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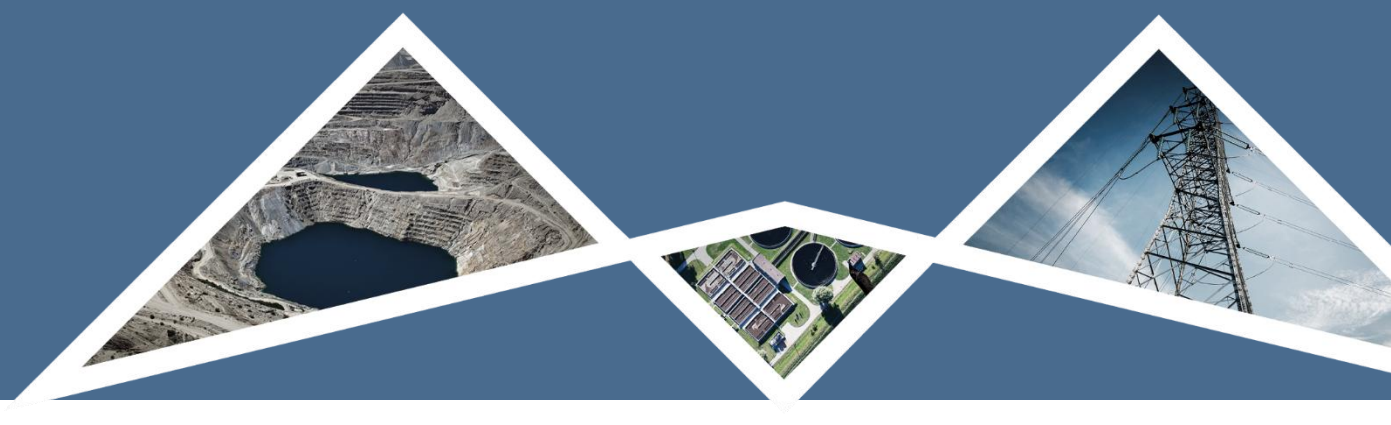
ENVIRONMENTAL MANAGEMENT PROGRAMME

PROPOSED OIL AND GAS EXPLORATION PROGRAMME IN BLOCK 2C OFF THE WEST COAST OF SOUTH AFRICA



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REVISION AND AMENDMENTS

REVISION DATE:	REV #	DESCRIPTION
2013/04/05	ORIGINAL DOCUMENT	EMPr compiled by CCA Environmental (Pty) Ltd
2025/05/19	REVISION 1	EMPr Amendment- based on 2025 Environmental Audit – Amendments in blue text

[1] The content of this EMPr was copied from the 2013 EMPr compiled by CCA Environmental (Pty) Ltd for Block 2C. EIMS was appointed in 2025 to revise and amend this EMPr based on recommendations from an Independent Audit undertaken in 2025.

EXECUTIVE SUMMARY

This Executive Summary incorporates the main findings of the Environmental Management Programme (EMPr) prepared for a proposed exploration programme in Licence Block 2C off the West Coast of South Africa.

It should be noted that a draft version of ~~this~~ the original EMP was distributed for a 30-day review / comment period. Although no comments were received during this period, the EMP ~~has been~~ was updated and finalised. All significant changes to the original report ~~are~~ were underlined and in a different font (Times New Roman) to the rest of the text.

1 INTRODUCTION

~~Anadarko South Africa (Pty) Ltd ("Anadarko") lodged an application for an Exploration Right with the Petroleum Agency of South Africa (PASA) in terms of Section 79 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA) in order to explore for oil and gas reserves in Licence Block 2C off the West Coast of South Africa. PASA accepted the application on 12 December 2012.~~

The Petroleum Oil and Gas Corporation of South Africa SOC Ltd (PetroSA) is the holder of an Exploration Right for petroleum issued in accordance with the Minerals and Petroleum Resources Development Act (Act 28 of 2002-MPRDA). PetroSA is required to implement the exploration activities in accordance with the requirements of the approved Environmental Management Programme (EMPr). The proposed Exploration Right area is situated in the Orange Basin roughly 200 km offshore of the Northern Cape in water depths ranging from approximately 300 m to 1 500 m (see Figure 1).

The ~~proposed~~ initial three-year exploration work programme ~~would~~ consisted of the following:

1. 3D and / or 2D seismic surveys;
2. Seafloor geochemical survey:
    a. Multi-beam bathymetry survey;
    b. Seafloor sampling programme; and
    c. Seafloor heatflow measurements.

However, it should be noted that none of the approved activities listed above were executed during the tenure of the Initial Exploration Period. A Section 102 application for the Initial Exploration Period was made by PetroSA and approved by PASA to reduce the work programme from the acquisition of 3D and/or 2D seismic surveys and conducting Seafloor geochemical surveys to reprocessing of 3D seismic data.

In terms of the MPRDA, a requirement for obtaining an Exploration Right is that an Environmental Management Programme (EMP) must be compiled in terms of Section 39 of the MPRDA and submitted to PASA for consideration and for approval by the Minister of Mineral Resources. Furthermore, Interested and/or Affected Parties (I&APs) must be notified and consulted in this regard.

~~Anadarko contracted CCA Environmental (Pty) Ltd (CCA) to compile this EMP to meet the relevant requirements of the MPRDA and the Regulations thereto.~~ Environmental Impact Management Services (Pty) Ltd, was appointed by PetroSA to amend the original Environmental Management Programme (EMPr) (i.e. CCA Environmental (Pty) Ltd, 2013), for submission to and approval by PASA.

2025 EMPr Update

PetroSA is required to implement the exploration activities (as approved in the work programme) in accordance with the requirements of the approved EMPr. A Regulation 34 National Environmental Management Act (Act 107 of 1998-NEMA), Environmental Impact Assessment Regulations (GNR982) (EIA Regulations) compliance audit was conducted in 2025. The findings of the audit included recommendations to amend the EMPr. This

EMPr reflects these amendments and will, once approved, form the EMPR to be implemented for future exploration activities. The 2025 amendments focus on addressing insufficient impact management outcomes and actions, as identified in the 2025 Audit. The 2025 amendments are reflected in the EMPr in blue text for ease of reference. Where aspects of the 2013 EMPr have been removed in this 2025 amendment, such are presented with strike through text.

2 EMP APPROACH AND METHODOLOGY

2.1 OBJECTIVES

The objectives for the EMPr process are:

- To provide a reasonable opportunity for I&APs to be consulted on the proposed project;
- To ensure that all potential key environmental issues and impacts that could result from the proposed project are identified;
- To identify feasible alternatives to the implementation of the proposed project;
- To assess potential impacts related to the proposed project;
- To present appropriate mitigation or optimisation measures to minimise potential impacts or enhance potential benefits; and
- Through the above, to ensure informed, transparent and accountable decision-making by the relevant authorities.

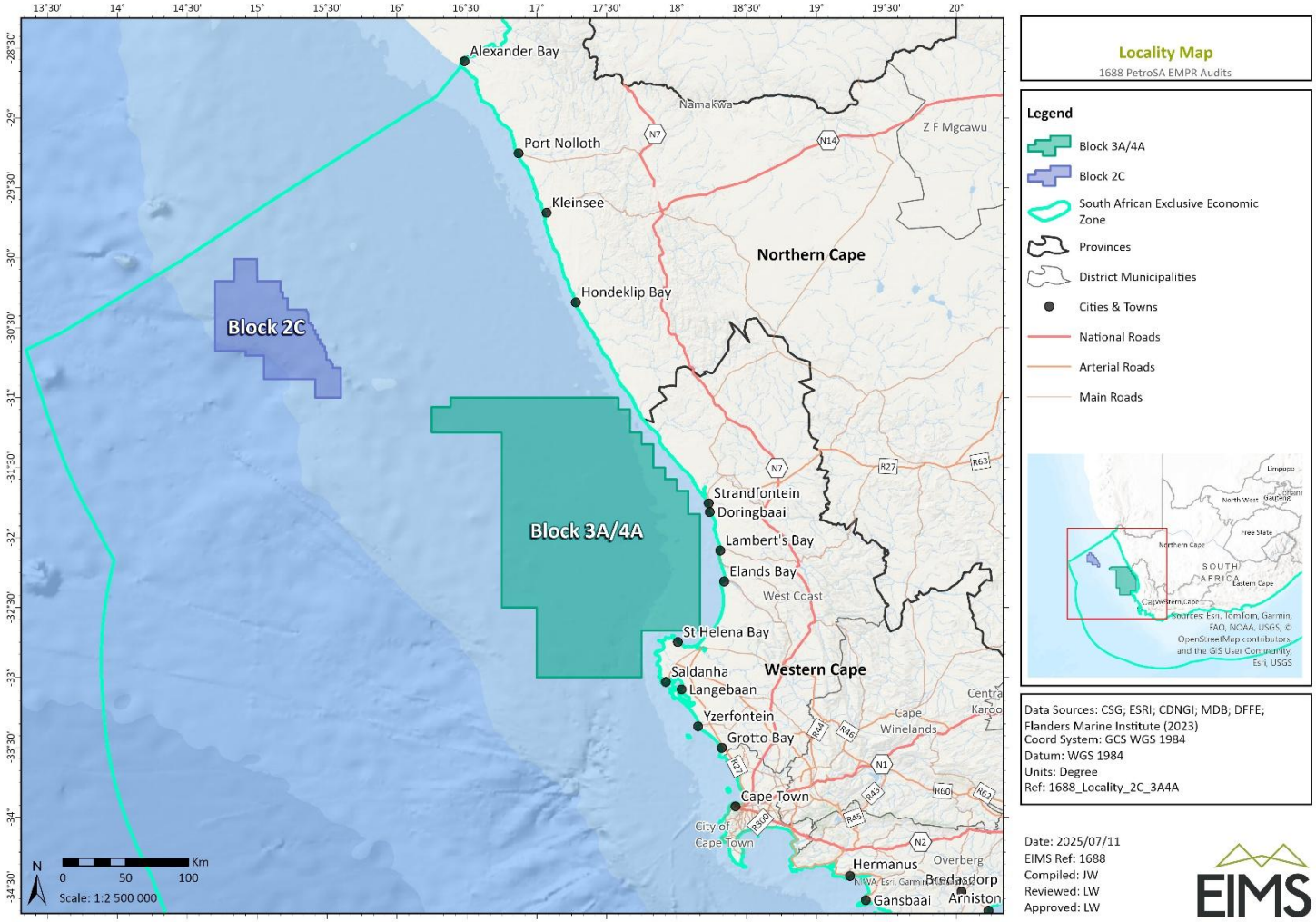

Figure 1: Location of the proposed Exploration Right area in Block 2C off the West Coast of South Africa.

2.2 PUBLIC PARTICIPATION PROCESS

The initial public participation process involved an open, participatory approach to ensure that I&APs were notified of the proposed project and given a reasonable opportunity to register on the project database and provide initial comments. Steps undertaken during this phase are summarised below:

- A preliminary I&AP database of authorities, Non-Governmental Organisations, Community-based Organisations and other key stakeholders was compiled using databases of previous studies in the area. Additional I&APs were added to the database based on responses to the advertisements and notification letter;
- A notification letter / email and Background Information Document (BID) were distributed for a 21-day registration and comment period from 30 January 2013 to 20 February 2013. The purpose of the letter / email and BID was to convey information on the proposed exploration programme and to invite I&APs to register on the project database and provide initial comment; and
- Advertisements announcing the proposed project, the availability of the BID and I&AP registration / comment period were placed in the Cape Times and Die Burger on 29 January 2013.

Comments received on the BID have been collated, and responded to, into an Issues and Responses Trail.

2.3 SPECIALIST INPUT AND DRAFT EMP COMPILATION

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.

The specialist information and other relevant information were integrated into a draft EMP. Many of the issues associated with the proposed exploration activities are generic in nature and were assessed based on previous exploration programmes off the coast of South Africa and the Generic EMP prepared for seismic surveys in South Africa. In addition, information was incorporated into the draft EMP in order to ensure compliance with Section 39 and Regulation 52 of the MPRDA.

The draft EMP was also informed by comments received during the BID comment and aimed to present all information in a clear and understandable format and suitable for easy interpretation by authorities, I&APs and other key stakeholders (e.g. operator, contractors, etc.).

2.4 DRAFT EMP REVIEW AND COMMENT PERIOD

The draft EMP was distributed for a 30-day review/ comment period from 1 March 2013 to 3 April 2013 (which made provision for the public holidays on 21 & 29 March 2013 and 1 April 2013) in order to provide l&APs and authorities with an opportunity to comment on any aspect of the proposed project and draft EMP. A copy of the full report was made available on the CCA website (www.ccaenvironmental.co.za).

Notification letters were sent to all I&APs registered on the project database on 1 March 2013, via mail and email, informing them of the release of the draft report. and where it could be reviewed. A copy of the Executive Summary was enclosed with the letter.

No comments were received during the 30-day review/ comment period.

2.5 FINALISE EMP

After closure of the review / comment period, the draft EMP was updated into ~~this~~ the final report. This report aims to present all information in a clear and understandable format and suitable for easy interpretation by authorities, I&APs and other key stakeholders (e.g. operator and contractors).

2.6 WAY FORWARD

The EMP is submitted to PASA for consideration and for approval by the Minister of Mineral Resources in terms of the MPRDA.

3 PROJECT DESCRIPTION

3.1 GENERAL INFORMATION

3.1.1 EXPLORATION RIGHT APPLICANT

PetroSA is the applicant for the Exploration Right.

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Project Manager:	Sumesh Naidoo
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3.1.2 EXPLORATION BLOCK DETAILS

Block 2C is situated off the West Coast of South Africa in the Orange Basin roughly 200 km offshore of the Northern Cape (see Figure 1). Block 2C has an area of 6 223.74 km^2 with water depths ranging from approximately 300 m to 1 500 m.

3.1.3 FINANCIAL PROVISION

In terms of the MPRDA, PetroSA is required to make financial provision to meet its obligations as described in this EMP. PetroSA will make provision for the requirements of the EMP such as monitoring, reporting or specialist studies as part of the normal budgeting process. Environmental management actions required as a result of an incident or accident would be covered by PetroSA's insurance. In addition, as a condition of contract PetroSA requires a Contractor to carry insurance that is appropriate for the work being performed.

3.1.4 MONITORING AND EMP PERFORMANCE ASSESSMENT

The operator would undertake appropriate monitoring during the proposed exploration programme. In this regard, the operator would track performance against environmental protection activities and procedures specified in Chapter 7 of the EMP.

In order to comply with the MPRDA and Regulations thereto, the operator would undertake regular performance assessments in order to monitor compliance with the EMP and to assess the continued appropriateness and adequacy of the EMP. These will take the form of "close-out" reports (one per exploration activity, unless activities are conducted simultaneously) and would include monitoring and performance assessments. These reports would outline the implementation of the EMP and highlight any problems and issues that arose during the surveys. Copies of the reports will be sent to PASA within 60 days after the completion of these activities.

3.2 SEISMIC SURVEY PROGRAMME

3.2.1 INTRODUCTION

The ~~proposed~~ initial three-year exploration work programme ~~would~~ consisted of the following:

1. 3D and / or 2D seismic surveys;

2. Seafloor geochemical survey:
    a. Multi-beam bathymetry survey;
    b. Seafloor sampling programme; and
    c. Seafloor heatflow measurements.

~~The proposed exploration programme would most likely commence with a 3D and / or 2D seismic survey in the summer survey window period (2013/2014). In addition, a seafloor geochemical survey (which may include multi-beam bathymetry survey, seafloor sampling programme and seafloor heatflow measurements) would be undertaken during the first exploration period, after the completion of the seismic surveys. Results of the seismic surveys will influence the final activities included in the seafloor geochemical survey.~~ However, it should be noted that none of the approved activities were executed during the tenure of the Initial Exploration Period. A Section 102 application for the Initial Exploration Period was made by PetroSA and approved by PASA to reduce the work programme from the acquisition of 3D and/or 2D seismic surveys and conducting Seafloor geochemical surveys to reprocessing of 3D seismic data.

3.2.2 SEISMIC SURVEYS

Seismic surveys are conducted during marine oil and gas exploration in order to investigate sub-sea geological formations. During seismic surveys high-level, low frequency sounds are directed towards the seabed from near-surface sound sources towed by a vessel. Signals reflected from geological discontinuities below the sea floor are recorded by lowed hydrophones. Analyses of the returned signals allow for interpretation of subsea geological formations.

Seismic surveys are undertaken to collect either 3D or 2D data. For this investigation the operator is proposing to undertake both 3D and / or 2D seismic surveys. 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 3D or 2D seismic survey is undertaken. The sound source or airgun array (two for 3D and one for 2D) would be situated some 100 m behind the vessel at a depth of 5 m to 10 m below the surface. 3D surveys use multiple streamers (up to 12 streamers spaced 100 m apart), whereas a 2D survey typically involves a single streamer. The array can be up to 10 000 m long. The streamer/s would be towed at a depth of between 5 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 to 1000 Hz, while the optimum wavelength for deep seismic work is in the 10 to 80 Hz range.

PetroSA is currently evaluating the existing 2D and 3D seismic data which cover portions of Block 2C. This evaluation and other factors will determine whether additional 2D seismic data is required prior to acquiring 3D seismic data or, if additional 2D seismic data is unnecessary, only additional 3D seismic data is necessary to evaluate the exploration potential of the block.

If additional 2D seismic data is required, it is anticipated that the proposed survey would comprise a number of low density spaced survey lines covering the majority of Block 2C. Although survey commencement would ultimately depend on a permit award date, availability of seismic contractors and other factors~~, it is anticipated that the 2D survey would be undertaken during the summer of 2013/2014 and would take in the order of one to two months to complete~~.

If additional 3D seismic data is required, it is anticipated that the proposed 3D seismic survey would cover a minimum area of 750 km^2 and the maximum area could cover the entire block. As with the 2D survey, commencement would depend on the permit award date, availability of seismic contractors and other factors. ~~It is anticipated that if a 3D seismic survey is deemed necessary it would be undertaken in the summer of 2013/2014 and would take in the order of two to three months to complete.~~

3.2.3 SEAFLOOR GEOCHEMICAL SURVEY MULTI-BEAM BATHYMETRY SURVEY

The operator proposes to undertake a multi-beam bathymetry survey to produce a digital terrain model of the seafloor. 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. 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. Although this type of survey typically does not require the vessel to tow any cables, it is "restricted in its ability to manoeuvre" due to the operational nature of this work.

Typical 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 (approximately 1 000 times less than a seismic survey). A typical 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.

The multi-beam bathymetry survey, if deemed necessary, would likely be undertaken over the majority of Block 2C area. It is anticipated that data acquisition would take in the order of three to four weeks to complete at a vessel speed of 5 to 8 knots.

Seafloor sampling programme

The seafloor sampling programme would consist of collecting seafloor sediment samples for laboratory geochemical analyses in order to determine if there are any naturally occurring hydrocarbons present.

Piston coring is one of the more common methods used to collect seafloor geochemical samples. A piston coring device with ultra-short baseline (USBL) navigation would be used to collect the seafloor samples. The programme would likely utilise a core barrel capable of retrieving sediment samples that are up to 6 m in length and 6.7 cm in diameter. The recovered cores are visually examined at the surface for indications of hydrocarbons (gas hydrate, gas parting or oil staining) and sub-samples retained for further geochemical analysis in an onshore laboratory. The remaining sediment would be returned to the seafloor.

It is anticipated that up to 200 piston core samples would be collected across Block 2C. Each individual piston core would have a potential disturbance volume of 0.02 m^3, resulting in a total disturbance volume of approximately 4 m^3. The exact volume of an individual core is dependent on the recovery which is rarely 100%, i.e. the potential disturbance of an Individual core would likely be <0.02 m^3. The exact number and location of core samples would be identified following the analysis of the 3D seismic and / or the multi-beam bathymetric survey results.

It is anticipated that the seafloor sampling programme would take in the order of three to five weeks to complete.

Seafloor heatflow measurements

The heatflow measurements would be conducted using heatflow probes, which would measure both the temperature and thermal conductivity of sediments *in situ* up to normally 3 m below the seafloor. The primary goal of this programme is to measure the thermal conductivity of the seafloor sediments at numerous locations throughout the survey area to provide a representative dataset. Acquisition of these data would be used to determine the thermal regime and calibrate thermal models to understand hydrocarbon system potential.

The measurement device or probe would be dropped from a vessel into the seafloor. The probe is navigated to specific target sites using the USBL navigation described. The probe is allowed to equilibrate and then recovered to the surface after about 20 minutes. A heat pulse is applied though the probe which allows the thermal conductivity of the sediments to be measured. No material is removed from the seabed, and the entire probe is retrieved at the end of the measurement.

It is anticipated that up to 50 separate healflow measurements would be collected across Block 2C, which would take in the order of three to five weeks to complete, if undertaken together with the piston coring programme

3.2.4 EXCLUSION ZONES

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part B, Rule 18), surveys vessel that is engaged in surveying or towing operations is defined as a "vessel restricted in its ability to manoeuvre" which requires that power-driven and sailing vessels give way to a vessel restricted in her 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.

3.2.8 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.

4 DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 PHYSICAL ENVIRONMENT

Block 2C lies within the southern zone of the Benguela Current region and is characterised by the cool Benguela upwelling system.

Wind and weather patterns along the 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 West Coast are subject to a simple semi-diurnal tidal regime.

The continental shelf along the 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 to the north of Cape Columbine to its widest of the Orange River (180 km).

The most important current is the Benguela current, which constitutes a broad, shallow and slow north-west 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 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.

4.2 BIOLOGICAL OCEANOGRAPHY

South Africa is divided into nine bioregions, two of which occur in the proposed Exploration Right area (namely Namaqua and Atlantic Offshore). Communities within marine habitats are largely ubiquitous throughout the southern African 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 near- and offshore marine ecosystems comprise a limited range of habitats, namely unconsolidated seabed sediments and the water column.

Species diversity, abundance and biomass of benthic invertebrate macrofauna increases from the shore to 80 m depth. 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.

The West Coast supports important commercial stocks of West Coast rock lobster. Female 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. The main cephalopod species that occurs within the southern Benguela system are the sepiods/cuttlefish.

Deep water corals (depths >150 m) establish themselves below the thermocline where there is a continuous and regular supply of concentrated particulate organic matter, caused by the flow of a relatively strong current over special topographical formations which cause eddies to form. Substantial shelf areas in the productive Benguela region should thus potentially be capable of supporting rich, cold water, benthic, filter- feeding communities.

A geological feature of note within the vicinity of the proposed Exploration Right area is Childs Bank, situated about 150 km offshore at about 31°S. The effect of such a seabed feature 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. Consequently, seamounts are usually highly unique and are usually, but not always, identified as Vulnerable Marine Ecosystems.

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. 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 survey area overlaps with the spring to early summer spawning areas for a number of these commercially important pelagic species. Large pelagic species include tunas, billfish and pelagic sharks, which migrate throughout the southern oceans, between surface and deep waters (>300 m) and have a highly seasonal abundance in the Benguela.

Three species of turtles, the green, leatherback and loggerhead, are found along the West Coast. However, only the Leatherback turtle (Critically Endangered) is likely to be encountered within the survey 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 resident species, 25 are migrants from the southern ocean and 10 are visitors from the northern hemisphere. Most of the 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).

The marine mammals occurring off the West Coast include seals and cetaceans (whales and dolphins). The marine mammal fauna of the West Coast comprises between 28 species of cetaceans and four seal species, of which the Cape fur seal is the most common. The distribution of whales and dolphins on the West Coast can

largely be split into those associated with the continental shelf and those that occur in deep, oceanic waters. Species from both environments may, however, be found associated with the shelf (200 - 1 000 m), making this a species-rich area for cetaceans. Cetaceans comprised two basic taxonomic groups: the mysticetes (filter-feeding baleen whales) and the odontocetes (toothed predatory whales and dolphins).

Mysticete (baleen) cetaceans occurring in the proposed survey area include the southern right, humpback, blue, fin, sei, minke, dwarf minke, sperm and two populations of Bryde's whale. 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 proposed Exploration Right 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. The most abundant baleen whales off the coast of South Africa are southern right (listed as Vulnerable) and humpback whales (listed as Endangered).

There is almost no data available on the abundance, distribution or seasonality of the smaller odontocetes (including the beaked whales and dolphins) known to occur in oceanic waters off the shelf of the West Coast. Beaked whales are all considered to be true deep water species usually being seen in waters in excess of 1 000 - 2 000 m depth. Of the smaller odontocetes known to occur offshore, the long-finned pilot whale is likely to be the most commonly encountered in the proposed survey area. False killer whales, killer whales and the offshore form of the bottlenose dolphin are also likely to be encountered with some regularity in deeper waters. Inshore of the 500 m isobath, dusky dolphins are likely to be the most frequently encountered small cetacean.

4.3 HUMAN UTILISATION

There are seven commercial fisheries active in the vicinity of Block 2C, including demersal trawl, demersal long-line, large pelagic long-line, tuna pole, traditional line fish (recreational and commercial), small pelagic purse-seine and West Coast rock lobster.

The majority of shipping traffic is located on the outer edge of the continental shelf with traffic inshore of the continental shelf along the South-West Coast largely comprising fishing vessels, especially between Kleinsee and Oranjemund.

Exploration for oil and gas is currently undertaken in a number of licence blocks off the West Coast. There is no current development or production from the South African West Coast offshore.

The majority of diamond mining concessions worked at present are those closer inshore. The proposed Exploration Right area, however, overlaps partly with offshore diamond mining concession 9d, which is held by Alexkor. This concession is currently not being mined. A number of prospecting areas for glauconite and phosphorite / phosphate are located off the West Coast, one of which is partially located within the proposed Exploration Right area. This area (Prospecting area 251) has, however, not yet been approved by the Department of Mineral Resources.

A number of Marine Protected Areas (MPAs) are located along the West Coast, none of which are located within the proposed Exploration Right area. Block 2C is, however, located partially in the proposed Namaqualand Marine Protected Area (MPA), which is located between the Groen and Spoeg rivers and extends to the edge of the EEZ. Block 2C is also located partially in the Child's Bank protection area proposed by the South African National Biodiversity Institute (SANBI), as well as in Critical Biodiversity and Ecological Support Areas.

5 IMPACT ASSESSMENT CONCLUSIONS

A summary of the assessment of potential environmental impacts associated with the proposed exploration programme is provided in Table 1.

The majority of the impacts associated with the various exploration activities would be of short-term duration and limited to the immediate survey area. As a result, the majority of the impacts are considered to be of **INSIGNIFICANT** to **LOW** significance after mitigation.

The two key issues identified in this study relate to:

- The potential impact on marine mammals (physiological injury and behavioural avoidance) as a result of seismic noise; and
- The potential impact on the fishing industry (vessel interaction, disruption to fishing operations and reduced catch) due to the presence of the various survey vessels, 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 breeding or feeding area for a prolonged period, impacts at the population level could be more significant. In order to mitigate the potential impact on cetaceans it is recommended that the proposed seismic survey programme be planned, as far as possible, to avoid the cetacean migration and breeding period which occurs from the beginning of June to end of November. It should, however, be noted that if the seismic survey programme is undertaken when more whales are likely to be present in the area, there could be increased downtime due to the temporary termination of the seismic surveys. Various other measures, which are in line with the Generic EMP prepared for seismic surveys in South Africa and the general principles of the JNCC seismic guidelines, are recommended to further mitigate the potential impact on cetaceans, e.g. the use of Passive Acoustic Monitoring (PAM) technology, “soft-starts”, temporary termination of survey, etc.

The potential impact on the fishing industry is assessed to be of **VERY LOW** significance for those sectors active in the vicinity of Block 2C, namely demersal trawl, demersal long-line, large pelagic long-line and tuna pole. However, if fish avoid the survey area and I 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. Similarly, if there was any interaction between the survey vessels and a fishery the significance of the impact could be higher. Thus it is important that the operator engage timeously with the fishing industry prior to and during the proposed exploration programme. Regular communication with fishing vessels in the vicinity during surveying or sampling would minimise the potential disruption to fishing operations and risk of gear entanglements. There is no anticipated impact on the small pelagic purse-seine, traditional line fish (recreational and commercial), and West Coast rock lobster fisheries.

Table 1: Summary of the significance of potential impacts of the proposed exploration programme in Block 2C off the West Coast of South Africa.

Potential impact	Significance	
	Without Mitigation	With Mitigation
Normal seismic / support vessels and helicopter operation:		
Emissions to the atmosphere	VL	**VL**
Deck drainage into the sea	VL	**VL**
Machinery space drainage into the sea	VL	**VL**
Sewage effluent into the sea	VL	**VL**
Galley waste disposal into the sea	VL	**VL**
Solid waste disposal into the sea	Insignificant	**INSIGNIFICANT**
Noise from survey and support vessel operations	VL	**VL**
Noise from helicopter operations	L-M	**VL**

Potential impact		Significance	
		Without Mitigation	With Mitigation
Impact* of *seismic noise* on *marine fauna:			
Plankton		VL	**VL**
Invertebrates	Physiological injury	Vl	**VL**
	Behavioural avoidance	Vl	**VL**
Fish	Physiological injury	L	**VL**
	Behavioural avoidance	L	**VL**
	Spawning and reproductive success	VL	**VL**
	Masking sound and communication	VL	**VL**
	Indirect impacts	VL	**VL**
Non-diving seabirds	Physiological injury	Insignificant	**INSIGNIFICANT**
	Behavioural avoidance	Insignificant	**INSIGNIFICANT**
Diving seabirds	Physiological injury	L	**VL**
	Behavioural avoidance	L	**VL**
	Indirect impacts	L	**VL**
Turtles	Physiological injury	VL	**VL**
	Behavloural avoidance	VL	**VL**
	Masking sound and communication	Insignificant	**INSIGNIFICANT**
	Indirect impacts	VL	**VL**
Seals	Physiological injury	VL	**VL**
	Behavioural avoidance	VL	**VL**
	Masking sound and communication	VL	**VL**
	Indirect impacts	VL	**VL**
Mysticetes Cetaceans	Physiological injury	M	**L**
	Behavioural avoidance	L	**VL**
	Masking sound and communication	VL	**VL**
	Indirect impacts	VL	**VL**
Odontoceles Cetaceans	Physiological injury	M	**L**
	Behavioural avoidance	VL-L	**VL**
	Masking sound and communication	M	**L**
	Indirect impacts	VL	**VL**
Impact* of *multi-beam noise on marine fauna:		VL	**VL**
Impact* of *seafloor sampling and heatflow measurements* on *benthlc biota:			
Sediment removal		Insignificant	**INSIGNIFICANT**
Physical crushing of benthic biota		Insignificant	**INSIGNIFICANT**
Impact on other users of the sea:			
Fishing Industry	Demersal trawl	VL	**VL**
	Demersal long-line	VL	**VL**
	Large pelagic long-line	VL	**VL**
	Tuna pole	VL	**VL**
Marine transport routes		M	**L**
Marine prospecting, mining, exploration and production	Prospecting and mining	Insignificant	**INSIGNIFICANT**
	Exploration and production	L	**VL**
H=High M=Medium L=Low VL=Very low			**All impacts are negative**

6 RECOMMENDATIONS

6.1 GENERAL

Compliance with environmental protection activities and procedures

- All phases of the proposed exploration programme (including pre-establishment phase, establishment phase, operational phase, and decommissioning and closure phase) must comply with the specific environmental protection activities and procedures presented in Chapter 7 of the EMP.

Compliance with MARPOL standards

- All vessels must comply with the MARPOL 73/78 standards (see Appendix 5 for selected Annexures of MARPOL).

Exemption application

- 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. Therefore, if necessary, apply to the ~~Department of Environmental Affairs (DEA)~~ Department of Forestry, Fisheries and the Environment for an exemption from the regulations.

Vessel safety

- The survey and support 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 vessel with staff familiar with the fisheries expected in the area (for seismic survey only);
    - The existence of an internationally agreed 500 m safely 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 the seismic vessel is engaged in towing surveys and is restricted in manoeuvrability, and must be fully illuminated during twilight and night; and
- Report any emergency situation to South African Maritime Safety Authority (SAMSA)

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.

Emissions, discharges into the sea and solid waste

- Diesel motors and generators are to be adequately maintained to minimise the volume of soot and unburned diesel released to the atmosphere;
- All hydraulic systems are to be adequately maintained and hydraulic hoses frequently inspected;

- Undertake training and awareness of crew members of the need for thorough cleaning up of any spillages immediately after they occur, as this would minimise the volume of contaminants washing off decks;
- Use of low toxicity, biodegradable detergents during deck cleaning to further minimise the potential impact of deck drainage on the marine environment;
- Collect deck drainage in oily wat.er catchment systems;
- Discharge effluent (e.g. sewage and galley waste) as per MARPOL requirements;
- Initiate an on board waste minimisation system;
- Onboard solid waste storage is to be secure; and
- Contractors must co-operate with the relevant local authority and dispose of waste (solid and hazardous) in accordance with the appropriate laws and ordinances.

Communication with key stakeholders

- Prior to the commencement of each exploration activity the following key stakeholders should be consulted and informed, in writing, of the proposed activities (including navigational co-ordinates of the survey/ sampling areas, timing and duration of proposed activities) and the likely implications thereof:
    - Fishing industry / associations (including South African Tuna Association, South African Tuna Long-Line Association, Fresh Tuna Exporters Association, South African Deep-Sea Trawling Industry Association, South African Hake Long-Line Association and South African Pelagic Fishing Industry Association); and
    - Other: ~~DEA~~ DFFE, Department of Agriculture~~, Forestry and Fisheries (DAFF)~~ (DoA), Port Captains, SAMSA, South African Navy Hydrographic office, oil/gas and mining Industries and Transnet National Ports Authority.
- The operator must request, in writing, the South African Navy Hydrographic office to release Radio Navigation Warnings and Notices to Mariners throughout the various survey periods. The Notice to Mariners should give notice of (1) the co-ordinates of the proposed survey / sampling areas, (2) an indication of the proposed survey / sampling 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 experienced onboard Independent Observer must be appointed to act as a Fisheries Liaison Officer (FLO);
- Ongoing notification is to be undertaken throughout the duration of survey/ sampling activities with the submission of daily reports (via email) indicating the vessel's location to key stakeholders;
- In the event of the tuna pole fleet moving into the proposed Exploration Right area during surveying / sampling, the possibility of co-ordinating exploration operations to avoid that particular area for a limited duration should be investigated; and
- Marine mammal incidence data and data arising from the survey should be made available, if requested, to the Marine Mammal Institute, ~~DEA~~ DFFE: Branch Oceans and Coasts, ~~DAFF~~ DoA and PASA.

6.2 RECOMMENDATIONS SPECIFIC TO SEISMIC SURVEYS

Survey timing

- Seismic surveys should, as far as possible, be planned to avoid cetacean migration period from their southern feeding grounds into low latitude waters (beginning of June to end of November). Should a

survey be required to extend into June for whatever reason, a formal request / motivation must be submitted to PASA for consideration.

Seismic survey procedures

- PAM technology and 'turtle-friendly' tail buoys
    - PAM technology must be used during seismic surveys at night and during daytime adverse weather conditions and thick fog. In addition, PAM technology must be implemented 24-hours a day should surveying extend into the sensitive cetacean migration period (i.e. from the beginning of June onwards). It is, however, also recommended that PAM be used 24-hours a day for the duration of the survey since most of the offshore migrating baleen whale species likely to be encountered are listed as "Endangered" and that the proposed survey would be undertaken in waters up to 1 500 m depth, including night-time, and in the vicinity of Child's Bank, where sperm whales are likely to be encountered;
    - 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; and
    - 'Turtle-friendly' tail buoys should be used by the survey contractor or existing tail buoys should be filled with either exclusion or deflector 'turtle guards'.
- "Soft-start" procedures and airgun firing
    - All initiations of seismic surveys 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.
    - The "soft-start" procedure should, as far as possible, be planned to commence within daylight hours;
    - "Soft-start" procedures must only commence once it has been confirmed (visually during the day[2] and using PAM technology and night-vision/infra-red binoculars at night[3]) that there is no seabird (diving), turtle, seal or cetacean activity within 500 m of the vessel. For cetaceans, the period of confirmation should be for at least 30 minutes prior to the commencement of the "soft- start" procedures, so that deep or long diving species can be detected. However, in the case of small cetaceans (particularly dolphins), which are often attracted to survey vessels, the normal "soft-start" procedures should be allowed to commence, if after a period of 30 minutes small cetaceans are still within 500 m of the airguns;
    - "Soft-start" procedures must also be implemented after breaks in airgun firing (for whatever reason) of longer than 20 minutes. Breaks of shorter than 20 minutes should be followed by 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 temporarily when:
        - Obvious negative changes to turtle, seal and cetacean behaviour are observed;

[2] Note: should surveying in the sensitive cetacean period be unavoidable, PAM technology must also be used during the day, in addition to the visual watches by the MMO. PAM technology should also be used during the day if a decision is taken to use PAM 24-hours a day for the duration of the survey.

[3] Note: there is no need to continue monitoring using night-vision/infra-red binoculars at night after soft-start procedure has commenced.

- 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 or cetaceans as a direct result of the survey.

- The survey should be terminated until such time the MMO 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 Ille 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) by the MMO or PAM Operator.

- Line changes
  - During line changes, at night and when turning within a 5 nautical mile radius of Child's Bank, low level warning airgun discharges should be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned. Commencement of surveying thereatt.er should include a "soft-start" procedure of at least 20 minutes.

Independent Observer or MMO and PAM Operator

- An onboard Independent Observer(s) must be appointed for the duration of the seismic survey to act as the FLO and MMO. The Independent Observer should be familiar with fisheries operational in the area and must have experience in seabird, turtle and marine mammal identification and observation techniques. The duties of the Independent Observer would be to:

  Marine fauna:

  - Observe and record responses of marine fauna to the seismic survey, including seabird, turtle, seal and cetacean incidence and behaviour and any mortality of marine fauna as a result of the surveys. 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;
  - Record airgun activities, including sound levels, "soft-start" procedures and pre-firing regimes; and
  - Request the temporary termination of a seismic survey, as appropriate. It is important that Observers have a full understanding of the financial implications of terminating firing, and that such decisions are made confidently and expediently.

  Fishing and other users of the sea:

  - Provide back-up onboard facilitation with the fishing industry and other users of the sea. This would include communication with fishing and shipping / sailing vessels in the area in order to reduce the risk of interaction between the proposed surveys and other existing or proposed activities. The Observer would need to identify fishing vessels active in the area and associated fishing gear; and
  - Daily electronic reporting on vessel activity and recording of any communication and/or interaction should also be undertaken in order to keep key stakeholders informed of survey activity and progress.

  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.

- A PAM operator must be appointed if surveying occurs during the night, daytime adverse weather conditions and thick fog, and the sensitive cetacean periods from the beginning of June to end of November. However, it is recommended that a PAM operator be appointed for the duration of the survey due to the proximity to Child's Bank and since most of the offshore migrating baleen whale species likely to be encountered are listed as "Endangered". The duties of the PAM Operator would be to:
  - Confirm that there is no marine mammal activity within 500 m of the vessel prior to commencing with the "soft-start" procedures;
  - Record species identification, position (latitude/longitude) and distance from the vessel, where possible;
  - Record airgun activities, including sound levels, "soft-start" procedures and pre-firing regimes; and
  - Request the temporary termination of the seismic survey, as appropriate.
- All data recorded by the Independent Observer (MMO / FLO) and PAM Operator should form part of the survey "close-out" report.

6.3 RECOMMENDATIONS SPECIFIC TO THE SEAFLOOR GEOCHEMICAL SURVEY

6.3.1 MULTI-BEAM BATHYMETRY SURVEY

Survey timing

- The multi-beam bathymetry survey should, as far as possible, be planned to avoid cetacean migration periods from their southern feeding grounds into low latitude waters (beginning of June to end of November). Should a survey be required to extend into June for whatever reason, a formal request / motivation must be submitted to PASA for consideration.

Multi-beam survey procedures

- <u>MMO</u>
  - An onboard Independent Observer(s) must be appointed for the duration of the multi-beam survey to act as the FLO and MMO.
- <u>Pre-watch survey</u>
  - Surveying must only commence once it has been confirmed by the MMO (visually during the day) that there is no large cetacean activity within 500 m of the vessel for a 15-minute period.
- <u>PAM technology and "soft-start" procedure</u>
  - If source level is greater than 210 dB re 1 µPa at 1 m the following is recommended:
    - Where equipment allows, a "soft-start" procedure shall be implemented for a period of 20 minutes. Where this is not possible, the equipment should be turned on and off over a 20 minute period to act as a warning signal and allow cetaceans 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) that there is no large cetacean activity within 500 m of the vessel for a 15-minute period. However, if after a period of 15 minutes small cetaceans (particularly dolphins) are still within 500 m of the vessel, the normal "soft-start" procedure should be allowed to commence;
- "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; and
- Should surveying in the sensitive cetacean period be unavoidable, PAM technology must be implemented 24 hours a day from beginning of June to end of November. 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. A PAM operator must be appointed during this period;

- Temporarily termination
  - Surveying should be terminated temporarily when cetaceans show obvious negative behavioural changes within 500 m of the survey vessel or equipment; and
  - The survey should be terminated until such time the MMO confirms that cetaceans have moved to a point that is more than 500 m from the source or despite continuous observation, 15 minutes has elapsed since the last sighting of the cetaceans within 500 m of the source.

6.3.1 SEAFLOOR SAMPLING PROGRAMME AND HEATFLOW MEASUREMENTS

No specific mitigation is recommended.

6.4 RECOMMENDATIONS SPECIFIC TO HELICOPTER OPERATIONS

Mitigation relating to helicopter operations includes:

- Flight paths must be pre-planned to ensure that no flying occurs over bird and seabird colonies, coastal reserves or marine islands;
- Extensive coastal flights (parallel to the coast within 1 nautical mile of the shore) should be avoided. There is a restriction of coastal flights (parallel to the coast within 1 nautical mile of the shore) on the South-West Coast between the months of June and November to avoid Southern Right whale breeding areas;
- Aircrafts may not approach to within 300 m of whales without a permit in terms of the Marine Living Resources Act, 1998;
- The operator must comply with the Seabirds and Seals Protection Act, 1973, which prohibits the wilful disturbance of seals on the coast or on offshore islands;
- 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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Acronyms

Acronyms	
2D	Two-dimensional
3D	Three-dimensional
BID	Background Information Document
AABW	Antarctic Bottom Water
AAIW	Antarctic Intermediate Water
BOD	Biological oxygen demand
CCA	CCA Environmental (Pty) Ltd
CITES	Convention on International Trade in Endangered Species
CO	Carbon monoxide

Acronyms	
CO_2	Carbon dioxide
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
CMS	Convention on Migratory Species
DoA~~FF~~	Department of Agriculture~~, Forestry and Fisheries~~
~~DEA~~ DFFE	~~Department of Environmental Affairs~~ Department of Forestry, Fisheries and the Environment
DMPR	Department of Mineral and Petroleum Resources
~~DEA: BOC~~	~~Department of Environmental Affairs: Branch Oceans and Coasts~~
DWA	Department of Water Affairs
EASSy	Eastern Africa Submarine Cable System
ECO	Environmental Control Officer
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GN	Government Notice
GRT	Gross Registered Tonnage
IAEA	International Atomic Energy Agency
IAGC	International Association of Geophysical Contractors
I&APs	Interested & Affected Parties
ICRC	International Commission on Radiological Protection
IMO	International Maritime Organisation
ISO	International Standards Organisation
IUCN	International Union for Conservation of Nature
MARPOL	International Convention for the Prevention of Pollution from Ships, 1973/1978
MMO	Marine Mammal Observer
MPA	Marine Protected Area
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002)
NBSA	National Biodiversity Spatial Assessment Report
NEMA	National Environmental Management Act, 1998 (No. 107 of 1998)
NNW	North-north-west
NOx	Nitrogen oxides
NW	North-west
OPRC	Oil Pollution Preparedness, Response and Co-operation
PAM	Passive Acoustic Monitoring
PASA	Petroleum Agency South Africa
PIM	Particulate Inorganic Matter
POM	Particulate Organic Matter
PTS	Permanent Threshold Shifts
psi	Per square inch
SAFE	South Africa Far East
SAHRA	South African Heritage Resources Agency
SAMSA	South African Maritime Safety Authority
SAN	South African Navy
SANBI	South African National Biodiversity Institute
SASAR	South African Search and Rescue
SAT3	South Atlantic Telecommunications cable no.3
SAWS	South African Weather Service

Acronyms	
SOx	Sulphur oxides
SSW	South-south-west
SW	South-west
TAC	Total Allowable Catch
TAE	Total Applied Effort
TSPM	Total Suspended Particulate Matter
TTS	Temporary Threshold Shifts
UNCLOS	United Nations Convention on Law of the Sea, 1982
VMEs	Vulnerable Marine Ecosystems
VOS	Voluntary Observing Ships
WACS	West Africa Cable System
WASC	West African Submarine Cable
WSW	West-south-west
NEMA	National Environmental Management Act, 1998 (No. 107 of 1998)

1 INTRODUCTION

This chapter provides background to the proposed project, presents the assumptions and limitations of the study, and describes the structure of the report.

It should be noted that a draft version of this EMP was distributed for a 30-day review/ comment period. Although no comments were received during this period. the EMP has been updated and finalised. All significant changes to the original report are underlined and in a different font (Times New Roman) to the rest of the text.

1.1 BACKGROUND

~~Anadarko South Africa (Pty) Ltd ("Anadarko") lodged an application for an Exploration Right with the Petroleum Agency of South Africa (PASA) in terms of Section 79 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA) in order to explore for oil and gas reserves in Licence Block 2C off the West Coast of South Africa. PASA accepted the application on 12 December 2012.~~

The Petroleum Oil and Gas Corporation of South Africa (SOC) Ltd (PetroSA) is the holder of an Exploration Right for petroleum issued in accordance with the Minerals and Petroleum Resources Development Act (Act 28 of 2002-MPRDA). PetroSA is required to implement the exploration activities in accordance with the requirements of the approved Environmental Management Programme (EMPr). The proposed Exploration Right area is situated in the Orange Basin roughly 200 km offshore of the Northern Cape in waler depths ranging from approximately 300 m to 1 500 m (see Figure 1.1).

The ~~proposed~~ initial three-year exploration work programme ~~would~~ consisted of the following:

1. 3D and / or 2D seismic surveys;
2. Seafloor geochemical survey:
    a. Multi-beam bathymetry survey;
    b. Seafloor sampling programme; and
    c. Seafloor heatflow measurements.

However, it should be noted that none of the approved activities were executed during the tenure of the Initial Exploration Period. A Section 102 application for the Initial Exploration Period was made by PetroSA and approved by PASA to reduce the work programme from the acquisition of 3D and/or 2D seismic surveys and conducting Seafloor geochemical surveys to reprocessing of 3D seismic data.

In terms of the MPRDA. a requirement for obtaining an Exploration Right is that an EMP must be compiled in terms of Section 39 of the MPRDA and submitted to PASA for consideration and for approval by the Minister of Mineral Resources. Furthermore, Interested and/or Affected Parties (I&APs) must be notified and consulted in this regard.

~~Anadarko contracted CCA Environmental (Pty) Ltd (CCA) to compile this EMP to meet the relevant requirements of the MPRDA and the Regulations thereto.~~ Environmental Impact Management Services (Pty) Ltd, was appointed by PetroSA to amend the original Environmental Management Programme (EMPr) (i.e. CCA Environmental (Pty) Ltd, 2013), for submission to and approval by PASA. This EMPr reflects these amendments. All amendments are reflected in blue text for ease of reference.

1.2 ASSUMPTIONS AND LIMITATIONS OF THIS EMP

This EMP was prepared with the following assumptions and limitations:

- CCA ~~has been~~ was provided with all relevant project description information;
- There will be no significant changes to the project description or surrounding environment between the completion of the report and implementation of the proposed project that could substantially influence findings and recommendations with respect to mitigation and management;

- The assessment is based, to a large extent, on a generic description of the proposed exploration activities (e.g. 2D/3D seismic surveys, multi-beam bathymetry survey, seafloor sampling programme and seafloor heatflow measurements), 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.);
- The extent (or location) of most of the proposed activities within the proposed Exploration Right area is not known at this stage, as subsequent phases would be based on the findings of previous phases. Where necessary, assumptions are made on the extent in order to facilitate the assessment;
- The study assumes that all mitigation measures incorporated into the project description would be implemented as proposed; and
- Specialists were provided with all relevant information required in order to produce accurate and unbiased assessments.

These assumptions and limitations, however, are not considered to have any negative implications in terms of the credibility of the results of the study or the required management actions included in this EMP.

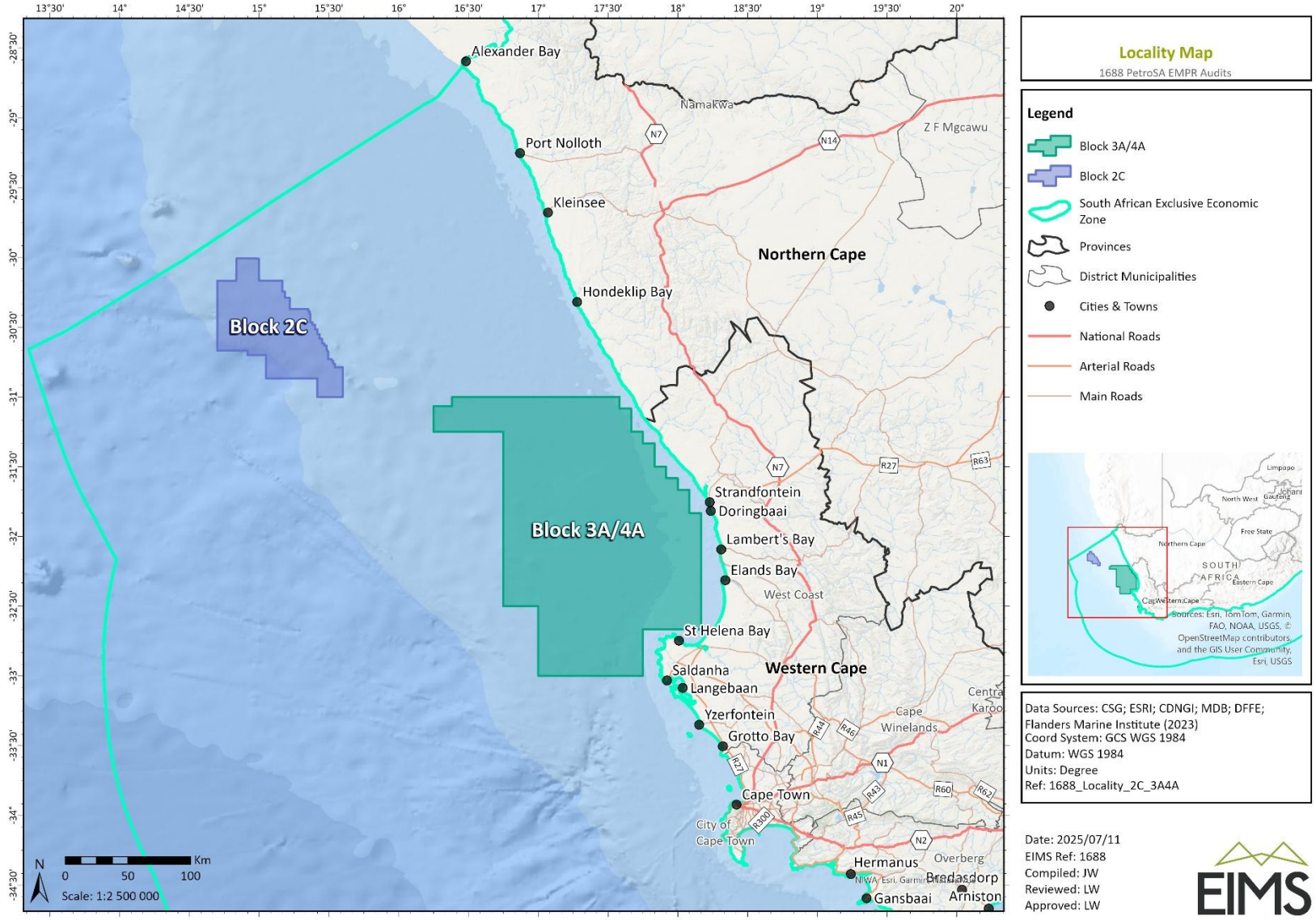


Figure 1.1: Location of the proposed Exploration Right area in Block 2C off the West Coast of South Africa.

