounds of received levels greater than 150 to 180 dB, while subtle behavioural responses have been noted at levels of above 120 dB. Although behavioural avoidance of seismic noise by baleen whales is highly likely, such avoidance is generally considered of minimal impact in relation to the distances of migrations of the majority of mysticete cetaceans. As noted above, the survey area overlaps with the migration route of both humpback and southern right whales. However, as the proposed surveys are scheduled outside of the main winter migration periods (beginning of June to end of November), interactions with migrating whales should be low.

Of greater concern than general avoidance of migrating whales is avoidance of critical feeding or breeding habitats. Displacement from a critical habitat is particularly important if the sound source is located at an

optimal feeding or breeding ground or areas where mating, calving or nursing occurs. The proposed exploration licence is located well offshore of important southern right mating, calving and nursery grounds off the West and South coasts, as well as summer feeding grounds around Cape Columbine utilised by localised resident populations of humpback and southern right whales. Other baleen whale species are also found year round or have seasonal occurrences, which are not well known, but existing data shows year-round presence of mysticetes.

Considering the distribution ranges of most species of cetaceans and the offshore location of the proposed exploration licence area in relation to important breeding and feeding grounds, the potential impact of behavioural avoidance of the seismic survey area (both alternatives) by mysticete cetaceans is considered to be of high intensity across the survey area and for the duration of the survey. The potential impact of behavioural avoidance of the proposed exploration licence area and key migratory routes by mysticete cetaceans is considered to be of **medium** significance before mitigation and **LOW** significance after mitigation.

There is very limited information on the response of odontocete cetaceans to seismic surveys. No seasonal patterns of abundance are known for odontocetes occupying the proposed exploration licence area, but several species are considered to be year round residents. Furthermore, a number of toothed whale species have a more pelagic distribution thus occurring further offshore, with species diversity and encounter rates likely to be highest on the shelf slope. The potential impact of behavioural avoidance of the seismic survey area (both alternatives) by odontocetes is considered to be of medium intensity across the survey area and for the duration of the survey. The overall significance varies between species, and consequently ranges between **low** and **very low** before mitigation and **VERY LOW** with mitigation.

Masking of environmental sounds and communication

Mysticete cetaceans appear to vocalise almost exclusively within the frequency range of the maximum energy of seismic survey noise, while odontocete cetaceans vocalise at frequencies higher than these. Since noise in the mid-frequency range can travel far, masking of communication sounds produced by whistling dolphins and blackfish[3] is likely. In the migratory baleen whale species, vocalisation increases once they reach the breeding grounds (the closest being well inshore of the proposed exploration licence area) and on the return journey in November / December when accompanied by calves. As the survey would be undertaken during a period that avoids the main cetacean migration / breeding period (beginning of December to end of May) encounters with migrating whales should be minimal, although some whales on their return journey may still be encountered. However, masking of communication signals is likely to be limited by the low duty cycle of seismic pulses (one firing impulse every 10 to 15 seconds). Consequently the intensity of impact on mysticetes is likely to be medium over the survey area (both alternatives) and of short duration, but high in the case of odontocetes and mother-calf pairs of baleen whales on their return migration. Whereas for mysticetes the significance is rated as **LOW** without mitigation and **VERY LOW** with mitigation, for odontocetes it is rated as **medium** without mitigation and **LOW** with mitigation.

Indirect impacts due to effects on predators or prey.

The majority of mysticete cetaceans would undertake little feeding within breeding ground waters and rely on blubber reserves for the migrations from the feeding grounds. In addition, the proposed exploration licence is located well to the south (approximately 350 km) of the summer feeding grounds around Cape Columbine utilised by localised resident populations of humpback and southern right whales. Therefore, the indirect effect on their food source is considered to be **INSIGNIFICANT**.

The assessment of indirect effects of seismic surveys on resident odontocete cetaceans is limited by the complexity of trophic pathways in the marine environment and depends on the diet make-up of the species

[3] The term blackfish refers to the delphinids: Melon-headed whale, Killer whale, Pygmy Killer Whale, False Killer Whale, Long-finned Pilot Whale and Short-finned Pilot Whale.

(and their flexibility in their diet) and the effect of seismic surveys on the diet species. However, it is expected that both fish and cephalopod prey of toothed whales and dolphins may be affected over limited areas. The broad ranges of prey species (in relation to the avoidance patterns of seismic surveys of such prey species) suggest that indirect impacts due to effects on prey would be **VERY LOW** before and after mitigation.

Mitigation

Recommendations to mitigate potential impacts on cetaceans are similar to that recommended for turtles (refer to Section 5.2.6). In addition, the following is recommended:

- The seismic survey should be planned to avoid the key cetacean migration and breeding period from the beginning of June to the end of November. However, in order to avoid whales (with calves) on their return journey potentially through the proposed exploration licence area, it is recommended that the exclusion period also include December. Thus the recommended survey period extends from the beginning of January to the end of May;
- The survey vessel must be fitted with Passive Acoustic Monitoring (PAM) technology, which detects animals through their vocalisations. As the proposed surveys would take place in waters deeper than 1 000 m depth where deep-diving sperm whales are likely to be encountered, it is recommended that PAM technology is used during both the pre-watch period and when the airguns are active (including "soft-starts", airgun tests and surveying). The PAM hydrophone streamer should ideally be towed behind the airgun array to minimise the interference of vessel noise, and should be fitted with two hydrophones to allow directional detection of cetaceans. In order to avoid unnecessary delays to the survey programme, it is recommended that a spare PAM cable and sensor are kept onboard should there be any technical problems with the system. However, if there is a technical problem with PAM during surveying, visual watches must be maintained by the MMO during the day and night-vision/infra-red binoculars must be used at night while PAM is being repaired;
- "Soft-start" procedures must only commence once it has been confirmed (visually and using PAM technology during the day and using only PAM technology at night or during periods of poor visibility) that there is no cetacean activity within 500 m of the vessel. This pre-watch period should be for at least 60 minutes[4] prior to the commencement of the "soft-start" procedures, so that deep- or long-diving species can be detected;
- If cetaceans are observed within 500 m of the airguns during the pre-watch period, the "soft-start" procedure should be delayed until such time as this area is clear of cetaceans, and should not begin until after the animals depart the 500 m exclusion zone or 30 minutes after they are last seen;
- All breaks in airgun firing of longer than 20 minutes must be followed by a 60-minute pre-shoot watch and a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing. In order to facilitate a more effective timing of proposed operations when surveying in deeper waters, the 60-minute pre-shoot watch can commence before the end of the survey line (whilst the airguns are still firing). Breaks of shorter than 20 minutes should be followed by a visual assessment for marine mammals within the 500 m mitigation zone (not a 60-minute pre-shoot watch) and a "soft-start" of similar duration;
- The use of the lowest practicable airgun volume should be defined by the operator and enforced;
- In terms of the Marine Living Resources Act, 1998 (No. 18 of 1998) it is illegal for any vessel to approach to or remain within 300 m of whales within South African waters without a permit or exemption. If the operator or seismic contractor are not able to comply with this restriction, it is recommended that an application be made to DEA for a permit or exemption; and
- Marine mammal incidence data and seismic source output data arising from the survey should be made available, if requested, to the Marine Mammal Institute, DEA, DAFF and PASA for analyses of survey impacts in local waters.

[4] The JNCC Guidelines state that the pre-watch period should be extended from 30 minutes to 60 minutes for deep-diving species when surveying in deeper water (>200 m).

Table 5.17: Impact of seismic noise on mysticete cetaceans (baleen whales).

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Physiological injury		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	High	Low to Medium
Significance	**Medium**	**LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium
Behavioural avoidance		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	High	Low
Significance	**Medium**	**LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High
Masking of environmental sounds and communication		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Medium	Low
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium
Indirect impacts		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Very Low	Very Low
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on mysticete cetaceans include other multi-beam bathymetry and seismic survey activities off the South-West Coast (e.g. the proposed multi-beam bathymetry survey in the proposed exploration licence area, as well as Rhino's proposed seismic and multi-beam bathymetry surveys in various licence blocks adjacent to the coast). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None to Low	

Table 5.18: Impact of seismic noise on odontocete cetaceans (toothed whales and dolphins).

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Physiological injury		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	High	Low to Medium
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium
Behavioural avoidance		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Medium	Low to Medium
Significance	**Very Low to Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High
Masking of environmental sounds and communication		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	High	Low
Significance	**Medium**	**LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium
Indirect impacts		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on odontocete cetaceans include other multi-beam bathymetry and seismic survey activities off the South-West Coast (e.g. Rhino's proposed seismic survey in various licence blocks adjacent to the coast). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None to Low	

5.3 IMPACTS OF A MULTI-BEAM BATHYMETRY SURVEY ON MARINE FAUNA

Impact description

Potential impacts of a multi-beam bathymetry survey on marine fauna (mainly cetaceans) could include physiological injury and behavioural avoidance of the survey area.

Impact assessment

There are significant differences in the effects of seismic and multi-beam surveys. Despite having similar sound levels to seismic surveys, the higher frequency emissions utilised in normal multi-beam operations tend to be dissipated to safe levels over a relatively short distance. The anticipated radius of influence of multi-beam sonar would thus be significantly less than that for an airgun array. Hence the most likely scenario for injury to an animal by acoustic equipment would be if the equipment were turned on full power while the animal was close to it.

Active sonar systems operate at frequency ranges >10 kHz, producing levels of sound pressure ranging from about 180 dB re 1µPa to 235 dB re 1µPa. Although both baleen and toothed whales would thus be expected to hear sonar signals at frequencies within their functional hearing range, the animals would only be affected if they were within the sonar beam below the survey vessel. Similarly, seals are also expected to hear sonar signals at frequencies within their functional hearing range if the animals pass through the cone of the sonar beam. Marine turtles appear to have their highest auditory sensitivity at frequencies of 250 to 700 Hz, and thus well below the frequency ranges typically used by oceanographic sonars.

The statistical probability of crossing a cetacean, seal or turtle with the narrow multi-beam fan several times, or even once, is very small. It is thus generally understood that in open coastal waters the effects of multi-beam sonars on marine fauna are negligible.

The potential physiological impact on marine fauna (mainly cetaceans) would be of low intensity across the survey area (within sonar beam below the survey vessel). The duration of the impact on the population would be limited to the short-term. The impact is therefore considered to be of **VERY LOW** significance with and without mitigation (see Table 5.19).

Mitigation measures

Despite the very low significance of potential impacts, the following mitigation measures, which are based on the Joint Nature Conservation Committee (JNCC) guidelines, are recommended for the proposed multi-beam bathymetry survey:

- MMO and PAM:
  - > Appoint an MMO for the duration of the survey.
  - > The MMO should conduct visual scans for the presence of diving birds, marine mammals and/or turtles around the survey vessel prior to the initiation of any acoustic impulses.
  - > The duties of the MMO would be to:
    - Monitor the survey pre-watch period;
    - Record sound levels, pre-watch sightings and “soft-start” procedures (where required);
    - Observe and record responses of diving birds, marine mammals and/or turtles to the multi-beam bathymetry survey. Data captured should include species identification, position (latitude/longitude), distance from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the survey activities; and
    - Request the temporary termination of survey, as appropriate. A log of all termination decisions must be kept for inclusion in both daily and “close-out” reports.
  - > PAM technology, which detects animals through their vocalisations, must be used for a source level greater than 190 dB re 1 µPa at 1 m when surveying at night or during adverse weather

conditions and thick fog. If there is a technical problem with PAM during nighttime surveying, night-vision/infra-red binoculars must be used; and

> The duties of the PAM operator would be similar to those of the MMO.

- For a source level less than 190 dB re 1 µPa at 1 m the following is recommended:
  > Surveying must only commence (subject to the need for a "soft-start") once it has been confirmed for a 30-minute period (visually during the day) that there is no diving bird, marine mammal and/or turtle activity within 500 m of the vessel. However, if after a period of 30 minutes cetaceans smaller than 3 m, seals and/or diving seabirds are still within 500 m of the vessel, the survey may commence; and
  > Terminate the survey if diving birds, marine mammals and/or turtles show obvious negative behavioural changes within 500 m of the survey vessel or equipment. The survey should be terminated until such time it is confirmed that the identified animal(s) has moved to a point that is more than 500 m from the source or despite continuous observation or 30 minutes has elapsed since the last sighting of the identified animal(s) within 500 m of the source.
- For a source level greater than 190 dB re 1 µPa at 1 m the following is recommended, in addition to the above:
  > A "soft-start" procedure shall be implemented for a period of 20 minutes. Where the equipment does not provide for a "soft-start", the equipment should be turned on and off over a 20 minute period to act as a warning signal and allow the above-mentioned animals to move away from the sound source;
  > "Soft-starts" should, as far as possible, be planned to commence within daylight hours;
  > "Soft-start" procedures must only commence once it has been confirmed by the MMO (visually during the day and in favourable weather conditions) or the PAM operator (at night or during poor daytime visibility), where applicable, that there is no diving bird, marine mammal and/or turtle activity within 500 m of the vessel for a 30-minute period. However, if after a period of 30 minutes diving birds, marine mammals smaller than 3 m and/or turtles are still within 500 m of the vessel, the normal "soft-start" procedure should be allowed to commence; and
  > "Soft-start" procedures must also be implemented after breaks in surveying (for whatever reason) of longer than 20 minutes. Breaks of shorter than 20 minutes should be followed by a "soft-start" of similar duration.
- In terms of the Marine Living Resources Act, 1998 it is illegal for any vessel to approach to or remain within 300 m of whales within South African waters without a permit or exemption. If the operator or seismic contractor are not able to comply with this restriction, it is recommended that an application be made to DEA for a permit or exemption.

