BASIC ASSESSMENT FOR A PROSPECTING RIGHT APPLICATION FOR OFFSHORE SEA CONCESSION 6C, WEST COAST, SOUTH AFRICA

Sea Concession 6C

Prepared for: De Beers Consolidated Mines (Pty) Ltd

Authority References:

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EXECUTIVE SUMMARY

1. INTRODUCTION

De Beers Consolidated Mines (Pty) Ltd (De Beers) lodged an application for a Prospecting Right with the Department of Mineral Resources (DMR) to undertake offshore diamond prospecting activities in Sea Concession 6C off the West Coast of South Africa. The application was lodged in terms of Section 16 of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) (MPRDA), as amended. In response to the application, DMR request (letter dated 18 June 2018) that a Basic Assessment Report (BAR) be submitted for the proposed geophysical activities and sampling activities.

Sea Concession 6C is situated approximately 400 km north of Cape Town, with the inshore boundary located 5 km seaward of the coast between Hondeklip Bay in the south and Kleinzee in the north and the offshore boundary located between approximately 70 to 100 km offshore (see Figure 1). Sea Concession 6C has a total extent of 345 746 hectares (ha).

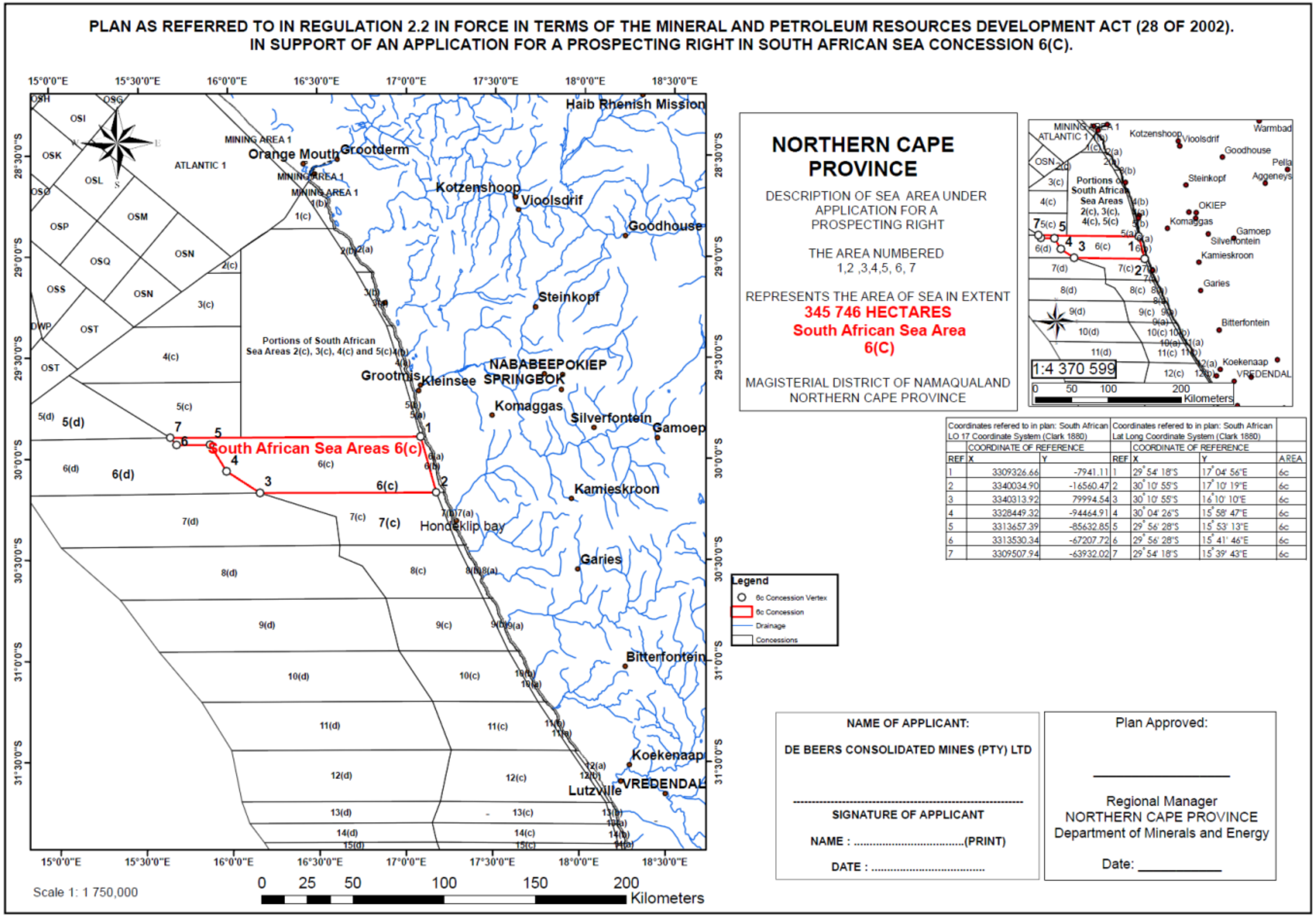
The proposed prospecting activities require authorisation in terms of the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), as amended, and a Prospecting Right has to be obtained in terms of the MPRDA. In terms of the Environmental Impact Assessment (EIA) Regulations 2014 (as amended), promulgated in terms of Chapter 5 of NEMA, an application for a prospecting Right requires Environmental Authorisation from the competent authority, the Minister of Mineral Resources, to carry out the proposed prospecting activities. In order for DMR to consider an application for Environmental Authorisation for prospecting, a Basic Assessment process must be undertaken.

De Beers Marine (Pty) Ltd has appointed SLR Consulting (South Africa) (Pty) Ltd (SLR) as the independent Environmental Assessment Practitioner to undertake a Basic Assessment process for the proposed prospecting activities in accordance with the requirements of NEMA and the EIA Regulations 2014, as amended.

The draft Basic Assessment Report (BAR) was made available for a 30-day review and comment period from 10 August to 10 September 2018 in order to provide Interested and Affected Parties (I&APs) and authorities the opportunity to comment on the proposed project and the draft BAR. Copies of the full report were made available on the SLR website (www.slrconsulting.com) and at the offices of SLR.

This revised BAR has been submitted to DMR for consideration and decision-making. The compilation of this report has been informed by comments received from I&APs during the above-mentioned review and comment period. It should be noted that all significant changes to the draft report are underlined and in a different font (Times New Roman) to the rest of the text.

A copy of the revised BAR has been placed on the SLR website for information purposes. After DMR has reached a decision, all registered I&APs on the project database will be notified of the decision. A statutory appeal period in terms of the National Appeal Regulations (GN No. R993) will follow the issuing of the decision.



Coordinates refered to in plan: South African LO 17 Coordinate System (Clark 1880)			Coordinates refered to in plan: South African Lat Long Coordinate System (Clark 1880)			
	COORDINATE OF REFERENCE			COORDINATE OF REFERENCE		
REF	X	Y	REF	X	Y	AREA
1	3309326.66	-7941.11	1	29° 54' 18"S	17° 04' 56"E	6c
2	3340034.90	-16560.47	2	30° 10' 55"S	17° 10' 19"E	6c
3	3340313.92	79994.54	3	30° 10' 55"S	16° 10' 10"E	6c
4	3328449.32	-94464.91	4	30° 04' 26"S	15° 58' 47"E	6c
5	3313657.39	-85632.85	5	29° 56' 28"S	15° 53' 13"E	6c
6	3313530.34	-67207.72	6	29° 56' 28"S	15° 41' 46"E	6c
7	3309507.94	-63932.02	7	29° 54' 18"S	15° 39' 43"E	6c

FIGURE 1: LOCATION OF THE 6C PROSPECTING RIGHT AREA, OFF THE WEST COAST OF SOUTH AFRICA (TAKEN FROM DRAFT APPLICATION).

3. PROJECT DESCRIPTION

3.1 GENERAL INFORMATION

The proposed prospecting activities would be undertaken within the Sea Concession 6C, located off the West Coast of South Africa. The target mineral for the prospecting activities is marine diamonds and the planned timeframe to complete the proposed prospecting work would be as follows:

- Phase I - Regional scale geophysical surveys (Year 1-2); and
- Phase II - High Resolution Geophysical Surveys and Exploration Sampling (Year 3-5).

Due to the dynamic nature of prospecting and evaluation the work programme may have to be modified, extended or curtailed as data and analyses become available.

3.2 NEED AND DESIRABILITY

In the recently published Department of Minerals Resources Strategic Plan 2014 – 2019, the foreword by the Minister of Mineral Resources notes that the Department *"will continue to promote mineral value addition to strengthen the interface between extractive industries and national socio-economic developmental objectives"*.

This project aims to establish whether economically viable diamond deposits occur on the continental shelf off the West Coast of South Africa.

3.3 MARINE PROSPECTING OVERVIEW

3.4.1 Phase I - Regional Geophysical Surveys

The first phase of the proposed prospecting activities would entail conducting regional scale geophysical surveys in order to identify geological features of interest for possible further exploration. The geophysical survey equipment will be deployed from a fit-for-purpose vessel that is suited to the water depth and selected survey method. The line spacing of the surveys for this phase of prospecting is planned such as to enable full regional scale seabed coverage.

The following tools are available for proposed regional geophysical surveys:

- Swath bathymetry;
- Sub-bottom profiler seismic systems;
- Side scan sonar systems;
- Magnetometer;
- Multibeam Echo Sounder
- Sleeve Gun system; and
- Boomer.

3.4.2 Phase II - High Resolution Geophysical Surveys and Exploration Sampling

Should geological features of interest be identified on completion for the Phase I surveys, then a decision will be made regarding the feasibility of proceeding to Phase II of the prospecting activities. This would include follow-up localised geophysical surveys and exploration sampling.
Once the detailed geophysical surveying has been completed and the results further analysed, it is assumed that these results would yield at least one deposit that would justify further exploration sampling to establish the distribution of the diamondiferous material within identified target area(s).

Exploration sampling would be undertaken using a fit-for-purpose tool and vessel of opportunity (e.g. *M/V The Explorer* and/or *M/V Coral Sea*) in water depths ranging from 70 m to 160 m. The proposed sampling may be divided into stages subject to reviews and follow-up sampling work. A decision on the planned sampling technology appropriate to each target area would be made based on the results of the preceding stage.

Depending on the outcomes of previous stage work, samples may be collected in a fixed pattern over an identified target area. Samples may be taken along lines spaced 10 m to 500 m apart, with samples spacing based on the geological nature of the target area. Once a decision is made on the selected sampling tool technology chosen for taking samples from the seabed, the accompanying metallurgical sample processing technology on board the relevant vessel would then also be determined. Possible sampling tool technologies that could be employed include a subsea sampling tool, drill sampling or a vertically mounted sampling tool.

For the purposes of this assessment it is assumed that up to 9 000 samples would be obtained within the potential deposit area(s). The likely sample spacings would be between 50 and 200 m apart. The total area of disturbance would be approximately 0.09 km^2.

3.4 NO-GO ALTERNATIVE

The No-Go alternative is the non-occurrence of the proposed project. The negative implications of not going ahead with the proposed project are as follows:

- Loss of opportunity to establish whether further viable offshore diamond resources exist;
- Prevention of any socio-economic benefits associated with the continuation of prospecting activities; and
- Lost economic opportunities.

The positive implications on the no-go option are that there would be no effects on the biophysical environment in the area proposed for the exploration activities.

4. AFFECTED ENVIRONMENT

The proposed prospecting activities fall within the offshore area of the West Coast region of South Africa. It lies within the southern zone of the Benguela Current region and is characterised by the cool Benguela upwelling system. The description of the offshore environment in the BAR contains a general overview of the oceanography and ecology of the west coast offshore region with specific reference to the concession area. The human utilisation, such as fishing, marine diamond mining / prospecting and petroleum exploration, of the area is also described.

5. ENVIRONMENTAL IMPACT ASSESSMENT

Table 1 provides a summary of the significance ratings assigned to each potential impact of the proposed prospecting activities.

Table 1: Summary of the significance of the potential impacts associated with the proposed prospecting activities and No-Go Alternative.

Potential impact		Significance	
		Without mitigation	With mitigation
Vessel operations:			
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		VL	**VL**
Impact on marine fauna:			
Noise associated with geophysical surveys and sampling		VL	**VL**
Sediment removal		L	**L**
Physical crushing of benthic biota		VL	**VL**
Generation of suspended sediment plumes		VL	**VL**
Smothering of benthos in redepositing tailings		VL - L	**VL**
Impact on other users of the sea:			
Fishing industry	Exclusion of the demersal long-line, traditional line-fish, tuna pole and fisheries research	VL	**VL**
	Sediment plume impact on fish stock recruitment	Insig	**INSIG**
Marine mining and prospecting		Insig	**INSIG**
Petroleum exploration		VL-L	**VL**
Marine transport routes		Insig	**INSIG**
Impact on cultural heritage material:			
Impact on historical shipwrecks		H	**INSIG**
No-Go Alternative:			
Lost opportunity to establish whether or not a viable offshore diamond resources exists off the West Coast and the lost economic opportunities.		L	**-**

Potential impact					Significance	
					Without mitigation	With mitigation
Cumulative Impact:						
Benthic environment					L	**L**
VH=Very High	H=High	M=Medium	L=Low	VL=Very low	Insig = insignificant	N/A= Not applicable

6. CONCLUSIONS

The majority of the impacts associated with the vessel operations would be of short-term duration and limited to the immediate sampling areas. As a result, the majority of the impacts associated with the sampling vessels are considered to be of **INSIGNIFICANT** to **LOW** significance after mitigation.

Potential impacts on marine fauna as a result of the proposed marine sediment sampling activities would be of medium- to short-term duration and limited to the immediate sampling areas. As a result, the impacts on marine fauna associated with the sampling activities are considered to be of **VERY LOW** to **LOW** significance after mitigation.

The likelihood of disturbing a shipwreck is expected to be very low considering the vast size of the South African offshore area. In the event that any cultural heritage material is disturbed during sampling activities, the impact would be at the national level, and of high intensity. Without mitigation this is of **High** significance. However, with the implementation of mitigation, cultural heritage sites can largely be avoided and if sampling is terminated in the unlikely event of encountering a shipwreck, the impact is regarded as **INSIGNIFICANT**.

The implications of not going ahead with the proposed marine sediment sampling activities relate to the lost opportunity to establish whether or not a viable offshore diamond resource exists off the West Coast and the lost economic opportunities. This potential impact of the No-Go Alternative is considered to be of **LOW** significance. The positive implications on the no-go option are that there would be no effects on the biophysical environment in the area proposed for the prospecting activities.

7. RECOMMENDATIONS

7.1 Compliance with Environmental Management Programme and MARPOL 73/78 standards

- All phases of the proposed project must comply with the Environmental Management Programme presented in Chapter 7.
- Vessels used during prospecting must ensure compliance with MARPOL 73/78 standards.

7.2 Notification and communication with key stakeholders

- Prior to the commencement of the proposed activities, De Beers should consult with the managers of the DAFF research survey programmes to discuss their respective programmes and the possibility of altering the prospecting programme in order to minimise or avoid disruptions to both parties, where required.
- Notify Cairn, PetroSA, Sungu Sungu, Sunbird, Africa Energy Corp and Simbo and their contractors, as well as any other neighbouring petroleum exploration rights holders, as well as any companies undertaking marine prospecting or mining activities in the study area, prior to the commencement of activities.
- Liaise with all petroleum exploration operators and any overlapping mineral prospecting rights holders to ensure that there is no overlapping of activities in the same area over the same time period.
- Prior to the commencement of the proposed survey and/or sampling activities the following key stakeholders should be consulted and informed of the proposed activities (including navigational co-ordinates of the sampling areas, timing and duration of proposed activities) and the likely implications thereof:
  - Fishing industry / associations (these include South African Tuna Association, South African Tuna Longline Association, Fresh Tuna Exporters Association, South African Commercial Linefish Association, Hake Longline Association, National SMME Fishing Forum); and
  - Other: Department of Agriculture, Forestry and Fisheries (DAFF), South African Maritime Safety Authority (SAMSA), South African Navy (SAN) Hydrographic office, overlapping and neighbouring exploration right holders and applicants, and Transnet National Ports Authority (ports of Cape Town and Saldanha Bay).
- The required safety zones around the sampling vessels should be communicated via the issuing of Daily Navigational Warnings for the duration of the sampling operations through the South African Naval Hydrographic Office.
- The SAN Hydrographic office should be notified when the programme is complete so that the Navigational Warning can be cancelled.

7.3 Discharges

- All process areas should be bunded to ensure drainage water flows into the closed drainage system.
- Undertake training and awareness of crew in spill management to minimise contamination.
- Low-toxicity biodegradable detergents and reusable absorbent cloths should be used in cleaning of all deck spillage.
- All hydraulic systems should be adequately maintained.
- Minimise the discharge of galley waste material should obvious attraction of marine fauna be observed.

7.4 Vessel seaworthiness and safety

- Vessels used during prospecting must be certified for seaworthiness through an appropriate internationally recognised marine certification programme (e.g. Lloyds Register, Det Norske Veritas).

- Collision prevention equipment should include radar, multi-frequency radio, foghorns, etc. Safety equipment and training of personnel to ensure the safety and survival of the crew in the event of an accident is a further legal requirement.
- A Notice to Mariners should provide the co-ordinates of the sampling areas.

7.5 Recommendations specific to the geophysical surveys

- A designated onboard Marine Mammal Observer (MMO) to ensure compliance with mitigation measures during geophysical surveying.
- The MMO should conduct visual scans for the presence of cetaceans around the survey vessel prior to the initiation of any acoustic impulses.
- Pre-survey scans should be of least a 15-minute duration prior to the start of survey equipment.
- Where equipment permits, “soft starts” should be carried out for equipment with source levels greater than 210 dB re 1 µPa at 1 m over a period of 20 minutes to give adequate time for marine mammals to leave the vicinity. 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.
- Terminate the survey if any marine mammals show affected behaviour within 500 m of the survey vessel or equipment until the mammal has vacated the area.
- Avoid planning geophysical surveys during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (beginning of June to end of November), and ensure that migration paths are not blocked by survey operations.
- For the months of June and November ensure that Passive Acoustic Monitoring (PAM) is incorporated into any survey programme.

7.6 Sampling activities

- Exploration sampling targets gravel bodies and would thus avoid known sensitive habitats and high-profile, predominantly rocky-outcrop areas without a sediment veneer. Prior to bulk sampling, a visual sampling programme must be undertaken in rocky-outcrop areas to identify sensitive communities.
- Existing geophysical data should be used to conduct a pre-sampling geohazard analysis of the seabed, and near-surface substratum to map potentially vulnerable habitats and prevent potential conflict with the sampling targets.
- Where possible, dynamically positioned sampling vessels should be used in preference to vessels requiring anchorage.

7.7 Cultural heritage material

- Areas where shipwreck sites are identified during the geophysical surveys must be excluded prior to undertaking sampling activities.
- The onboard De Beers representative must undergo a short induction on archaeological site and artefact recognition, as well as the procedure to follow should archaeological material be encountered during sampling.

- The contractor must be notified that archaeological sites could be exposed during sampling activities, as well as the procedure to follow should archaeological material be encountered during sampling.
- If shipwreck material is encountered during the course of sampling in any of the concession areas, the following mitigation measure should be applied:
    - Cease work in the directly affected area to avoid damage to the wreck until the South African Heritage Resources Agency (SAHRA) has been notified and the contractor/De Beers has complied with any additional mitigation as specified by SAHRA; and
    - Where possible, take photographs of artefacts found, noting the date, time, location and types. Under no circumstances may any artefacts be removed, destroyed or interfered on the site, unless under permit from SAHRA.

8. ENVIRONMENTAL MANAGEMENT PROGRAMME

The EMPr has been compiled for the proposed prospecting activities, which consolidates management activities required to address the issues and mitigation measures identified in this BAR.

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ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
CITES	Convention on International Trade in Endangered Species
DAFF	Department of Agriculture, Forestry and Fisheries
DMR	Department of Mineral Resources
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ha	Hectares
I&AP	Interested and Affected Party
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)
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)
nm	Nautical mile
ROV	Remote Operated Vehicle
SAHRA	South African Heritage Resources Agency
SAMSA	South African Maritime Safety Authority
SAN	South African Navy
SANBI	South African National Biodiversity Institute
TAC	Total Allowable Catch
TAE	Total Applied Effort
VME	Vulnerable Marine Ecosystem

1. INTRODUCTION

This section provides background to the proposed project, describes the purpose of this report, presents the assumptions and limitations of the study and describes the structure of the report. It also records the process followed for inviting Interested and Affected Parties (I&APs) to submit comment on the draft Basic Assessment Report (BAR).

It should be noted that all significant changes made to the draft BAR in this report are underlined and in a different font (Times New Roman) to the rest of the text.

1.1 BACKGROUND TO THE PROPOSED PROJECT

On 14 June 2018, De Beers Consolidated Mines (Pty) Ltd (De Beers) lodged an application for a Prospecting Right with the Department of Mineral Resources (DMR) to undertake offshore diamond prospecting activities in Sea Concession 6C off the West Coast of South Africa. The application was lodged in terms of Section 16 of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) (MPRDA), as amended. In response to the application, DMR request (letter dated 18 June 2018) that a Basic Assessment Report (BAR) be submitted for the proposed geophysical activities and sampling activities.

Sea Concession 6C is situated approximately 400 km north of Cape Town, with the inshore boundary located 5 km seaward of the coast between Hondeklip Bay in the south and Kleinzee in the north and the offshore boundary located between approximately 70 to 100 km offshore (see Figure 1-1). Sea Concession 6C has a total extent of 345 746 hectares (ha).

The proposed prospecting activities require authorisation in terms of the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), as amended, and a Prospecting Right has to be obtained in terms of the MPRDA. These two regulatory processes are summarised below and presented in more detail in Section 2.

In terms of the MPRDA, a Prospecting Right must be issued prior to the commencement of any prospecting activities. A requirement for obtaining a Prospecting Right is that an applicant must comply with Chapter 5 of NEMA with regards to consultation and reporting.

In terms of the Environmental Impact Assessment (EIA) Regulations 2014 (as amended), promulgated in terms of Chapter 5 of NEMA, an application for a prospecting Right requires Environmental Authorisation from the competent authority, the Minister of Mineral Resources (or delegated authority), to carry out the proposed prospecting activities. In order for DMR to consider an application for Environmental Authorisation for prospecting, a Basic Assessment process must be undertaken.

De Beers has appointed SLR Consulting (South Africa) (Pty) Ltd (SLR) as the independent Environmental Assessment Practitioner to undertake a Basic Assessment process for the proposed prospecting activities in accordance with the requirements of NEMA and the EIA Regulations 2014, as amended.

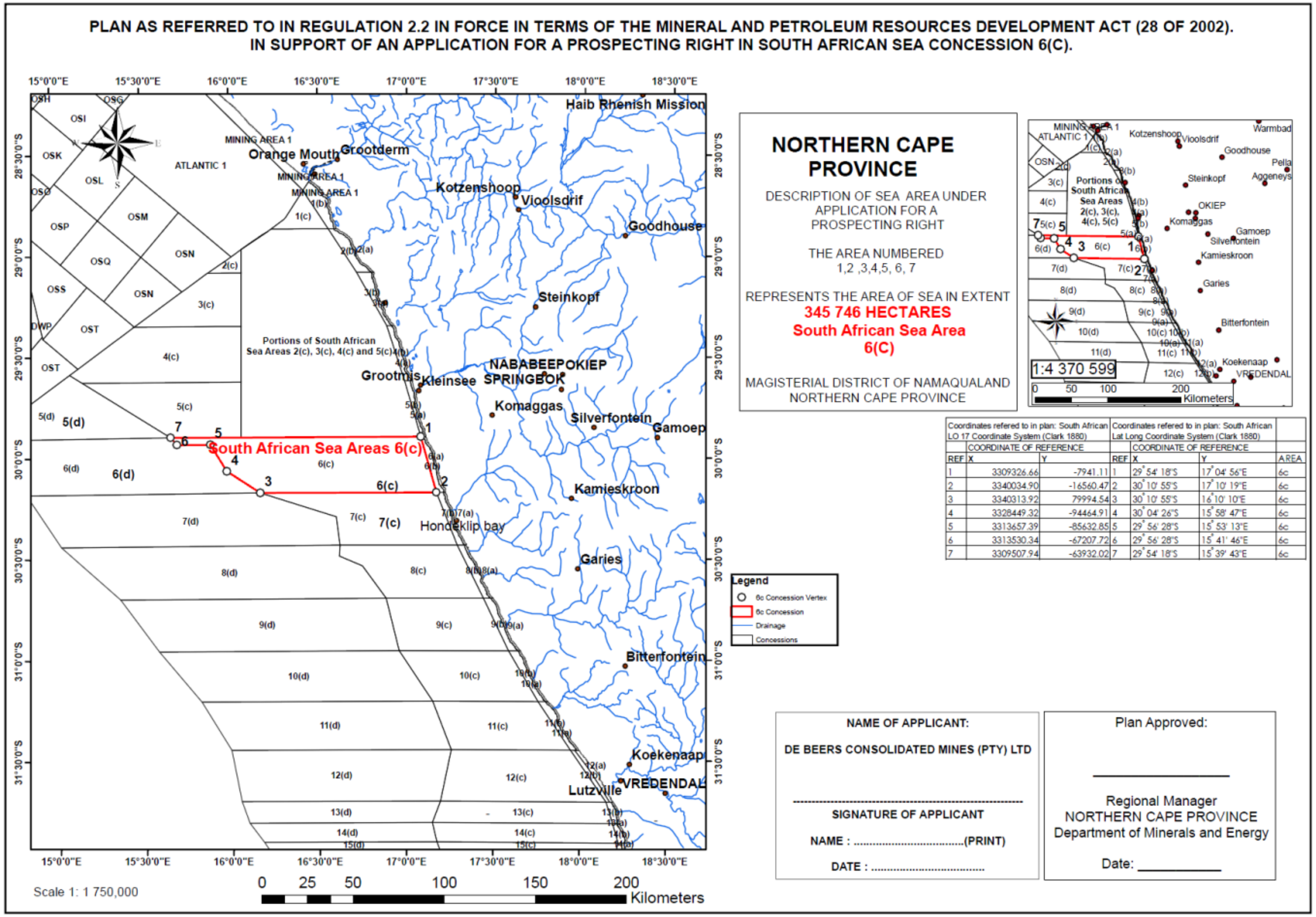

FIGURE 1-1: LOCATION OF THE 6C PROSPECTING RIGHT AREA, OFF THE WEST COAST OF SOUTH AFRICA (TAKEN FROM DRAFT APPLICATION).

1.2 PURPOSE OF THIS REPORT

This revised BAR has been compiled as part of the Basic Assessment process undertaken for the application by De Beers to obtain prospecting activities in Sea Concession 6C. It summarises the process followed to date and provides a description of the proposed project and affected environment. It also provides an assessment of the impacts of the proposed project. It should be noted that the DMR standard BAR template has also been completed and is presented in Appendix A.

1.3 ASSUMPTIONS AND LIMITATIONS

The study assumptions and limitations are listed below:

- The study assumes that SLR has been provided with all relevant project description information by De Beers and that it was correct and valid at the time it was provided;
- 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, recommendations with respect to mitigation and management, etc.;
- Certain details regarding the proposed sampling activities were not available at the time of report writing (e.g. the actual specific locations of the sample sites); and
- The study assumes that all mitigatory measures incorporated into the project description would be implemented as proposed.