1.3 STRUCTURE OF THIS REPORT

This report consists of eight chapters and five appendices as shown below.

Section	Contents
Executive Summary	Provides an overview of the main findings of the EMP.
Chapter 1	**Introduction** Provides background to the proposed project, the assumptions and limitations of the study, and describes the structure of the report.
Chapter 2	**Approach and Methodology** Covers the legislative requirements of the EMP process and presents the process undertaken.
Chapter 3	**Project Description** Provides general information on the proposed project and a description of the proposed exploration activities.
Chapter 4	**The Affected Environment** Describes the existing biophysical and socio-economic environment that could be affected by the proposed project.
Chapter 5	**Environmental Impact Assessment** Describes and assesses the potential impacts of the proposed project on the affected environment. It also presents mitigation measures that could be used to reduce the significance of any negative impacts or enhance any benefits.
Chapter 6	**Conclusion and Recommendations** Provides conclusions to the EMP and summarises the recommendations for the proposed project.
Chapter 7	**Environmental Protection Activities and Procedures** Provides the environmental protection activities and procedures for the proposed exploration programme.
Chapter 8	**References** Provides a list of the references used in compiling this report.
Appendices	
Appendix 1	Public Participation Process Appendix 1.1 I&AP database Appendix 1.2 Notification letter, BID and Registration/ Response Form Appendix 1.3 Advertisements Appendix 1.4 I&AP correspondence Appendix 1.5 Issues and Responses Trail

2 APPROACH AND METHODOLOGY

This chapter outlines the key legislative requirements for the proposed project and outlines the methodology and public participation process undertaken in the study.

2.1 LEGISLATIVE REQUIREMENTS

2.1.1 MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002

An Exploration Right must be issued prior to the commencement of any exploration activities. As noted earlier, a requirement of obtaining an Exploration Right is that an EMP[4] has to be compiled in terms of Section 39 and Regulation 52 of the MPRDA and submitted to PASA for consideration and for approval by the Minister of Mineral Resources.

In terms of Section 39[5] of the MPRDA an EMP must:

3(a) Establish baseline information concerning the affected environment to determine protection, remedial measures and environmental management objectives;

(b) Investigate, assess and evaluate the impact of the proposed project on:

(i) The environment; and

(iii) Any national estate referred to in Section 3(2) of the National Heritage Resources Act, 1999 (No. 25 of 1999), with the exception of the national estate contemplated in Section 3(2)(i)(vi) and (vii) of that Act.

(d) Describe the manner in which the Applicant intends to:

(i) Modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;

(ii) Contain or remedy the cause of pollution or degradation and migration of pollutants; and

(iii) Comply with any prescribed waste standard or management or practices.

In terms of Regulation 52 of the MPRDA an EMP must include the following:

2(a) A description of the environment likely to be affected by the proposed exploration;

(b) An assessment of the potential impacts of the proposed exploration on the environment, socio-economic conditions and cultural heritage, if any;

(c) A summary of the assessment of the significance of the potential impacts, and the proposed mitigation and management measures to minimise adverse impacts and benefits;

(d) Financial provision;

(e) Planned monitoring and performance assessment of the EMP;

(f) Closure and environmental objectives;

(g) A record of the public participation process undertaken and the results thereof; and

(h) An undertaking by the Applicant regarding the execution of the EMP.

This EMP has been compiled to meet the legislative requirements indicated above.

[4] In terms of Section 79(4)(b) of the MPRDA an *Environmental Management Programme* is a requirement for an Exploration Right. However, in terms of Section 69(2)(vii) "prospecting rights must be construed as reference to exploration rights" and a prospecting right requires an *Environmental Management Plan* in terms of Section 16(4)(a), Although this EMP is referred to a *Programme*, it includes the contents of a Plan.

[5] Section 39(7) stales that "the provisions of subsection (3)(b)(ii) and subsection (3)(c) do not apply to *the applications for reconnaissance permissions, prospecting rights or mining permits.*" Since "*prospecting rights must be construed as reference to exploration rights"* (Section 69(2)(vii)), these sections are not applicable to the current application.

2.1.2 NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998

The Environmental Impact Assessment (EIA) Regulations 2010~~0~~4 promulgated in terms of Chapter 5 of the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), as amended, provide for the control of certain activities that are listed in Government Notices ~~(GN) R544~~ GN983 (Listing Notice 1), ~~R545~~ GN984 (Listing Notice 2) and ~~R546~~ GN985 (Listing Notice 3). Activities listed in these notices must comply with the regulatory requirements listed in GN ~~R543~~982, which prohibits such activities until written authorisation is obtained from the competent authority.

There are currently no activities listed in Listing Notice 1, 2 or 3 applicable to the proposed exploration programme. ~~Two key activities that require mentioning include:~~

- ~~Activity 18(ii) in Listing Notice 1 relating to *"the removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 m³ from the sea"*. This activity is not applicable as less than 5 m³ of material would be removed during the proposed seafloor sampling programme; and~~
- ~~Activity 21 in Listing Notice 2 relating to *"any activity which requires an exploration right or renewal thereof"* in terms of the MPRDA. This activity is not yet in effect (refer to GN No. R662) and is, therefore, not applicable.~~

Thus no Basic Assessment or Scoping and EIA process is thus required.

2.1.3 OTHER RELEVANT LEGISLATION

In addition to the foregoing, PetroSA must also comply with the provisions of other relevant international and national legislation and conventions, which include, but are not limited to, 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 Matier, 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: Air Quality Act, 2004 (No. 39 of 2004);
- 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: Waste Act, 2008 (No. 59 of 2008);
- 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); and
- Wreck and Salvage Act, 1995 (No. 94 of 1995).

2.2 EMP PROCESS

2.2.1 OBJECTIVES

The objectives of the EMP process are:

- To provide a reasonable opportunity for I&APs to be consulted on the proposed project;
- To ensure that all potential key environmental issues and impacts that could result from the proposed project are identified;
- To identify feasible alternatives to the implementation of the proposed project;
- To assess potential impacts related to the proposed project;
- To present appropriate mitigation or optimisation measures to minimise potential impacts or enhance potential benefits; and

- Through the above, to ensure informed, transparent and accountable decision-making by the relevant authorities.

2.2.2 PROCESS UNDERTAKEN

2.2.2.1 INITIAL PUBLIC PARTICIPATION PROCESS

The initial public participation process involved an open, participatory approach to ensure that I&APs were notified of the proposed project and given a reasonable opportunity to register on the project database and provide Initial comments. Steps undertaken during this phase are summarised below and all supporting Information is presented in Appendix 1:

- A preliminary I&AP database of authorities, Non-Governmental Organisations, Community-based Organisations and other key stakeholders was compiled using databases of previous studies in the area. Additional I&APs were added to the database based on responses to the advertisements and notification letter (see below). I&APs registered on the project database to date are included in Appendix 1.1;
- A notification letter/ email and Background Information Document (BID) were distributed for a 21-day registration and comment period from 30 January 2013 to 20 February 2013 (see Appendix 1.2 for letter/email, BID and proof of distribution). The purpose of the letter / email and BID was to convey information on the proposed exploration programme and to invite I&APs to register on the project database and provide initial comment. To simplify the registration process, a Registration/ Response Form was distributed with the BID; and
- Advertisements announcing the proposed project, the availability of the BID and I&AP registration I comment period were placed in the Cape Times and Die Burger on 29 January 2013 (see Appendix 1.3).

All Registration / Response Forms and other written correspondence received from I&APs during the registration and comment period are presented in Appendix 1.4. Comments received on the BID have been collated, and responded to, into an Issues and Responses Trail (see Appendix 1.5).

2.2.2.2 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 2.1.

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 .2.1). Specialists also recommended appropriate mitigation / control or optimisation measures to minimise potential negative impacts or enhance potential benefits, respectively.

Table 2.1: List of specialist studies and specialists.

No.	Specialist study	Specialist/s	Qualifications	Company	Appendix
1	Fishing	Mr Dave Japp	MSc (Ichthyology and Fisheries Science), Rhodes University	CapFish cc	2.2
		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	2.3

2.2.2.4 DRAFT EMP COMPILATION

The specialist information and other relevant information were integrated into a draft EMP. Many of the issues associated with the proposed exploration activities are generic in nature and were assessed based on previous exploration programmes off the coast of South Africa and the Generic EMP[6] prepared for seismic surveys in South Africa. Recommendations proposed are based on specialist input (see Section 2.2.2.2) and are in line with the Generic EMP and the general principles of the Joint Nature Conservation Committee (JNCC) seismic guidelines. Information was incorporated into the draft EMP in order to ensure compliance with Section 39 and Regulation 52 of the MPRDA.

The draft EMP was also informed by comments received during the BID comment period (see Appendix 1.4 and 1.5) and aimed to present all information in a clear and understandable format and suitable for easy interpretation by authorities, I&APs and other key stakeholders (e.g. operator and contractors).

2.2.2.5 DRAFT EMP REVIEW AND COMMENT PERIOD

The draft EMP was distributed for a 30-day review/ comment period from 1 March 2013 to 3 April 2013 (which made provision for the public holidays on 21 & 29 March 2013 and 1 April 2013) in order to provide I&APs and authorities with an opportunity to comment on any aspect of the proposed project and draft EMP. A copy of the full report was made available on the CCA website (www.ccaenvironmental.co.za).

Notification letters were sent to all I&APs registered on the project database on 1 March 2013, via mail and email, informing them of the release of the draft report. and where it could be reviewed (see Appendix 1.6). A copy of the Executive Summary was enclosed with the letter.

No comments were received during the 30-day review/ comment period.

2.2.2.6 FINALISE EMP

After closure of the review / comment period, the draft EMP was updated into this final report. This report aims to present all information in a clear and understandable format and suitable for easy interpretation by authorities. I&APs and other key stakeholders (e.g. operator and contractors).

2.2.2.6 WAY FORWARD

The EMP is submitted to PASA for consideration and for approval by the Minister of Mineral Resources in terms of the MPRDA. In terms of Section 39(4)(a) of the MPRDA, the Minister must, within 120 days from the lodgement of the EMP, approve it, if:

1. It complies with the requirements of Section 39(3);
2. The Applicant complies with Section 41(1) (i.e. financial provision); and
3. The Applicant has the capacity, or has provided for the capacity, to rehabilitate and manage negative impacts on the environment.

During authority review period, the Minister must request comments from other government departments within 60 days from the date of request.

[6] Crowther Campbell & Associates and Centre for Marine Studies (1999) Generic Environmental Programme Reports for oil and gas exploration off the coast of South Africa. Volume 4: Generic Manual for the preparation of a Lease Specific Environmental Management Programme Report for seismic surveys. Petroleum Agency of South Africa, Cape Town, South Africa
Crowther Campbell & Associates and Centre for Marine Studies (2001) Generic Environmental Programme Reports for oil and gas exploration off the coast of South Africa. Generic Manual for the preparation of a Lease Specific Environmental Management Programme Report for seismic surveys. Petroleum Agency of South Africa, Cape Town, South Africa.

3 PROJECT DESCRIPTION

This chapter provides general information on the proposed exploration programme and a description of the proposed exploration activities.

3.1 GENERAL INFORMATION

3.1.1 EXPLORATION RIGHT APPLICANT

PetroSA is the applicant for the Exploration Right.

Address:	Private Bag X5, Parow, 7499 151 Frans Conradie Drive, Parow, 7500
Project Manager:	Sumesh Naidoo
Telephone:	021 929 3000
E-mail:	sumesh.naidoo@petrosa.co.za

3.1.2 DETAILS OF EXPLORATION RIGHT AREA

Block 2C is situated off the West Coast of South Africa in the Orange Basin roughly 200 km offshore of the Northern Cape (see Figure 1.1). The co-ordinates of block boundary are provided in Table 3.1. Block 2C currently has an area of 6 223.74 km^2 with water depths ranging from approximately 300 m to 1 500 m. This may change once the block is awarded and the relinquishment takes place.

Table 3.1: Co-ordinates of the proposed Exploration Right area (Block 2C).

Point	Latitude (S)	Longitude (E)	Point	Latitude (S)	Longitude (E)
1	30° 00' 01.4127"	14° 41' 56.4251"	11	30° 53' 01.2799"	15° 38' 56.5661"
2	30° 00' 01.3247"	15° 11' 56.5226"	12	30° 53' 01.2745"	15° 43' 56.5844"
3	30° 14' 01.3005"	15° 11' 56.5025"	13	31° 00' 01.2687"	15° 43' 56.6100"
4	30° 14' 01.2840"	15° 16' 56.5139"	14	31° 00' 01.2941"	15° 24' 56.5100"
5	30° 22' 01.2756"	15° 16' 56.4984"	15	30° 52' 01.2932"	15° 24' 56.5245"
6	30° 22' 01.2469"	15° 26' 56.5154"	16	30° 52' 01.3125"	15° 02' 56.4834"
7	30° 31' 01.2592"	15° 26' 56.5060"	17	30° 42' 01.3073"	15° 02' 56.4684"
8	30° 31' 01.2544"	15° 29' 56.5127"	18	30° 42' 01.3245"	14° 54' 56.4598"
9	30° 43' 01.2771"	15° 29' 56.5179"	19	30° 40' 01.3581"	14° 54' 56.4591"
10	30° 43' 01.2677"	15° 38' 56.5424"	20	30° 40' 01.3581"	14° 41' 56.4410"

3.1.3 FINANCIAL PROVISION

In terms of the MPRDA, PetroSA is required to make financial provision to meet its obligations as described in this EMP (see Section 7).

PetroSA will make provision for the requirements of the EMP such as monitoring, reporting or specialist studies as part of the normal budgeting process.

Environmental management actions required as a result of an incident or accident would be covered by PetroSA's insurance, as described below:

- Third Party liability, which includes personal injury, properly damage, seepage and pollution as a result of any offshore exploration operations, is covered up to USD150 000 000 (one hundred and fifty million US Dollars) per occurrence (see Appendix 3);

In addition, as a condition of contract PetroSA requires a Contractor to carry insurance that is appropriate for the work being performed which may include the following:

- Workmen's compensation insurance as required in terms of the provisions of the Compensation for Occupational Injuries and Diseases Act, 1993 (No. 130 of 1993) or similar applicable Acts;
- Employer's liability insurance with a limit of liability at all times of not less than USD 1 000 000 (one million US Dollars) for each occurrence or such larger amounts for which Contractor already have cover;
- Non-ownership aviation liability with a limit of liability at all times of not less than USO 50 000 000 (fifty million US Dollars) for each occurrence or such larger amounts for which Contractor already has cover;
- Comprehensive general public liability insurance including pollution with a limit of liability of not less than USO 1 000 000 (one million US Dollars) per occurrence;
- Motor vehicle liability insurance including passenger liability indemnity;
- Physical Damage Insurance for loss or damage to Contractor's equipment and machinery. Such coverage shall be on All Risks Insurance basis or its equivalent for full value of Contractor Group material and equipment. However, the Contractor shall have the right to self-insure these items;
- Hull and Machinery Insurance in the form of Full Form Hull and Machinery Insurance, including collision liability, with limits of liability at least equal to the full value of the vessel; and
- Standard Protection and Indemnity Insurance, at least equal to the value of each vessel owned or chartered (including Tower's Liability, where applicable).

Proof of Financial Provision will be provided to PASA in the following manner:

- Copies of the insurance cover carried by the Contractors and PetroSA will be provided together with the environmental notification submitted to PASA at least ~~14 days~~ 3 weeks prior to the commencement of any exploration activity;
- A copy of the insurance certificate for the year will be provided on the renewal date of each year; and
- The annual revision of the closure provision will be submitted together with the annual Performance Assessment reports.

3.1.4 MONITORING AND EMP PERFORMANCE ASSESSMENT

The operator would undertake appropriate monitoring during the proposed exploration programme. In this regard, the operator would track performance against environmental protection activities and procedures specified in Chapter 7.

In order to comply with the MPRDA and Regulations thereto, the operator would undertake regular performance assessments in order to monitor compliance with the EMP and to assess the continued appropriateness and adequacy of the EMP. These will take the form of "close-out" reports (one per exploration activity, unless activities are conducted simultaneously) and would include monitoring and performance

assessments. These reports would outline the implementation of the EMP and highlight any problems and issues that arose during the surveys. Copies of the reports will be sent to PASA within 60 days after the completion of these activities.

3.1.5 PLANS AND PROCEDURES FOR ENVIRONMENTAL RELATED EMERGENCIES AND REMEDIATION

PetroSA would prepare a project specific Emergency Response Plan (ERP) for each exploration activity, which would define their organisational structure and protocols that would be implemented to respond to any major incident in a safe, rapid, effective and efficient manner. The ERP would be submitted to PASA for information purposes as part of their formal notification (see Section 3.2.9).

All offshore emergencies (e.g. streamer cable damage and fuel oil release) would be managed in terms of a bridging document between the ERP and the emergency response procedures and plans of the selected Contractor/s.

3.1.6 UNDERTAKING BY THE APPLICANT

PetroSA undertakes to comply with the specifications of the EMP and provisions of the MPRDA and Regulations thereto (see Appendix 4).

3.2 PROPOSED EXPLORATION PROGRAMME

3.2.1 INTRODUCTION

The ~~proposed~~ initial three-year exploration work programme ~~would~~ consisted of the following:

1. 3D and / or 2D seismic surveys;
2. Seafloor geochemical survey:
    a. Multi-beam bathymetry survey;
    b. Seafloor sampling programme; and
    c. Seafloor heatflow measurements.

However, it should be noted that none of the approved activities were executed during the tenure of the Initial Exploration Period. A Section 102 application for the Initial Exploration Period was made by PetroSA and approved by PASA to reduce the work programme from the acquisition of 3D and/or 2D seismic surveys and conducting Seafloor geochemical surveys to reprocessing of 3D seismic data.

~~The proposed exploration activities are described below. The proposed exploration programme would be conducted in a phased approach. It should, however, be noted that some of the phases might occur in parallel or the final order of activities may change.~~

~~The proposed exploration programme would most likely commence with a 3D and / or 2D seismic survey in the summer survey window period (2013/2014). In addition, a seafloor geochemical survey (which may include multi-beam bathymetry survey, seafloor sampling programme and seafloor heatflow measurements) would be undertaken during the first exploration period, after the completion of the seismic surveys. Results of the seismic surveys will Influence the final activities included in the seafloor geochemical survey.~~

3.2.2 SEISMIC SURVEY

3.2.2.1 **INTRODUCTION**

Seismic surveys are conducted during marine oil and gas exploration in order to investigate sub-sea geological formations. During seismic surveys high-level, low frequency sounds are directed towards the seabed from near-surface sound sources towed by a vessel. Signals reflected from geological discontinuities below the sea floor are recorded by towed hydrophones (see Figure 3.1). 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 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 proposed 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 the operator is proposing to undertake both 3D and/ or 2D seismic surveys.

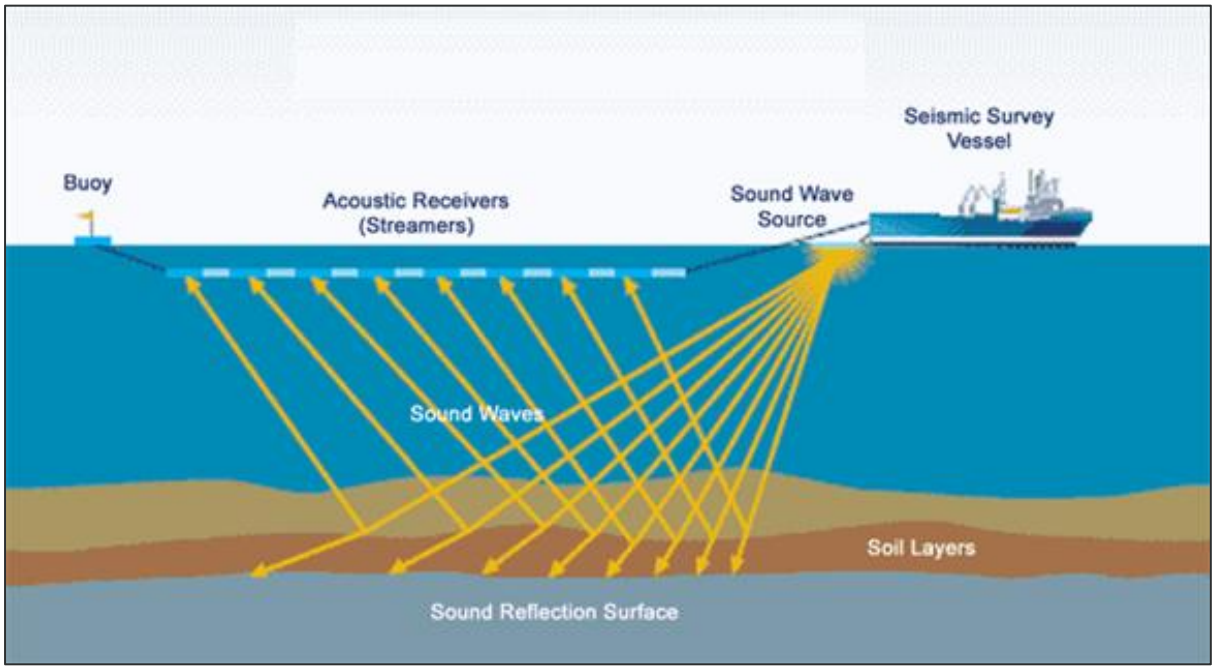


Figure 3.1: Principles of offshore seismic acquisition surveys (from fishsafe.eu).

3.2.2.2 SURVEY METHODOLOGY AND AIRGUN ARRAY

The seismic surveys 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 3D or 2D seismic survey is undertaken. The sound source or airgun array (two for 30 and one for 20) would be situated some 100 m behind the vessel at a depth of 5 m to 10 m below the surface. 3D surveys use multiple streamers (up to 12 streamers spaced 100 m apart), whereas a 2D survey typically involves a single streamer. The array can be up to 10 000 m long. The streamer/s would be towed at a depth of between 5 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 3.2.

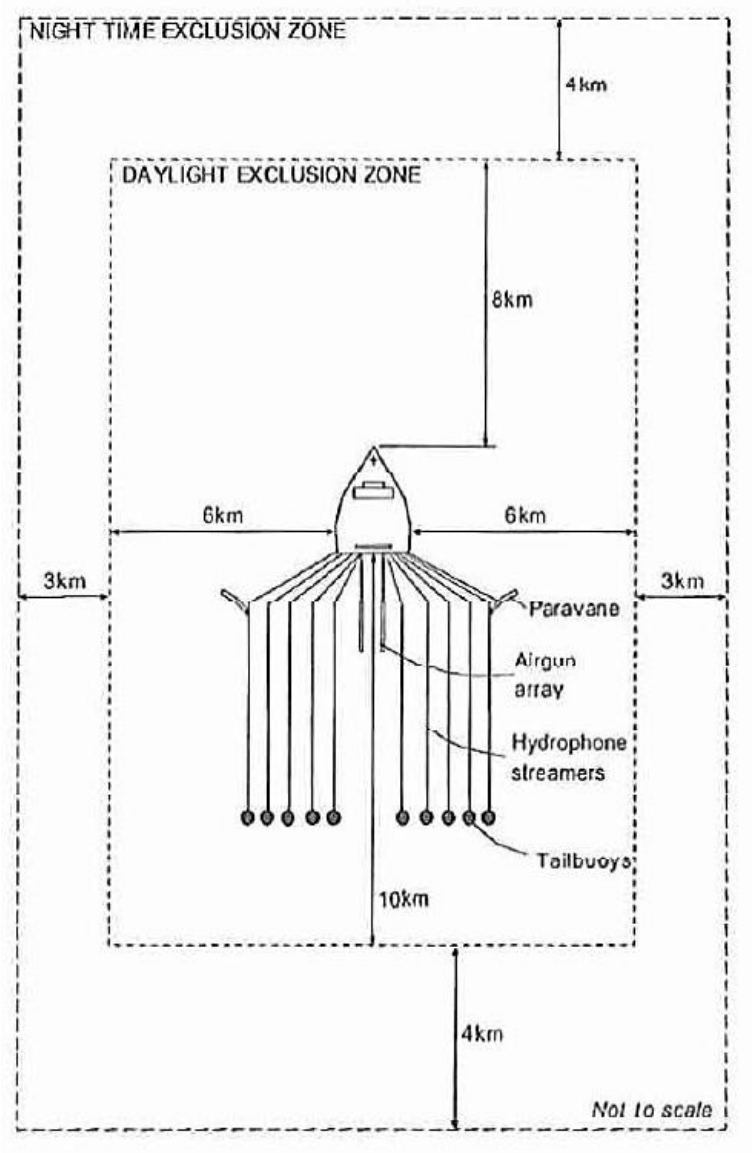


Figure 3.2: Typical configuration for a 3D seismic survey operation. Safe operational limits applicable to both 2D and 3D surveys are also shown.

Airguns, which are the most common sound source used in modern seismic surveys, would be used for the proposed surveys. 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 100 m to 200 m behind the vessel at a depth of 5 to 10 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.

3.2.2.3 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 3.3). Although the peak levels during the shot may be high, the overall energy is limited by the duration of the shot.

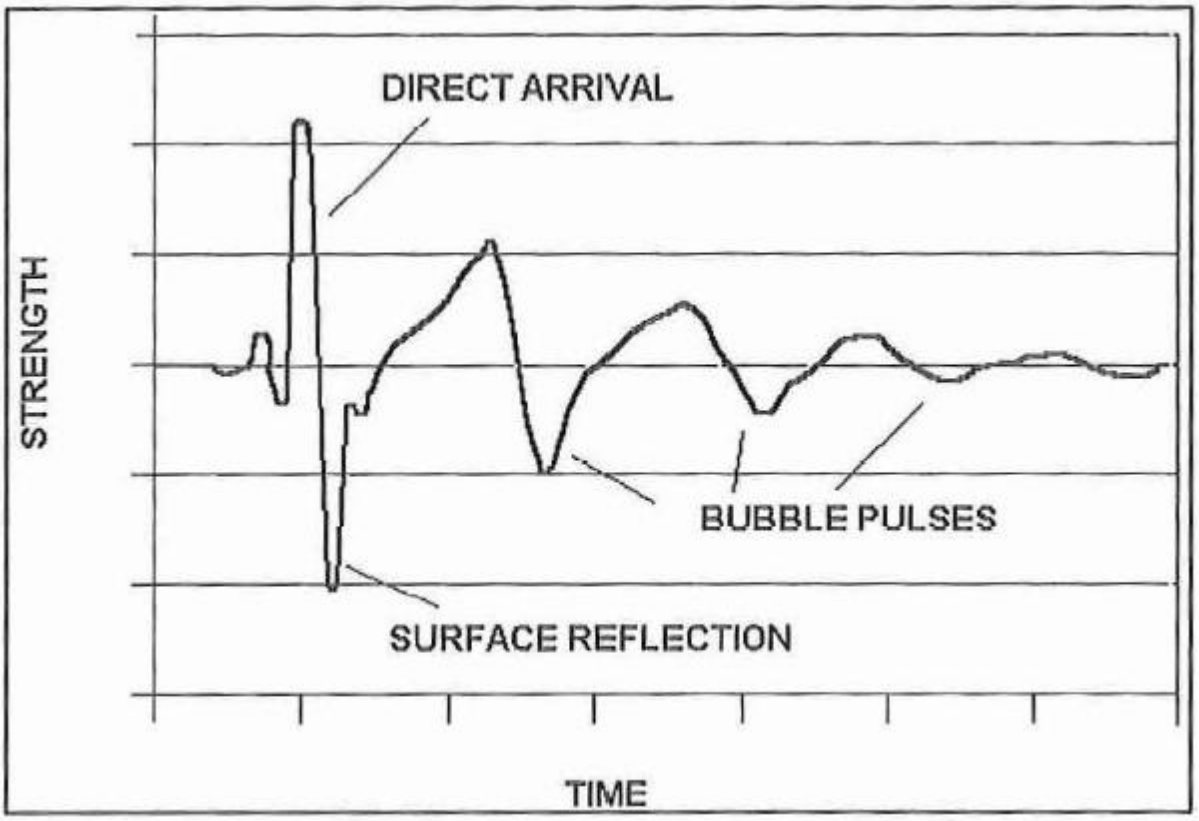


Figure 3.3: A typical pressure signature produced on firing of an airgun.

3.2.2.4 EXTENT, DURATION AND TIMING

PetroSA is currently evaluating the existing 2D and 3D seismic data which cover portions of Block 2C. This evaluation and other factors will determine whether additional 2D seismic data is required prior to acquiring 3D seismic data or, if additional 2D seismic data is unnecessary, only additional 3D seismic data is necessary to evaluate the exploration potential of the block.

If additional 2D seismic data is required, it is anticipated that the proposed survey would comprise a number of low density spaced survey lines covering the majority of Block 2C. Although survey commencement would ultimately depend on a permit award date, availability of seismic contractors and other factors, ~~it is anticipated that the 2D survey would be undertaken during the summer of 2013/2014 and would take in the order of one to two months to complete~~.

If additional 3D seismic data is required, it is anticipated that the proposed 3D seismic survey would cover a minimum area of 750 km^2 and the maximum area could cover the entire block. As with the 2D survey, commencement would depend on the permit award date, availability of seismic contractors and other factors. ~~It is anticipated that if a 3D seismic survey is deemed necessary it would be undertaken in the summer of 2013/2014 and would take in the order of two to three months to complete.~~

3.2.3 SEAFLOOR GEOCHEMICAL SURVEY

3.2.3.1 INTRODUCTION

The proposed seafloor geochemical survey would provide critical information regarding the exploration potential of the survey area, which can be used throughout the entire exploration and production lifecycle of the basin. The data can be collected rapidly and will guide future exploration efforts to the most prospective portions of the permit area further limiting potential impact from exploration and production activities. The multi-component survey would likely consist of a combination of multi-beam echo sounders, sub-bottom acoustic profiles, navigated sea-bottom piston cores and seafloor heatflow measurements. The necessity of each of these components will be evaluated following the results of the seismic surveys. For example, if 3D seismic data are acquired over the entire block area, the multi-beam echo sounder survey may not be necessary as the 3D seismic data may be sufficient to image the seabed.

3.2.3.2 MULTI-BEAM BATHYMETRY SURVEY INTRODUCTION

There are a number of different sonar surveying tools for investigating the structure of the ocean bed 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 3.4).

Figure 3.4: Illustration of a vessel using multi-beam depth/echo sounders (http://www.gns.cri.nz/).

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. 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. Although this type of survey typically does not require the vessel to tow any cables, it is "restricted in its ability to manoeuvre" due to the operational nature of this work.

Typical 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 (approximately 1 000 times less than a seismic survey). A typical 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.

Extent and duration

The multi-beam bathymetry survey, if deemed necessary, would likely be undertaken over the majority of Block 2C area. It is anticipated that data acquisition would take in the order of three to four weeks to complete at a vessel speed of 5 to 8 knots.

3.2.3.3 SEAFLOOR SAMPLING PROGRAMME

Introduction

The seafloor sampling programme would consist of collecting seafloor sediment samples for laboratory geochemical analyses in order to determine if there are any naturally occurring hydrocarbons present.

Seafloor sampling

Piston coring is one of the more common methods used to collect seafloor geochemical samples, with the sequence of operation illustrated in Figure 3.5. The piston coring rig is comprised of a trigger assembly, the coring weight assembly, core barrels, lip assembly and piston. The programme would likely utilise a core barrel capable of retrieving sediment samples that are up to 6 m in length and 6.7 cm in diameter.

A piston coring device with ultra-short baseline (USBL) navigation would be used to collect the seafloor samples. The USBL navigation system is used to accurately track the position of the core through the water column and position the core over the desired target for sampling. The piston corer is lowered over the side of the survey vessel and allowed to free fall from about 3 m above the seafloor to allow good penetration (A). As the trigger weight hits the bottom (B), it releases the weight on the trigger arm and the corer is released to “free-fall” the 3 m distance to the bottom (B & C), forcing the core barrel to travel down over the piston into the sediment (D). The movement of the core barrel over the piston creates suction below the piston and expels the water out the top of the corer. When forward momentum of the core has stopped, a slow pullout of the winch commences. This suction triggers the separation of the top and bottom sections of the piston (E).

The recovered cores are visually examined at the surface for indications of hydrocarbons (gas hydrate, gas parting or oil staining) and sub-samples retained for further geochemical analysis in an onshore laboratory. The remaining sediment would be returned to the seafloor.

Water depth, date, time and latitude and longitude would be recorded for each sample.

Extent and duration

It is anticipated that up to 200 piston core samples would be collected across Block 2C. Each individual piston core would have a potential disturbance volume of 0.02 m3, resulting in a total disturbance volume of approximately 4 m^3. The exact volume of an individual core is dependent on the recovery which is rarely 100%, i.e. the potential disturbance of an individual core would likely be <0.02 m^3. The exact number and location of core samples would be identified following the analysis of the 3D seismic and / or the multi-beam bathymetric survey results.

It is anticipated that the seafloor sampling programme would take in the order of three to five weeks to complete.

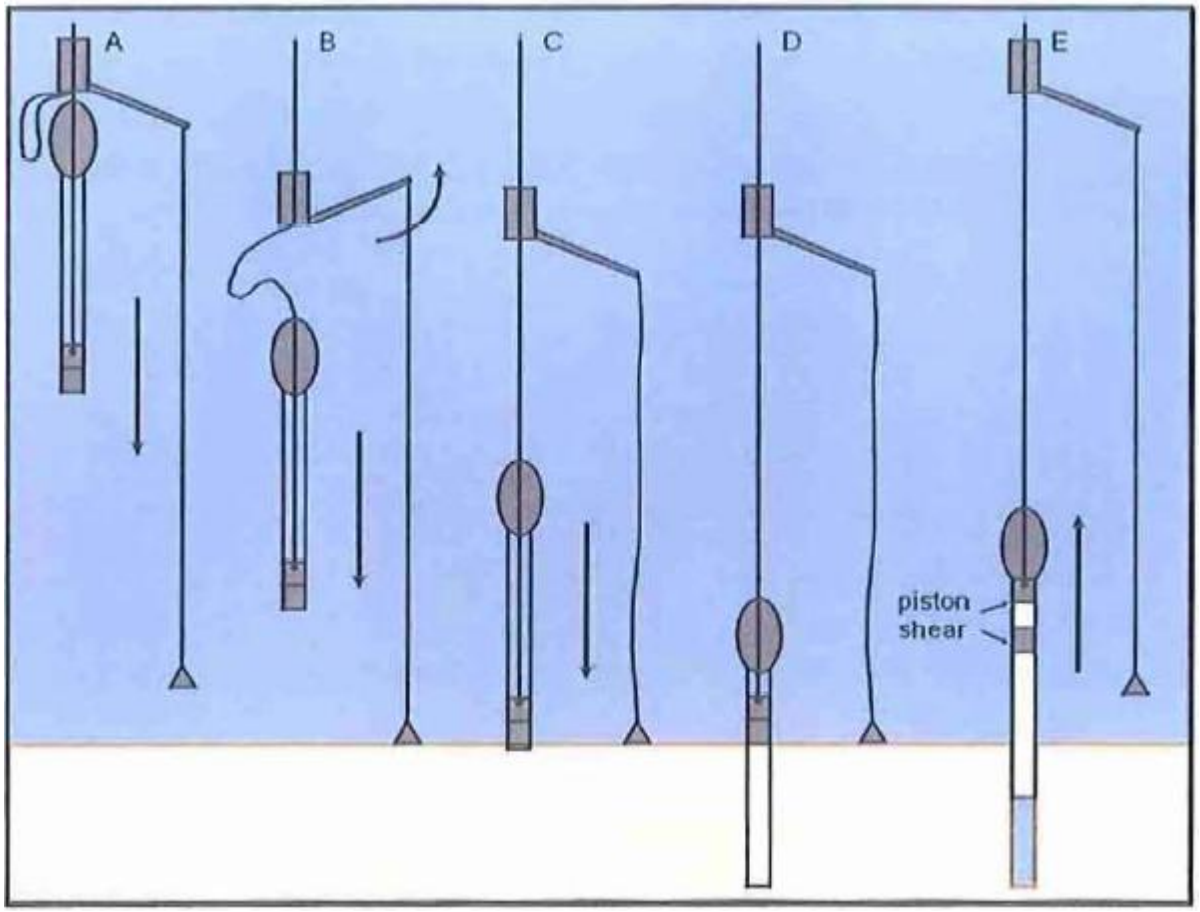


Figure 3.5: Schematic of the piston core operation at the seafloor (Source: TDI-Brooks).

3.2.3.4 SEAFLOOR HEATFLOW MEASUREMENTS

Introduction

The heatflow measurements would be conducted using heatflow probes, which would measure both the temperature and thermal conductivity of sediments *in situ* up to normally 3 m below the seafloor. The primary goal of this programme is to measure the thermal conductivity of the seafloor sediments at numerous locations throughout the survey area to provide a representative dataset. Acquisition of these data would be used to determine the thermal regime and calibrate thermal models to understand hydrocarbon system potential.

Seafloor heatflow measurements can be taken simultaneous with the seabed sampling (see Section 3.2.4).

Methodology

The heat probe (see Figure 3.6) consists of (1) instrumentation, consisting of 1 cm diameter sensor string tube, electronics data logger, heat pulse system, batteries and pingers all contained within cylindrical pressure housings, (2) mechanical components, including weight stand and 6 cm solid steel bar which extends continuously from wire termination at the top to the sensor tube support fin at the bottom, and (3) software with modules for communication, data analysis and graphic display (http://www.tdi-bi.com/field_services/hf_info/description.htm).

The heatflow probe is normally 3 m in length and has 16 sensors. The first eleven sensors (thermistors1[7]) measure temperature within the probe at 30 cm intervals down into the sediment. The remaining sensors

[7] A resistor made of semiconductors having resistance that varies rapidly and predictably with temperature.

measure the water temperature, internal temperature of the probe, the tilt of the probe from vertical and water pressure, as well as a reference resistor.

The measurement device or probe would be dropped from a vessel into the seafloor. The probe is navigated to specific target sites using the USBL navigation described in Section 3.2.3.3. The probe is allowed to equilibrate and then recovered to the surface after about 20 minutes. A heat pulse is applied though the probe which allows the thermal conductivity of the sediments to be measured. No material is removed from the seabed, and the entire probe is retrieved at the end of the measurement.

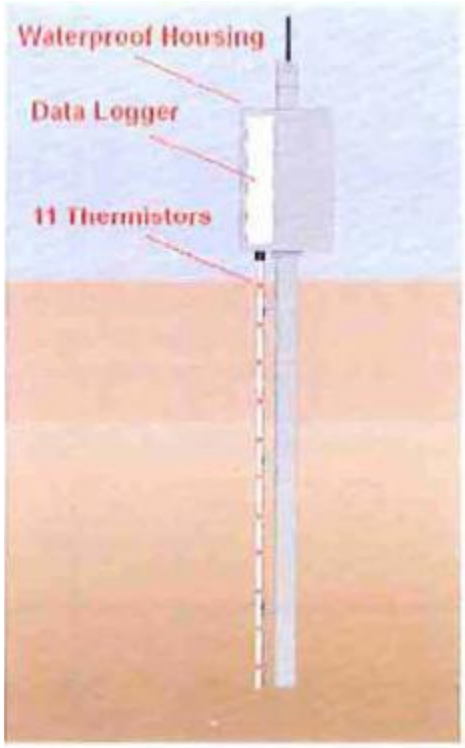


Figure 3.6: Heatflow probe (http://www.tdi-bi.com/field_services/hf_info/descriptlon.htm).

Extent and duration

It is anticipated that up to 50 separate heatflow measurements would be collected across Block 2C, which would take in the order of three to five weeks to complete, if undertaken together with the piston coring programme (see Section 3.2.4).

3.2.4 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. Although the bathymetry survey typically does not require the vessel to tow any cables, it also has restricted manoeuvrability due to the operational nature of this work.

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part B, Rule 18), survey vessels engaged in surveying or towing operations are defined as “vessel restricted in its ability to manoeuvre[8]” which requires that power-driven and sailing vessels give way to a vessel restricted in its ability

[8] 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;

to manoeuvre. Vessels engaged in fishing shall, so far as possible, keep out of the way of the survey operations. 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 3.2.

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.

3.2.5 SUPPORT SERVICES

A support vessel may be required to perform logistics support to the survey vessel. Helicopters may be utilised for crew/ supply transfers between the survey and support vessels and the mainland.

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.

3.2.6 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 ~~14 days~~ 3 weeks prior to the commencement thereof. The Environmental Notification may include, depending on the activity, the following:

- Survey lines / sampling target areas;
- Number of samples;
- Survey timing and duration;
- Contractor details;
- Vessel specifications (including relevant certificates and insurance);
- Plans not included in the EMP (e.g. Emergency Response Plan and Oil Spill Contingency Plan); and
- Details of Marine Mammal Observer, Passive Acoustic Monitoring Operator and Fisheries Liaison Officer, where applicable.

- (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 low in their ability to deviate from their course.

4 THE AFFECTED ENVIRONMENT

This chapter provides a description of the biophysical and socio-economic environment that is likely to be affected by the exploration programme in Block 2C off the West Coast of South Africa. The information provided here is based on previous information compiled for the area (CCA Environmental 2007a; 2007b; 2005; 2011) and the specialist benthic and fishing studies undertaken as part of this study. This chapter has been divided into two sections, *viz*. marine environment and nearshore environment.

4.1 MARINE ENVIRONMENT (OFFSHORE)

This section provides a general overview of the physical and biological oceanography and human utilisation of South African West Coast and, where applicable, detailed descriptions of the marine environment that may be directly affected by the proposed survey.

The proposed survey area lies within the southern zone of the Benguela Current region and 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.

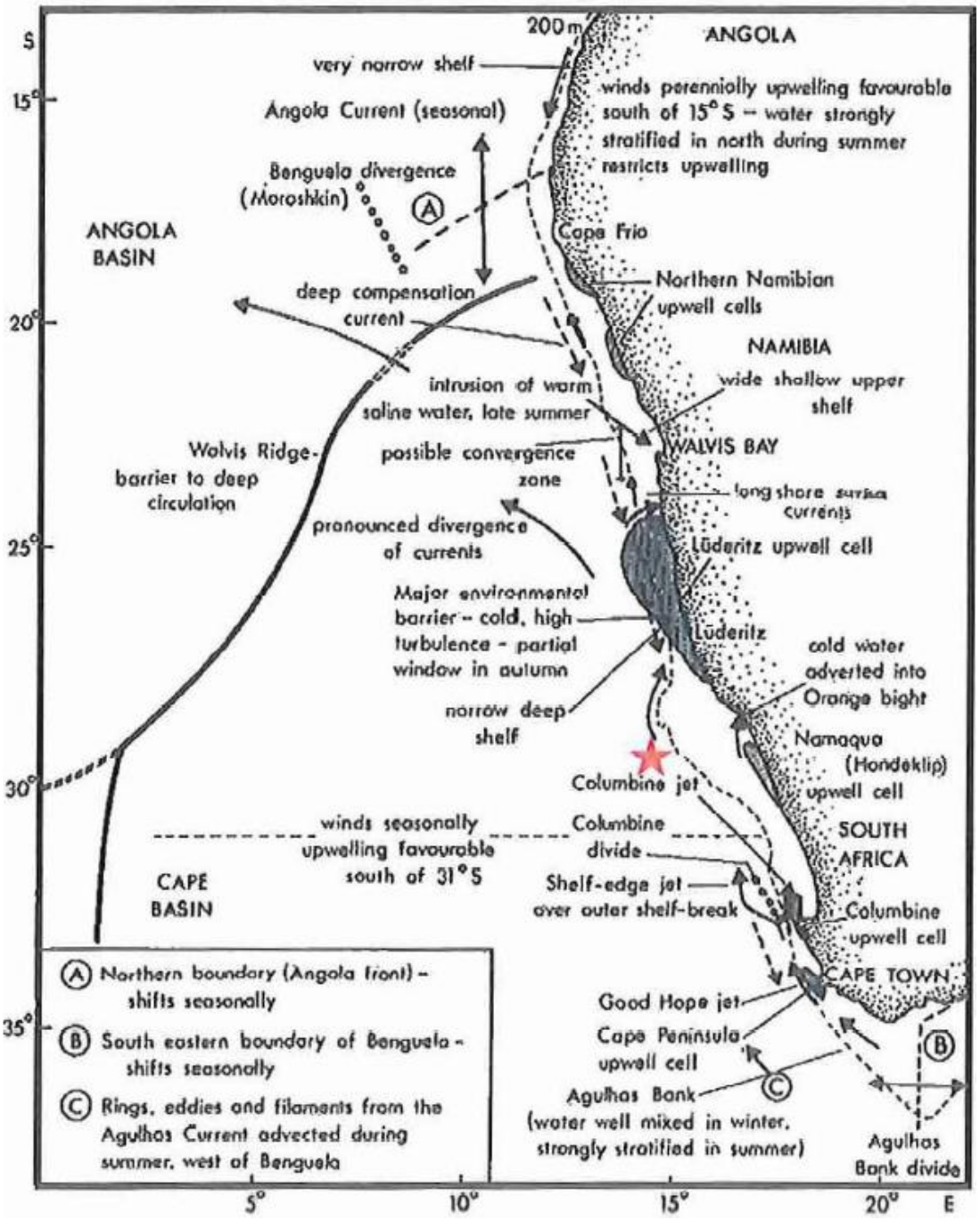


Figure 4.1: A conceptual model of the Benguela system (after Shannon 1985). Approximate location of Block 2C is also indicated (*).

4.1.1 METEOROLOGY

The meteorological processes of the South African 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 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 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 West Coast.

A second important wind type that occurs along the 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 West Coast have been reported by Heydorn and Tinley (1980), Bickerton (1981a and b, 1982) and Morant (1984).

Wave patterns along the 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 Oranjemund, are shown in Figure 4.2. 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.

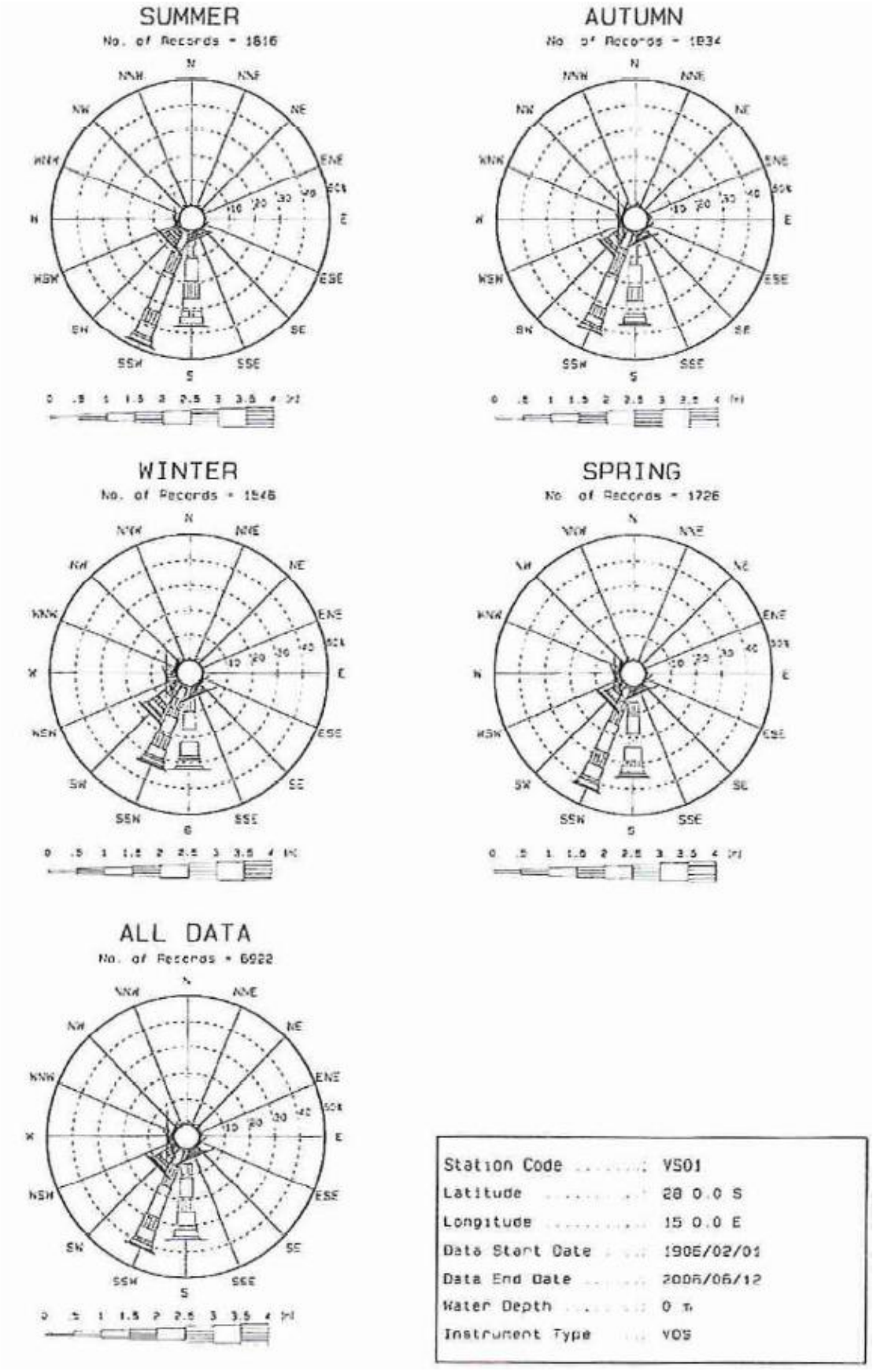


Figure 4.2: Voluntary Observing Ship (VOS) data Wave Height vs Wave Direction data for the offshore area (28°-29°S; 15°-16°E recorded during the period 1 February 1906 and 12 June 2006)) (Source: Southern African Data Centre for Oceanography (SADCO)).

4.1.2.2 TIDES

Tides along the 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 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 Coast is generally both wide and deep, although large variations in both depth and width occur (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 of the Orange River (180 km).

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.

Banks on the continental shelf include the Orange Bank (Shelf or Cone), a shallow (160 to 190 m) zone that reaches maximal widths (180 km) offshore of the Orange River, and Childs Bank, situated about 150 km offshore at about 31°S. Tripp Seamount is a geological feature to the north-west of Block 2C, which rises from the seabed at approximately 1 000 m water depth to a depth of 150 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.

The nature of the shelf break varies off the West Coast. Between Cape Columbine and the Orange River, there is usually a double shelf break, with the distinct inner (closest to shore) and outer slopes separated by a gently sloping ledge.