Table 5.19: Impact of a multi-beam sonar on marine fauna.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on marine fauna include other multi-beam bathymetry and seismic survey activities off the South-West Coast (e.g. the proposed seismic survey in the proposed exploration licence area, as well as Rhino's proposed seismic and multi-beam bathymetry surveys in various licence blocks adjacent to the coast). Cumulative impact is considered to be of LOW significance.	

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None to Very Low	

5.4 IMPACT ON OTHER USERS OF THE SEA

5.4.1 POTENTIAL IMPACT ON FISHING INDUSTRY

5.4.1.1 Potential impact on fishing sectors

Description of impact

The proposed surveys could result in impacts on fishing as a result of the 500 m safety zones around the survey vessel. In addition to the statutory 500 m safety zone, a seismic contractor would request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond. Typical safe operational limits for 2D and 3D surveys are illustrated in Figure 3.3. The operator would commission support / chase vessels equipped with appropriate radar and communications to patrol the area during the seismic survey to ensure that other vessels adhere to the safe operational limits. The estimated 3 km turning circle radius would also make the effective area of operation slightly larger than the actual survey acquisition area.

The impact on the fishing industry include the likely disruption to fishing operations, loss of access to fishing grounds in the proposed survey area over the survey period, fish avoidance of the seismic survey area and changes in feeding behaviour (with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound – see Section 5.2.3).

Assessment

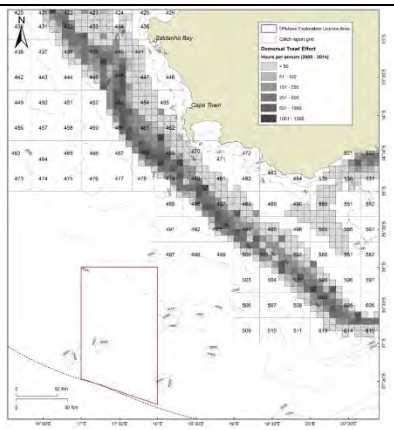
Eight fishing sectors operate off the South-West Coast (see Figure 5.1), including: demersal trawl, hake-directed demersal long-line, shark-directed demersal long-line, large pelagic long-line, small pelagic purse seine, tuna pole, traditional line-fish and West Coast rock lobster.

The proposed exploration licence area, however, occurs well offshore of, and thus does not overlap with, the following sectors: demersal trawl, hake-directed demersal long-line, shark-directed demersal long-line, small pelagic purse seine, traditional line-fish and West Coat rock lobster. Thus **NO IMPACT** is anticipated on these sectors.

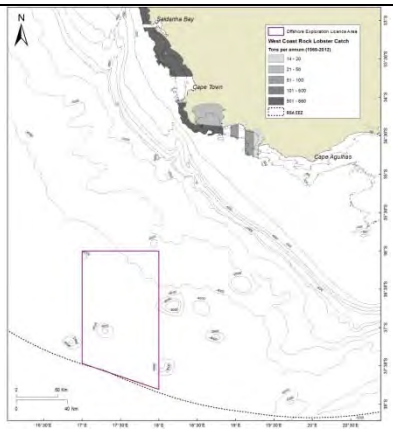
The proposed survey could potentially impact the large pelagic long-line and the tuna pole sectors. These impacts are described and assessed below.

Large pelagic long-line

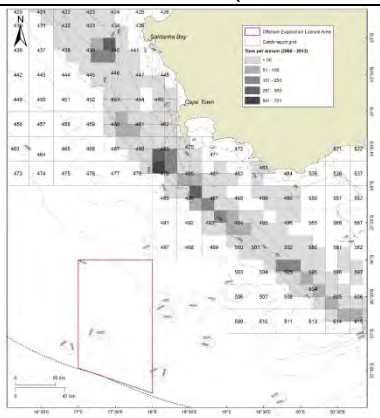
This sector utilises surface long-lines to target migratory pelagic species including albacore tuna, yellowfin tuna, bigeye tuna, swordfish and various shark species. The fishery operates extensively from the continental shelf break into deeper waters, year-round. Pelagic long-line vessels are primarily concentrated seawards of the 500 m depth contour where the continental slope is steepest (see Figures 4.21 and 5.1). During the period 2000 to 2014, an average of 2.6 tons and 4 100 hooks per annum was recorded within the proposed exploration licence area. This amounts to approximately 0.1% of both the national catch and the national effort. Based on the total average national catch over this same period, it is estimated that between < 0.1 tons and 0.2 tons could be lost by this sector over the duration of the survey (15 – 20 days), although this is unlikely considering the effort expended in the area and the fishery would likely be able to direct fishing effort elsewhere over the duration of the survey.



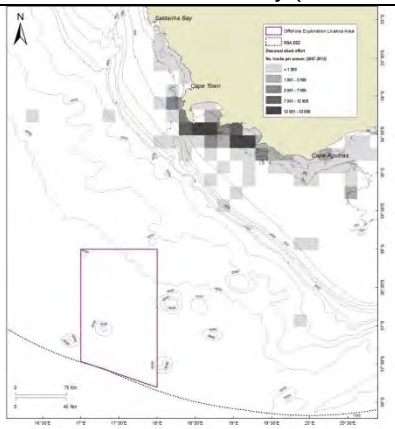
Demersal trawl effort (2000 to 2014)



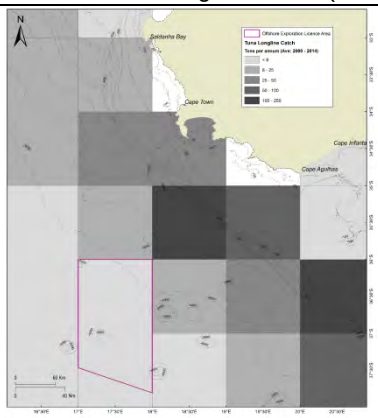
West Coast Rock Lobster fishery (1969 and 2012)



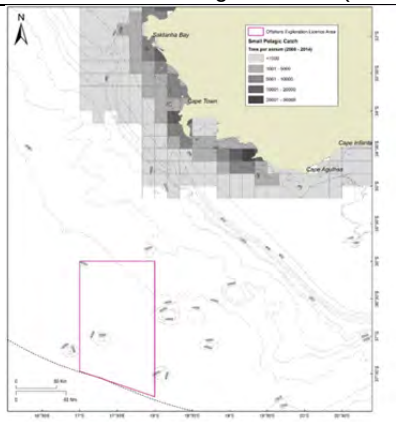
Hake-directed demersal long-line catch (2000 – 2013)



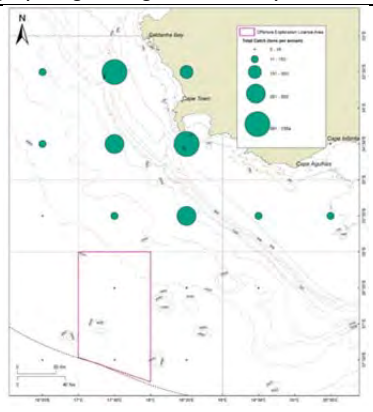
Shark-directed demersal long-line effort (2007 - 2012)



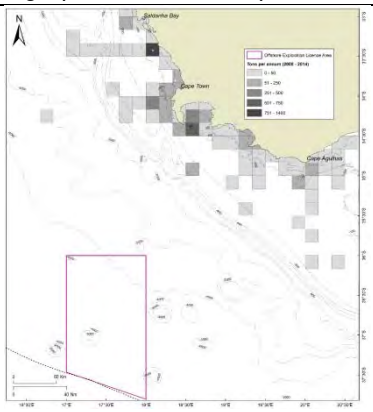
Large pelagic long-line catch (2000 - 2014)



Pelagic purse-seine effort (2000 - 2014)



Tuna pole catch (2003 - 2014)



Traditional line-fish catch (2000 - 2014)

Figure 5.1: Summary of the different fisheries operating off the South-West Coast in relation to the proposed exploration licence area.

The impact on the large pelagic long-line sector is considered to be localised and of low intensity in the short-term. The overall significance is expected to be **VERY LOW** both with and without mitigation (see Table 5.20).

Tuna pole sector

The tuna pole fishery is based on migratory species of tuna, predominantly Atlantic longfin tuna stock and a very small amount of skipjack tuna, yellowfin tuna and bigeye tuna. The fishery is seasonal with vessel activity mostly between December and May and with peak catches recorded from November to February. Fishing activity occurs along the entire West Coast, with effort being directed mainly inshore of the 500 m bathycontour. Fishing activity occurs along the shelf break with favoured fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore from Saldanha Bay. Incidental fishing activity has been recorded in the vicinity of the proposed exploration licence area around Protea Seamount situated adjacent to the boundary of the licence area (see Figures 4.25 and 5.1). Catch taken from the area during 2013 amounted to 2.3 tons, which is less than 0.01% of the overall catch reported by the sector. Based on the total average national catch between 2000 and 2014, it is estimated that between 0.2 tons and 0.4 tons could be lost by this sector over the duration of the survey (15 – 20 days), although this is unlikely considering the effort expended in the area and the fishery would likely be able to direct fishing effort elsewhere over the duration of the survey.

Based on the very low proportion of the overall national fishing catch that has been recorded within the proposed exploration licence area, the impact on the tuna pole sector is considered to be localised and of very low intensity in the short-term. The overall impact is considered to be **INSIGNIFICANT** with and without mitigation (see Table 5.20).

Mitigation

The mitigation measures listed below are unlikely to reduce the significance of potential impacts, but they would minimise disruptions to survey and fishing operations.

- Prior to survey commencement the following key stakeholders should be consulted and informed of the proposed survey activity (including navigational co-ordinates of the survey area, timing and duration of proposed activities) and the likely implications thereof:
  - > Fishing industry / associations: South African Tuna Association, South African Tuna Long-Line Association and Fresh Tuna Exporters Association; and
  - > Other key stakeholders: DAFF, Transnet National Ports Authority (ports of Cape Town and Saldanha Bay), SAMSA and South African Navy Hydrographic office.

  These stakeholders should again be notified at the completion of surveying when the survey vessel and support vessels are off location.
- The operator must request, in writing, that the South African Navy Hydrographic office release Radio Navigation Warnings and Notices to Mariners throughout the survey periods. The Notice to Mariners should give notice of (1) the co-ordinates of the proposed survey area, (2) an indication of the proposed survey timeframes and day-to-day location of the survey vessel, and (3) an indication of the 500 m safety zones and the proposed safe operational limits of the survey vessel. These Notices to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible;
- An independent onboard Fisheries Liaison Officer (FLO) who is familiar with fisheries operational in the area must be appointed for the duration of the survey. The FLO should provide a fisheries facilitation role to identify and communicate with fishing vessels in the area to reduce the risk of gear interaction between fishing and survey activities. The FLO should:
  - > report on vessel activity daily;
  - > advise on actions to be taken in the event of encountering fishing gear; and
  - > set up a daily electronic reporting routine to keep key stakeholders informed of survey activity and progress and fisheries and environmental issues.

- The survey vessel should be accompanied by a chase boat; and
- Any fishing vessel targets at a radar range of 12 nm from the survey vessel should be called via radio and informed of the navigational safety requirements around the survey vessel.

Table 5.20: Potential impact on fishing sectors operating off the South-West Coast.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Demersal trawl, hake-directed demersal long-line, shark-directed demersal long-line, small pelagic purse seine, traditional line-fish and West Coat rock lobster		
Extent	**NO IMPACT**	
Duration		
Intensity		
Significance		
Status		
Probability		
Confidence		
Large pelagic long-line		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
Tuna pole		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Very Low	Very Low
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on those fishing sectors operating in the area include other exploration activities off the South-West Coast (e.g. Rhino's proposed exploration activities in various licence blocks adjacent to the coast). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	None to Very Low	

5.4.1.2 Potential impact on fisheries research

Description of impact

Fisheries research on demersal and small pelagic fish resources are undertaken by DAFF off the South African coastline on a bi-annual basis in order to set the annual TAC. The presence of the survey vessel, and associated 500 m safety zone and proposed safe operational limits, could interfere with these research surveys should they occur in a similar areas at the same time. In addition, fish could temporarily avoid the survey area while the seismic source array or sonar is active.