1.4 STRUCTURE OF THIS REPORT

This report consists of eight sections and six appendices, the contents of which are outlined below.

Section	Contents
Executive Summary	Provides an overview of the main findings of the BAR.
Chapter 1	**Introduction** Provides background to the proposed project, describes the purpose of this report, presents the assumptions and limitations of the study, and describes the structure of the report. It also invites Interested & Affected Parties (I&APs) to submit comments on the draft BAR.
Chapter 2	**Basic Assessment approach and methodology** Covers the legislative requirements of the Basic Assessment process, presents the process undertaken and presents the way forward in the Basic Assessment process.
Chapter 3	**Project description** Provides a description of the proposed prospecting activities.
Chapter 4	**Description of the affected environment** Describes the existing biophysical and social environment that could be affected by the proposed project.
Chapter 5	**Impact description and assessment** Describes and assesses the potential impacts of the proposed project on the affected environment. It also presents mitigation or optimisation measures that could be used to reduce the significance of any negative impacts or enhance any benefits, respectively.

Section	Contents
Chapter 6	**Conclusion and recommendations** Provides conclusions to the BAR and summarises the recommendations for the proposed project.
Chapter 7	**Environmental Management Programme** Provides an Environmental Management Programme for the proposed project.
Chapter 8	**References** Provides a list of the references used in compiling this report.
Appendices	Appendix A: DMR BAR template Appendix B: DMR correspondence Appendix C: Marine Faunal Assessment Appendix D: Fisheries Impact Assessment Appendix E: Underwater Heritage Impact Assessment Appendix F: Convention for assigning significance ratings to impacts Appendix G: Public Participation Appendix G1: I&AP database Appendix G2: I&AP Notification Appendix G3: Advertisement Appendix G4: Comments and Responses Report

1.5 OPPORTUNITY TO COMMENT ON THE DRAFT BAR

The draft BAR was made available for a 30-day review and comment period from 10 August to 10 September 2018 in order to provide Interested and Affected Parties (I&APs) and authorities the opportunity to comment on the proposed project and the draft BAR. Copies of the full report were made available on the SLR website (www.slrconsulting.com) and at the offices of SLR. One written submission was received during the draft BAR review and comment period. The compilation of this report has been informed by comments received from I&APs during the above-mentioned review and comment period.

This revised BAR has been submitted to DMR for consideration and decision-making. A copy of the revised BAR has been placed on the SLR website for information purposes. After DMR has reached a decision, all I&APs on the project database will be notified of the decision. A statutory appeal period in terms of the National Appeal Regulations (GN No. R993) will follow the issuing of the decision.

2. APPROACH AND METHODOLOGY

This section outlines the key legislative requirements for the proposed study and outlines the methodology and I&AP consultation process followed in the study.

2.1 LEGISLATIVE REQUIREMENTS

2.1.1 Mineral and Petroleum Resources Development Act, 2002

In terms of the MPRDA, a Prospecting Right must be obtained prior to the commencement of any prospecting activities. A requirement for obtaining a Prospecting Right is that an applicant must submit an application in terms to Section 16(1) of the MPRDA to the Regional Manager, and they must accept the application within 14 days if, *inter alia*, no other person holds a Prospecting Right, Mining Right, Mining Permit or Retention Permit for the same mineral and land. If the application for a Prospecting Right is accepted, the Regional Manager must request that the applicant comply with Chapter 5 of NEMA with regards to consultation and reporting (see Section 2.1.2 below).

As mentioned previously, in June 2018, De Beers lodged an application for a Prospecting Right in terms of the MPRDA and an Application for Environmental Authorisation in terms of NEMA with DMR. In response to the application, DMR request (letter dated 18 June 2018) that a Basic Assessment Report (BAR) be submitted for the proposed geophysical activities and sampling activities. Bulk sampling activities will require the completion of a Scoping and EIA process, which will be completed before bulk sampling is undertaken.

2.1.2 National Environmental Management Act, 1998

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

Chapter 5 of NEMA outlines the general objectives and implementation of Integrated Environmental Management (IEM), which provides a framework for the integration of environmental issues into the planning, design, decision-making and implementation of plans and development proposals. Section 24 provides a framework for granting of Environmental Authorisations. In order to give effect to the general objectives of IEM, the potential impacts on the environment of listed activities must be considered, investigated, assessed and reported on to the competent authority. Section 24(4) provides the minimum requirements for procedures for the investigation, assessment and communication of the potential impact of activities.

2.1.3 EIA Regulations 2014 (as amended)

The EIA Regulations 2014 (as amended) promulgated in terms of Chapter 5 of NEMA, and published in Government Notice (GN) No. R982 (as amended by GN No. 326 of 7 April 2017) controls certain listed activities. These activities are listed in GN No. R983 (Listing Notice 1; as amended by GN No. 327 of 7 April 2017), R 984 (Listing Notice 2; as amended by GN No. 325 of 7 April 2017) and R985 (Listing Notice 3; as amended by GN No. 324 of 7 April 2017), and are prohibited until Environmental Authorisation has been obtained from the competent authority. Such Environmental Authorisation, which may be granted subject to conditions, will only be considered once there has been compliance with GN No. R982 (as amended).

GN No. R 983 (as amended) sets out the procedures and documentation that need to be complied with when applying for Environmental Authorisation. A Basic Assessment process must be applied to an application if the authorisation applied for is in respect of an activity or activities listed in Listing Notices 1 and/or 3 and an EIA process must be applied to an application if the authorisation applied for is in respect of an activity or activities listed in Listing Notice 2.

The proposed project triggers Activities 19A, 20 and 22 contained in Listing Notice 1 (see Table 2.1), thus a Basic Assessment process must be undertaken in order for DMR to consider the application in terms of NEMA and make a decision as to whether to grant environmental authorisation or not.

TABLE 2-1: LIST OF APPLICABLE ACTIVITIES IN TERMS OF LISTING NOTICE 1.

Activity No.	Activity Description	Description of activity in relation to the proposed project
19A	*"The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from:* *(iii) the sea. …"*	The proposed sampling activities would result in various forms of disturbance to the seafloor and would result in more than 5 m^3 of sediment being disturbed and moved.
20	*"Any activity including the operation of that activity which requires a prospecting right in terms of section 16 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including* *(a) associated infrastructure, structures and earthworks, directly related to prospecting of a mineral resource; or* *(b) the primary processing of a mineral resource including winning, extraction, classifying, concentrating, crushing, screening or washing;* *but excluding the secondary processing of a mineral resource, including the smelting, beneficiation, reduction, refining, calcining or gasification of the mineral resource in which case activity 6 in Listing Notice 2 applies."*	The proposed project entails the removal and primary processing of seabed sediments to determine the presence of marine diamonds, thus the proposed sampling activities would trigger this listed activity.

Activity No.	Activity Description	Description of activity in relation to the proposed project
22	*"The decommissioning of any activity requiring -* *(i) a closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002); or* *(ii) a prospecting right … where the throughput of the activity has reduced by 90% or more over a period of 5 years excluding where the competent authority has in writing agreed that such reduction in throughput does not constitute closure."*	On completion of the proposed prospecting operation, De Beers would be required to apply to the DMR for a closure certificate. The process of applying for a Closure Certificate would trigger this listed activity.

2.2 LEGISLATION CONSIDERED IN THE PREPARATION OF THE BASIC ASSESSMENT REPORT

In accordance with the EIA Regulations 2014 (as amended), all legislation and guidelines that have been considered in the EIA process must be documented. Table 2-2 below provides a summary of the applicable legislative context and policy.

TABLE 2-2: LEGAL FRAMEWORK

Applicable legislation and guidelines	Relevance or reference
Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002)	Refer to Section 2.1.1.
National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA)	Refer to Section 2.1.2.
EIA Regulations 2014, as amended (GN No. R982), Listing Notice 1 (GN No. R983), Listing Notice 2 (GN No. R984) and Listing Notice 3 (GN No. R985)	Refer to Section 2.1.2 and Table 2-1. The proposed project triggers activities listed in Listing Notice 1 and, therefore, requires a Basic Assessment process to inform the application for Environmental Authorisation. This Basic Assessment Report has been compiled in accordance with Appendix 2 of the EIA Regulations 2014 (as amended).

2.3 GUIDELINES

The guidelines listed below have been or will be taken into account during the Basic Assessment process.

Applicable legislation and guidelines	Governing Body	Relevance or reference
Integrated Environmental Management Guideline Series Guideline 7: Public participation in the EIA process (2012)	DEA	The purpose of these guidelines is to ensure that an adequate public participation process was undertaken during the Basic Assessment Process.
Guideline for consultation with communities and Interested and Affected Parties (2014)	DMR	

Applicable legislation and guidelines	Governing Body	Relevance or reference
Guideline on need and desirability in terms of the EIA Regulations (2014)	DEA	This guideline informed the consideration of the need and desirability aspects of the proposed project.
Specialist Studies, Integrated Environmental Management, Information Series 4 (2002)	DEA	This guideline was consulted to ensure adequate development of terms of reference for specialist studies.
Impact significance, Integrated Environmental Management, Information Series 5 (2002)	DEA	This guideline was consulted to inform the assessment of significance of impacts of the proposed project.
Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7 (2004)	DEA	This guideline will be consulted to inform the consideration of potential cumulative effects of the proposed project.
Criteria for determining Alternatives in EIA, Integrated Environmental Management, Information Series 11 (2004)	DEA	This guideline was consulted to inform the consideration of alternatives.
Environmental Management Plans, Integrated Environmental Management, Information Series 12 (2004)	DEA	This guideline will be consulted to ensure that the Environmental Management Programme (EMP) has been adequately compiled.
Environmental Impact Reporting, Integrated Environmental Management, Information Series 15 (2004)	DEA	This guideline was consulted to inform the approach to impact reporting.

3. PROPOSED PROJECT DESCRIPTION

This section provides general information, the need and desirability for the proposed project, description of alternatives, and provides information on the proposed geophysical surveys and marine sediment sampling activities.

3.1 GENERAL INFORMATION

3.1.1 Prospecting Right Applicant

Address:

De Beers Consolidated Mines (Pty) Ltd
36 Stockdale Street
Kimberly
8301

Responsible Persons:	**Andrew Phillip Barton**	**Anette Basson**
Telephone:	+27 (0) 53 839 4243	+27 (0) 53 839 4243
Facsimile:	+27 (0) 53 839 4880	+27 (0) 53 839 4880

3.1.2 Details of the Sea Concession Area

The proposed prospecting activities would be undertaken within the Sea Concession 6C, located off the West Coast of South Africa (see Figure 1-1). The co-ordinates of the boundary points of Sea Concession 6C are provided in Table 3-1 below.

TABLE 3-1: CO-ORDINATES OF THE BOUNDARY POINTS OF SEA CONCESSION 6C.

Point	Latitude	Longitude	Total Area (km^2)
1	29° 54’ 18’’ S	17° 04’ 56’’ E	3 457.46 km^2
2	30° 10’ 55’’ S	17° 10’ 19’’ E	
3	30° 10’ 55’’ S	16° 10’ 10’’ E	
4	30° 04’ 26’’ S	15° 58’ 47’’ E	
5	29° 56’ 28’’ S	15° 53’ 13’’ E	
6	29° 56’ 28’’ S	15° 41’ 46’’ E	
7	29° 54’ 18’’ S	15° 39’ 43’’ E	

3.1.3 Proposed Work Programme

The target mineral for the prospecting activities is marine diamonds. The planned timeframe to complete the proposed prospecting work is provided in Table 3.2.

TABLE 3-2: PROPOSED WORK PROGRAMME.

Activity	Timeframe
Phase I - Regional scale geophysical surveys	Year 1-2
Phase II - High Resolution Geophysical Surveys and Exploration Sampling	Year 3-5

Due to the dynamic nature of prospecting and evaluation the work programme may have to be modified, extended or curtailed as data and analyses become available.

3.2 NEED AND DESIRABILITY OF THE PROPOSED PROJECT

3.2.1 Background

In order for mining to continue to be a core contributor to the South African economy and in the pursuance of the sustainable development of the nation's mineral resources it is necessary to identify new resources through prospecting. A key intent of the Minerals and Mining Policy of South Africa states that Government will: "promote exploration and investment leading to increased mining output and employment" (Minerals and Mining Policy of South Africa, 1998). The Policy states further that:

- "The South African mining industry, one of the country's few world-class industries, has the capacity to continue to generate wealth and employment opportunities on a large scale;
- Mining is an international business and South Africa has to compete against developed and developing countries to attract both foreign and local investment. Many mining projects in South Africa have tended to be unusually large and long term, requiring massive capital and entailing a high degree of risk; and
- South Africa has an exceptional minerals endowment, and in several major commodities has the potential to supply far more than the world markets can consume."

In the more recently published Department of Minerals Resources Strategic Plan 2014 – 2019, the foreword by the Minister of Mineral Resources notes that the Department "*will continue to promote mineral value addition to strengthen the interface between extractive industries and national socio-economic developmental objectives*" and "*contribute towards decent employment, inclusive growth and industrialisation of South Africa*".

The Northern Cape Provincial Spatial Development Framework 2012 (PSDF) also notes that "*the greatest value from marine and coastal resources is generated through the mining and fishing sectors"* and that the *"Northern Cape has an abundance of diamond deposits both onshore and in marine deposits. This has led to the development of a large diamond mining sector, which has become the dominant activity of the coastal zone"*.

In terms of the above, it is evident that mining-related activities are deemed to be a key component of the current national and provincial economies and future mining projects are a means to assist Government in meeting broader societal needs.

3.2.2 Rationale for the Proposed Project

The proposed project aims to establish whether economically viable diamond deposits occur on the continental shelf off the West Coast of South Africa. The principal objectives are to use the best available technology to (i) locate possible deposits of mineralised diamonds and (ii) evaluate the potential diamond resource in these areas in order to obtain an estimate of the extent and size of the resource present. The information gathered during prospecting will be used to inform a future mining feasibility study for the sea concession so as to assess the size and extent of the mineable resource and its economic viability.

3.3 CONSIDERATION OF ALTERNATIVES

This section presents the various alternatives considered in this Basic Assessment.

3.3.1 Marine Sediment Sampling Alternatives

Alternatives specifically related to the proposed Marine Prospecting Activities are discussed further in Section 3.4 and assessed in Section 5. These include:

- Choice of survey tools;
- Choice of sampling platform;
- Sampling techniques; and
- Number of sample sites.

3.3.2 The No-Go Alternative

The No-Go alternative is the non-occurrence of the proposed project. The negative implications of not going ahead with the proposed project are as follows:

- Loss of opportunity to establish whether further viable offshore diamond resources exist;
- Prevention of any socio-economic benefits associated with the continuation of prospecting activities; and
- Lost economic opportunities.

The positive implications of the no-go option are that there would be no effects on the biophysical environment in the area proposed for the prospecting activities.

3.4 MARINE PROSPECTING OVERVIEW

The prospecting activities would be conducted in a phased approach, with each phase dependant on the results of the previous phase. The two phases planned are as follows and it is proposed that they would run over a five year period:

- Phase I (Year 1-2) - Regional scale geophysical surveys; and
- Phase II (Year 3-5) - High Resolution geophysical surveys and exploration sampling.

Phases I and II would utilise the exploration sampling methods, detailed below.

3.4.1 Phase I - Regional Geophysical Surveys

The first phase of the proposed prospecting activities would entail conducting regional scale geophysical surveys in order to identify geological features of interest for possible further exploration. The geophysical survey equipment will be deployed from a fit-for-purpose vessel that is suited to the water depth and selected survey method. The line spacing of the surveys for this phase of prospecting is planned such as to enable full regional scale seabed coverage.

The following tools are available for proposed regional geophysical surveys:

- *Swath bathymetry:*
  Swath bathymetry typically utilises backscattered sound energy from sonar signals to produce a digital terrain model of the seafloor and develop textural models.

- *Sub-bottom profiler seismic systems:*
  Sub-bottom profiler seismic systems (e.g. boomer, chirp and sleeve gun) are powerful low frequency echo-sounders that provide profiles of the upper layers of the ocean floor. A typical bottom profiler emits an acoustic pulse at frequencies ranging from 1.5 – 12.5 kHz and typically produces sound levels in the order of 202 dB re 1µPa at 1m.

- *Side scan sonar systems:*
  Side scan sonar systems produce acoustic intensity images of the seafloor and are used to map the different sediment textures of the seafloor. Side-scan uses a sonar device, towed from a surface vessel or mounted on the ship's hull, that emits conical or fan-shaped pulses down toward the seafloor across a wide angle perpendicular to the path of the sensor through the water (see Figure 3-1). The intensity of the acoustic reflections from the seafloor of this fan-shaped beam is recorded in a series of cross-track slices. When stitched together along the direction of motion, these slices form an image of the sea bottom within the swath (coverage width) of the beam. A typical side scan sonar emits a pulse at frequencies ranging from 135 to 850 kHz and typically produces sound levels in the order of 190 – 242 dB re 1µPa at 1m.

- *Magnetometer:*
  A magnetometer measures local variations in the intensity of the Earth's magnetic field, which are caused by differences in composition of the sediment layers beneath the seafloor. A magnetometer is useful in defining magnetic anomalies which represent ore (direct detection), or minerals associated with ore deposits (indirect detection).

- *Multibeam Echo Sounder*
  The use of multi-beam bathymetry survey allows the operator to produce a digital terrain model of the seafloor. 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 200 kHz to 400 kHz and typically produces sound levels in the order of 221 db re 1µPa at 1m.

- *Sleeve Gun system:*
  Sleeve Gun systems generate medium penetration profiles up to 50 m beneath the seafloor in order to provide a cross section view of the sedimentary layers. The emitted pulse would be at frequencies ranging from 100 – 800 kHz and typically would produce sound levels in the order of 220 dB re 1µPa at 1m.

- *Boomer:*
  The boomer is a broad-band sound source operating in the 300 Hz – 3 kHz range. The system electrically charges two spring loaded plates that repel one another to generate an acoustic pulse while being towed behind the vessel. The reflected signal from the acoustic pulse is then received by a towed hydrophone streamer. Depending on the subsurface material types, resolution of the boomer system ranges from 0.5 to 1 m with a penetration depth from 25 to 50 m. Source level sound is expected to be around 215 dB re 1µPa at 1m.

Each and/or all of these techniques may be used during Phase I of the proposed prospecting operation. The likely survey equipment (and its source level noise) to be used for the geophysical surveys is listed in Table 3-3.

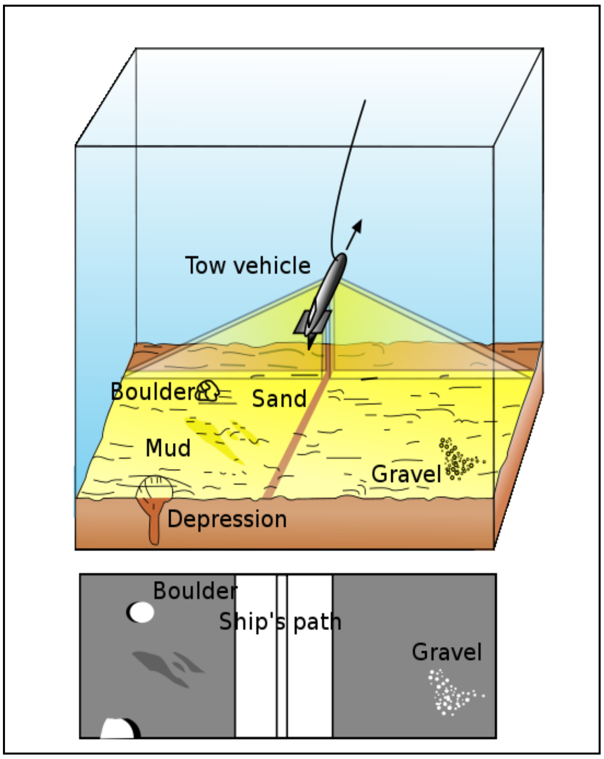

FIGURE 3-1: SCHEMATIC OF A TYPICAL SIDE SCAN SONAR DEVICE AND RESULTING INFORMATION.

TABLE 3-3: ACOUSTIC EQUIPMENT THAT MAY BE UTILISED IN THE PROPOSED GEOPHYSICAL SURVEYS.

Sound Type	Frequency	Cycle (impulses per second)	Source level (dB re 1 µPa at 1m)
Swath bathymetry	200 – 455 kHz	15 – 40	190 – 220
Sub Bottom Profiler – Chirp	1.5 – 12.5 kHz	4	202
Side Scan Sonar	135 khz – 850 khz	10	190 – 242

Sound Type	Frequency	Cycle (impulses per second)	Source level (dB re 1 µPa at 1m)
Magnetometer:	Passive system	1	Not Applicable
Multibeam Echo Sounder	200 khz – 400 khz	40	221
Sleeve gun system	100 – 800 Hz	1	220
Boomer	300 Hz - 3.0kHz	-	215

In general terms, sound sources that have high sound pressure and low frequency will travel the greatest distances in the marine environment. Conversely, sources that have high frequency will tend to have greater attenuation over distance due to interference and scattering effects (Anon 2007). It is for this reason that the acoustic footprint of the above-mentioned sonar survey tools is considered to be much lower than that of deeper penetration low frequency seismic surveys and in addition have lower sound pressure levels. It should be noted that a decibel is a logarithmic scale of pressure where each unit of increase represents a tenfold increase in the quantity being measured.

The low frequency sound source of the airgun arrays associated with seismic surveys tends to produce a larger acoustic footprint in the marine environment due to the high intensity and low frequency of the source. Due to the higher frequency emissions utilised in normal multi-beam and sub-bottom profiling operations, the associated sound pressure tends 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 a deeper penetration low frequency seismic airgun array (Anon 2007).

3.4.2 Phase II – High Resolution Geophysical Surveys and Exploration Sampling

Should geological features of interest be identified on completion for the Phase I surveys, then a decision will be made regarding the feasibility of proceeding to Phase II of the prospecting activities.

3.4.3 Localised geophysical surveys

Follow-up localised geophysical surveys may be undertaken during Phase II in order to refine the definition of the target features identified during Phase I. These surveys would be more detailed and of higher resolution and would utilise similar tools to those listed for Phase I above. In addition, an Autonomous Underwater Vehicle (AUV), an unmanned underwater vehicle, may be used to undertake surveys in areas where more detailed surveys with a line spacing of typically less than 100 m is required (see Figure 3-2).

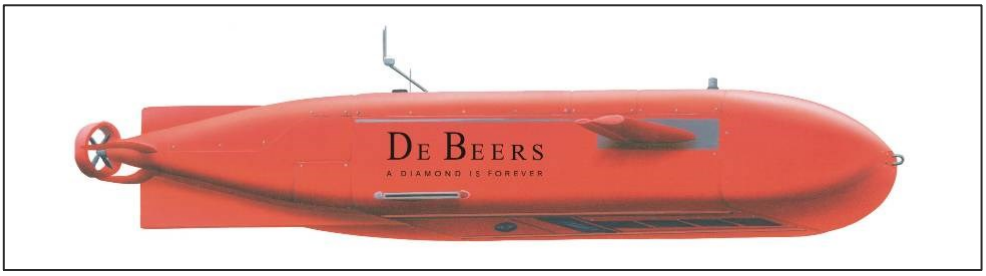

FIGURE 3-2: AN AUTONOMOUS UNDERWATER VEHICLE (AUV).

Exploration sampling would be undertaken using a fit-for-purpose tool and vessel of opportunity (e.g. *M/V The Explorer* and/or *M/V Coral Sea* - see Figure 3-3) in water depths ranging from 70 m to 160 m. The proposed sampling may be divided into stages subject to reviews and follow-up sampling work. A decision on the planned sampling technology appropriate to each target area would be made based on the results of the preceding stage.

Depending on the outcome of previous stage work, samples may be collected in a fixed pattern over an identified target area. Samples may be taken along lines spaced 10 m to 500 m apart, with samples spacing based on the geological nature of the target area. Once a decision is made on the selected sampling tool technology chosen for taking samples from the seabed, the accompanying metallurgical sample processing technology on board the relevant vessel would then also be determined. Possible sampling tool technologies that could be employed are described in more detail below.

FIGURE 3-3 : POSSIBLE VESSELS OF OPPORTUNITY THAT COULD BE UTILISED DURING SAMPLING - *M/V THE EXPLORER* (LEFT) AND *M/V CORAL SEA* (RIGHT).

- <u>*Coring (e.g. vibrocoring)*</u>
  A vibrocorer consists of a core barrel in a landing frame with a vibrating motor on top. The vibrocorer is landed on the seafloor, the motor turned on and the barrel penetrates the unconsolidated sediment. Once the core stops penetrating, the motor is turned off and the vibrocorer is raised back up to the deck. A PVC pipe is placed inside the core barrel prior to coring and the core sample is collected in this pipe. Cores can penetrate up to 6 m and typically have a diameter of approximately 11 cm.

- <u>*Subsea Sampling Tool:*</u>
  Sampling would be undertaken using a subsea sampling tool comprising of a 5 - 10 m^2 footprint operated from a drill frame structure (see Figure 3-4), which is launched through the moon pool of the support vessel and positioned on the seabed. The unconsolidated sediments are fluidised with strong water jets and airlifted to the support vessel where they are treated in the on board mineral recovery plant. All oversized and undersized tailings are discharged back to the sea on site. The depth of sediment sampled typically varies between 0.5 m and 5 m below the seafloor surface. Depending on sea conditions and the seabed geotechnical conditions, up to 60 samples can be successfully taken per day.

- *Vertically Mounted Sampling Tool*
  Sampling would be undertaken using a vertically mounted drill suspended from a derrick mounted mid ships and deployed through a moon poo (see Figure 3-4)l. The drill stem is suspended in a state of constant tension by means of a compensation system that absorbs the motion of the ship, enabling the bit to remain in contact with the seabed. The head of the sampling tool is a circular steel disk with channels which feed loose sediment to a central aperture through which they are airlifted to the surface and fed to the processing plant. Samples consist of individual holes drilled at a site. The evaluation drill bit removes a sample of 10 m^2 and is referred to as a decadrill. As with the Subsea Sampling Tool (discussed above), all oversized and undersized tailings are discharged back to the sea on site. The depth of sediment sampled typically varies between between 0.5 and 5 m below the seafloor surface, and up to 60 samples can be successfully taken per day.

For the purposes of this assessment it is assumed that up to 9 000 samples would be obtained within the potential deposit area(s). The sample spacings would typically be between 50 and 200 m apart. The total area of disturbance would be approximately 0.09 km^2.

FIGURE 3-4: ILLUSTRATIVE EXAMPLE OF A DRILL BIT OPERATED FROM A DRILL FRAME STRUCTURE LOCATED ON BOARD A VESSEL OF OPPORTUNITY.

3.5 VESSEL EMISSIONS AND DISCHARGES

This section provides a brief description of the types of emissions and discharges that are expected from the activities relating to the sampling activities. These would include:

- Discharges such as deck drainage, machinery space wastewater, sewage, etc.; and
- Disposal of solid waste such as food waste.

These are discussed in more detail below.