Block 2C covers an area of approximately 6 224 km^2 with water depths ranging from approximately 300 m to 1 500 m.

4.1.2.4 SEDIMENTS

Figure 4.4 illustrates the distribution of seabed surface sediment types off the West Coast. 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. An almost 500 km long mud belt (of up to 40 km wide and of 15 m average thickness) is situated over the outer edge of the middle shelf between the Orange River and St Helena Bay (Birch *et al*. 1976). Within the broad area of the proposed survey area, sediment is dominated by sands, sandy muds and muds. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze.

Present day sedimentation is limited to input from the Orange River. This sediment is generally transported northward. Most of the sediment in the area is therefore considered to be relict deposits by now ephemeral rivers active during wetter climates in the past. The Orange River, when in flood, still contributes largely to the mud belt as suspended sediment is carried southward by poleward flow. In this context, the absence of large sediment bodies on the inner shelf reflects on the paucity of terrigenous sediment being introduced by the few rivers that presently drain the West Coast coastal plain.

Nearshore sediments are subject to suspension by waves and longshore transport. This effect penetrates to 90 m. Natural turbidity levels range from 3 and 12 mg/l with significantly higher concentrations associated with storm waves and floods.

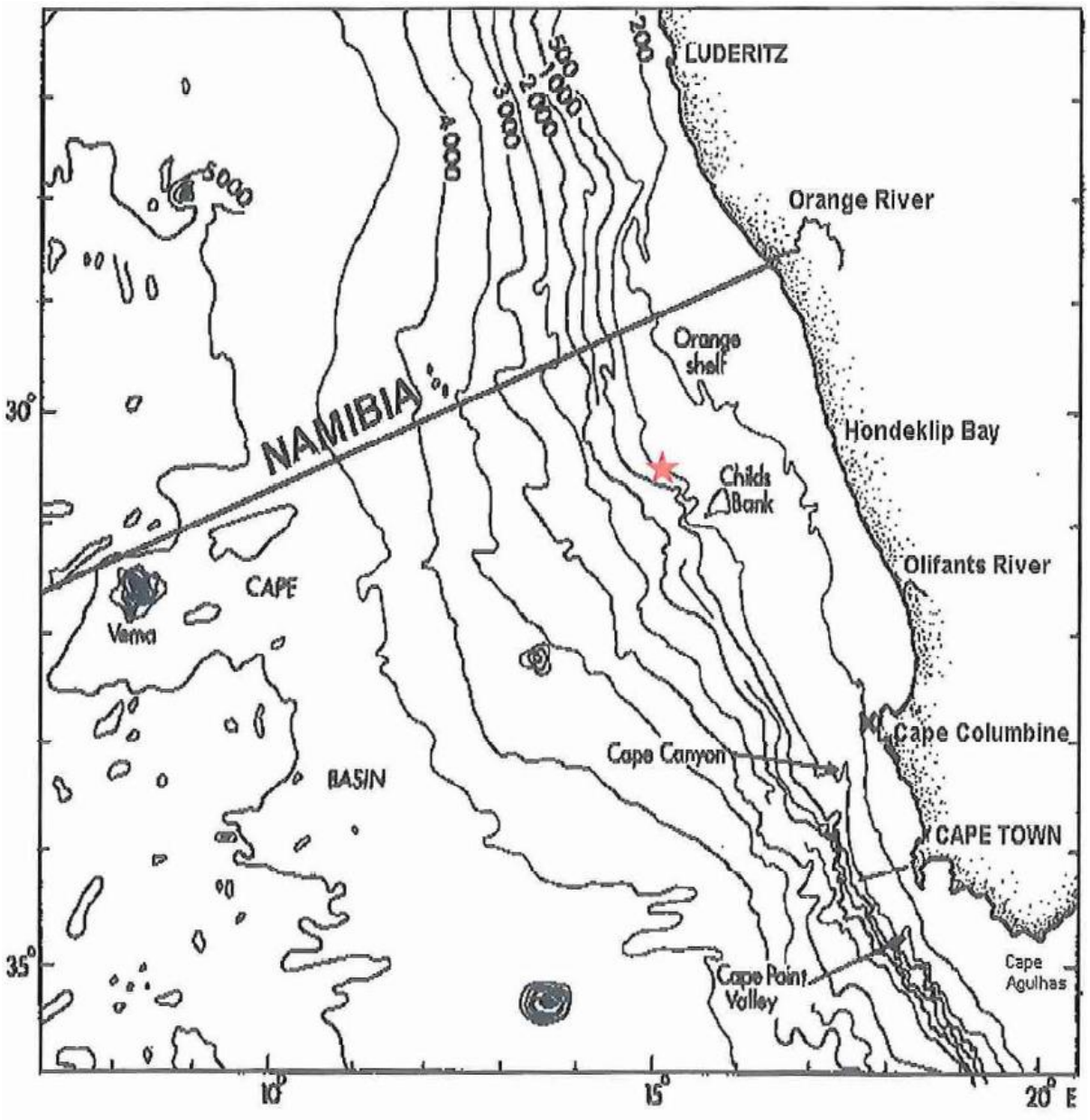


Figure 4.3: Bathymetry of the continental shelf off the West Coast of southern Africa (after Dingle *et al.* 1987). Approximate location of Block 2C is also indicated (*).

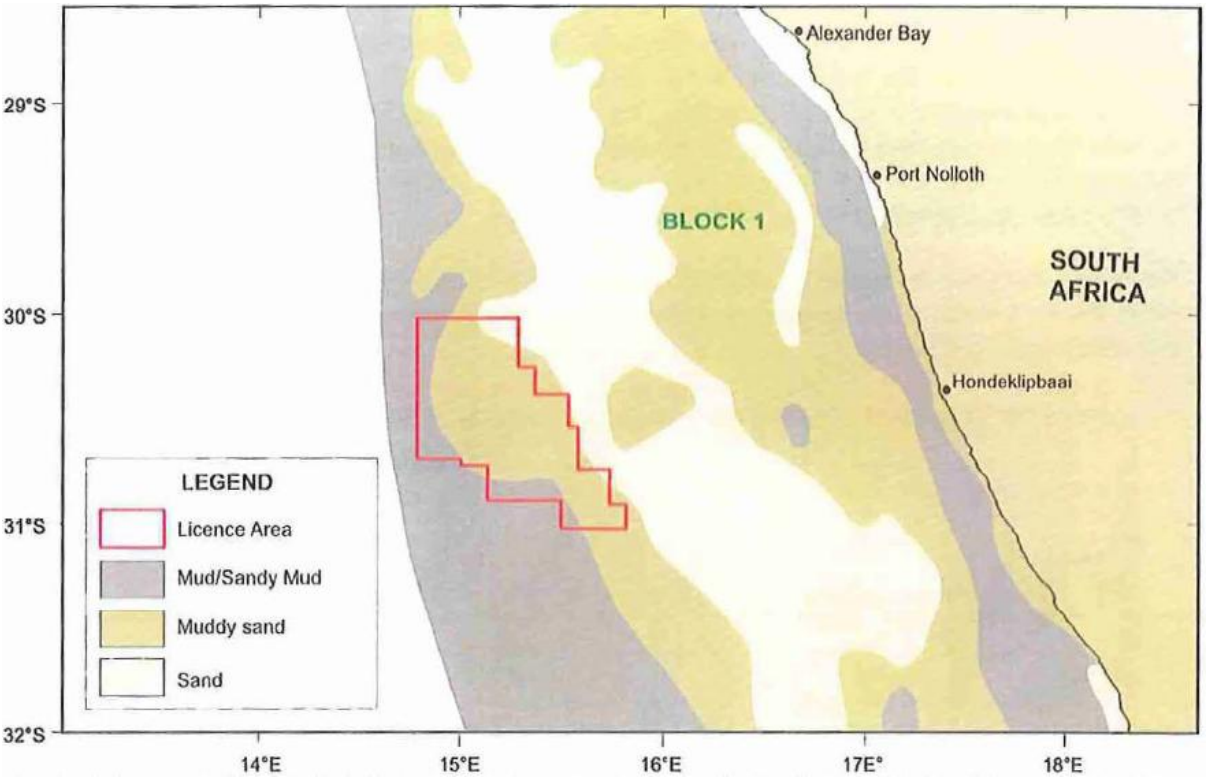


Figure 4.4: Sediment distribution on the continental shelf of the South African West Coast (Adapted from Rogers 1977).

4.1.2.5 WATER MASSES AND SEA SURFACE TEMPERATURES

A number of water masses are found along the West Coast, including tropical and sub-tropical surface waters, thermocline waters (comprising South Atlantic, 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.

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). In the northern Benguela system where cool upwelling occurs during the winter months, a far more pronounced seasonal difference (12 to 17 °C) in sea surface temperatures occurs (Shannon 1985). The sea surface temperature along the coast of Namaqualand near Port Nolloth ranges from a minimum of 10 °C to a maximum of just over 20 °C, with 84 % of the temperatures falling within a range of 12°C to 17 °C (Figure 4.5).

Over the continental margin, progressively colder waters encroach onto the continental shelf between the Orange River and the Cape Peninsula (Shannon and Nelson 1996). The area between 31°S and 33°S has the minimum shelf temperatures, with isotherms retreating into deeper water south of 34°S (Dingle and Nelson 1993).

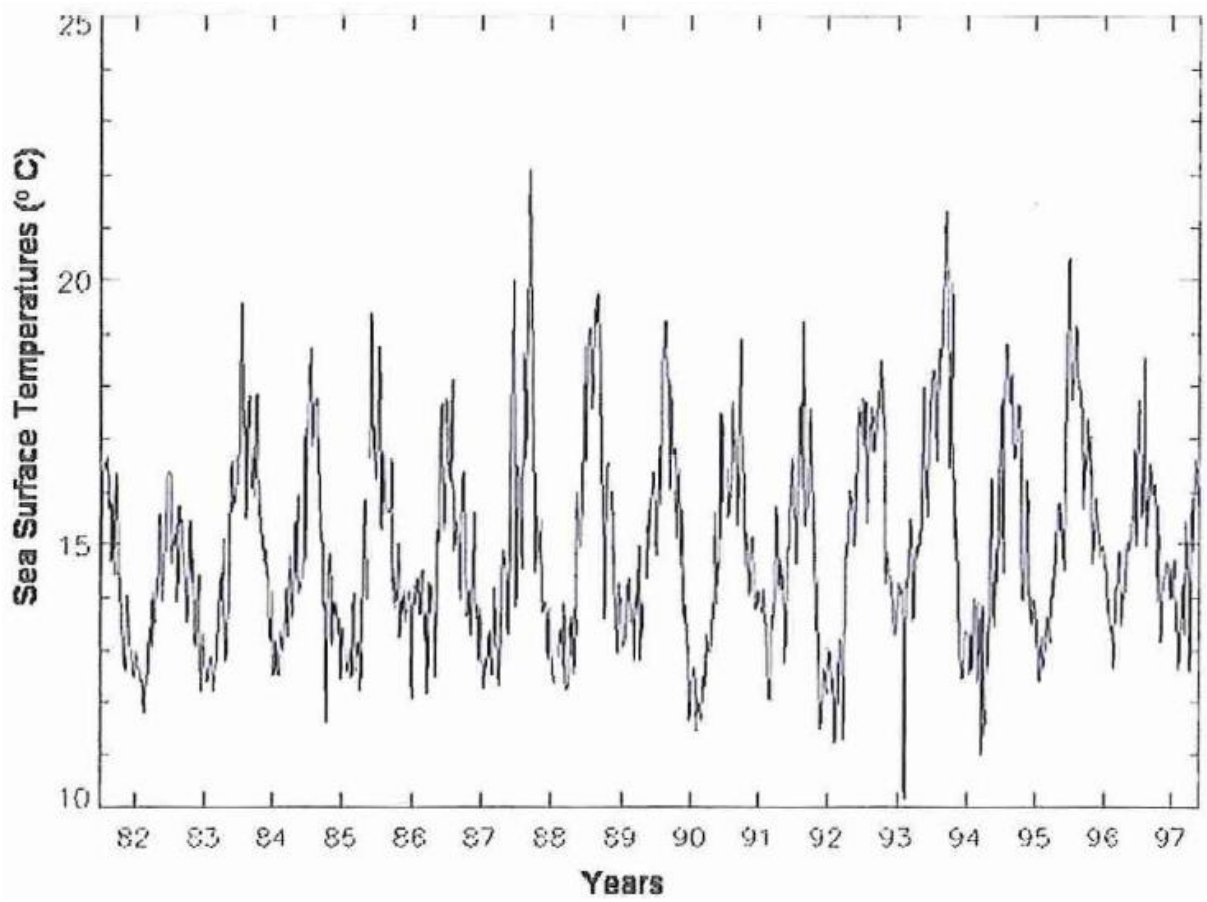


Figure 4.5: Weekly sea surface temperature recordings for the Namaqualand coastal waters, from 1980 -1998 (Figure after Enviro-Fish Africa, Grahamstown).

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 4.6. 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 emfs (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.

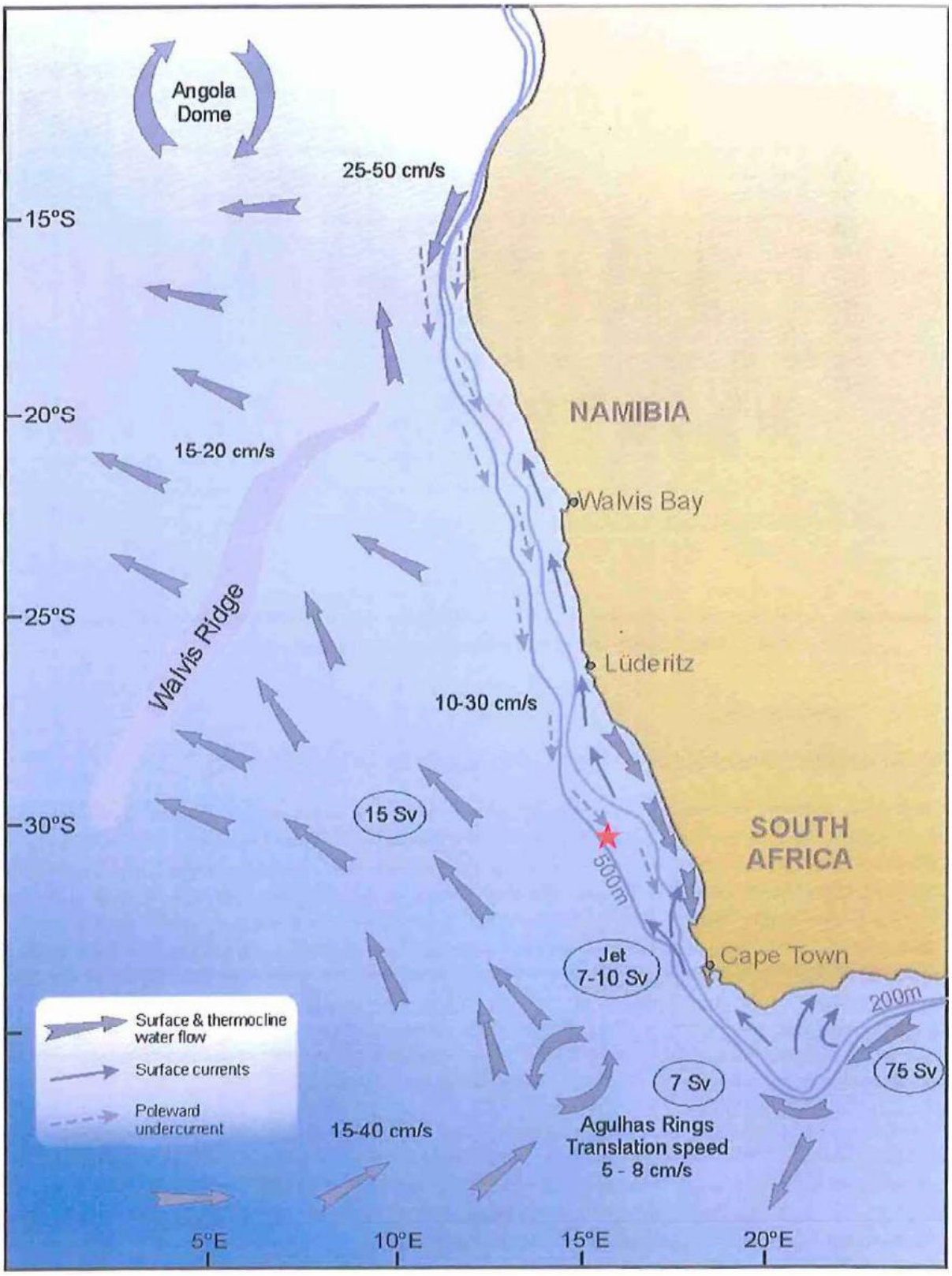


Figure 4.6: Major features of the predominant circulation patterns and volume flows in the Benguela System, along the southern Namibian and South African west coasts (re-drawn from Shannon & Nelson 1996). Approximate location of Block 2C is also indicated (*).

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 West Coast from Cape Agulhas to northern Namibia. 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) (Figure 4.7).

The Namaqualand upwelling zone (or Hondeklipbaai Cell) is a cool wedge-shaped zone lying between Hondeklip Bay and the Orange Bight, where the narrow shelf to the south-west of Hondeklip Bay results in enhanced upwelling. 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 $cm.sec^{-1}$ on the surface and 120 $cm.sec^{-1}$ 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.

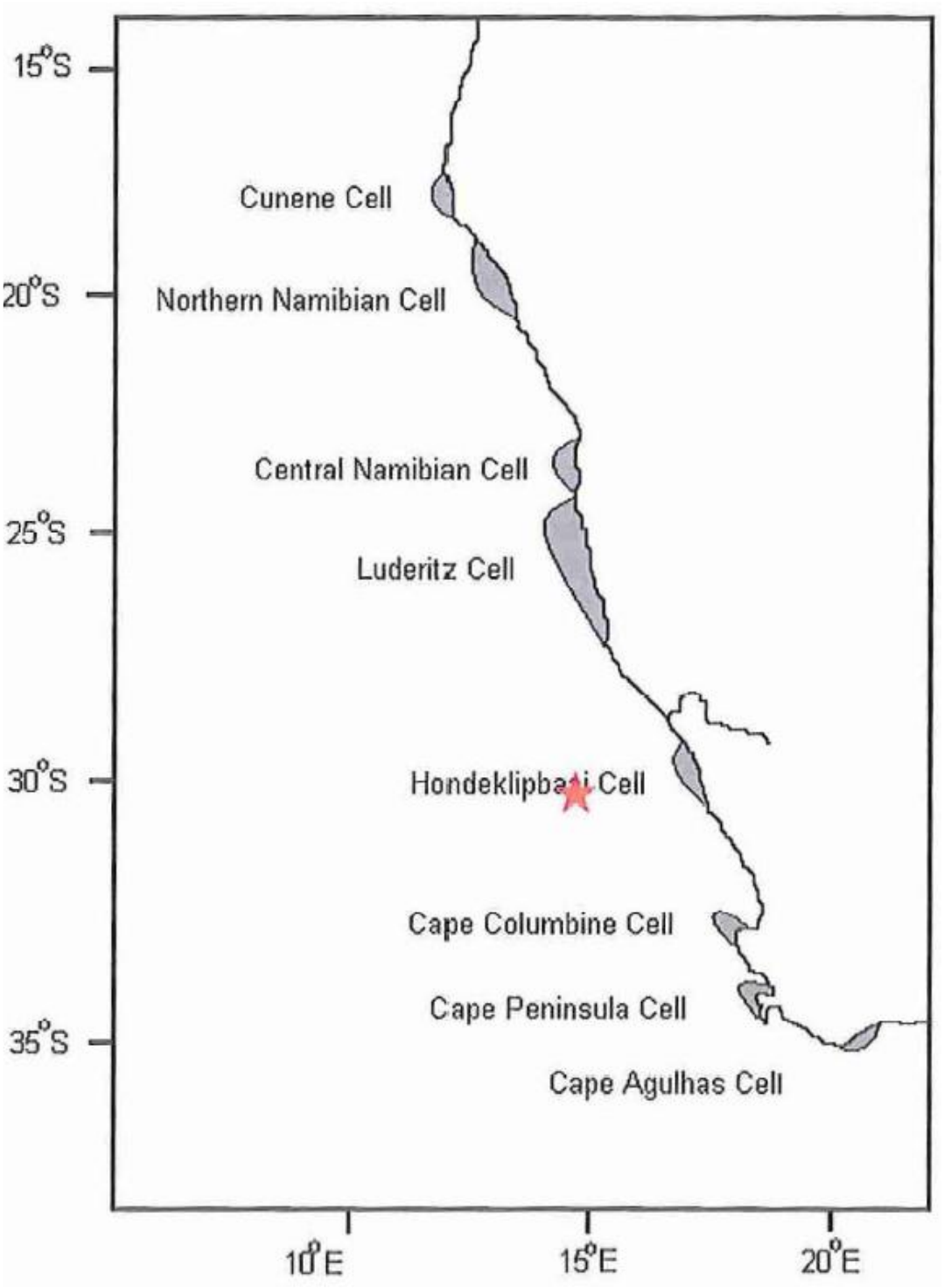


Figure 4.7: The location of three major upwelling cells along the West Coast (Shannon and Nelson, 1996). Approximate location of Block 2C is also indicated (*).

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 (see Figure 4.4), there are corresponding preferential areas for the formation of oxygen-poor water.

There are including three centres of oxygen-depleted shelf water; one of which is well north of the region (2°S to 24°S), another to the north of the Namaqualand upwelling cell and the third in St Helena Bay (Chapman and Shannon 1985). The spatial distribution of oxygen-poor water in each of the areas is subject to short- and medium-term variability in the volume of hypoxic water that develops.

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 Maller (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.

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 & Macke 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).

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)

Region	TSPM	PIM	Source
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)

4.1.3 BIOLOGICAL OCEANOGRAPHY

South Africa is divided into nine bioregions (see Figure 4.8), two of which occur in the proposed Exploration Right area (namely Namaqua and Atlantic Offshore) (Lombard *et al*. 2004). The Namaqua Bioregion extends from the Namibian border to Cape Columbine. Atlantic Offshore Bioregion extends from a line south-east of Cape Agulhas up into Namibia. The portion of the proposed survey Exploration Right area that extends beyond the shelf break onto the continental slope and into abyssal depths falls into the Atlantic Offshore Bioregion.

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). Areas which have been identified as priority areas for protection are presented in Section 4.1.4.6e. The proposed Child's Bank protection area is located partly within Block 2C (see Figure 4.35). Sink, *et. al*. (2012) also mapped the ecosystem threat status of offshore benthic and pelagic habitats. The proposed Exploration Right area coincides with areas mapped as largely vulnerable or critically endangered benthic habitats and vulnerable pelagic habitat, which generally occur along the shelf break (see Figure 4.9 and Figure 4.10).

Communities within marine habitats are largely ubiquitous throughout the southern African 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 near- and offshore 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.

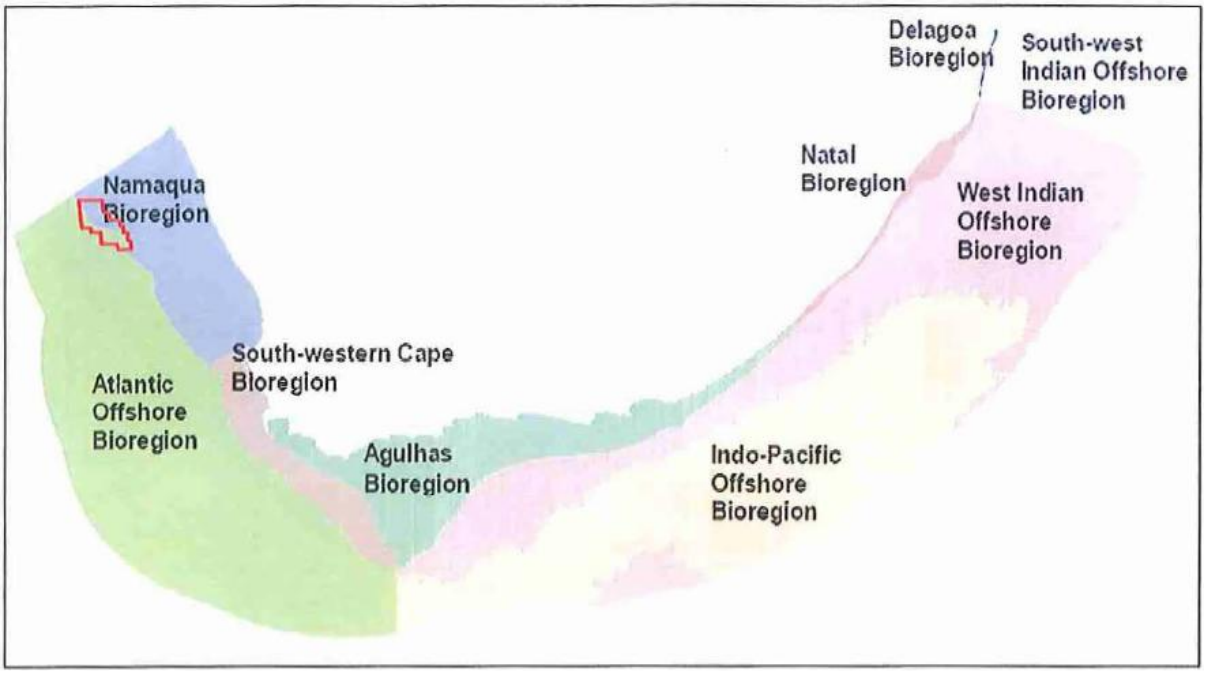


Figure 4.8: The nine bioregions defined by the NBSA study (Lombard and Strauss 2004). The approximate location of Block 2C is also shown.

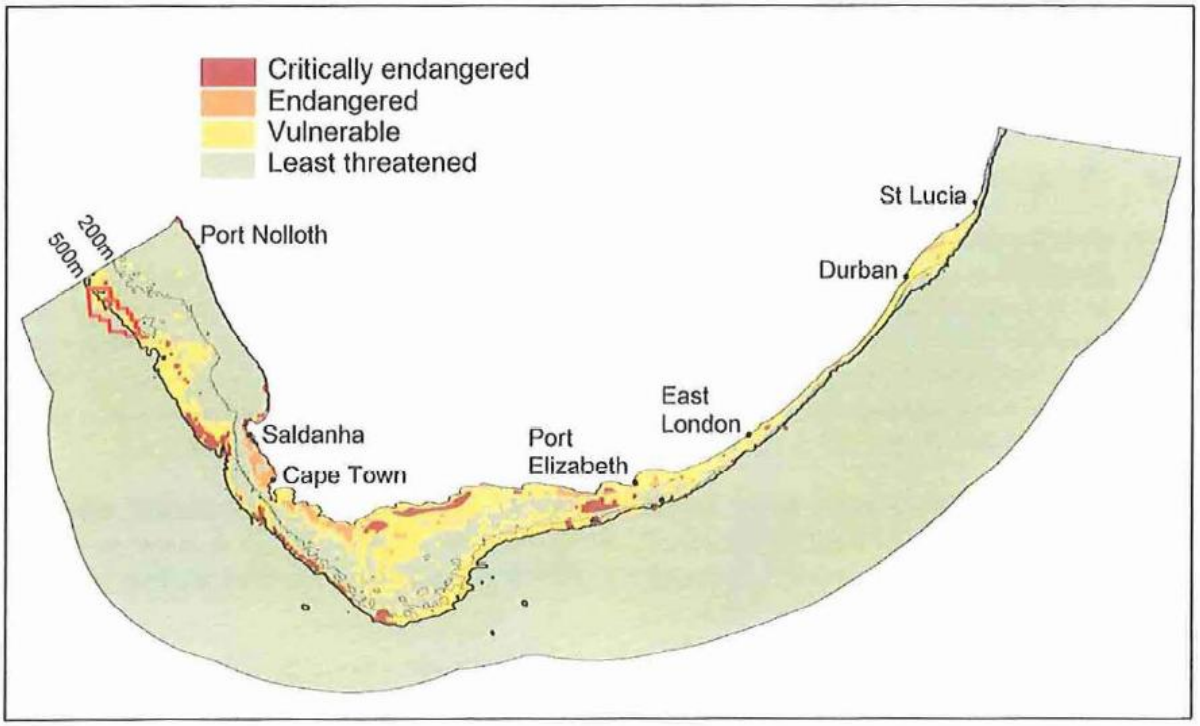


Figure 4.9: Ecosystem threat status for coastal and offshore benthic habitat types in South Africa (Sink, *et. al.*, 2012). The approximate location of Block 2C is also shown.

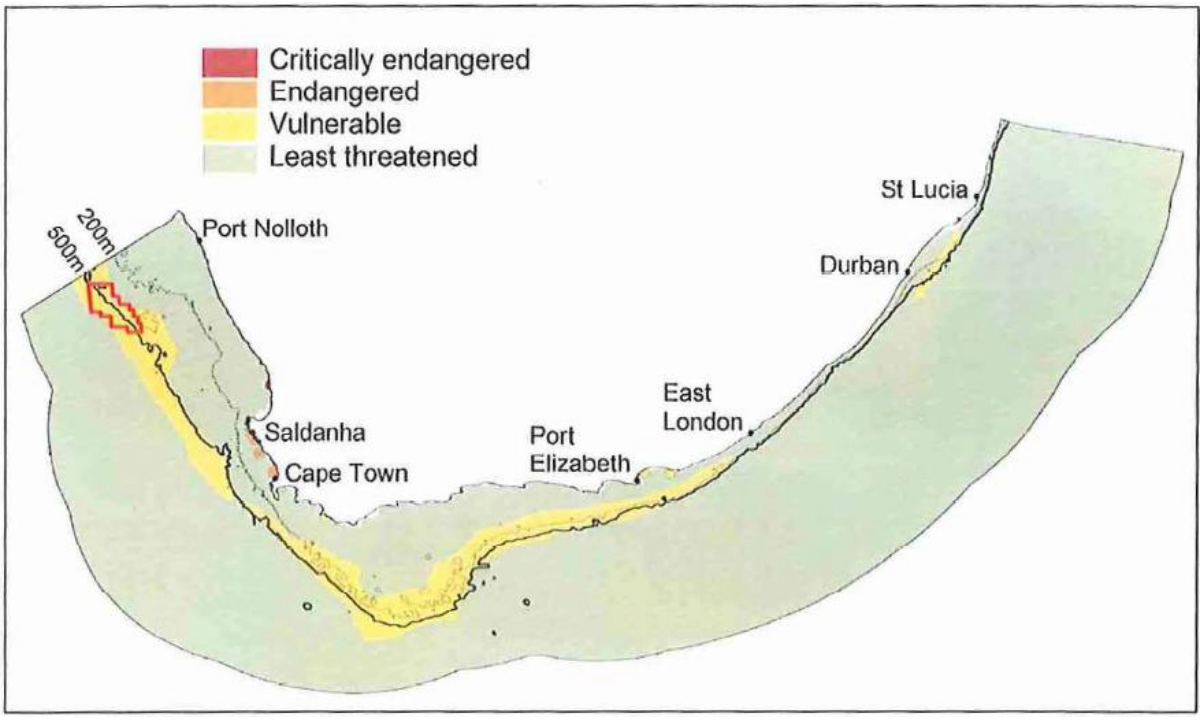


Figure 4.10: Ecosystem threat status for offshore pelagic habitat types in South Africa (Sink, *et. al*., 2012). The approximate location of Block 2C is also shown.

4.1.3.1 PLANKTON

Plankton comprises of three components:

(a) *Phytoplankton*

Features of phytoplankton distribution in the Benguela system are summarised in Figure 4.11. Phytoplankton and "chlorophyll a" concentrations vary seasonally along the West Coast, being minimal in winter and summer (<1-2 mg/m^3) and maximal (2-4 mg/m^3) 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.

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 filler 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 (Pilcher *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	Mean chlorophyll a concentrations ($mg.m^{-3}$)		
	Total shelf	Inshore shelf (< 200m depth)	Offshore shelf (200m – 500m depth)
All year	2.11	3.32	0.78
Spring	4.98	5.41	
Summer	2.28	3.62	0.79
Autumn	2.68	3.94	0.52
Winter	1.88	2.75	0.88

(b) *Zooplankton*

Features of the zooplankton distribution in the Benguela system are summarised in Figure 4.12.

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.

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.

Euphauslids (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.

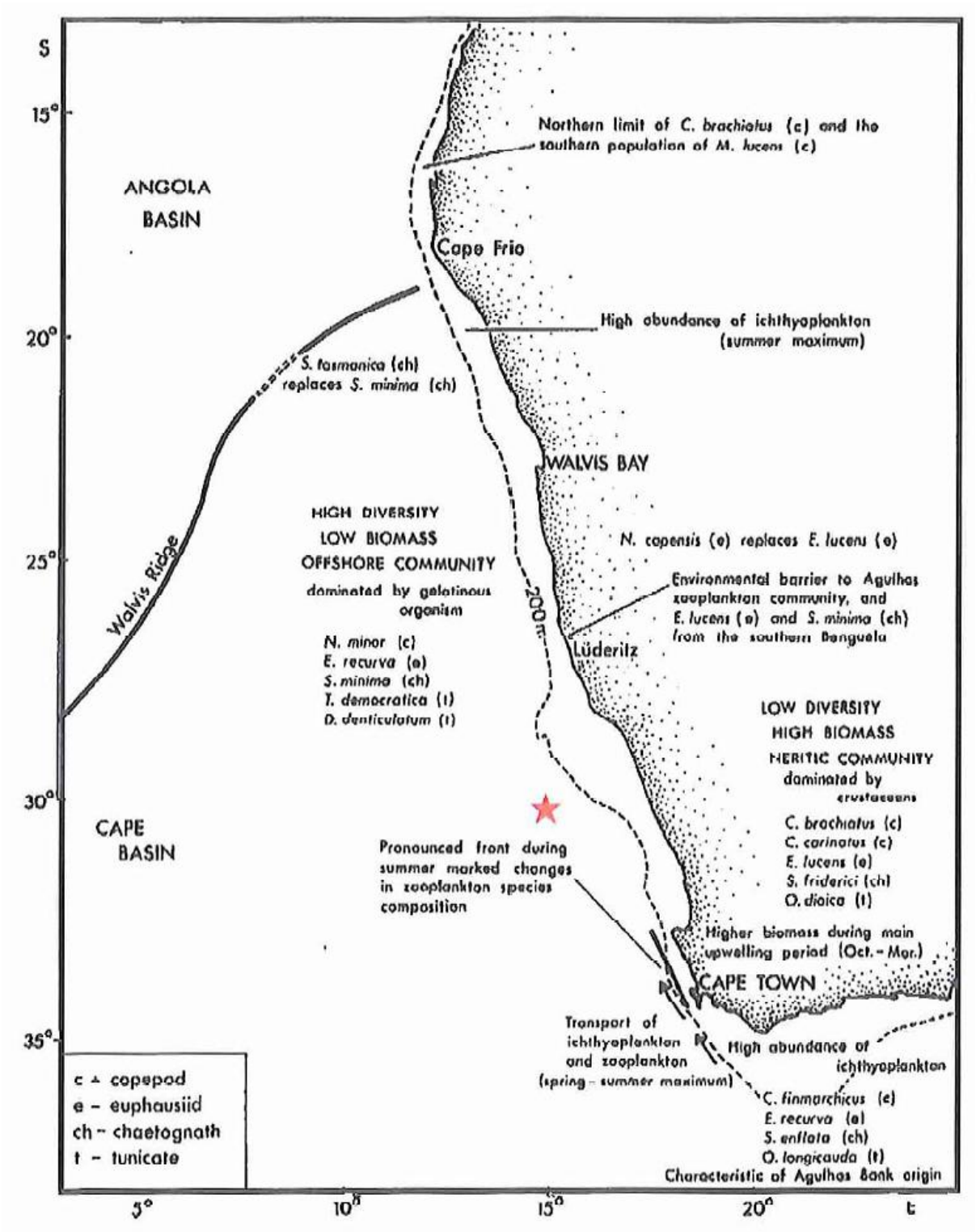


Figure 4.11: Features of phytoplankton distribution in the Benguela System (after Shannon and Pillar 1986). Approximate location of Block 2C is also indicated (*).

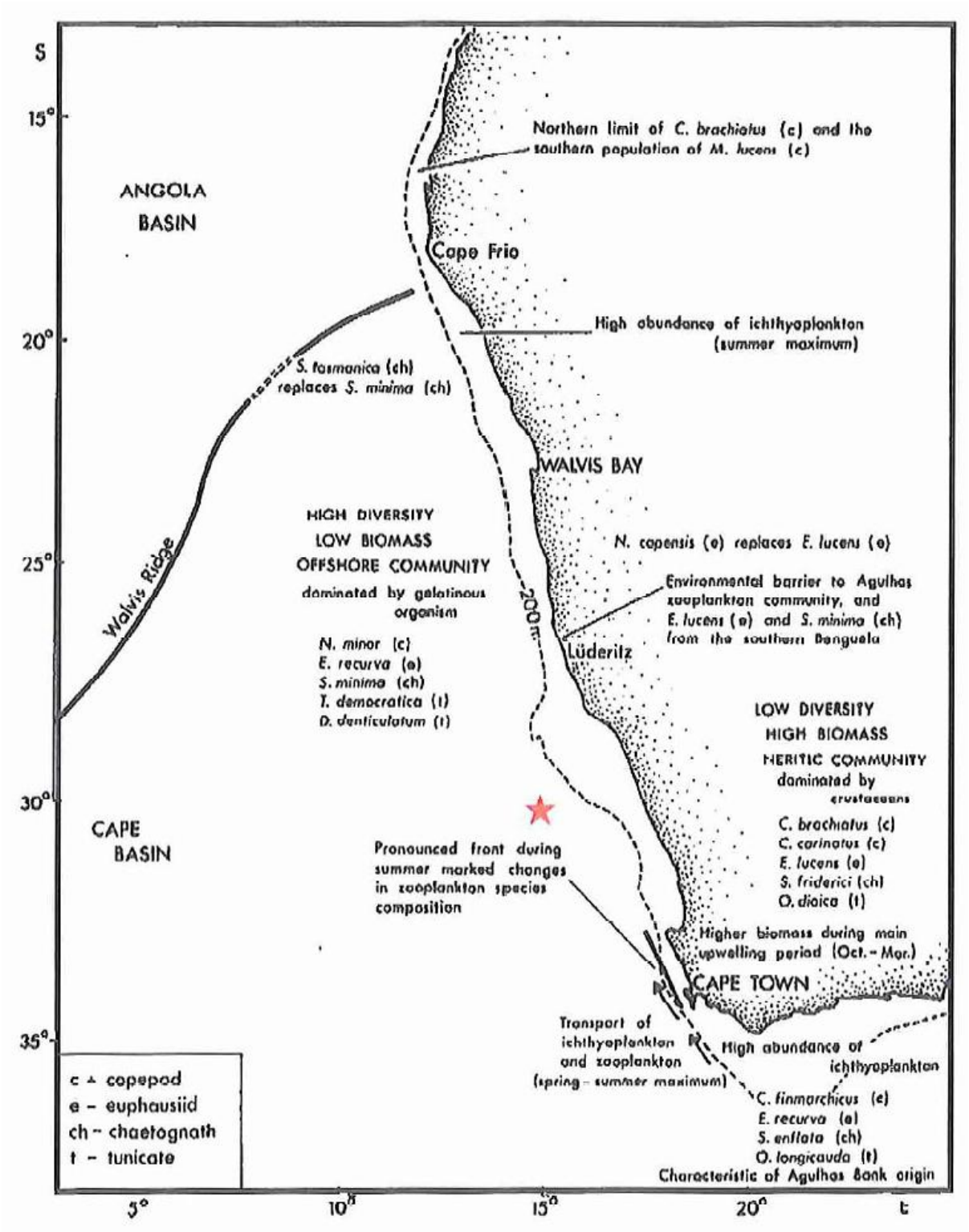


Figure 4.12: Features of zooplankton and ichtyoplankton distribution in the Benguela system (after Shannon and Pillar 1986). Approximate location of Block 2C Is also indicated (*).

(c) *Ichthyoplankton*

Ichthyoplankton comprises both fish eggs and larvae, and despite comprising a small component of the overall plankton, is important due to commercial fisheries. Features of the ichthyoplanklon distribution in the Benguela system are summarised in Figure 4.12 (Shannon and Pillar 1986).

Spawning areas for pilchard (*Sardinops sagax*), anchovy (*Engraulis japonicus*) and round herring (*Etrumeus Whiteheadi*) along the West Coast in relation to Block 2C are shown in Figure 4.13. Each spring, anchovy migrate southwards from the West Coast to spawning grounds on the western Agulhas Bank (Peterson *et al*. 1992), where the fish spawn serially with frequency of spawning being dependent on food concentration (copepod biomass). Most spawning takes place to the east of Cape Point some 40 to 100 km offshore in 16 to 19°C water.

Of the demersal species, the two hake species (*Merluccius capensis* and *M. paradoxus*) spawn on the continental shelf off St Helena Bay and the western Agulhas Bank (see Figure 4.14). Hake spawning occurs in spring and early summer, with a secondary spawning peak in autumn. Kingklip (*Genypterus capensis*) spawning occurs along the southern African West Coast from Cape Point northwards (Payne 1977). Eggs and/or larvae of snoek (*Thyrsites atun*), jacopever (*Helicolenus dactylopterus*), dragonet (*Paracallionymus costatus*) and saury (*Scomberesox saurus scomberoides*) have also been reported in the southern Benguela.

Ichthyoplankton abundance in the offshore waters of Block 2C is expected to be low.

4.1.3.2 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 80 m depth, 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 Telllna 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 sea floor 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.

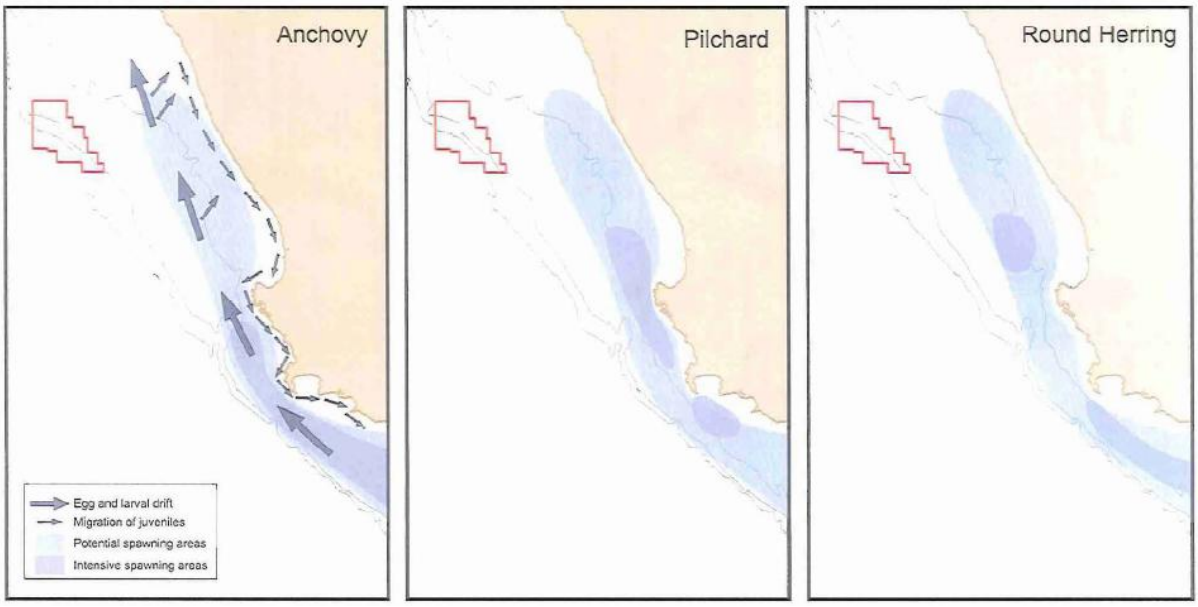


Figure 4.13: Major spawning areas in the southern Benguela region in relation to Block 2C for different pelagic species. Adapted from Cruikshank (1990).

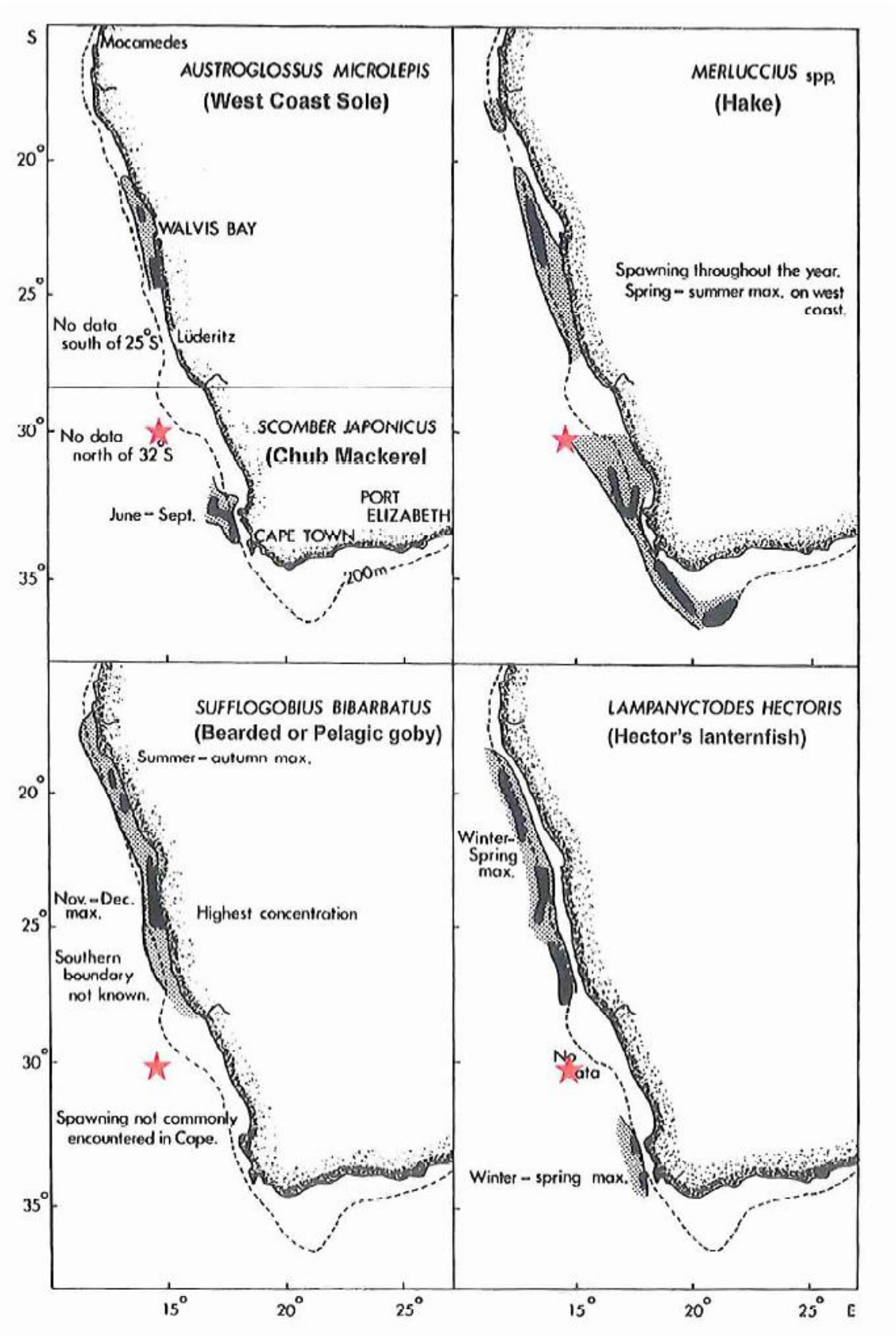


Figure 4.14: Spawning and recruitment information for a number of pelagic and demersal fish species inhabiting the West Coast. Modified from Shannon & Pillar (1986). Approximate location of Block 2C is also indicated (*).

4.1.3.3 INVERTEBRATES

The West Coast supports important commercial stocks of West Coast rock lobster (*Jasus lalandii*) between Cape Agulhas and about 25° 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)*
Anthoptilum 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
Kophobelemnon stelliferum	Widespread	400-1 180
Pennatula inflata	Widespread	457-741
Scleroptilum grandiflorum	Widespread	500-4 200
Stylatula macpheersoni	Benguela	245-318
Umbellula thomsoni	Widespread	1 300-6 200
Virgularia mirabilis	Widespread	9-400
Virgularia tuberculata	Benguela	75-1 050

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

4.1.3.4 DEEP WATER CORAL COMMUNITIES

There has been increasing interest in deep-water corals (depths >150 m) in recent years because of their likely sensitivity to disturbance and their long generation times. Some species form reefs while others are smaller and remain solitary. Corals add structural complexity to otherwise uniform seabed habitats thereby creating areas of high biological diversity (Breeze *et al*. 1997; Maclssac *et al*. 2001).

Deep water corals establish themselves below the thermocline where there is a continuous and regular supply of concentrated particulate organic matter, caused by the flow of a relatively strong current over special topographical formations which cause eddies to form. Nutrient seepage from the substratum might also promote a location for settlement (Hovland *et al*. 2002). Substantial shelf areas in the productive Benguela region should thus potentially be capable of supporting rich, cold water, benthic, filter-feeding communities.

4.1.3.5 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 major cephalopod resource in the southern Benguela are 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.

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.

Scientific Name	Importance
Histioteulhis miranda	No fisheries.

4.1.3.6 SEAMOUNT COMMUNITIES

Two geological features of note within the vicinity of Block 2C are Childs Bank, situated approximately 150 km offshore at about 31° S, and Tripp Seamount, situated approximately 250 km offshore at about 29°40' S (see Figure 4.16). Features such as banks, knolls and seamounts (referred to collectively here as "seamounts"), which protrude into the water column, 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 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.

The enhanced fluxes of detritus and plankton that develop in response to the complex current regimes lead to the development of detritivore-based food-webs, which in turn lead to the presence of seamount scavengers and predators. 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 (Rogers 2004). There is also associated mobile benthic fauna that includes echinoderms (sea urchins and sea cucumbers) and crustaceans (crabs and lobsters) (Rogers 1994). Seamounts also provide an important habitat for commercial deepwater fish stocks, such as orange roughy, oreos, alfonsino and Patagonian toothfish, which aggregate around these features for either spawning or feeding (Koslow 1996).

The coral frameworks offer refugia for a great variety of invertebrates and fish within, or in association with, the living and dead coral framework thereby creating spatially fragmented areas of high biological diversity (biological hotspots). 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). Consequently, seamounts are usually highly unique and are usually, but not always, identified as Vulnerable Marine Ecosystems (VMEs). South Africa's seamounts and their associated benthic communities have not been sampled by either geologists or biologists (Sink & Samaai 2009). However, evidence from video footage taken on hard-substrate habitats to the south-east of the Child's Bank suggest that vulnerable communities, including gorgonians, octocorals and reef-building sponges, can be expected on the seamount.

4.1.3.7 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 mesa-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.

a) *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). 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 dactylopferus*, 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).

(b) *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 and thus unlikely to be encountered in the proposed Exploration Right survey area.

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 4.13 and Figure 4.14).

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).

Large pelagic species include tunas, billfish and pelagic sharks, which migrate throughout the southern oceans, between surface and deep waters (>300 m) and have a highly seasonal abundance in the Benguela. 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. Concentrations of large pelagic species are also known to occur associated with underwater features such as canyons and seamounts as well as meteorologically-induced oceanic fronts (Penney *et al.* 1992).