Assessment

Stratified, bottom trawls are conducted to assess the biomass, abundance and distribution of hake, horse mackerel, squid and other demersal trawl species on the shelf and upper slope of the South African coast. These surveys are carried out in January (West Coast survey) and May (South Coast survey) each year. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000 m bathymetric contour (see Figure 4.29), thus inshore of the proposed exploration licence area.

Two further acoustic surveys are undertaken on the small pelagic species in order to assess their biomass. The first of these surveys is timed to commence mid-May and runs until mid-June while the second starts in mid-October and runs until mid-December. During the surveys the survey vessel travels pre-determined transects (perpendicular to bathycontours) running from the coast out to approximately the 200 m bathymetric contour (see Figure 4.30), thus inshore of the proposed exploration licence area.

Since neither the demersal or pelagic research surveys would be expected to coincide with the spatial extent of the proposed exploration licence area, **NO IMPACT** is expected on fisheries research (see Table 5.21).

Mitigation

No mitigation is considered necessary.

Table 5.21: Potential impact on fishing research off the South-West Coast.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	**NO IMPACT**	
Duration		
Intensity		
Significance		
Status		
Probability		
Confidence		
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on fishing research surveys include other exploration activities off the South-West Coast (e.g. Rhino's proposed exploration activities in various licence blocks adjacent to the coast). Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	N/A	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	N/A	

5.4.2 POTENTIAL IMPACT ON MARINE TRANSPORT ROUTES

Description of impact

The acquisition of high quality data requires that the position of the survey vessel is accurately known and that the survey vessel would need to travel in uninterrupted lines. For this reason the survey vessel (together with its towed array and hydrophone streamers) is considered to be restricted in its ability to manoeuvre and under COLREGS, 1972 (Part A, Rule 10) requires that power-driven and sailing vessels give way to a vessel restricted in its ability to manoeuvre. Vessels engaged in fishing are also required to, so far as possible, keep out of the way of a vessel restricted in its ability to manoeuvre. Furthermore, under the Marine Traffic Act, 1981, a vessel (including array of airguns and hydrophones) used for the purpose of exploiting the seabed falls under the definition of an "offshore installation" and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone. In addition to a

statutory 500 m safety zone, a seismic contractor would request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond. Typical safe operational limits are illustrated in Figure 3.3.

The presence of the survey vessel with the associated 500 m safety zone and proposed safe operational limits could interfere with shipping in the area.

Assessment

The majority of shipping traffic is located on the outer edge of the continental shelf (between 12 and 24 nm offshore) with traffic inshore of the continental shelf along the South-West Coast largely comprising fishing vessels. Thus the majority of the shipping traffic would pass inshore of the proposed exploration licence area (see Figure 4.31).

Although the safety zone around the survey vessel would be relatively small, all vessels would be prohibited from entering this area. The displacement of shipping would thus be limited to within the extreme near vicinity of the survey vessel. Although the majority of shipping occurs inshore of the proposed exploration licence area, there could be some interaction with marine traffic during surveying, resulting in disruptions and/or delays. This is normally mitigated by a notice to mariners and regular communication through daily notifications.

The potential impact on shipping traffic in the proposed exploration licence area is considered to be localised, of medium intensity in the short-term. The significance of this potential impact is therefore assessed to be **VERY LOW** with and without mitigation (see Table 5.22).

Mitigation

Recommendations to mitigate the potential impacts on marine transport routes are similar to that recommended for fishing (refer to Section 5.4.1.1). In addition, the following is recommended:

- All vessels must be certified for seaworthiness through an appropriate internationally recognised marine certification programme (e.g. Lloyds Register, Det Norske Veritas). The certification, as well as existing safety standards, requires that safety precautions would be taken to minimise the possibility of an offshore accident;
- Collision prevention equipment should include radar, multi-frequency radio, foghorns, etc. Additional precautions include:
  - A support / chase vessel with an on-board FLO who is familiar with the fisheries expected in the area;
  - The existence of an internationally agreed 500 m safety zone around the survey vessels;
  - Cautionary notices to mariners; and
  - Access to current weather service information.
- The vessels are required to fly standard flags, lights (three all-round lights in a vertical line, with the highest and lowest lights being red and the middle light being white) or shapes (three shapes in a vertical line, with the highest and lowest lights being balls and the middle light being a diamond) to indicate that they are engaged in towing surveys and are restricted in manoeuvrability, and must be fully illuminated during twilight and night; and
- Report any emergencies to SAMSA.

Table 5.22: Impact on marine traffic and transport routes.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Medium	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on shipping traffic include other exploration activities off the South-West Coast (e.g. Rhino's proposed exploration activities in various licence blocks adjacent to the coast). Cumulative impact is considered to be of LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Very Low	

5.4.3 POTENTIAL IMPACT ON MARINE PROSPECTING, MINING, EXPLORATION AND PRODUCTION ACTIVITIES

Description of impact

The presence of the survey vessel with the associated 500 m safety zone and proposed safe operational limits could interfere with other prospecting, mining, exploration and production activities in the area.

Assessment

Prospecting and mining

The proposed exploration licence area is located offshore of all known prospecting areas off the South West Coast, including glauconite and phosphorite / phosphate. There are also no known mining rights off the South-West Coast. Thus there would be **NO IMPACT** on prospecting and mining as a result of the proposed exploration activities **(see Table 5.23)**.

Exploration and production

Exploration for oil and gas is currently undertaken in a number of licence blocks off the West, South and East coasts of South Africa (see Figure 4.32). The survey vessels would need to exit the proposed survey area during line changes, which may, although unlikely, have an impact on adjacent exploration right holders and associated exploration activities.

There are no current development or production activities off the South-West Coast. The closest production related activities are located in Block 9 on the South Coast, approximately 400 km to the north-east of the proposed exploration licence area. Thus, the proposed exploration activities would have **NO IMPACT** on other production related activities.

The potential impact on exploration activities, although unlikely, is considered to be localised, of low to medium intensity in the short-term. The significance of this impact is assessed to be **VERY LOW** with and without mitigation (see Table 5.23).

Mitigation

- Rhino should engage timeously with overlapping and neighbouring right holders in order to discuss the scheduling of the proposed survey in relation to current / proposed exploration activities. This would involve pre-survey notification of navigational co-ordinates of the survey area, timing and duration of proposed activities; and
- Any dispute arising with other right holders should be referred to the DMR or PASA for resolution.

Table 5.23: Impact on marine prospecting, mining, exploration and production activities.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Prospecting, mining and production		
Extent	**NO IMPACT**	
Duration		
Intensity		
Significance		
Status		
Probability		
Confidence		
Exploration		
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Low to Medium	Low
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High
Nature of cumulative impact	Other activities that may contribute to the cumulative impact on marine prospecting, mining, exploration and production activities include other exploration activities off the coast of South Africa. Cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	Low	
Degree to which impact can be mitigated	Very Low	

5.5 SOCIO-ECONOMIC IMPACT OF EXPLORATION ACTIVITIES

Description of impact

The proposed development would create a minor number of local employment and business opportunities. Direct revenues would be generated as a result of the proposed exploration activities. Revenue generating activities are related to the actual operations and include refuelling, vessel / gear repair, port dues, hire of local fishing vessels as support vessel.

Assessment

Offshore exploration is highly technical and requires specialised survey vessels and crews, none of which are based in South Africa. Thus job opportunities during exploration would also be very limited. There would, however, be opportunities for local companies to provide support services during the proposed surveys, e.g. vessel supplies, support vessels, etc. In addition, opportunities are further limited by the very short duration of the proposed operations (i.e. 15 – 20 days per survey).

The overall positive impact of job creation and the generation of direct revenues is considered to be local, of very low to low intensity over the short-term. Thus the potential impact of job creation during this phase of exploration is considered to be ***INSIGNIFICANT (positive)*** with and without mitigation (see Table 5.23).

Mitigation

The use of local companies for support services should be promoted as far as possible.

Table 5.24: Impact of job creation and the generation of direct revenues.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	Local	Local
Duration	Short-term	Short-term
Intensity	Very Low	Very Low
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Positive	Positive
Probability	Probable	Probable
Confidence	Medium	Medium
Nature of cumulative impact	Other activities that may contribute to the cumulative impact of job creation and the generation of direct revenues include other exploration activities off the coast of South Africa. Cumulative impact is considered to be of LOW (positive) significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	None	

5.6 NO-GO ALTERNATIVE

Description of impact

The no-go alternative is the non-occurrence of the proposed exploration activities. Thus there would be no acquisition of bathymetry and seismic data for the proposed exploration licence area as proposed. The negative implications of not going ahead with the proposed exploration are as follows:

- South Africa would lose the opportunity to further establish the extent of indigenous oil or gas reserves off the South-West Coast;
- Lost economic opportunities related to sunken costs (i.e. costs already incurred) of initial desktop investigations in the proposed exploration licence area; and
- If economic oil and gas reserves do exist and are not developed, South Africa / Rhino would lose the opportunity to maximise the use of its own indigenous oil and gas reserves.

Assessment

The potential impact related to the lost opportunity to further explore oil and gas reserves within their licence area and maximise the use of South Africa's own reserves should they exist is considered to be of **LOW** significance (see Table 5.24).

Table 5.25: Assessment of impact related to No-Go alternative.

RATING SCALES	WITHOUT MITIGATION	WITH MITIGATION
Extent	Regional to National	N/A
Duration	Permanent	
Intensity	Very Low to Low	
Significance	**Low**	
Status	Negative	
Probability	Improbable	
Confidence	Low	
Nature of cumulative impact	Other activities that may contribute to the cumulative impact include the non-approval of other exploration activities off the coast of South Africa. Cumulative impact is considered to be of MEDIUM significance.	
Degree to which impact can be reversed	N/A	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	N/A	

6. CONCLUSIONS AND RECOMMENDATIONS

Rhino is proposing to undertake an exploration programme in Licence Blocks 3617 and 3717 off the South-West Coast of South Africa in order to identify potential oil or gas target areas for future exploration. The exploration licence area, which is approximately 13 279 km^2 in extent, is located between approximately 190 km and 385 km off the coast in water depths greater than 3 500 m.

The proposed exploration programme would commence with the acquisition and collation of existing data. Thereafter multi-beam bathymetry and seismic surveys would be conducted to identify potential target areas for future exploration. Rhino is proposing to undertake acquisition of a 2D seismic survey. However, if it is determined by subsequent analysis of existing data, that acquisition of a seismic dataset utilising 3D seismic techniques might be a more advantageous approach for data collection, then a 3D seismic survey might be substituted for the 2D survey or may be done in addition to the 2D seismic survey.

The proposed exploration programme requires authorisation in terms of both the MPRDA and NEMA. CCA has been appointed by Rhino to undertake an EIA process to meet the relevant requirements of the MPRDA, NEMA and Regulations thereto. Specialists were appointed to address the two key issues that required further investigation, namely (1) the impact on commercial fishing, and (2) the impact on marine fauna. The findings of the specialist studies and other relevant information have been integrated and synthesised into this report. The two main objectives of this report are, firstly, to assess the significance of environmental impacts resulting from the proposed exploration activities and to suggest ways of mitigating negative impacts and enhancing benefits, and secondly, to provide I&APs with an opportunity to comment on the proposed project.

This chapter summarises the key findings of the EIA and presents mitigation measures that should be implemented for the proposed exploration activities.

6.1 CONCLUSIONS

6.1.1 GENERAL CONCLUSIONS

A summary of the assessment of potential environmental impacts associated with the proposed exploration activities and No-Go Alternative is provided in Table 6.1.

In summary, the majority of the impacts associated with the proposed exploration activities (namely multi-beam bathymetry and 2D / 3D seismic surveys) would be of short-term duration (15 – 20 days per survey) and limited to the immediate survey area. As a result, the majority of the impacts associated with the multi-beam bathymetry and seismic surveys are considered to range from **INSIGNIFICANT** to **LOW** significance after mitigation.

The two key issues associated with the proposed exploration activities relate to:

- The potential impact on cetaceans (physiological injury and behavioural avoidance) as a result of seismic and sonar noise; and
- The potential impact on the fishing industry (vessel interaction, disruption to fishing operations and reduced catch) due to the presence of the survey vessel with its associated safety zone, potential fish avoidance of the survey area and changes in feeding behaviour.