3.5.1 Discharges to sea

3.5.1.1 Vessel machinery spaces (bilges), ballast water and deck drainage

The concentration of oil in discharge water from any vessel (bilge and ballast) would comply with the MARPOL Regulation 21 standard of less than 15 ppm oil in water. Any oily water would be processed through a suitable separation and treatment system to meet the MARPOL Annex I standard before discharge overboard. Drainage from marine (weather) deck spaces would wash directly overboard.

3.5.1.2 Sewage

South Africa is a signatory to MARPOL Annex IV Regulations for the Prevention of Pollution by Sewage from Ships and contracted vessels would be required to comply with the legislated requirements of this Annex.

3.5.1.3 Food (galley) wastes

The disposal into the sea of food waste is permitted in terms of MARPOL Annex V when it has been comminuted or ground and the vessel is located more than 3 nautical miles (approximately 5.5 km) from land. Such comminuted or ground food wastes shall be capable of passing through a screen with openings no greater than 25 mm. Disposal overboard without macerating can occur greater than 12 nautical miles (approximately 22 km) from the coast. Although De Beers vessels macerate food regardless of the distance, this may not be the case for all contracted vessels, although it would encourage this best practice. The daily discharge from a sampling vessel is typically about 0.15 m^3.

3.5.1.4 Detergents

Detergents used for washing exposed marine deck spaces would be discharged overboard. The toxicity of detergents varies greatly depending on their composition. Water-based detergents are low in toxicity and are preferred for use. Preferentially biodegradable detergents would be used. Detergents used on work deck space would be collected with the deck drainage and treated as described under deck drainage (see Section 3.5.1.1 above).

3.5.1.5 Other

Vessel used during prospecting would have a certified antifouling coating system that is tin free.

3.5.2 Land disposal

A number of other types of wastes generated during the sampling activities would not be discharged at sea but would be transported onshore for ultimate disposal. Waste transported to land would be disposed at a licensed municipal landfill facility or at an alternative approved site. Operators would co-operate with local authorities to ensure that waste disposal is carried out in an environmentally acceptable manner.

A summary of these waste types generated by a vessel used during a typical sampling operation, their expected amounts, environmental properties, and destination is given below. Typical volumes are presented in Table 3-4 (note: these quantities should be viewed as rough estimates based on experience).

Garbage generated on board would be sorted and stored in separate bins e.g. plastic, paper, metals, food stuffs and glass.

TABLE 3-4: ESTIMATED VOLUME/MASS OF WASTES PRODUCED DURING SAMPLING ACTIVITIES OF 100 DAYS.

Waste Type	Volume / Mass produced per day	Total Volume / Mass produced during sampling
Rubbish/trash	Rubbish/trash	1 m^3
Scrap metal	Scrap metal	0.2 m^3
Drums/containers	Drums/containers	0-2 units
Used oil	Used oil	0.05 m^3
Chemicals/hazardous water	Chemicals/hazardous waste	0.02 m^3
Infectious waste	Medical waste	Negligible
Filters and filter media	Rubbish/trash	1 m^3

3.5.2.1 Garbage

This includes wastes originating from vessel and sampling operations, including waste paper, plastics, wood, metal, glass, etc. Waste would be disposed of at an onshore landfill site in accordance with legal requirements.

3.5.2.2 Scrap metal

Scrap metal would be stored and recycled / disposed of on land in accordance with legal requirements.

3.5.2.3 Drums and containers

Empty drums containing residues, which may have adverse environmental effects (solvents, lubricating/gear oil, etc.), would be recycled / disposed of in a local landfill site in accordance with legal requirements.

3.5.2.4 Used oil

Examples include used lubricating and gear oil, solvents, hydrocarbon-based detergents and machine oil. Toxicity varies depending on oil type. All non-recycled waste oils would be securely stored, transported to shore and disposed of at a licensed site acceptable to the relevant authorities.

3.5.2.5 Chemicals and hazardous wastes

Disposal of any unexpected chemical and hazardous substance (e.g. fluorescent tubes, toner cartridges, batteries, etc.) would be undertaken on a case-by-case basis and in a manner acceptable to appropriate regulatory authorities.

3.5.2.6 Infectious wastes

Infectious wastes include bandages, dressings, surgical waste, tissues, medical laboratory wastes, needles, and food wastes from persons with infectious diseases. Only minor quantities of medical waste are expected. Prevention of exposure to contaminated materials is essential, requiring co-operation with local medical facilities to ensure proper disposal. All such waste will be stored and brought onshore for disposal via a registered medical waste company.

3.5.2.7 Filters and filter media

This includes air, oil and water filters from machinery. Oily residue and used media in oil filters that may contain metal (e.g. copper) fragments, etc. are possibly toxic. Filters and media would be transported onshore and disposed of at a licensed landfill facility.

3.5.3 Discharges to air

Compliance with the requirements of Marpol Annex VI - Prevention of Air Pollution from Ships will be required for all vessel engines and where vessels are fitted with garbage incinerators.

4. THE AFFECTED ENVIRONMENT

This chapter provides a description of the biophysical and socio-economic environment likely to be affected by the proposed project in the study area. The information provided here is based on previous information compiled for the area, as well as the specialist marine fauna and fisheries studies undertaken as part of this study.

4.1 MARINE ENVIRONMENT

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 prospecting activities.

The study 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 is shown in Figure 4-1.

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).

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.

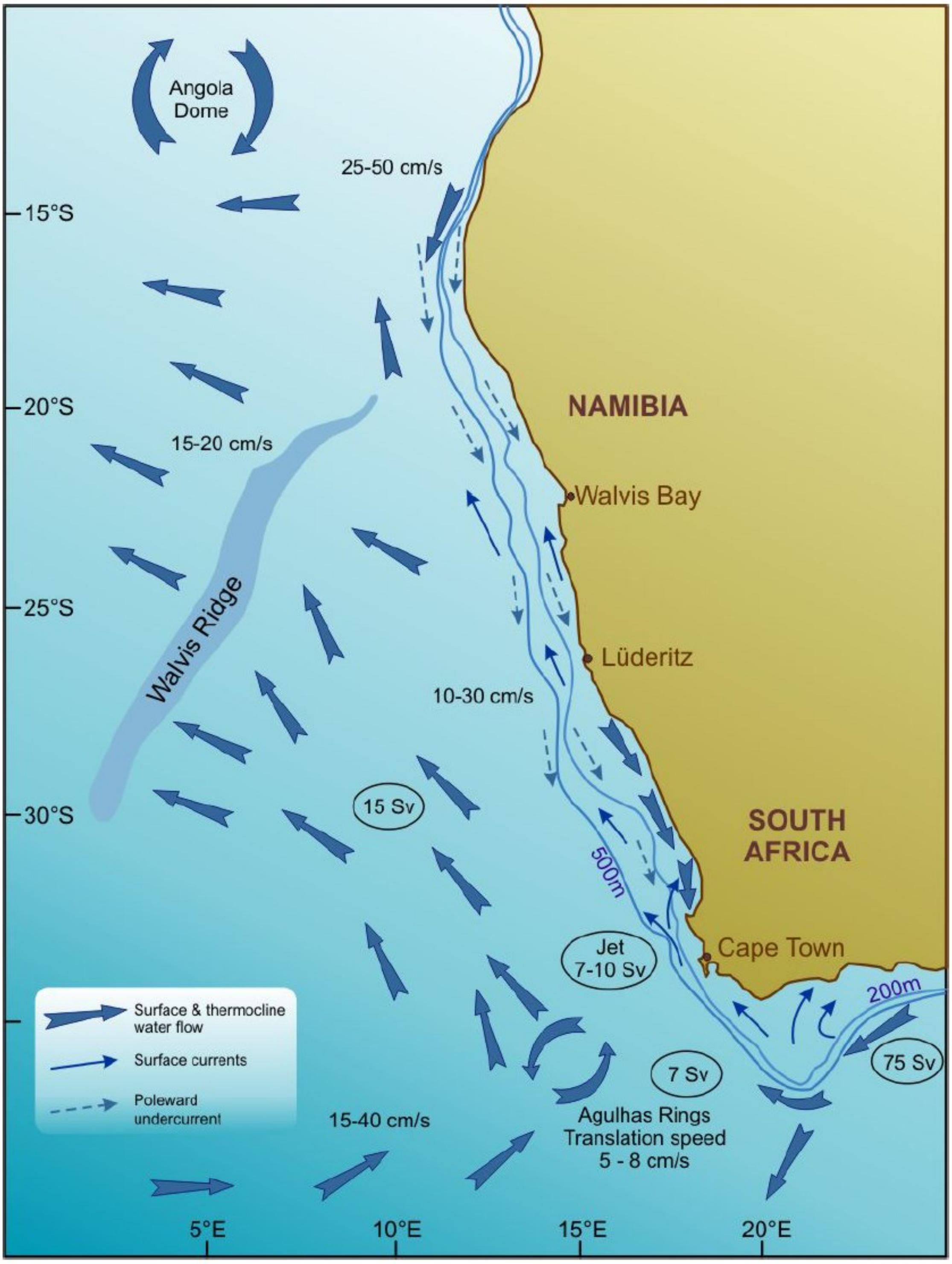

FIGURE 4-1: CIRCULATION AND VOLUME FLOWS OF THE BENGUELA CURRENT (AFTER SHANNON & NELSON, 1996).

4.1.2 Physical Oceanography

4.1.2.1 Waves

Most of the west coast of southern Africa is classified as exposed, experiencing strong wave action, rating between 13-17 on the 20 point exposure scale (McLachlan 1980). Much of the coastline is therefore impacted by heavy south-westerly swells generated in the roaring forties, as well as significant sea waves generated locally by the prevailing southerly winds. The peak wave energy periods fall in the range 9.7 – 15.5 seconds.

The wave regime along the southern African west coast shows only moderate seasonal variation in direction, with virtually all swells throughout the year coming from the south-west - south direction. Winter swells are strongly dominated by those from the south-west – south-south-west 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.

4.1.2.2 Tides

Tides along the West Coast are subject to a simple semi-diurnal tidal regime with a mean tidal range along the Namaqualand coast 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 Topography

The continental shelf along the West Coast is generally wide and deep, although large variations in both depth and width occur. The shelf maintains a general north-north-west trend, widening north of Cape Columbine and reaching its widest off the Orange River (180 km). Between Cape Columbine and the Orange River, there is usually a double shelf break, with the distinct inner and outer slopes, separated by a gently sloping ledge, the middle shelf. The immediate nearshore area consists mainly of a narrow (about 8 km wide) rugged rocky zone, sloping steeply seawards to a depth of around 80 m. The middle and outer shelf typically lacks relief, sloping gently seawards before reaching the shelf break at a depth of approximately 300 m.

Banks on the continental shelf include the Orange River pro-delta, a shallow (160 - 190 m) zone that reaches maximal widths (180 km) offshore of the Orange River, and Child's Bank, situated approximately 150 km offshore at about 31°S. Tripp Seamount is a geological feature located to the west-northwest of the western extent of Sea Concession 6C (Figure 4-2), which rises from approximately 1 000 m to a depth of 150 m.

4.1.2.4 Coastal and Continental Shelf Geology and Seabed Geomorphology

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 surface sediment cover is generally thin, often less than 1 m. Sediments are finer seawards, changing from sand on the inner and middle 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 (Figure 4-3).

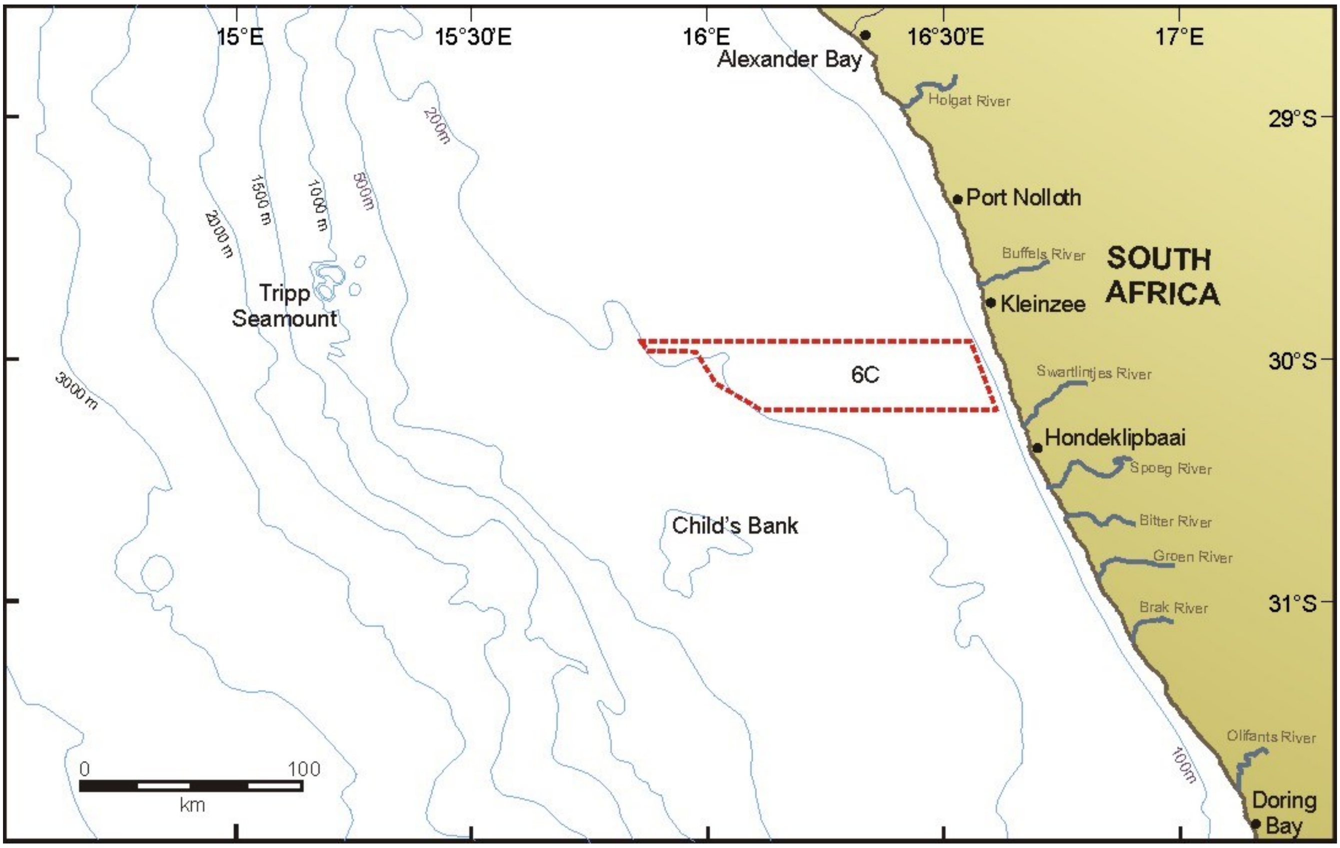

FIGURE 4-2: SEA CONCESSION 6C IN RELATION TO THE REGIONAL BATHYMETRY AND SHOWING PROXIMITY OF PROMINENT SEABED FEATURES.

An approximately 500 km long mud belt (up to 40 km wide, and of 15 m average thickness) is situated at water depths of between -30 m and -100 m over the innershelf slope between the Orange River and St Helena Bay (Birch *et al.* 1976). Further offshore, sediment is dominated by muddy sands, sandy muds, mud and some sand. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze.

Present day sedimentation is limited to input mainly from the Orange River and minor contributions from other rivers like the Buffels and the Olifants Rivers. As the coarser sand and gravel sediment fractions are generally transported northward, most of the sediment containing the diamond mineralisation in the project area is considered to be relict deposits of ephemeral rivers active during wetter climates in the geological past. The Orange River, when in flood, still contributes largely to the mudbelt 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 South African West Coast coastal plain and hinterland.

4.1.2.5 Upwelling and Plankton Production

The cold, upwelled water is rich in inorganic nutrients, the major contributors being various forms of nitrates, phosphates and silicates (Chapman & Shannon 1985). During upwelling the comparatively nutrient-poor surface waters are displaced by enriched deep water, supporting substantial seasonal primary phytoplankton production. This, in turn, serves as the basis for a rich food chain up through zooplankton, pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (hake and snoek), mammals (primarily seals and dolphins) and seabirds (African penguins, cormorants, pelicans, terns and others). High phytoplankton productivity in the upper layers again depletes the nutrients in these surface waters. This results in a wind-related cycle of plankton production, mortality, sinking of plankton detritus and eventual nutrient re-enrichment occurring below the thermocline as the phytoplankton decays.

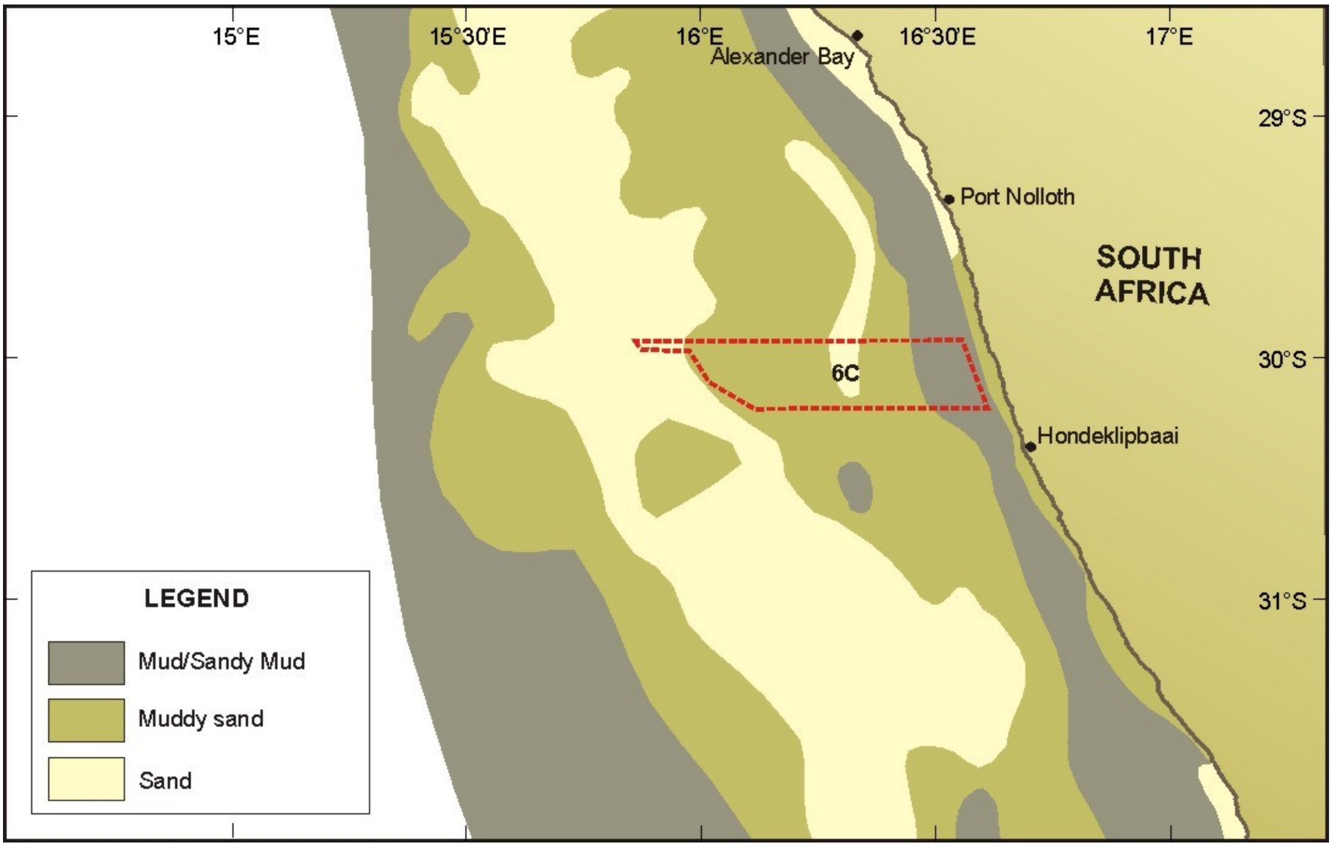

FIGURE 4-3: SEA CONCESSION 6C IN RELATION TO SEDIMENT DISTRIBUTION ON THE CONTINENTAL SHELF (ADAPTED FROM ROGERS 1977).

4.1.2.6 Organic Inputs

The Benguela upwelling region is an area of particularly high natural productivity, with extremely high seasonal production of phytoplankton and zooplankton. These plankton blooms in turn serve as the basis for a rich food chain up through pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (snoek), mammals (primarily seals and dolphins) and seabirds (African penguins, cormorants, pelicans, terns and others). All of these species are subject to natural mortality, and a proportion of the annual production of all these trophic levels, particularly the plankton communities, die naturally and sink to the seabed.

Balanced multispecies ecosystem models have estimated that the Benguela region supported biomasses of 76.9 tons/km^2 of phytoplankton and 31.5 tons/km^2 of zooplankton alone (Shannon *et al.* 2003). Thirty-six percent of the phytoplankton and 5% of the zooplankton are estimated to be lost to the seabed annually. This natural annual input of millions of tons of organic material onto the seabed 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 of this area, and results in the high organic content of the muds in the region. As most of the organic detritus is not directly consumed, it enters the seabed decomposition cycle, resulting in subsequent depletion of oxygen in deeper waters.

An associated phenomenon ubiquitous to the Benguela system are red tides (dinoflagellate and/or ciliate blooms) (see Shannon & Pillar 1985; Pitcher 1998). Also referred to as Harmful Algal Blooms (HABs), these red tides can reach very large proportions, extending over several square kilometres of ocean. Toxic dinoflagellate species can cause extensive mortalities of fish and shellfish through direct poisoning, while degradation of organic-rich material derived from both toxic and non-toxic blooms results in oxygen depletion of subsurface water.

4.1.2.7 Low Oxygen Events

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations with less than 40% saturation occurring frequently (e.g. 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 4-3), there are corresponding preferential areas for the formation of oxygen-poor water. The two main areas of low-oxygen water formation in the southern Benguela region are in the Orange River Bight and St Helena Bay (Chapman & Shannon 1985; Bailey 1991; Shannon & O'Toole 1998; Bailey 1999; Fossing *et al.* 2000).

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. De Decker (1970) showed that the occurrence of low oxygen water off Lambert's Bay is seasonal, with highest development in summer/autumn. Bailey & Chapman (1991), on the other hand, demonstrated that in the St Helena Bay area daily variability exists as a result of downward flux of oxygen through thermoclines and short-term variations in upwelling intensity. Subsequent upwelling processes can move this low-oxygen water up onto the inner shelf, and into nearshore waters, often with devastating effects on marine communities.

Periodic low oxygen events in the nearshore region can have catastrophic effects on the marine communities leading to large-scale stranding of rock lobsters, and mass mortalities of marine biota and fish (Newman & Pollock 1974; 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. The blooms develop over a period of unusually calm wind conditions when sea surface temperatures were high. 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.

4.1.2.8 Turbidity

Turbidity is a measure of the degree to which water loses its transparency due to the presence of suspended particulate matter. Total Suspended Particulate Matter (TSPM) can be divided into Particulate Organic Matter (POM) and Particulate Inorganic Matter (PIM), the ratios between them varying considerably. The POM usually consists of detritus, bacteria, phytoplankton and zooplankton, and serves as a source of food for filter-feeders. Seasonal microphyte production associated with upwelling events will play an important role in determining the concentrations of POM in coastal waters. PIM, on the other hand, is primarily of geological origin consisting of fine sands, silts and clays. Off Namaqualand, the PIM loading in nearshore waters is strongly related to natural inputs from the Orange River or from 'berg' wind events. 'Berg' wind events can potentially contribute the same order of magnitude of sediment input as the annual estimated input of total sediment by the Orange River (Shannon & Anderson 1982; Zoutendyk 1992, 1995; 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. During storm events, concentrations near the seabed may even reach up to 10 000 mg/l (Miller & Sternberg 1988). In the vicinity of the Orange River mouth, where river outflow strongly influences the turbidity of coastal waters, measured concentrations ranged from 14.3 mg/l at Alexander Bay just south of the mouth (Zoutendyk 1995) to peak values of 7 400 mg/l immediately upstream of the river mouth during the 1988 Orange River flood (Bremner *et al.* 1990).

The major source of turbidity in the swell-influenced nearshore areas off the West Coast is the redistribution of fine inner shelf sediments by long-period Southern Ocean swells. The current velocities typical of the Benguela (10-30 cm/s) are capable of re-suspending and transporting considerable quantities of sediment equatorwards. Under relatively calm wind conditions, however, much of the suspended fraction (silt and clay) that remains in suspension for longer periods becomes entrained in the slow poleward undercurrent (Shillington *et al.* 1990; Rogers & Bremner 1991).

Superimposed on the suspended fine fraction, is the northward littoral drift of coarser bedload sediments, parallel to the coastline. This northward, nearshore transport is generated by the predominantly south-westerly swell and wind-induced waves. Longshore sediment transport varies considerably in the shore-perpendicular dimension, being substantially higher in the surf-zone than at depth, due to high turbulence and convective flows associated with breaking waves, which suspend and mobilise sediment (Smith & Mocke 2002).

On the inner and middle continental shelf, the ambient currents are insufficient to transport coarse sediments typical of those depths, and re-suspension and shoreward movement of these by wave-induced currents occur primarily under storm conditions (see also Drake *et al.* 1985; Ward 1985; De Decker 1986). Data from a Waverider buoy at Port Nolloth have indicated that 2 m waves are capable of re-suspending medium sands (200 µm diameter) at approximately 10 m depth, whilst 6 m waves achieve this at approximately 42 m depth. Low-amplitude, long-period waves will, however, penetrate even deeper. Most of the sediment shallower than 90 m can therefore be subject to re-suspension and transport by heavy swells (Lane & Carter 1999).

Mean sediment deposition is naturally higher near the seafloor due to constant re-suspension of coarse and fine PIM by tides and wind-induced waves. Aggregation or flocculation of small particles into larger aggregates occurs as a result of cohesive properties of some fine sediments in saline waters. The combination of re-suspension of seabed sediments by heavy swells, and the faster settling rates of larger inorganic particles, typically causes higher sediment concentrations near the seabed. Significant re-suspension of sediments can also occur up into the water column under stronger wave conditions associated with high tides and storms. Re-suspension can result in dramatic increases in PIM concentrations within a few hours (Sheng *et al.* 1994). Wind speed and direction have also been found to influence the amount of material re-suspended (Ward 1985).

Although natural turbidity of seawater is a global phenomenon, there has been a worldwide increase of water turbidity and sediment load in coastal areas as a consequence of anthropogenic activities. These include dredging associated with the construction of harbours and coastal installations, beach replenishment, accelerated runoff of eroded soils as a result of deforestation or poor agricultural practices, discharges from terrestrial, coastal and marine mining operations (Airoldi 2003), and sediment plumes as a result of bottom trawling fishery activities. Such increase of sediment loads has been recognised as a major threat to marine biodiversity at a global scale (UNEP 1995).

4.1.3 Biological Oceanography

Biogeographically, Sea Concession 6C falls into the cold temperate Namaqua Bioregion, which extends from Sylvia Hill, north of Lüderitz in Namibia to Cape Columbine (Emanuel *et al.* 1992; Lombard *et al.* 2004) (see Figure 4-4). The coastal, wind-induced upwelling characterising the western Cape coastline, is the principle physical process which shapes the marine ecology of the southern Benguela region. The Benguela system is characterised by the presence of cold surface water, high biological productivity, and highly variable physical, chemical and biological conditions. The West Coast is, however, characterized by low marine species richness and low endemicity (Awad *et al.* 2002).