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).

4.1.3.8 TURTLES

Three species of turtles, namely the green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*) and loggerhead (*Caretta caretta*) are found along the West Coast. Loggerhead and green turtles are expected to occur only as occasional visitors along the West Coast.

The leatherback turtle is likely to be encountered within the survey area. However, their abundance is expected to be low. 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[9]).

Leatherback turtles inhabit deeper waters and are considered a pelagic species, travelling the ocean currents in search of their prey (primarily jellyfish). While hunting they may dive to over 600 m and remain submerged for up to 54 minutes (Hays *et al.* 2004), thus making them difficult to observe from the surface and potentially susceptible to seismic operations. 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 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.

4.1.3.9 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) 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, particularly those between Dyer Island and Lamberts Bay. 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 (Table 4.6).

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

Common Name	Species Name	Global IUCN
Shy albatross	*Thafassarche cauta*	Near Threatened
Black browed albatross	*Thalassarche melanophrys*	Endangered

[9] SASTN Meeting - Second meeting of the South Atlantic Sea Turtle Network, Swakopmund, Namibia, 24-30 July 2011.

Common Name	Species Name	Global IUCN
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

Common Name	Species Name	Global IUCN Status
Greyheaded Gull	*Larus cirrocephalus*	Least Concern
Hartlaub's Gull	*Larus hartlaubii*	Least Concern
Caspian Tern	*Hydroprogne caspia*	Vulnerable
Swift Tern	*Stema bergii*	Least Concern
Roseate Tern	*Sterna dougallii*	Least Concern
Damara Tern	*Stema balaenarum*	Near Threatened

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 (10-30 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.

African penguin colonies (Spheniscus demersus) occur at 27 localities around the coast of South Africa and Namibia (see Figure 4.15). The species forages at sea with most birds being found within 20 km of their colonies. African penguin distribution at sea is consistent with that of the pelagic shoaling fish, which generally occur within the 200 m isobath.

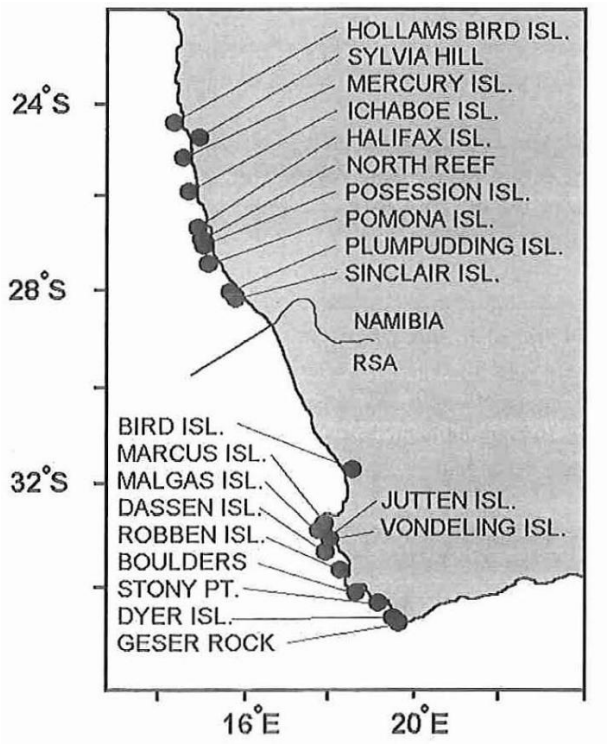


Figure 4.15: The distribution of breeding colonies of African penguins on the South African West Coast.

The Cape Gannet and Bank Cormorant are listed in the South African Red Data Book as "Vulnerable". The Caspian Tern, Cape Cormorant and Crowned Cormorant are listed in the South African Red Data Book as "Near-threatened", while the African Penguin and Damara Tern is listed as "Endangered". The decline in the African Penguin population is ascribed primarily to the removal of the accumulated guano from the islands during the nineteenth century. Penguins used to breed in burrows in the guano and are now forced to nest in the open, thereby being exposed to much greater predation and thermal stress.

The Cape Gannet, a plunge diver feeding on epipelagic fish, is thought to have declined as a result of the collapse of the pilchard, whereas the Cape Cormorant was able to shift its diet to pelagic goby. Furthermore, the recent increase in the seal population has resulted in seals competing for island space to the detriment of the breeding success of both gannets and penguins.

4.1.3.10 MARINE MAMMALS

The marine mammal fauna occurring off the West Coast of South Africa, north of Cape Columbine, include whales, dolphins and seals.

(a) *Cetaceans*

South of Cape Columbine, some cetacean species more commonly associated with warmer Agulhas current waters are known to occur. As Block 2C is north of Cape Columbine, the description below focusses on those species associated with the Benguela ecosystem proper and the waters offshore of this.

The cetacean fauna of the West Coast comprises 28 species of whales and dolphins known or to occur here (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.

The distribution of whales and dolphins on the West Coast can largely be split into those-associated with the continental shelf and those that occur in deep, oceanic waters. Species from both environments may, however, be found associated with the shelf (200 - 1 000 m), making this the most species-rich area for cetaceans. The most common species within the proposed Exploration Right area (in terms of likely encounter rate not total

population sizes) are likely to be the dusky dolphin, long finned pilot whale, southern right whale and humpback whale.

Cetaceans comprised two basic taxonomic groups: the mysticetes (filter-feeding baleen whales) and the odontocetes (toothed predatory whales and dolphins).

Mysticete cetaceans occurring in the proposed Exploration Right area include the southern right, humpback, blue, fin, sei, minke, dwarf minke, sperm and two populations of Bryde's whale. 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, Block 2C 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.

Table 4.7: Cetaceans occurrence off the West Coast, their seasonality and likely encounter frequency.

Common Name	Species	Shelf	Offshore	Seasonality	Likely encounter freq.
Delphinids					
Dusky dolphin	*Lagenorhynchus obscurus*	Yes (0- 800 m)	No	Year round	Daily
Heaviside's dolphin	*Cephalorhynchus heavisidii*	Yes (0-200 m)	No	Year round	Daily
Common bottlenose dolphin	*Tursiops truncatus*	No	Yes	Year round	Monthly
Common (short beaked) dolphin	*Delphinus delphis*	Yes	Yes	Year round	Monthly
Long-finned pilot whale	*Globicephafa melas*		Yes	Year round	<Weekly
Killer whale	*Orcinus orca*	Occasional	Yes	Year round	Occasional
False killer whale	*Pseudorca crassidens*	Occasional	Yes	Year round	Monthly
Risso's dolphin	*Grampus griseus*	Yes (edge)	Yes	Year round	Occasional
Pygmy killer whale	*Feresa attenuate*		Yes	Year round	Occasional
Sperm whales					
Pygmy sperm whale	*Kogia breviceps*		Yes	Year round	Occasional
Sperm whale	*Physeter macrocephalus*		Yes	Year round	Occasional
Beaked whales					
Cuvier's	*Ziphius cavirostris*		Yes	Year round	Occasional
Arnoux's	*Beradius arnouxii*		Yes	Year round	Occasional

Common Name	Species	Shelf	Offshore	Seasonality	Likely encounter freq.
Southern bottlenose	*Hyperoodon planifrons*		Yes	Year round	Occasional
Layard's	*Mesoplodon layardii*		Yes	Year round	Occasional
True's	*M. mirus*		Yes	Year round	
Gray's	*M. grayi*		Yes	Year round	Occasional
Blainville's	*M. densirostris*		Yes	Year round	
Baleen whales					
Minke	*Balaenoptera bonaerensis*	Yes	Yes	>Winter	Monthly
Dwarf minke	*B. acutorostrata*	Yes		Year round	Occasional
Fin whale	*B. physalus*		Yes	MJJ & ON, rarely in summer	Occasional
Blue whale	*B. musculus*		Yes	MJJ	Occasional
Sei whale	*B. borealis*		Yes	MJ & ASO	Occasional
Bryde's (offshore)	*B. brydei*	Yes		Summer (JF)	Occasional
Bryde's (inshore)	*B brydei (subspp)*		Yes	Year round	Occasional
Pygmy right	*Caperea marginata*	Yes		Year round	Occasional
Humpback	*Megaptera novaeangliae*	Yes	Yes	SONDJF	Daily*
Southern right	*Eubalaena australis*	Yes		SONDJF	Daily*

- The most abundant baleen whales off the coast of South Africa are southern right (listed as Vulnerable) and humpback whales (listed as Endangered). Southern right whales migrate to the southern Africa subcontinent to breed and calve, where they tend to have an extremely coastal distribution mainly in sheltered bays (90% <2 km from shore; Best 1990, Elwen & Best 2004). They typically arrive in coastal waters off the West Coast in June, increasing to a maximum number in September/October, with most departing in December (although animals may be sighted as early as April and as late as February). On the West Coast they are most common south of Lambert's Bay (CCA & CMS 2001), although a number of the bays between Chameis Bay (27°56'S) and Conception Bay (23°55'S) in Namibia have in recent years become popular calving sites (Currie *et al.* 2009), with sightings reported as far north as the Kunene and Mowe Bay (Roux *et al.* 2001). The Southern Right calving season extends from late June to late October, peaking in August (Best 1994; Roux *et al.* 2001), with cow-calf pairs remaining in sheltered bays for up to two months before starting their southern migration.

  The majority of humpback whales on the West Coast are migrating past the southern African continent to breeding grounds off Angola, Republic of Congo and Gabon (Rosenbaum *et al.* 2009, Barendse *et al.* 2010). On the West Coast it is thought that only a small proportion of the main migration comes close inshore, the majority choosing the shortest route to the central West African breeding grounds by following the edge of the continental shelf (Best 2007; Best & Allison 2010). Humpback whales migrate at various distances from the coast including pelagic waters (Barendse *et al.* 2002), and as they are likely to regularly cross the proposed Exploration Right survey area, will probably be the most abundant large whale encountered. Most humpbacks reach southern African waters around April, continuing through to September/October when the southern migration begins and continues through to December. The calving season for humpbacks extends from July to October, peaking in early August (Best 2007). Cow-calf pairs are typically the last to leave southern African waters on the return southward migration, although considerable variation in the departure time from breeding areas has been recorded (Barendse *et al.* 2010).

  In the last decade, deviations from the predictable and seasonal migration patterns of these two species have been reported from the Cape Columbine - Yzerfontein area (Best 2007; Barendse *et al.* 2010). High abundances of both Southern Right and Humpback whales in this area during spring and summer (September-February), indicates that the upwelling zones off Saldanha and St Helena Bay may serve as an important summer feeding area (Barendse *et al.* 2011, Mate *et al.* 2011). It was previously thought that whales feed only rarely while migrating (Best *et al.* 1995), but these localised summer concentrations suggest that these whales may in fact have more flexible foraging habits. The offshore location of the proposed exploration area makes encounters with whales undergoing summer migrations highly unlikely.

  Best (2000) estimated that southern right population was increasing at approximately 7% per annum. The most recent abundance estimate for the South African Southern right whale population (2008) puts the population at approximately 4 600 individuals of all age and sex classes, which is thought to be at least 23% of the original population size (Brandão *et al.* 2011). At least one third of the total South African population (approximately 1 033 - 1 577 individuals) has been estimated to use the West Coast feeding ground (Peters *et al.* 2011), showing the potential importance of this area for the population as a whole. Recent abundance estimates for humpback whales put the number of animals using the West Coast feeding area, over the period 2001-2007, at around 500 animals (Barendse *et al.* 2011).

- 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, south and east of Lambert's Bay, 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 proposed survey area likely to be highest in January-February.

- Sei whales (listed as Endangered) 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).

- 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 abundance or distribution of fin whales off the West Coast.

- Although blue whales (listed as Endangered) were historically caught in high numbers off the West Coast, there have been only two confirmed sightings of the species in the area since 1973 (Branch *et al*. 2007), suggesting that the population using the area may have been extirpated by whaling. However, scientific-related search effort (and thus information) in pelagic waters is very low. The chance of encountering the species in Block 2C is considered low.

- 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, 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.

There is almost no data available on the abundance, distribution or seasonality of the smaller odontocetes (including the beaked whales and dolphins) known to occur in oceanic waters off the shelf of the West Coast. Beaked whales are all considered to be true deep water species usually being seen in waters in excess of 1 000 - 2 000 m depth (Best 2007). Their presence in the area may fluctuate seasonally, but insufficient data exist to define this clearly.

Of the smaller odontocetes known to occur offshore, the long-finned pilot whale is likely to be the most commonly encountered in the proposed Exploration Right area (S. Elwen pers comm). False killer whales, killer whales and the offshore form of the bottlenose dolphin are also likely to be encountered with some regularity in deeper waters (Findlay *et al.* 1992, Best 2007).

Inshore of the 500 m isobath, dusky dolphins are likely to be the most frequently encountered small cetacean. This species is resident year round throughout the Benguela ecosystem coastal waters to depths of at least 500 m (Findlay *et al.* 1992). Although no information is available on the size of the population, they are regularly encountered in nearshore waters (Elwen *et al.* 2010) suggesting a relatively large population of several thousand at least. The species is very boat-friendly and will often approach vessels to bowride.

Heaviside's dolphins are abundant in the southern Benguela, extending from the coast to at least 200 m depth (Elwen *et al.* 2006; Best 2007). It is estimated that around 10 000 animals live in the 400 km stretch of coast between Cape Town and Lambert's Bay (Elwen *et al*. 2009). This species shows a strong diurnal movement pattern being most abundant in nearshore waters (<2 km from shore) in the early mornings and moving offshore at night to feed (Elwen *et al.* 2006, Elwen *et al.* 2009).

(b) *Seals*

The Cape fur seal (*Arctocephalus pusillus pusillus*) congregates in seven breeding and five non-breeding colonies along the West Coast (Figure 4.16). Four other seal species may occasionally be found as vagrants along the West Coast, including southern elephant seal (*Mirounga leoninas*), subantarctic fur seal (Arclocephalus troplcalis), crabeater (Lobodon carclnophagus) and leopard seals (Hydrurga leptonyx) (David 1989).

There are two Cape fur seal breeding colonies within the study area: at Kleinzee (incorporating Robeiland) and at Bucchu Twins near Alexander Bay. The colony at Kleinzee has the highest seal population and produces the highest seal pup numbers on the South African Coast (Wickens 1994). The colony at Buchu Twins, formerly a non-breeding colony, has also attained breeding status (M. Meyer, SFRI, pers. comm.). Non-breeding colonies occur south of Hondeklip Bay at Strandfontein Point and on Bird Island at Lamberts Bay, with the McDougalls Bay islands and Wedge Point being haul-out sites only and not permanently occupied by seals. All have important conservation value since they are largely undisturbed at present.

Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nautical miles offshore (Shaughnessy 1979), with bulls ranging further out to sea than females. The timing of the annual breeding cycle is very regular occurring between November and January. Breeding success is highly dependent on the local abundance of food, territorial bulls and lactating females being most vulnerable to local fluctuations as they feed in the vicinity of the colonies prior to and after the pupping season (Oosthuizen 1991).

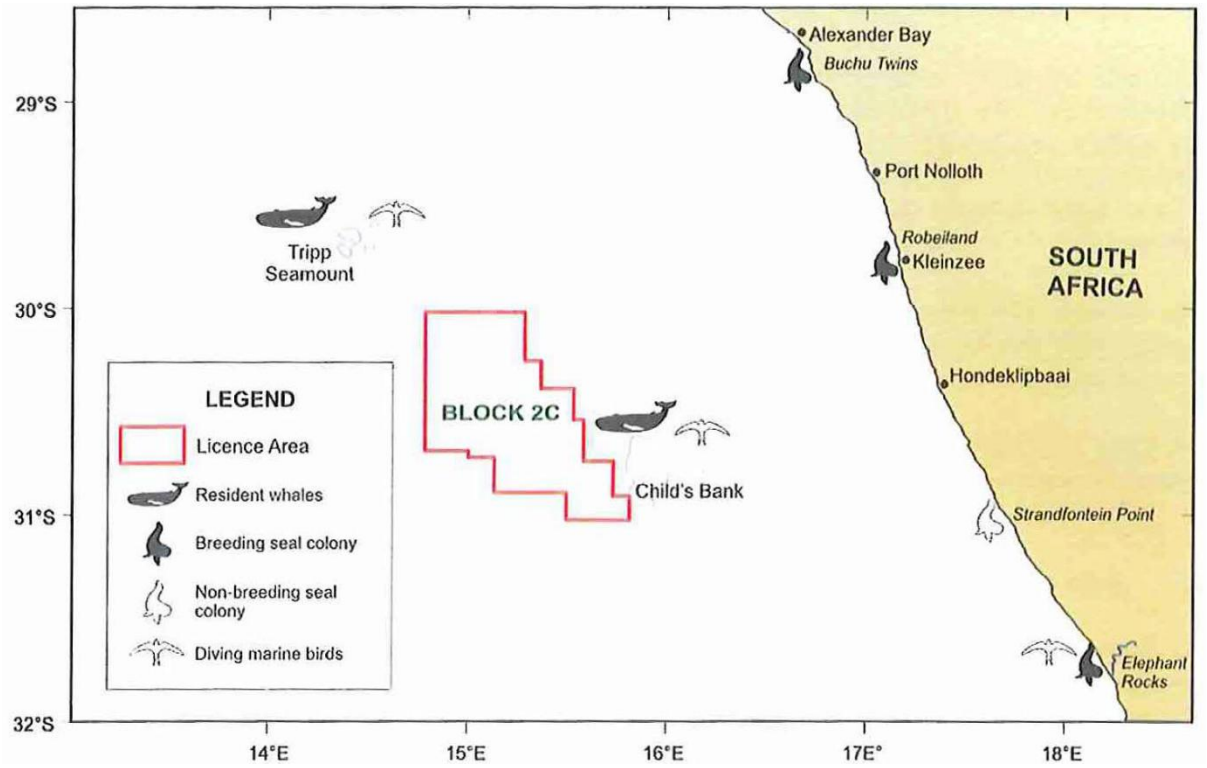


Figure 4.16: Location of seabird and seal colonies and resident whale populations in relation to Block 2C.

4.1.4 HUMAN UTILISATION

4.1.4.1 FISHERIES

The South African fishing industry consists of 14 commercial sectors operating within the country's 200 nautical mile Exclusive Economic Zone (EEZ). The following fisheries are active in the vicinity of Block 2C:

- Demersal trawl;
- Small pelagic purse-seine;
- Demersal long-line;
- Pelagic long-line;
- Tuna pole;
- Traditional line fish; and

- West Coast rock lobster.

(a) *Demersal trawl*

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*). Main by-catch species include monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*). 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 operating on both the South and West coasts. There are currently 54 trawlers operating within the offshore sector. The current Total Allowable Catch (TAC) of hake for the demersal trawl fishery in South Africa is currently set at 150 000 tons. The deep-sea trawl sector on the West Coast operates mainly in a continuous band along the shelf edge between the 300 m and 1 000 m bathymetric contours (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 five nautical miles of the coastline.

The demersal trawl fishery is active year-round with approximately 1% of the average annual effort (approximately 650 trawls) and 1.6% of the average annual catch (2 350 tons) of targeted species being recorded within Block 2C between 2004 and 2010 (see Figure 4.17).

The towed gear typically consists of trawl warps, bridles and trawl doors, a footrope, headrope, net and codend (see Figure 4.18).

(b) Small pelagic purse-seine

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 landings of 312 000 tons recorded for 2009.

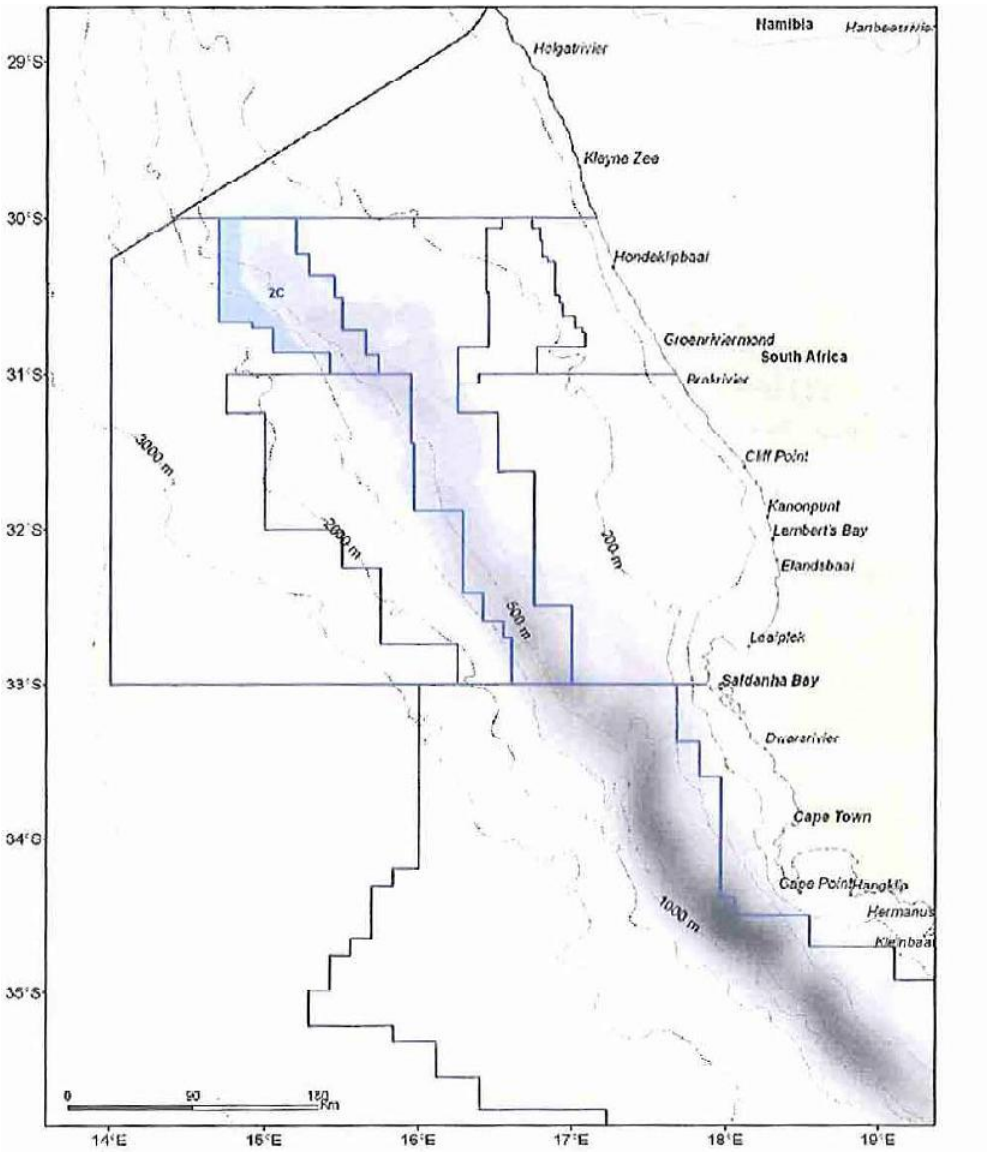


Figure 4.17: Location and effort (2004 to 2010) of the demersal trawl fishery in relation to Block 2C.

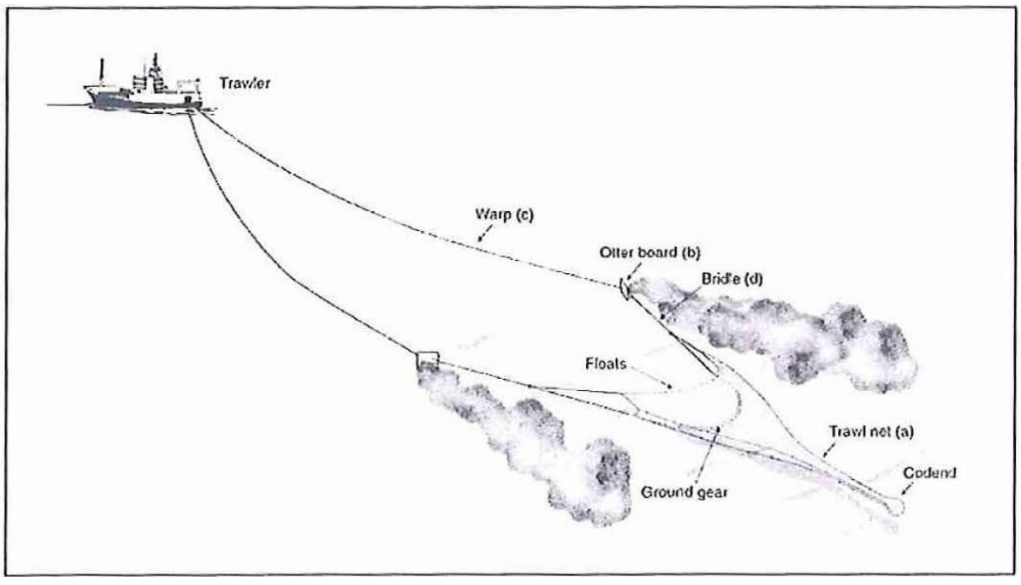


Figure 4.18: Typical gear configuration used by demersal trawlers (offshore) targeting hake.

The South African fishery, consisting of approximately 100 vessels, is active all year round with a short break from mid-December to mid-January, 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 50 nautical miles offshore, but usually closer inshore. The sardine-directed fishery tends to concentrate effort in a broad area extending from St Helena 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 St Helena Bay to Cape Point and is most active in the period from March to September. Round herring (non-quota species) is targeted when available and specifically in the early part of the year (January to March) and is distributed South of Cape Point to St Helena Bay. The fishing grounds of the small pelagic purse-seine fishery do not extend into Block 2C (see Figure 4.19).

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 4.20). 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 to1.5 hours. Vessels usually operate overnight and return to offload their catch the following day.

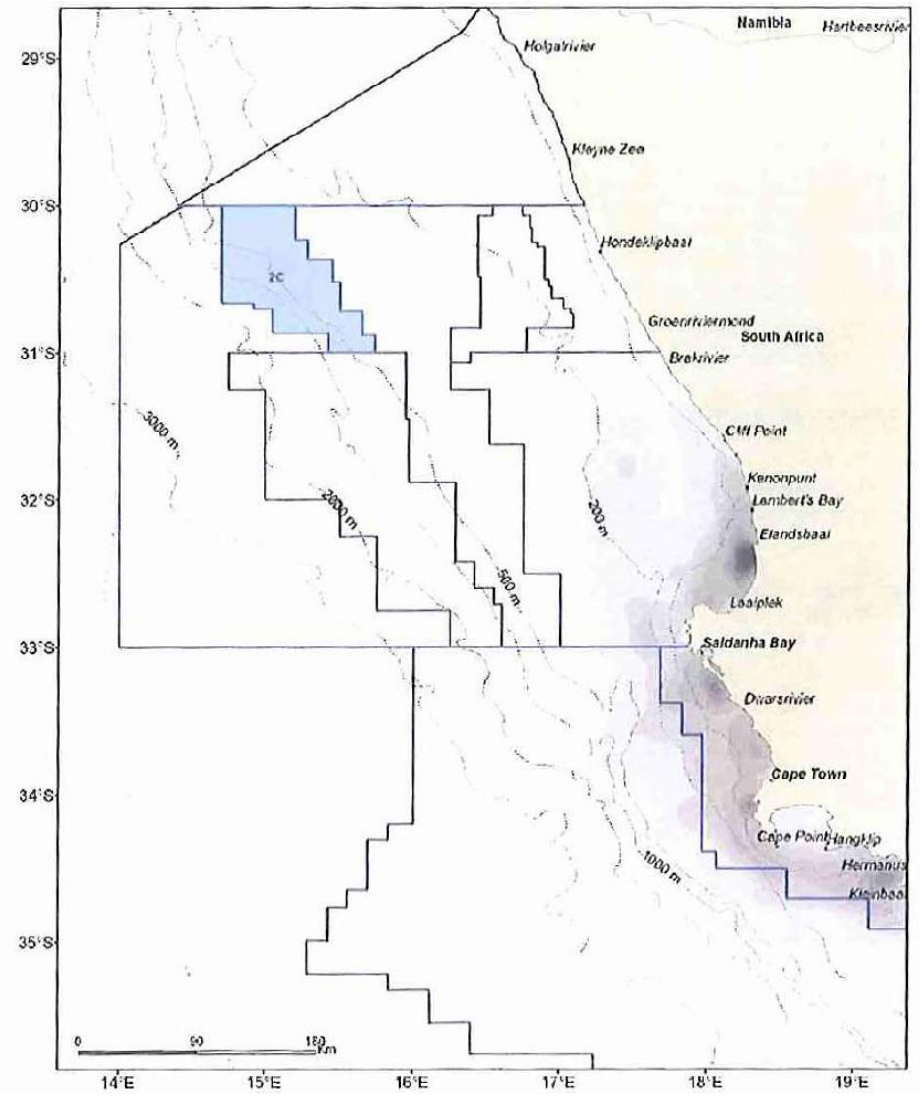


Figure 4.19: Spatial distribution of the catch (2001 to 2009) by the purse-seine fishery in South African waters in relation to Block 2C.

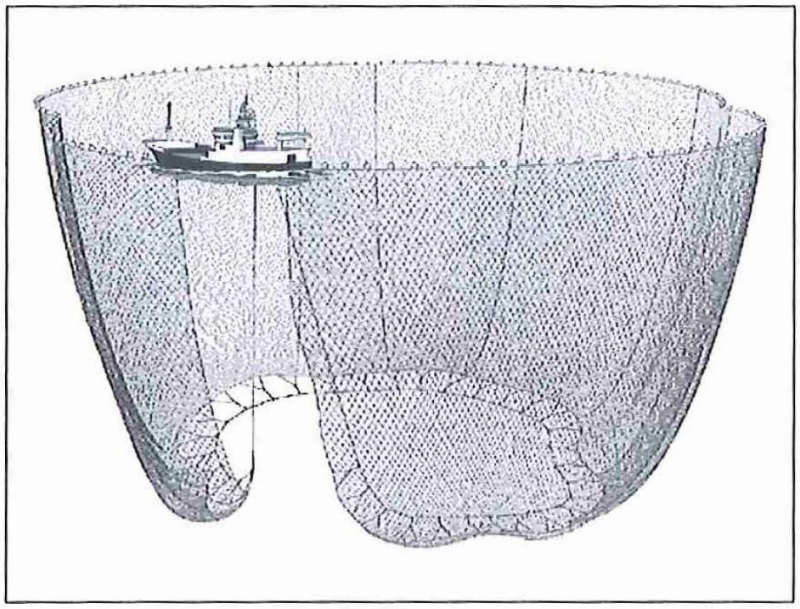


Figure 4.20: Pelagic purse-seine gear configuration.

(c) *Demersal long-line*

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 targets the Cape hakes, with a small non-targeted commercial by-catch that includes kingklip. Currently 64 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. Approximately 8 000 tons of hake are landed by South African long-line vessels (2011).

Demersal long-lining is expected to occur in similar areas used by the hake-directed trawling, i.e. along the shelf edge from 300 m to a water depth of 1 000 m with lines usually set parallel to bathymetric contours. The spatial extent of demersal long-line effort off the West Coast of South Africa in the vicinity of Block 2C is presented in Figure 4.21. Approximately 1% of the total national effort between 2002 and 2008 has been recorded within the survey area (which amounts to an average of 50 demersal long-lines per year).

Bottom-set long-line gear is robust and comprises two lines as well as dropper lines with subsurface floats attached (see Figure 4.22). 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.

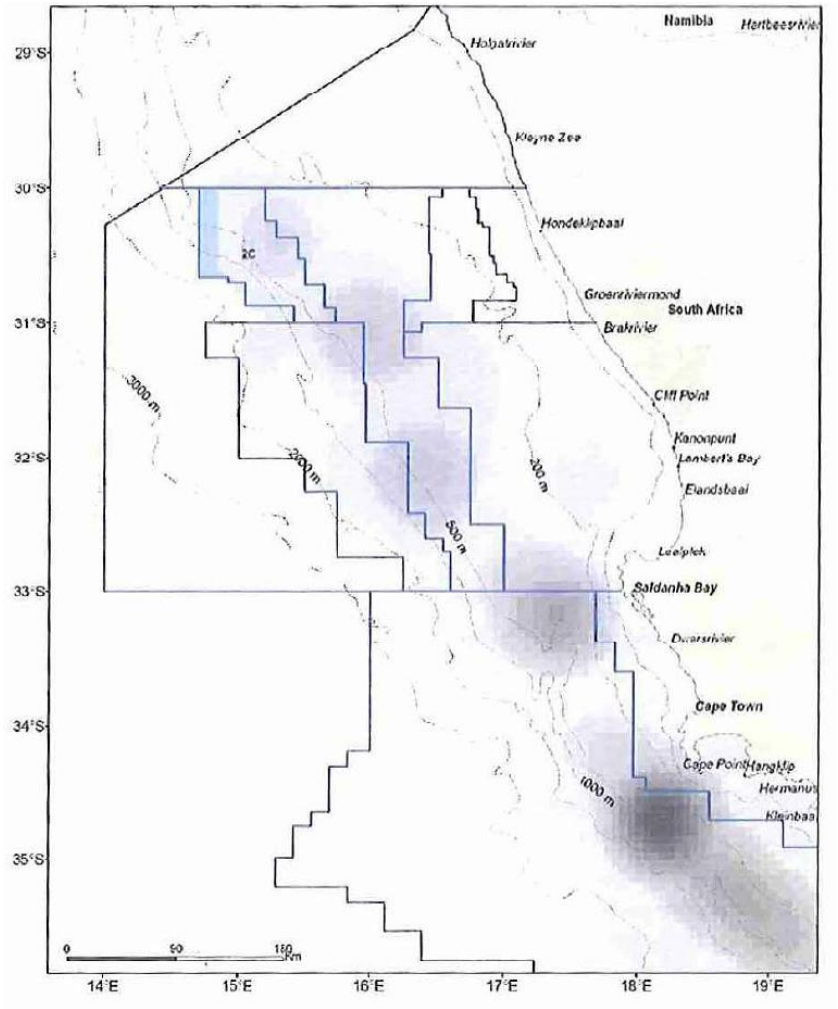


Figure 4.21: Effort (2002 to 2008) expended by the demersal long-line fishing sector on the West Coast of South Africa in relation to Block 2C.

(d) *Pelagic long-line*

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 50 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 4.23). Approximately 1.7% of the average annual effort (approximately 10 lines) and 1.9% (12.6 tons) of the average annual catch of targeted species has been recorded within Block 2C between 2002 and 2008.

Pelagic long-line vessels set a drifting mainline, which are 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 4.24). 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. A line may be left drifting for up to 18 hours before retrieval by means of a powered hauler at a speed of approximately 1 knot. 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. The presence of long-lines would present a potential threat to the seismic survey operations in terms of entanglements with towed seismic gear. Extreme vigilance would be needed to avoid any drifting lines and regular communications with vessels in the area would be essential.

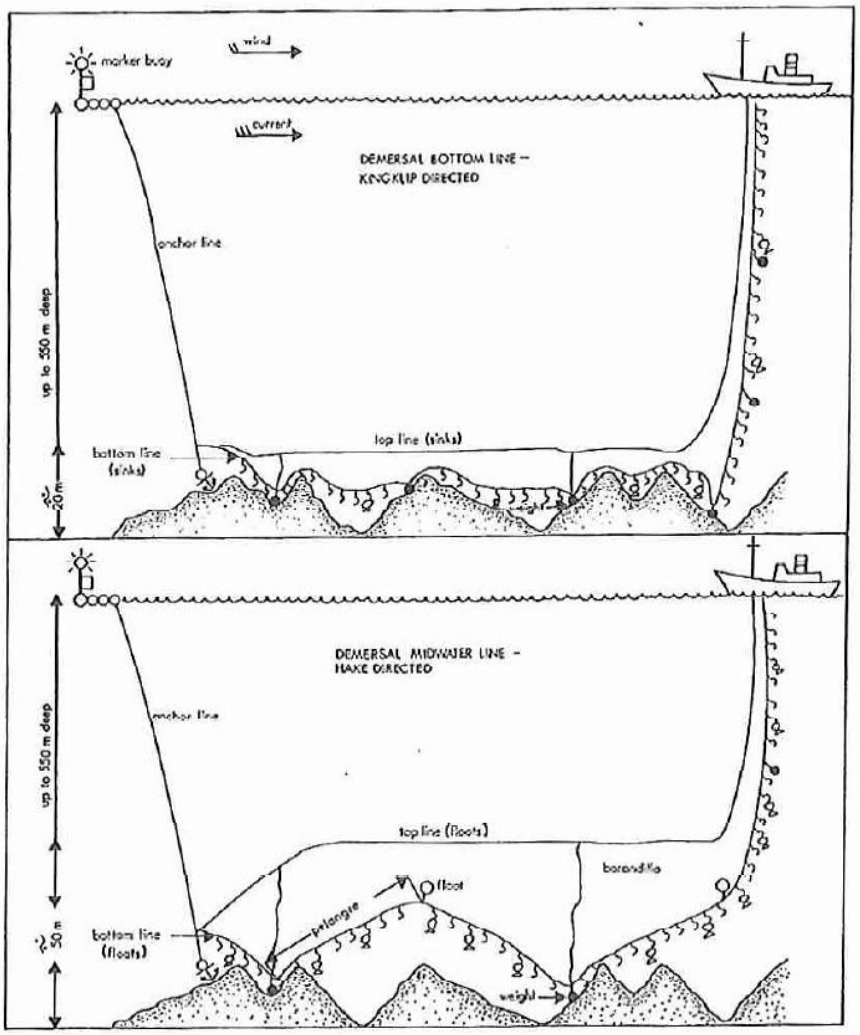


Figure 4.22: Typical configuration of demersal (bottom-set) hake long-line gear used in South African waters.

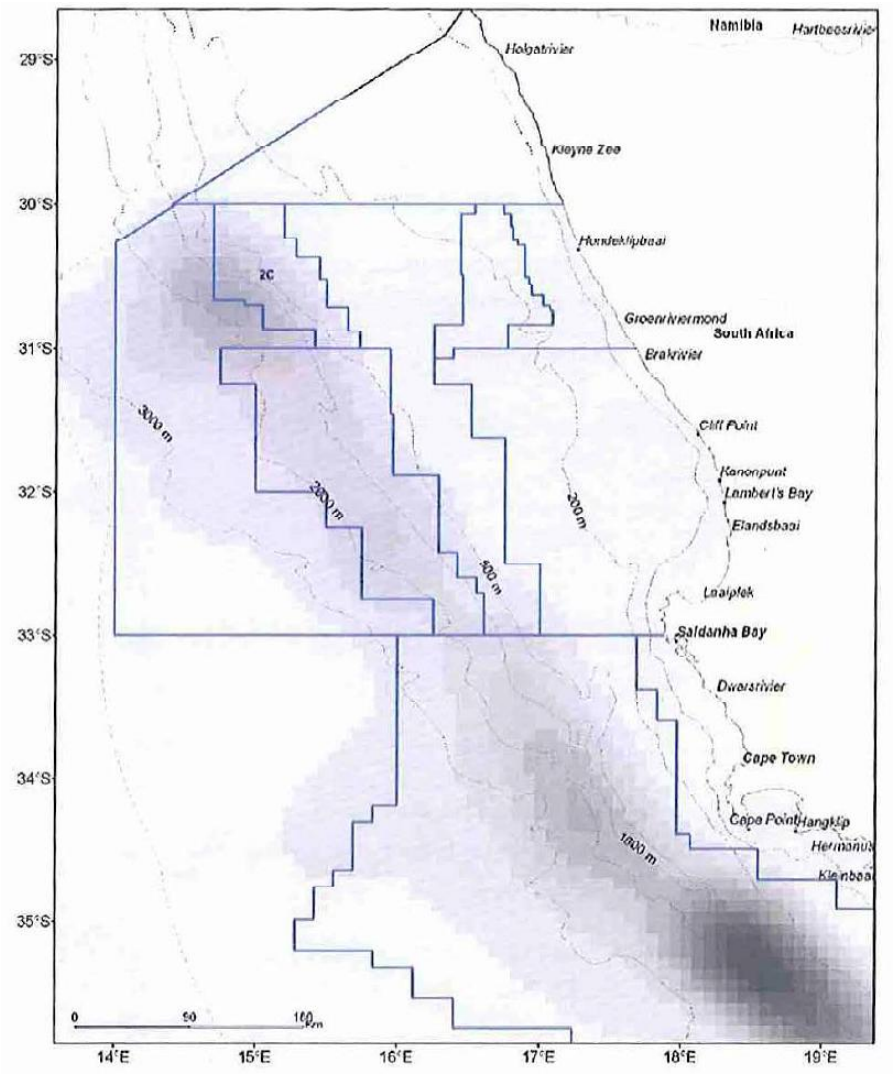


Figure 4.23: Effort expended by the large pelagic long-line fishery in South Africa waters and the high seas in relation to Block 2C (2002 and 2008).

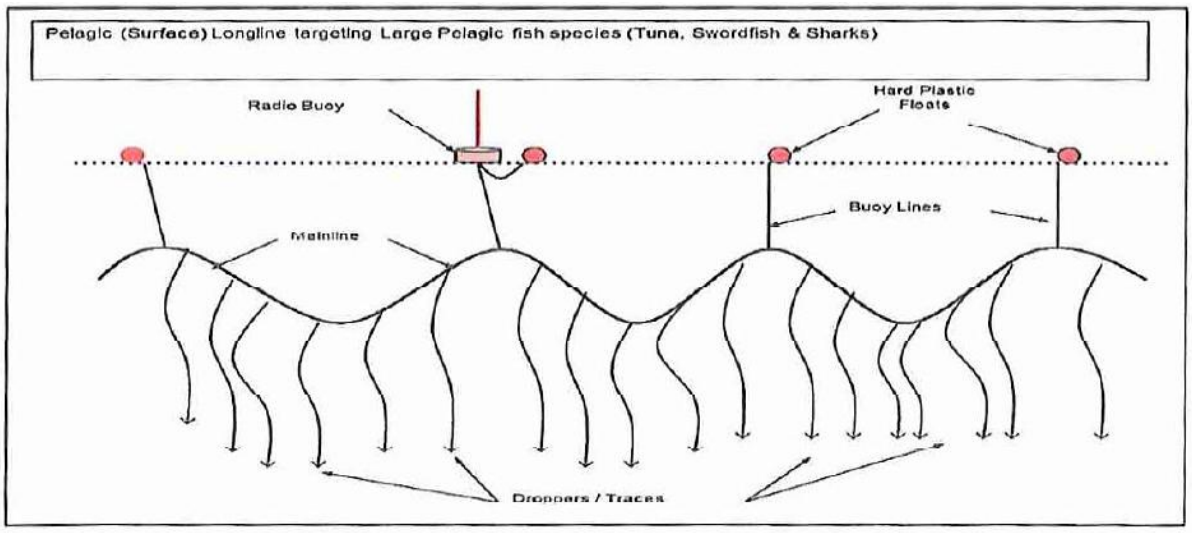


Figure 4.24: Typical Pelagic long-line configuration targeting tuna, swordfish and shark species.

(e) *Tuna pole*

The tuna pole fishery is based on migratory species of tuna, predominantly Atlantic longfin tuna stock (*T. alalunga*) and a very small amount of skipjack tuna (*Katsumonus pelamis*), 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.

Fishing activity occurs along the entire West Coast beyond the 200 m bathymetric contour. Activity would be expected to occur along the shelf break within Block 2C (see Figure 4.25). The available records (provided by the International Commission for the Conservation of Atlantic Tunas - ICCAT) are reported for the whole EEZ and no detailed spatial catch and effort data is therefore available. The fishery is seasonal with vessel activity mostly between December and May and peak catches in February and March. This sector lands approximately 3 000 tons per annum.

Vessels drift whilst attracting and catching shoals of pelagic tunas. Sonars and echo sounders are used to locale 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. 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).

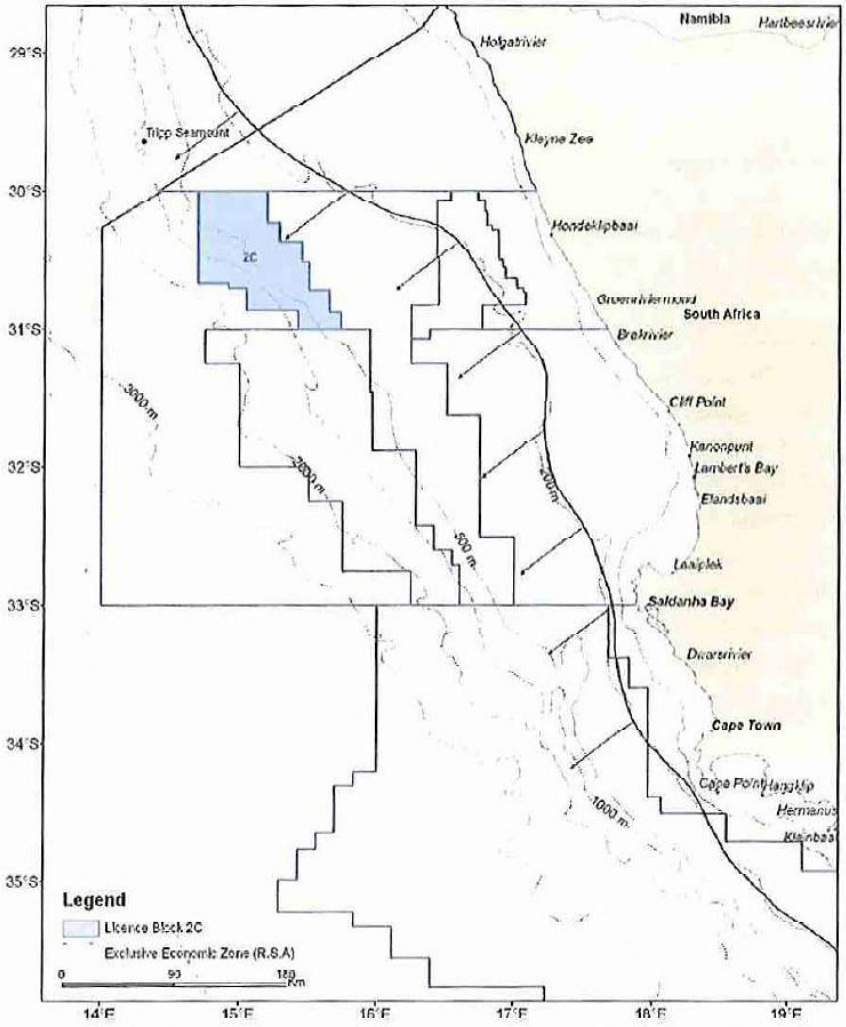


Figure 4.25: Spatial distribution of tuna pole fishing in relation to Block 2C.

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.

(f) *Traditional line fish*

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 95%) is landed by the Cape commercial fishery, which operates on the continental shelf up to a maximum depth of 200 m from the Namibian border on the West Coast to the Kei River in the Eastern Cape. Fishing vessels range up to a maximum of 20 nm offshore, although fishing at the outer limit of this range is sporadic. Up to 3 000 boats are involved in the fishery on the national level, 450 of which are involved in the commercial fishery.

Line fish catches are reported inshore of the 200 m bathymetric contour mostly from October to March. Thus Block 2C is not specifically targeted by the line fish fishery.

Line fishing techniques consist of hook and tine 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.

(g) *West Coast rock lobster*

The West Coast rock lobster (*J. lalandii*) 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 (see Figure 4.26). 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. 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. 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. A total national landing of approximately 3 300 tons (whole weight) was recorded for 2011. In the last decade however, the TAC allocated to the Northern Cape has only been fully landed twice and there has been very little commercial effort recorded in this area for the last five seasons.

The fishing grounds of the West Coast rock lobster fishery do not coincide with Licence Block 2C (see Figure 4.26).

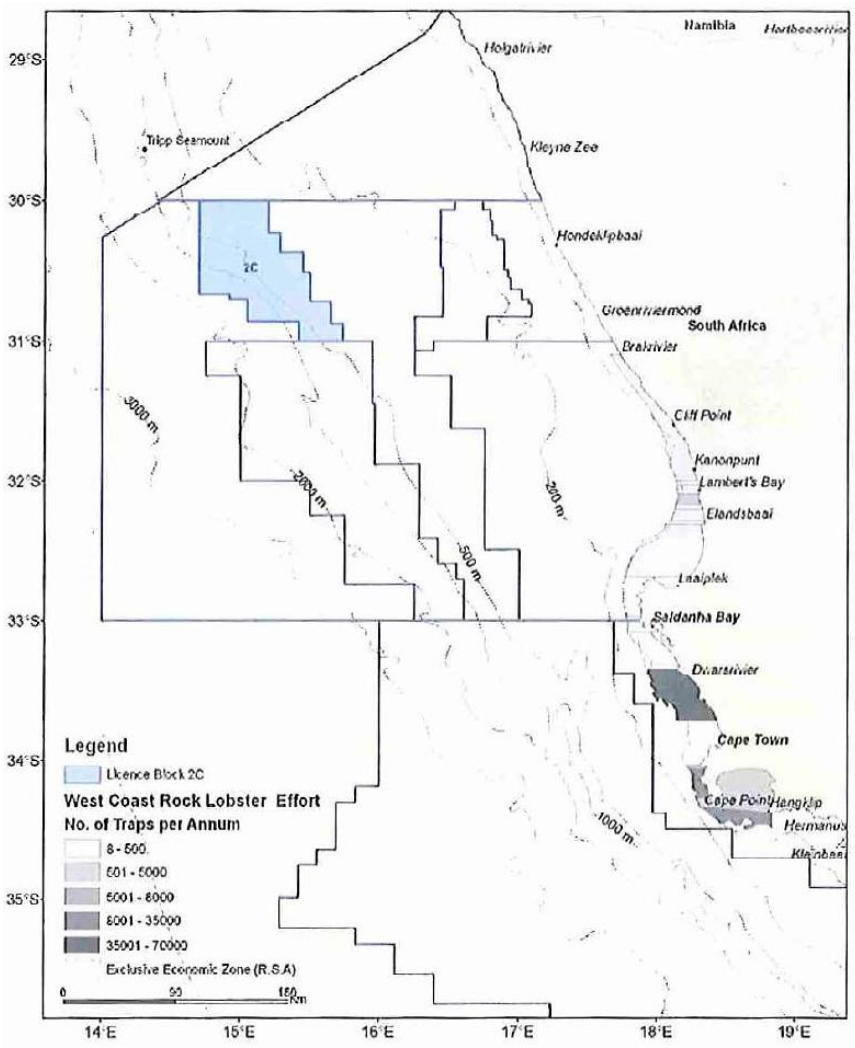


Figure 4.26: Location of Block 2C in relation to the South African rock lobster fishery.

4.1.4.2 SHIPPING TRANSPORT

The majority of shipping traffic is located on the outer edge of the continental shelf with traffic inshore of the continental shelf along the West Coast largely comprising fishing and mining vessels, especially between Kleinsee and Oranjemund (Figure 4.27). Charted Traffic Separation Schemes, which are International Maritime Organisation (IMO) adapted, and other relevant information are listed in the South African Annual Notice to Mariners No 5.

4.1.4.3 OIL AND GAS 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 4.28).

There is no current development or production from the South African West Coast offshore. The Ibhubesi Gas Field (Block 2A) and Kudu Gas Field (off the coast of southern Namibia) have been identified for development.