Although most of the impacts on cetaceans are assessed to have **VERY LOW to LOW** significance with mitigation, the impact could be of much higher significance due to the limited understanding of how short-term effects of seismic surveys relate to longer term impacts. For example, if a sound source displaces a

species from an important feeding or breeding area for a prolonged period, impacts at the population level could be more significant. This said, the proposed exploration licence area is located well offshore of important southern right mating, calving and nursery grounds off the West and South coasts, as well as summer feeding grounds around Cape Columbine utilised by resident populations of humpback and southern right whales. In order to mitigate the potential impact on migrating cetaceans it is strongly recommended that the proposed seismic survey programme be planned to avoid they key cetacean migration and breeding period from the beginning of June to the end of November, as well as December when whales (with calves) are on their return journey, which potentially passes through the proposed exploration licence area. Thus the recommended survey period extends from the beginning of January to the end of May. Various other measures are recommended to further mitigate the potential impact on cetaceans, including a 60-minute pre-watch period, 20-minute "soft-start" procedure, temporary termination of survey, etc.

The proposed exploration activities would only potentially have an impact on the large pelagic long-line and tuna pole sectors. The proposed exploration licence area occurs well offshore of, and thus does not overlap with, the demersal trawl, hake-directed demersal long-line, shark-directed demersal long-line, small pelagic purse seine, traditional line-fish and West Coat rock lobster fishing grounds. Thus **NO IMPACT** is anticipated on these fishing sectors. The potential impacts on the large pelagic long-line and tuna pole sectors are considered to be of **VERY LOW** significance and **INSIGNIFICANT**, respectively. This assessment is based primarily on the short-term duration of the survey (15 – 20 days) and the minor catch recorded from the proposed exploration licence area (namely 0.1% and 0.01% of the national catch recorded within the proposed exploration area for the large pelagic long-line and tuna pole sectors, respectively). However, if fish avoid the survey area and / or change their feeding behaviour it could have a more significant impact on the fishing industry. Research has, however, shown that behavioural effects are generally short-term with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound. However, there have been recent concerns that seismic survey activities in southern Namibia and the Australian Bight are responsible for substantially reduced catches of tuna. According to other sources, it is probable that fluctuating tuna catches are caused by a number of variables (e.g. fluctuation of fishing effort, general decline in longfin tuna abundance and changes in fishing strategy) and that a simple correlation between seismic survey acquisition and reduced tuna catches cannot be inferred and more in-depth research is required.

Any interaction between the survey vessels and fishing vessels could also increase the significance of the impact on the large pelagic long-line and tuna pole sectors. Thus it is important that the operator engage timeously with the fishing industry prior to and during the surveys in order to minimise any interaction. Thus prior to survey commencement it is recommended that key stakeholders (including fishing industry associations) are informed of the proposed survey details (including navigational co-ordinates of the survey areas, and timing and duration of proposed activities) and the likely implications thereof (500 m safety zone and proposed safe operational limits). In addition, it is recommended that Radio Navigation Warnings and Notices to Mariners are distributed throughout the seismic survey periods. The placement of an on-board FLO would also help ensure that ongoing communication (via daily reports) is maintained between the survey vessels and the fishing industry and other users of the sea. This proposed regular communication with fishing vessels in the vicinity of the proposed surveys would minimise the potential disruption to fishing operations and risk of gear entanglements.

Table 6.1: Summary of the significance of potential impacts related to the proposed exploration activities in Licence Block 3617 and 371 off the South-West Coast of South Africa. (Note: * indicates that no mitigation is possible and / or considered necessary, thus significance rating remains).

Potential impact		Probability (with mitigation)	Significance	
			Without mitigation	With mitigation
Normal vessels and helicopter operation:				
Emissions to the atmosphere		Definite	VL	**VL**
Deck drainage into the sea		Highly probable	VL	**VL**
Machinery space drainage into the sea		Highly probable	VL	**VL**
Sewage effluent into the sea		Definite	VL	**VL**
Galley waste disposal into the sea		Highly probable	VL	**VL**
Solid waste disposal into the sea		Improbable	Insig.	**INSIG.**
Accidental oil spill during bunkering / refuelling	Within port limits	Improbable	Insig.	**INSIG.**
	Offshore	Improbable	L	**VL**
Noise from seismic and support vessel operations		Probable	VL	**VL***
Noise from helicopter operation		Probable	L-M	**VL**
Impact of seismic noise on marine fauna:				
Plankton		Probable	Insig.	**INSIG.***
Invertebrates	Physiological injury	Improbable - Probable	Insig. - VL	**INSIG. - VL***
	Behavioural avoidance	Probable	VL	**VL***
Fish	Physiological injury	Improbable	Insig. - L	**INSIG. - VL**
	Behavioural avoidance	Improbable	M	**L**
	Spawning and recruitment	Improbable	Insig.	**INSIG.**
	Masking sound and communication	Improbable	VL	**VL**
	Indirect impacts on food sources	Improbable	VL	**VL**
Diving seabirds	Physiological injury	Improbable	L	**VL**
	Behavioural avoidance	Improbable	L	**VL**
	Indirect impacts on food sources	Improbable	VL	**VL**
Non-diving seabirds	Physiological injury	Improbable	Insig.	**INSIG.**
	Behavioural avoidance	Improbable	Insig.	**INSIG.**
Turtles	Physiological injury	Improbable	L	**VL**
	Behavioural avoidance	Probable	L	**VL**
	Masking sound and communication	Improbable	Insig.	**INSIG.**
	Indirect impacts on food sources	Improbable	VL	**VL**
Seals	Physiological injury	Improbable	VL	**VL**
	Behavioural avoidance	Improbable	VL	**VL**
	Masking sound and communication	Improbable	Insig.	**INSIG.**
	Indirect impacts on food sources	Improbable	VL	**VL**
Mysticetes Cetaceans	Physiological injury	Probable	M	**L**
	Behavioural avoidance	Probable	M	**L**
	Masking sound and communication	Probable	L	**VL**
	Indirect impacts on food sources	Improbable	Insig.	**INSIG.**
Odontocetes Cetaceans	Physiological injury	Probable	L	**VL**
	Behavioural avoidance	Probable	VL - L	**VL**
	Masking sound and communication	Probable	M	**L**
	Indirect impacts on food sources	Probable	VL	**VL**

Potential impact		Probability (with mitigation)	Significance	
			Without mitigation	With mitigation
Impact of multi-beam bathymetry survey:				
Impact on marine fauna		Improbable	VL	**VL**
Impact on other users of the sea:				
Fishing industry	Demersal trawl	Improbable	**NO IMPACT**	
	Hake demersal long-line	Improbable	**NO IMPACT**	
	Shark demersal long-line	Improbable	**NO IMPACT**	
	Large pelagic long-line	Improbable	VL	**VL**
	Small pelagic purse-seine	Improbable	**NO IMPACT**	
	Tuna pole	Improbable	Insig.	**INSIG.**
	Traditional line-fish	Improbable	**NO IMPACT**	
	West Coast rock lobster	Improbable	**NO IMPACT**	
	Fisheries research	Improbable	**NO IMPACT**	
Marine transport routes		Probable	VL	**VL**
Marine prospecting, mining, exploration and production	Prospecting, mining and production	Improbable	**NO IMPACT**	
	Exploration	Improbable	VL	**VL**
Socio-economic impact:				
Impact of job creation and the generation of direct revenues		Probable	Insig. (+ve)	**INSIG. (+VE)**
No-Go Alternative:				
Lost opportunity to further explore on the South-West Coast and to maximise the use of South Africa's own reserves. Also lost economic opportunities related to sunken costs		Improbable	L	**-**
VH=Very High - H=High - M=Medium - L=Low - VL=Very Low - Insig = insignificant - All impacts are negative				

6.1.2 COMPARATIVE ASSESSMENT OF PROJECTS ALTERNATIVES

6.1.2.1 Site and survey area alternatives

The location of the proposed exploration activities is ultimately determined by Rhino's application for an Exploration Right in Licence Blocks 3617 and 3717. Thus the proposed exploration activities would be limited to these blocks and no further site alternatives can be considered.

Although Rhino is considering two indicative alternative seismic survey plans in the proposed exploration licence area, there are no additional impacts or differences in impact significance between the two alternative survey areas. There would also be no change to the assessment if the final survey plan differed slightly from that assessed, as the EIA has considered a seismic survey located anywhere within the proposed exploration licence area.

6.1.2.2 Survey timing alternatives

Although survey commencement would ultimately depend on the Exploration Right award date, availability of seismic contractors and other factors, Rhino is proposing to commence the seismic surveys in a fair weather period in 2017 (Q1/Q2). The summer period has specifically been selected in order to avoid the main cetacean migration / breeding period from June to December, as well as ensuring optimal sea state and weather conditions.

In order to avoid whales (with calves) on their return journey potentially passing through the proposed exploration licence area, it is recommended that the exclusion period also include December. Thus the recommended survey period extends from the beginning of January to the end of May.

6.1.2.3 Sonar survey technologies

In order to further investigate the structure of the ocean floor sediment layers, there are several possible alternative technologies available, including:

- Depth sounders;
- Side scan sonar;
- Bottom profilers; and
- Multi-beam bathymetry.

Rhino is, however, only proposing to undertake a multi-beam bathymetry survey, as it produces high quality bathymetric data along a wider track beam compared to the other alternatives. Although no other sonar survey technology alternatives are being considered in the EIA process, it should be noted that the potential impacts associated with the other sonar survey technology alternatives would be no more significant than that associated with the proposed multi-beam bathymetry survey.

6.1.2.4 Seismic survey technologies

For this investigation Rhino is proposing to undertake acquisition of a 2D seismic survey. However, if it is determined by subsequent analysis of existing data, that acquisition of a seismic dataset utilising 3D seismic techniques might be a more advantageous approach for data collection, then a 3D seismic survey might be substituted for the 2D survey or may be done in addition to the 2D seismic survey.

This EIA thus assesses the potential impacts related to undertaking both a 2D and 3D seismic survey. Since the airgun and streamer type, array configurations, etc. would ultimately be limited to what equipment is available on the contacted survey vessel, this assessment is based, to a large extent, on a generic description of seismic surveys, specifically airgun and hydrophone array specifications.

There are no additional impacts or differences in impact significance associated with either the 2D or 3D seismic survey, or the equipment that would ultimately be used during the survey.

6.1.2.5 No-go alternative

The no-go alternative is the option of not undertaking the proposed exploration activities. Thus there would be no acquisition of bathymetry and seismic data for the proposed exploration licence area as proposed. The negative implications of not going ahead with the proposed exploration are as follows:

- South Africa would lose the opportunity to further establish the extent of indigenous oil or gas reserves off the South-West Coast;
- Lost economic opportunities related to sunken costs (i.e. costs already incurred) of initial desktop investigations in the proposed exploration licence area; and
- If economic oil and gas reserves do exist and are not developed, South Africa / Rhino would lose the opportunity to maximise the use of its own indigenous oil and gas reserves.

This potential impact associated with the no-go alternative is considered to be of **LOW** significance.

6.1.3 RECOMMENDATION / OPINION OF ENVIRONMENTAL ASSESSMENT PRACTITIONER

The key principles of sustainability, including ecological integrity, economic efficiency, and equity and social justice, are integrated below as part of the supporting rationale for recommending an opinion on whether the proposed project should be approved.

- Ecological integrity[1]

  The proposed exploration licence area lies well offshore of the Cape Peninsula and Cape Columbine upwelling cells. These offshore areas are characterised by diminished phytoplankton biomass due to the predominance of nutrient-poor oceanic waters. A deficiency of phytoplankton results in poor feeding conditions for zooplankton and ichthyoplankton. Key spawning areas and northward egg and larval drift also occur well inshore of the proposed exploration licence area. Thus plankton abundance in these offshore oceanic waters is expected to be extremely low.

  Three seamounts occur adjacent to the proposed exploration licence area, namely Protea, Argentina and Simpson seamounts. A further smaller, unnamed seamount occurs within the proposed exploration licence area. These seamounts could potentially host sensitive and potentially vulnerable benthic communities. However, as the survey would be conducted in water depths in excess of 3 000 m, the received noise at the seabed would be within the far-field range and outside of distances at which physiological injury of benthic invertebrates and demersal fish species would be expected. There is a likelihood of encountering feeding aggregations of large pelagic fish species, which are attached to seamount communities. However, given the high mobility of most large pelagic species, it is assumed that the majority of fish species would avoid seismic noise at levels below those where physiological injury or mortality would result.

  The proposed exploration licence area, which is approximately 190 km offshore at its closest point, is located beyond the normal foraging range of animals from seabird and seal colonies located off the South-West Coast. Thus there is a low likelihood of encountering seabirds (except pelagic seabird such as albatrosses, petrels, shearwaters, etc.) and seals in the proposed exploration licence area.