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 majority of the proposed prospecting right area is located beyond the 80 m depth contour. The near- and offshore marine ecosystems comprise a limited range of habitats, namely unconsolidated seabed sediments, deep water reefs 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 or sensitive species, which may be affected by the proposed prospecting activities.

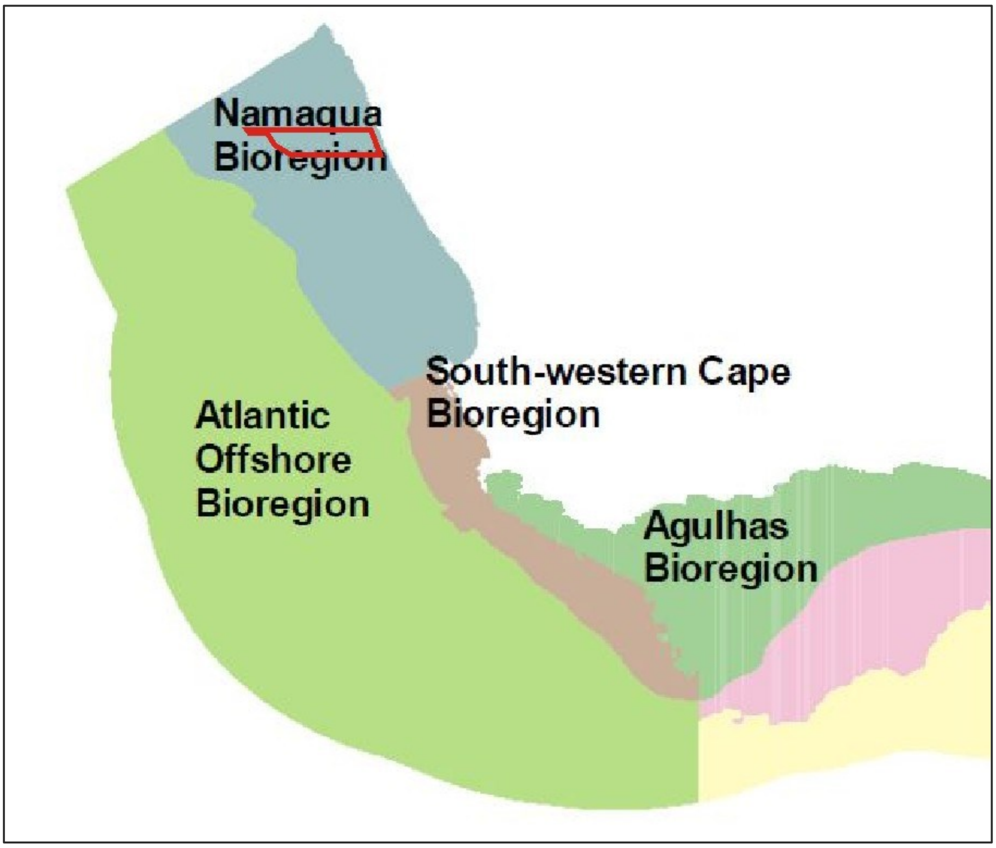

FIGURE 4-4: SEA CONCESSION 6C (RED POLYGON) IN RELATION TO THE SOUTH AFRICAN INSHORE AND OFFSHORE BIOREGIONS (ADAPTED FROM LOMBARD *ET AL.* 2004).

4.1.3.1 Demersal Communities

4.1.3.1.1 Nearshore and Offshore unconsolidated habitats

The benthic biota of unconsolidated marine sediments constitute invertebrates that live on (epifauna) or burrow within (infauna) the sediments, and are generally divided into macrofauna (animals >1 mm) and meiofauna (<1 mm).

Sea Concession 6C includes three macro-infauna communities on the inner- (i.e. 0-30 m depth) and midshelf (i.e. 30-150 m depth, Karenyi unpublished data). The inner-shelf community, which is affected by wave action, is characterised by various mobile predators (e.g. the gastropod *Bullia laevissima* and polychaete *Nereis* sp.), sedentary polychaetes and isopods. The mid-shelf community inhabits the mudbelt and is characterised by the mud prawns *Callianassa* sp. and *Calocaris barnardi.* A second mid-shelf sandy community occurring in sandy sediments, is characterised by various polychaetes including deposit-feeding *Spiophanes soederstromi* and Paraprionospio *pinnata*.

Polychaetes, crustaceans and molluscs make up the largest proportion of individuals, biomass and species on the West Coast. The distribution of species within these communities are inherently patchy reflecting the high natural spatial and temporal variability associated with macro-infauna of unconsolidated sediments (e.g. Kenny *et al.* 1998; Kendall & Widdicombe 1999; van Dalfsen *et al.* 2000; Zajac *et al.* 2000; Parry *et al.* 2003), with evidence of mass mortalities and substantial recruitments recorded on the South African West Coast (Steffani & Pulfrich 2004). Given the state of our current knowledge of South African macro-infauna it is not possible to determine the threat status or endemicity of macro-infauna species on the West Coast, although such research is currently underway (pers. comm. Ms N. Karenyi, SANBI and NMMU). However, the marine component of the 2011 National Biodiversity Assessment (Sink *et al.* 2012), rated portions of the outer continental shelf on the West Coast as 'vulnerable' and 'critically endangered'. Sea Concession 6C does not fall within these areas.

Generally species richness increases from the inner shelf across the mid shelf and is influenced by sediment type (Karenyi unpublished data). The highest total abundance and species diversity was measured in sandy sediments of the mid-shelf. Biomass is highest in the inshore (± 50 g/m2 wet weight) and decreases across the mid-shelf averaging around 30 g/m^2 wet weight. This is contrary to Christie (1974) who found that biomass was greatest in the mudbelt at 80 m depth off Lamberts Bay, south of Sea Concession 6C, where the sediment characteristics and the impact of environmental stressors (such as low oxygen events) are likely to differ from those in the concession area.

Surveys conducted between 180 m and 480 m depth in the vicinity of Sea Concession 6C revealed high proportions of hard ground rather than unconsolidated sediment on the outer shelf, although this requires further verification (Karenyi unpublished data). The benthic fauna of the outer shelf and continental slope (beyond approximately 450 m depth) are very poorly known largely due to limited opportunities for sampling as well as the lack of access to Remote Operated Vehicles (ROVs) for visual sampling of hard substrata. To date very few areas of the continental slope off the West Coast have been biologically surveyed.

Benthic communities are structured by the complex interplay of a large array of environmental factors. Water depth and sediment grain size are considered the two major factors that determine benthic community structure and distribution on the South African west coast (Christie 1974, 1976; Steffani & Pulfrich 2004a, 2004b; 2007; Steffani 2007a; 2007b). However, studies have shown that shear bed stress - a measure of the impact of current velocity on sediment – oxygen concentration (Post *et al.* 2006; Currie *et al.* 2009; Zettler *et al.* 2009), productivity (Escaravage *et al.* 2009), organic carbon and seafloor temperature (Day *et al.* 1971) may also strongly influence the structure of benthic communities. There are clearly other natural processes operating in the deepwater shelf areas of the West Coast that can override the suitability of sediments in determining benthic community structure, and it is likely that periodic intrusion of low oxygen water masses is a major cause of this variability (Monteiro & van der Plas 2006; Pulfrich *et al.* 2006). In areas of frequent oxygen deficiency, benthic communities will be characterised either by species able to survive chronic low oxygen conditions, or colonising and fast-growing species able to rapidly recruit into areas that have suffered oxygen depletion. The combination of local, episodic hydrodynamic conditions and patchy settlement of larvae will tend to generate the observed small-scale variability in benthic community structure.

The invertebrate macrofauna are important in the marine benthic environment as they influence major ecological processes (e.g. remineralisation and flux of organic matter deposited on the sea floor, pollutant metabolism, sediment stability) and serve as important food source for commercially valuable fish species and other higher order consumers. As a result of their comparatively limited mobility and permanence over seasons, these animals provide an indication of historical environmental conditions and provide useful indices with which to measure environmental impacts (Gray 1974; Warwick 1993; Salas *et al.* 2006).

Also associated with soft-bottom substrates are demersal communities that comprise epifauna and bottom-dwelling vertebrate species, many of which are dependent on the invertebrate benthic macrofauna as a food source. According to Lange (2012) a single epifaunal community exists between the depths of 100 m and 250 m characterised by the hermit crabs *Sympagurus dimorphus* and *Parapaguris pilosimanus,* the prawn *Funchalia woodwardi* and the sea urchin *Brisaster capensis*. Atkinson (2009) also reported numerous species of urchins and burrowing anemones beyond 300 m depth off the West Coast.

4.1.3.1.2 Deep-water coral communities

There has been increasing interest in deep-water corals in recent years because of their likely sensitivity to disturbance and their long generation times. These benthic filter-feeders generally occur deeper than 150 m with some species being recorded from as deep as 3 000 m. 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; MacIssac *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). In the productive Benguela region, substantial areas on the shelf should thus potentially be capable of supporting rich, cold water, benthic, filter-feeding communities.

In the vicinity of Sea Concession 6C there are two geological features of note, namely Child's Bank, situated 150 km offshore at 31°S and approximately 60 km due south of the Sea Concession 6C, and Tripp Seamount situated 250 km offshore at approximately 29°40'S and 150 km to the west-northwest of the concession area. Child's Bank was described by Dingle *et al.* (1987) to be a carbonate mound (bioherm). Composed of sediments and the calcareous deposits from an accumulation of carbonate skeletons of sessile organisms (e.g. cold-water coral, foraminifera or marl), such features typically have topographic relief, forming isolated seabed knolls in otherwise low profile homogenous seabed habitats (Kopaska-Merkel & Haywick 2001; Kenyon *et al.* 2003, Wheeler *et al.* 2005, Colman *et al.* 2005). 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 up-welling of relatively cool, nutrient-rich water into nutrient-poor surface water thereby resulting in higher productivity (Clark *et al.* 1999), which can in turn strongly influences the distribution of organisms on and around seamounts. Evidence of enrichment of bottom-associated communities and high abundances of demersal fishes has been regularly reported over such seabed features.

The enhanced fluxes of detritus and plankton that develop in response to the complex current regimes lead to the development of detritivore-based food-webs, which in turn lead to the presence of seamount scavengers and predators. Seamounts provide an important habitat for commercial deepwater fish stocks such as orange roughy, oreos, alfonsino and Patagonian toothfish, which aggregate around these features for either spawning or feeding (Koslow 1996).

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

Enhanced currents, steep slopes and volcanic rocky substrata, in combination with locally generated detritus, favour the development of suspension feeders in the benthic communities characterising seamounts (Rogers 1994). Deep- and cold-water corals (including stony corals, black corals and soft corals) are a prominent component of the suspension-feeding fauna of many seamounts, accompanied by barnacles, bryozoans, polychaetes, molluscs, sponges, sea squirts, basket stars, brittle stars and crinoids (reviewed in Rogers 2004). There is also associated mobile benthic fauna that includes echinoderms (sea urchins and sea cucumbers) and crustaceans (crabs and lobsters) (reviewed by Rogers 1994; Kenyon *et al.* 2003). Some of the smaller cnidarians species remain solitary while others form reefs thereby adding structural complexity to otherwise uniform seabed habitats. The coral frameworks offer refugia for a great variety of invertebrates and fish (including commercially important species) within, or in association with, the living and dead coral framework thereby creating spatially fragmented areas of high biological diversity.

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

It is not always the case that seamount habitats are VMEs, as some seamounts may not host communities of fragile animals or be associated with high levels of endemism. South Africa's seamounts and their associated benthic communities have not been extensively sampled by either geologists or biologists (Sink & Samaai 2009). Deep water corals are known from Child's Bank as well as the iBhubezi Reef to the south-east of Child's Bank. Furthermore, evidence from video footage taken on hard-substrate habitats in 100 - 120 m depth off the West Coast of South Africa (De Beers Marine (Pty) Ltd, unpublished data) suggest that sensitive communities including gorgonians, octocorals and reef-building sponges do occur on the continental shelf, and similar communities may thus be expected in Sea Concession 6C.

4.1.3.1.3 Demersal Fish Species

Demersal fish are those species that live and feed on or near the seabed. 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 *M. capensis,* and includes jacopever (*Helicolenus* *dactylopterus*), Izak catshark (*Holohalaelurus regain*), soupfin shark (*Galeorhinus galeus*) and whitespotted houndshark (*Mustelus palumbes*). The more diverse deeper water community is dominated by the deepwater hake (*Merluccius 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 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. In a more recent study, 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.* 2008).

The diversity and distribution of demersal cartilagenous fishes on the West Coast is discussed by Compagno *et* al. (1991). The species likely to occur in the licence area, and their approximate depth range, are listed in Table 4-1.

TABLE 4-1: DEMERSAL CARTILAGINOUS SPECIES FOUND ON THE CONTINENTAL SHELF ALONG THE WEST COAST, WITH APPROXIMATE DEPTH RANGE AT WHICH THE SPECIES OCCURS (COMPAGNO *ET AL.* 1991).

Common Name	Scientific name	Depth Range
Frilled shark	*Chlamydoselachus anguineus*	200-1 000
Six gill cowshark	*Hexanchus griseus*	150-600
Gulper shark	*Centrophorus granulosus*	480
Leafscale gulper shark	*Centrophorus squamosus*	370-800
Bramble shark	*Echinorhinus brucus*	55-285
Black dogfish	*Centroscyllium fabricii*	>700
Portuguese shark	*Centroscymnus coelolepis*	>700
Longnose velvet dogfish	*Centroscymnus crepidater*	400-700
Birdbeak dogfish	*Deania calcea*	400-800
Arrowhead dogfish	*Deania profundorum*	200-500
Longsnout dogfish	*Deania quadrispinosum*	200-650
Sculpted lanternshark	*Etmopterus brachyurus*	450-900
Brown lanternshark	*Etmopterus compagnoi*	450-925
Giant lanternshark	*Etmopterus granulosus*	>700
Smooth lanternshark	*Etmopterus pusillus*	400-500
Spotted spiny dogfish	*Squalus acanthias*	100-400
Shortnose spiny dogfish	*Squalus megalops*	75-460
Shortspine spiny dogfish	*Squalus mitsukurii*	150-600
Sixgill sawshark	*Pliotrema warreni*	60-500

Common Name	Scientific name	Depth Range
Goblin shark	*Mitsukurina owstoni*	270-960
Smalleye catshark	*Apristurus microps*	700-1 000
Saldanha catshark	*Apristurus saldanha*	450-765
“grey/black wonder” catsharks	*Apristurus spp.*	670-1 005
Tigar catshark	*Halaelurus natalensis*	50-100
Izak catshark	*Holohalaelurus regani*	100-500
Yellowspotted catshark	*Scyliorhinus capensis*	150-500
Soupfin shark/Vaalhaai	*Galeorhinus galeus*	<10-300
Houndshark	*Mustelus mustelus*	<100
Whitespotted houndshark	*Mustelus palumbes*	>350
Little guitarfish	*Rhinobatos annulatus*	>100
Atlantic electric ray	*Torpedo nobiliana*	120-450
African softnose skate	*Bathyraja smithii*	400-1 020
Smoothnose legskate	*Cruriraja durbanensis*	>1 000
Roughnose legskate	*Crurirajaparcomaculata*	150-620
African dwarf skate	*Neoraja stehmanni*	290-1 025
Thorny skate	*Raja radiata*	50-600
Bigmouth skate	*Raja robertsi*	>1 000
Slime skate	*Raja pullopunctatus*	15-460
Rough-belly skate	*Raja springeri*	85-500
Yellowspot skate	*Raja wallacei*	70-500
Roughskin skate	*Raja spinacidermis*	1 000-1 350
Biscuit skate	*Raja clavata*	25-500
Munchkin skate	*Raja caudaspinosa*	300-520
Bigthorn skate	*Raja confundens*	100-800
Ghost skate	*Raja dissimilis*	420-1 005
Leopard skate	*Raja leopardus*	300-1 000
Smoothback skate	*Raja ravidula*	500-1 000
Spearnose skate	*Raja alba*	75-260
St Joseph	*Callorhinchus capensis*	30-380
Cape chimaera	*Chimaera sp.*	680-1 000
Brown chimaera	*Hydrolagus sp.*	420-850
Spearnose chimaera	*Rhinochimaera atlantica*	650-960

4.1.3.2 Pelagic Communities

In contrast to demersal and benthic biota that are associated with the seabed, pelagic species live and feed in the open water column. The pelagic communities are typically divided into plankton and fish, and their main predators, marine mammals (seals, dolphins and whales), seabirds and turtles.

4.1.3.2.1 Plankton

Plankton is particularly abundant in the shelf waters off the West Coast, being associated with the upwelling characteristic of the area. Plankton range from single-celled bacteria to jellyfish of 2 m diameter, and include bacterio-plankton, phytoplankton, zooplankton, and ichthyoplankton

Phytoplankton are the principle primary producers with mean productivity ranging from 2.5 - 3.5 g C/m^2/day for the midshelf region and decreasing to 1 g C/m^2/day inshore of 130 m (Shannon & Field 1985; Mitchell-Innes & Walker 1991; Walker & Peterson 1991). The phytoplankton is dominated by large-celled organisms, which are adapted to the turbulent sea conditions. The most common diatom genera are *Chaetoceros, Nitschia, Thalassiosira, Skeletonema, Rhizosolenia*, *Coscinodiscus* and *Asterionella* (Shannon & Pillar 1985). Diatom blooms occur after upwelling events, whereas dinoflagellates (e.g. *Prorocentrum, Ceratium* and *Peridinium*) are more common in blooms that occur during quiescent periods, since they can grow rapidly at low nutrient concentrations. In the surf zone, diatoms and dinoflagellates are nearly equally important members of the phytoplankton, and some silicoflagellates are also present.

Red-tides are ubiquitous features of the Benguela system (see Shannon & Pillar, 1986). The most common species associated with red tides (dinoflagellate and/or ciliate blooms) are *Noctiluca scintillans*, *Gonyaulax tamarensis, G. polygramma* and the ciliate *Mesodinium rubrum. Gonyaulax* and *Mesodinium* have been linked with toxic red tides. Most of these red-tide events occur quite close inshore although Hutchings *et al.* (1983) have recorded red-tides 30 km offshore. They are unlikely to occur in the offshore regions of Sea Concession 6C.

The mesozooplankton (≥200 µm) is dominated by copepods, which are overall the most dominant and diverse group in southern African zooplankton. Important species are *Centropages brachiatus, Calanoides carinatus, Metridia lucens, Nannocalanus minor, Clausocalanus arcuicornis, Paracalanus parvus, P*. *crassirostris* and *Ctenocalanus vanus.* All of the above species typically occur in the phytoplankton rich upper mixed layer of the water column, with the exception of *M. lucens* which undertakes considerable vertical migration.

The macrozooplankton (≥1 600 µm) are dominated by euphausiids of which 18 species occur in the area. The dominant species occurring in the nearshore are *Euphausia lucens* and *Nyctiphanes capensis,* although neither species appears to survive well in waters seaward of oceanic fronts over the continental shelf (Pillar *et al.* 1991). Standing stock estimates of mesozooplankton for the southern Benguela area range from 0.2 - 2.0 g C/m^2, with maximum values recorded during upwelling periods. Macrozooplankton biomass ranges from 0.1 - 1.0 g C/m^2, with production increasing north of Cape Columbine (Pillar 1986). Although it shows no appreciable onshore-offshore gradients, standing stock is highest over the shelf, with accumulation of some mobile zooplanktors (euphausiids) known to occur at oceanographic fronts. Beyond the continental slope biomass decreases markedly.

Zooplankton biomass varies with phytoplankton abundance and, accordingly, seasonal minima will exist during non-upwelling periods when primary production is lower (Brown 1984; Brown & Henry 1985), and during winter when predation by recruiting anchovy is high. More intense variation will occur in relation to the upwelling cycle; newly upwelled water supporting low zooplankton biomass due to paucity of food, whilst high biomasses develop in aged upwelled water subsequent to significant development of phytoplankton. Irregular pulsing of the upwelling system, combined with seasonal recruitment of pelagic fish species into West Coast shelf waters during winter, thus results in a highly variable and dynamic balance between plankton replenishment and food availability for pelagic fish species.

Sea Concession 6C lies within the influence of the Namaqua upwelling cell, and seasonally high phytoplankton abundance can be expected, providing favourable feeding conditions for micro-, meso- and macrozooplankton, and for ichthyoplankton. Immediately to the north of the upwelling cell, high turbulence and deep mixing in the water column result in diminished phytoplankton biomass and consequently the area is considered to be an environmental barrier to the transport of ichthyoplankton from the southern to the northern Benguela upwelling ecosystems. Important pelagic fish species, including anchovy, redeye round herring, horse mackerel and shallow-water hake, are reported as spawning on either side of the Orange River Banks area, but not within it (Figure 4-5). Phytoplankton, zooplankton and ichthyoplankton abundances in the Sea Concession area are thus expected to be comparatively high relative to the Orange River Banks area. In the offshore portions of the Sea Concession 6C area plankton abundance is also expected to be low, with the major fish spawning and migration routes occurring further inshore on the shelf.

4.1.3.2.2 Cephalopods

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 was 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.

4.1.3.2.3 Pelagic Fish

Small pelagic species occurring beyond the surfzone and generally within the 200 m contour include the 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 (Crawford *et al.* 1987), and exhibit similar life history patterns involving seasonal migrations between the west and south coasts. The spawning areas of the major pelagic species are distributed on the continental shelf and along the shelf edge 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.

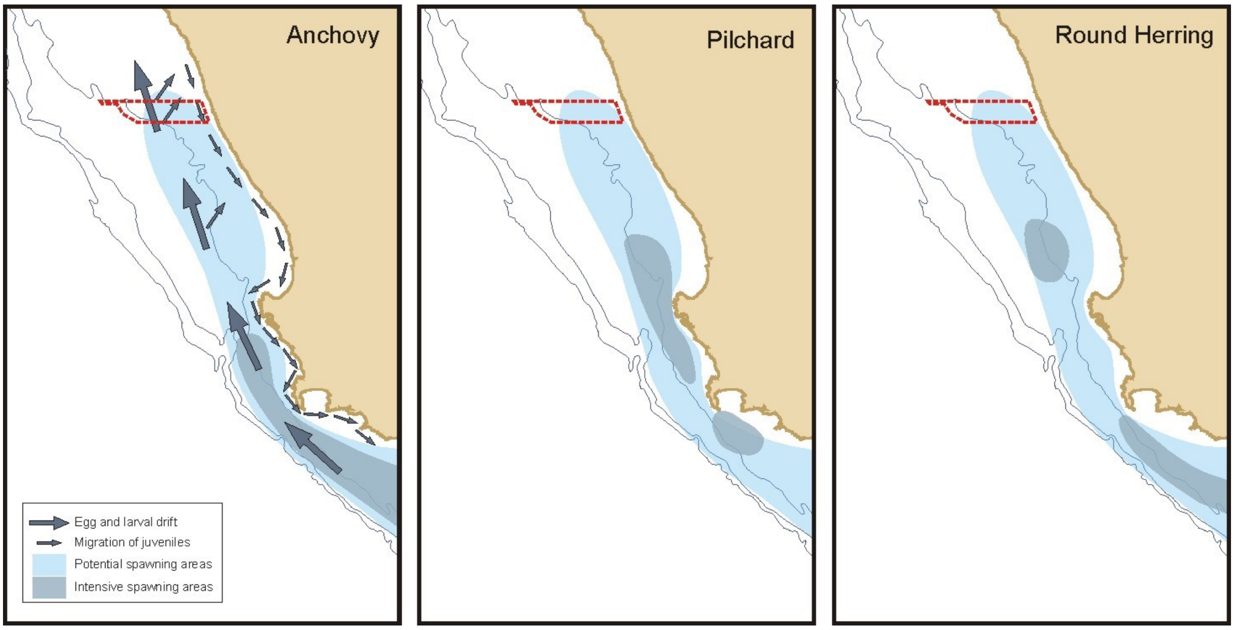

FIGURE 4-5: SEA CONCESSION 6C (RED POLYGON) IN RELATION TO MAJOR SPAWNING AREAS IN THE SOUTHERN BENGUELA REGION (ADAPTED FROM CRUIKSHANK 1990).

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 recruit in the pelagic stage, across broad stretches of the shelf, to 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). They are voracious predators occurring throughout the water column, feeding on both demersal and pelagic invertebrates and fish. 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 feature 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*). Occurring throughout the world in warm temperate waters, these species are usually found further offshore on the West Coast. Great whites (*Carcharodon carcharias*) may also be encountered in coastal and offshore areas. This species is a significant apex predator along the southern African coast, particularly in the vicinity of the seal colonies. Although not necessarily threatened with extinction, great whites are listed in Appendix II (species in which trade must be controlled in order to avoid utilization incompatible with their survival) of CITES (Convention on International Trade in Endangered Species) and is described as "vulnerable" in the International Union for Conservation of Nature (IUCN) Red listing. In response to global declines in abundance, white sharks were legislatively protected in South Africa in 1991.

Many of the large migratory pelagic species are considered threatened by the IUCN, primarily due to overfishing (Table 4-2). Tuna and swordfish are targeted by high seas fishing fleets and illegal overfishing has severely damaged the stocks of many of these species. Similarly, pelagic sharks, are either caught as bycatch in the pelagic tuna longline fisheries, or are specifically targeted for their fins, where the fins are removed and the remainder of the body discarded.

TABLE 4-2: SOME OF THE MORE IMPORTANT LARGE MIGRATORY PELAGIC FISH LIKELY TO OCCUR IN THE OFFSHORE REGIONS OF THE SOUTH COAST.

Common Name	Species	IUCN Conservation Status
Tunas		
Southern Bluefin Tuna	Thunnus maccoyii	Critically Endangered
Bigeye Tuna	Thunnus obesus	Vulnerable
Longfin Tuna/Albacore	Thunnus alalunga	Near Threatened
Yellowfin Tuna	Thunnus albacares	Near Threatened
Frigate Tuna	Auxis thazard	Least concern
Skipjack Tuna	Katsuwonus pelamis	Least concern
Billfish		
Blue Marlin	Makaira nigricans	Vulnerable
Sailfish	Istiophorus platypterus	Least concern
Swordfish	Xiphias gladius	Least concern
Black Marlin	Istiompax indica	Data deficient
Pelagic Sharks		
Pelagic Thresher Shark	Alopias pelagicus	Vulnerable
Common Thresher Shark	Alopias vulpinus	Vulnerable
Great White Shark	Carcharodon carcharias	Vulnerable
Shortfin Mako	Isurus oxyrinchus	Vulnerable
Longfin Mako	Isurus paucus	Vulnerable
Blue Shark	Prionace glauca	Near Threatened
Oceanic Whitetip Shark	Carcharhinus longimanus	Vulnerable

4.1.3.2.4 Turtles

Three species of turtle occur along the West Coast, namely the Leatherback (*Dermochelys coriacea*), and occasionally the Loggerhead (*Caretta caretta*) and the Green (*Chelonia mydas*) turtle. Loggerhead and Green turtles are expected to occur only as occasional visitors along the West Coast. The Leatherback is the only turtle likely to be encountered in the offshore waters of west South Africa.