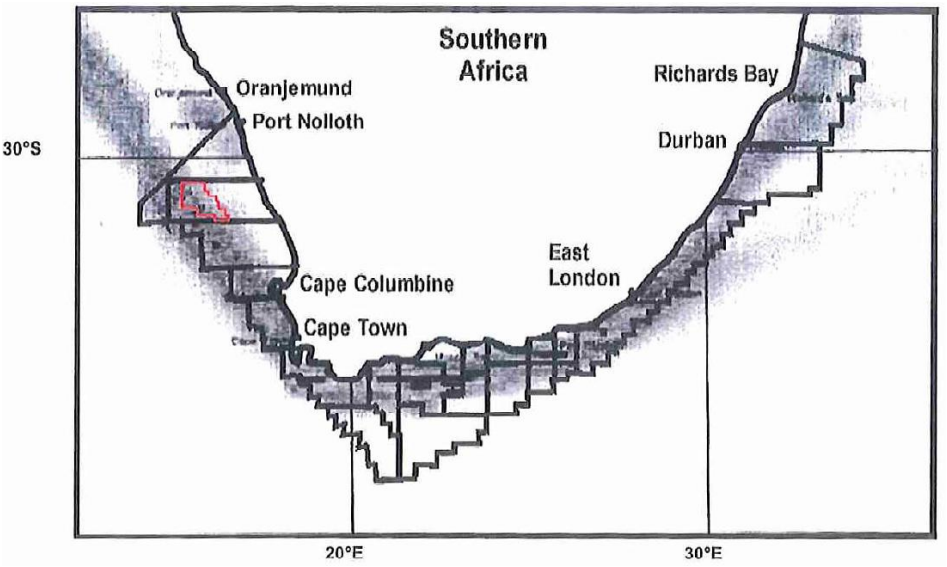


Figure 4.27: The major shipping routes along the west coast of South Africa showing petroleum license blocks (Data from the South African Centre for Oceanography). Approximate location of Block 2C is also shown.

4.1.4.4 DIAMOND PROSPECTING AND MINING

Marine diamonds are mined along the West Coast from just south of Lamberts Bay to the Orange River mouth. Twenty diamond mining concessions have been established along the West Coast with each concession divided into four zones from the coat seaward (a, b, c & d) (see Figure 4.29). The majority of concessions worked at present are those closer inshore. Block 2C falls within or adjacent to concession Zone d. Offshore diamond concession holders in the Block 2C area are presented in Table 4.8 and Figure 4.29.

Table 4.8: Offshore diamond concession holders in the Block 2C area.

Block	Concession holder in Zone d
6	Vacant
7	Vacant
8	Vacant
9	Alexkor

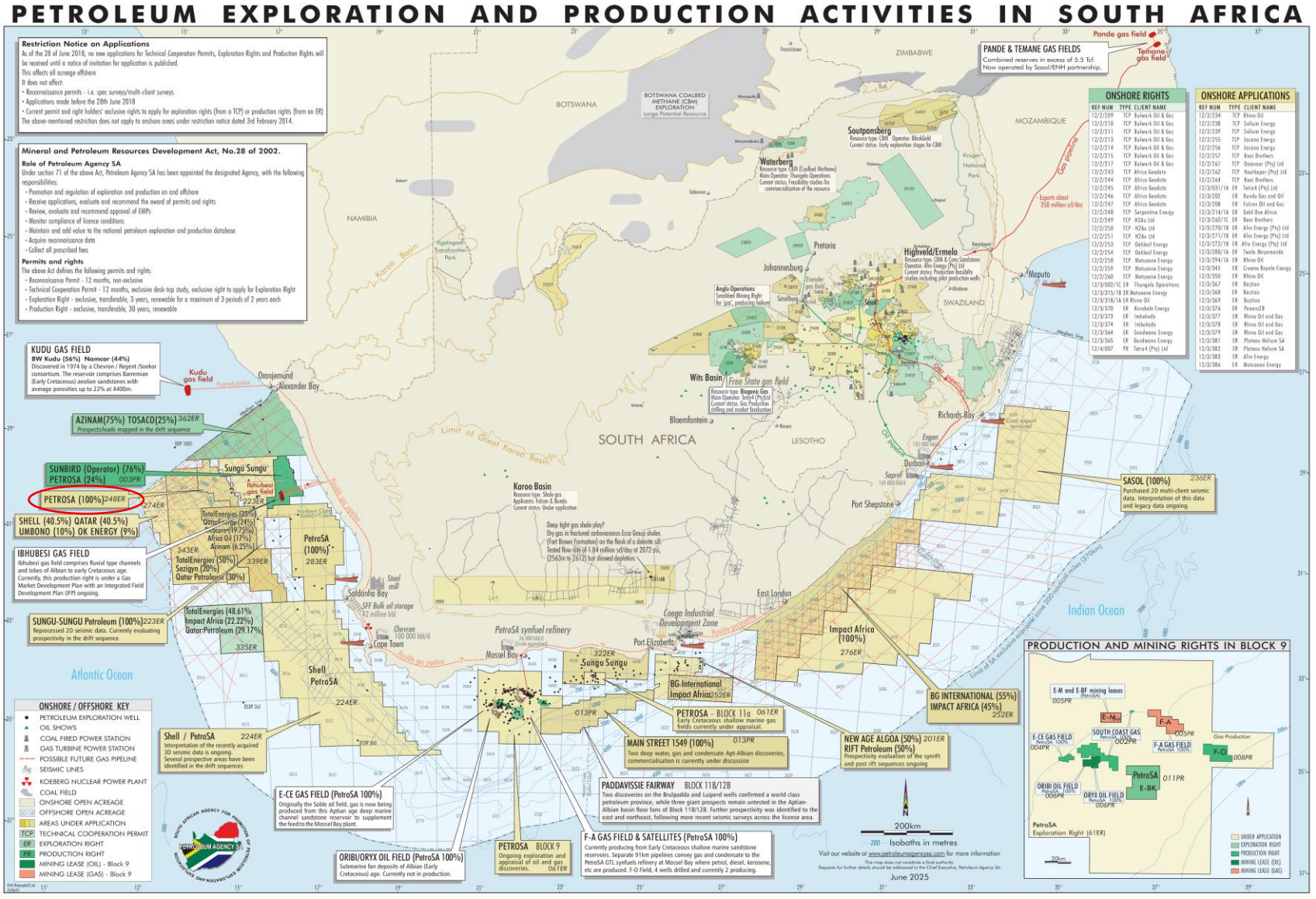


Figure 4.28: Petroleum licence blocks off the West, South and East coasts of South Africa (after PASA, 2013). The proposed Exploration Right area is highlighted in red.

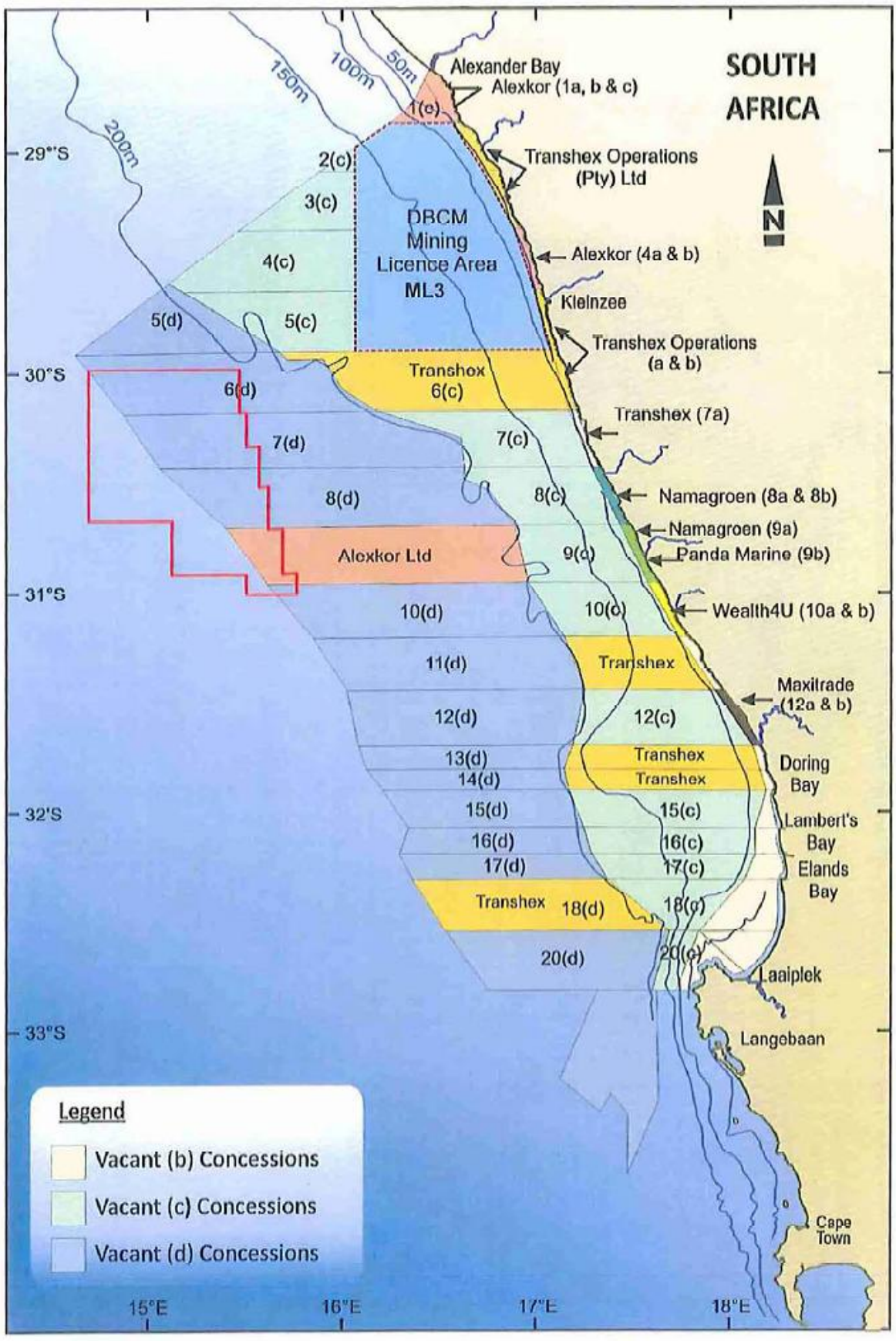


Figure 4.29: South African Diamond Rights Holders off the West Coast (compiled by De Beers, 2011). Approximate location of Block 2C is also indicated.

4.1.4.5 PROSPECTING AND MINING OF OTHER MINERALS

(a) *Heavy minerals*

Heavy mineral sands containing, amongst other minerals, zircon, ilmenite, garnet and rutile may be found offshore of the West Coast. Exxaro's Namakwa Sands is currently exploiting heavy minerals from onshore deposits near Brand-se-Baai (approximately 385 km north of Cape Town). In October 2009, De Beers secured a Prospecting Right for platinum group metals, gold and sapphires in the DMBC licence area (see Figure 4.30). Between December 2008 and March 2011, AuruMar (Pty) Ltd, a joint venture entity created by De Beers Group Exploration Holdings Limited and AngloGold Ashanti Marine Exploration Limited, secured Prospecting Rights (including heavy minerals, platinum group metals, gold and sapphire) for sea areas: 1c, inshore portions of 2c, 3c, 4c and 5c, as well as 6c, 7c, 8c, 9c, 10c, 12c, 14c, 15c, 16c, 17c, 18c and 20c (see Figure 4.30).

(b) *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 Coast. 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 4.31), one of which is partially located within Block 2C (i.e. Prospecting area 251). Prospecting areas 251 and 257 have not yet been approved and the current status of Agrimin1, Agrimin2 and SOM1 is unknown.

(c) *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 4.32). 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.

4.1.4.6 OTHER

(a) *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 West Coast.

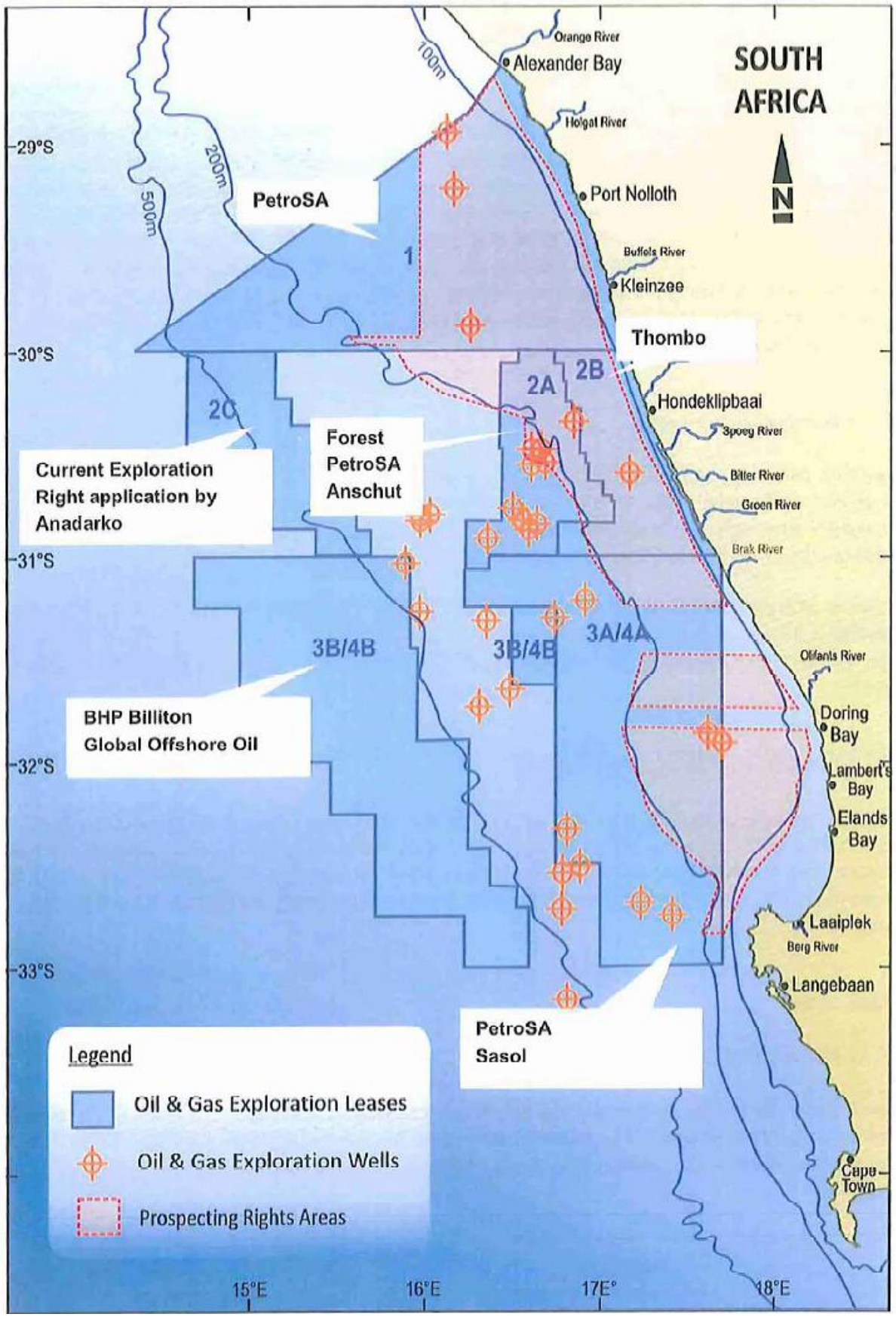


Figure 4.30: AuruMar's prospecting rights area in relation to Petroleum Licence Blocks off the West Coast of South Africa (adapted from De Beers, 2012).

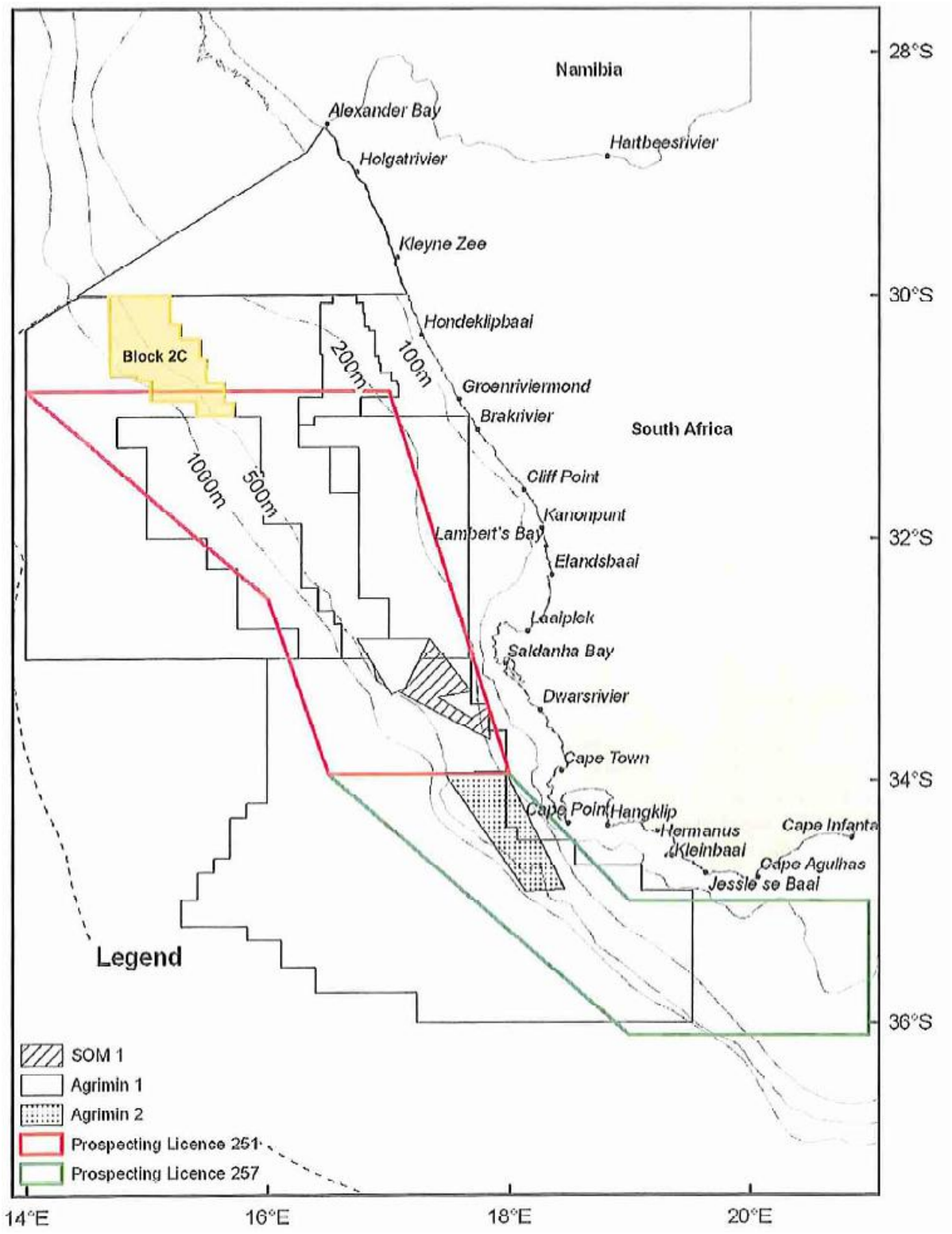


Figure 4.31: Location of glauconite and phosphorite / phosphate prospecting areas in relation to Block 2C.

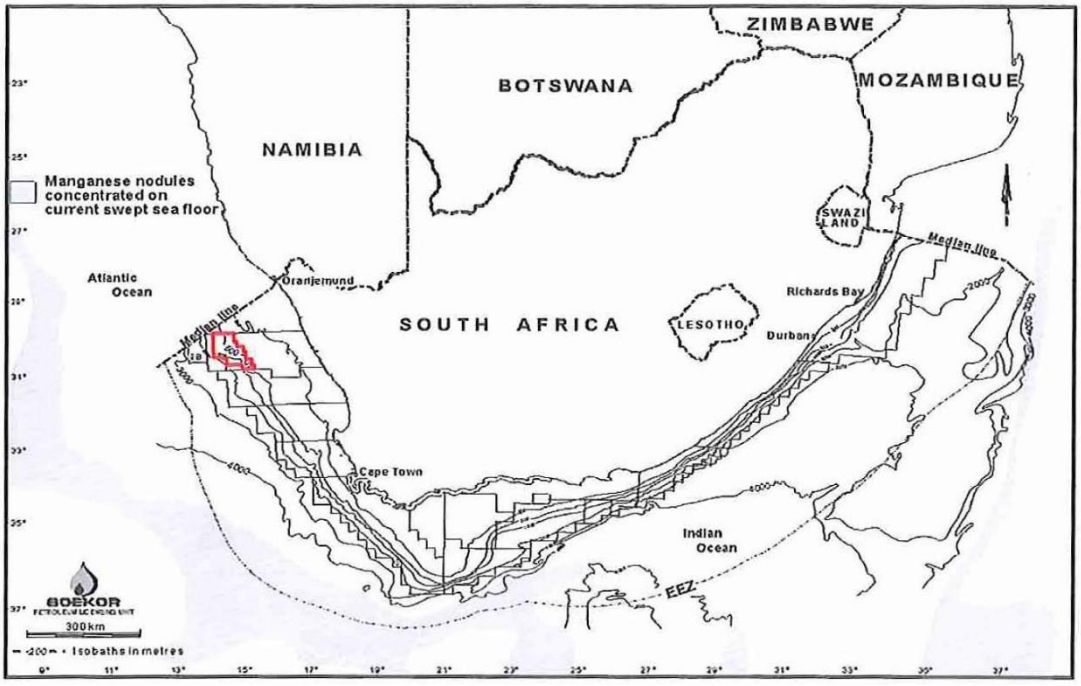


Figure 4.32: Schematic of location of manganese nodules off Southern Africa, showing petroleum licence blocks (Modified from Rogers 1995). Approximate location of Block 2C indicated.

(b) *Undersea cables*

There is a submarine telecommunications cable system across the Atlantic and the Indian Ocean (see Figure 4.33). This system is called "SAT3/WASC/SAFE" (South Atlantic Telecommunications cable no.3 / West African Submarine Cable / South Africa Far East). The 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).

There is also a high bandwidth fibre optic cable system, Eastern Africa Submarine Cable System (EASSy), which connects countries of eastern Africa to the rest of the world (see Figure 4.33). EASSy runs from Mtunzini in South Africa to Port Sudan in Sudan, with landing points in nine countries, and connected to at least ten landlocked countries.

In addition to the new 14 000 km long West Africa Cable System (WACS), which links South Africa to London, and the 17 000 km long Africa Coast to Europe (ACE) cable system to link Africa to France, three new cable systems to link South America and Africa (SAex, WASACE and BRIGS) are also being proposed for 2014 (see Figure 4.33).

There is an exclusion zone applicable to the telecommunication cables one nautical mile each side of the cable in which no anchoring is permitted.

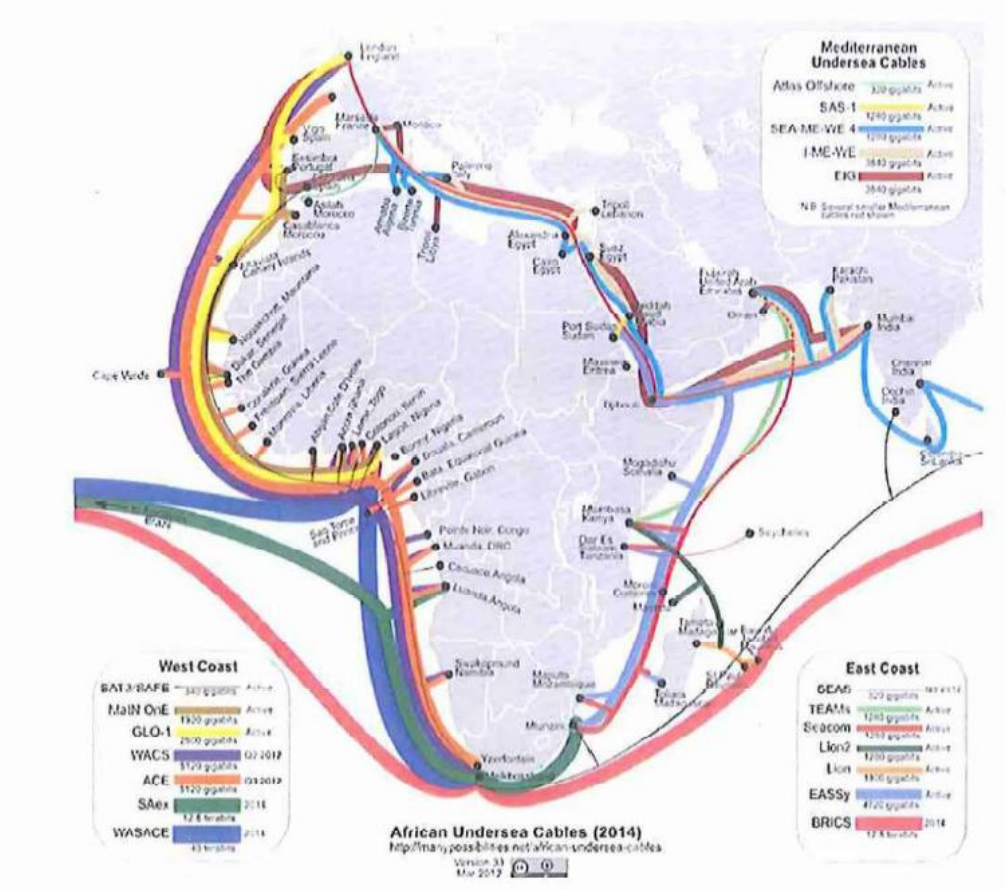


Figure 4.33: Configuration of the current African undersea cable systems as well as cables proposed for 2013 and 2014 (From http://www.manypossibilities.net).

(c) *Marine archaeological sites*

Over 2 000 shipwrecks are present along the South African coastline. The majority of known wrecks along the West Coast are located in relatively shallow water close inshore (within the 100 m isobath). Wrecks older than 50 years old have National Monument status. All known shipwrecks off the coast of South Africa occur in waters shallower than 100 m within 50 km of the coast. There are no known wrecks in Block 2C (Mr Sean Berry, pers comm[10]).

(d) *Ammunition dump sites*

Ammunition and explosive dumpsites off the South-West Coast are presented on SAN Chart 56. Such sites are well to the south of Block 2C.

(e) *Conservation areas*

A number of reserves and MPAs are located along the West Coast, none of which are located within Block 2C (Figure 4.34). Block 2C is, however, located partially in the proposed Namaqualand Marine Protected Area (MPA), which is located between the Groen and Spoeg rivers and extends to the edge of the EEZ. The proposed Namaqualand MPA was opposed due to a lack of consultation with oil/gas and mining industry.

Through systematic biodiversity planning to identify a potential offshore Marine Protected Areas network, Sink, *et al.* (2012) identified a number of priority areas off the South African coastline for the protection of benthic and pelagic habitats (see Figure 4.35). Block 2C is also located partially in the proposed Child's Bank protection area (see Figure 4.35).

[10] Mr Sean Berry of SAHRA was contacted telephonically (021 465 2198) on 3 October 2012.

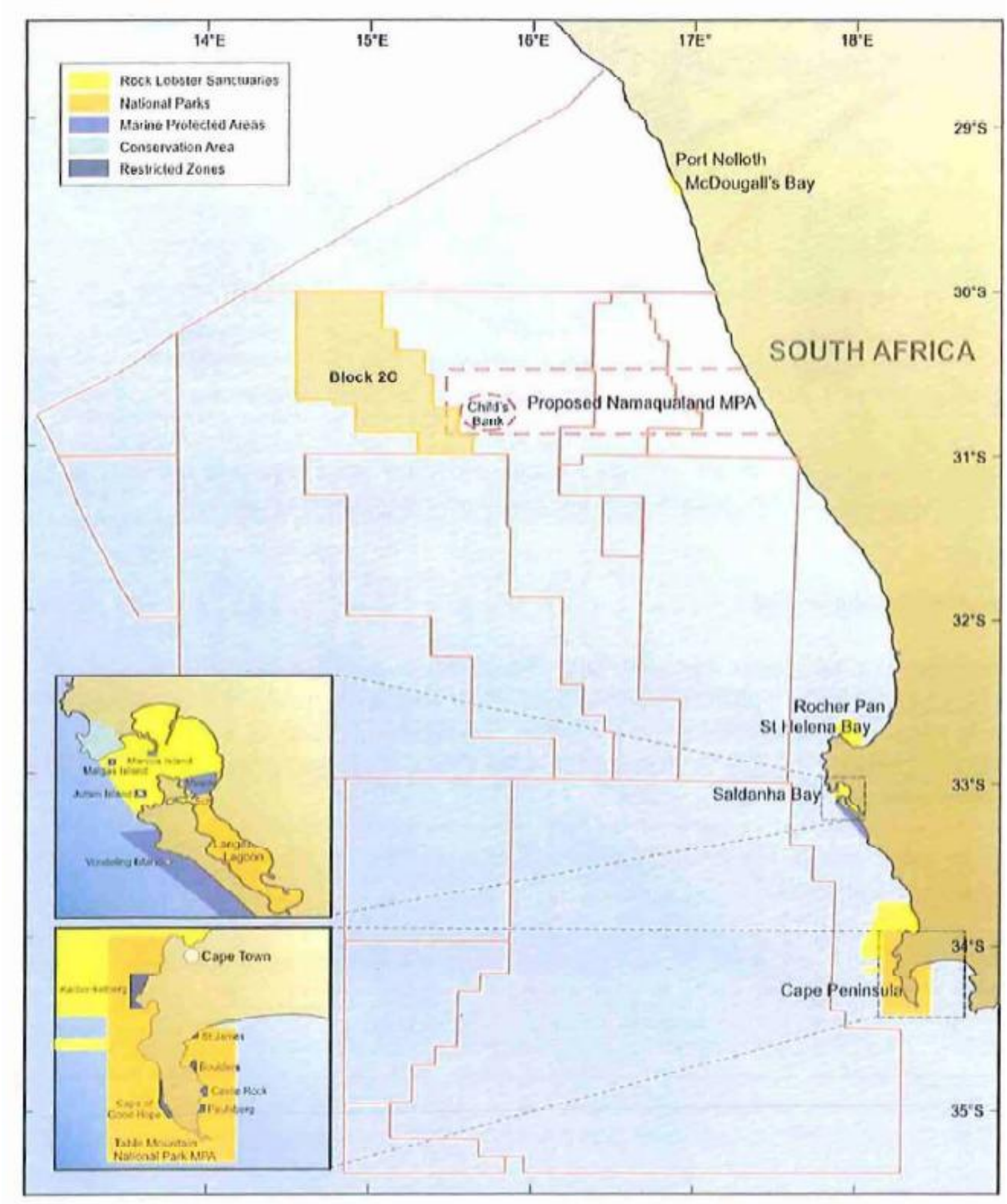


Figure 4.34: Reserves and Marine Protected Areas on the West Coast in relation to Block 2C.

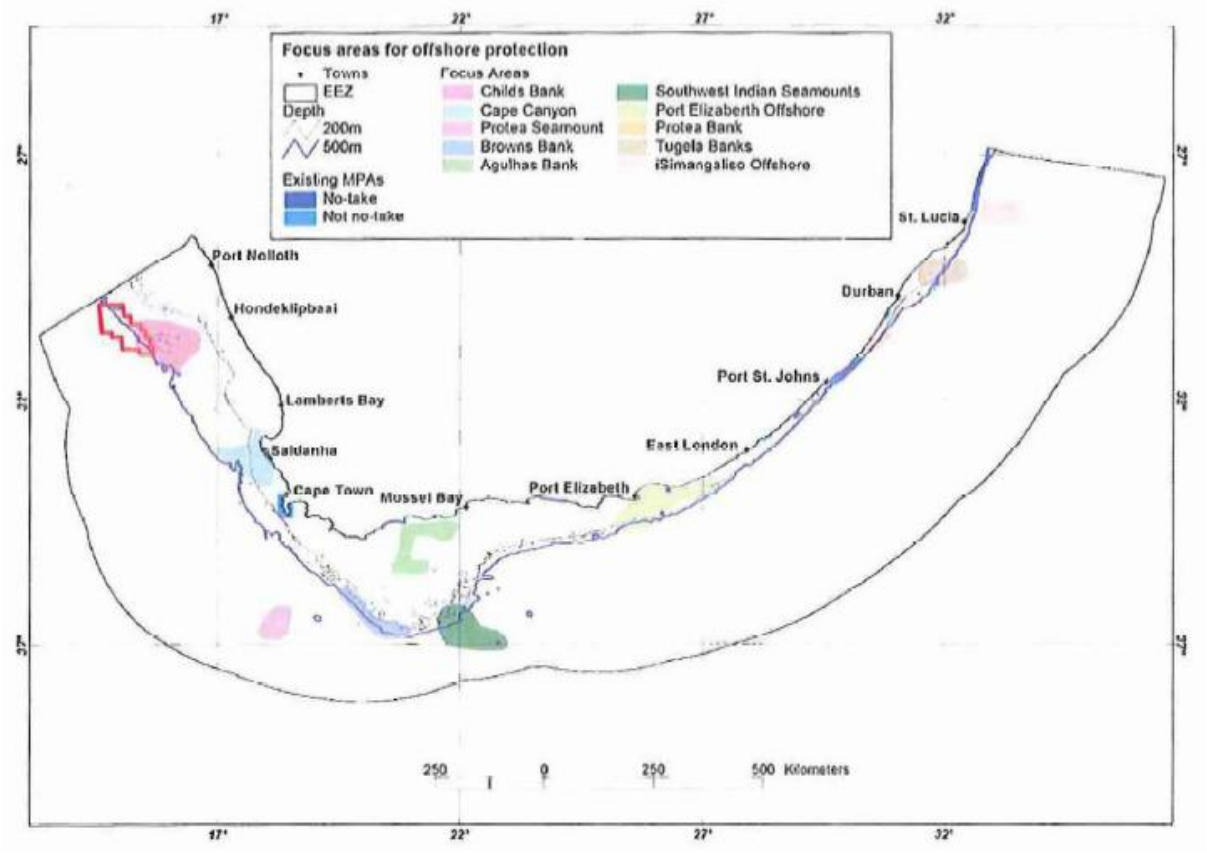


Figure 4.35: Potential priority areas for seabed protection in relation to Block 2C (adapted from Sink, *et. al*., 2012).

4.2 NEARSHORE REGION AND SHORELINE

4.2.1 INTRODUCTION

The National Biodiversity Spatial Assessment (NBSA) (Lombard and Strauss, 2004) study analysed available data on rocky shores, mixed shores, sandy beaches, pebble beaches and boulder beaches and identified areas of high value/ irreplaceability (see Figure 4.36). There are no extremely high / irreplaceable habitats along the shoreline area to east of Block 2C.

Two coastal habitat types that dominate the Namaqua bioregion are rocky shores (approximately 53% of the coastline) and sandy shores (about 37%). Mixed shores make up a further 9%. Pebble or boulder beaches are very rare in the Namaqua bioregion, making up less than 1% of the coastline (Lombard & Strauss 2004).

4.2.2 OCEANOGRAPHY

This section briefly describes the oceanography of the coastal region of the West Coast of South Africa, which comprises rocky shores, sandy shores and kelp beds.

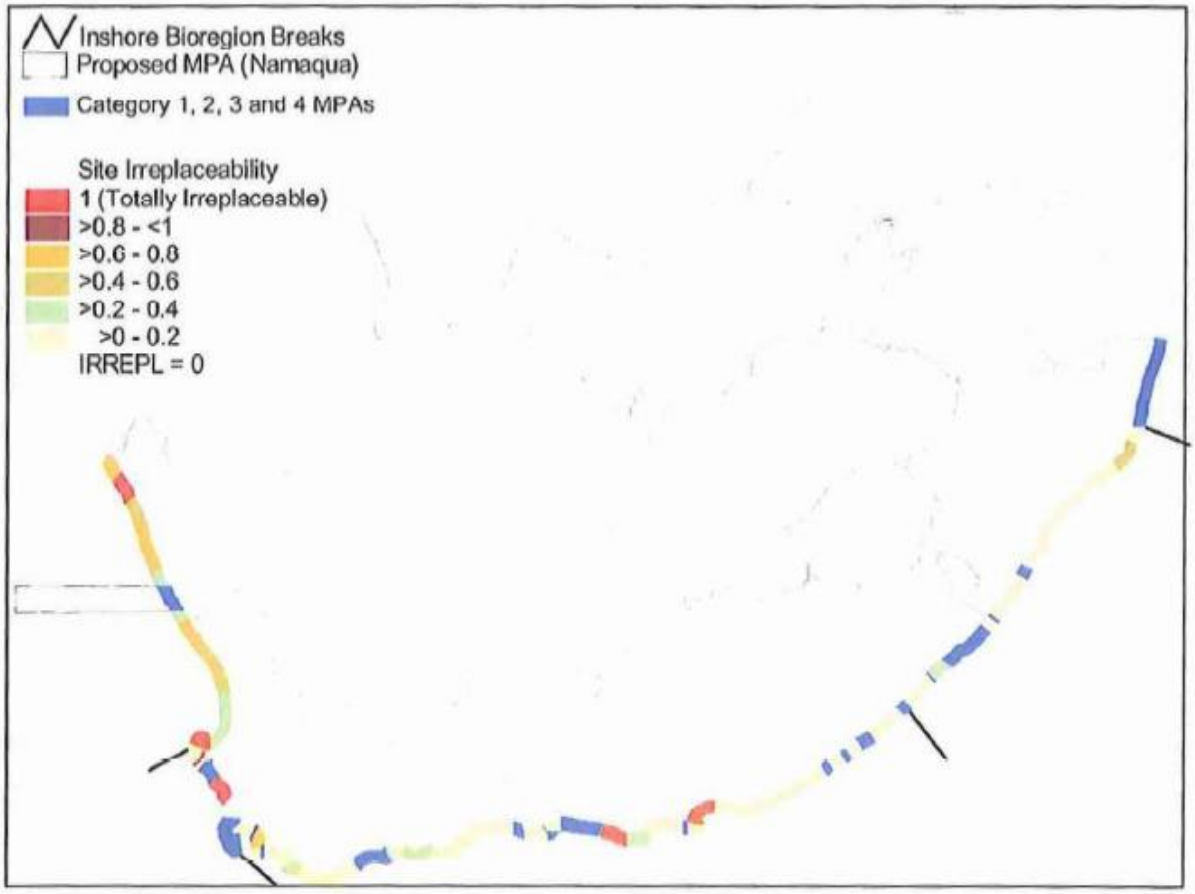


Figure 4.36: Irreplaceability analyses for intertidal habitats, in 50 km strips around South Africa, per bioregion (Lombard and Strauss, 2004).

4.2.2.1 ROCKY SHORES

Approximately 54% of the West Coast (west of Cape Agulhas) Is rocky shore. Over 80% of this rocky shore comprises exposed rocky headlands, the balance being wave cut platforms (Jackson and Lipschitz 1984). The biota of the rocky shores of the study area is classified as cool temperate and forms one of the four main biogeographic provinces of southern Africa. Rocky shore faunal diversity Is low although biomass may be high (Branch and Griffiths 1988), while floral diversity and biomass are high (Bolton 1986).

The fauna of rocky shores of the West Coast show distinct up/down-shore zonation into five zones including:

1. The *littorina zone* (also known as the supralittoral or splash zone) extends from the highest reaches of spring high tide to the normal high tide level. This area is dry much of the time, but is sprayed with salt water during high tides. It is only flooded during storms and extremely high tides. It is so named because of the dominance of small periwinkles of the genus *Littorina*. On the west coast the dominant periwinkle is *Liltorina africana*. The red algae *Porphyra capensis* is the only notable floral representative of this zone.
2. The *upper balanoid zone* (also known as the upper-eulittoral, high tide or high intertidal zone) is flooded only during high tides. This zone is usually dominated by large numbers of barnacles. However, although barnacles such as *Tetraclita serrata* and *Chthamalus dentatus* are present in the Namaqualand bioregion, the limpet *Patella granularis* (and to some extent *P. granatina*) is by far the most common animal species. The green alga called “sea lettuce” (*Ulva* spp.) is the most common floral representative found in this zone.

3. The *lower balanoid zone* (also known as the mid-eulittoral zone) is flooded twice a day. It is the first zone in which algae is well represented (Branch & Griffiths 1988). The red algae *Gigartina radula, Gigartina stiriata*, *Aeodes orbitosa* and *Champia lumbricalis* as well as the brown *alga Splachnidium rugosum* occur in this zone, whilst the limpet *P. granatina* is the most common faunal species. The tubeworm *Gunnarea capensis* may form distinctive colonies in this zone along the southern parts of the Namaqua bioregion.

4. The *cochlear / argenvillei zone* (also known as the lower-eulittoral zone) is covered and uncovered twice a day with salt water from the tides. Along the Namaqualand coast, the zone is dominated by very dense aggregations of the limpet *P. cochlear* in the south and *P. argenvillei* in the north. Depending on the local conditions, the black mussel, *Choromytilus meridionalis* is also present, and can completely displace the limpets along rocky shores exposed to strong wave action. The Mediterranean mussel (*Mytilus galloprovincialis*) appears to be displacing the black mussel along the Namaqualand coast, in turn. The definitive flora in this zone is coralline encrusting algae.

5. The *intertidal zone* can be divided into the sublittoral fringe, infratidal zone and sublittoral zone. In the study area the region stretching from the low tide level to, and including, the kelp beds is considered to be the sublittoral zone. Along the central Namaqualand coast this zone is dominated by the Mediterranean mussels, rock lobsters, sea urchins and various red algae.

A number of predatory species are associated with the fauna found along the rocky shores of the central parts of the Namaqualand coast. These include the whelks such as *Natica tecta*, *Nucella cinulata* and *N. dubia*; the starfish (*Marthasterias glacialis*); tidal pool fish such as the klipvis (*Clinus superciliosus*); the common octopus (*Octopus vulgaris*) and seabirds, primarily the African oyster catcher (*Haemaptopus moquini*). The African oyster catcher is listed in the South African Red Data Book as "Near-threatened". Scavengers such as the shore crab (*Cyclograpsus puncatus*) and the kelp gull (*Larus dominicanus*) are also common along these shores.

4.2.2.2 SANDY SHORES

Approximately 46% of the West Coast comprises sandy beaches. Apart from the larger bays such as St Helena Bay, the sandy shores within the study area are exposed to strong wave action.

There has been little work on sandy beach ecology between Walvis Bay and St Helena Bay (Branch and Griffiths 1988). The invertebrate fauna is cool temperate and relatively consistent throughout the region (Field and Griffiths 1988). Sandy beaches have no stable substrate for plant attachment and consequently have little or no primary production. Major nutrient input into Benguela beaches arise from beach cast kelp wrack and upwelling-related coastal phytoplankton in the nearshore region. Macrofaunal species are generally primary or secondary consumers and can be divided into four major trophic groups, including air breathing scavengers, aquatic particle feeders, aquatic scavengers and predators.

The South African sandy beach up/down-shore environment can be divided into a number of zones (Brown and Maclachlan 1990) (Figure 4.37) including:

1. The *supralittoral zone* runs from the foredunes to the high water drift line. The sand remains mostly dry. The dominant force disturbing the substrate in this zone is the wind. The zone is populated by insects and air-breathing crustaceans.

2. The littoral or intertidal zone extends from the high tide drift line down to the low tide mark. This zone is flushed periodically by the changing tide, and the sand is generally damp. The dominant force in this zone comes fram the swash. No macro-flora grows in this zone, especially on an exposed beach. Near the drift line, air-breathing crustaceans such as the pill bug isopod (*Tylos granulatus*) or the beach hopper amphipod (*Talorchestia capensis*) are common, as well as some oligochaete worms, usually found under rotting beach cast seaweed. Further down the beach, lsopods such as the right-angle beach louse (*Eurydice longicornis*) and the wide-foot beach louse (*Pontogeloides laticeps*) typify the mid-shore region. Also common to this region of the zone are polychaete worms such as *Scolelepis squamata*. While the white sand mussel (*Donex serra*) occurs in certain instances, it apparently is not

found in the Port Nolloth region. In the lower reaches of the intertidal zone, including the sublittoral fringe, the common organisms are the surf mysid shrimp (*Gastrosaccus psammodytes*) and a ubiquitous gastropod scavenger, the finger ploughshell (*Bullia digitalis*).

3. The *surf zone* starts below the low water level. In the surf zone the sand substrate is always saturated, and experiences strong wave action and currents. The sand bed is generally in a state of mobility in this zone. The macro-fauna found in this zone are much the same as that which occurs in the sublittoral fringe, with some species of amphipods present. Micro-flora in the form of diatoms can be an important component in this zone, migrating between the water column during the day and the sandy substrate at night. High densities of these diatoms can result in semi-stable formations of foam in the inner surf zone.
4. The *transition zone* occurs between the turbulence of the surf zone and the more stable outer turbulent zone. This is the region across which the wave break line will range, depending on the prevailing weather conditions.
5. The *outer turbulent zone* is typified by a return to stability after the turbulence of the surf zone. The currents are weak compared to the surf zone, and although the effects of wave surge are apparent, the sandy substrate is stable enough to be colonised by macro-fauna including amphipods and other small crustaceans, tube-building polychaetes such as *Nephys* spp., delicate cnidarians and anemones such as *Anthopleura michaelseni*.

The three-spot swimming crab (*Ovalipes trimaculatus*) is probably the only resident predator on the sandy shores along the West Coast. The rest of the organisms that predate on the intertidal macro-fauna originate from outside of the sandy beaches. Birds are the most important predators when the shores are exposed during low tides; fish are most important when the shores are submerged during high tides. On exposed beaches the migratory sanderlings (*Calidris alba*) and white-fronted plovers (*Charadrius marginatus*) are the most common bird species, but African black oystercatchers (*Haematopus moquini*), kelp gulls (*Larus dominicanus*), Hartlaubs gulls (*Larus hartlaubii*), turnstones (*Arenaria interpres*) and curlew sandpipers also visit the sandy shores of the West Coast. The galjoen (*Dichristius capensis*) and white steenbras (*Lithognathus lithognathus*) are representatives or the predatory teleost fishes in the region, as is the blue stingray (*Dasyatis chrysonota*) for elasmobranch fishes. There have also been reports of the west coast sole (*Austroglossus microlepis*) occurring in the sheltered embayment during periods of warmer waler temperatures.

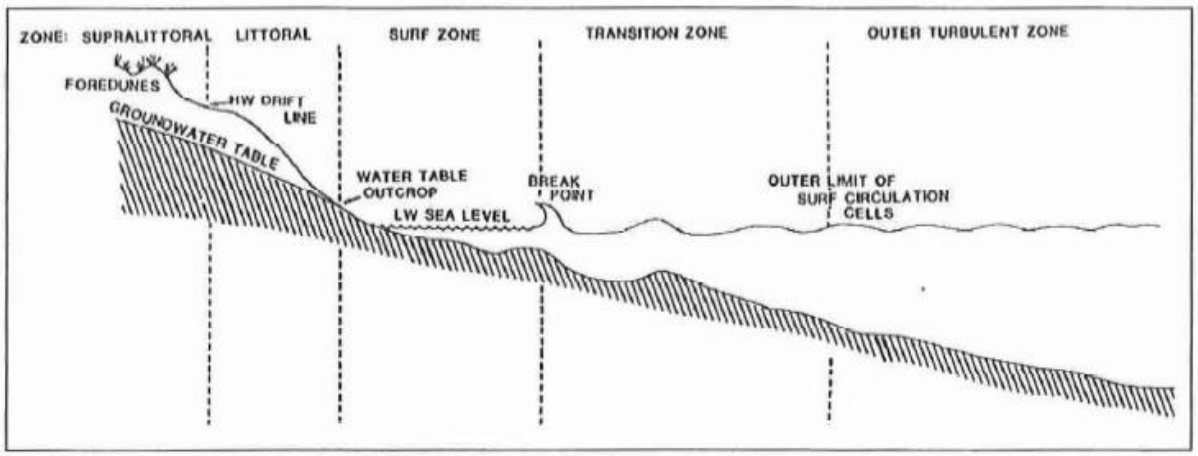


Figure 4.37: Generalised scheme of zonation on sandy shores (Modified from Brown & Maclachlan 1990).

4.2.2.3 KELP BEDS

Kelp beds along the West coast of South Africa are characterised by four species, *Ecklonia maxima* reaching up to 12 m in length, *Laminaria pallida* and *Laminaria schintzei* reaching 5 m in length and the smaller species *Macrocystis angustifolia*. These kelp beds occur in shallow waters and extend from the shore to as much as 3 km offshore. Because of the clearer waters around Cape Point, kelp extends out to the 30 m depth contour (Branch, 1981).

The shallow kelp beds are colonised by relatively few faunal species, with diversity increasing on their deeper, seaward fringes (Branch and Griffiths, 1988). The faunal species include grazers such as the sea urchin (*Parechinus angulosus*), limpet (*Patella compressa*), kelp louse (*Paridotea reticulate*) and amphipods; and filter feeders including mussels, sponges, ascidians and barnacles. Carnivorous species are also represented, including anemones, whelks, starfish, fish and crustaceans (including the most important predator in the ecosystem, the West Coast rock lobster).

4.2.3 ANTHROPOGENIC ACTIVITIES

4.2.3.1 MARICULTURE INDUSTRIES

The following mariculture facilities can be found along the West Coast of South Africa (O'Sullivan 1998; after MCM - http://www.mcm-deat.gov.za/):

- Alexkor Diamond Mines has an oyster (*Crassostrea gigax*) growout system in the seawater reservoirs employed by diamond processing plants south of Alexander Bay, while a similar facility for oysters, perlemoen and the red seaweed *Gracilaria gracilis* can be found at Kleinsee.
- A permit has been granted for perlemoen (*Haliotis midae*) ranching within a 100 km long 0 to 20 m deep zone north and south of Port Nolloth. Oysters are also grown at Port Nolloth.
- Oysters and perlemoen are grown in Kleinsee.
- A perlemoen aquaculture operation at Hondeklip Bay.
- Abalone, oysters and finfish are grown in Jacobs Bay.
- Abalone, mussels, seaweed, oysters, clams and scallops are grown in Paternoster.
- Oysters and seaweed are grown in St Helena Bay.
- Mussels and oysters are grown within Saldanha Bay.

4.2.3.2 RECREATIONAL UTILISATION

Coastal recreation along the West Coast may be either consumptive or non-consumptive.

Consumptive recreational uses involve people collecting material from the sea for their own use. Recreational anglers (Brouwer, Mann, Lamberth, Sauer and Erasmus 1997) and divers (Mann, Scott, Mann- Lang, Brouwer, Lamberth, Sauer and Erasmus 1997) target linefish from either a boat or the shore, while shore-based divers also target perlemoen and West Coast rock lobsters. Rock lobsters are also exploited recreationally from boats with the use of hoop nets. The majority of recreational exploitation of marine resources occurs from inshore waters, and is not substantial compared to activities along the South and East Coasts.

Non-consumptive recreational uses of the marine environment include watersports, nature watching and beach recreation. Recreational practices are mostly undertaken near coastal settlements, and are largely practised for their aesthetic value. Recreational sites are listed by Jackson and Lipshitz (1984).

Although few resource economic studies exist for South African marine recreational use, the value of recreational coastal use and tourism should not be underestimated.

4.2.3.3 MARINE OUTFALL/INTAKE PIPES

Thirty-four outfalls, of which the majority are sewerage outfalls, and 17 intakes are located along the West Coast of South Africa. An important pipeline intake/outfall is the Koeberg Nuclear Power Station; a thermal outfall, discharging warmed cooling water into the cooler coastal waters rather than a chemical effluent. A two nautical mile marine exclusion zone exists offshore of the nuclear power station.