  A wide diversity of cetaceans (between 28 and 32 species) may be encountered within the proposed exploration license area, including year round resident species and those migrating through the area to mate and breed. Available information suggests that an animal would need to be in close proximity to operating airguns to suffer physiological injury, and being highly mobile it is assumed that they would avoid sound sources at distances well beyond those at which injury is likely to occur. A key concern would be the displacement of animals from critical feeding or breeding habitats. However, the proposed exploration licence is located well offshore of important southern right mating, calving and nursery grounds off the West and South coasts, as well as summer feeding grounds around Cape Columbine utilised by localised resident populations of humpback and southern right whales.

  In summary, the proposed project with the implementation of the proposed mitigation measures would not result in a significant loss of or impact on ecological integrity within the proposed exploration licence area.

- Economic efficiency

  Operation Phakisa aims to, *inter alia*, unlock the economic potential of South Africa's oceans, and in terms of offshore oil and gas exploration, the goal is to further enhance the enabling environment for exploration of oil and gas while simultaneously maximising the value captured for South Africa. The proposed exploration programme provides an opportunity to further explore oil and gas reserves off the coast of South Africa, thereby meeting one of the aims of Operation Phakisa.

[1] Ecological integrity is the abundance and diversity of organisms at all levels, and the ecological patterns, processes and structural attributes responsible for that biological diversity and for ecosystem resilience.

During survey operations the 500 m safety zone and proposed safe operational limits around the survey vessel would essentially exclude other maritime and fishing vessels from portions of the survey area for a very short period of time (15 to 20 days per survey). Since the majority of shipping traffic is located on the outer edge of the continental shelf (between 12 and 24 nm offshore), it passes well inshore of the proposed exploration licence area. Only two fishing sectors operate in the vicinity of the proposed exploration licence area, namely the pelagic long-line and tuna pole sectors. These sectors could thus potentially be affected by the proposed exploration activities. This is, however, considered unlikely based on the minor catch and effort recorded in the proposed exploration licence area.

Although offshore exploration is highly technical and requires specialised survey vessels and crews, there would be a few opportunities for local companies to provide support services during the proposed surveys, e.g. vessel supplies, support vessels, etc.

The proposed project is considered to be economically efficient, as it provides an opportunity to meet one of the aims of Operation Phakisa and establish the extent of indigenous oil / gas reserves in the Orange Basin, while not significantly impacting any other party/ies.

- Equity and social justice
  Due to the extent, duration and offshore location of the proposed project, it would not unfairly discriminate, directly or indirectly, against any one party nor result in an unequal distribution of negative impacts.

It is the opinion of CCA in terms of the sustainability criteria described above, the nature and extent of the proposed exploration programme (all alternatives), and the findings of the specialist studies, that the generally **VERY LOW** to **LOW** significance, with the implementation of the proposed mitigation measures, should support a positive decision being made by the Minister of Mineral Resources (or delegated authority) in this regard.

Since the proposed exploration activities are associated with Rhino's initial three-year exploration work programme, Rhino requests that that environmental authorisation (should it be granted) be issued and remain valid for a period of three years or more.

6.2 RECOMMENDATIONS

6.2.1 GENERAL RECOMMENDATIONS FOR BOTH SEISMIC AND MULTI-BEAM BATHYMETRY SURVEYS

6.2.1.1 Compliance with EMP and MARPOL standards

- All phases of the proposed project (including pre-establishment phase, establishment phase, operational phase, and decommissioning and closure phase) must comply with the EMP presented in Chapter 7. In addition, the seismic and support vessels must ensure compliance with the MARPOL 73/78 standards.

6.2.1.2 Permit / exemption requirements

- In terms of the Marine Living Resources Act, 1998 (No. 18 of 1998) it is illegal for any vessel to approach to or remain within 300 m of whales within South African waters without a permit or exemption. Thus if the operator or seismic contractor are not able to comply with this restriction, an application should be made to DEA for a permit or exemption.

6.2.1.3 Communication with key stakeholders

- Prior to survey commencement the following key stakeholders should be consulted and informed of the proposed survey activity (including navigational co-ordinates of the survey area, timing and duration of proposed activities) and the likely implications thereof:
  - > Fishing industry / associations:
    - South African Tuna Association;
    - South African Tuna Long-Line Association; and
    - Fresh Tuna Exporters Association.
  - > Other:
    - PASA;
    - DAFF;
    - Transnet National Ports Authority (ports of Cape Town and Saldanha Bay);
    - SAMSA;
    - South African Navy Hydrographic office; and
    - Overlapping and neighbouring right holders.

  These stakeholders should again be notified at the completion of surveying when the survey vessel and support vessels are off location.
- The operator must request, in writing, that the South African Navy Hydrographic office release Radio Navigation Warnings and Notices to Mariners throughout the survey periods. The Notice to Mariners should give notice of (1) the co-ordinates of the proposed survey area, (2) an indication of the proposed survey timeframes and day-to-day location of the survey vessel, and (3) an indication of the 500 m safety zones and the proposed safe operational limits of the survey vessel. These Notices to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible;
- An independent on-board FLO who is familiar with fisheries operational in the area must be appointed for the duration of each survey. The FLO should provide a fisheries facilitation role to identify and communicate with fishing vessels in the area to reduce the risk of gear interaction between fishing and survey activities. The FLO should:
  - > report on vessel activity daily;
  - > advise on actions to be taken in the event of encountering fishing gear;
  - > provide back-up on-board facilitation with the fishing industry and other users of the sea; and
  - > set up a daily electronic reporting routine to keep key stakeholders informed of survey activity and progress and fisheries and environmental issues.
- Any fishing vessel targets at a radar range of 12 nm from the survey vessel should be called via radio and informed of the navigational safety requirements around the survey vessel;
- Ongoing notification is to be undertaken throughout the duration of survey with the submission of daily reports (via email) indicating the vessel's location to key stakeholders, as appropriate;
- Any dispute arising with other right holders should be referred to DMR or PASA for resolution; and
- Marine mammal incidence data and seismic source output data arising from the survey should be made available, if requested, to the Marine Mammal Institute, DEA, DAFF and PASA for analyses of survey impacts in local waters.

6.2.1.4 Vessel safety

- All vessels must be certified for seaworthiness through an appropriate internationally recognised marine certification programme (e.g. Lloyds Register, Det Norske Veritas). The certification, as well as existing safety standards, requires that safety precautions would be taken to minimise the possibility of an offshore accident;

- Collision prevention equipment should include radar, multi-frequency radio, foghorns, etc. Additional precautions include:
  - > A support / chase vessel with an on-board FLO familiar with the fisheries expected in the area;
  - > The existence of an internationally agreed 500 m safety zone around the survey vessel;
  - > Cautionary notices to mariners; and
  - > Access to current weather service information.
- The vessels are required to fly standard flags, lights (three all-round lights in a vertical line, with the highest and lowest lights being red and the middle light being white) or shapes (three shapes in a vertical line, with the highest and lowest lights being balls and the middle light being a diamond) to indicate that they are engaged in towing surveys and are restricted in manoeuvrability, and must be fully illuminated during twilight and night; and
- Report any emergency situation to SAMSA.

6.2.1.5 Emissions, discharges into the sea and solid waste

- Ensure adequate maintenance of diesel motors and generators to minimise the volume of soot and unburned diesel released to the atmosphere;
- Route deck and machinery space drainage to a separate drainage system (oily water catchment system) for treatment to ensure compliance with MARPOL (15 ppm);
- Ensure all process areas are bunded to ensure drainage water flows into the closed drainage system;
- Use drip trays to collect run-off from equipment that is not contained within a bunded area and route contents to the closed drainage system;
- Use of low toxicity, biodegradable detergents during deck cleaning to further minimise the potential impact of deck drainage on the marine environment;
- Ensure adequate maintenance of all hydraulic systems and frequent inspection of hydraulic hoses;
- Undertake spill management training and awareness of crew members of the need for thorough clean-up of any spillages immediately after they occur, as this would minimise the volume of contaminants washing off decks;
- Initiate an on-board waste minimisation system;
- Ensure on-board solid waste storage is secure;
- Ensure that waste (solid and hazardous) disposal onshore is carried out in accordance with the appropriate laws and ordinances; and
- Prepare a project specific Emergency Response Plan and Shipboard Oil Pollution Emergency Plan for the proposed seismic survey, which defines the organisational structure and protocols that would be implemented to respond to any incident (including accidental oil / fuel spills) in a safe, rapid, effective and efficient manner.

6.2.1.6 Offshore bunkering

- Offshore bunkering should not be undertaken in the following circumstances:
  - > Wind force and sea state conditions of 6 or above on the Beaufort Wind Scale;
  - > During any workboat or mobilisation boat operations;
  - > During helicopter operations;
  - > During the transfer of in-sea equipment; and
  - > At night or times of low visibility.
- Support vessels must have the necessary spill response capability to deal with accidental spills in a safe, rapid, effective and efficient manner; and
- Crew must be trained in spill management.

6.2.1.7 Job creation and the generation of direct revenues

- The use of local companies for support services should be promoted as far as possible.

6.2.1.8 Vessel lighting

- Lighting on-board survey vessels should be reduced to the minimum safety levels to minimise stranding of pelagic seabirds on the survey vessels at night. All stranded seabirds must be retrieved and released during daylight hours.

6.2.2 RECOMMENDATIONS SPECIFIC TO SEISMIC SURVEYS

6.2.2.1 Survey timing and scheduling

- The seismic survey should be planned to avoid the key cetacean migration and breeding period, which occurs from the beginning of June to the end of November. However, in order to avoid whales (with calves) on their return journey potentially through the proposed exploration licence area, it is recommended that the exclusion period also include December. Thus the recommended survey period extends from the beginning of January to the end of May.

6.2.2.2 Equipment

- 'Turtle-friendly' tail buoys should be used by the survey contractor or existing tail buoys should be fitted with either exclusion or deflector 'turtle guards'.

6.2.2.3 Seismic survey procedures

- PAM technology
  - > The survey vessel must be fitted with PAM technology, which detects animals through their vocalisations. As the proposed surveys would take place in waters deeper than 1 000 m depth where deep-diving sperm whales are likely to be encountered, it is recommended that PAM technology is used during both the pre-watch period and when the airguns are active (including "soft-starts", airgun tests and surveying).
  - > The PAM hydrophone streamer should ideally be towed behind the airgun array to minimise the interference of vessel noise, and should be fitted with two hydrophones to allow directional detection of cetaceans.
  - > In order to avoid unnecessary delays to the survey programme, it is recommended that a spare PAM cable and sensor are kept onboard should there be any technical problems with the system. However, if there is a technical problem with PAM during surveying, visual watches must be maintained by the MMO during the day and night-vision/infra-red binoculars must be used at night while PAM is being repaired.
- "Soft-start" procedure, pre-watch period and airgun firing
  - > A "soft-start" procedure of a minimum of 20 minutes' duration must be implemented when initiating airgun tests (a single or a number of airguns at full power)[2] and / or seismic surveying. This requires that the sound source be ramped from low to full power rather than initiated at full power, thus allowing a flight response by marine fauna to outside the zone of injury or avoidance.

[2] Note: If the intention is to test a single airgun on low power then a "soft-start" is not required.

> "Soft-start" procedures must only commence once it has been confirmed for at least a 60-minute[3] period (visually and using PAM technology during the day and using only PAM technology at night or during periods of poor visibility) that there is no cetacean activity within 500 m of the vessel. Similarly, it must also be confirmed (visually during the day and using night-vision/infra-red binoculars at night) that there is no seabird (significant diving activity), turtle or seal activity within 500 m of the vessel just prior to initiating the "soft-start" procedure.
> "Soft-starts" should be delayed until such time as this area is clear of seabirds (diving), turtles, seals or cetaceans. In the case of turtles and cetaceans the "soft-start" procedure should not begin until after the animals depart the 500 m exclusion zone or 30 minutes after they are last seen. In the case of seals, which are often attracted to survey vessels, the normal "soft-start" procedures should be allowed to commence, if after a period of 30 minutes seals are still within 500 m of the airguns.
> All breaks in airgun firing of longer than 20 minutes must be followed by a 60-minute pre-shoot watch and a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing. In order to facilitate a more effective timing of proposed operations when surveying in deeper waters, the 60-minute pre-shoot watch can commence before the end of the survey line (whilst the airguns are still firing). Breaks of shorter than 20 minutes should be followed by a visual assessment for marine mammals and turtles within the 500 m mitigation zone (not a 60-minute pre-shoot watch) and a "soft-start" of similar duration.
> The use of the lowest practicable airgun volume, as defined by the operator, should be defined and enforced.
> During surveying, airgun firing should be terminated when:
  - obvious negative changes to turtle, seal and cetacean behaviour is observed;
  - turtles or cetaceans are observed within 500 m of the operating airgun and appear to be approaching the firing airgun; or
  - there is mass mortality of fish or mortality / injuries to seabirds, turtles, seals or cetaceans as a direct result of the survey.
> The survey should remain terminated until such time the time MMO / PAM operator confirms that:
  - turtles or cetaceans have moved to a point that is more than 500 m from the source;
  - despite continuous observation, 30 minutes has elapsed since the last sighting of the turtles or cetaceans within 500 m of the source; and
  - risks to seabirds, turtles, seals or cetaceans have been significantly reduced.
> A log of all termination decisions must be kept (for inclusion in both daily and "close-out" reports).