The Benguela ecosystem, especially the northern Benguela where jelly fish numbers are high, is increasingly being recognized 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). Leatherback turtles from the east South Africa population have been satellite tracked swimming around the west coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (Lambardi *et al.* 2008) (Figure 4-6).

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). Their abundance in the study area is unknown but expected to be low. Leatherbacks feed on jellyfish and are known to have mistaken plastic marine debris for their natural food. Ingesting this can obstruct the gut, lead to absorption of toxins and reduce the absorption of nutrients from their real food. 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 Convention on Migratory Species. Loggerhead and green turtles are listed as "Endangered". As a signatory of the Convention on Migratory Species, South Africa has endorsed and signed an International Memorandum of Understanding specific to the conservation of marine turtles. South Africa is thus committed to conserve these species at an international level.

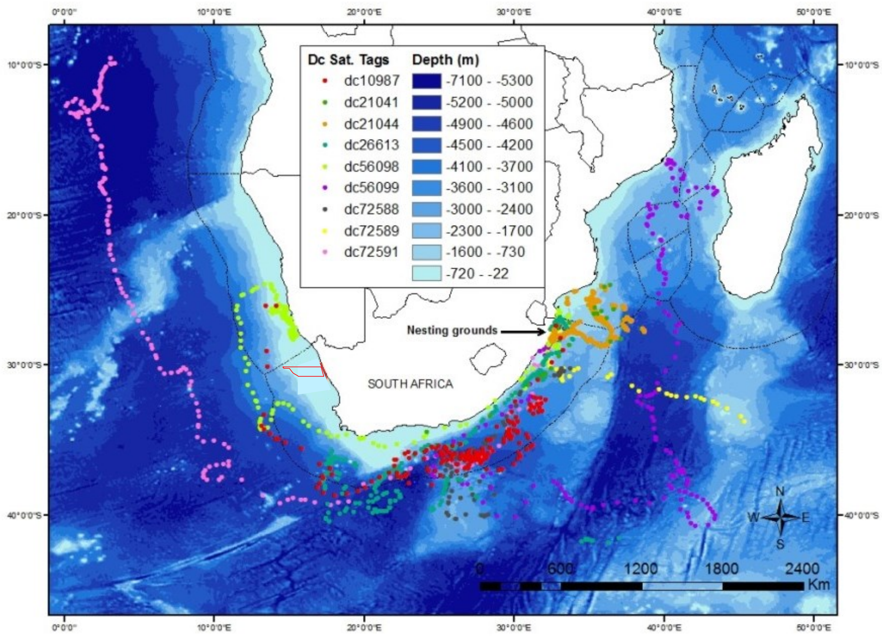

FIGURE 4-6: THE POST-NESTING DISTRIBUTION OF NINE SATELLITE TAGGED LEATHERBACK FEMALES (1996 – 2006; OCEANS AND COAST, UNPUBLISHED DATA). THE APPROXIMATE LOCATION OF CONCESSION 6C IS INDICATED (RED POLYGON).

4.1.3.2.5 Seabirds

Large numbers of pelagic seabirds exploit the pelagic fish stocks of the Benguela system. Of the 49 species of seabirds that occur in the Benguela region, 14 are defined as resident, 10 are visitors from the northern hemisphere and 25 are migrants from the southern Ocean. The 18 species classified as being common in the southern Benguela are listed in Table 4-3. 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 – 500 m depth) with highest population levels during their non-breeding season (winter). Pintado petrels and Prion spp. show the most marked variation here.

Fourteen species of seabirds breed in southern Africa; Cape Gannet, African Penguin, four species of Cormorant, White Pelican, three Gull and four Tern species (Table 4-4). The breeding areas are distributed around the coast with islands being especially important. The number of successfully breeding birds at the particular breeding sites varies with food abundance. 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.

TABLE 4-3: PELAGIC SEABIRDS COMMON IN THE SOUTHERN BENGUELA REGION (CRAWFORD *ET AL.* 1991).

Common Name	Species name	Global IUCN
Shy albatross	*Thalassarche cauta*	Near Threatened
Black browed albatross	*Thalassarche melanophrys*	Endangered[1]
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

1. May move to Critically Endangered if mortality from long-lining does not decrease.

TABLE 4-4: 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*	Endangered
Bank Cormorant	*Phalacrocorax neglectus*	Endangered
Crowned Cormorant	*Phalacrocorax coronatus*	Near Threatened
White Pelican	*Pelecanus onocrotalus*	Least Concern
Cape Gannet	*Morus capensis*	Vulnerable
Kelp Gull	*Larus dominicanus*	Least Concern
Greyheaded Gull	*Larus cirrocephalus*	Least Concern
Hartlaub's Gull	*Larus hartlaubii*	Least Concern
Caspian Tern	*Hydroprogne caspia*	Least Concern
Swift Tern	*Sterna bergii*	Least Concern
Roseate Tern	*Sterna dougallii*	Least Concern
Damara Tern	*Sterna balaenarum*	Near Threatened

4.1.3.2.6 Marine Mammals

The marine mammal fauna occurring off the southern African coast includes several species of whales and dolphins and one resident seal species. Thirty-four species of whales and dolphins are known (based on historic sightings or strandings records) or likely (based on habitat projections of known species parameters) to occur in these waters (Table 4-5). The offshore areas have been particularly poorly studied with almost all available information from deeper waters (>200 m) arising from historic whaling records prior to 1970. Current information on the distribution, population sizes and trends of most cetacean species occurring on the west coast of southern Africa is lacking. Information on smaller cetaceans in deeper waters is particularly poor and the precautionary principal must be used when considering possible encounters with cetaceans in this area.

Records from stranded specimens show that the area between St Helena Bay (~32° S, 18° E) and Cape Agulhas (~34° S, 20° E) is an area of transition between Atlantic and Indian Ocean species, as well as those more commonly associated with colder waters of the west coast (e.g. dusky dolphins and long finned pilot whales) and those of the warmer east coast (e.g. striped and Risso's dolphins) (Findlay *et al.* 1992). The project area lies north of this transition zone and can be considered to be truly on the 'West Coast'. However, the warmer waters that occur offshore of the Benguela ecosystem (more than approximately 100 km offshore) provide an entirely different habitat, that despite the relatively high latitude may host some species associated with the more tropical and temperate parts of the Atlantic such as rough toothed dolphins, Pan-tropical spotted dolphins and short finned pilot whales. Owing to the uncertainty of species occurrence offshore, species that may occur there have been included here for the sake of completeness.

TABLE 4-5: CETACEANS OCCURRENCE OFF THE WEST COAST OF SOUTH AFRICA, THEIR SEASONALITY, LIKELY ENCOUNTER FREQUENCY WITH PROPOSED EXPLORATION DRILLING OPERATIONS AND IUCN CONSERVATION STATUS.

Common Name	Species	Shelf	Offshore	Seasonality	Likely encounter frequency	IUCN Conservation Status
Delphinids						
Dusky dolphin	*Lagenorhynchus obscurus*	Yes (0- 800 m)	No	Year round	Daily	Data Deficient
Heaviside's dolphin	*Cephalorhynchus heavisidii*	Yes (0-200 m)	No	Year round	Daily	Least Concern
Common bottlenose dolphin	*Tursiops truncatus*	Yes	Yes	Year round	Monthly	Least Concern
Common (short beaked) dolphin	*Delphinus delphis*	Yes	Yes	Year round	Monthly	Least Concern
Southern right whale dolphin	*Lissodelphis peronii*	Yes	Yes	Year round	Occasional	Least Concern
Striped dolphin	*Stenella coeruleoalba*	No	?	?	Very rare	Least Concern
Pantropical spotted dolphin	*Stenella attenuata*	Edge	Yes	Year round	Very rare	Least Concern
Long-finned pilot whale	*Globicephala melas*	Edge	Yes	Year round	<Weekly	Least Concern
Short-finned pilot whale	*Globicephala macrorhynchus*	?	?	?	Very rare	Least Concern
Rough-toothed dolphin	*Steno bredanensis*	?	?	?	Very rare	Least Concern
Killer whale	*Orcinus orca*	Occasional	Yes	Year round	Occasional	Data Deficient
False killer whale	*Pseudorca crassidens*	Occasional	Yes	Year round	Monthly	Least Concern
Pygmy killer whale	*Feresa attenuata*	?	Yes	?	Occasional	Least Concern
Risso's dolphin	*Grampus griseus*	Yes (edge)	Yes	?	Occasional	Least Concern
Sperm whales						
Pygmy sperm whale	*Kogia breviceps*	Edge	Yes	Year round	Occasional	Data Deficient
Dwarf sperm whale	*Kogia sima*	Edge	?	?	Very rare	Data Deficient
Sperm whale	*Physeter macrocephalus*	Edge	Yes	Year round	Occasional	Vulnerable

Common Name	Species	Shelf	Offshore	Seasonality	Likely encounter frequency	IUCN Conservation Status
Beaked whales						
Cuvier's	*Ziphius cavirostris*	No	Yes	Year round	Occasional	Data Deficient
Arnoux's	*Beradius arnouxii*	No	Yes	Year round	Occasional	Data Deficient
Southern bottlenose	*Hyperoodon planifrons*	No	Yes	Year round	Occasional	Least Concern
Layard's	*Mesoplodon layardii*	No	Yes	Year round	Occasional	Data Deficient
True's	*M. mirus*	No	Yes	Year round		Data Deficient
Gray's	*M. grayi*	No	Yes	Year round	Occasional	Data Deficient
Blainville's	*M. densirostris*	No	Yes	Year round		Data Deficient
Baleen whales						
Antarctic Minke	*Balaenoptera bonaerensis*	Yes	Yes	>Winter	Monthly	Least Concern
Dwarf minke	*B. acutorostrata*	Yes	Yes	Year round	Occasional	Least Concern
Fin whale	*B. physalus*	Yes	Yes	MJJ & ON, rarely in summer	Occasional	Endangered
Blue whale	*B. musculus*	No	Yes	?	Occasional	Critically Endangered
Sei whale	*B. borealis*	Yes	Yes	MJ & ASO	Occasional	Endangered
Bryde's (offshore)	*B. brydei*	Yes	Yes	Summer (JF)	Occasional	Not assessed
Bryde's (inshore)	*B brydei (subspp)*	Yes	Yes	Year round	Occasional	Vulnerable
Pygmy right	*Caperea marginata*	Yes	?	Year round	Occasional	Least Concern
Humpback	*Megaptera novaeangliae*	Yes	Yes	Year round, higher in SONDJF	Daily*	Vulnerable
Southern right	*Eubalaena australis*	Yes	No	Year round, higher in JFASOND	Daily*	Least Concern

The distribution of cetaceans can largely be split into those associated with the continental shelf and those that occur in deep, oceanic water. Importantly, species from both environments may be found on the continental slope (200 – 2000 m) making this the most species rich area for cetaceans. Cetacean density on the continental shelf is usually higher than in pelagic waters as species associated with the pelagic environment tend to be wide ranging across thousands of kilometers. As the prospecting area is located on the continental shelf, cetacean diversity in the area can be expected to be high. In the offshore portions of Sea Concession 6C abundances will, however, be low compared to further inshore. The most common species within the project area (in terms of likely encounter rate not total population sizes) are likely to be the long-finned pilot whale and humpback whale.

Cetaceans are comprised of two taxonomic groups, the mysticetes (filter feeders with baleen) and the odontocetes (predatory whales and dolphins with teeth). The term 'whale' is used to describe species in both groups and is taxonomically meaningless (e.g. the killer whale and pilot whale are members of the Odontoceti, family Delphinidae and are thus dolphins). Due to differences in sociality, communication abilities, ranging behavior and acoustic behavior, these two groups are considered separately.

The cetaceans likely to be found within the project area, based on data sourced from: Findlay *et al.* (1992), Best (2007), Weir (2011), Dr J-P. Roux, (MFMR pers. comm.) and unpublished records held by the Namibian Dolphin Project are listed in Table 4-5. Of the 34 species listed, one is critically endangered, two are endangered and two are considered vulnerable (South African Red Data list Categories, 2016). Altogether 10 species are listed as "data deficient" underlining how little is known about cetaceans, their distributions and population trends. The majority of data available on the seasonality and distribution of large whales in the project area is the result of commercial whaling activities mostly dating from the 1960s. Changes in the timing and distribution of migration may have occurred since these data were collected due to extirpation of populations or behaviours (e.g. migration routes may be learnt behaviours). Some data on species occurrence is available from newer datasets, mainly from marine mammal observers working on earlier seismic surveys, but these are almost all confined to the summer months.

A review of the distribution and seasonality of the key cetacean species likely to be found within the project area is provided below.

(a) Mysticete (Baleen) whales

The majority of mysticetes whales fall into the family Balaenopeteridae. Those occurring in the area include the blue, fin, sei, Antarctic minke, dwarf minke, humpback and Bryde's whales. The southern right whale (Family Balaenidae) and pygmy right whale (Family Neobalaenidae) are from taxonomically separate groups. The majority of mysticete species occur in pelagic waters with only occasional visits to shelf waters. All of these species show some degree of migration either to or through the latitudes encompassed by the broader project area when en route between higher latitude (Antarctic or Subantarctic) feeding grounds and lower latitude breeding grounds.

Depending on the ultimate location of these feeding and breeding grounds, seasonality may be either unimodal, usually in winter months, or bimodal (e.g. May to July and October to November), reflecting a northward and southward migration through the area. Northward and southward migrations may take place at different distances from the coast due to whales following geographic or oceanographic features, thereby influencing the seasonality of occurrence at different locations. Because of the complexities of the migration patterns, each species is discussed separately below.

Two genetically and morphologically distinct populations of Bryde's whales live off the coast of southern Africa (Best 2001; Penry 2010). The "offshore population" lives beyond the shelf (>200 m depth) off west Africa and migrates between wintering grounds off equatorial west Africa (Gabon) and summering grounds off western South Africa. Its seasonality on the west coast is thus opposite to the majority of the balaenopterids with abundance likely to be highest in the broader project area in January - March. The "inshore population" of Bryde's, which lives on the continental shelf and Agulhas Bank, is unique amongst baleen whales in the region by being non-migratory. It may move further north into the Benguela current areas of the west of coast of South Africa and Namibia, especially in the winter months (Best 2007).

Sei whales migrate through South African waters, where they were historically hunted in relatively high numbers, to unknown breeding grounds further north. Their migration pattern thus shows a bimodal peak with numbers west of Cape Columbine highest in May and June, and again in August, September and October. All whales were caught in waters deeper than 200 m with most deeper than 1000 m (Best & Lockyer 2002). Almost all information is based on whaling records 1958-1963 and there is no current information on abundance or distribution patterns in the region.

Fin whales were historically caught off the West Coast of South Africa, with 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 western South Africa.

Although blue whales were historically caught in high numbers off the South African West Coast, with a single peak in catch rates during June to July in Walvis Bay, Namibia and at Namibe, Angola suggesting that in the eastern South Atlantic these latitudes are close to the northern migration limit for the species (Best 2007). Several recent (2014-2015) sightings of blue whales have occurred during seismic surveys off the southern part of Namibia in water >1 000 m deep confirming their current existence in the area and occurrence in autumn months. The chance of encountering the species in the Sea Concession area is considered low.

Two forms of minke whale occur in the southern Hemisphere, the Antarctic minke whale (*Balaenoptera bonaerensis*) and the dwarf minke whale (*B. acutorostrata* subsp.); both species occur in the Benguela (Best 2007). Antarctic minke whales range from the pack ice of Antarctica to tropical waters and are usually seen more than approximately 50 km offshore. Although adults migrate from the Southern Ocean (summer) to tropical/temperate waters (winter) to breed, some animals, especially juveniles, are known to stay in tropical/temperate waters year round. The dwarf minke whale has a more temperate distribution than the Antarctic minke and they do not range further south than 60-65°S. Dwarf minkes have a similar migration pattern to Antarctic minkes with at least some animals migrating to the Southern Ocean during summer. Dwarf minke whales occur closer to shore than Antarctic minkes. Both species are generally solitary and densities are likely to be low in the project area.

The most abundant baleen whales in the Benguela are Southern Right whales and Humpback whales. In the last decade, both species have been increasingly observed to remain on the west coast of South Africa well after the ‘traditional’ South African whale season (June – November) into spring and early summer (October – February) where they have been observed feeding in upwelling zones, especially off Saldanha and St Helena Bay (Barendse *et al.* 2011; Mate *et al.* 2011).

The majority of Humpback whales passing through the Benguela are migrating to breeding grounds off tropical west Africa, between Angola and the Gulf of Guinea (Rosenbaum *et al.* 2009; Barendse *et al.* 2010). In coastal waters, the northward migration stream is larger than the southward peak (Best & Allison 2010; Elwen *et al.* 2013), suggesting that animals migrating north strike the coast at varying places north of St Helena Bay, resulting in increasing whale density on shelf waters and into deeper pelagic waters as one moves northwards, but no clear migration ‘corridor. On the southward migration, many humpbacks follow the Walvis Ridge offshore then head directly to high latitude feeding grounds, while others follow a more coastal route (including the majority of mother-calf pairs) possibly lingering in the feeding grounds off west South Africa in summer (Elwen *et al.* 2013, Rosenbaum *et al.* in press). Recent abundance estimates put the number of animals in the west African breeding population to be in excess of 9 000 individuals in 2005 (IWC 2012) and it is likely to have increased since this time at about 5% per annum (IWC 2012). Humpback whales are thus likely to be the most frequently encountered baleen whale in the project area, ranging from the coast out beyond the shelf, with year round presence but numbers peaking in July – February associated with the breeding migration and subsequent feeding in the Benguela.

The southern African population of Southern Right whales historically extended from southern Mozambique (Maputo Bay) to southern Angola (Baie dos Tigres) and is considered to be a single population within this range (Roux *et al.* 2011). The most recent abundance estimate for this population is available for 2017 which estimated the population at approximately 6 100 individuals including all age and sex classes, and still growing at 6.5% per annum (Brandaõ et al. 2017). When the population numbers crashed, the range contracted down to just the south coast of South Africa, but as the population recovers, it is repopulating its historic grounds including Namibia (Roux *et al.* 2001, 2015; de Rock *et al.,* in review) and Mozambique (Banks *et al.* 2011). Southern right whales are seen regularly in the nearshore waters of the West Coast (<3 km from shore), extending north into southern Namibia (Roux *et al.* 2001, 2011). Southern Right whales have been recorded off the West Coast in all months of the year, but with numbers peaking in winter (June - September). Notably, all available records have been very close to shore with only a few out to 100 m depth, so they are unlikely to be encountered in the concession area.

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.

(b) Odontocetes (toothed) whales

The Odontoceti are a varied group of animals including the dolphins, porpoises, beaked whales and sperm whales. Species occurring within the broader project area display a diversity of features, for example their ranging patterns vary from extremely coastal and highly site specific to oceanic and wide ranging. Those in the region can range in size from 1.6 m long (Heaviside's dolphin) to 17 m (bull sperm whale).

All information about sperm whales in the southern African sub-region results from data collected during commercial whaling activities prior to 1985 (Best 2007). Sperm whales are the largest of the toothed whales and have a complex, structured social system with adult males behaving differently to younger males and female groups. They live in deep ocean waters, usually greater than 1000 m depth, although they occasionally come onto the shelf in water 500 - 200 m deep (Best 2007). They are considered to be relatively abundant globally (Whitehead 2002), although no estimates are available for South African waters. Seasonality of catches suggests that medium and large sized males are more abundant in winter months while female groups are more abundant in autumn (March - April), although animals occur year round (Best 2007). Sperm whales are thus likely to be encountered in relatively high numbers in deeper waters (>500 m), predominantly in the winter months (April - October). Sperm whales feed at great depths during dives in excess of 30 minutes making them difficult to detect visually, however the regular echolocation clicks made by the species when diving make them relatively easy to detect acoustically using Passive Acoustic Monitoring (PAM).

There are 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 (>200 m) off the shelf of the southern African West Coast. Beaked whales are all considered to be true deep water species usually being seen in waters in excess of 1000 - 2000 m deep (see various species accounts in Best 2007). Presence in the project area may fluctuate seasonally, but insufficient data exist to define this clearly.

The genus *Kogia* currently contains two recognised species, the pygmy (*K. breviceps*) and dwarf (*K. sima*) sperm whales, both of which most frequently occur in pelagic and shelf edge waters, although their seasonality is unknown. The majority of what is known about Kogiidae whales in the southern African subregion results from studies of stranded specimens (e.g. Ross 1979; Findlay *et al.* 1992; Plön 2004; Elwen *et al.* 2013).

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

The false killer whale has a tropical to temperate distribution and most sightings off southern Africa have occurred in water deeper than 1 000 m, but with a few recorded close to shore (Findlay *et al.* 1992). They usually occur in groups ranging in size from 1 - 100 animals (Best 2007). The strong bonds and matrilineal social structure of this species makes it vulnerable to mass stranding (8 instances of 4 or more animals stranding together have occurred in the Western Cape, all between St Helena Bay and Cape Agulhas). There is no information on population numbers or conservation status and no evidence of seasonality in the region (Best 2007).

Long-finned pilot whales display a preference for temperate waters and are usually associated with the continental shelf or deep water adjacent to it (Mate *et al.* 2005; Findlay *et al.* 1992; Weir 2011). They are regularly seen associated with the shelf edge by marine mammal observers (MMOs) and fisheries observers and researchers. The distinction between long-finned and short-finned pilot whales is difficult to make at sea. As the latter are regarded as more tropical species (Best 2007), it is likely that the vast majority of pilot whales encountered in the project area will be long-finned.

The common dolphin is known to occur offshore in West Coast waters (Findlay *et al.* 1992; Best 2007), although the extent to which they occur in the project area is unknown, but likely to be low. Group sizes of common dolphins can be large, averaging 267 (± SD 287) for the South Africa region (Findlay *et al.* 1992). They are more frequently seen in the warmer waters offshore and to the north of the country, seasonality is not known.

In water <500 m deep, dusky dolphins are likely to be the most frequently encountered small cetacean as they are very “boat friendly” and often approach vessels to bowride. The species is resident year round throughout the Benguela ecosystem in waters from the coast to at least 500 m deep (Findlay *et al.* 1992). Although no information is available on the size of the population, they are regularly encountered in near shore waters between Cape Town and Lamberts Bay (Elwen *et al.* 2010a; NDP unpubl. data) with group sizes of up to 800 having been reported (Findlay *et al.* 1992). A hiatus in sightings (or low density area) is reported between approximately 27°S and 30°S, associated with the Lüderitz upwelling cell (Findlay *et al.* 1992). Dusky dolphins are resident year round in the Benguela.

Heaviside’s dolphins are relatively abundant in the Benguela ecosystem region with 10 000 animals estimated to live in the 400 km of coast between Cape Town and Lamberts Bay (Elwen *et al.* 2009). This species occupies waters from the coast to at least 200 m depth, (Elwen *et al.* 2006; Best 2007), and may show a diurnal onshore-offshore movement pattern (Elwen *et al.* 2010b), but this varies throughout the species range. Heaviside’s dolphins are resident year round.

Several other species of dolphins that might occur in deeper waters at low levels include the pygmy killer whale, Risso’s dolphin, rough toothed dolphin, pan tropical spotted dolphin and striped dolphin (Findlay *et al.* 1992; Best 2007). Nothing is known about the population size or density of these species in the project area but encounters are likely to be rare.

Beaked whales were never targeted commercially and their pelagic distribution makes them the most poorly studied group of cetaceans. With recorded dives of well over an hour and in excess of 2 km deep, beaked whales are amongst the most extreme divers of any air breathing animals (Tyack *et al.* 2011). They also appear to be particularly vulnerable to certain types of anthropogenic noise, although reasons are not yet fully understood. All the beaked whales that may be encountered in the project area are pelagic species that tend to occur in small groups usually less than five, although larger aggregations of some species are known (MacLeod & D’Amico 2006; Best 2007).

In summary, the Humpback and Southern Right whale are likely to be encountered year-round, with numbers in the Cape Columbine area highest between September and February, and not during winter as is common on the South Coast breeding grounds. Several other large whale species are also most abundant on the West

Coast during winter: fin whales peak in May-July and October-November; sei whale numbers peak in May-June and again in August-October and offshore Bryde's whale numbers are likely to be highest in January-February. Whale numbers on the shelf and in offshore waters are thus likely to be highest between October and February.

Of the migratory cetaceans, the Blue is listed as 'critically endangered', Fin and Sei whales are listed as 'Endangered' and the Bryde's (inshore) and Humpback whale as 'Vulnerable' in the IUCN Red Data book. All whales and dolphins are given protection under the South African Law. The Marine Living Resources Act, 1998 (No. 18 of 1998) states that no whales or dolphins may be harassed, killed or fished. No vessel or aircraft may, without a permit or exemption, approach closer than 300 m to any whale and a vessel should move to a minimum distance of 300 m from any whales if a whale surfaces closer than 300 m from a vessel or aircraft.

The Cape fur seal (*Arctocephalus pusillus pusillus*) is the only species of seal resident along the west coast of Africa, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs (see Figure 4-7). Vagrant records from four other species of seal more usually associated with the subantarctic environment have also been recorded: southern elephant seal (*Mirounga leoninas*), subantarctic fur seal (*Arctocephalus tropicalis*), crabeater (*Lobodon carcinophagus*) and leopard seals (*Hydrurga leptonyx*) (David 1989).

There are a number of Cape fur seal colonies within the study area: at Kleinzee (incorporating Robeiland), at Bucchu Twins near Alexander Bay, and Strandfontein Point (south of Hondeklipbaai). 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 McDougall's 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).

4.1.4 Human Utilisation

4.1.4.1 Fisheries and other harvesting

The South African fishing industry consists of approximately 14 commercial sectors operating within the 200 nautical mile Exclusive Economic Zone (EEZ)[1]. The western coastal shelf is a highly productive upwelling ecosystem (Benguela current) and supports a number of fisheries.

[1] The Exclusive Economic Zone is the zone extending from the coastline out to a distance of 200 nautical miles within which South Africa holds exclusive economic rights.