4.2.3.4 MARINE PROTECTED AREAS

A number of MPAs are located along the West Coast, none of which are located within Block 2C (see Figure 4.34 and Table 4.9).

Block 2C is located partly in the proposed Namaqualand MPA, which is located between the Groen and Spoeg rivers (see Section 4.1.4.6 and Figure 4.34).

Table 4.9: List of marine conservation areas along the West Coast of South African.

Bioregion	Marine Protected Area	Protection	Location
Namaqualand	McDougall's Bay Rock Lobster Sanctuary: 2.5 km of coastline, 3 km south of Port Nolloth	No rock lobsters may be caught.	29°14' S 16°52' E
	Robeiland / Kleinzee Seal Colony Robeiland: 15 km north or Kleinzee	Island reserve for seabirds and seals, no access	29°33' S 16°59' E
	Elephant Rocks (Olifants River Mouth)	Island reserve for seabirds and seals, no access	31°38' S 18°07' E
	Penguin / Bird Island (Lambert's Bay)	Island reserve for seabirds and seals, no access	32°05' S 18°18' E
	Rocherpan Marine Reserve: Adjacent to the Rocherpan Nature Reserve extending 500 m seaward, 2.75 km of coastline (in process of being registered as a declared reserve)	Exploitation limited to shore-based angling.	32°35'-37'S 18°07' E
	St Helena Bay Rock Lobster Sanctuary From Shelly Bay Point to Stompneus Point, extending three nautical miles seaward of the high-water mark; From Stompneus Point to SHBE/DR beacon, extending six nautical miles seaward of the high-water mark	No rock lobster may be caught	32°43' S 18°00'-07' E

5 ENVIRONMENTAL IMPACT ASSESSMENT

This chapter describes and assesses the significance of potential impacts related to the proposed exploration programme in Block 2C ("Exploration Right area") off the West Coast of South Africa. The potential impacts of the proposed activities are addressed in five categories, namely:

1. Impacts of normal vessel (incl. helicopter) operation;
2. Impacts of seismic survey on marine fauna;
3. Impacts of multi-beam bathymetry survey on marine fauna;
4. Impacts of heatflow measurements and seabed sampling programme on marine fauna; and
5. Impacts of exploration activities on other users of the sea.

All impacts are systematically assessed and presented according to predefined rating scales (see Appendix 2.1). For each potential impact a table is provided that summarises the significance level assessment for that impact. 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.

Unless otherwise indicated, all potential impacts discussed below would be for the duration of the exploration programme only, i.e. short term (three weeks to three months depending on the activity), because of the high-energy marine environment and/or the transient nature of survey activities.

5.1 IMPACT OF NORMAL VESSEL AND HELICOPTER OPERATION

5.1.1 EMISSIONS TO THE ATMOSPHERE

Description of impact

Emissions to the atmosphere may include exhaust gases from the use of diesel for generators and vessel engines and aviation fuel for helicopters, as well as the burning of wastes.

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.

Combustion of fuel in aircraft engines results in emissions of CO_2 and NO_x, as well as water vapour and particulates. Aviation emissions have a greater climate impact than the same emissions made at ground level because emissions at altitude can initiate other chemical and physical processes (http://www.climatecare.org/media/documents/pdf/aviation_emissions_offsets.pdf).

Incineration of waste on board survey vessels would also release soot as well as CO, CO_2 and dioxins (depending on the composition of the waste). However, many vessels do not have an incinerator on board. In these circumstances solid waste would be stored on board for later onshore disposal at an approved disposal facility.

Assessment

The atmospheric emissions from vessels and aircrafts are expected to be similar to those from similar diesel-powered vessels of comparable tonnage (approximately 3 000 tonnes), with the addition of the emissions from the airgun compressors and possible helicopter operations. The volume of solid waste incinerated on board survey vessels, and hence also the volume of atmospheric emissions, would be minimal and incineration must comply with the relevant MARPOL 73/78[11] standards.

The potential impact of emissions to the atmosphere during exploration operations would be limited to the Exploration Right 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 (assuming incineration is in compliance with the MARPOL 73/78 standards), but it is recommended that all 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 vessel and helicopter operations.

	Extent	Duration	Intensity	Probability	Significance	Confidence
Without mitigation	Local	Short-term	Low to Medium	Definite	**Very Low**	High
With mitigation	Local	Short-term	Low	Definite	**VERY LOW**	High

5.1.2 DISCHARGES/DISPOSAL TO THE SEA

Discharges from the survey and support vessels to the marine environment include deck drainage, machinery space drainage, sewage, galley wastes and solid wastes. The majority of these discharges would take place in the vicinity of the proposed Exploration Right area, which is located approximately 200 km offshore (at its closest point) in water depths ranging from approximately 300 m to 1 500 m.

5.1.2.1 **DECK DRAINAGE**

Description of impact

Drainage of deck areas may result in small volumes of oils, solvents or cleaners being introduced into the marine environment.

Assessment

Oils, solvents and cleaners could be introduced into the marine environment in very small volumes through spillage and drainage of deck areas. The potential impact of deck drainage on the marine environment would therefore be of low intensity across the Exploration Right area 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:

- Deck drainage should be collected in oily water separator systems. Discharged water must meet MARPOL 73/78 standards;
- Low-toxicity biodegradable detergents should be used in cleaning of all deck spillage;

[11] MARPOL 73/78 is an International Convention for the Prevention off Pollution from Ships 1973, as modified by the Protocol of 1978 relating thereto. All vessels operating within the South African Exclusive Economic Zone 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 (No. 73 of 1965). These Acts make provision for the discharge of sewage, plastics, oil, galley wastes, hazardous liquids and packaged hazardous material.

- Training and awareness of crew in spill management could minimise contamination; and
- All hydraulic systems should be adequately maintained and hydraulic hoses should be frequently inspected.

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

	Extent	Duration	Intensity	Probability	Significance	Confidence
Without mitigation	Local	Short-term	Low	Highly Probable	**Very Low**	High
With mitigation	Local	Short-term	Low	Highly Probable	**VERY LOW**	High

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 survey and support vessels could enter the marine environment.

Assessment

The vessels must comply fully with international agreed standards regulated under MARPOL 73/78. All machinery space drainage would pass through an oil/water separator to reduce the oil in water concentration to 15 mg/l, in accordance with MARPOL 73/78 requirements.

Concentrations of oil reaching the marine environment through drainage of machinery spaces are, therefore, expected to be low. The potential impact of such low concentrations would be of low intensity and limited to the Exploration Right area 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

No mitigation measures are recommended (assuming discharges are in compliance with the MARPOL 73/78 standards).

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

	Extent	Duration	Intensity	Probability	Significance	Confidence
Without mitigation	Local	Short-term	Low	Highly Probable	**Very Low**	High
With mitigation	Local	Short-term	Low	Highly Probable	**VERY LOW**	High

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 immediate marine environment. Although treated sewage would also increase BOD, it does not pose a bacterial load.

Assessment

The volumes of sewage wastes released from 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 are expected to assist in rapid dispersal.

The potential impact of sewage effluent from the survey and support vessels on the marine environment is expected to be limited to the Exploration Right area over the short-term, and is therefore considered to be of **VERY LOW** significance with or without mitigation (see Table 5.4).

Mitigation

No mitigation measures are recommended (assuming sewage discharges are in compliance with the MARPOL 73/78 standards).

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

	Extent	Duration	Intensity	Probability	Significance	Confidence
Without mitigation	Local	Short-term	Low	Highly Probable	**Very Low**	High
With mitigation	Local	Short-term	Low	Highly Probable	**VERY LOW**	High

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 vessels 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 nautical miles (± 22 km) from the coast, with no disposal within 3 nautical miles (± 5.5 km) of the coast. The potential impact of galley waste disposal on the marine environment would be of low intensity and limited to the Exploration Right area 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

No mitigation measures are recommended (assuming galley waste discharges are in compliance with the MARPOL 73/78 standards).

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

	Extent	Duration	Intensity	Probability	Significance	Confidence
Without mitigation	Local	Short-term	Low	Highly Probable	**Very Low**	High
With mitigation	Local	Short-term	Low	Highly Probable	**VERY LOW**	High

5.1.2.5 SOLID WASTE

Description of impact

The disposal 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 would be incinerated or transported ashore for disposal at an approved disposal facility, and consequently would have no impact on the marine environment. However, a spill may result in a small amount of waste entering the marine environment (e.g. blown by wind, spill during transfer to support vessel, etc.).

Hazardous waste would be disposed of by specialist waste disposal contractors. The potential impact of the disposal of solid waste on the marine environment is therefore **INSIGNIFICANT** (see Table 5.6).

Mitigation

The following measures are recommended for the mitigation of waste:

- Initiate a waste minimisation system on board all vessels;
- Onboard solid waste storage is to be secure; and
- Contractors must co-operate with the relevant local authority and dispose of waste (solid and hazardous) in accordance with the appropriate laws and ordinances.

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

	Extent	Duration	Intensity	Probability	Significance	Confidence
Without mitigation	Local	Short-term	Zero	Improbable	**Insignificant**	Medium
With mitigation	Local	Short-term	Zero	Improbable	**INSIGNIFICANT**	Medium

5.1.3 NOISE FROM VESSEL AND HELICOPTER OPERATIONS

5.1.3.1 NOISE FROM SURVEY AND SUPPORT VESSEL OPERATIONS

Description of impact

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

Assessment

Noise from vessels is likely to be no higher than those from other small shipping vessels in the region. The potential impact of noise from 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 5.7).

Mitigation

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

Table 5.7: Impact of noise from survey and support vessel operations.

	Extent	Duration	Intensity	Probability	Significance	Confidence
Without mitigation	Local	Short-term	Low	Probable	**Very Low**	Medium
With mitigation	Local	Short-term	Low	Probable	**VERY LOW**	Medium

5.1.3.2 NOISE FROM HELICOPTER OPERATIONS

Description of impact

Helicopters may be utilised for crew / supply transfers between the survey and support vessels and the mainland, which could result in localised disturbance of and / or injury to marine fauna.

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. There are 14 species of seabirds that breed in southern Africa, including Cape Gannet, African Penguin, four species of Cormorant, White Pelican, three Gull and four Tern species. Although breeding areas are distributed along the whole coast, islands are especially

important, particularly those between Dyer Island and Lamberts Bay. Cape Gannets breed only on islands and Lamberts Bay and Malgas Island are important colonies. Cape cormorants breed mainly on offshore islands (Dyer, Julten, 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 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. African penguin colonies occur at 27 localities around the coast of South Africa and Namibia (see Figure 4.15).

In addition, low altitude flight paths over seal colonies can cause stampedes of animals to sea resulting in trampling of pups and nesting seabirds within seal colonies. There are two Cape fur seal breeding colonies within the study area: at Kleinzee (incorporating Robeiland) and at Bucchu Twins near Alexander Bay (see Figure 4.16). Non-breeding colonies occur south of Hondeklip Bay at Strandfontein Point and on Bird Island at Lamberts Bay, with the McDougalls Bay islands and Wedge Point being haul-out sites only and not permanently occupied by seals.

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. 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. 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.

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 5.8), if helicopter flight paths cross any of these areas at an altitude of less than 500 m.

Mitigation

- Flight paths must be pre-planned to ensure that no flying occurs over bird and seabird colonies, coastal reserves or marine islands;
- Extensive coastal flights (parallel to the coast within 1 nautical mile of the shore) should be avoided. There is a restriction of coastal flights (parallel to the coast within 1 nautical mile of the shore) on the South-West Coast between the months of June and November to avoid Southern Right whale breeding areas;
- Aircrafts may not approach to within 300 m of whales without a permit in terms of the Marine Living Resources Act, 1998;
- The operator must comply with the Seabirds and Seals Protection Act, 1973, which prohibits the wilful disturbance of seals on the coast or on offshore islands;
- 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 5.8).

Table 5.8: Impact of noise from helicopter operations.

	Extent	Duration	Intensity	Probability	Significance	Confidence
Without mitigation	Local	Short-term	Low to High	Probable	**Low to Medium**	Medium
With mitigation	Local	Short-term	Low	Improbable	**VERY LOW**	Medium

5.2 IMPACTS OF 3D/2D SEISMIC SURVEYS 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 phytoplankton (floral plankton) and zooplankton (faunal plankton). Zooplankton includes meroplankton[12] (planktonic larval stages of fish and invertebrate larvae 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 Exploration Right area by plankton 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. As plankton distribution is naturally temporally and spatially variable and natural mortality rates are high, any impacts would thus be of low to negligible intensity across the Exploration Right area and for the duration of the survey (short-term).

The intensity is further reduced as the proposed Exploration Right area lies in the Orange River Cone (LUCORC) area, which is characterised by powerful upwelling, high turbulence and deep mixing in the water column. Areas of intense upwelling are characterised by diminished phytoplankton biomass, and a deficiency of phytoplankton results in poor feeding conditions for micro-, meso- and macrozooplanklon and for ichthyoplankton. Thus, phytoplankton, zooplankton and ichthyoplankton abundances in the Exploration Right area are thus expected to be comparatively low.

The proposed Exploration Right area also does not overlap with the spring to early summer spawning areas for a number of commercially important species, including anchovy, pilchard, round herring and chub mackerel (refer to Figure 4.13 and Figure 4.14). There is also no overlap with the northward egg and larval drift for anchovy. lchthyoplankton abundance are thus expected to be negligible.

The overall potential impact of seismic noise on plankton is consequently deemed to be of **VERY LOW** significance both with and without mitigation (see Table 5.9).

Mitigation

No measures to mitigate the impacts of seismic sounds on plankton are deemed necessary or practical.

[12] Also termed “ichthyoplankton”.

Table 5.9: Impact of seismic noise on plankton.

	Extent	Duration	Intensity	Probability	Significance	Confidence
Without mitigation	Local	Short-term	Low	Probable	**Very Low**	Medium
With mitigation	Local	Short-term	Low	Probable	**VERY LOW**	Medium

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 Exploration Right 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

The eastern boundary of the proposed Exploration Right area potentially encroaches into depths frequented by West Coast rock lobster. Rock lobsters generally exhibit strong associations with, and a preference for, nearshore creviced reef habitats and kelp beds and avoid gravel and sand areas. Since the seabed offshore of the Namaqualand coast is dominated by unconsolidated sediments of Orange River origin, abundances of rock lobsters beyond approximately 30 m depth are likely to be insignificant. During the summer lobsters typically occur inshore in response to declining bottom oxygen levels in deeper waters. However, during the winter months lobsters migrate offshore and can occur to depths of 130 m when conditions are favourable.

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 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. As the proposed survey would mostly be conducted in excess of 300 m water depth and outside the depth range of the West Coast rock lobster, the received noise at the seabed would be within the far-field range and outside of distances at which physiological injury of benthic invertebrates would be expected.

The potential impact of seismic noise on physiological injury or mortality of invertebrates is consequently deemed of low to negligible intensity across the Exploration Right area and for the survey duration and is considered to be of **VERY LOW** significance both with and without mitigation (see Table 5.10).

Behavioural avoidance of seismic survey areas

Similarly, there is 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 large seismic source.

The received noise at the seabed would be within the far-field range and outside of distances at which avoidance of benthic invertebrates would be expected, but potentially within the response range of cephalopods. However, most of the cephalopod resource is distributed on the mid-shelf with *Sepia australis* being most abundant at depths between 60 to 190 m, whereas *S. hieronis* densities are higher at depths between 110 to 250 m. *Rossia enigmatica* occurs more commonly on the edge of the shelf to depths of 500 m. Thus, the Exploration Right area lies mainly offshore of the main cephalopod distribution.

The potential impact of seismic noise on invertebrate behaviour is consequently deemed of low to negligible intensity across the survey areas and for the survey duration and is considered to be of **VERY LOW** significance both with and without mitigation (see Table 5.10).

Mitigation

No mitigation measures for potential impacts on marine invertebrates are feasible or deemed necessary.

Table 5.10: Impact of seismic noise on marine invertebrates

	Extent	Duration	Intensity	Probability	Significance	Confidence
Physiological injury						
Without mitigation	Local	Short-term	Low	Probable	**Very Low**	Medium
With mitigation	Local	Short-term	Low	Probable	**VERY LOW**	Medium
Behavioural avoidance						
Without mitigation	Local	Short-term	Low	Probable	**Very Low**	Medium
With mitigation	Local	Short-term	Low	Probable	**Very Low**	Medium

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 and mortality, behavioural avoidance of seismic survey areas, masking of environmental sounds and communication, and indirect impacts due to effects on predators or prey.

Assessment

Impacts on fish are summarised in Table 5.11.

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 surveys would be located in water depths greater than 300 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.

Economically important pelagic species (e.g. sardine/pilchard, anchovy, chub mackerel, horse mackerel and round herring) generally occur within the 200 m bathymetry contour and thus unlikely to be encountered in the proposed Exploration Right area. The most likely fish species to be encountered in the survey area are the large pelagic species (e.g. the highly migratory tuna and billfish), which occur offshore of the 100 m isobath. These species show seasonal association with Child's Bank (situated approximately 150 km offshore at about 31°S) and Tripp Seamount (situated approximately 250 km offshore at about 29°40'S) between October and June, with commercial catches often peaking in March and April. As the proposed survey programme is scheduled to commence over the summer months (to avoid the winter migration of humpback and southern right whales) there is thus a high likelihood that the survey vessel would encounter tuna and billfish *en route* to their seasonal

aggregation around the seamounts. 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. The potential physiological impact on pelagic species would be of high intensity. The potential physiological impact on demersal and nearshore reef species would, however, be insignificant as they would only be affected in the far-field range, if at all. The duration of the impact on the population would be limited to the short-term. The impact is therefore considered to be of **low** significance without mitigation and of **VERY LOW** significance with mitigation measures.

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.

The potential impact on fish behaviour could therefore be of high intensity (particularly in the near-field of the airgun array), over the short term, but limited to the Exploration Right area. Consequently it is considered to be of **low** significance without mitigation and **VERY 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. Considering that the surveys would primarily be conducted at depths in excess of 300 m and well offshore of the major spawning areas (Figure 4.13), the wide range over which potentially affected species occur and the spatial extent of major spawning areas, and the low frequency and relatively short duration of the seismic surveys, the impact is considered to be of **VERY LOW** significance 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 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. Such impacts would occur across the Exploration Right area 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. Although large pelagic species are known to aggregate around seamounts (e.g. Child's Bank) to feed, considering the extensive range over which large pelagic fish species feed in relation to the survey area 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 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;
- During line changes, at night and when turning within a 5 nautical mile radius of Child's Bank, low level warning airgun discharges should be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned. Commencement of surveying thereafter should include a "soft-start" procedure of at least 20 minutes; and
- Airgun firing should be terminated if mass mortalities of fish are observed as a direct result of shooting.

Table 5.11: Impact of seismic noise on fish.

	Extent	Duration	Intensity	Probability	Significance	Confidence
Physiological injury						
Without mitigation	Local	Short-term	High	Probable	**Very Low**	Medium
With mitigation	Local	Short-term	Low to Medium	Improbable	**VERY LOW**	Medium
Behavioural avoidance						
Without mitigation	Local	Short-term	High	Probable	**Very Low**	Medium
With mitigation	Local	Short-term	Medium	Improbable	**VERY LOW**	Medium
Spawning and reproductive success						
Without mitigation	Local	Short-term	Low to Medium	Improbable	**Very Low**	Medium
With mitigation	Local	Short-term	Low to Medium	Improbable	**VERY LOW**	Medium
Masking sounds and communication						
Without mitigation	Local	Short-term	Low	Improbable	**Very Low**	Low
With mitigation	Local	Short-term	Low	Improbable	**VERY LOW**	Low

	Extent	Duration	Intensity	Probability	Significance	Confidence
Indirect impacts						
Without mitigation	Local	Short-term	Low	Improbable	**Very Low**	Low
With mitigation	Local	Short-term	Low	Improbable	**VERY LOW**	Low

5.2.4 POTENTIAL IMPACTS ON SEABIRDS

Description of effect

Among the marine avifauna occurring along the 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 5.12 (non-diving seabirds) and Table 5.13 (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 West Coast, only the Cape Gannet regularly feeds as far offshore as 100 km, with most other species foraging in nearshore areas up to 40 km from the coast. The nearest Cape Gannet nesting grounds in South Africa are at Bird Island in Lambert's Bay, approximately 250 km to the south-east of the southern limit of the proposed Exploration Right area. African Penguins are known to forage as far as 60 km offshore and juveniles have been reported to travel up the coast regularly.

The nearest African Penguin nesting sites in South Africa are at the Saldanha Bay Islands and those in Namibia at Possession Island near Lüderitz, approximately 280 km south and north-west of the proposed Exploration Right area, respectively. There is also a cormorant roosting site at Elephant Rocks, approximately 230 km to the south-east of the proposed Exploration Right area. To the north in Namibia, the nearest seabird breeding colonies are on Sinclair and Plumpudding Islands at Baker's Bay, approximately 150 km to the north-west of the Orange River mouth. There is therefore a low likelihood of encountering gannets, penguins and cormorants in the proposed Exploration Right area. Pelagic seabirds that dive for their prey may, however, be encountered in the area around Child's Bank, as such features act as mid- ocean focal points for a variety of pelagic species that may migrate large distances in search of food.

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 proposed Exploration Right area and survey duration (short-term). 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

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. Although the likelihood of encountering gannets, penguins and cormorants in the proposed Exploration Right is low, there is a likelihood of encountering pelagic seabirds around Child's Bank. The potential impact on the behaviour of diving seabirds is considered to be of medium to high intensity, and of **low** significance without mitigation and of **VERY LOW** significance with mitigation.

Avoidance behaviour would only last for as long as the seismic survey continues. 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. In the vicinity of Child's Bank, however, there may be an increased probability of encountering foraging seabirds. 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 of **low** significance without mitigation and of **VERY LOW** significance with 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 diving seabird activity within 500 m of the vessel. It is, however, further recommended that "soft-starts" should, as far as possible, be planned to commence within daylight hours;
- Daylight observations of the survey region should be carried out by an onboard Observer or 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. However, it is important that Observers or MMOs have a full understanding of the financial implications of terminating firing, and that such decisions are made confidently and expediently. In this light it is suggested that Observers or MMOs advise when surveys are 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 according to appropriate guidelines; and
- All data recorded by the Observers or 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 5.12: Impact of seismic noise on non-diving seabirds.

	Extent	Duration	Intensity	Probability	Significance	Confidence
Physiological injury						

	Extent	Duration	Intensity	Probability	Significance	Confidence
Without mitigation	Local	Short-term	Zero	Improbable	**Insignificant**	High
With mitigation	Local	Short-term	Zero	Improbable	**INSIGNIFICANT**	High
Behavioural avoidance						
Without mitigation	Local	Short-term	Zero	Improbable	**Insignificant**	High
With mitigation	Local	Short-term	Zero	Improbable	**INSIGNIFICANT**	High

Table 5.13: Impact of seismic noise on diving seabirds.

	Extent	Duration	Intensity	Probability	Significance	Confidence
Physiological injury						
Without mitigation	Local	Short-term	High	Probable	**Low**	Medium
With mitigation	Local	Short-term	Low	Improbable	**VERY LOW**	Medium
Behavioural avoidance						
Without mitigation	Local	Short-term	Medium to High	Probable	**Low**	Medium
With mitigation	Local	Short-term	Low	Improbable	**VERY LOW**	Medium
Indirect impacts						
Without mitigation	Local	Short-term	Medium to High	Improbable	**Low**	Low
With mitigation	Local	Short-term	Low	Improbable	**VERY LOW**	Low

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 occur along the West Coast, it is only the leatherback turtle which is likely to be encountered in deeper waters. However, abundances are likely to be extremely low comprising occasional visitors. Impacts on turtles are summarised in Table 5.14.

Physiological injury and mortality

The overlap of turtle hearing sensitivity with the higher frequencies produced by airguns suggests 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 medium intensity (due to extremely low abundance), 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. This is not limited to seismic vessels, but the seismic array increases the potential for collision or entrapment. Basking turtles are particularly slow to react to approaching objects and they may not be able to move rapidly away from approaching airguns / array. 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. Since the abundance of turtles in the area is low, the likelihood of encountering turtles during the proposed Exploration Right area is also expected to be low. Thus 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 **VERY LOW** significance both with and without 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. Of greater concern than general avoidance is avoidance of critical mating and breeding habitats. Since the breeding areas for leatherback turtles are located over 2 000 km to the north-west of the proposed Exploration Right area in the Republic of Congo and Gabon, turtles encountered during the survey are likely to be migrating vagrants. The impact of seismic sounds on turtle behaviour is considered to be of medium intensity (due to extremely low abundance), 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 the proposed survey area 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

As noted above, breeding adults of sea turtles undertake large migrations between distant foraging areas and their nesting sites, which are located over 2 000 km to the north-west of the survey area in the Republic of Congo and Gabon. 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 effect 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 onboard Observer or 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. Observers or 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;

- Seismic shooting must be 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 5.14: Impact of seismic noise on turtles.

	Extent	Duration	Intensity	Probability	Significance	Confidence
Physiological injury from seismic noise or collision and entanglement						
Without mitigation	Local	Short-term	Medium	Probable to Highly Probable	**Very Low**	Medium
With mitigation	Local	Short-term	Low	Probable	**VERY LOW**	Medium
Behavioural avoidance of seismic survey areas						
Without mitigation	Local	Short-term	Medium	Highly Probable	**Very Low**	High
With mitigation	Local	Short-term	Low	Probable	**VERY LOW**	High
Masking sounds and communication						
Without mitigation	Local	Short-term	Very Low	Improbable	**Insignificant**	Low
With mitigation	Local	Short-term	Very Low	Improbable	**INSIGNIFICANT**	Low
Indirect impacts						
Without mitigation	Local	Short-term	Low	Improbable	**Very Low**	Low
With mitigation	Local	Short-term	Low	Improbable	**VERY LOW**	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 proposed Exploration Right area, masking of environmental sounds and underwater communication and indirect impacts due to effects on predators or prey.

Assessment

The Cape fur seal is common along the West Coast, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands. There are two breeding colonies located east of the proposed Exploration Right area, namely at Buchu Twins near Alexander Bay (approximately 200 km to the north- east), Robeiland at Kleinzee (approximately 200 km to the east), with a further breeding colony at Elephant Rocks near the Olifants River mouth (approximately 230 km to the south). There are non-breeding colonies located at

Strandfontein Point near the mouth of the Groen River (approximately 100 km to the south) and Bird Island at Lambert's Bay (approximately 270 km to the south). The proposed Exploration Right area therefore falls within the foraging range of seals from the nearby colonies. Far less common in the waters of the West Coast are the subantarctic fur seal, the leopard seal, the crabeater seal and the southern elephant seal. These species are represented by vagrant individuals. Impacts on seals are summarised in Table 5.15.

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. Past studies suggest that noise of moderate Intensity and duration is sufficient to induce temporary threshold shifts in seals. 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 proposed Exploration Right area, although injury could extend beyond the survey duration. The significance of the impact without mitigation is **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 proposed Exploration Right area is thus considered to be of low to medium intensity and limited to the survey areas 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). The impacts of masking are considered **VERY LOW** 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 would be **VERY LOW** with and without mitigation.

<u>Mitigation</u>

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, if after a period of 30 minutes seals are still within 500 m of the airguns; and
- airgun firing should only 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.

Table 5.15: Impact of seismic noise on seals.

	Extent	Duration	Intensity	Probability	Significance	Confidence
Physiological injury						
Without mitigation	Local	Short-term	Medium	Probable	**Very Low**	Medium
With mitigation	Local	Short-term	Low	Probable	**VERY LOW**	Medium
Behavioural avoidance of seismic survey areas						
Without mitigation	Local	Short-term	Low to Medium	Probable	**Very Low**	High
With mitigation	Local	Short-term	Low	Probable	**VERY LOW**	High
Masking sounds and communication						
Without mitigation	Local	Short-term	Low	Probable	**Very Low**	Medium
With mitigation	Local	Short-term	Low	Probable	**VERY LOW**	Medium
Indirect impacts						
Without mitigation	Local	Short-term	Low	Probable	**Very Low**	High
With mitigation	Local	Short-term	Low	Probable	**VERY LOW**	High

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 (whales and dolphins) occur off the West Coast of South Africa. 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 (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.

The distribution of whales and dolphins on the West Coast can largely be split into those associated with the continental shelf and those that occur in deep, oceanic waters. Species from both environments may, however, be found associated with the shelf (200 m to 1 000 m), making this a species-rich area for cetaceans. he most common species within the proposed Exploration Right area (in terms of likely encounter rate, not total population sizes) are likely to be the dusky dolphin, long-finned pilot whale, southern right whale and humpback whale.

Impacts on mysticete cetaceans and odontocete cetaceans are summarised in Table 5.16 and Table 5.17, 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 the 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 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.

The majority of the toothed whales that occur in inshore and offshore waters are resident, and interaction with the proposed surveys would thus occur throughout the year. As the proposed Exploration Right area is located in deep water, there is a likelihood of encounters with sperm whales.

The majority of baleen whales migrate to the southern African subcontinent to breed during winter months. The main winter concentration areas for humpback whales are to the north of Namibia in Angola, Republic of Congo and Gabon. The migration route follows the West Coast of southern Africa although it has been speculated that only a small proportion of the main migration chooses to come close inshore, the majority choosing the shortest route to the central West African breeding grounds and thus following the edge of the continental shelf (200 m to 500 m depth) and thus passing through the proposed Exploration Right area. Most humpback whales reach southern African waters around April, continuing through to September/October when the southern migration begins and continues through to December.

Southern Right whales arrive in coastal waters off the southern African West Coast in June, building up to a maximum in September/October and departing again in December (although animals may be sighted as early as April and as late as February). On the West Coast southern right whales are most common south of Lambert's Bay (and thus well to the south of the proposed survey area), although a number of the bays between Chameis Bay (27°56'S) and Conception Bay (23°55'S) in Namibia have in recent years become popular calving sites, with sightings reported as far north as the Kunene and Mowe Bay. Thus, southern right whales may also migrate through the proposed Exploration Right area.

High abundances of both southern right and humpback whales along the southern portions of the West Coast around the Cape Columbine - Yzerfontein area during spring and summer (September-February), however, suggests that the upwelling zones off Saldanha and St Helena Bay may serve as an important summer feeding area and that these populations maybe localised resident populations. The offshore location of the proposed Exploration Right area makes encounters with whales making exploratory trips northwards along the coast from the summer feeding grounds highly unlikely.

The potential impact of physiological injury to both mysticete and odontocete cetaceans 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 Exploration Right area. The impact is, therefore, considered to be of **medium** significance without mitigation and **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.

The proposed Exploration Right area is located well to the north of the West Coast feeding ground around the Cape Columbine - Yzerfontein area, where local abundances of temporary resident humpbacks and southern

rights whales occur during summer months. Of greater concern than general avoidance of resident or migrating whales is avoidance of critical breeding habitat or areas where mating, calving or nursing occurs. Southern right whales mostly remain in the coastal area south of Lambert's Bay, well to the south and inshore of the proposed Exploration Right area. There are also a number of the bays to the north of the proposed Exploration Right area between Chameis Bay and Conception Bay in Namibia have in recent years become popular southern right calving sites. The main winter concentration areas for humpback whales are to the north of Namibia in Angola, Republic of Congo and Gabon. There is, however, potential overlap with migration routes of both humpback and southern right whales to and from their breeding grounds.

The potential impact of behavioural avoidance by mysticete cetaceans is considered to be of high intensity across the proposed Exploration Right area and for the duration of the survey. However, the likelihood of the survey encountering southern right and humpback whales is extremely low, as the proposed survey would likely be scheduled over the summer months to avoid the winter migration of humpback and southern right whales and the offshore location of the Exploration Right area makes encounters with whales making exploratory trips northwards along the coast from the summer feeding grounds highly unlikely. Due to the unlikely encounter rate, the impact of behavioural avoidance by mysticete cetaceans is thus considered of low significance before mitigation and of **VERY LOW** significance with 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 Right area and there is less evidence of avoidance of seismic surveys by toothed whales (including dolphins). The endemic Heaviside's dolphin has a restricted distribution on the continental shelf in waters less than 200 m depth and, therefore, overlap with the proposed survey area. A number of other toothed whale species, however, have a more pelagic distribution thus occurring further offshore. The overall significance of the potential impact would therefore vary between species, and consequently ranges between very low and 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[13] is likely. In the migratory baleen whale species, vocalisation increases once they reach the breeding grounds and on the return journey in December to January when accompanied by calves. 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). The intensity of impact on mysticetes is likely to be low over the proposed Exploration Right area and of short duration, but high in the case of odontocetes. Whereas for mysticetes the significance is rated as **VERY LOW**, both with and without 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. However, high abundances of both southern right and humpback whales around the Cape Columbine - Yzerfontein area during spring and summer (September-February) suggests that the upwelling zones off Saldanha and St Helena Bay may serve as an important summer feeding area and that these populations maybe localised resident populations year round. The significance of indirect effects on their food source is **VERY LOW** before and after mitigation.

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 (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

[13] 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.

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:

- Seismic surveys should, as far as possible, be planned to avoid cetacean migration periods from their southern feeding grounds into low latitude waters (beginning of June to end of November);
- Passive Acoustic Monitoring (PAM) technology must be used during seismic surveys at night and during daytime adverse weather conditions and thick fog. In addition, PAM technology must be implemented 24-hours a day should surveying extend into the sensitive cetacean migration period (i.e. from the beginning of June onwards). It is, however, also recommended that PAM be used 24- hours a day for the duration of the survey since most of the offshore migrating baleen whale species likely to be encountered are listed as "Endangered" and that the proposed survey would be undertaken in waters up to 1 500 m depth, including night-time, and in the vicinity of Child's Bank, where sperm whales are likely to be encountered;
- "Soft-start" procedures must only commence once it has been confirmed (visually and using PAM technology during the day and using PAM technology at night) that there is no large cetacean activity within 500 m of the vessel for a 30-minute period. In the case of small cetaceans (particularly dolphins), which are often attracted to survey vessels, "soft-start" procedures should, if possible, only commence once it has been confirmed that there is no small cetacean activity within 500 m of the airguns. However, if after a period of 30 minutes small cetaceans are still within 500 m of the airguns, the normal "soft start" procedure should be allowed to commence;
- The use of the lowest practicable airgun volume should be defined by the operator and enforced; and
- 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. Therefore, if necessary, apply to ~~Department of Environmental Affairs (DEA)~~ Department of Forestry, Fisheries and the Environment (DFFE) for an exemption from the regulations; and
- Marine mammal incidence data and seismic source output data arising from surveys should be made available, if requested, to the Marine Mammal Institute, Department of Environmental Affairs: Branch Oceans and Coasts, Department of Agriculture~~, Forestry and Fisheries~~ (DoA~~FF~~) and PASA for analyses of survey impacts in local waters.

Table 5.16: Impact of seismic noise on mysticete cetaceans (baleen whales).

	Extent	Duration	Intensity	Probability	Significance	Confidence
Physiological injury						
Without mitigation	Local	Short-term	High	Probable	**Medium**	Medium
With mitigation	Local	Short-term	Low to Medium	Probable	**LOW**	Medium
Behavioural avoidance						
Without mitigation	Local	Short-term	High	Probable	**Low**	High
With mitigation	Local	Short-term	Low	Probable	**VERY LOW**	High

	Extent	Duration	Intensity	Probability	Significance	Confidence
Masking sounds and communication						
Without mitigation	Local	Short-term	Low	Probable	**Very Low**	Medium
With mitigation	Local	Short-term	Low	Probable	**VERY LOW**	Medium
Indirect impacts						
Without mitigation	Local	Short-term	Low	Probable	**Very Low**	High
With mitigation	Local	Short-term	Low	Probable	**VERY LOW**	High

Table 5.17: Impact of seismic noise on odontocete cetaceans (toothed whales and dolphlns).

	Extent	Duration	Intensity	Probability	Significance	Confidence
Physiological injury						
Without mitigation	Local	Short-term	High	Probable	**Medium**	Medium
With mitigation	Local	Short-term	Low to Medium	Probable	**LOW**	Medium
Behavioural avoidance						
Without mitigation	Local	Short-term	Medium	Probable	**Very Low to Low**	High
With mitigation	Local	Short-term	Low to Medium	Probable	**VERY LOW**	High
Masking sounds and communication						
Without mitigation	Local	Short-term	High	Probable	**Medium**	Medium
With mitigation	Local	Short-term	Low	Probable	**LOW**	Medium
Indirect impacts						
Without mitigation	Local	Short-term	Low	Probable	**Very Low**	High
With mitigation	Local	Short-term	Low	Probable	**VERY LOW**	High

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

Description of impact

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

Assessment

There are significant differences in the effects of seismic and multi-beam/side-scan surveys. A typical 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, which is approximately 1 000 times less than a seismic survey. The higher frequency emissions utilised in normal multi-beam and sub-bottom profiling 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.

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. The statistical probability of crossing a cetacean 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 proposed Exploration Right area (within sonar beam below the survey vessel). The duration of the impact would be limited to the short-term. The impact is therefore considered to be of **VERY LOW** significance with and without mitigation (see Table 5.18).

Mitigation

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:

- The multi-beam bathymetry survey should, as far as possible, be planned to avoid cetacean migration period from their southern feeding grounds into low latitude waters (beginning of June to end of November);
- An onboard Independent Observer must be appointed for the duration of the survey to act as the MMO;
- Surveying must only commence once it has been confirmed by the MMO (visually during the day) that there is no large cetacean activity within 500 m of the vessel for a 15-minute period;
- If source level is greater than 210 dB re 1 µPa at 1 m the following is recommended:
    - Where equipment allows, a “soft-start” procedure shall be implemented for a period of 20 minutes. Where this is not possible, the equipment should be turned on and off over a 20 minute period to act as a warning signal and allow cetaceans 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) that there is no large cetacean activity within 500 m of the vessel for a 15-minute period. However, if after a period of 15 minutes small cetaceans (particularly dolphins) are still within 500 m of the vessel, the normal “soft-start” procedure should be allowed to commence;
    - “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; and
    - Should surveying in the sensitive cetacean period be unavoidable, PAM technology must be implemented 24 hours a day from beginning of June to end of November. A PAM operator must be appointed during this period.

- Terminate the survey if cetaceans show obvious negative behavioural changes within 500 m of the survey vessel or equipment until the animal/s has vacated the area; and
- 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. Therefore, if necessary, apply to ~~DEA~~ DFFE for an exemption from the regulations.

Table 5.18: Impact of multi-beam bathymetry surveying on marine fauna.

	Extent	Duration	Intensity	Probability	Significance	Confidence
Without mitigation	Local	Short-term	Low	Improbable	**Very Low**	High
With mitigation	Local	Short-term	Low	Improbable	**VERY LOW**	High

5.4 IMPACTS OF SEAFLOOR SAMPLING PROGRAMME AND HEATFLOW MEASUREMENTS

Description of impact

During the seafloor sampling programme sediment cores/ samples would be removed from the seafloor. As benthic fauna typically inhabit the top 20 to 30 cm of sediment, removal of the sediment samples would result in the disturbance and loss of benthic macrofauna, which would result in a loss of some benthic biodiversity.

Some disturbance or loss of adjacent benthic biota can also be expected as a result of the placement on the seafloor of the trigger weight and penetration of the healflow probe (note: no material is removed from the seabed during heatflow measurements). Epifauna and infauna beneath the footprint of the weight and heat probe may be smothered or crushed resulting in a reduction in benthic biodiversity. Crushing is likely to primarily affect soft-bodied species as some molluscs and crustaceans may be robust enough to survive. In addition, the discarding overboard of excess sediment overboard may result in limited smothering effects on the seafloor.

Assessment

Sediment removal

It is proposed to remove up to 200 piston core samples from the seafloor, which would amount to the removal of approximately 4 m^3 of sediment (i.e. 0.02 m^3 per sample). Considering the available area of similar habitat on and off the edge of the continental shelf in the vicinity of the proposed Exploration Right area, this reduction in benthic biodiversity can be considered negligible.

Depending on the texture of the sediments at the target sites, slumping of adjacent unconsolidated sediments into the excavation can be expected over the very short-term. Although this may result in localised disturbance (i.e. confined to the sample footprints) of macrofauna associated with these sediments and alteration of sediment structure, it also serves as a means of natural recovery of the excavations. Studies have shown that some mobile benthic animals are capable of actively migrating vertically through overlying sediment thereby significantly affecting the recolonisation of impacted areas and the subsequent recovery of disturbed areas of seafloor.

Natural rehabilitation of the seafloor following sampling or dredging operations, through a process involving influx of sediments and recruitment of invertebrates, has been demonstrated on the southern African continental shelf. Recovery rates of impacted communities are variable and dependent on the sampling method, sediment influx rates and the influence of natural disturbances on succession communities. Recovery rates have been found to range from one year for fine grained sediments to five years for coarse grained sediments.

Any change in sediment composition is expected to be minimal and would not affect recovery. Impacts on the offshore benthos as a result of sediment removal are considered to be of very low intensity at an extremely local scale (i.e. confined to the sample footprints). Full recovery is expected to take place within 1 to 5 years (i.e. short term), as the excavations would be refilled through sediment influx and recolonisation would occur through

recruitment and immigration from adjacent areas. Therefore, this impact is rated as being **INSIGNIFICANT** (see Table 5.19).

Crushing and smothering

The piston core sampling would impact a very small surface area at any one core sample site (footprint of approximately 0.0035 m^2) resulting in a cumulative footprint of 0.7 m^2 across the proposed Exploration Right area. Most of the discarded material would be dispersed as it settles through the water column. Thus crushing and smothering effects are considered negligible.

The impacts would be of very low intensity, but highly localised, and short-term as recolonisation would occur rapidly from adjacent undisturbed sediments. The potential impact is consequently deemed to **INSIGNIFICANT** (see Table 5.19).

Mitigation

No mitigation measures are feasible or deemed necessary.

Table 5.19: Impacts of seafloor sampling programme and heatflow measurements on benthic fauna.

	Extent	Duration	Intensity	Probability	Significance	Confidence
Sediment removal						
Without mitigation	Local (highly)	Short-term	Very Low	Definite	**Insignificant**	High
With mitigation	Local (highly)	Short-term	Very Low	Definite	**INSIGNIFICANT**	High
Crushing and smothering						
Without mitigation	Local (highly)	Short-term	Very Low	Definite	**Insignificant**	High
With mitigation	Local (highly)	Short-term	Very Low	Definite	**INSIGNIFICANT**	High

5.5 IMPACT ON OTHER USERS OF THE SEA

5.5.1 POTENTIAL IMPACT ON FISHING INDUSTRY

Description of impact

The proposed exploration programme could result in impacts on fishing as a result of the 500 m safety zones around the survey vessels (in terms of the Marine Traffic Act (No. 2 of 1981)). 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/3D surveys are illustrated in Figure 3.2. The operator would commission a chase vessel 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 impact on the fishing industry include the likely disruption to fishing operations and loss of access to fishing grounds in the proposed survey area over the survey period. The fishing sectors that could potentially be impacted by the proposed exploration programme include: demersal trawl; demersal long-line; large pelagic long-line; and tuna pole. There is no anticipated impact on the small pelagic purse-seine, traditional line fish (recreational and commercial), and West Coast rock lobster fisheries (see Sections 4.1.4.1b, f & g).

Assessment

Demersal trawl

The demersal trawl fishery, which primarily targets the bottom-dwelling (demersal) species of hake, is South Africa's most valuable fishing sector. The deep-sea trawl sector on the West Coast operates mainly in a continuous band along the shelf edge between the 300 m and 1 000 m bathymetric contours. The demersal trawl fishery is active year-round with approximately 1% of the average annual effort (approximately 650 trawls) and 1.6% of the average annual catch (2 350 tons) of targeted species being recorded within the proposed Exploration Right area between 2004 and 2010 (see Figure 4.17)

The demersal trawl fishery is active year-round and it is highly probable that trawl activity would be affected by the proposed exploration programme between the 300 m and 1 000 m bathymetric contours. The potential impact on the demersal trawl sector is considered to be local and of low intensity over the short-term. This impact is assessed to be of **VERY LOW** significance with and without mitigation (see Table 5.20).

Demersal long-line

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 targets the Cape hakes, with a small non-targeted commercial by-catch that includes kingklip. Demersal long-lining is expected to occur in similar areas used by the hake- directed trawling, i.e. along the shelf edge from 300 m to a waler depth of 1 000 m with lines usually set parallel to bathymetric contours. The fishing effort within the proposed Exploration Right between 2002 and 2008 averaged at 50 demersal long-lines set per year (i.e. approximately 1% of the total fishing effort expenditure for the sector) (see Figure 4.21).

Although the survey vessel would be expected to encounter relatively low levels of fishing effort in the proposed Exploration Right area, demersal long-line vessels are severely restricted in manoeuvrability during hauling operations. Therefore, direct communication with the fishing industry prior to and during each exploration activity would be required to reduce risks to both the proposed exploration programme and fishing operations.

The impact on the demersal long-line fishery is considered to be local and of low intensity over the short-term. This impact is assessed to be of **VERY LOW** significance with and without mitigation (see Table 5.20).

Large pelagic long-line

The large pelagic long-line fishery operates year-round, extensively within the South African EEZ targeting primarily tuna and swordfish. 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 4.23). Approximately 1.7% of the average annual effort (approximately 10 lines) and 1.9% (12.6 tons) of the average annual catch of targeted species has been recorded within the proposed Exploration Right area between 2002 and 2008.

The presence of long-lines would present a potential threat to seismic survey operations in terms of entanglements with towed seismic gear. Extreme vigilance would be needed to avoid any drifting lines and regular communications with vessels in the area would be essential.

The potential impact on the pelagic long-line fishery is considered to be local and of low intensity over the short-term. This impact is assessed to be of **VERY LOW** significance with and without mitigation (see Table 5.20).

Tuna pole

The tuna pole fishery targets predominantly the southern Atlantic longfin tuna stock and a small amount of skipjack tuna, yellowfin tuna and bigeye tuna. Fishing activity occurs along the entire West Coast beyond the 200 m bathymetric contour. Activity would be expected to occur along the shelf break within the proposed Exploration Right area (see Figure 4.25). The fishery is seasonal with vessel activity mostly between December and May and peak catches in February and March. These periods coincide with the normal seismic survey period in South Africa from the beginning of December to end of May.

Effort fluctuates according to the availability of fish in the area, but once a shoal of tuna is located a number of vessels move into the area and target a single shoal resulting in a large number of vessels operating in close proximity to each other at a time. As such the fishery is dependent on window periods of favourable conditions

relating to catch availability. The available records are reported for the whole EEZ and no detailed spatial catch and effort data is therefore available. This sector lands approximately 3 000 tons per annum.

The potential impact on the tuna pole fishery would be local and of medium intensity in the short-term. The overall significance of this potential impact is expected to be **VERY LOW** both 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 the commencement of each exploration activity the following key stakeholders should be consulted and informed of the proposed activities (including navigational co-ordinates of the survey areas, timing and duration of proposed activities) and the likely implications thereof:
    - Fishing industry / associations (these include South African Tuna Association, South African Tuna Long-Line Association, Fresh Tulia Exporters Association, South African Deep-Sea Trawling Industry Association, South African Hake Long-Line Association, South African Pelagic Fishing Industry Association); and
    - Other: ~~DEA~~ DFFE, DAFF, Port Captains, South African Maritime Safety Authority (SAMSA), South African Navy Hydrographic office, oil/gas and mining industries and Transnet National Ports Authority.
- The operator must request, in writing, the South African Navy Hydrographic office to release Radio Navigation Warnings and Notices to Mariners throughout the various survey periods. The Notice to Mariners should give notice of (1) the co-ordinates of the proposed survey / sampling areas, (2) an indication of the proposed survey/ sampling 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 experienced onboard Independent Observer must be appointed to act as a Fisheries Liaison Officer (FLO). The observer 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 Observer should thus be familiar with fisheries operational in the area. The Observer 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 / sampling activities and progress and fisheries and environmental issues.
- The 3D / 20 seismic survey vessels should be accompanied by a chase boat with staff familiar with the fisheries expected in the area; and
- In the event of the tuna pole fleet moving into the proposed Exploration Right area during surveying / sampling, the possibility of co-ordinating exploration operations to avoid that particular area for a limited duration should be investigated.

Table 5.20: Assessment of the potential impact on fishing activities in the proposed Exploration Right area.

	Extent	Duration	Intensity	Probability	Significance	Confidence
Demersal Trawl						

	Extent	Duration	Intensity	Probability	Significance	Confidence
Without mitigation	Local	Short-term	Low	Highly probable	**Very Low**	High
With mitigation	Local	Short-term	Low	Highly probable	**VERY LOW**	High
Demersal long-line						
Without mitigation	Local	Short-term	Low	Highly probable	**Very Low**	High
With mitigation	Local	Short-term	Low	Highly probable	**VERY LOW**	High
Large pelagic long-line						
Without mitigation	Local	Short-term	Low	Highly probable	**Very Low**	High
With mitigation	Local	Short-term	Low	Highly probable	**VERY LOW**	High
Tuna pole						
Without mitigation	Local	Short-term	Medium	Probable	**Very Low**	Medium
With mitigation	Local	Short-term	Medium	Probable	**VERY LOW**	Medium

5.5.2 POTENTIAL IMPACT ON MARINE TRANSPORT ROUTES

Description of impact

The acquisition of high quality seismic data requires that the position of the survey vessel is accurately known and that ii travel in uninterrupted lines. For this reason the survey vessel, together with its towed arrays I source, is considered to be restricted in its ability to manoeuvre and under COLREGS, 1972 (Part B, Rule 18) 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 the seismic survey operation. Although the bathymetry survey typically does not require the vessel to tow any cables, it is also has restricted manoeuvrability due to the operational nature of this work.

Furthermore, 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. In addition to the statutory 500 m safety zone, the 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. The presence of the survey vessels could thus interfere with shipping in the area.

Assessment

The majority of shipping traffic off the West Coast is located on the outer edge of the continental shelf (see Figure 4.27) with traffic inshore of the continental shelf largely comprising fishing and mining vessels, especially between Kleinsee and Oranjemund. Therefore, a high degree of shipping traffic is expected to occur in and pass through the proposed Exploration Right area.

Although the safety zone around the survey vessels would be relatively small all vessels would be prohibited from entering this area. The displacement of shipping would be limited to within the extreme near vicinity of the survey vessels. Although survey vessels are protected by a 500 m safety zone, 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 survey area is considered to be regional and of high intensity in the short-term. The significance of this potential impact is therefore assessed to be **medium** without mitigation and **LOW** with mitigation (see Table 5.21).

Mitigation

Recommendations to mitigate the potential impacts on marine transport routes are similar to that recommended for fishing (refer to Section 5.5.1). In addition, the following is recommended:

- The survey and support vessels must be certified for seaworthiness through an appropriate internationally recognised marine certification programme (e.g. Lloyds Register, Del 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 on the vessels should include radar, multi-frequency radio, foghorns, etc. Additional precautions include: the existence of an internationally agreed 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 the seismic vessel is engaged in towing surveys and is restricted in manoeuvrability, and must be fully illuminated during twilight and night; and
- Report any emergencies to SAMSA.

Table 5.21: Assessment of interference with marine transport routes,

	Extent	Duration	Intensity	Probability	Significance	Confidence
Without mitigation	Regional	Short-term	High	Probable	**Medium**	Medium
With mitigation	Regional	Short-term	Medium	Probable	**LOW**	Medium

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

Description of impact

The presence of the survey vessels with the associated 500 m safety zones could Interfere with other prospecting, mining, exploration and production activities in the area.