- MMO and PAM operator
  > An independent on-board MMO and a PAM operator must be appointed for the duration of the seismic survey. The MMO and PAM operator must have experience in seabird, turtle and marine mammal identification and observation techniques.
  > The duties of the MMO would be to:
  <u>Marine fauna:</u>
    - Confirm that there is no marine faunal activity within 500 m of the seismic source array prior to commencing with the "soft-start" procedures;
    - Record pre-shoot observation regime;
    - Record survey activities, including sound levels, "soft-start" procedures and survey periods (duration);
    - Monitor marine faunal activity during daytime surveying. Observe and record responses of marine fauna to the seismic survey, including seabird, turtle, seal and cetacean incidence and behaviour and any mortality or injuries of marine fauna as a result of the

[3] The JNCC Guidelines state that the pre-watch period should be extended from 30 minutes to 60 minutes for deep-diving species when surveying in deeper water (>200 m).

seismic survey. Data captured should include species identification, position (latitude/longitude), distance from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the survey activities; and
- Request the temporary termination of the seismic survey, as appropriate. It is important that the MMOs' decisions to terminate firing are made confidently and expediently;

Other:
- Record meteorological conditions;
- Monitor compliance with international marine pollution regulations (MARPOL 73/78 standards); and
- Prepare daily reports of all observations. These reports should be forwarded to the key stakeholders, as appropriate.

> The duties of the PAM operator would be to:
- Ensure that hydrophone streamers are optimally placed within the towed array;
- Confirm that there is no cetaceans activity within 500 m of the vessel prior to commencing with the "soft-start" procedures;
- Record survey activities, including sound levels, "soft-start" procedures and survey periods (duration);
- Record pre-shoot observation regime;
- Monitor cetacean activity during daytime and night time surveying. Record species identification, position (latitude/longitude) and distance from the vessel, where possible; and
- Request the temporary termination of the seismic survey, as appropriate.

> All data recorded by the MMO and PAM operator should form part of the survey "close-out" report.

6.2.3 RECOMMENDATIONS SPECIFIC TO MULTI-BEAM BATHYMETRY SURVEYS

- MMO and PAM operator:
  > Appoint an MMO for the duration of the survey.
  > The MMO should conduct visual scans for the presence of diving birds, marine mammals and/or turtles around the survey vessel prior to the initiation of any acoustic impulses.
  > PAM technology, which detects animals through their vocalisations, must be used for a source level greater than 190 dB re 1 µPa at 1 m when surveying at night or during adverse weather conditions and thick fog. If there is a technical problem with PAM during nighttime surveying, night-vision/infra-red binoculars must be used;
  > The duties of the MMO and PAM operator would be to:
    - Monitor the survey pre-watch period;
    - Record sound levels, pre-watch sightings and "soft-start" procedures (where required);
    - Observe and record responses of diving birds, marine mammals and/or turtles to the multi-beam bathymetry survey. Data captured should include species identification, position (latitude/longitude), distance from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the survey activities; and
    - Request the temporary termination of survey, as appropriate. A log of all termination decisions must be kept for inclusion in both daily and "close-out" reports.
- For a source level less than 190 dB re 1 µPa at 1 m the following is recommended:
  > Surveying must only commence (subject to the need for a "soft-start") once it has been confirmed (visually during the day) that there is no diving bird, marine mammal and/or turtle activity within 500 m of the vessel. For cetaceans the period of confirmation should be at least

30 minutes. However, if after a period of 30 minutes cetaceans smaller than 3 m, seals and/or diving seabirds are still within 500 m of the vessel, the survey may commence; and

> Terminate the survey if diving birds, marine mammals and/or turtles show obvious negative behavioural changes within 500 m of the survey vessel or equipment. The survey should be terminated until such time it is confirmed that the identified animal(s) has moved to a point that is more than 500 m from the source or despite continuous observation or 30 minutes has elapsed since the last sighting of the identified animal(s) within 500 m of the source.

- For a source level greater than 190 dB re 1 µPa at 1 m the following is recommended, in addition to the above:
  > A "soft-start" procedure shall be implemented for a period of 20 minutes. Where the equipment does not provide for a "soft-start", the equipment should be turned on and off over a 20 minute period to act as a warning signal and allow the above-mentioned animals to move away from the sound source;
  > "Soft-starts" should, as far as possible, be planned to commence within daylight hours;
  > "Soft-start" procedures must only commence once it has been confirmed by the MMO (visually during the day and in favourable weather conditions) or the PAM operator (at night or during poor daytime visibility), where applicable, that there is no diving bird, marine mammal and/or turtle activity within 500 m of the vessel for a 30-minute period. However, if after a period of 30 minutes diving birds, marine mammals smaller than 3 m and/or turtles are still within 500 m of the vessel, the normal "soft-start" procedure should be allowed to commence; and
  > "Soft-start" procedures must also be implemented after breaks in surveying (for whatever reason) of longer than 20 minutes. Breaks of shorter than 20 minutes should be followed by a "soft-start" of similar duration.

6.2.4 RECOMMENDATIONS SPECIFIC TO HELICOPTER OPERATIONS

- Flight paths must be pre-planned to ensure that no flying occurs over seal and seabird colonies or marine islands. Important areas between Cape Town and the proposed exploration area include: Seal Island and Boulders Beach in False Bay, and Duikerklip in Hout Bay;
- Extensive coastal flights (parallel to the coast within 1 nm of the shore) should be avoided. There is a restriction of coastal flights (parallel to the coast within 1 nm of the shore) on the South Coast between the months of June and November to avoid Southern Right whale breeding areas;
- The contractor should comply fully with aviation and authority guidelines and rules; and
- All pilots must be briefed on ecological risks associated with flying at a low level parallel to the coast.

7. ENVIRONMENTAL MANAGEMENT PROGRAMME

This chapter lists the auditable environmental protection activities and procedures required to avoid or minimise impacts on the environment from the proposed exploration activities in Blocks 3617 and 3717. It also indicates who is the responsible party and includes a compliance audit column (✓) for auditing purposes and the requirements for closure.

The specific environmental protection activities and procedures are addressed under each of the project life cycle phases listed below:

7.1	PLANNING PHASE	7.1.1 Seismic survey timing and scheduling
		7.1.2 Survey equipment
		7.1.3 Survey personnel
		7.1.4 Preparation of subsidiary plans
		7.1.5 Stakeholder consultation and notification
		7.1.6 Permits / exemptions
		7.1.7 Financial provision
7.2	ESTABLISHMENT PHASE	7.2.1 Compliance with the EMP
		7.2.2 Environmental awareness training
		7.2.3 Notifying other users of the sea
7.3	OPERATIONAL PHASE	7.3.1 Adherence to the EMP
		7.3.2 Communication with other users of the sea and resource managers
		7.3.3 Prevention of emergencies
		7.3.4 Dealing with emergencies including major oil spills
		7.3.5 Seismic survey procedure and monitoring
		7.3.6 Multi-beam bathymetry survey procedure and monitoring
		7.3.7 Pollution control and waste management
		7.3.8 Equipment loss
		7.3.9 Use of helicopters
		7.3.10 Bunkering / refuelling at sea
		7.3.11 Vessel lighting
7.4	DECOMMISSIONING AND CLOSURE PHASE	7.4.1 Survey vessels to leave area
		7.4.2 Inform key stakeholders of survey completion
		7.4.3 Final waste disposal
		7.4.4 Information sharing
		7.4.5 Compile seismic survey “close-out” reports

7.1 PLANNING PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
7.1.1 SEISMIC SURVEY TIMING AND SCHEDULING	Minimise impact on cetaceans	• The seismic survey should be undertaken outside of the key cetacean migration and breeding period which extends from the beginning of June to the end of November, as well as December when whales (with calves) are on their return journey, which potentially passes through the proposed exploration licence area. Thus the recommended survey period extends from the beginning of January to the end of May.		Rhino	Prior to finalisation of survey schedule / timing	MMO close-out report
7.1.2 SURVEY EQUIPMENT	Minimise impact on cetaceans and turtles	• Use 'turtle-friendly' tail buoys. Alternatively, the existing tail buoys should be fitted with either exclusion or deflector 'turtle guards' to prevent turtle entrapment. • The MMO shall inspect tail buoys prior to the survey to ensure guards are in place. If turtles are observed to be trapped, survey operations will be ceased until the animal can be freed from the towed equipment.		Rhino and Survey Contractor	Prior to commencement of operation	MMO close-out report
		Seismic surveys: • The seismic survey vessel must be fitted with PAM technology. • PAM technology must be used during both the pre-watch period and when the airguns are active (including "soft-starts", airgun tests and surveying). • In order to avoid unnecessary delays to the survey programme, it is recommended that a spare PAM cable and sensor are kept onboard should there be any technical problems with the system. Multi-beam bathymetry surveys: • For a source level greater than 190 dB re 1 µPa at 1 m, PAM technology must be used if surveying is to be undertaken at night or poor daytime visibility.				PAM operator close-out report
7.1.3 SURVEY PERSONNEL	Minimise impact on marine fauna	Seismic surveys: • Appoint an independent on-board Marine Mammal Observer (MMO) and PAM operator for the duration of the survey. • The MMO and PAM operator must have experience in seabird, turtle and marine mammal identification and observation techniques. Multi-beam bathymetry surveys: • Appoint an independent on-board Marine Mammal Observer (MMO) and, if necessary, PAM operator for the duration of the survey.		Rhino	Prior to commencement of operation	MMO and PAM operator close-out reports
	Minimise impact on other users of the sea	• Appoint an independent on-board Fisheries Liaison Officer (FLO). The FLO must be familiar with fisheries operational in the area.				FLO close-out report

7.1 PLANNING PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
7.1.4 PREPARATION OF SUBSIDIARY PLANS	Preparation for any emergency that could result in an environmental impact	• Ensure the following plans are prepared and in place: > Shipboard Oil Pollution Emergency Plan (SOPEP) as required by MARPOL; > Emergency Response Plan (including MEDIVAC plan); and > Waste Management Plan (see contents in Section 7.3.7). • In addition to the above, ensure that: > There is adequate protection and indemnity insurance cover for oil pollution incidents; and > There is a record of the vessel's seaworthiness certificate and/or classification stamp.		Rhino and Survey Contractor	Prior to commencement of operation	Confirm compliance and justify any omissions
7.1.5 STAKEHOLDER CONSULTATION AND NOTIFICATION	PASA notification	• Compile the specific details of each survey into a Survey Notification document and submit to the Commissioner for Petroleum Affairs, Ministry of Mines and Energy (MME). The notification should provide details on the following: > Survey plan / lines; > Survey timing and duration; > Contractor details; > Vessel specifications (including relevant certification and insurance); > Emergency Response Plan; > Shipboard Oil Pollution Emergency Plan (SOPEP); and > Details of MMO, PAM operator and FLO.		Rhino	30-days prior to commencement of operations or as requested by PASA	Confirm that notification was sent to PASA
	Stakeholder notification	• Prior to survey commencement the following key stakeholders should be consulted and informed of the proposed survey activity (including navigational co-ordinates of the survey area, timing and duration of proposed activities) and the likely implications thereof: > Fishing industry / associations: - South African Tuna Association; - South African Tuna Long-Line Association; and - Fresh Tuna Exporters Association. > Other: - PASA; - DAFF; - Transnet National Ports Authority (ports of Cape Town and Saldanha); - SAMSA; and - South African Navy Hydrographic office; and - Overlapping and neighbouring right holders.		Rhino	30 days prior to commencement of operations	Provide copies of all correspondence