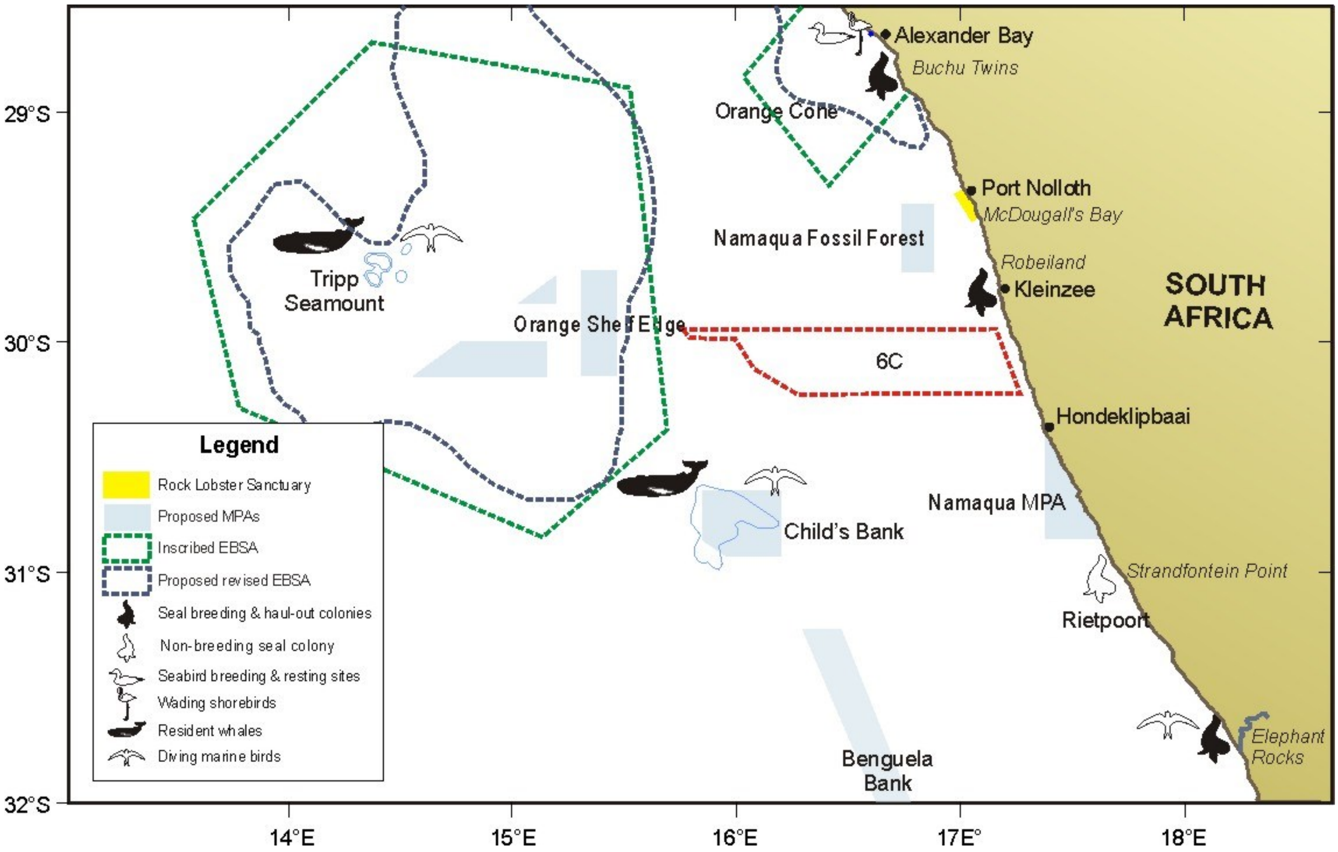

FIGURE 4-7: PROJECT - ENVIRONMENT INTERACTION POINTS ON THE WEST COAST, ILLUSTRATING THE LOCATION OF SEA CONCESSION 6C (RED POLYGON) IN RELATION TO SEABIRD AND SEAL COLONIES AND RESIDENT WHALE POPULATIONS.

Primary fisheries in terms of economic value and overall tonnage of landings are the demersal (bottom) trawl and long-line fisheries targeting the cape hakes *Merluccius paradoxus* and M. *capensis*, and the pelagic purse-seine fishery targeting pilchard (*Sardinops sagax*), anchovy (*Engraulis encrasicolus*) and red-eye round herring (*Etrumeus whitheadii*). Secondary commercial species in the hake-directed fisheries include an assemblage of demersal (bottom-dwelling) fish of which monk fish (*Lophius vomerinus*) and snoek (Thyrsites atun) are the most important commercial species. Other fisheries active on the West Coast are the pelagic long-line fishery for tunas and swordfish and the tuna pole and traditional line-fish sectors. West Coast rock lobster (*Jasus lalandi*) is an important trap fishery exploited close to the shoreline (waters shallower than 100 m) including the intertidal zone and kelp beds off the West Coast.

On the West Coast of South Africa, major fishing grounds tend to be centred along the shelf break which is located approximately along the 500 m isobath. Historically and currently the bulk of the main commercial fish stocks caught on the northern West Coast of South Africa have been landed and processed at the Western Cape ports of Cape Town and Saldanha (less than 1% of the South African commercial allowable catch is landed in the Northern Cape Province). The main reasons for this include lack of local infrastructure, distance to market and relatively low volumes of fish landings.

Sea Concession area 6C is situated near to the fishing harbour of Port Nolloth, a regional fishing node which operates at a low level of development. Historically, the harbour accommodated a West Coast rock lobster fishery, an experimental hake-long-line fishery and a small experimental trawl fishery during the 1980's (targeting gurnards and sole). Currently there is little fishing activity taking place from Port Nolloth (only inshore West Coast rock lobster and traditional line fishing). As the harbour is relatively shallow and does not have a breakwater, it becomes inaccessible to vessels during rough weather conditions and cannot accommodate larger vessels (length greater than 22 m). This has been a restrictive factor to the development of fisheries in the region. The main commercial sectors operating in the vicinity of the study area are discussed below:

4.1.4.1.1 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 391 000 tons recorded per annum between 2008 and 2012.

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 4-8). Once the shoal has been encircled the net is pursed and hauled in and the fish are pumped on board 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 on board, which may take up to 1.5 hours. Vessels usually operate overnight and return to offload their catch the following day.

The South African fishery, consisting of approximately 101 vessels, is active all year round with a short break from mid-December to mid-January (to reduce impact on juvenile sardine), with seasonal trends in the specific species targeted. The geographical distribution and intensity of the fishery is largely dependent on the seasonal fluctuation and geographical distribution of the targeted species. Fishing grounds occur primarily along the Western Cape and Eastern Cape coast up to a distance of 100 km offshore, but usually closer inshore. The sardine-directed fishery tends to concentrate effort in a broad area extending from 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 spatial extent of the fishing grounds in relation to the Sea Concession area are shown in Figure 4-9. The map omits fishing grid blocks which have less than one hour of fishing effort per year (average values for the period 2000 to 2016), as sporadic fishing events have been recorded within the concession area but these are considered to be insignificant in the overall context of the distribution of fishing activity by the sector. The concession area is situated at least 120 km northward of grounds fished regularly by the purse-seine sector. The concession area does, however, overlap spawning and recruitment areas for small pelagic species.

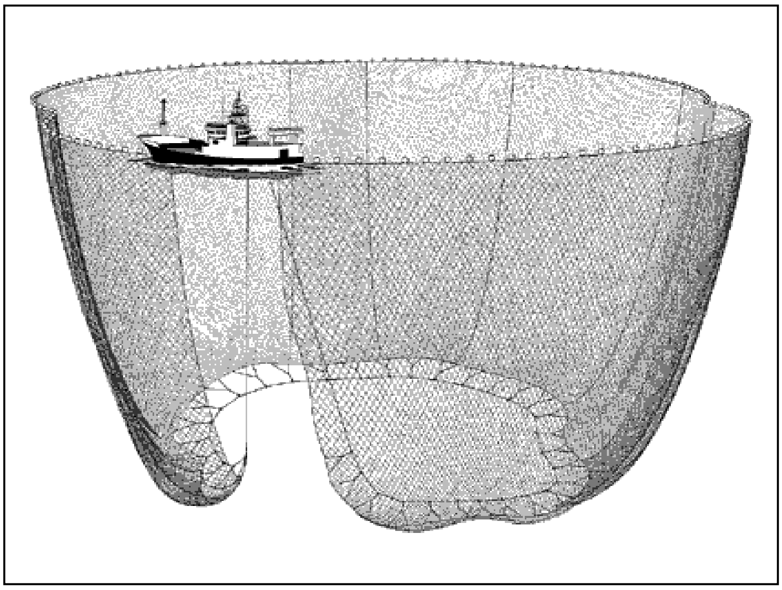

FIGURE 4-8: PELAGIC PURSE-SEINE GEAR CONFIGURATION.

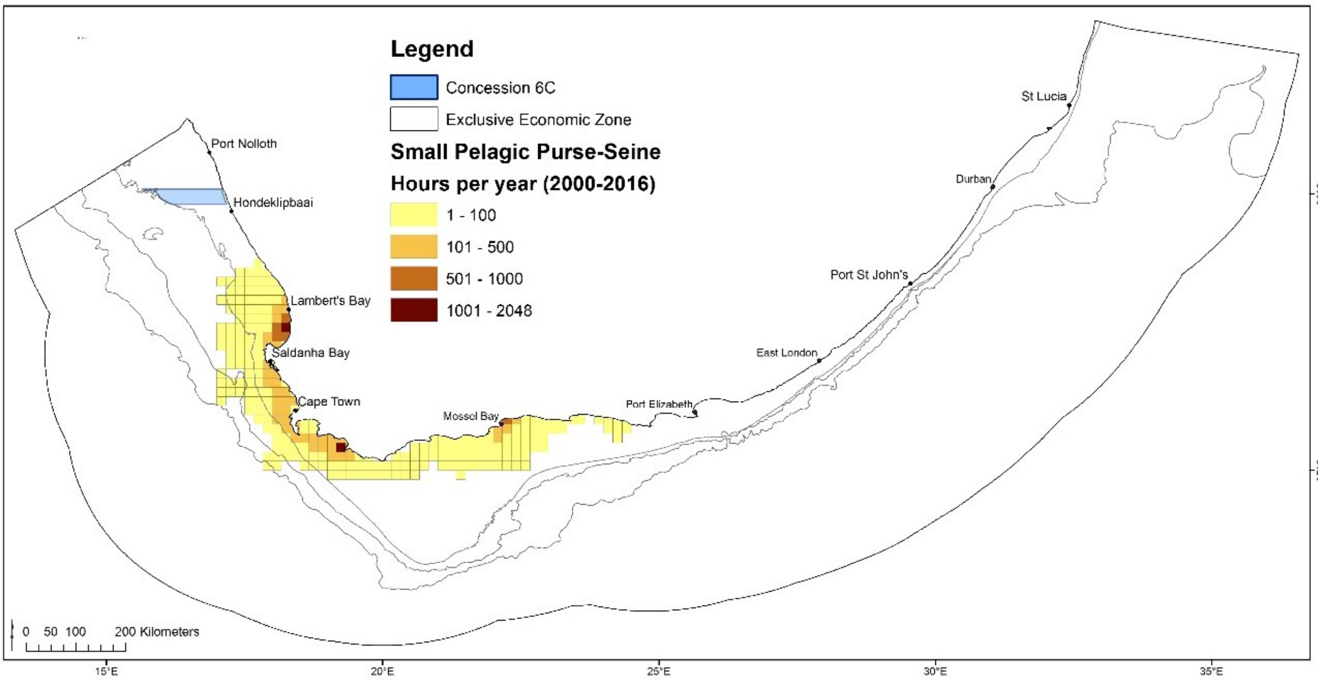

FIGURE 4-9: SEA CONCESSION 6C IN RELATION TO THE SPATIAL DISTRIBUTION OF EFFORT REPORTED BY THE SOUTH AFRICAN SMALL PELAGIC PURSE-SEINE FISHERY (2000 – 2016).

4.1.4.1.2 Demersal Trawl

The hake-directed trawl fishery is the most valuable sector of the South African fishing industry and is split into two sub-sectors: the offshore ("deep-sea") sector which is active off both the South and West Coasts, and the much smaller inshore trawl sector which is active off the South Coast. A fleet of 45 trawlers operate within the offshore sector targeting the Cape hakes (*Merluccius capensis* and *M. paradoxus*). Main by-catch species include monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*).

Trawls are usually conducted along specific trawling lanes on "trawl friendly" substrate (flat, soft ground). On the West Coast, these grounds extend in a continuous band along the shelf edge between the 300 m and 1 000 m bathymetric contours. Monk-directed trawlers tend to fish shallower waters than hake-directed vessels on mostly muddy substrates. 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. 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 offshore fleet is segregated into wetfish and freezer vessels which differ in terms of the capacity for the processing of fish at sea and in terms of vessel size and capacity. While freezer vessels may work in an area for up to a month at a time, wetfish vessels may only remain in an area for about a week before returning to port. Wetfish vessels range between 24 m and 56 m in length while freezer vessels are usually larger, ranging up to 80 m in length. The gear configurations are similar for both freezer and wet fish vessels. Trawl gear is deployed astern of the vessel.

The towed gear typically consists of trawl warps, bridles and trawl doors, a footrope, headrope, net and codend (see Figure 4-10). The monk-directed trawlers use slightly heavier trawl gear, trawl at slower speeds and for longer periods (up to eight hours) compared to the hake-directed trawlers (60 minutes to four hours). Monk gear includes the use of "tickler" chains positioned ahead of the footrope to chase the monk off the substrate and into the net.

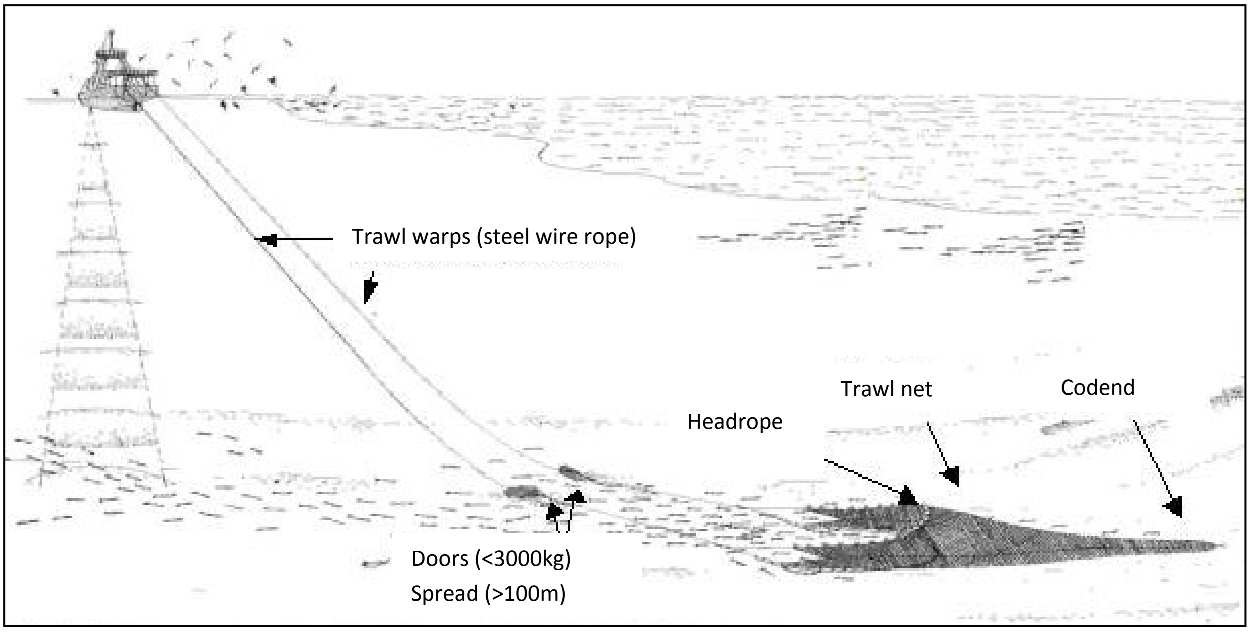

FIGURE 4-10: TYPICAL GEAR CONFIGURATION USED BY DEMERSAL TRAWLERS (OFFSHORE) TARGETING HAKE.

Figure 4-11 shows the demersal trawl effort and catch between 2008 and 2016 in relation to the area of interest. The South African Deepsea Trawling Industry Association (SADSTIA) has implemented a self-imposed restriction which confines fishing effort to a designated area ("the historical footprint of the fishery"). This spatial restriction is also written into the permit conditions for the fishery. In the vicinity of the concession area, demersal trawling is centred along the 500 m bathymetric contour but ranges to 300 m and to 200 m in places (e.g. around Child's Bank submarine canyon). There is no direct overlap between trawling grounds and Sea Concession area 6C, which is situated at least 30 km from the designated footprint of trawling ground. The concession area does, however, coincide with spawning and recruitment areas for hake and other demersal species.

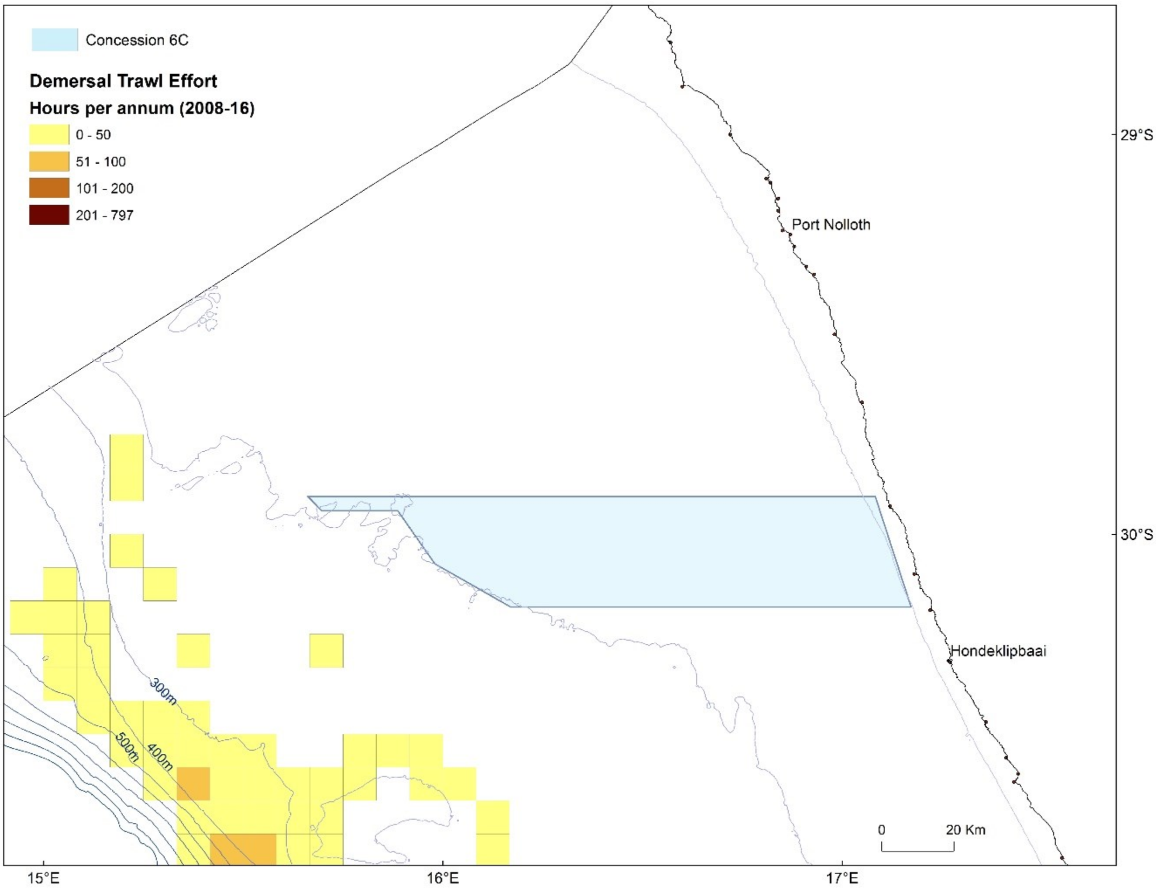

FIGURE 4-11: SEA CONCESSION 6C IN RELATION TO THE SPATIAL DISTRIBUTION OF TRAWLING EFFORT EXPENDED BY THE DEMERSAL TRAWL SECTOR (2008 TO 2016).

4.1.4.1.3 Demersal Long-Line

The demersal long-line fishing technique is used to target bottom-dwelling species of fish. Like the demersal trawl fishery, the target species of the longline fishery is the Cape hakes, with a small amount of non-targeted commercial by-catch.

A demersal long-line vessel may deploy either a double or single line which is weighted along its length to keep it close to the seafloor (see Figure 4-12). Steel anchors, of 40 kg to 60 kg, are placed at the ends of each line to anchor it, and are marked with an array of floats. If a double line system is used, top and bottom lines are connected by means of dropper lines. 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 to soak 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. Currently 64 hake-directed vessels are active within the fishery, most of which operate from the harbours of Cape Town and Hout Bay.

The target fishing grounds are similar to those targeted by the hake-directed trawl fleet. Off the West Coast, vessels target fish along the shelf break from Port Nolloth (15°E, 29°S) to the Agulhas Bank (21°E, 37°S). Off the West Coast (westward of 20°E) the fishery is prohibited from operating within five nautical miles of the coastline and effort is concentrated at about 300 m depth on areas of rough ground. Fishing activity records (from 2000 to 2017) shows frequented grounds at distances of 20 km and 40 km from the north-westerly and south-westerly extents of the concession area, respectively (see Figure 4-13). However, there are records of sporadic activity within the concession area that amounts to an average of one line set per year and a catch of approximately 4 tons of hake. This is equivalent to approximately 0.05% of the total landing of hake by the sector per year during this period. As noted above, that the concession area overlaps spawning and recruitment areas for hake and other demersal species.

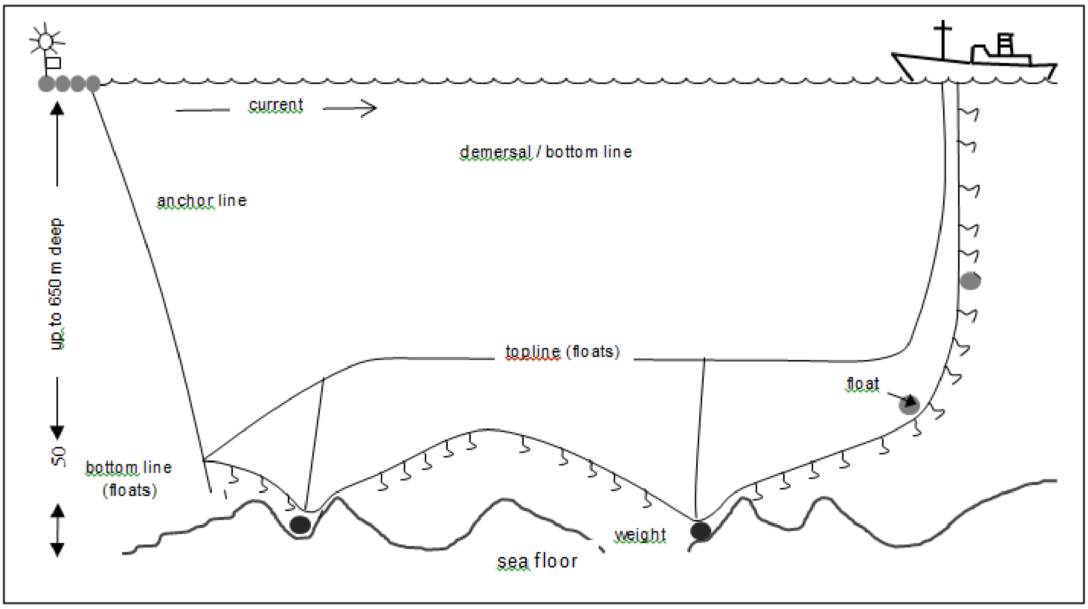

FIGURE 4-12: TYPICAL CONFIGURATION OF DEMERSAL (BOTTOM-SET) HAKE LONG-LINE GEAR USED IN SOUTH AFRICAN WATERS.

4.1.4.1.4 Large 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 30 commercial large pelagic fishing rights issued for South African waters and there are 21 vessels active in the fishery.

Pelagic long-line vessels set a drifting mainline, which can be up to 100 km in length. The mainline is kept near the surface or at a certain depth (20 m below) by means of buoys connected via “buoy-lines”, which are spaced approximately 500 m apart along the length of the mainline (see Figure 4-14). 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.

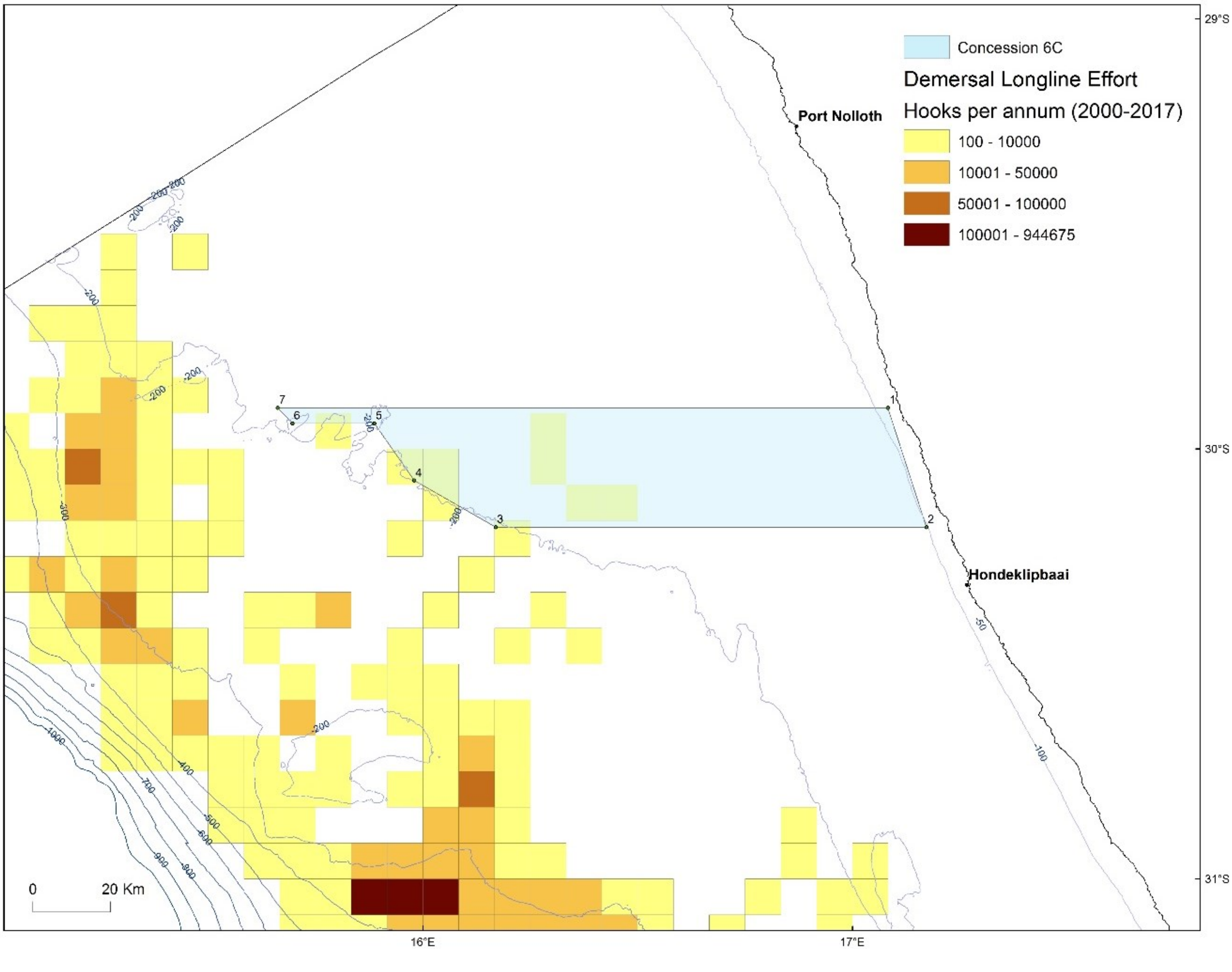

FIGURE 4-13: SEA CONCESSION 6C IN RELATION TO THE SPATIAL DISTRIBUTION OF EFFORT EXPENDED BY DEMERSAL LONG-LINE FISHERY (2000 – 2017).