Assessment

Prospecting and mining

The majority of diamond mining concessions worked at present are those closer inshore. The proposed Exploration Right area, however, overlaps partly with offshore diamond mining concession 9d, which is held by Alexkor (see Figure 4.29). This concession is currently not being mined. However, should mining activities commence in concession 9d, the proposed exploration programme could have an impact on future mining and prospecting activities.

AuruMar (Pty) Ltd, a joint venture entity created by De Beers Group Exploration Holdings Limited and AngloGold Ashanti Marine Exploration Limited, secured Prospecting Rights for heavy minerals, platinum group metals, gold and sapphire for an area off the West Coast (see Figure 4.30). The proposed Exploration Right area does not overlap with this prospecting area.

A number of prospecting areas for glauconite and phosphorite / phosphate are located off the West Coast (see Figure 4.31), one of which is partially located within the proposed Exploration Right area. This area (Prospecting area 251) has, however, not yet been approved by the Department of Mineral Resources.

Manganese nodules enriched with valuable metals occur in water depths of over 3 000 m on the West Coast (see Figure 4.32). The proposed Exploration Right area does not overlap with these areas, thus no Impact is expected. ~~The area also~~

The potential Impact on prospecting and mining in the proposed Exploration Right area is considered to be localised and of very low intensity in the short-term. The significance of this potential impact is thus assessed to be **INSIGNIFICANT** with and without mitigation (see Table 5.22).

Exploration and production

Exploration for oil and gas is currently undertaken in a number of licence blocks off the West Coast of South Africa (see Figure 4.28). Although the proposed exploration programme would be limited to Block 2C, the survey vessels may need to exit the licence block for various reasons (e.g. line change operations), which may have an impact on other operators. Therefore, should PetroSA and adjacent operators undertake any exploration activities (mainly seismic surveys) at a similar time there could be a localised impact, of high intensity in the short-term. There are currently no production activities off the West Coast of South Africa. The significance of this impact is therefore assessed to be **low** without mitigation and **VERY LOW** with mitigation (see Table 5.22).

Mitigation

- PetroSA should engage timeously with other exploration right holders and applicants to discuss the scheduling of proposed exploration activities in order to reduce the risk of delay to or interference with the proposed exploration programme; and
- Any dispute arising should be referred to the Department of Mineral Resources or PASA for resolution.

Table 5.22: Impact on marine prospecting, mining, exploration and production activities.

	Extent	Duration	Intensity	Probability	Significance	Confidence
Prospecting and mining						
Without mitigation	Local	Short-term	Very Low	Improbable	**Insignificant**	Medium
With mitigation	Local	Short-term	Very Low	Improbable	**INSIGNIFICANT**	Medium
Exploration and production						
Without mitigation	Local	Short-term	High	Improbable	**Low**	Medium
With mitigation	Local	Short-term	Low	Improbable	**VERY LOW**	Medium

6 CONCLUSIONS AND RECOMMENDATIONS

PetroSA is proposing to undertake an exploration programme in Block 2C off the West Coast of South Africa to explore for oil and gas reserves. The proposed Exploration Right area is situated in the Orange Basin roughly 200 km offshore of the Northern Cape in water depths ranging from approximately 300 m to 1 500 m.

The proposed initial three-year exploration work programme would have consisted of the following:

1. 30 and/ or 2D seismic surveys;
2. Seafloor geochemical survey:
    a. Multi-beam bathymetry survey;
    b. Seafloor sampling programme; and
    c. Seafloor heatflow measurements.

However, it should be noted that none of the approved activities listed above were executed during the tenure of the Initial Exploration Period. A Section 102 application for the Initial Exploration Period was made by PetroSA and approved by PASA to reduce the work programme from the acquisition of 3D and/or 2D seismic surveys and conducting Seafloor geochemical surveys to reprocessing of 3D seismic data.

~~The proposed exploration programme would most should have likely commence with a 3D and / or 2D seismic survey in the summer survey window period (2013/2014). In addition, a seafloor geochemical survey (which may include multi-beam bathymetry survey, seafloor sampling programme and seafloor heatflow measurements) would have been undertaken during the first exploration period, after the completion of the seismic surveys. Results of the seismic surveys will influence the final activities included in the seafloor geochemical survey.~~

~~Anadarko appointed CCA to compile~~ This EMP was compiled to meet the relevant requirements of the MPRDA and the Regulations thereto. Specialists were appointed to address the two key issues, namely the effect on the fishing industry and effects on marine fauna. The findings of the specialist studies and other relevant information have been integrated and synthesised into this EMP.

This chapter summarises the key findings of the study and presents mitigation measures that should be implemented if the proposed exploration programme goes ahead.

6.1 CONCLUSIONS

A summary of the assessment of potential environmental impacts associated with the proposed exploration programme is provided in Table 6.1.

The majority of the impacts associated with the various exploration activities would be of short-term duration and limited to the immediate survey area. As a result, the majority of the impacts are considered to be of **INSIGNIFICANT** to **LOW** significance after mitigation.

The two key issues identified in this study relate to:

- The potential impact on marine mammals (physiological injury and behavioural avoidance) as a result of seismic noise; and
- The potential impact on the fishing industry (vessel interaction, disruption to fishing operations and reduced catch) due to the presence of the various survey vessels, 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 breeding or feeding area for a prolonged period, impacts at the population level could be more significant. In order to mitigate the potential impact on cetaceans it is recommended that the proposed seismic survey programme be planned, as far as possible, to avoid the cetacean migration and breeding period which

occurs from the beginning of June to end of November. It should, however, be noted that if the seismic survey programme is undertaken when more whales are likely to be present in the area, there could be increased downtime due to the temporary termination of the seismic surveys. Various other measures, which are in line with the Generic EMP prepared for seismic surveys in South Africa and the general principles of the JNCC seismic guidelines, are recommended to further mitigate the potential impact on cetaceans, e.g. the use of PAM technology, "soft-starts", temporary termination of survey, etc.

The potential impact on the fishing industry is assessed to be of **VERY LOW** significance for those sectors active in the vicinity of Block 2C, namely demersal trawl, demersal long-line, large pelagic long-line and tuna pole. However, if fish avoid the survey area and I 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. Similarly, if there was any interaction between the survey vessels and a fishery the significance of the impact could be higher. Thus it is important that the operator engage timeously with the fishing industry prior to and during the proposed exploration programme. Regular communication with fishing vessels in the vicinity during surveying or sampling would minimise the potential disruption to fishing operations and risk of gear entanglements. There is no anticipated impact on the small pelagic purse-seine, traditional line fish (recreational and commercial), and West Coast rock lobster fisheries

Table 6.1: Summary of the significance of potential impacts of the proposed exploratlon programme in Block 2C off the West Coast of South Africa.

Potential Impact		Significance	
		Without mitigation	With mitigation
Normal seismic / support vessels and helicopter operation:			
Emissions to the atmosphere		VL	**VL**
Deck drainage into the sea		VL	**VL**
Machinery space drainage into the sea		VL	**VL**
Sewage effluent into the sea		VL	**VL**
Galley waste disposal into the sea		VL	**VL**
Solid waste disposal into the sea		Insignificant	**INSIGNIFICANT**
Noise from survey and support vessel operations		VL	**VL**
Noise from helicopter operations		L-M	**VL**
Impact of seismic noise on marine fauna:			
Plankton		VL	**VL**
Invertebrates	Physiological injury	VL	**VL**
	Behavioural avoidance	VL	**VL**

Potential Impact		Significance	
		Without mitigation	With mitigation
Fish	Physiological injury	L	**VL**
	Behavioural avoidance	L	**VL**
	Spawning and reproductive success	VL	**VL**
	Masking sound and communication	VL	**VL**
	Indirect impacts	VL	**VL**
Non-diving seabirds	Physiological injury	Insignificant	**INSIGNIFICANT**
	Behavioural avoidance	Insignificant	**INSIGNIFICANT**
Diving seabirds	Physiological injury	L	**VL**
	Behavioural avoidance	L	**VL**
	Indirect impacts	L	**VL**
Turtles	Physiological injury	VL	**VL**
	Behavioural avoidance	VL	**VL**
	Masking sound and communication	Insignificant	**INSIGNIFICANT**
	Indirect impacts	VL	**VL**
Seals	Physiological injury	VL	**VL**
	Behavioural avoidance	VL	**VL**
	Masking sound and communication	VL	**VL**
	Indirect impacts	VL	**VL**
Mysticetes Cetaceans	Physiological injury	M	**L**
	Behavioural avoidance	L	**VL**
	Masking sound and communication	VL	**VL**
	Indirect impacts	VL	**VL**
Odontocetes Cetaceans	Physiological injury	M	**L**

Potential Impact		Significance	
		Without mitigation	With mitigation
	Behavioural avoidance	VL-L	**VL**
	Masking sound and communication	M	**L**
	Indirect impacts	VL	**VL**
Impact on multi-beam noise on marine fauna:		VL	VL
Impact of seafloor sampling and heatflow measurements on benthic biota:			
Sediment removal		Insignificant	**INSIGNIFICANT**
Physical crushing of benthic biota		Insignificant	**INSIGNIFICANT**
Impact on other users of the sea:			
Fishing industry	Demersal trawl	VL	**VL**
	Demersal long-line	VL	**VL**
	Large pelagic long-line	VL	**VL**
	Tuna pole	VL	**VL**
Marine transport routes		M	**L**
Marine prospecting, mining, exploration and production	Prospecting and mining	Insignificant	**INSIGNIFICANT**
	Exploration and production	L	**VL**
H=High M=Medium L=Low VL=Very Low		All impacts are negative	

6.2 RECOMMENDATIONS

6.2.1 GENERAL

Compliance with environmental protection activities and procedures

- All phases of the proposed exploration programme (including pre-establishment phase, establishment phase, operational phase, and decommissioning and closure phase) must comply with the specific environmental protection activities and procedures presented in Chapter 7.

Compliance with MARPOL standards

- All vessels must comply with the MARPOL 73/78 standards (see Appendix 5 for selected Annexures of MARPOL).

Exemption application

- 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. Therefore, if necessary, apply to ~~DEA~~ DFFE for an exemption from the regulations.

Vessel safety

- The survey and support 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 vessel with staff familiar with the fisheries expected in the area (for seismic survey only);
    - 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 the seismic vessel is engaged in towing surveys and is restricted in manoeuvrability, and must be fully illuminated during twilight and night; and
- Report any emergency situation to SAMSA.

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.

Emissions, discharges into the sea and solid waste

- Diesel motors and generators are to be adequately maintained to minimise the volume of soot and unburned diesel released to the atmosphere;
- All hydraulic systems are to be adequately maintained and hydraulic hoses frequently inspected;
- Undertake training and awareness of crew members of the need for thorough cleaning up of any spillages immediately after they occur, as this would minimise the volume of contaminants washing off decks;
- Use of low toxicity, biodegradable detergents during deck cleaning to further minimise the potential impact of deck drainage on the marine environment;
- Collect deck drainage in oily water catchment systems;
- Discharge effluent (e.g. sewage and galley waste) as per MARPOL requirements;
- Initiate an on board waste minimisation system;
- Onboard solid waste storage is to be secure; and
- Contractors must co-operate with the relevant local authority and dispose of waste (solid and hazardous) in accordance with the appropriate laws and ordinances.

Communication with key stakeholders

- Prior to the commencement of each exploration activity the following key stakeholders should be consulted and informed, in writing, of the proposed activities (including navigational co-ordinates of the survey/ sampling areas, timing and duration of proposed activities) and the likely implications thereof:
    - Fishing industry / associations (Including South African Tuna Association, South African Tuna Long-Line Association, Fresh Tuna Exporters Association, South African Deep-Sea Trawling Industry Association, South African Hake Long-Line Association and South African Pelagic Fishing Industry Association); and
    - Other: ~~DEA~~ DFFE, ~~DAFF~~DoA, Port Captains, SAMSA, South African Navy Hydrographic office, oil/gas and mining industries and Transnet National Ports Authority.
- The operator must request, in writing, the South African Navy Hydrographic office to release Radio Navigation Warnings and Notices to Mariners throughout the various survey periods. The Notice to Mariners should give notice of (1) the co-ordinates of the proposed survey / sampling areas, (2) an indication of the proposed survey/ sampling 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 experienced onboard Independent Observer must be appointed to act as a FLO. The duties of the FLO are presented together with those of the MMO (see Section 6.2.2);
- Ongoing notification is to be undertaken throughout the duration of survey / sampling activities with the submission of daily reports (via email) indicating the vessel's location to key stakeholders;
- In the event of the tuna pole fleet moving into the proposed Exploration Right area during surveying / sampling, the possibility of co-ordinating exploration operations to avoid that particular area for a limited duration should be investigated; and
- Marine mammal incidence data and data arising from the survey should be made available, if requested, to the Marine Mammal Institute, ~~DEA~~ DFFE: Branch Oceans and Coasts, ~~DAFF~~ DoA and PASA.

6.2.2 RECOMMENDATIONS SPECIFIC TO SEISMIC SURVEYS

Survey timing

- Seismic surveys should, as far as possible, be planned to avoid cetacean migration period from their southern feeding grounds into low latitude waters (beginning of June to end of November). Should a survey be required to extend into June for whatever reason, a formal request / motivation must be submitted to PASA for consideration.

Seismic survey procedures

- <u>PAM technology and 'turtle-friendly' tail buoys</u>
    - PAM technology must be used during seismic surveys at night and during daytime adverse weather conditions and thick fog. In addition, PAM technology must be implemented 24-hours a day should surveying extend into the sensitive cetacean migration period (i.e. from the beginning of June onwards). It is, however, also recommended that PAM be used 24-hours a day for the duration of the survey since most of the offshore migrating baleen whale species likely to be encountered are listed as "Endangered" and that the proposed survey would be undertaken in waters up to 1 500 m depth, including night-time, and in the vicinity of Child's Bank, where sperm whales are likely to be encountered;

- 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; 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'.

- <u>"Soft-start" procedures and airgun firing</u>
  - All initiations of seismic surveys 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.
  - The "soft-start" procedure should, as far as possible, be planned to commence within daylight hours;
  - "Soft-start" procedures must only commence once it has been confirmed (visually during the day[14] and using PAM technology and night-vision/infra-red binoculars at night[15]) that there is no seabird (diving), turtle, seal or cetacean activity within 500 m of the vessel. For cetaceans, the period of confirmation should be for at least 30 minutes prior to the commencement of the "soft- start" procedures, so that deep or long diving species can be detected. However, in the case of small cetaceans (particularly dolphins), which are often attracted to survey vessels, the normal "soft-start" procedures should be allowed to commence, if after a period of 30 minutes small cetaceans are still within 500 m of the airguns;
  - "Soft-start" procedures must also be implemented after breaks in airgun firing (for whatever reason) of longer than 20 minutes. Breaks of shorter than 20 minutes should be followed by 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 temporarily when:
    - Obvious negative changes to turtle, seal and cetacean behaviour are 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 or cetaceans as a direct result of the survey.
  - The survey should be terminated until such time the MMO 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.

[14] Note: should surveying in the sensitive cetacean period be unavoidable, PAM technology must also be used during the day, in addition to the visual watches by the MMO. PAM technology should also be used during the day if a decision is taken to use PAM 24- hours a day for the duration of the survey.
[15] Note: there is no need to continue monitoring using night-vision/infra-red binoculars at night after soft-start procedure has commenced.

- A log of all termination decisions must be kept (for inclusion in both daily and "close-out" reports) by the MMO or PAM Operator.

- Line changes

  - During line changes, at night and when turning within a 5 nautical mile radius of Child's Bank, low level warning airgun discharges should be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned. Commencement of surveying thereafter should include a "soft-start" procedure of at least 20 minutes.

Independent Observer or MMO and PAM Operator

- An onboard Independent Observer(s) must be appointed for the duration of the seismic survey to act as the FLO and MMO. The Independent Observer should be familiar with fisheries operational in the area and must have experience in seabird, turtle and marine mammal identification and observation techniques. The duties of the Independent Observer would be to:

  Marine fauna:

  - Observe and record responses of marine fauna to the seismic survey, including seabird, turtle, seal and cetacean incidence and behaviour and any mortality of marine fauna as a result of the surveys. 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;

  - Record airgun activities, including sound levels, "soft-start" procedures and pre-firing regimes; and

  - Request the temporary termination of a seismic survey, as appropriate. It is important that Observers have a full understanding of the financial implications of terminating firing, and that such decisions are made confidently and expediently.

  Fishing and other users of the sea:

  - Provide back-up onboard facilitation with the fishing industry and other users of the sea. This would include communication with fishing and shipping / sailing vessels in the area in order to reduce the risk of interaction between the proposed surveys and other existing or proposed activities. The Observer would need to identify fishing vessels active in the area and associated fishing gear; and

  - Daily electronic reporting on vessel activity and recording of any communication and/or interaction should also be undertaken in order to keep key stakeholders informed of survey activity and progress.

  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.

- A PAM operator must be appointed if surveying occurs during the night, daytime adverse weather conditions and thick fog, and the sensitive cetacean periods from the beginning of June to end of November. However, ii is recommended that a PAM operator be appointed for the duration of the survey due to the proximity to Child's Bank and since most of the offshore migrating baleen whale

species likely to be encountered are listed as “Endangered”. The duties of the PAM Operator would be to:

- Confirm that there is no marine mammal activity within 500 m of the vessel prior to commencing with the “soft-start” procedures;
- Record species identification, position (latitude/longitude) and distance from the vessel, where possible;
- Record airgun activities, including sound levels, “soft-start” procedures and pre-firing regimes; and
- Request the temporary termination of the seismic survey, as appropriate.

- All data recorded by the Independent Observer (MMO / FLO) and PAM Operator should form part of the survey “close-out” report.

6.2.3 RECOMMENDATIONS SPECIFIC TO THE SEAFLOOR GEOCHEMICAL SURVEY

6.2.3.1 MULTI-BEAM BATHYMETRY SURVEY

Survey timing

- The multi-beam bathymetry survey should, as far as possible, be planned to avoid cetacean migration periods from their southern feeding grounds into low latitude waters (beginning of June to end of November). Should a survey be required to extend into June for whatever reason, a formal request / motivation must be submitted to PASA for consideration.

Multi-beam survey procedures

- MMO
  - An onboard Independent Observer(s) must be appointed for the duration of the multi-beam survey to act as the FLO and MMO. The duties of the MMO are detailed in Section 6.2.2.
- Pre-watch survey and commencement
  - Surveying must only commence once it has been confirmed by the MMO (visually during the day) that there is no large cetacean activity within 500 m of the vessel for a 15-minute period.
- PAM technology and “soft-start” procedure
  - If source level is greater than 210 dB re 1 µPa at 1 m the following is recommended:
    - Where equipment allows, a “soft-start” procedure shall be implemented for a period of 20 minutes. Where this is not possible, the equipment should be turned on and off over a 20 minute period to act as a warning signal and allow cetaceans 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) that there is no large cetacean activity within 500 m of the vessel for a 15-minute period. However, if after a period of 15 minutes small cetaceans (particularly dolphins) are still within 500 m of the vessel, the normal “soft-start” procedure should be allowed to commence;
    - “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; and

- Should surveying in the sensitive cetacean period be unavoidable, PAM technology must be implemented 24 hours a day from beginning of June to end of November. 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. A PAM operator must be appointed during this period. The duties of the PAM operator are detailed in Section 6.2.2.

- Temporarily termination
    - Surveying should be terminated temporarily when cetaceans show obvious negative behavioural changes within 500 m of the survey vessel or equipment; and
    - The survey should be terminated until such time the MMO confirms that cetaceans have moved to a point that is more than 500 m from the source or despite continuous observation, 15 minutes has elapsed since the last sighting of the cetaceans within 500 m of the source.

6.2.3.2 SEAFLOOR SAMPLING PROGRAMME AND HEATFLOW MEASUREMENTS

- No specific mitigation is recommended.

6.2.4 RECOMMENDATIONS SPECIFIC TO HELICOPTER OPERATIONS

Mitigation relating to helicopter operations includes:

- Flight paths must be pre-planned to ensure that no flying occurs over bird and seabird colonies, coastal reserves or marine islands;
- Extensive coastal flights (parallel to the coast within 1 nautical mile of the shore) should be avoided. There is a restriction of coastal flights (parallel to the coast within 1 nautical mile of the shore) on the South-West Coast between the months of June and November to avoid Southern Right whale breeding areas;
- Aircrafts may not approach to within 300 m of whales without a permit in terms of the Marine Living Resources Act, 1998;
- The operator must comply with the Seabirds and Seals Protection Act, 1973, which prohibits the wilful disturbance of seals on the coast or on offshore islands;
- 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 PROTECTION ACTIVITIES AND PROCEDURES

This chapter lists the specific environmental protection activities and procedures required to avoid or minimise impacts on the environment from the proposed exploration programme in Block 2C.

Each sub-section deals with a different activity giving the rationale, objectives, audible actions, responsibilities and timing / frequency of these actions.

The specific environmental protection activities and procedures are addressed under the following sections:

7.1	PLANNING PHASE	7.1.1 Legal Requirements
		7.1.2 Subsidiary Plans
		7.1.3 Survey Contractor Certification
7.2	STAKEHOLDER ENGAGEMENT	7.2.1 Stakeholder Engagement
7.3	ENVIRONMENTAL TRAINING AND AWARENESS	7.3.1 Environmental Training and Awareness
7.4	POLLUTION PREVENTION	7.4.1 Vessels and Other Shipping
		7.4.2 Helicopter Services
		7.4.3 Transfer of Materials / Dropped Objects
		7.4.4 Workshops, Repairs and Chemical Handling and Storage
		7.4.5 Refuelling / Bunkering
7.5	SURVEY OPERATIONS[16]	7.5.1 Seismic Surveys
		7.5.2 Multi-Beam Bathymetry Survey
		7.5.3 Maintenance of Exclusion Zones
		7.5.4 Marine Mammal Observer / Independent Observer and PAM Operator
7.6	WASTE MANAGEMENT	7.6.1 General Measures for Solid Waste Management
		7.6.2 Discharge of Effluent
		Error! Reference source not found. Deck and Bilge Water
		Error! Reference source not found. Sewage
		7.6.3 Gaseous Emissions

[16] Note: separate sections have not been included for (1) seafloor sampling programme and (2) heatflow measurements, as no additional mitigation is recommended.

7.7	INCIDENTS AND EMERGENCIES	7.7.1 Uncontrolled Release of Polluting Liquids
		7.7.2 Materials and Equipment Lost Overboard
		7.7.3 Injury or Death of Marine Fauna
		7.7.4 General Incident Reporting and Auditing
7.8	DECOMMISSIONING & CLOSE OUT	7.8.1 Decommissioning and Close-Out
7.9	SYSTEM ADMINISTRATIVE REQUIREMENTS	7.9.1 Monitoring
		7.9.2 Reporting
		7.9.3 Auditing
		7.9.4 Record Keeping
		7.9.5 EMP Review and Revision

7.1 PLANNING PHASE

OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		PLANNING PHASE RESPONSIBILITY	TIMING
7.1.1	**LEGAL REQUIREMENTS**		
Rationale: A number of international conventions and national legislation and guidelines regulate the offshore oil and gas industry. These are primarily focused on combating marine pollution and maintaining vessel safety at sea. The MARPOL standards are the primary international standards governing pollution at sea and specify limits for release of oily water, sewage, galley waste and solid waste. South Africa's Air Pollution Standards under the NEMA Air Quality Act (No. 39 of 2004) are applicable to air emissions from offshore installations, and apply to survey vessels. PetroSA will be responsible for ensuring all the necessary legal requirements including permits are obtained prior to initiating the proposed exploration programme in Block 2C. This EMP is also a legal document and the specified measures included here, once approved, are legally binding on PetroSA and associated contractor/s.			
Objectives: • To ensure all legal requirements described in Section 2.1 and all provisions specified in Activity Schedules (7.1-7.9) are complied with in order to ensure environmental protection and human and vessel safety at sea.			
7.1.1.1	Prepare a register of all legislation applicable to the exploration programme / activities.	PetroSA	Prior to survey/ sampling
7.1.1.2	Ensure all required permits and approvals are obtained prior to undertaking the exploration programme and adhere to all conditions attached.	PetroSA	Prior to survey/ sampling
7.1.1.3	Prepare schedule of all environmental and compliance monitoring measures required during each exploration activity as well as a schedule of all reports required during and after each activity has been completed. The schedule must specify the inspection and reporting frequency and party responsible for the inspection and reporting, using Activity 7.9.2 as minimum guideline.	PetroSA	Prior to survey/ sampling
7.1.1.4	Contractors must be provided with a copy of the EMP and a written confirmation of receipt must be obtained.	PetroSA	Prior to survey/ sampling
7.1.1.5	Copies of the EMP must be readily available on-board the survey vessels and support vessels at all times and the necessary equipment and personnel are available to meet the requirements of the EMP.	Contractors	Throughout survey/ sampling
7.1.1.6	Contracts with service providers shall specifically require that the service provider complies with all relevant legislation. PetroSA reserves the right to inspect survey aclivities at any time during the survey operations to assess compliance to the EMP. Deviations from the EMP without sound justification will be deemed a breach of contract.	PetroSA	Prior and during survey / sampling

	PLANNING PHASE		
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.1.1.7	• The Holder must appoint an independent Environmental Control Officer (ECO) prior to commencement of any offshore exploration activities. • The ECO should have appropriate training and/or experience in the implementation of environmental management specifications. The ECO must preferably have a tertiary qualification in an Environmental Management or appropriate field. The ECO's key role is auditing the implementation of the EMPr. • The ECO will be responsible for the auditing function as well as the clarification of environmental conditions contained in this EMPr to anyone working on the site. The ECO does not necessarily have to be onboard the survey vessel, provided that relevant information is provided by the MMO / PAM. • The ECO roles include: o Recommendations for review and update of the EMPr; o Liaison between the Applicant, Contractors, authorities and other lead stakeholders on high importance environmental concerns; o Ensures that correct shape files have been uploaded into the vessel navigation systems to support effective implementation of spatial controls; o Review the site induction training to ensure environmental issues receive adequate attention and important site-specific issues are included; o Conduct environmental audits of the site/contractors including relevant documentation on a monthly basis; o Validating the regular site inspection reports, which are to be prepared by the relevant contractor's EO or Lead MMO/PAM (who will be tasked with the onsite responsibilities of the ECO); o Maintain a record of all non-conformances and incidents to ensure that measures are put in place to remedy such; o Maintain a public consultation register in which all complaints are recorded, as well as action taken; and	PetroSA SHEQ Manager	Prior and during seismic activities

	PLANNING PHASE		
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
	○ Verification that all environmental monitoring programmes (sampling, measuring, recording etc. when specified) are carried out according to protocols and schedules.		
7.1.1.8	Audit guidelines • Audits should, through examination of records retained by the contractor verify that: ○ Legislation register was prepared prior to exploration activities; ○ All the re Updated specialist assessments completed, and any additional recommendations and Impact Management Actions incorporated into approved EMPr; ○ quired permits were obtained prior to the start of the exploration operations; ○ All license conditions have been complied with throughout exploration operations; ○ Schedule of monitoring requirements prepared for all exploration activities; ○ Contractors were provided with copies of the EMP and proof of receipt was obtained; ○ A copy of the EMP was available on-board throughout the exploration operations; ○ All monitoring requirements have been undertaken in accordance with the scheduled frequency; and ○ All audit guidelines specified throughout this report have been complied with.	PetroSA	Prior to and throughout survey / sampling

PLANNING PHASE			
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		RESPONSIBILITY	TIMING
7.1.2	SUBSIDIARY PLANS		
Rationale: This EMP specifies the requirements for environmental management, pollution control and emergency procedure as far as possible for this generic EMP. However, under the framework provided by this EMP, certain subsidiary plans will need to be developed by PetroSA or contractors for each exploration activity, and which details the specific measures that need to be taken for certain activities; the roles and responsibilities of staff in this regard, and reporting procedures and lines of communication.			
Objectives: • Subsidiary plans are developed and are in place prior to exploration activities. • Subsidiary plans provide the necessary level of detail and are aligned with the requirements provided in this EMP and relevant existing procedures of PetroSA.			
7.1.2.1	Ensure that the service providers (survey and support vessels etc.) have the following subsidiary plans in place: • Oil Spill Contingency Plan; • Emergency Response Plan, including MEDIVAC plan; • Support Vessel and Helicopter Emergency Response Plans; • Waste Management Plan; and • Incident Management and Reporting.	PetroSA and Contractor	Prior to commencing exploration activities
7.1.2.2	Compile a Communications Plan that outlines the communications procedures for all stakeholder engagement, including a Stakeholder Engagement Register, responsibilities for review of stakeholder comments, feedback to the stakeholder and close out actions and requirements. The plan must include an effective Grievance Mechanism aligned with the requirements of the IFC, considering mechanisms for grievance input, assessment, action, monitoring, and closure.	PetroSA	Prior to commencing exploration activities
7.1.2.3	Ensure that subsidiary plans are aligned with national plans and other regional, provincial, local and PetroSA plans and procedures as relevant (e.g. Integrated Waste Management Plans, Incident Management Plan, Communications Plan, etc.).	PetroSA	Prior to commencing exploration activities
7.1.2.4	All contingency response plans contain up to date details of: • Contact names and numbers for different response contingencies; • Clear lines of communication for specific tasks are tabulated;	PetroSA & Contractor	Before and throughout exploration activities

		PLANNING PHASE	
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
	• Clear role and responsibilities allocated to specific staff roles with incumbents particular to the operation specified; • Training and awareness needs and activities, if relevant; and • Formats for reporting e.g. filing incident reports, waste manifests, etc.		
7.1.2.5	All plans shall be readily available and accessible on the survey and support vessels at all times.	Contractor	Throughout survey/ sampling
7.1.2.6	PetroSA to keep copies of all subsidiary plans (listed in 7.1.2.1) in the Emergency Response Centre during exploration activities.	PetroSA	Throughout survey/ sampling
7.1.2.7	The pre-survey/sampling meeting agenda between PetroSA and Contractor must Include a formal handover of subsidiary plans. All relevant staff of the contractor and PetroSA must be familiar with the content of the plans.	PetroSA and Contractor	Pre survey/ sampling
7.1.2.8	Audit Guidelines • Audits should, through examination of records retained by the facility, visual inspections and targeted interviews, verify that: ○ The required subsidiary plans are compiled prior to commencing exploration activities; ○ The plans contain the necessary level of detail to meet the intended purposes while ensuring optimal environmental protection; ○ The plans are aligned with the content of this EMP; and ○ The plans are aligned with relevant National, Provincial and Local Plans where relevant.	PetroSA	Pre survey/ sampling

PLANNING PHASE			
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		RESPONSIBILITY	TIMING
7.1.3	SURVEY CONTRACTOR CERTIFICATION		
Rationale: Exploration activities are a highly specialist activities. For this reason, highly qualified contractors and staff, and certified equipment and materials, are required to ensure maximum safely and environmental protection.			
Objectives: • Ensure all contractors and staff operate to the highest possible safety and environmental protection standards, and are appropriately certified.			
7.1.3.1	Contractors shall be registered with the International Association for Geophysics Contractors (IAGC) and shall be able to demonstrate a track record for maintaining optimum safety and environmental protection.	PetroSA	Prior to Contract Award
7.1.3.2	Ensure survey and support vessels are certified for seaworthiness through an appropriate internationally recognised certification programme (e.g. Lloyds Register, Det Norske Veritas).	PetroSA	Prior to Contract Award
7.1.3.3	Audit Guidelines • Audits should, through examination of documents retained by PetroSA verify that: ○ The contractors, where applicable, are registered with IAGC; and ○ The survey and support vessels hold a valid certificate for seaworthiness through an international certification body.	PetroSA	Pre survey / sampling

7.2 STAKEHOLDER ENGAGEMENT

		STAKEHOLDER ENGAGEMENT	
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.2.1	**STAKEHOLDER ENGAGEMENT**		
	Rationale: Exploration activities may impact a number of different stakeholders. In the case of offshore exploration activities, this normally includes short-term negative impacts such as limitations on fishing efficiency and navigational restrictions on other marine users, and potential disruption of biodiversity, particularly cetaceans (whales and dolphins). It is incumbent on PetroSA to engage with stakeholders in terms of the principles of NEMA in order to improve the level of transparency of the nature and timing of PetroSA's operations and exploration campaigns.		
	Objectives: • To establish and maintain a register of stakeholders. • To accommodate the fishing industry and other users of the sea, where possible, by presenting and discussing the anticipated survey programme/s. • To provided timeous notification to stakeholders regarding each exploration activity. • To provide regular general feedback to relevant and key stakeholders. • To receive, process and respond to inputs from external and internal stakeholders.		
7.2.1.1	The specific details of the survey shall be compiled into an Environmental Notification for submission to PASA. The Environmental Notification may include, depending on the activity, the following: • Survey lines / sampling target areas, • Number of samples; • Survey / sampling liming and duration; • Contractor details; • Vessel specifications (including relevant certificates and insurance); • Plans not Included in the EMP (see Activity 7.1.2.1); and • Details of Marine Mammal Observer, Passive Acoustic Monitoring Operator and Fisheries Liaison Officer, where applicable.	PetroSA	~~14 days~~ 3 weeks prior to each exploration activity
7.2.1.2	The following key stakeholders should be consulted and informed, in writing, of each exploration activity (including navigational co-ordinates of the survey/ sampling areas, timing and duration of proposed activities) and the likely implications thereof: • Fishing industry/ associations (including South African Tuna Association, South African Tuna Long-Line Association, Fresh Tuna Exporters Association, South African Deep-Sea Trawling Industry Association, South African Hake Long-Line Association and South African Pelagic Fishing Industry Association); • Government Departments with jurisdiction over marine activities, particularly the ~~Department of~~	PetroSA	~~14 days~~ 3 weeks prior to each exploration activity and within 24 hours if an extension is required

	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	STAKEHOLDER ENGAGEMENT RESPONSIBILITY	TIMING
	~~Environmental Affairs (DEA)~~ Department of Forestry, Fisheries and the Environment (DFFE), Department of Agriculture~~, Forestry and Fisheries~~ (DoA~~FF~~), South African Navy Hydrographer, South African Maritime Safely Authority (SAMSA), Transnet National Ports Authority and local Port Captains; and • Overlapping and neighbouring users with delineated boundaries in the marine petroleum and mineral prospecting and mining industries; • DFFE Vessel Monitoring, Control and Surveillance Unit in Cape Town. 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) (see Section 7.2.1.5).		
7.2.1.3	The operator must request, in writing, the South African Navy Hydrographic office to release Radio Navigation Warnings and Notices to Mariners throughout the various survey periods. The Notice to Mariners should give notice of: • the co-ordinates of the proposed survey/ sampling areas; • an indication of the proposed survey/ sampling timeframes and day-to- day location of the survey vessel; and • an indication of the proposed safe operational limits of the survey vessel.	PetroSA	Notice to Mariners 24 hours prior to start
7.2.1.4	• An experienced onboard Independent Observer must be appointed to act as a FLO. 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/ sampling activities. The FLO should thus be familiar with fisheries operational in the area. The FLO should: • report on vessel activity daily; • advise on actions to be taken in the event of encountering fishing gear; • set up a daily electronic reporting routine to keep key stakeholders informed of survey/ sampling activities and progress and fisheries and environmental issues (see Activity 7.2.1.5 below); • be placed on board the seismic or escort vessel to facilitate communications with fishing vessels in the vicinity of the seismic survey area; • ensure project vessels fly standard flags and lights to indicate that they are engaged in towing surveys and are restricted in manoeuvrability.	PetroSA	Throughout survey/ sampling

		STAKEHOLDER ENGAGEMENT	
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
	• notify any fishing vessels at a radar range of 12 nautical mile (nm) from the seismic vessel via radio regarding the safety requirements around the seismic vessel. In the case of the seismic and multi-beam surveys the FLO should also be able to act as the Marine Mammal Observer (MMO) and thus must also be familiar with environmental monitoring protocols relating specifically to marine mammals, birds and other fauna. The duties of the MMO are presented in Activity 7.5.4.		
7.2.1.5	Daily reports shall be submitted, via email, to those stakeholders that request to be notified during the survey (see Activity 7.2.1.3). Daily reports should include, but not limited to, the following: • Survey / sampling details (incl., where applicable, 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).	FLO/ MMO	Daily throughout survey/ sampling
7.2.1.6	In the event of the tuna pole fleet moving into the proposed Exploration Right area during surveying/ sampling, the possibility of co-ordinating exploration operations to avoid that particular area for a limited duration should be investigated.	PetroSA & Contractor	During survey / sampling, as required
7.2.1.7	Incident and emergency reporting is dealt with in Activity 7.7.	PetroSA & Contractor	Throughout survey/ sampling
7.2.1.8	Stakeholder engagement process will be undertaken in accordance with a Communications Plan (see Activity 7.1.2.2)	PetroSA	Throughout survey / sampling
7.2.1.9	PetroSA will implement and maintain a Stakeholder Engagement Register which shall include the following information: • Contact details of stakeholder; • Date and time of stakeholder input; • Nature of input; • Stakeholder engagement form reference number; • Name of reviewing manager; • Date of Review; • Result of Review; and • Date of communication with stakeholder.	PetroSA	Prior and throughout survey/ sampling

		STAKEHOLDER ENGAGEMENT	
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.2.1.10	Inform all key stakeholders of the completion of survey/ sampling activities within 24 hours.	PetroSA	Within 24 hours of end of survey/ sampling
7.2.1.11	Marine mammal incidence data and data arising from the survey should be made available, if requested, to the Marine Mammal Institute, ~~DEA~~ DFFE: Branch Oceans and Coasts, ~~DAFF~~ DoA and PASA	PetroSA	As required
7.2.1.12	Audit Guidelines • Audits should, through examination of records retained by PetroSA, verify that: ○ A stakeholder engagement register has been maintained; ○ Documents notifying stakeholders have been retained (e.g. Environmental Notification, notification letters, daily reports and completion of survey / sampling); ○ Any stakeholder inputs have been reviewed by the responsible manager; ○ The above stakeholder inputs have been responded to appropriately; and ○ The stakeholder has been informed of the outcome of the review by the responsible manager.	PetroSA	End of survey/ sampling activities

7.3 ENVIRONMENTAL TRAINING AND AWARENESS

	ENVIRONMENTAL TRAINING AND AWARENESS		
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.3.1	ENVIRONMENTAL TRAINING AND AWARENESS		
	Rationale: Poor staff awareness about potential survey effects on marine fauna, waste management and pollution control can result in accidents or avoidable incidents through ignorance. It is important to raise environmental awareness to encourage active staff participation in implementation of environmental protection measures and human safely and how to respond in an emergency event.		
	Objectives: • To equip all personnel on the survey and support vessels to perform their duties in an environmentally responsible manner through regular training. • To raise environmental awareness through feedback on environmental performance and any changes in legislation governing best practices.		
7.3.1.1	Contractors must be registered with IAGC (see Activity 7.1.3.1) and all staff on the survey and support vessels must be suitably trained and qualified to fulfil their duties as demonstrated by the crew manifest and training records.	PetroSA	Prior to Contract Award
7.3.1.2	Toolbox talks or similar shall be used to discuss environmental awareness and to report back on environmental performance applicable to the specific work area. Topics should include content of subsidiary plans as a minimum.	Contractor	Monthly
7.3.1.3	All personnel shall receive regular training on the handling and management of waste, and incident response and reporting procedures.	Contractor	Prior to and during survey / sampling

7.3.1.4	Audit Guidelines
	• Audits should verify that:
	  ○ All survey personnel have received appropriate training;
	  ○ Regular tool box talks or similar have been undertaken on environmental awareness and management; and
	  ○ Staff members are Familiar with the provisions of the EMP related to their area of work and the general incident and emergency reporting procedures.
		PetroSA	End of survey / sampling activities

7.4 POLLUTION PREVENTION

	POLLUTION PREVENTION		
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.4.1	**VESSELS AND OTHER SHIPPING**		
	Rationale: Offshore survey and support vessels pose potential hazards to marine traffic, creating a navigational obstacle and a restriction to fishing activities. Vessels carrying personnel or supplies to and from the offshore installations may negatively impact on the environment through reckless behaviour, negligence and/or accidents. A collision involving a survey vessel and other vessels can create a pollution risk to the marine environment through the release of oils and fuels and the deposition of objects on the seabed. PetroSA and/or contractors may be jointly responsible for the immediate response and remediation of any such environmental damage. Various measures need to be taken to minimise the risk of collisions through alerting shipping to the presence of the survey operations. The survey and support vessels should be equipped with and use all the required navigational aids and warnings. A chase boat will be on duty at all limes throughout the seismic survey operations to alert marine users ahead to the survey operations and to ensure the survey path is clear. It is obviously important that the survey and chase vessels are operated by competent personnel, are seaworthy and appropriate for their tasks, and managed in such a way as to minimise the risk of any environmental damage occurring. In the event that damage does occur, the correct and appropriate response is undertaken by the Master(s) of the vessel(s) concerned.		
	Objectives: • To minimise navigational risks to other marine users. • To inform the Masters of survey and support vessels of the actions to be taken to minimise environmental damage and the actions to be taken in the event of such damage occurring. • To check that the requisite actions are taken and that they are effective in minimising environmental damage. • To ensure that the provisions are effective in maintaining “visibility” of the vessels.		
7.4.1.1	All measures prescribed by SAMSA to minimise the risks of collision of marine traffic with the survey and support vessel(s) must be implemented and maintained.	Contractor	Throughout survey/ sampling
7.4.1.2	Measures to be implemented include: • Maintenance of safely and exclusion zones through Notices to Mariners issued by South African Navy Hydrographic Office 24 hours prior to commencement of survey (see Activity 7.2.1.3); • 24-hour chase boat on patrol in exclusion zone during seismic surveying; • Maintenance of standard watch procedures; • Issue Radio Navigational Warnings if visibility of vessel(s) is diminished (e.g. power outages or failure of fog horn); • Radio communication to alert approaching vessels; • Use warning lights during twilight and at night and in periods of low visibility.	Contractor	During survey/ sampling

POLLUTION PREVENTION			
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		RESPONSIBILITY	TIMING
	• Vessels are to fly standard flags, lights (three all-round lights in a vertical line, with Urn 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, and must be fully illuminated during twilight and night; • Use of flares and sirens where necessary; • Recording of interactions with vessels in a log book; and • Collisions, near misses or other transgressions with associated pollution risks will be treated as incidents and handled according to the procedure detailed under Activity 7.7.		
7.4.1.3	• Avoid the unnecessary discharge of ballast water. • Use filtration procedures during loading in order to avoid the uptake of potentially harmful aquatic organisms, pathogens and sediment that may contain such organisms. • Ensure that routine cleaning of ballast tanks to remove sediments is carried out, where practicable, in mid-ocean or under controlled arrangements in port or dry dock, in accordance with the provisions of the ship's Ballast Water Management Plan. • Ensure all infrastructure (e.g. arrays, streamers, tail buoys etc) that has been used in other regions is thoroughly cleaned prior to deployment. • Comply with the requirements of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention).	Geophysics Contractor	During seismic survey

POLLUTION PREVENTION			
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		RESPONSIBILITY	TIMING
7.4.2	HELICOPTER SERVICES		
Rationale: Helicopters may be used for crew changes, other support or to attend to life-threatening events should they arise. Helicopter operations may disturb coastal and marine life and interfere with coastal activities such as tourism and fishing. An accident involving a helicopter could cause marine pollution as well as threaten human safety.			
Objectives: • To minimise disturbance to coastal seabird/ seal populations and large marine fauna from helicopter flights. • To minimise disturbance to coastal communities and activities such as tourism and recreational fishing.			
7.4.2.1	Implement procedures to minimise the risk of objects and chemical substances being dropped overboard, during cargo transfer, leaking from storage containers and during handling.	Logistics Service Provider	Throughout survey
7.4.2.2	Helicopter transfers to and from survey areas shall: • avoid flying over bird and seal colonies, coastal reserves or marine islands; • fly at a minimum height of 500 m above sea level and shall not hover or circle over whales, dolphins, sharks, turtles or aggregations of seabirds. Aircrafts may not approach to within 300 m of whales without a permit in terms of the Marine Living Resources Act, 1998; • avoid extensive coastal flights (parallel to the coast within 1 nautical mile of the shore). There is a restriction of coastal flights (parallel to the coast within 1 nautical mile of the shore) on the South-West Coast between the months of June and November to avoid Southern Right whale breeding areas; and • comply fully with aviation and authority guidelines and rules.	Logistics Service Provider	Throughout survey/ sampling
7.4.2.3	Helicopter flight logs shall be kept to demonstrate compliance with set flight paths.	Logistics Service Provider	Throughout survey/ sampling
7.4.2.4	Audit guidelines • Audits should, through examination of records retained by the logistics service provider, verify that: ○ Flight logs are maintained and can demonstrate compliance with set flight paths with reasons provided for any deviations from such routes.	PetroSA	During and post survey/ sampling activities

POLLUTION PREVENTION			
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		**RESPONSIBILITY**	**TIMING**
7.4.3	TRANSFER OF MATERIALS / DROPPED OBJECTS		
Rationale: Vessel operations and loading and offloading of equipment and personnel poses a risk of solid objects and liquids falling into the sea, which could pose a risk to shipping or fisheries, while certain articles and liquids may also be detrimental to marine life and could pollute the sea. Since all such cargo has a monetary value, standard procedures are in place to limit any such loss and to retrieve objects falling overboard wherever possible.			
Objectives: • To minimise the risk of objects being lost overboard during transit or transfer. • To retrieve objects that have fallen overboard before they pose a risk to the environment or shipping. • To log the existence and location of fallen objects for future reference/ action. • To notify interested parties of the existence and location of un-retrieved fallen objects that constitute a seafloor or navigational hazard.			
7.4.3.1	Procedures shall be implemented to minimise the risk of objects and other materials being dropped overboard during transfer of goods or leaking from storage containers or during handling.	Logistics Service Provider	Throughout survey/ sampling
7.4.3.2	The incident management procedure should be followed in the event of a lost object or other materials (see Activity 7.7.2).	Logistics Service Provider	Throughout survey/ sampling
7.4.3.3	Audit guidelines • Audits should, through examination of records retained by the vessel, verify that: ○ Incidents involving dropped objects were recorded in the incident reports; ○ The response time of incidents is appropriate to their significance; ○ The decision whether or not to retrieve objects was environmentally appropriate; ○ Incidents were subject to comprehensive evaluation by management; ○ Requisite changes were made to operational procedures, where needed, to ensure that the incident is not repeated; ○ Incidents resulting from the same root cause(s) are not repeated; ○ Trial runs and/or drills for major incidents are conducted at least annually; and ○ The response for major contingencies is formally reviewed by management annually.	PetroSA and Contractor	During and post surveys / sampling

POLLUTION PREVENTION		
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING

7.4.4 WORKSHOPS, REPAIRS AND CHEMICAL HANDLING AND STORAGE

Rationale:

Survey and support vessels may store small quantities of oils and fuels, and other potentially polluting substances. Equipment and repair operations do not always take place in a defined workshop area but may take place anywhere on the vessel. These activities pose a risk of polluting substances leaking or spilling into the sea and/ or solid objects falling overboard (see Activity 7.4.3 above). However, the first line of pollution prevention is behavioural and contingent upon adequately trained staff and appropriate operational protocols. Many of the procedures for chemical handling and storage are legislated under the Occupational Health and Safety Act, 1993 (No. 85 of 1993), as amended, but the focus of the EMP is to ensure that environmental issues are adequately addressed.

Objectives:

- To manage repairs in a manner that minimises the risk of liquids polluting the sea and to expedite clean up of any such spillages that do occur.
- To handle, store and dispose of chemicals in such a way as to minimise the risk of spillage or leakage.
- To respond to any spills and or leaks in such a way that environmental damage does not occur.