7.1 PLANNING PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
		• The notification must also invite stakeholders to be included on the daily report distribution list (only those included on the daily notification database will receive further notification during the survey).				
	Dispute resolution	• Any dispute arising with other right holders should be referred to Department of Mineral Resources (DMR) or PASA for resolution.		Rhino	As required	Decision taken by DMR or PASA
7.1.6 PERMITS / EXEMPTIONS	Compliance with legislative requirements	If necessary, apply to DEA for a permit or exemption to approach to or remain within 300 m of whales (see note below). The application for a permit or request for an exemption should be submitted to: - Zintle Mapekula, email: zmapekula@environment.gov.za; or - Gcobani Popose, email: gpopose@environment.gov.za). Notes: In terms of the Marine Living Resources Act, 1998 (No. 18 of 1998): • No person may approach within 300 m of a whale by vessel, aircraft or other means without a permit; • A vessel approached by a whale is required to distance itself at 300 m from the whale, unless in possession of a permit; • A vessel may not proceed directly through a school of dolphins or porpoises; and • No person shall attempt to feed, harass, disturb or kill great white sharks, dolphins, seals or turtles.		Rhino or Survey Contractor	Prior to commencement of operations	Provide copy of permit / exemption
7.1.7 FINANCIAL PROVISION	Ensure there is adequate financial provision in place to execute the requirements of the EMP	• Review, assess and adjust financial provision in order to ensure that there is adequate financial provision in place to execute the requirements of the EMP.		Rhino	Within 1 yr of commencement of operations and annually thereafter	Verify that the financial provision has been reviewed and adjusted, if required

7.2 ESTABLISHMENT PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
7.2.1 COMPLIANCE WITH EMP	Operator and contractor to commit to adherence to environmental protection activities and procedures	• Verify that a copy of the approved EIA is supplied to all Contractors and is on-board the survey and support vessels during the operation. • Operator to commit organisation and Contractor to meet the requirements of the EMP. • Verify procedures and systems for compliance are in place. • Verify correct equipment and personnel are available to meet the requirements of the EMP.		Rhino and Survey Contractor	Prior to commencement of operation	Ensure that a copy of the EIA is provided to the Seismic Contractor and that an acknowledgment of receipt form is signed
7.2.2 ENVIRONMENTAL AWARENESS TRAINING	Ensure personnel are appropriated trained	• Undertake Environmental Awareness Training (including spill management) to ensure the vessel's personnel are appropriately informed of the purpose and requirements of the EMP. • Verify responsibilities are allocated to personnel.		Rhino and Survey Contractor		Copy of attendance register
7**.2.3 NOTIFYING OTHER USERS OF THE SEA**	Ensure that other users are aware of the seismic survey	• Request, in writing, that the South African Navy Hydrographic office release Radio Navigation Warnings and Notices to Mariners throughout the survey periods. The Notice to Mariners should give notice of (1) the co-ordinates of the proposed survey area, (2) an indication of the proposed survey timeframes and day-to-day location of the survey vessel, and (3) an indication of the 500 m safety zones and the proposed safe operational limits of the survey vessel. • Notices to Mariners should also be distributed timeously to fishing companies and directly onto vessels where possible.		Rhino and Survey Contractor	Notice to mariners to be issued 24 hours prior to start	Confirm that notices were sent to relevant parties Provide copies of notices and list of those to whom it was sent

7.3 OPERATIONAL PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
7.3.1 ADHERENCE TO THE EMP	Operate in an environmentally responsible manner	• Comply fully with the EMP (compliance would mean that all activities were undertaken successfully and details recorded); • Subscribe to the principles of an internationally acceptable Environmental Management System on-board the vessels. This includes environmental awareness training, waste management and environmental monitoring, record keeping and continuous improvement; and • Comply with the "Environmental Guidelines for Worldwide Geophysical Operations" issued by the International Association of Geophysical Contractors (IAGC).		Survey Contractor	Throughout programme	Copies of self-audit reports
7.3.2 COMMUNICATION WITH OTHER USERS OF THE SEA AND RESOURCE MANAGERS	Promote cooperation and successful multiple use of the sea, including promotion of safe navigation	• Daily reports shall be submitted, via email, to key stakeholders and those stakeholders that request to be notified during the survey (see Section 7.1.5). Daily reports should include, but not limited to, the following: > Survey details (incl. percentage completion & start-up procedure); > Vessel interaction; > Meteorological Conditions; > Observation times and sightings; > Waste management; and > Survey strategy (incl. survey progress and next line to be acquired).		MMO	During operations as required	Provide copies of written notices and list of those to whom it was sent
		• Keep constant watch for approaching vessels during operations. Warn by radio and chase boat if required. The duties of the FLO include: > Reporting on vessel activity daily; > Advising on actions to be taken in the event of encountering fishing gear; > Providing back-up on-board facilitation with the fishing industry and other users of the sea; and > Daily electronic reporting on vessel activity and recording of any communication and/or interaction.		Officer on watch / FLO	Throughout operation	Daily reports and FLO close-out report
		• Call, via radio, any vessel targets at a radar range of 12 nm from the survey vessel to inform them of the safety requirements around the survey vessel.		FLO		Daily reports and FLO close-out report

7.3 OPERATIONAL PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
7.3.3 PREVENTION OF EMERGENCIES	Minimise disruption to other legitimate users of the sea by respecting their rights and the chance of emergency occurring and subsequent damage to the environment	• Co-operate with other legitimate users of the sea to minimise disruption to other marine activities. • Vessels are required to fly standard flags, lights (three all-round lights in a vertical line, with the highest and lowest lights being red and the middle light being white) or shapes (three shapes in a vertical line, with the highest and lowest lights being balls and the middle light being a diamond) to indicate that the seismic vessel is engaged in towing surveys and is restricted in manoeuvrability. • Use warning lights during twilight and at night and in periods of low visibility. • Maintain standard visual watch procedures (see Section 7.3.2). • Maintain 500 m safety zone around survey vessel through Notices to Mariners and Navigation Warnings. • 24 hr chase boat on patrol during seismic surveying. • Radio communication to alert approaching vessels (see Section 7.3.2). • Use flares or fog horn where necessary. • Practice weekly emergency response drills. • Ensure vessel has access to current weather service information. • Establish lines of communication with emergency response agencies/facilities: South African Maritime Safety Authority (SAMSA), Department of Environmental Affairs (DEA): Marine and Coastal Pollution Management, Smit Amandla Marine and Port Captain(s).		Survey Contractor / FLO	Throughout operation	Record any incidents outside of normal occurrence

7.3 OPERATIONAL PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
7.3.4 DEALING WITH EMERGENCIES INCLUDING MAJOR OIL SPILLS (owing to collision, vessel break-up, refuelling etc.)	Minimise damage to the environment by implementing response procedures efficiently	• Adhere to obligations regarding other vessels in distress. • Implement emergency plans in Section 7.1.4. • Notify SAMSA about wrecked vessels (safety and pollution) and the Department of Finance (salvage, customs, royalties). Provide location details to SAN Hydrographer. • Vessels must have the necessary spill response capability to deal with accidental spills in a safe, rapid, effective and efficient manner. • In the event of a routine incident (e.g. onboard spill or leak) confined to the survey vessel or other incident that does not pose a risk of major harm to the environment or people, then the following steps may be taken: > Mobilisation of onboard response person or team to: - contain the spill and shut off or control the source of the incident event; - clean up the spill or take steps to rectify the incident consequences. > Complete an incident report form; > Conduct an investigation; and > Close out the incident. • In the event of a major oil spill (emergency): > Notify (a) the Principal Officer of the nearest SAMSA office, (b) the DEA's Chief Directorate of Marine & Coastal Pollution Management in Cape Town and (c) Smit Amandla Marine. Information that should be supplied when reporting a spill includes: - Name and contact details of person reporting the incident; - The type and circumstances of incident, ship type, port of registry, nearest agent representing the ships company; - Date and time of spill; - Location (co-ordinates), source and cause of pollution; - Type and estimated quantity of oil spilled and the potential and probability of further pollution; - Weather and sea conditions; and - Action taken or intended to respond to the incident. > Mobilise on-board resources and take all practical steps on the seismic vessel to contain the oil spill; and > Adhere to all notification, investigation procedures, and reporting requirements.		Rhino and Survey Contractor	In the event of accident / spill	Record of all spills (Spill Record Book), including spill reports; emergency exercises and audit records. Incident log

7.3 OPERATIONAL PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
		• Where diesel, which evaporates relatively quickly, has been spilled, the water should be agitated or mixed using a propeller boat/dinghy to aid dispersal and evaporation. • Dispersants should not be used without authorisation of DEA (Marine & Coastal Pollution Management). • Dispersants should not be used: > On diesel or light fuel oil; > On heavy fuel oil; > On slicks > 0.5 cm thick; > On any oil spills within 5 nautical miles off-shore or in depths less than 30 metres; and > In areas far offshore where there is little likelihood of oil reaching the shore. • Dispersants are most effective: > On fresh crude oils; under turbulent sea conditions (as effective use of dispersants requires mixing); and > When applied within 12 hours or at a maximum of 24 hours. • The volume of dispersant application should not exceed 20-30% of the oil volume.				
7.3.5 SEISMIC SURVEY PROCEDURE AND MONITORING	Reduce disturbance of marine life, particularly cetaceans (whales and dolphins), seals, turtles and seabirds (particularly penguins)	MMO and PAM operator: • An on-board MMO and PAM operator shall be assigned to perform marine mammal observations and notifications.		Rhino and Seismic Contractor		MMO & PAM operator close-out reports
		Source level: • Ensure the lowest practicable seismic source array volume to achieve the geophysical objective is defined and used throughout the survey period.		Rhino	Prior to survey operations	
		PAM equipment: • The PAM hydrophone streamer should ideally be towed behind the airgun array to minimise the interference of vessel noise, and should be fitted with two hydrophones to allow directional detection of cetaceans. • If there is a technical problem with PAM during surveying, visual watches must be maintained by the MMO during the day and night-vision/infra-red binoculars must be used at night while PAM is being repaired.		PAM operator		MMO & PAM operator close-out reports

7.3 OPERATIONAL PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
		Pre-shoot watch: • Undertake a pre-shoot watch (prior to soft-starts) in order to confirm there is no diving seabird (significant diving activity), seal, turtle or cetacean activity within 500 m of the seismic source array. The period of confirmation for cetaceans must be at least 60 minutes. • The pre-survey watch is to be undertaken visually and using PAM technology during the day and using only PAM technology at night or during periods of poor visibility visibility.		MMO/ PAM operator	Prior to "soft-start" procedures	MMO & PAM operator close-out report
		"Soft-start" procedure: • All initiations of airgun tests (a single or a number of airguns at full power)[1] and / or seismic surveying must be carried out as "soft-starts" for a minimum of 20 minutes. This requires that the sound source be ramped from low to full power rather than initiated at full power, thus allowing a flight response by marine fauna to outside the zone of injury or avoidance. • "Soft-starts" should be delayed until such time as this area is clear of seabirds (diving), turtles, seals or cetaceans. > In the case of turtles and cetaceans the "soft-start" procedure should not begin until after the animals depart the 500 m exclusion zone or 30 minutes after they are last seen. > In the case of seals, which are often attracted to survey vessels, the normal "soft-start" procedures should be allowed to commence, if after a period of 30 minutes seals are still within 500 m of the airguns.		Seismic Contractor	Prior to airgun tests (at full power) and surveying	MMO & PAM operator close-out report
		Break in seismic acquisition: • All breaks in seismic acquisition of longer than 20 minutes must be followed by the 60-minute pre-shoot watch and a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing. • In order to facilitate a more effective timing of proposed operations when surveying in deeper waters, the 60-minute pre-shoot watch can commence before the end of the survey line (whilst the airguns are still firing). • Breaks shorter than 20 minutes should be followed by a visual scan for marine mammals within the 500 m mitigation zone (not a 60 minute pre-shoot watch) and a "soft-start", of similar duration.		Seismic Contractor	After breaks in seismic acquisition	MMO & PAM operator close-out report

[1] Note: If the intention is to test a single airgun on low power then a "soft-start" is not required.