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 and can be expected within the area of interest.

Vessels operate predominantly from the shelf break and into deeper waters and are prohibited from operating within 12 nm of the coastline (or within 20 nm of the coastline off KwaZulu-Natal). In the vicinity of Concession Area 6C, vessels operate along and offshore of the 500 m depth contour, which is situated about 90 km offshore of the concession area (see Figure 4-15). There is no direct overlap of the concession area with either fishing ground or spawning and recruitment areas of large pelagic species.

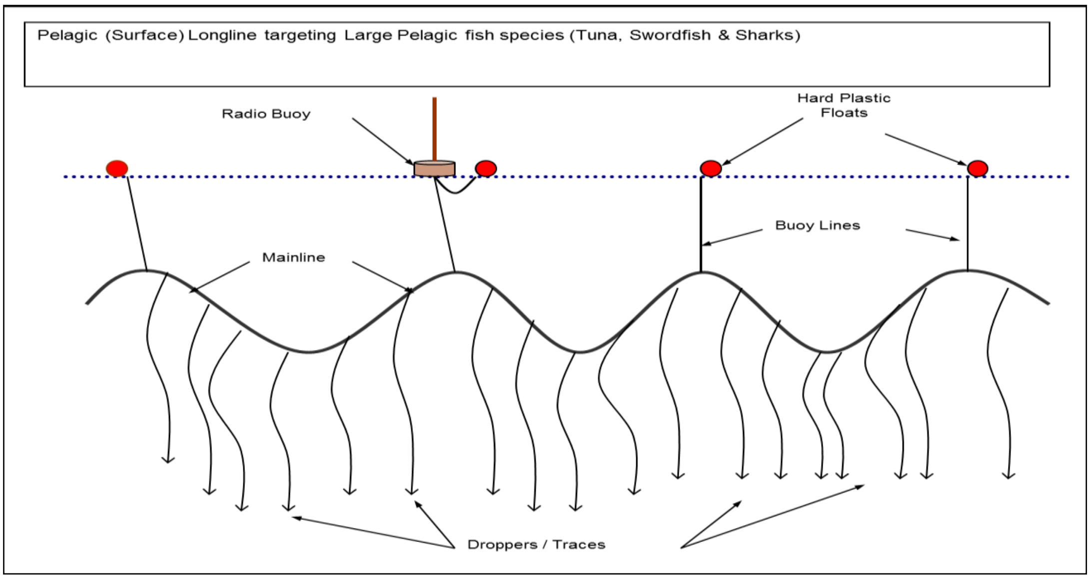

FIGURE 4-14: TYPICAL PELAGIC LONG-LINE CONFIGURATION TARGETING TUNA, SWORDFISH AND SHARK SPECIES

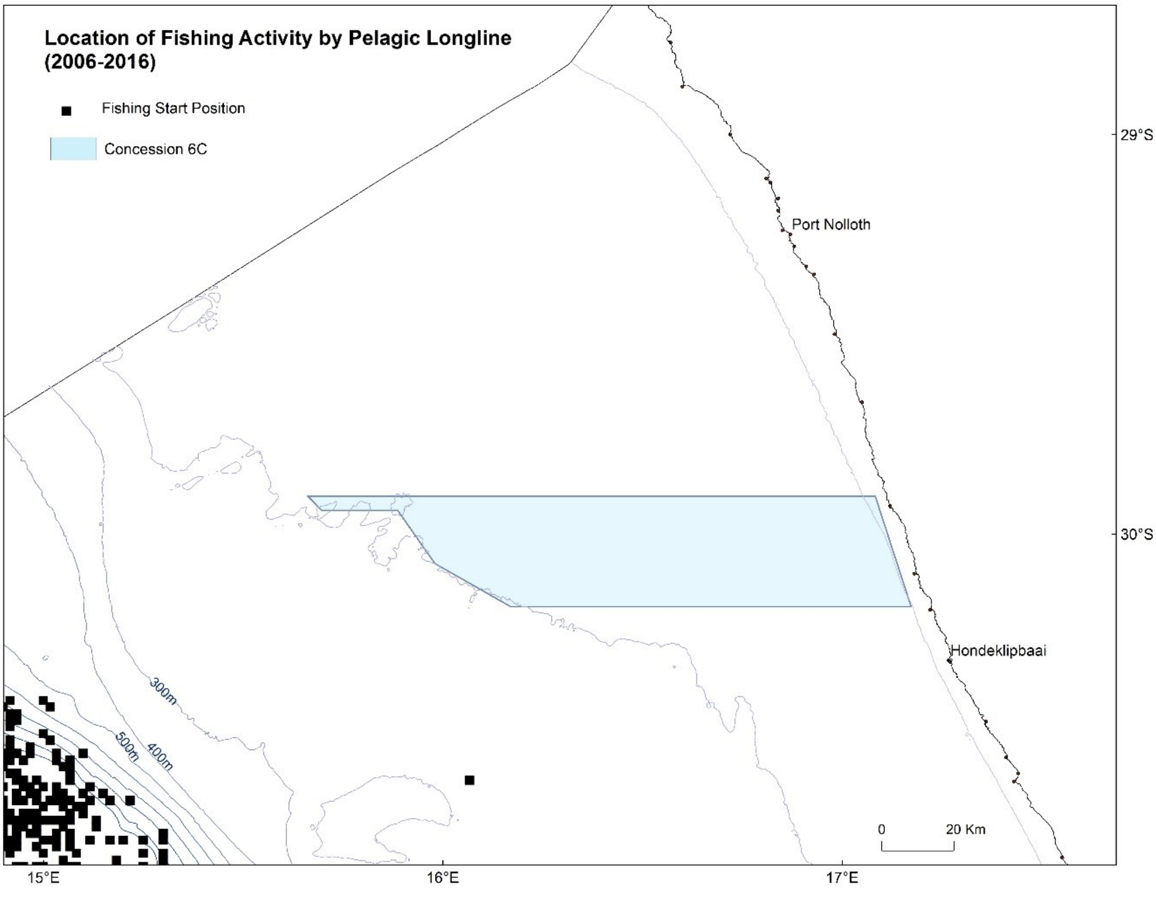

FIGURE 4-15: SEA CONCESSION 6C IN RELATION TO SPATIAL DISTRIBUTION OF FISHING POSITIONS RECORDED BETWEEN 2006 AND 2016 BY THE SOUTH AFRICAN LARGE PELAGIC LONGLINE SECTOR.

4.1.4.1.5 Tuna Pole

The tuna pole fishery is based on migratory species of tuna, predominantly Atlantic longfin tuna stock and a very small amount of skipjack tuna, yellowfin tuna and bigeye tuna. The South African fleet consists of approximately 128 pole-and-line vessels, which are based at the ports of Cape Town, Hout Bay and Saldanha Bay. The fishery is seasonal with vessel activity mostly between December and May and peak catches in February and March.

Vessels drift whilst attracting and catching shoals of pelagic tunas. Sonars and echo sounders are used to locate schools of tuna. Once a school is located, water is sprayed outwards from high-pressure nozzles to simulate small baitfish aggregating near the water surface. Live bait is then used to entice the tuna to the surface (chumming). Tuna swimming near the surface are caught with hand-held fishing poles. The ends of the 2 to 3 m poles are fitted with a short length of fishing line leading to a hook. In order to land heavier fish, lines may be strung from the ends of the poles to overhead blocks to increase lifting power (see Figure 4-16). 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).

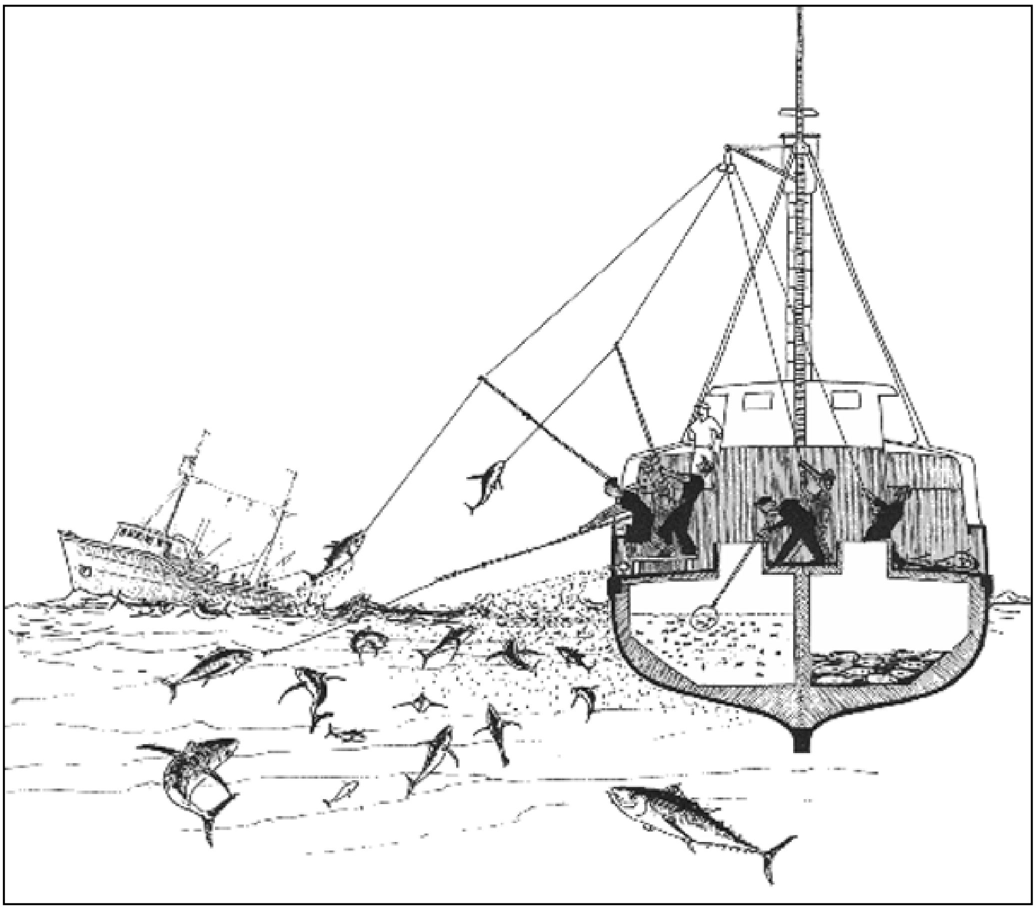

FIGURE 4-16: SCHEMATIC DIAGRAM OF POLE AND LINE OPERATION (WWW.FAO.ORG/FISHERY).

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.

Fishing activity occurs along the entire West Coast beyond the 200 m bathymetric contour. Activity would be expected to occur along the shelf break with favoured fishing grounds including areas north of Cape Columbine and between 60 km and 120 km offshore from Saldanha Bay. The tuna pole effort and catch between 2007 and 2016 in relation to the area of interest is shown in Figure 4-17. Although the main targeted fishing grounds off the West Coast are situated south of the concession area, there are records of fishing activity which coincide with the north-western extent of the concession area which is most likely due to vessels fishing en route to favoured grounds off Tripp Seamount on the Namibian side of the maritime border. Over the period 2007 to 2016, 32 fishing events were reported within the concession area (this is comparable to 32 days of fishing effort) with a cumulative catch of 58.3 tons of albacore over this period. This amounts to 5.8 tons per year which is equivalent to 0.2% of the total albacore landed by the sector (nationally).

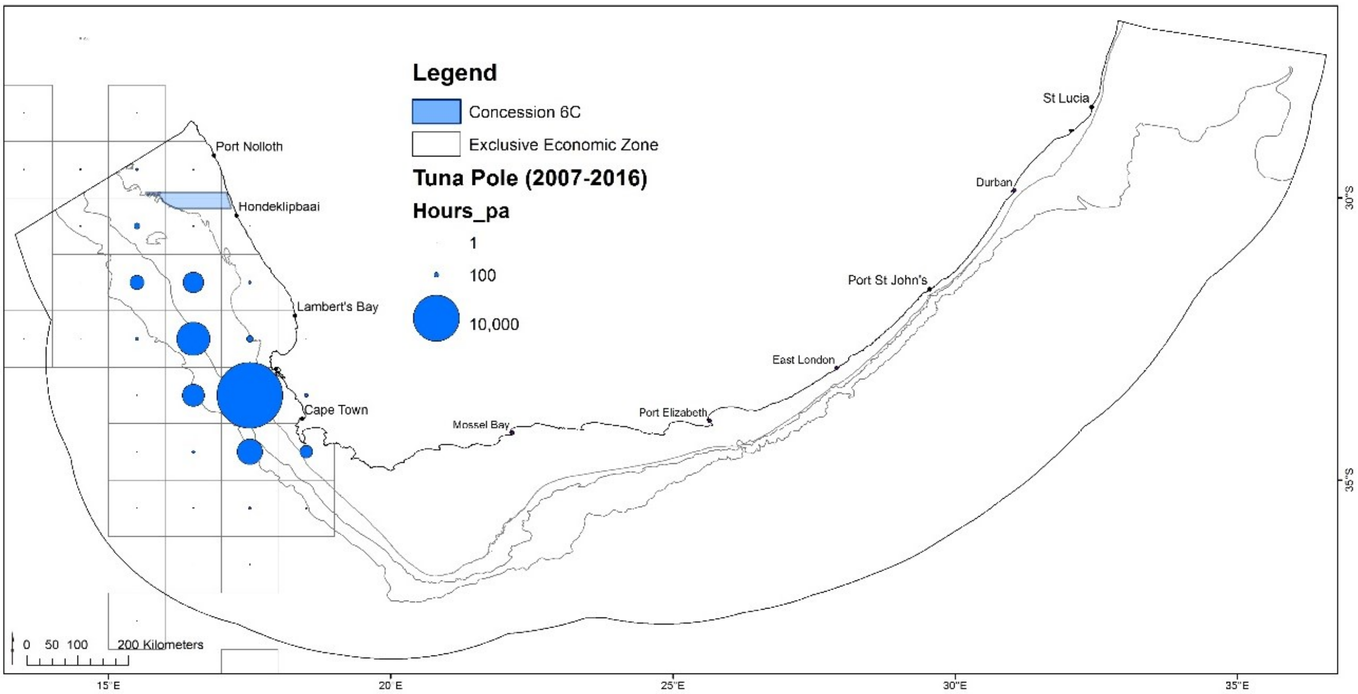

FIGURE 4-17: SEA CONCESSION 6C IN RELATION TO THE SPATIAL DISTRIBUTION OF TUNA POLE CATCH (2007 TO 2016).

4.1.4.1.6 Traditional line-fish

The line-fishery is divided into the commercial and recreational sectors, with the subsistence sector now falling under the classification of small-scale fishing. The commercial (or traditional) 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 about 35 different species of reef fish as well as pelagic and demersal species which are mostly marketed locally as "fresh fish". 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 mostly up to a depth of 200 m from the Namibian border on the West Coast to the Kei River in the Eastern Cape. Sea Concession 6C coincides with line-fish management Zone A which extends from the Namibian border to Cape Infanta. Fishing vessels generally range up to a maximum offshore distance of about 70 km, although fishing at this outer limit and beyond is sporadic (C. Wilke, pers. comm).

The traditional line fishery is defined by the use of a simple hook-and-line fishing system (excluding the use of longlines and drumlines), with a limit of 10 hooks per line (DAFF 2017). There are 450 vessels operating in the fishery, making it the largest fishing fleet in South Africa. Vessels are monitored by Vessel Monitoring System (VMS) and permit conditions require that catch be reported for each fishing trip; however, logbook data are unverified and may underestimate total landings (da Silva et al., 2015).

The recreational line fishery includes shore- and boat-based fishing with the predominant use of rod and line. An estimated 500 000 participants are active in the recreational sector (Griffiths and Lamberth, 2002). Community-based fishing of line-fish species for subsistence purposes is now managed under South Africa's small-scale fishery policy which was implemented in 2016 (DAFF 2016).

Fishing activity is reported by landing point. In the vicinity of Sea Concession 6C, Hondeklipbaai is the closest landing point. Over the period 2000 to 2016, an average landing of 182 kg per year were reported for the area. Over the same period 2.5 tons of catch was reported for fishing positions in the vicinity of Port Nolloth, situated 70 km northward of the concession area. The combined catch at Hondeklipbaai and Port Nolloth is equivalent to approximately 0.03% of the overall national landings of the sector. The reporting of fishing positions is not specific, but generally reported according to reference positions for different areas. It is assumed that fishing could take place across the extent of Sea Concession 6C.

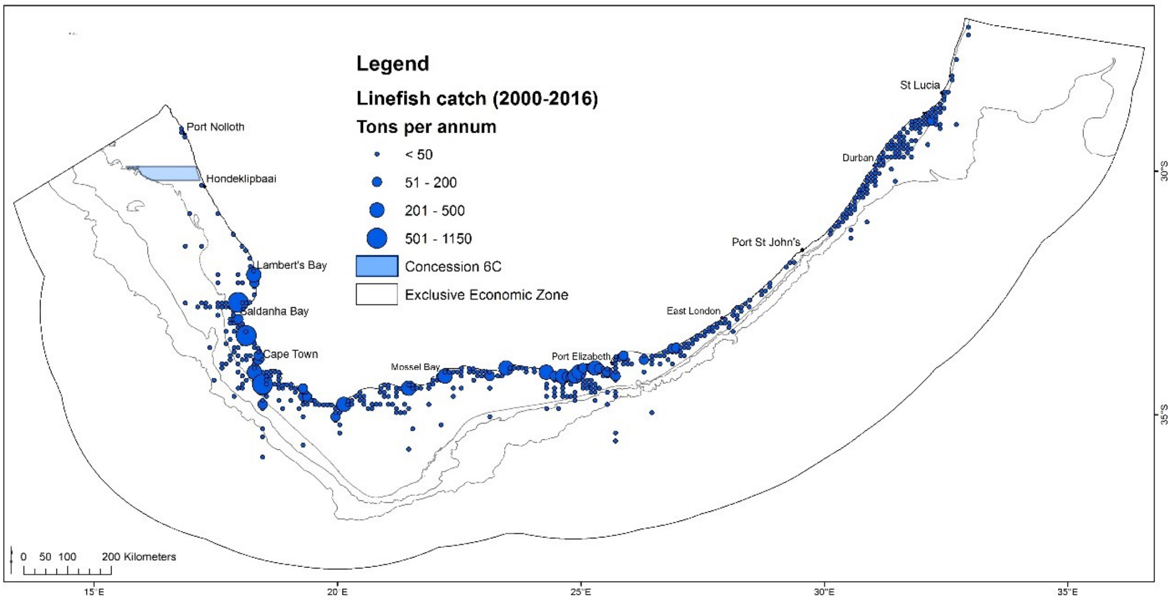

FIGURE 4-18: SEA CONCESSION 6C IN RELATION TO SPATIAL DISTRIBUTION OF CATCH LANDED BY THE SOUTH AFRICAN TRADITIONAL LINE-FISH SECTOR (2000 – 2016).

4.1.4.1.7 West Coast Rock Lobster

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

Fishing grounds are divided into Zones stretching from the Orange River mouth to east of Cape Hangklip in the South-Eastern Cape. Effort is seasonal with boats operating from the shore and coastal harbours. Catch is managed using a TAC set annually for different management areas. The fishery operates seasonally, with closed seasons applicable to different management zones.

The Sea Concession area falls within Zone A, Management Area 2 (Hondeklipbaai) and Subarea 1 (Agtervoorklip to Swartduin), which extends along the coastline from 30°19´S to 29°40´S. Over the period 2006 to 2017 there has been no effort recorded by trap boats within the area, however there has been activity recorded by the near-shore sector amounting to 230 traps per year yielding 930 kg of rock lobster. Commercial catches of rock lobster in Management Area 2 are limited to shallow water (<30 m) with almost all the catch being taken shallower than 15 m depth. There is therefore no direct overlap with the proposed prospecting operations which would be located offshore of the 70 m depth contour. The areas fished by bakkies (using hoopnets) in the vicinity of marine concession area 6C are shown in Figure 4-19.

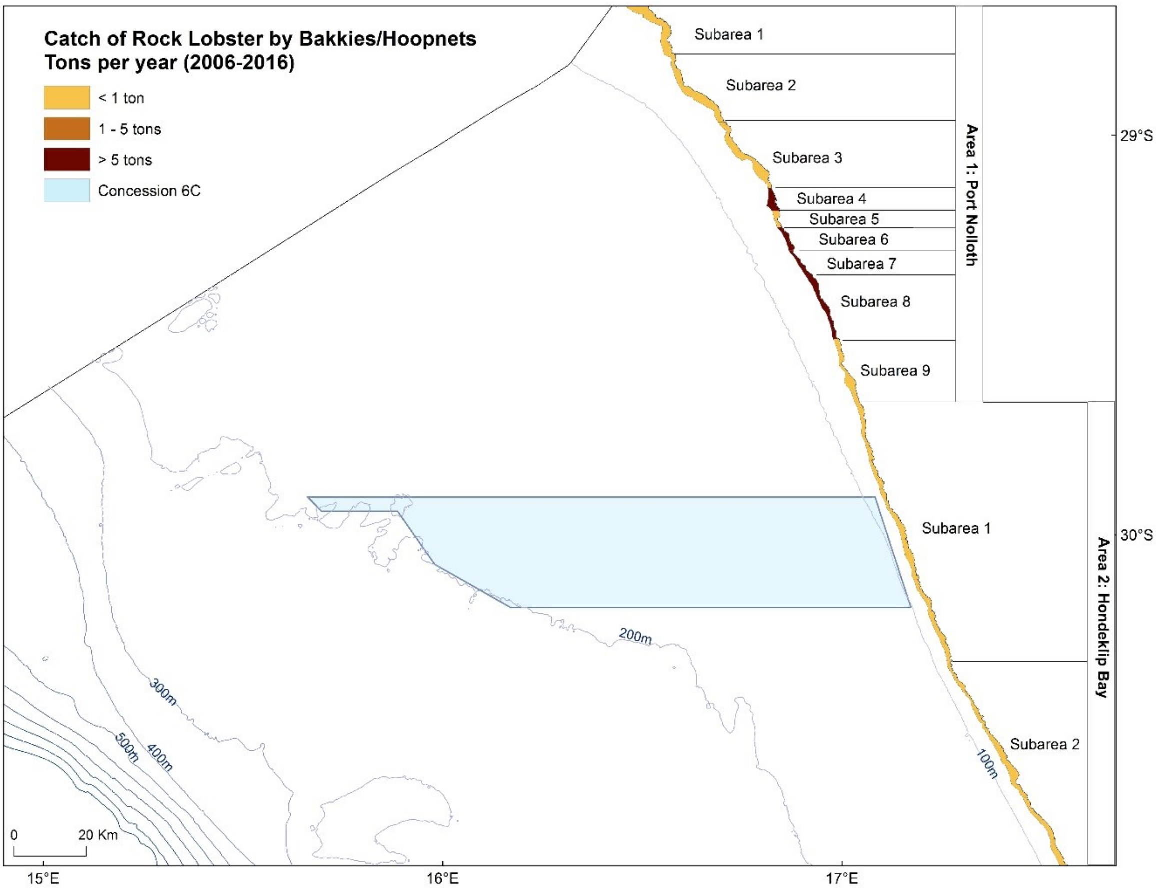

FIGURE 4-19: SEA CONCESSION 6C IN RELATION TO THE AVERAGE CATCH PER SEASON (TONS WHOLE WEIGHT) BY THE NEARSHORE (BAKKIE) SECTOR OF THE WEST COAST ROCK LOBSTER FISHERY (2006 TO 2016).

4.1.4.1.8 Abalone ranching

The Abalone (*Haliotus midae*), is endemic to South Africa with the natural population extending east from St Helena Bay in the Western Cape to Port St Johns on the east coast (Branch et al. 2010; Troell et al 2006). Seeding of abalone in designated areas (ranching) has led to the establishment of abalone outside this natural range, including sites along approximately 50 km of the Namaqualand coast in the Northern Cape. The potential to increase this seeded area to 175 km has been made possible through the issuing of “Abalone Ranching Rights” (Government Gazette No. 729 of 20 August 2010) in four concession zones between Alexander Bay and Hondeklipbaai (Diamond Coast Abalone 2016).

Kelp forests are a key habitat for abalone, as they provide a key food source for abalone as well as an ideal ecosystem for abalone’s life cycle (Branch *et al.,* 2010). Light is a limiting factor for kelp beds, which are therefore limited to depths of 10 m on the Namaqualand coast (Anchor Environmental, 2012). In the wild, abalone may take 30 years to reach full size of 200 mm, but farmed abalone attain 100 mm in only 5 years, which is the maximum harvest size (Sales & Britz, 2001).

Abalone ranching was pioneered by Port Nolloth Sea Farms who were experimentally seeding kelp beds in Port Nolloth by 2000. Abalone ranching expanded in the area in 2013 when the Department of Agriculture, Forestry and Fisheries (DAFF) issued rights for each of four Concession Area Zones. Two hatcheries exist in Port Nolloth producing up to 250 000 spat. To date, there has been no seeding in Zones 1 or 2. However, seeding has taken place in Zones 3 and 4, both of which are situated on the inshore portion of Sea Concession 6C, thus there is a small degree of overlap (see Figure 4-18).

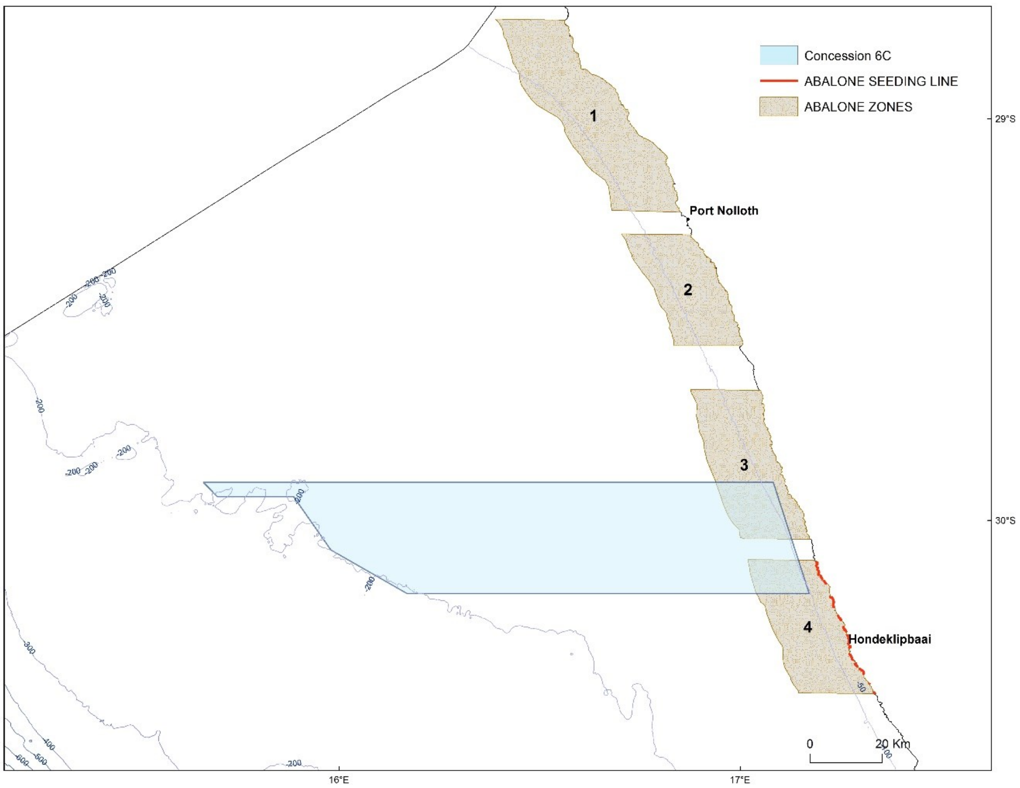

FIGURE 4-20: LOCATION OF SEA CONCESSION 6C IN RELATION TO OF ABALONE RANCHING ZONES.