7.4.4.1	Repair and servicing of loose equipment or machinery shall be undertaken only in defined workshop areas or where adequate drainage is in place to contain spilled liquid and where risk of loss of object overboard is minimised.	Contractor	Throughout survey/ sampling activities
7.4.4.2	Any spills of liquids or polluting substances shall be treated as an incident and handled according to the procedure detailed under Activity 7.7.1.	Contractor	Immediately on occurrence
7.4.4.3	A chemical register shall be maintained and will detail: • All chemicals used and stored on the vessel; • Chemical characterisation of each chemical including SABS (or similar) class and hazard rating; • Specific storage handling or disposal requirements for each chemical including Personal Protective Equipment; • Emergency response actions for each chemical; and • The process used to verify the information contained in the register.	Contractor	Throughout survey activities
7.4.4.4	All fuels, greases, oils and other chemicals shall be stored and handled as per chemical handling procedures specified in the contractor's standard operating procedures and in accordance with the Material Data Safely Sheets (MSDS).	Contractor	Throughout survey/ sampling activities
7.4.4.5	All chemicals shall have current MSDS prominently displayed at the location of storage and use.	Contractor	Throughout survey/ sampling activities

		POLLUTION PREVENTION	
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.4.4.6	Personnel using chemicals shall be trained in their use, disposal and clean-up.	Contractor	Annually
7.4.4.7	Expired chemicals shall be labelled as waste and treated in accordance with the disposal requirements specified in their MSDS.	Contractor	Throughout survey / sampling activities
7.4.4.8	Appropriate absorbent materials and clean up equipment is on board and easily available in the event of a chemical spill.	Contractor	Throughout survey / sampling activities
7.4.4.9	Any liquid spills of more than 5 litres shall be treated as an incident and handled according to the incident procedure detailed under Activity 7.7.1 below.	Contractor	Immediately on occurrence
7.4.4.10	Any loss of chemicals overboard shall be treated as an incident and handled according to the procedure detailed under Activity 7.7.1.	Contractor	Immediately on occurrence
7.4.4.11	Audit Guidelines • Audits should verify that: ○ Repair and servicing of mobile equipment and machinery takes place in defined areas with adequate drainage measures in place; ○ The chemical register is current and verified and storage accords with details contained in the MSDS; ○ All hazardous chemicals were labelled correctly and the emergency procedures to be adopted in the event of a spill clearly are detailed on MSDS at the site of storage; ○ Chemical dispensers or drums are positioned on / or over drip trays; ○ Spills are reported and handled according to the liquid incident management procedure under Activity 7.7.1; ○ Spill absorbents are available at the location use and that they are appropriate to the nature of the chemical being used; and ○ Expired chemicals are labelled as expired and handled as waste.	PetroSA	During survey/ sampling activities

OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		RESPONSIBILITY	TIMING
7.4.5	REFUELLING / BUNKERING		
Rationale: In the event that offshore bunkering is required there is a risk of fuel spillage, especially when connecting and disconnecting hoses and valves. Spillage may be more likely to occur in rough marine or stormy conditions. Bunkering activities are regulated under International Convention for the Protection of Pollution from Ships MARPOL 73/78 (Annex 1); PACOPOSOA (Prevention and Combating of Pollution of the Sea by Oil Act) Amendment Act, 1991 (No. 24 of 1991) and the Marine Pollution (Control and Civil Liability) Act, 1981 (No. 6 of 1981).			
Objectives: • To minimise the risk of spills and marine pollution during bunkering.			
7.4.5.1	No bunkering is permitted within 50 nautical miles of the coast.	Contractor / Service Provider	Bunkering
7.4.5.2	The transfer of oil at sea is not permitted within the economic zone (i.e. 200 miles from the coast) without the permission of the Minister or delegated authority.	Contractor / Service Provider	Transfer of oil
7.4.5.3	If bunkering at sea is found to be necessary, permission must be obtained from SAMSA five days prior to bunkering. An application in terms of Regulation 14 must be to the Principal Officer at the port nearest to where the transfer is to take place.	Contractor / Service Provider	Five days prior to bunkering
7.4.5.4	Diesel and other fuels must be stored in enclosed and secured tanks, designed to withstand extreme events and conditions.	Contractor / Service Provider	Bunkering
7.4.5.5	Drip trays must be in place to collect leakage from connection and discharge points.	Contractor/ Service Provider	Bunkering
7.4.5.6	Offshore bunkering shall not be allowed 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.	Contractor / Service Provider	Bunkering
7.4.5.7	Floating hoses shall be made of flexible double carcass sections and shall be equipped with a breakaway coupling for protection against excessive tension or overpressures in the fuel system. The closure time shall be set to minimise the volume of oil spilled to the sea whilst being slow enough to prevent surge pressure building up. Hoses shall also be fitted with marker lights and shall have built-in buoyancy with a minimum	Contractor/ Service Provider	During bunkering

		POLLUTION PREVENTION	
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
	reserve of 25% (to cope with a situation where the hose becomes filled with seawater and immersed). This will also prevent accidental damage to unseen hoses by supply/ crew boats.		
7.4.5.8	Spillages of fuel during bunkering must be logged as an incident in accordance with the procedures given in Activity 7.7.1.	Contractor / Service Provider	Immediately
7.4.5.9	Audit Guidelines • Audits should, through examination of records retained by the facility, verify that: ○ Proof of SAMSA approval for bunkering and notification of bunkering events; ○ Fuel is stored and drip trays provided and available for bunkering; ○ Hoses and other equipment meet the required specifications; and ○ Incidents recorded in the incident register were investigated and closed out.	PetroSA	During and post-survey / sampling activities

7.5 SURVEY OPERATIONS

	SURVEY OPERATIONS		
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.5.1	SEISMIC SURVEYS		
	Rationale: Acoustic emissions during seismic operations may cause damage to the hearing organs and air-containing tissues of marine animals such as swim bladders in fish and lungs in turtles and mammals. Risks to such animals, particularly cetaceans (whales and dolphins) will be higher during the months when they breed and calve in South African walers (from beginning of June to end of November). Disorientation of fish due to acoustic firing may increase seabird predation. Seismic surveys are generally restricted to periods outside of whale breeding seasons when significant disturbance may be caused. Therefore, seismic surveys must take precautions to ensure that sensitive marine mammals are not present at the commencement of firing airguns.		
	Objectives: • To reduce risk of injury to marine animals by discouraging them from entering the seismic survey area. • To minimise risk of behavioural disturbance to breeding mammals, particularly whales. • To ensure site specific sensitivities are identified, assessed and controlled depending on the location and extent of the planned activities.		
7.5.1.1	Seismic surveys should, as far as possible, be planned to avoid cetacean migration period from their southern feeding grounds into low latitude waters (beginning of June to end of November). Should a survey be required to extend into June for whatever reason, a formal request/ motivation must be submitted to PASA for consideration.	PetroSA	Planning of seismic operations
7.5.1.2	Passive Acoustic monitoring (PAM) technology: • PAM technology must be used during seismic surveys at night and during daytime adverse weather conditions and thick fog. • In addition, PAM technology must be implemented 24-hours a day should surveying extend into the sensitive cetacean migration period (i.e. from the beginning of June onwards). • It is, however, also recommended that PAM be used 24-hours a day for the duration of the survey since most of the offshore migrating baleen whale species likely to be encountered are listed as "Endangered" and that the proposed survey would be undertaken in waters up to 1 500 m depth, Including night-time, and in the vicinity of Child's Bank, where sperm whales are likely to be encountered. • 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	Seismic Contractor PAM Operator PetroSA SHEQ Manager	Throughout seismic operations

	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
	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. • All seismic vessels must be fitted with Passive Acoustic Monitoring (PAM) technology, which detects animals through their vocalisations. • The PAM technology must have enough bandwidth to be sensitive to the whole frequency range of sensitive marine life expected in the area. • The use of PAM 24-h a day must be implemented to detect deep diving species. • Ensure the PAM streamer is fitted with at least four hydrophones, of which two are HF and two LF, to allow directional detection of cetaceans. • Ensure the PAM hydrophone streamer is towed in such a way that the interference of vessel noise is minimised. • Ensure spare PAM hydrophone streamers (e.g. 4 heavy tow cables and 6 hydrophone cables) are readily available in the event that PAM breaks down, in order to ensure timeous redeployment. • An independent Passive Acoustic Monitoring (PAM) Operator is required on board at all times. As a minimum, at least one PAM must be on watch at all times while the acoustic source is active. The duties of the PAM operator would be to: ○ Provide effective regular briefings to crew members, and establish clear lines of communication and procedures for onboard operations; ○ Ensure that the hydrophone cable is optimally placed, deployed and tested for acoustic detections of marine mammals; ○ Confirm that there is no marine mammal activity within 500 m of the seismic source array prior to commencing with the “soft-start” procedures; ○ Record species identification, position (latitude/longitude), distance and bearing from the vessel and acoustic source, where possible; ○ Record general environmental conditions; ○ Record seismic source activities, including sound levels, “soft-start” procedures and pre-start regimes; ○ Request the delay of start-up and temporary termination of the seismic survey, as appropriate.		

		SURVEY OPERATIONS	
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.5.1.3	'Turtle-friendly' tail buoys shall be used or existing tail buoys shall be fitted with either exclusion or deflector 'turtle guards'.	Seismic Contractor	Throughout seismic operations
7.5.1.4	Seismic shooting shall follow the procedure below: • The use of the lowest practicable airgun volume, as defined by the operator, should be defined and enforced; • Design arrays to maximise downward propagation, minimise horizontal propagation and minimise high frequencies in seismic source pulses (have this verified by independent evaluators). • All initiations of seismic surveys shall 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 Hight response by marine fauna to outside the zone of injury or avoidance; • "Soft-starts" should, where possible, be planned so that they commence within daylight hours; • "Soft-start" procedures must only commence once it has been confirmed (visually during the day[17] and using PAM technology and night-vision/infra-red binoculars at night[18]) that there is no seabird (diving), turtle, seal or cetacean activity within 500 m of the vessel. For cetaceans, the period of confirmation should be for at least 30 minutes prior to the commencement of the "soft-start" procedures, so that deep or long diving species can be detected. However, in the case of small cetaceans (particularly dolphins), which are often attracted to survey vessels, the normal "soft-start" procedures should be allowed to commence, if after a period of 30 minutes small cetaceans are still within 500 m of the airguns; • The MMO must be in close communication with the seismic airgun or seabed logging personnel and should issue an "all clear" signal prior to initiating seismic airgun firing or seabed logging. • "Soft-start" procedures shall also be implemented after breaks in airgun firing (for whatever reason) of longer than 20 minutes. Breaks of shorter than 20 minutes should be followed by a "soft-start" of similar duration;	Seismic Contractor MMO	Throughout seismic operations

[17] Note: should surveying in the sensitive cetacean period be unavoidable, PAM technology must also be used during the day, in addition to the visual watches by the MMO. PAM technology should also be used during the day if a decision is taken to use PAM 24-hours a day for the duration of the survey.

[18] Note: there is no need to continue monitoring using night-vision/infra-red binoculars at night after soft-start procedure has commenced.

		SURVEY OPERATIONS	
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING

	• During line changes, at night and when turning within a 5 nautical mile radius of Child's Bank, low level warning airgun discharges should be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned. Commencement of surveying thereafter should include a "soft-start" procedure of at least 20 minutes;
	• During surveying, airgun firing should be terminated when:
	  ○ Obvious negative changes to turtle, seal and cetacean behaviour are 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 or cetaceans as a direct result of the survey.
	The survey should be terminated until such time the MMO 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.
	• The vessel operators should keep a constant watch for marine mammals and turtles in the path of the vessel.
	• Keep watch for marine mammals behind the vessel when tension is lost on the towed equipment and either retrieve or regain tension on towed gear as rapidly as possible.
	• Ensure that 'turtle-friendly' tail buoys are used by the survey contractor or that existing tail buoys are fitted with either exclusion or deflector 'turtle guards'.
	• Ensure vessel transit speed between the survey area and port is a maximum of 12 knots (22 km/hr), except in MPAs where it is reduced further to 10 knots (18 km/hr).
	• Should a cetacean become entangled in towed gear, contact the South African Whale Disentanglement Network (SAWDN) formed under the auspices of DEA to provide verbal specialist assistance in releasing entangled animals where necessary.
	• Report any collisions with large whales to the International Whaling Commission (IWC) database, which has been shown to be a valuable		

	SURVEY OPERATIONS		
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
	tool for identifying the species most affected, vessels involved in collisions, and correlations between vessel speed and collision risk		
7.5.1.5	No survey-related activities are to take place within proclaimed MPAs.	Seismic Contractor	Throughout seismic operations
7.5.1.6	Audit guidelines • Audits should verify that: ○ Updated specialist assessments completed, and any additional recommendations and Impact Management Actions incorporated into approved EMPr. ○ The contractor was using the use of the lowest practicable airgun volume, as defined by PetroSA. ○ All initiations of seismic surveys were carried out as "soft-starts" for a minimum of 20 minutes; ○ PAM was used as required; ○ PAM Records are being kept; and ○ Airgun firing was temporarily terminated when required.	PetroSA SHEQ Manager MMO and PAM operator	Throughout seismic operations
7.5.1.7	Once specific target areas for future seismic surveys are defined the following must be undertaken prior commencement: • Undertake survey (technical specifications) and location specific sound transmission loss modelling (acoustic modelling) in order to define the magnitude and extent of potential underwater noise. • A cultural heritage impact assessment should be undertaken by a suitable qualified specialist with specific focus on the intangible heritage. • Revise the impact assessment on the basis of the outcomes of the acoustic modelling (with inputs from relevant specialists including but not limited to marine ecology, and fisheries). Impact on Small Scale Fisheries must be included. • Supplement the impact management actions and impacts contained in the EMPr to account for the site and survey specific controls. • Obtain relevant approvals from the competent environmental authority in accordance with relevant legal requirements (e.g. amendments to EA and/or EMPR in accordance with NEMA requirements).	PetroSA SHEQ Manager	Well in advance of commencement of survey.

	SURVEY OPERATIONS	
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.5.2 MULTI-BEAM BATHYMETRY SURVEY		
Rationale: Acoustic emissions during multi-beam bathymetry operations may cause damage to the hearing organs and air-containing tissues of marine animals such as swim bladders in fish and lungs in turtles and mammals. Risks to such animals, particularly cetaceans (whales and dolphins) will be higher during the months when they breed and calve in South African waters (from beginning of June to end of November). Therefore, multi-beam bathymetry surveys must take precautions to ensure that sensitive marine mammals are not present at the commencement of survey.		
Objectives: • To reduce risk of injury to marine animals by discouraging them from entering the survey area. • To minimize risk of behavioural disturbance to breeding mammals, particularly whales.		
7.5.2.1	The multi-beam bathymetry survey should, as far as possible, be planned to avoid cetacean migration periods from their southern feeding grounds into low latitude waters (beginning of June to end of November). Should a survey be required to extend into June for whatever reason, a formal request/ motivation must be submitted to PASA for consideration.	PetroSA	Planning of survey operations
7.5.2.2	Multi-beam shooting shall follow the procedure below: • Surveying shall only commence once it has been confirmed by the MMO (visually during the day) that there is no large cetacean activity within 500 m of the vessel for a 15-minute period; • If source level is greater than 210 dB re 1 µPa at 1 m the following is recommended: ○ Where equipment allows, a “soft-start” procedure shall be implemented for a period of 20 minutes. Where this is not possible, the equipment should be turned on and off over a 20 minute period to act as a warning signal and allow cetaceans 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) that there is no large cetacean activity within 500 m of the vessel for a 15-minute period. However, if after a period of 15 minutes small cetaceans (particularly dolphins) are still within 500 m of the vessel, the normal “soft-start” procedure should be allowed to commence; ○ “Soft-start” procedures must also be implemented after breaks in surveying (for	Contractor	Throughout survey operations

	SURVEY OPERATIONS		
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
	whatever reason) or longer than 20 minutes. Breaks of shorter than 20 minutes should be followed by a "soft-start" of similar duration; and ○ Should surveying in the sensitive cetacean period be unavoidable, PAM technology must be implemented 24 hours a day from beginning of June to end of November. 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. • Surveying should be terminated temporarily when cetaceans show obvious negative behavioural changes within 500 m of the survey vessel or equipment. The survey should be terminated until such time the MMO confirms that cetaceans have moved to a point that is more than 500 m from the source or despite continuous observation, 15 minutes has elapsed since the last sighting of the cetaceans within 500 m of the source.		
7.5.2.3	No survey-related activities are to take place within proclaimed MPAs.	Contractor	Throughout survey operations
7.5.2.4	Audit guidelines • Audits should verify that: ○ A "soft-start" procedure (20 minutes) was implemented for any equipment with a source level greater than 210 dB re 1µPa at 1 m; ○ PAM was used as required; and ○ Surveying was temporarily terminated when required	PetroSA / MMO and PAM operator	Throughout survey operations

SURVEY OPERATIONS		
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.5.3 MAINTENANCE OF EXCLUSION ZONES		
Rationale: Survey vessels are defined as offshore installations in terms of the Marine Traffic Act, 1981 (No. 2 of 1981) and as such, survey operations are protected by a 500 m exclusion zone in which it is an offence for any unauthorised vessel to enter. In addition, because of a seismic survey vessel's inability to manoeuvre to avoid other vessels when in operation a seismic contractor would request a safe operational limit (that is greater than the 500 m safety zone) that ii would like other vessels to stay beyond. Typical safe operational limits for 2D/3D surveys are illustrated in Figure 3.2. The operator would commission a chase vessel 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 (note: support vessels would not be used for multi-beam bathymetry survey).		
Objectives: • To minimise safety risks to other vessels at sea and to avoid conditions that could pose a risk of marine pollution. • To avoid disruptions and delays to the survey programme.		
7.5.3.1	Comply with standard marine navigation warnings requirements issued to keep other marine users informed of survey/ sampling activities (see Activity 7.2.1.2, 7.2.1.3 & 7.2.1.5), including Radio Navigational Warnings, Notices to Mariners and email notices to known marine users operating in the area.	Contractor	Throughout survey operations
7.5.3.2	Keep constant watch for approaching vessels during operations (including radar), and issue warnings by radio and chase boat if required.	Contractor	Throughout survey operations
7.5.3.3	Vessels shall 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.	Contractor	Throughout survey operations
7.5.3.4	Use warning lights during twilight and at night and in periods of low visibility. Lighting on board survey vessels shall be reduced to the minimum safety levels to minimise stranding of pelagic seabirds on the survey vessel at night.	Contractor	Throughout survey operations
7.5.3.5	Transgressions of the exclusion zone must be recorded as an incident and adhere to the incident reporting and investigation procedure in Activity 7.7.4.	Contractor	Throughout survey operations
7.5.3.6	Report any emergency situation to SAMSA.	PetroSA	Throughout survey operations

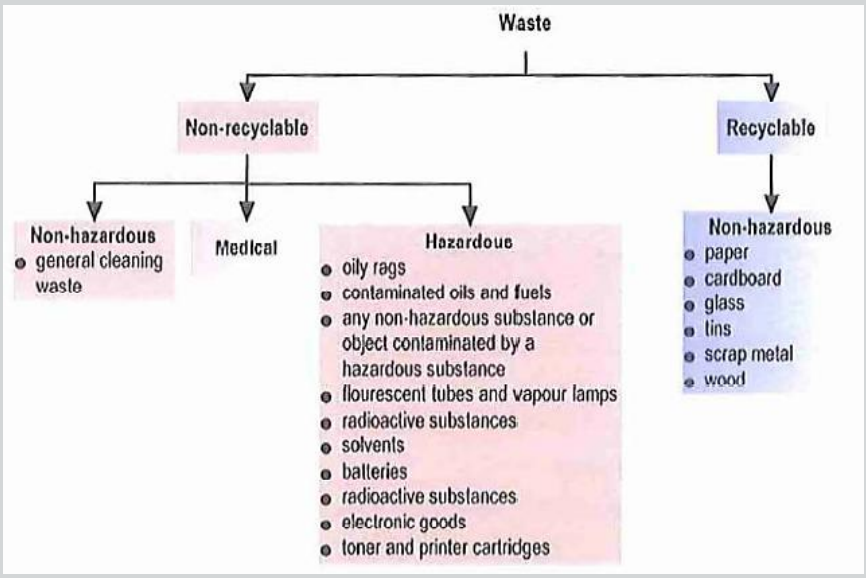
		SURVEY OPERATIONS	
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.5.3.7	Audit guidelines • Audits should verify that: ○ The appropriate communications were undertaken and proof of notifications were retained; and ○ Incidents were recorded and investigated as per requirements in Activity 7.7.4.	PetroSA	Throughout survey operations

SURVEY OPERATIONS		
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.5.4 MARINE MAMMAL OBSERVER / INDEPENDENT OBSERVER AND PAM OPERATOR		
Rationale: Acoustic emissions during seismic operations may cause damage to the hearing organs and air-containing tissues of marine animals such as swim bladders in fish and lungs in turtles and mammals. Risks to such animals, particularly cetaceans (whales and dolphins) will be higher during the months when they breed and calve in South African waters (from beginning of June to end of November). Therefore, precautions are specified to ensure that sensitive marine mammals are not present at the commencement of seismic and multi-beam surveys (Activity 7.5.1 & 7.5.2). The implementation of these specifications in the EMP must be independently monitored.		
Objectives: • To reduce risk of injury or disturbance to marine animals.		
7.5.4.1	An onboard Independent Observer(s) must be appointed for the duration of the seismic survey to act as the Fisheries Liaison Officer (FLO) and Marine Mammal Observer (MMO). The Independent Observer should be familiar with fisheries operational in the area and must have experience in seabird, turtle and marine mammal identification and observation techniques. The duties of the MMO shall include: Marine fauna: • Observe and record responses of marine fauna to the seismic survey, including seabird, turtle, seal and cetacean incidence and behaviour and any mortality of marine fauna as a result of the surveys. 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; • Record airgun activities, including sound levels, "sort-start" procedures and pre-firing regimes; and • Request the temporary termination of a seismic survey, as appropriate. It is important that Observers have a full understanding of the financial implications of terminating firing, and that such decisions are made confidently and expediently. Fishing and other users of the sea: • Provide back-up onboard facilitation with the fishing industry and other users of the sea. This would include communication with fishing and shipping / sailing vessels in the area in order to reduce the risk of interaction between the proposed surveys and other existing or proposed	PetroSA	Throughout seismic/ multi-beam operations

	SURVEY OPERATIONS		
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
	activities. The Observer would need to identify fishing vessels active in the area and associated fishing gear; and • Daily electronic reporting on vessel activity and recording of any communication and/or interaction should also be undertaken in order to keep key stakeholders informed of survey activity and progress. Other: • Record meteorological conditions; • Monitor compliance with international marine pollution regulations (MARPOL 73/78 standards); and • Prepare daily reports on all observations. These reports should be forwarded to the key stakeholders.		
7.5.4.2	A PAM operator must be appointed if seismic surveying occurs during the night, daytime adverse weather conditions and thick fog, and the sensitive cetacean periods from the beginning of June to end of November. However, it is recommended that a PAM operator be appointed for the duration of the survey due to the proximity to Child's Bank and since most of the offshore migrating baleen whale species likely to be encountered are listed as "Endangered". The duties of the PAM Operator would be to: • Confirm that there is no marine mammal activity within 500 m of the vessel prior to commencing with the "soft-start" procedures; • Record species identification, position (latitude/longitude) and distance from the vessel, where possible; • Record airgun activities, including sound levels, "soft-start" procedures and pre-firing regimes; and • Request the temporary termination of the survey, as appropriate.	PAM operator	Throughout seismic operations
7.5.4.3	A PAM operator must be appointed if multi-beam surveying is to lake place during the sensitive cetacean periods from the beginning of June to end of November. See duties above.	PetroSA	Throughout multi-beam operations
7.5.4.4	Audit guidelines • Audits should verify that: ○ MMOs, and where necessary a PAM operator, were employed and records indicate that watch periods and record keeping accord with the requirements indicated 7.5.4.1 & 7.5.4.2 above.	PetroSA	Throughout seismic/ multi-beam operations

7.6 WASTE MANAGEMENT

			WASTE MANAGEMENT
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		RESPONSIBILITY	TIMING
7.6.1	GENERAL MEASURES FOR SOLID WASTE MANAGEMENT		
	Rationale: Globally there is a recognition that wastage of resources must cease. A major concern is that final disposal to landfill of potentially renewable resources unnecessarily uses up landfill airspace and wastes resources that still have value. Since the enactment of the National Environmental Management: Waste Act, 2008 (No. 59 of 2008) there is now a positive obligation on waste generators to assess their resource usage and attempt to eliminate or reduce waste production and where this is not possible, to develop ways of re-using or recycling waste. Disposal to landfill should only be adopted as a final resort. This requires an active and ongoing assessment of waste production to identify creative ways of satisfying the objectives of this Act. The procedure below provides an overview of the steps which should be taken.		
	Objectives: • To prevent any waste from entering the marine environment except for macerated galley waste and macerated and treated sewage waste. • To reduce the amount of waste disposed to landfill by reducing waste generation and maximising recycling and reuse. • To comply with waste management legislation. • To dispose of all solid waste in an environmentally responsible manner.		
7.6.1.1	The contractor is required to have and provide to PetroSA prior to commencing survey operations, an Integrated Waste Management Plan in line with the waste management hierarchy presented in Figure 7.1.	Contractor	Prior to survey/ sampling
7.6.1.2	Waste Management Hierarchy  Figure 7.1: Waste Management Hierarchy		
7.6.1.3	The survey and support vessel shall maintain a Waste Register which shall detail: • Categories and volume estimates of different waste types generated on the vessels; • Their source; • Their SABS class and hazard rating;	Contractor	Prior and throughout survey/ sampling

	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
	• Their storage requirements; • Their disposal methods; and • Any specific precautions or legislative requirements.		
7.6.1.4	The Waste Register shall be updated to record actual waste volumes generated during the survey campaign.	Contractor	As required
7.6.1.5	Waste shall be segregated into the following categories shown in Figure 7.2. Recyclables shall be stored separately as shall hazardous waste.	Contractor	Throughout survey / sampling
	 Figure 7.2: Possible waste segregation categories		
7.6.1.6	All wastes shall be handled according to the flow diagram in Figure 7.3 below while awaiting transport to disposal sites.	Contractor	Throughout survey/ sampling
	 Figure 7.3: Waste Handling		
7.6.1.7	No waste may be stored for more than 30 days on any vessel without formal permission from ~~DEA~~ DFFE.	Contractor	Throughout survey / sampling
7.6.1.8	Wastes shall be stored in sealed containers or bags and protected from the environment according to specifications for storage in the Minimum	Contractor	Throughout survey / sampling

	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
	Requirements for the Handling, Classification and Disposal of Hazardous Waste published by Department of Water Affairs and Forestry in 1998 (or the latest update thereof).		
7.6.1.9	Incompatible waste may not be stored in the same location (see the hazard ratings for wastes in the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste published by Department of Water Affairs and Forestry in 1998 for compatibility, or the latest update of this document).	Contractor	Throughout survey/ sampling
7.6.1.10	Galley waste shall be macerated at sea to pieces smaller than 25 mm and deposited overboard at a distance at least 12 nautical miles (± 22 km) from shore in accordance with MARPOL requirements. No galley waste to be discharged within 3 nautical miles (± 5.5km) of shore. Alternatively, galley waste shall be incinerated (see Activity 7.6.3).	Contractor	Throughout survey/ sampling
7.6.1.11	Sewage shall be discharged as outlined in Activity 7.6.2.	Contractor	Throughout survey/ sampling
7.6.1.12	The survey contractor shall develop and maintain a Waste Manifest System which includes: • The quantities of different categories of wastes leaving the vessel; • The nature and source of the waste types; • The date upon which the waste was removed; • The date upon which they were received by the disposal facility; • Proof of correct disposal by the landfill site (Including a safe disposal certificate for any hazardous waste); and • Obtaining completed waste disposal certificates including quantities and method of disposal for different waste types.	Contractor	Throughout survey/ sampling
7.6.1.13	Hazardous waste shall be disposed of at a registered waste disposal site, and a safe disposal certificate shall be issued for each load of hazardous waste.	Contractor/ Logistics Service Provider	Throughout survey/ sampling
7.6.1.14	Waste manifests shall be provided to PetroSA.	Contractor	Monthly
7.6.1.15	Audit Guidelines • During survey/ sampling, audits should, through examination of records retained, verify that: ○ The waste register is current and verified; ○ Storage accords with legal requirements and the details contained in the register and waste management plan; ○ Any hazardous wastes were labelled as such;	PetroSA	During and after survey / sampling

WASTE MANAGEMENT			
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		RESPONSIBILITY	TIMING
	○ No wastes are stored on the vessel for longer than 30 days without approval from ~~DEA~~ DFFE; ○ Each container of waste is labelled with its source and contents; and ○ Safe disposal certificates were obtained for any hazardous waste load.		
	• The post-seismic audit should verify that: ○ Waste reduction targets were met; ○ All relevant personnel received training in waste management and handling on at least one occasion during the seismic survey; and ○ A complete record of waste management throughout the seismic campaign for record keeping.	PetroSA	After survey/ sampling

OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		RESPONSIBILITY	TIMING
7.6.2	DISCHARGE OF EFFLUENT		
Rationale: Liquid wastes arise from cleaning the decks, works areas, ablutions and bilges. The discharge has the potential to be detrimental to the marine environment if it does not meet MARPOL discharge standards.			
Objectives: • To contain effluents that could pose a threat to the marine environment. • To treat effluents before discharge in order to minimise damage to the marine environment. • To comply with legislative obligations for effluent discharge.			
7.6.2.1	**Deck & Bilge Water**		
7.6.2.1.1	Drainage water from deck and bilges shall be routed to separate drainage systems on survey vessels, and shall include contaminated oily water from closed drains and drainage water from non-process areas (open drains).	Contractor	Throughout survey/ sampling
7.6.2.1.2	Drip trays or bunds shall be provided to contain contaminated water from all works areas that do not drain or route to a closed drainage system.	Contractor	Throughout survey/ sampling
7.6.2.1.3	No deck or bilge water may be discharged to the sea unless the oil concentration is below 15 ppm (MARPOL standard). Monitoring must be undertaken to ensure compliance with this standard.	Contractor	Throughout survey/ sampling
7.6.2.1.4	In the event that the discharged oil concentration exceeds 15 ppm the root cause of non-compliance shall be investigated and rectified.	Contractor	Immediately on occurrence
7.6.2.1.5	Oil concentration records shall be retained and submitted to PetroSA.	Contractor	Monthly
7.6.2.1.6	Where possible, environmentally-friendly, low toxicity, and biodegradable cleaning materials shall be used.	Contractor	Throughout survey/ sampling
7.6.2.2	**Sewage**		
7.6.2.2.1	Sewage shall be comminuted to <25mm in size before discharge to the sea at greater than 12 nautical miles in accordance with MARPOL standards.	Contractor	Throughout survey/ sampling
7.6.2.3	**Audit Guidelines**		
7.6.2.4	Audits should, through examination of records retained by the contractor and Monthly and Close-Out Reports to PetroSA, verify that: • The waste water streams were monitored at the specified frequency;	PetroSA	During and post survey

	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
	• The laboratory equipment used for analysis has valid certificates, and is calibrated and maintained according to manufacturer's specifications; • Sewage macerators are maintained and fully functional; • Any elevated levels were investigated and the sources identified and appropriate action was taken; • Any such remedial action was documented and the effectiveness monitored; • No waste water was discharged from bilge tanks with a concentration greater than 15 ppm oil (MARPOL); • Any discharges of concentrations greater than those specified were formally investigated, reported and remedial action taken; and • Any such remedial action was documented and the effectiveness monitored.		
7.6.3	GASEOUS EMISSIONS		
	Rationale: Gaseous emissions of concern on survey and support vessels are limited to gases generated from the combustion of diesel fuel used to power the survey vessel, and are not expected to be any greater than any other vessel of similar tonnage. Some vessels may incinerate waste on board. Gas emissions from these sources may include SO_2, CO_2, CO, NO_x and sooty particulates. At present there are no legislated limits for the emissions produced by the offshore oil and gas industry in South Africa.		
	Objectives: • To reduce the volumes of greenhouse gases emitted and minimise air pollution.		
7.6.3.1	Incinerators, if used on board, shall be maintained to ensure efficient combustion of waste. Instances of release of excessive black smoke shall be investigated and rectified.	Contractor	Throughout survey/ sampling
7.6.3.2	Incineration of waste must comply with MARPOL standards.	Contractor	Throughout survey/ sampling
7.6.3.3	Sustained emission of black smoke for a period of more than 24 hours shall be recorded as an incident (see Activity 7.7.4) and incinerator waste should be stored separately until the problem is rectified.	Contractor	Immediately
7.6.3.4	All valves, taps and pipe connections should be inspected regularly in accordance with the maintenance and monitoring schedule to check for leaks and should be immediately rectified in the event of leak detection.	Contractor	According to maintenance & monitoring schedule

		WASTE MANAGEMENT	
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.6.3.5	Audit Guidelines • Audits should, through examination of records, verify that: ○ Emissions are monitored according to the specified schedule; ○ The laboratory equipment used for analysis has valid certificates; ○ The laboratory equipment use for analysis was calibrated and maintained according to the manufacturer's specifications: ○ Incinerators, if used, have been maintained in accordance with the maintenance schedule; and ○ Incidents of black smoke for extended duration were investigated appropriately and measures taken to rectify the identified problem.	PetroSA	During and on completion of survey/ sampling

7.7 INCIDENTS AND EMERGENCIES

INCIDENTS AND EMERGENCIES		
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	**RESPONSIBILITY**	**TIMING**
7.7.1 UNCONTROLLED RELEASE OF POLLUTING LIQUIDS		
Rationale: An incident is an unplanned event which could or does result in harm or loss to people, property, process or environment and covers every incident from minor spills and leaks to large-scale emergencies, and pollution or damage to marine life. In the case of the exploration activities, incidents could include injury or death of marine fauna due to acoustic emissions from airguns; near miss and collisions involving vessels; spills during fuel bunkering or any other maintenance activity, and loss of objects overboard. Prevention of incidents and emergencies during surveys / sampling is generally achieved through: • Following appropriate navigation notification procedures (Activity 7.2.1); • Preparing emergency response plans and other subsidiary plans prior to survey activities (Activity 7.1.2); • Contracting internationally certified survey contractors (Activity 7.1.3); • Scheduling surveys outside of peak cetacean breeding and migration seasons (Activity 7.5.1 and 7.5.2); • Maintaining exclusion and safety zones (Activity 7.5.3); • Adhering to pollution prevention requirements (Activity 7.6); and • Following precautions relating to surveying operations, e.g. "soft start" procedures, etc. (Activities 7.5.1and 7.5.2). Nonetheless, despite adherence to the above procedures, there is still a risk of incidents and emergencies occurring in any survey activity. The procedures to be followed should such an incident or emergency occur are outlined below.		
Objectives: • To undertake survey/ sampling operations in such a way as to minimise risks to marine life; • To provide a coherent, planned response to any incident which could adversely affect the environment; • To improve response time and efficiency or the plans and the activities of staff members through drills and test runs; • To provide a process for the management of an incident or emergency depending upon the severity of the occurrence; • To minimise the risk of loss of solid objects overboard and to expedite the retrieval (if possible) of any objects which fall overboard; • To log the existence and location of fallen objects for future reference/ action; • To notify interested parties of the existence and location of un-retrieved fallen objects that constitute a seafloor or navigational hazard; and • Through post-emergency evaluations, minimise the risk of a recurrence of the incident.		
7.7.1.1	The contractor shall comply with the incident management steps outlined in Activity 7.7.1.2 below and with the contractor's Incident Management Plan and Emergency Response Plan in place prior to commencing survey activities	Contractor	Throughout survey/ sampling
7.7.1.2	Incident management shall entail the following key steps: • Incident detection;	Contractor, PetroSA and other	Immediately on occurrence

	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
	• Rapid assessment of incident severity; • Implement response actions, as follows: 1. Routine Incident: In the case of an onboard spill or leak confined to the survey or support 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; and ○ 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. 2. Major Oil Spill (Emergency): In the case of an oil spill to sea with serious potential consequences to marine and human life, the following key steps will be required: • Classify the spill scenario, size and nature of the spill; • Notify PetroSA, who will in turn notify ~~DEA~~ DFFE, SAMSA and other relevant authorities to respond depending on the nature of the emergency; • Mobilise on-board resources and take all practical steps on the survey/ support vessel to contain the oil spill; and • Adhere to all notification, investigation procedures, and reporting requirements.	agencies (as required)	
7.7.1.3	An incident and the results of any investigation shall be recorded and submitted to PetroSA.	Contractor	Monthly

OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		RESPONSIBILITY	TIMING
7.7.2	MATERIALS AND EQUIPMENT LOST OVERBOARD		
Rationale: As per Activity 7.7.1.			
Objectives: As per Activity 7.7.1.			
7.7.2.1	If a solid object falls overboard, the incident shall be managed as follows: • Retrieve object if possible to do so; • If object not retrievable, record location (GPS Coordinates) and assess whether it will pose a hazard to other marine users; • If object poses a hazard then notify PetroSA who in turn shall inform SAMSA / HydroSAN; • Complete the Incident Report Form and Dropped Object Log; and • Conduct an Incident Investigation through to close out.	Contractor, PetroSA and other agencies (if required)	Immediately
7.7.2.2	Notifiable Incidents as set out in the Incident Management Plan shall be reported by the contractor to PetroSA within 48 hours. Incidents posing a threat to human life or significant marine pollution shall immediately be reported to the designated Emergency Coordinator of PetroSA.	Contractor	48 hours of incident or immediately on occurrence

OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		RESPONSIBILITY	TIMING
7.7.3	INJURY OR DEATH OF MARINE FAUNA		
Rationale: As per Activity 7.7.1.			
Objectives: As per Activity 7.7.1.			
7.7.3.1	Notifiable incidents related to death or injury of marine fauna that may be discovered during surveys shall follow the general incident reporting requirements of outlined in Activity 7.7.4 below, and shall include: • Completion of an incident reporting form including recording of details such as time of observation, status of seismic/ multi-beam firing, location in relation to survey vessel and streamers, GPS coordinates, type and number of animals involved and other comments relating to possible correlation with survey activities; • Immediately reported to PetroSA; • PetroSA shall immediately report to the ~~DEA~~ DFFE: Oceans and Coasts who will in turn follow the correct procedures to investigate or retrieve injured or dead animals; and • Follow up investigations and close-out of the incident.	Contractor	Immediately on occurrence
7.7.3.2	All seabirds stranded on vessels shall be retrieved and released according to appropriate guidelines.	Contractor	Immediately on occurrence

OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		RESPONSIBILITY	TIMING
7.7.4	GENERAL INCIDENT REPORTING AND AUDITING		
Rationale:	As per Activity 7.7.1.		
Objectives:	As per Activity 7.7.1.		
7.7.4.1	General Reporting • All incidents that may occur during surveys/ sampling shall require the following investigation and reporting, and which shall be detailed in the Incident Management Plan: ○ Assessment of the nature and source of the incident; ○ Assessment and evaluation of the impact and affected environmental receptors; ○ Recording the date and lime; ○ Description of incident; ○ Actions taken to remedy the incident and report the incident; ○ Investigation into root cause (if applicable, depends on the severity of the incident); and ○ Identification of measures to prevent reoccurrence and communication of such.	Contractor	During and after an incident
7.7.4.2	Audit Guidelines • Audits should, through examination of records retained by the contractor or PetroSA, verify that: ○ Maintenance and system checks were undertaken in accordance with specifications and all spill preventive measures recorded as fully operational; ○ All incidents have been reported and recorded as per specifications indicated in the sections above; ○ All incidents have been investigated to identify root causes (if applicable, depends on the severity of the incident); ○ The incident reports detail the results of the investigations into root causes and advises on amendments to procedures or equipment as needed; ○ The advised changes are implemented; ○ A trend analysis on incidents is conducted monthly; ○ Incidents are reported within an appropriate timeframe, along with the root cause analyses;	PetroSA	After incident or during post survey/ sampling audit

		INCIDENTS AND EMERGENCIES	
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		RESPONSIBILITY	TIMING
	○ Sufficient oil and chemical spill containment and absorbent equipment and materials are stored in sufficient quantities in areas where spills are most likely to occur; and ○ The emergency response plan and oil spill contingency plan is current and in particular all contact details are up to date.		

7.8 DECOMMISSIONING AND CLOSE-OUT

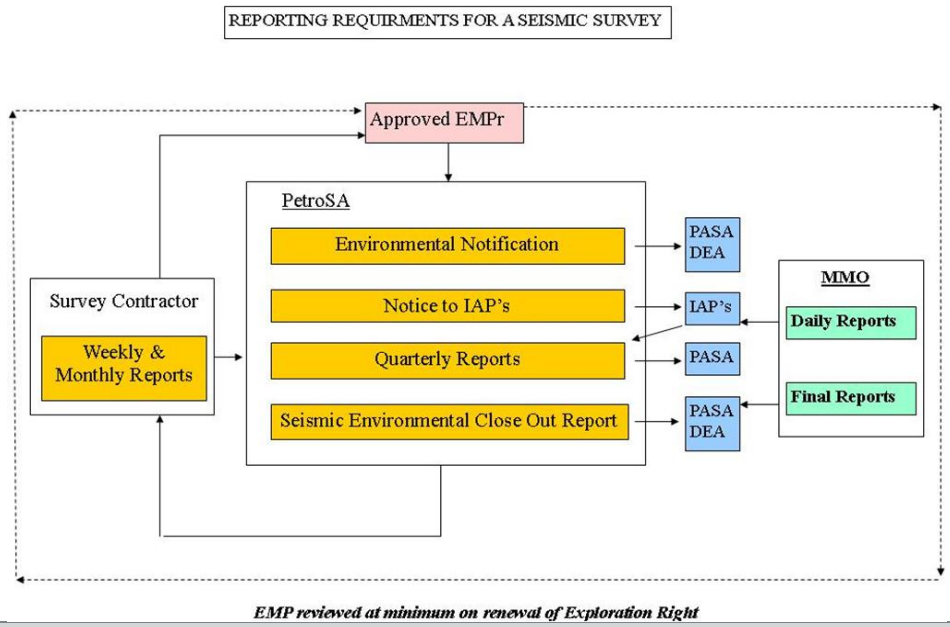
DECOMMISSIONING AND CLOSE-OUT			
OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		**RESPONSIBILITY**	**TIMING**
7.8.1	DECOMMISSIONING AND CLOSE-OUT		
Rationale: At the end of each exploration activity, several actions must be taken to ensure that the survey area is left in its original condition and no restrictions remain on other marine users who previously used the area. This includes: • Retrieval of all equipment; • Disposal of all onboard waste; and • Informing other marine users of the removal of the exclusion and safety zone.			
Objectives: • To restore the marine environment and seafloor to its pre-survey condition by removing any equipment used or dropped during the survey and correctly disposing of on-board waste. • To allow other marine users to use the area for fishing or marine traffic by informing stakeholders of the cessation of activities.			
7.8.1.1	Retrieve all deployed equipment and any dropped objects from the marine environment prior to cessation of survey activities.	Contractor	End of survey/ sampling
7.8.1.2	Inform all key stakeholders (see Activity 7.2.1.10) of the closure of survey activities within 24 hours.	PetroSA	Within 24 hours of end of survey / sampling
7.8.1.3	Dispose of all waste retained onboard at a licensed waste site using a licensed waste disposal contractor and obtain a final waste disposal certificate (see Activity 7.6.1).	Contractor	End of survey/ sampling
7.8.1.4	Compile a Close-Out Report at the end of each exploration activity which shall document compliance with the provision of this EMP, deviations from specified standards, and details of any incidents arising (see Activity 7.9.2.2.4 for contents).	PetroSA	Within 60 days post- survey / sampling

7.9 SYSTEM ADMINISTRATIVE REQUIREMENTS

OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		SYSTEM ADMINISTRATIVE REQUIREMENTS: RESPONSIBILITY	SYSTEM ADMINISTRATIVE REQUIREMENTS: TIMING
7.9.1 MONITORING			
Rationale: A contractor generally has its' own administrative requirements for environmental protection that complies with international best practice and legislation. This section outlines the administrative requirements that must be complied with during exploration activities to ensure adherence to legal and best practice, and to demonstrate proof of compliance. Administrative systems and record keeping enable an organisation to: • assure itself of its conformance with its own stated environmental policy; • demonstrate conformance; and • ensure compliance with environmental laws and regulations amongst other things. This section summarises some key system requirements to ensure the effective implementation of the environmental management plan at different stages of a survey programme: planning and design, during and post-survey operations based on the ISO system model of the Plan - Do - Check - Act cycle. • Plan - establish objectives and make plans (analyse your organization's situation, establish your overall objectives and set your interim targets, and develop plans to achieve them). • Do- implement your plans (do what you planned do). • Check - measure your results (measure/monitor how far your actual achievements meet your planned objectives). • Act - correct and improve your plans and how you put them into practice (correct and learn from your mistakes to improve your plans in order to achieve better results next time).[19]			
Objectives: • To provide a comprehensive and coherent system which accesses and stores information pertinent to environmental management from diverse sources to verify responsible environmental practices. • To provide a formal platform for reporting on environmental performance. • To monitor and audit environmental performance against pre-determined criteria. • To use formal management reviews to continuously improve the system itself and thereby environmental performance as a whole.			
The following parameters shall be monitored during survey activities:			
7.9.1.1	Deck & bilge water discharge: oil concentrations to ensure compliance with MARPOL standards of <15 ppm (Refer to Activity 7.6.2.1).	Contractor	MARPOL requirements
7.9.1.2	Solid waste production and disposal (Refer to Activities 7.6.1.3 and 7.6.1.12)	Contractor	Daily
7.9.1.3	Marine fauna: sightings (Refer to Activity 7.5.4).	MMO and PAM operator	Daily

[19] http://www.iso.org/iso/iso_catalogue/management_standards/understand_the_basics.htm

	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	SYSTEM ADMINISTRATIVE REQUIREMENTS RESPONSIBILITY	TIMING
7.9.1.4	Survey procedure (Refer to Activities 7.5.1& 7.5.2)	MMO and PAM operator	Daily
7.9.1.5	Monitoring results shall be reported to PetroSA.	Contractor	Monthly
7.9.1.6	PetroSA shall report monitoring results to PASA in the Quarterly Report.	PetroSA	Quarterly

OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		SYSTEM ADMINISTRATIVE REQUIREMENTS: RESPONSIBILITY	SYSTEM ADMINISTRATIVE REQUIREMENTS: TIMING
7.9.2 REPORTING			
Rationale: As per Activity 7.9.1.			
Objectives: As per Activity 7.9.1.			
7.9.2.1	Reporting requirements for a survey/ sampling campaign are indicated in the now chart below.  		
7.9.2.2	**Reporting by PetroSA to PASA**		
7.9.2.2.1	EMP: • In accordance with the requirements of the MPRDA, 2008 (No. 49 of 2008), PetroSA shall submit an EMP to obtain approval for an exploration right (as per this EMP).	PetroSA	Prior to exploration activities
7.9.2.2.2	Notification of PASA: • PetroSA shall notify PASA in writing of the commencement of survey activities ~~14 days~~ 3 weeks prior to starting activities (see Activity 7.2.1.1). • The specific details of the survey shall be compiled into an Environmental Notification for submission to PASA. The Environmental Notification shall provide details on the following: ○ Survey lines / sampling target areas, ○ Number of samples; ○ Survey/ sampling timing and duration;	PetroSA	~~14 days~~ 3 weeks prior to survey / sampling activities

	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	SYSTEM ADMINISTRATIVE REQUIREMENTS RESPONSIBILITY	TIMING
	○ Contractor details; ○ Vessel specifications (including relevant certificates and insurance); ○ Plans not included in the EMP (see Activity 7.1.2.1); and ○ Details of Marine Monitoring Operator applicable.		
7.9.2.2.3	Quarterly Reports: • PetroSA shall submit Quarterly Reports to PASA, which shall include key information on: ○ the progress of survey/ sampling activities and any changes to the exploration schedule; ○ any incidents (e.g. pollution spills, navigational incidents, loss of equipment etc.); and ○ non-compliance with or exceedance of monitoring standards and steps taken to rectify these.	PetroSA	Quarterly
7.9.2.2.4	The environmental monitoring data collected (including the MMO and PAM) must be made available to the DFFE, SANBI and SAEON for their use in future scientific research.	ECO	Monthly
7.9.2.2.5	Close-Out Report: • PetroSA shall submit a close-out report to PASA within 60 days of completing a survey/ sampling campaign. The information contained in this report shall be based on the monthly reports compiled by the MMO, survey contractor and other data and records compiled during the seismic campaign. • The Close-Out Report shall contain a full description of all aspects of the survey campaign, including: ○ The contractor and vessel details; ○ MMO details; ○ Description of the survey/ sampling campaign (location, timetable & duration); ○ Establishment information (e.g. receipt of EMP by Contractor and notification of other sea users/ stakeholders); ○ Operational phase activities (e.g. environmental awareness, communications, provision for emergencies, waste management, lost equipment, helicopter use, acoustic emissions; faunal monitoring results (including final MMO report);	PetroSA	Within 60 days of completing survey/ sampling

	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	SYSTEM ADMINISTRATIVE REQUIREMENTS RESPONSIBILITY	TIMING
	○ Monitoring and performance assessments; and ○ Decommissioning and closure (e.g. notification, close-out reporting and final waste disposal).		

		SYSTEM ADMINISTRATIVE REQUIREMENTS	
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.9.2.3	**Contractor Reporting to PetroSA and Documentation Requirements**		
7.9.2.3.1	Pre-Survey Agreements and Documentation • Prior to surveys/ sampling, the following documentation will be provided to PetroSA by the contractor: ○ Signed Contractor's Acknowledgement of receipt of EMP; ○ Environmental Safety and Health Policy; ○ Subsidiary Plans (see Activity (7.1.2); ○ Certificates of Sea Worthiness and Safely & Pollution Prevention Certificates; and ○ Plan for supply of information to compile the Environmental Close-Out report.	Contractor	Prior to survey/ sampling
7.9.2.3.2	Monthly Report • The following information shall be compiled by the survey contractor, and submitted to PetroSA on a monthly basis in the form of a Monthly Report: ○ Incidents, including tangling of gear, incidents with marine fauna, spills and discharges, encroachments in the exclusion zone, etc; ○ Amount and type of waste generated and disposed of; and ○ Times and durations of firing including number and duration of soft starts.	Contractor	Monthly
7.9.2.4	**Reporting by PetroSA to other government department and institutes**		
7.9.2.4.1	Marine mammal incidence data and data arising from surveys shall be made available, if requested, to the Marine Mammal Institute, ~~DAFF~~ DoA and PASA.	PetroSA	Post survey / sampling

		SYSTEM ADMINISTRATIVE REQUIREMENTS	
	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	RESPONSIBILITY	TIMING
7.9.3	AUDITING		
Rationale: As per Activity 7.9.1.			
Objectives: As per Activity 7.9.1.			
7.9.3.1	**General**		
7.9.3.1.1	Compliance with the EMP shall be subject to an internal review before, during and at the end of a survey/ sampling campaign. The findings of these audits shall contribute towards PetroSA's annual performance report on EMP compliance.	PetroSA	Throughout survey/ sampling
7.9.3.1.2	The audits should review and report on the auditing guidelines detailed in each section of this EMP.	PetroSA	Throughout survey/ sampling
7.9.3.2	**Pre-survey / sampling**		
7.9.3.2.1	The pre-survey audit shall check the following: • The EMP has been approved by PASA and all reporting requirements have been complied with; • The contractor has received a copy of the EMP, understands the content; the content of the EMP is aligned with the survey contractor's standard operating procedures, and has agreed to its implementation; and • The contractor has the necessary equipment and protocols in place and staff on the vessel are suitably trained to implement the monitoring requirements outlined in the EMP.	PetroSA	Pre- survey / sampling
7.9.3.3	**During survey/ sampling audit**		
7.9.3.3.1	Audits during the survey/ sampling campaign shall check the following: • Monitoring is being undertaken in accordance with the requirements described in this EMP for the variables summarised in Activity 7.9.1; • Monitoring data are retained and all deviances reported correctly in the Monthly Reports; • Incidents, where relevant, have been reported as per the incident reporting and investigating requirements (see Activity 7.7); • Observations made on the vessels check the contractor's commitments to good housekeeping and waste management protocols; and	PetroSA	During survey/ sampling

	OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS	SYSTEM ADMINISTRATIVE REQUIREMENTS RESPONSIBILITY	TIMING
	• General audit measures indicated in Activity 7.9.3.4.2.		
7.9.3.4	**Post-survey/ sampling audit**		
7.9.3.4.1	The post-seismic audit shall take the form of a close out report shall check and include the following: • Monitoring was undertaken in accordance with the requirements described in this EMP for the variables summarised in Activity 7.9.1; • Monitoring data are retained and all deviances reported correctly in the Monthly Reports; • Incidents, where relevant, have been reported as per the incident reporting and investigating requirements and have been closed out (see Activity 7.7); and • All records comply with EMP requirements and are stored in an accessible and logical manner.	PetroSA	Post survey / sampling
7.9.3.4.2	Audit Guidelines • Audits should, through examination of records retained by the contractors and PetroSA, verify that: ○ All records required by this EMP have been retained and are stored in an accessible and logical manner; ○ All reports required by this EMP have been completed and submitted to the designated recipient; ○ All monitoring has been completed and any deviances responded to accordingly; and ○ Management reviews have been conducted and were comprehensive and any action required has been Implemented.	PetroSA	Annually

OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		SYSTEM ADMINISTRATIVE REQUIREMENTS	
		RESPONSIBILITY	TIMING
7.9.4 RECORD KEEPING			
Rationale: As per Activity 7.9.1.			
Objectives: As per Activity 7.9.1.			
7.9.4.1	The following records shall be maintained as part of the EMP and cross- referenced for auditing purposes: • Effluent discharge volumes, quality results, including non-compliance; • Incident reports, including incident close out results; • Water manifests and disposal certificates; • Training records; • Prosecutions/ notices of non-compliance; • Stakeholder inputs and the review thereof; • Audit reports; • Results of management reviews; • Weekly, monthly and annual internal reports; • Planned maintenance reports / logs; • All previous versions of the EMP; • All EIAs and application for environmental authorisations; and • Correspondence with permitting authorities such as PASA, DEA, SAMSA, etc.	PetroSA & Contractor	Ongoing

OPERATIONAL ACTIVITIES/ ASPECTS & AUDITABLE ACTIONS		SYSTEM ADMINISTRATIVE REQUIREMENTS	
		RESPONSIBILITY	TIMING
7.9.5 EMP REVIEW AND REVISION			
Rationale: As per Activity 7.9.1.			
Objectives: As per Activity 7.9.1.			
7.9.5.1	The EMP shall be subject to reviewal least upon renewal of exploration right and updated if required. The review shall consider the following information: • Audit reports; • Feedback from stakeholders; • Technology changes; • Performance assessment reports; and • Changes in regulations/legal compliance.	PetroSA	Renewal of exploration rights (every 2-3 years)

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