7.3 OPERATIONAL PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
		Monitoring: • MMO is to monitor survey operations visually during the day. Duties include: > Confirm that there is no marine faunal activity within 500 m of the seismic source array prior to commencing with the "soft-start" procedures. > Record pre-shoot observation regime. > Record survey activities, including sound levels, "soft-start" procedures and survey periods (duration). > Monitor marine faunal activity during daytime surveying. Observe and record responses of marine fauna to the seismic survey, including seabird, turtle, seal and cetacean incidence and behaviour and any mortality or injuries of marine fauna as a result of the seismic survey. Data captured should include species identification, position (latitude/longitude), distance from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the survey activities. > Requesting the temporary termination of seismic acquisition, as appropriate; > Recording meteorological conditions. > Monitoring compliance with international marine pollution regulations (MARPOL 73/78 standards). > Preparing daily reports of all observations. • PAM operator is monitor at night and during periods of poor visibility. Duties include: > Ensure that hydrophone streamers are optimally placed within the towed array. > Confirm that there is no cetaceans activity within 500 m of the vessel prior to commencing with the "soft-start" procedures. > Record survey activities, including sound levels, "soft-start" procedures and survey periods (duration). > Record pre-shoot observation regime. > Monitor cetacean activity during daytime and night time surveying. Record species identification, position (latitude/longitude) and distance from the vessel, where possible. > Request the temporary termination of the seismic survey, as appropriate.		MMO/ PAM operator	Throughout survey operations	MMO & PAM operator close-out report

7.3 OPERATIONAL PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
		Temporary termination of seismic acquisition: • During surveying, airgun firing should be terminated when: > obvious negative changes to turtle, seal and cetacean behaviour is observed; > turtles or cetaceans are observed within 500 m of the active sound source and appear to be approaching the sound source; or > there is visual evidence of mass mortality of fish or mortality / injuries to seabirds, turtles, seals or cetaceans as a direct result of the seismic survey. • The survey should be terminated until such time the MMO / PAM operator confirms that: > Turtles or cetaceans have moved to a point that is more than 500 m from the sound source; > Despite continuous observation, 30 minutes has elapsed since the last sighting of the turtles or cetaceans within 500 m of the sound source; and > Risks to seabirds, turtles, seals or cetaceans have been significantly reduced. • A log of all termination decisions must be kept.		Seismic Contractor and MMO / PAM operator	Throughout survey operations	MMO & PAM operator close-out report

7.3 OPERATIONAL PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
7.3.6 MULTI-BEAM BATHYMETRY SURVEY PROCEDURE AND MONITORING	Reduce disturbance of marine life, particularly cetaceans (whales and dolphins), seals, turtles and seabirds (particularly penguins)	MMO and PAM operator: • An on-board MMO and, if necessary, PAM operator shall be assigned to perform marine mammal observations and notifications. • As indicated in Section 7.1.2, PAM technology must for a source level greater than 190 dB re 1 µPa at 1 m when surveying at night or poor daytime visibility. If there is a technical problem with PAM during nighttime surveying, night-vision/infra-red binoculars must be used.		Rhino and Survey Contractor		MMO & PAM operator close-out reports
		For a source level less than 190 dB re 1 µPa at 1 m: • Surveying must only commence once it has been confirmed (visually during the day) that there is no diving bird, marine mammal and/or turtle activity within 500 m of the vessel. For cetaceans the period of confirmation should be at least 30 minutes. However, if after a period of 30 minutes cetaceans smaller than 3 m, seals and/or diving seabirds are still within 500 m of the vessel, the survey may commence. • Terminate the survey if diving birds, marine mammals and/or turtles show obvious negative behavioural changes within 500 m of the survey vessel or equipment. The survey should be terminated until such time it is confirmed that the identified animal(s) has moved to a point that is more than 500 m from the source or despite continuous observation or 30 minutes has elapsed since the last sighting of the identified animal(s) within 500 m of the source.		MMO/ PAM operator	Throughout survey operations	MMO & PAM operator close-out report
		For a source level greater than 190 dB re 1 µPa at 1 m: • A "soft-start" procedure shall be implemented for a period of 20 minutes. Where the equipment does not provide for a "soft-start", the equipment should be turned on and off over a 20 minute period to act as a warning signal and allow the above-mentioned animals to move away from the sound source. • "Soft-start" procedures must only commence once it has been confirmed by the MMO (visually during the day and in favourable weather conditions) or the PAM operator (at night or in unfavourable weather conditions), where applicable, that there is no diving bird, marine mammal and/or turtle activity within 500 m of the vessel for a 30-minute period. However, if after a period of 30 minutes diving birds, marine mammals smaller than 3 m and/or turtles are still within 500 m of the vessel, the normal "soft-start" procedure should be allowed to commence. • "Soft-starts" should, as far as possible, be planned to commence within daylight hours.		MMO/ PAM operator	Throughout survey operations	MMO & PAM operator close-out report

7.3 OPERATIONAL PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
		• "Soft-start" procedures must also be implemented after breaks in surveying (for whatever reason) of longer than 20 minutes. Breaks of shorter than 20 minutes should be followed by a "soft-start" of similar duration. • Terminate the survey if diving birds, marine mammals and/or turtles show obvious negative behavioural changes within 500 m of the survey vessel or equipment. The survey should be terminated until such time it is confirmed that the identified animal(s) has moved to a point that is more than 500 m from the source or despite continuous observation or 30 minutes has elapsed since the last sighting of the identified animal(s) within 500 m of the source.				
		Monitoring: • MMO / PAM operator duties include: > Monitor the survey pre-watch period. > Record sound levels, pre-watch sightings and "soft-start" procedures (where required). > Observe and record responses of diving birds, marine mammals and/or turtles to the multi-beam bathymetry survey. Data captured should include species identification, position (latitude/longitude), distance from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the survey activities. > Request the temporary termination of survey, as appropriate.		MMO / PAM operator	Throughout survey operations	MMO & PAM operator close-out report

7.3 OPERATIONAL PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
7.3.7 POLLUTION CONTROL AND WASTE MANAGEMENT of products disposed of: into the air (exhausts, cfcs and incinerators), to sea (sewage, food, oils), to land (used oils etc, metals, plastics, glass, etc.)	Minimise pollution and maximise recycling by implementing and maintain pollution control and waste management procedures at all times	• Implement Waste Management Plan (see Section 7.1.4). The plan must comply with legal requirements for waste management and pollution control (for air and water quality levels at sea) and ensure "good housekeeping" and monitoring practices: > <u>General waste:</u> - Initiate a waste minimisation system. - No disposal overboard. - Ensure on-board solid waste storage is secure. - Transport ashore for disposal. Retain waste receipts. Note: Incineration would require an Atmospheric Emissions Licence. > <u>Galley (food) waste</u>: - No disposal within 3 nm of the coast. - Disposal between 3 nm and 12 nm needs to be comminuted to particle sizes smaller than 25 mm. - Disposal beyond 12 nm requires no treatment. - Minimise the discharge of waste material should obvious attraction of fauna be observed. > <u>Deck drainage</u>: - Deck drainage should be routed to a separate drainage system (oily water catchment system). - Ensure all process areas are bunded to ensure drainage water flows into the closed drainage system. - Use drip trays to collect run-off from equipment that is not contained within a bunded area and route contents to the closed drainage system. - Ensure that weather decks are kept free of spillage. - Mop up any spills immediately with biodegradable low toxicity detergents. - Low-toxicity biodegradable detergents should be used in cleaning of all deck spillage. - Ensure compliance with MARPOL standards (15 ppm). > <u>Machinery space drainage</u>: - Vessels must comply with international agreed standards regulated under MARPOL. - Ensure all process areas are bunded to ensure drainage water flows into the closed drainage system. - Use drip trays to collect run-off from equipment that is not contained within		Survey Contractor	Throughout operation	Provide summary of waste record book / schedule and receipts. Manifest required for all shipments to shore. Report occurrence of minor oil spills and destination of wastes

7.3 OPERATIONAL PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
		a bunded area and route contents to the closed drainage system - All machinery space drainage would pass through an oil/water filter to reduce the oil in water concentration to less than 15 mg/l. > Sewage: - Use approved treatment plants to the MARPOL standards. - No disposal within 4 nm of the coast. - Disposal between 4 nm and 12 nm needs to be comminuted and disinfected prior to disposal into the sea. - Disposal beyond 12 nm requires no treatment. > Medical waste: Seal in aseptic containers for appropriate disposal onshore. > Metal: Send to shore for recycling or disposal. > Other waste: - Transport ashore for disposal. - Ensure waste disposal is carried out in accordance with appropriate laws and ordinances. - Retain waste receipts. - Note: Incineration would require an Atmospheric Emissions Licence. > Waste oil: Return used oil to a port with a registered facility for processing or disposal. > Wastewater: Comply with MARPOL. > Minor oil spill: Use oil absorbent. > Emissions to the atmosphere: Properly tune and maintain all engines, motors, generators and all auxiliary power to contain the minimum of soot and unburned diesel. > Other hazardous waste: - Record types and volumes of chemical and hazardous wastes (e.g. neon lights, fluorescent tubes, toner cartridges, batteries, etc.) and destination thereof. - Send to designated onshore hazardous disposal site. Retain waste receipts. • Ensure all crew is trained in spill management.				

7.3 OPERATIONAL PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
7.3.8 EQUIPMENT LOSS	Minimise hazards left on the sea bed or floating in the water column, and inform relevant parties	• Keep a record of lost equipment and all items lost overboard and not recovered. • When any item that constitute a seafloor or navigation hazard are lost on the sea bed, or in the sea, a standard form must be completed which records the date and cause of loss, details of equipment type, vessel Sea Control location, sea state and weather, and the nature of the sea bed. Pass information to PASA and SAMSA. • Notify SAN Hydrographer, relevant fishing associations. SAN Hydrographer will send out Notice to Mariners with this information.		Survey Contractor	Throughout operation, in the event of an incident	Provide a list of lost equipment and a copy of record sheet
7.3.9 USE OF HELICOPTERS for crew changes, servicing, etc.	Minimise disturbance / damage to marine and coastal fauna	• Flight paths must be pre-planned to ensure that no flying occurs over seal and seabird colonies or marine islands. Important areas between Cape Town and the proposed exploration area include: Seal Island and Boulders Beach in False Bay, and Duikerklip in Hout Bay. • Report any deviations from set flight plans. • Extensive coastal flights (parallel to the coast within 1 nm of the shore) should be avoided. There is a restriction of coastal flights (parallel to the coast within 1 nm of the shore) on the South Coast between the months of June and November to avoid Southern Right whale breeding areas. • Comply with the Marine Living Resources Act, 1998 which prohibits aircrafts approaching within 300 m of whales without a permit or exemption (see Section 7.1.6). • Comply with the Seabirds and Seals Protection Act, 1973, which prohibits the wilful disturbance of seals on the coast or on offshore islands. • Comply with aviation and authority guidelines and rules. • Brief all pilots on the ecological risks associated with flying at a low level parallel to the coast.		Rhino and Helicopter contractor	As required	Submit copy of set flight path Copies of reports on deviations from set flight paths

7.3 OPERATIONAL PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	**✓**	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
7.3.10 BUNKERING / REFUELLING AT SEA	Minimise damage to marine and coastal fauna	• Transfer of oil at sea is not permitted within the economic zone (i.e. 200 miles from the coast) without the permission of SAMSA. Submit an application (including location, supplier and timing) in terms of Regulation 14 to the Principal Officer at the port nearest to where the transfer is to take place. • Offshore bunkering should not be undertaken in the following circumstances: > Wind force and sea state conditions of 6 or above on the Beaufort Wind Scale; > During any workboat or mobilisation boat operations; > During helicopter operations; > During the transfer of in-sea equipment; and > At night or times of low visibility. • Ensure support vessels must have the necessary spill response capability to deal with accidental spills in a safe, rapid, effective and efficient manner		Survey Contractor	As required, 5 days prior to refuelling	Confirm that a notice was sent to SAMSA
7.3.11 VESSEL LIGHTING	Minimise impact on seabirds	• Lighting on-board survey vessels should be reduced to the minimum safety levels to minimise stranding of pelagic seabirds on the survey vessels at night. • All stranded seabirds must be retrieved and released during daylight hours		Survey Contractor		Results of faunal monitoring

7.4 DECOMMISSIONING AND CLOSURE PHASE						
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PLAN REPORT OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**	**REQUIREMENT FOR "CLOSE-OUT" REPORT:**
7.4.1 SURVEY VESSELS TO LEAVE AREA	Leave survey area as it was prior to survey	• Ensure that all deployed equipment is retrieved.		Survey Contractor	On completion of survey	
7.4.2 INFORM KEY STAKEHOLDERS OF SURVEY COMPLETION	Ensure that relevant parties are aware that the seismic campaign is complete	• Inform the PASA and other key stakeholders (see Section 7.1.5) of the survey completion.		Rhino	Within two weeks after completion of survey	Copies of notification documentation required.
7.4.3 FINAL WASTE DISPOSAL	Minimise pollution and ensure correct disposal of waste	• Dispose all waste retained on-board at a licensed waste site using a licensed waste disposal contractor.		Survey Contractor	When vessel is in port	Receipt required from contractor
7.4.4 INFORMATION SHARING	Information sharing	• Take steps to share data collected during the survey (e.g. marine mammal incidence and behaviour), if requested, to resource managers (including Marine Mammal Institute, DEA, DAFF and PASA).		Rhino	As requested	
7.4.5 COMPILE SEISMIC SURVEY "CLOSE-OUT" REPORTS	Ensure corrective action and compliance and contribute towards improvement of EMP implementation	• Compile a "close-out" report at the end of each survey. • The "close-out" report must be based on requirements of the monitoring and EMP. • Provide information / records as indicated in the "close-out" report column of the EMP. • Provide a copy of the report to PASA.		Rhino	Within 90 days post surveying or as requested by PASA	

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