4.1.4.1.9 Small-scale fisheries

Small-scale fishers using traditional fishing gear have historically harvested marine resources along the coastline of South Africa for consumptive use, livelihoods, and medicinal purpose. In compliance with an order from the Equality Court to redress the inequality suffered by the small scale fishers, the small-scale fishery policy implementation plan was initiated in 2016 (DAFF 2016).

Small-scale fishers fish to meet food and basic livelihood needs, and may be directly involved in harvesting, processing and distribution of fish for commercial purposes. These fishers traditionally operate on nearshore fishing grounds, using traditional low technology or passive fishing gear to harvest marine living resources on a full-time, part-time or seasonal basis. Fishing trips are usually a single day in duration and fishing/harvesting techniques are labour intensive.

In the Eastern Cape, KwaZulu-Natal and the Northern Cape, small-scale fishers live predominantly in rural areas while those in the Western Cape live mainly in urban and peri-urban areas. Resources are managed in terms of a community-based co-management approach that aims to ensure that harvesting and utilisation of the resource occurs in a sustainable manner in line with the ecosystems approach.

The small-scale fisheries policy proposes that certain areas on the coast be prioritized and demarcated as small-scale fishing areas. In some areas access rights could be reserved exclusively for use by small-scale fishers. The community, once they are registered as a community-based legal entity, could apply for the demarcation of these areas and should conflict arise, it should be referred to conflict resolution under the Policy. The policy also requires a multi-species approach to allocating rights, which will entail allocation of rights for a basket of species that may be harvested or caught within particular designated areas.

DAFF recommended five basket areas: 1. Basket Area A – The Namibian border to Cape of Good Hope – 57 different resources 2. Basket Area B – Cape of Good Hope to Cape Infanta – 109 different resources 3. Basket Area C – Cape Infanta to Tsitsikamma – 107 different resources 4. Basket Area D – Tsitsikamma to the Pondoland MPA – 138 different resources 5. Basket Area E – Pondoland MPA to the Mozambican border – 127 different resources. Sea Concession Area 6C falls within the area demarcated as Basket Area 1, within which Hondeklipbaai is the access point for participants in the small-scale fishing sector.

4.1.4.1.10 Beach-seine and gillnet fisheries

There are a number of active beach-seine and gillnet operators throughout South Africa (collectively referred to as the “netfish” sector). Initial estimates indicate that there are at least 7 000 fishermen active in fisheries using beach-seine and gillnets, mostly (86%) along the West and South coasts. These fishermen utilise 1 373 registered nets and report an average catch of about 1 600 tons annually, constituting 60% harders (also known as mullet, *Liza richardsonii*), 10% St Joseph shark (*Callorhinchus capensis*) and 30% "bycatch" species such as galjoen (*Dichistius capensis*), yellowtail (*Seriola lalandii*) and white steenbras (*Lithognathus lithognathus*).

The fishery is managed on a Total Allowable Effort (TAE) basis with a fixed number of operators in each of 15 defined areas. The number of Rights Holders for 2014 was listed as 28 for beach-seine and 162 for gill-net

(DAFF, 2014a). Permits are issued solely for the capture of harders, St Joseph and species that appear on the 'bait list'. The exception is False Bay, where Right Holders are allowed to target line-fish species that they traditionally exploited.

The beach-seine fishery operates primarily on the West Coast of South Africa between False Bay and Port Nolloth (Lamberth 2006) with a few permit holders in KwaZulu-Natal targeting mixed shoaling fish during the annual winter migration of sardine (Fréon et al. 2010). Beach-seining is an active form of fishing in which woven nylon nets are rowed out into the surf zone to encircle a shoal of fish. They are then hauled shorewards by a crew of 6–30 persons, depending on the size of the net and length of the haul. Nets range in length from 120 m to 275 m. Fishing effort is coastal and net depth may not exceed 10 m (DAFF 2014b). There are currently no rights issued for Area B (Hondeklipbaai).

The gillnet fishery operates from Yzerfontein to Port Nolloth on the West Coast. Surface-set gillnets (targeting mullet) are restricted in size to 75 m x 5 m and bottom-set gillnets (targeting St Joseph shark) are restricted to 75 m x 2.5 m (da Silva et al. 2015) and are set in waters shallower than 50 m. The spatial distribution of effort is represented as the annual number of nets per kilometre of coastline and ranges up to a maximum of 15 off St Helena Bay. Of a total of 162 right holders, two operate within Area B (Hondeklipbaai).

Sea Concession 6C is situated offshore of Management Area B (Figure 4-21) and the range of gillnets (50 m) and that of beach-seine activity (20 m) is not likely to directly overlap with the concession area where prospecting would take place in waters deeper than 70 m.

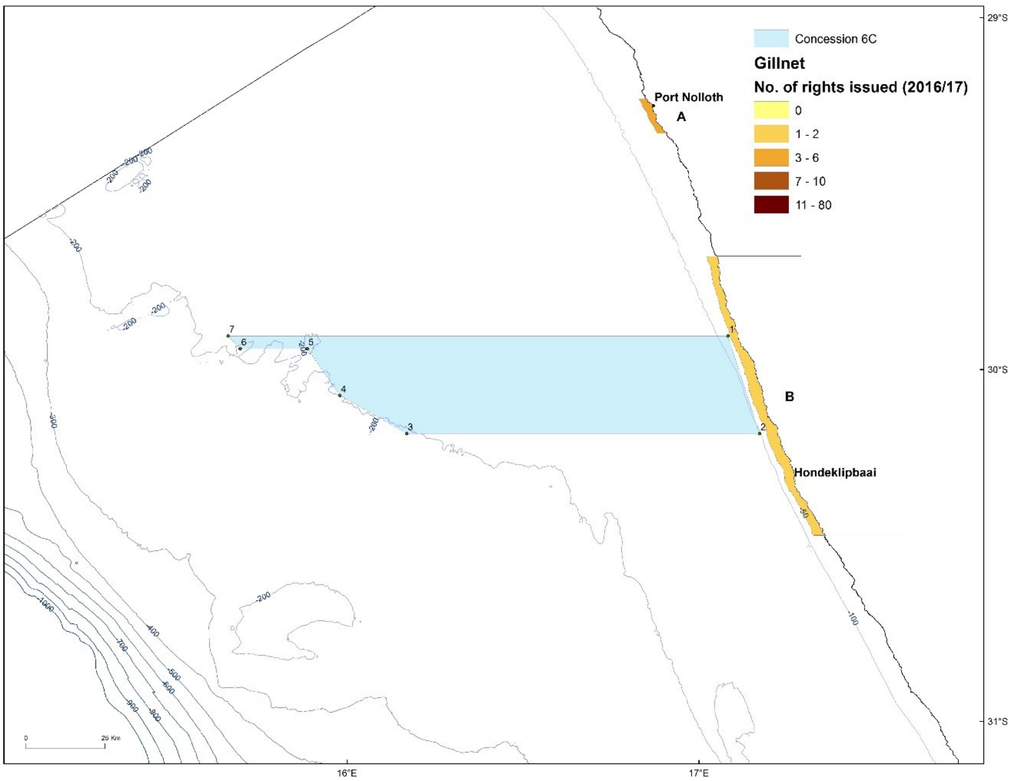

FIGURE 4-21: SEA CONCESSION 6C IN RELATION TO THE RIGHTS ISSUED FOR GILLNET FISHING AREAS A AND B.

4.1.4.1.11 Fisheries Research

Swept-area trawl surveys of demersal fish resources are carried out in January (West Coast survey) and April/May (South Coast survey) each year by DAFF in order to set the annual TACs for demersal fisheries. Stratified, bottom trawls are conducted to assess the biomass, abundance and distribution of hake, horse mackerel, squid and other demersal trawl species on the shelf and upper slope of the South African coast. The gear configuration is similar to that of commercial demersal trawlers, however, nets are towed for a shorter duration of generally 30 minutes per tow. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000 m bathymetric contour (see Figure 4-22). Approximately 120 trawls are conducted during each survey over a period of approximately one month.

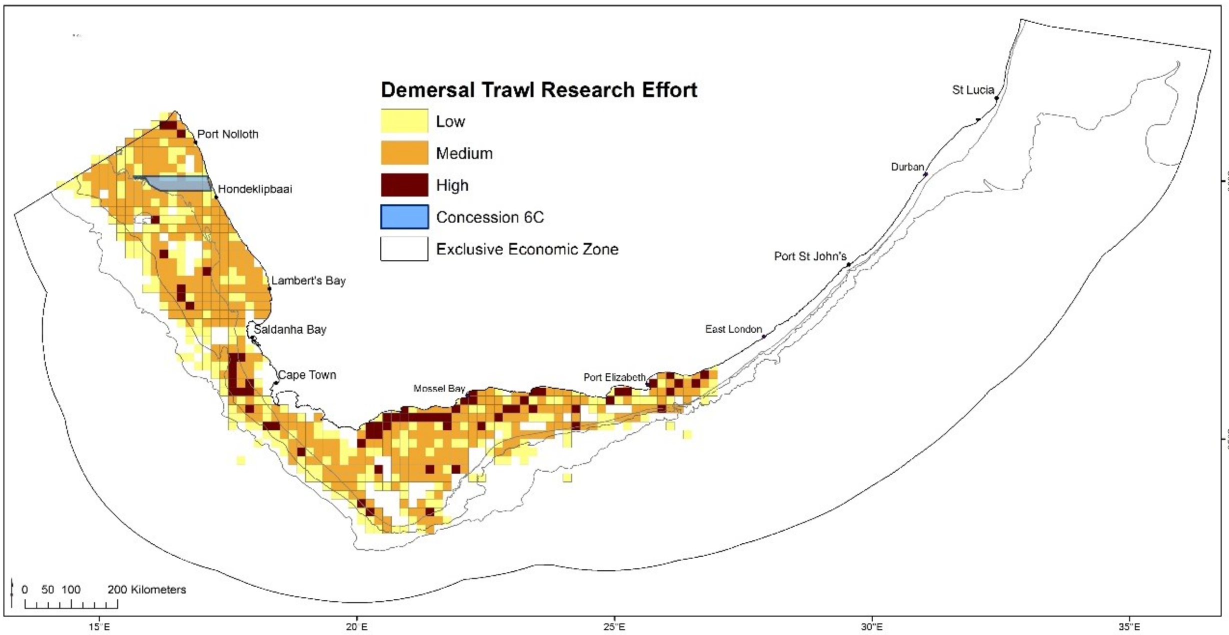

Figure 4-22: Sea Concession 6C in relation to the spatial distribution of trawling effort expended during research surveys undertaken by DAFF between 1985 and 2012.

The biomass of small pelagic species is assessed bi-annually by an acoustic survey. The first of these surveys is timed to commence in mid-May and runs until mid-June, while the second starts in mid-October and runs until mid-December. The timing of the demersal and acoustic surveys is not flexible, due to restrictions with availability of the research vessel as well as scientific requirements. During these surveys the survey vessels travel pre-determined transects (perpendicular to bathymetric contours) running offshore from the coastline to approximately the 200 m isobath (see Figure 4-23**Error! Reference source not found.**). The surveys are designed to cover an extensive area from the Orange River on the West Coast to Port Alfred on the East Coast and the DAFF survey vessel progresses systematically from the Northern border Southwards, around Cape Agulhas and on towards the east. Acoustic biomass surveys take place inshore of the 200 m isobath.

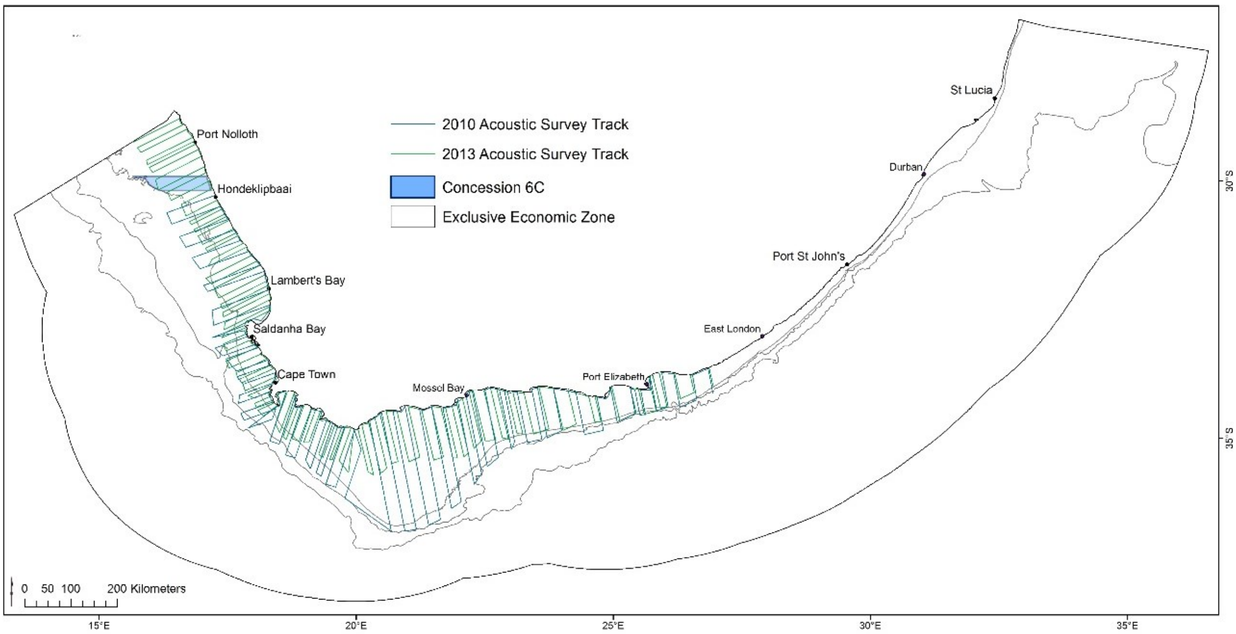

Figure 4-23: Sea Concession 6C in relation to the spatial distribution of tracks undertaken during biomass surveys of small pelagic species undertaken by DAFF during 2010 and 2013..

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 4-24). The main shipping lanes overlap with the western portion of the Sea Concession 6C area.

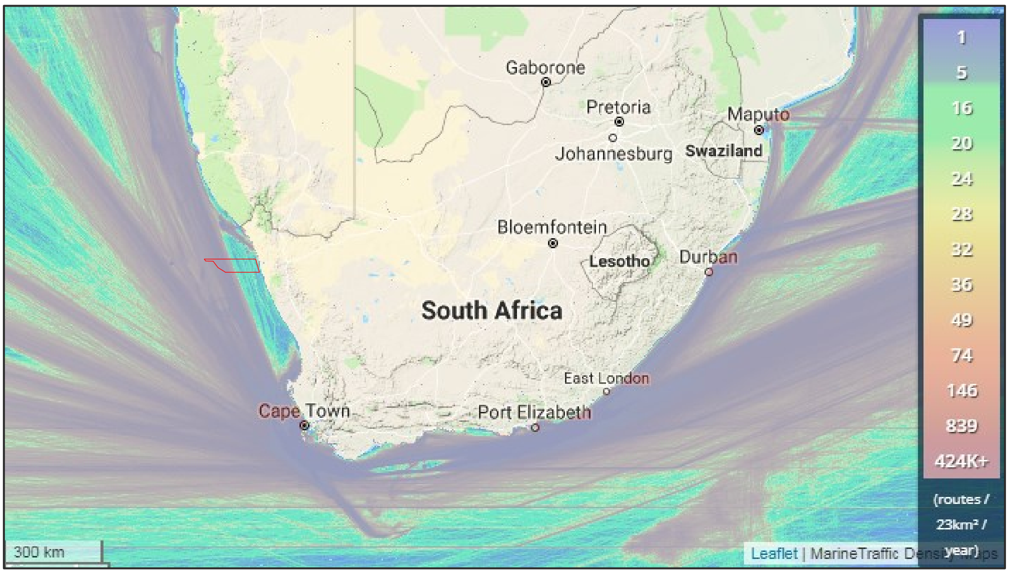

FIGURE 4-24: THE MAJOR SHIPPING ROUTES ALONG THE WEST COAST OF SOUTH AFRICA SHOWING PETROLEUM LICENSE BLOCKS (DATA FROM THE SOUTH AFRICAN CENTRE FOR OCEANOGRAPHY). APPROXIMATE LOCATION OF SEA CONCESSION AREA 6C IS ALSO SHOWN.

4.1.4.3 Oil and Gas exploration and production

4.1.4.3.1 Exploration

The South African continental shelf and economic exclusion zone (EEZ) have similarly been partitioned into Licence blocks for petroleum exploration and production activities. Oil and gas exploration in the South African offshore commenced with seismic surveys in 1967. Since then numerous 2D and 3D seismic surveys have been undertaken in the West Coast offshore.

Approximately 40 exploration wells have been drilled since the 1960's. Prior to 1983, reliable technology was not available for removing wellheads from the seafloor. Since then, however, on completion of drilling operations, the well casing has been severed 3 m below the sea floor and removed from the seafloor together with the permanent and temporary guide bases. Of the approximately 40 wells drilled, 35 wellheads remain on the seafloor (Figure 4-25). Location and wellhead details are available from the Hydrographic office of the South African Navy (which issues the details to the public in a notice to mariners) or directly from PASA. Although no wells have recently been drilled in the area, further exploratory drilling is proposed for inshore and offshore portions of Block 1, with further target areas in Block 2B and the Orange Basin.

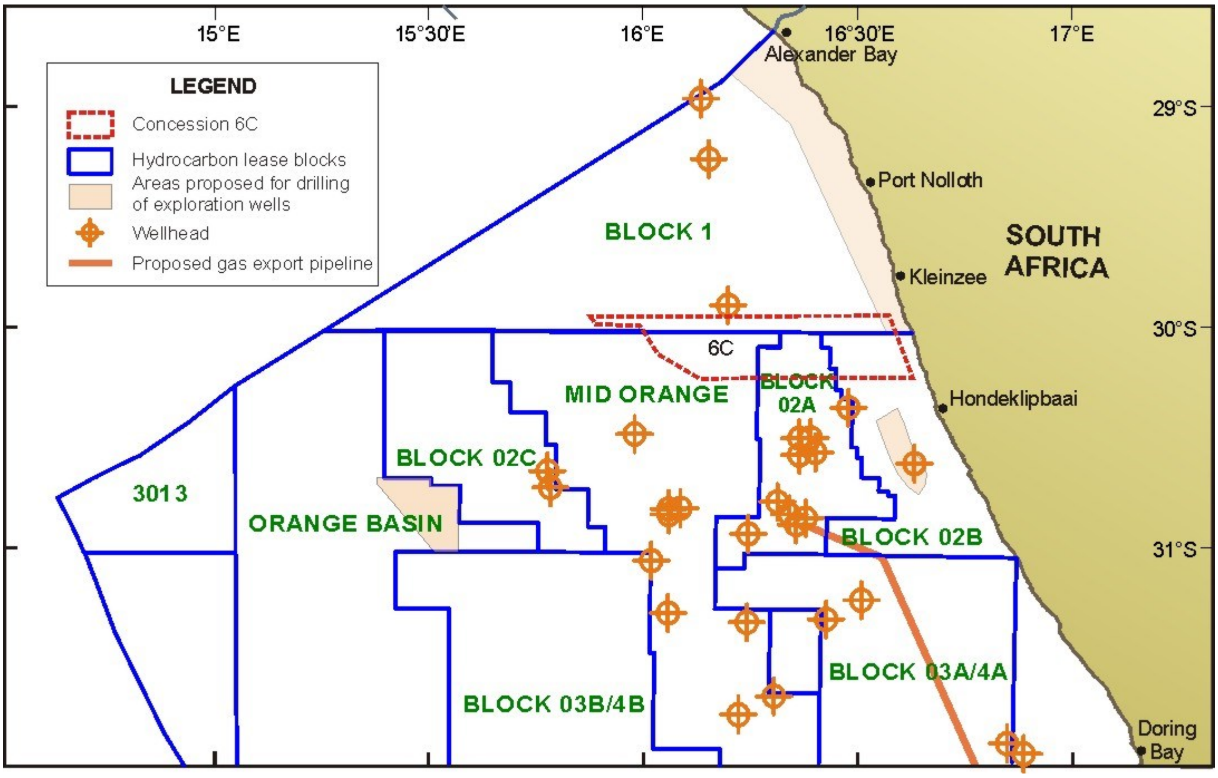

FIGURE 4-25: SEA CONCESSION AREAS 6C IN RELATION TO THE LOCATION OF HYDROCARBON LEASE BLOCKS, EXISTING WELL HEADS, PROPOSED AREAS FOR EXPLORATORY WELLS AND THE ROUTING OF THE PROPOSED IBHUBESI GAS EXPORT PIPELINE.

4.1.4.3.2 Development and production

There is no current development or production from the South African west coast offshore. The Ibhubesi Gas Field (Block 2A) and Kudu Gas Field (which lies several hundred kilometres to the north-west off the coast of southern Namibia) have been identified for development. In this regard, a subsea pipeline to export gas from the iBhubesi field to a location either on the Cape Columbine peninsula or to Ankerlig approximately 25 km north of Cape Town is currently being proposed by Sunbird SA.

4.1.4.4 Diamond prospecting and mining

The coastal area onshore of Sea Concession 6C falls within the West Coast Resources coastal diamond mining areas and as public access is restricted, recreational activities along the coastline between Hondeklipbaai and Alexander Bay is limited to the area around Port Nolloth.

The concession area lies adjacent to a number of marine diamond mining concession areas (see Figure 4-26). The marine diamond mining concession areas are split into four or five zones (Surf zone and (a) to (c) or (d)-concessions), which together extend from the high water mark out to approximately 500 m depth (Figure 4-27).

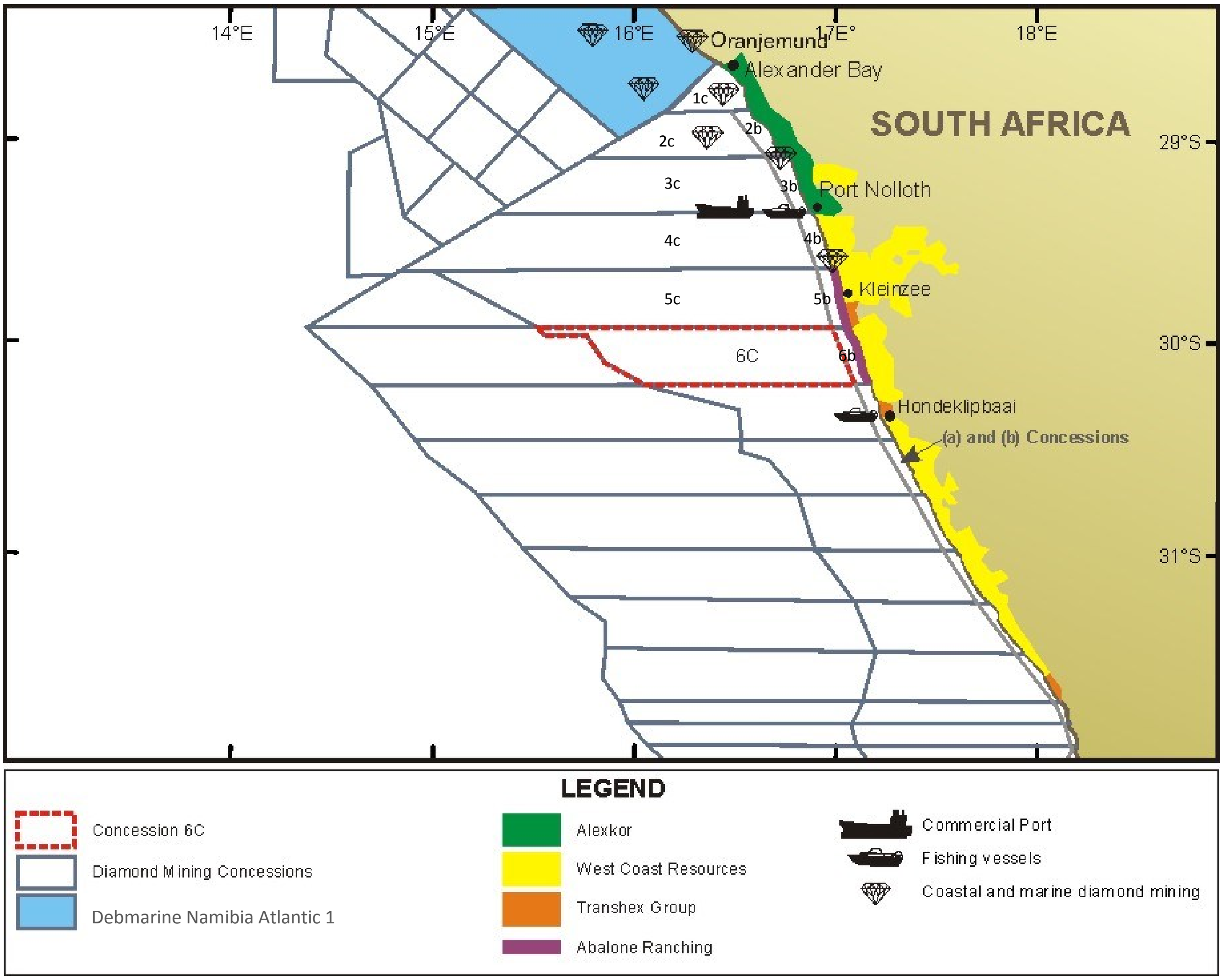

FIGURE 4-26: LOCATION OF SEA CONCESSION 6C IN RELATION TO MARINE DIAMOND MINING CONCESSIONS AND PORTS FOR COMMERCIAL AND FISHING VESSELS AND THE PROPOSED SAMPLING TARGET AREA.

On the Namaqualand coast marine diamond mining activity is primarily restricted to the surf-zone and (a)-concessions. Nearshore shallow-water mining is typically conducted by divers using small-scale suction hoses operating either directly from the shore or from converted fishing vessels out to approximately 20 m depth. Diver-assisted mining is largely exploratory and highly opportunistic in nature, being dependent on suitable, calm sea conditions. The typically exposed and wave-dominated nature of the Namaqualand coast effectively limits the periods in which mining can take place to a few days per month. As shore-based divers cannot excavate a gravel depth much more than 0.5 m, mining rates are low, approximately 35 m2 worked by each contractor per year. Because of the tidal cycle and limitations imposed by sea conditions, such classifiers usually operate for less than 4 hours per day for an average of 5-6 days per month, although longer periods may be feasible in certain protected areas. However, with reference to the Alexkor 2013 Annual Report, it is noted that the number of days had declined from 79 in 2003 to eight in 2012 and 23 in 2013.

Vessel-based diver-Appointed contractors usually work in the depth range immediately seaward of that exploited by shore-based divers, targeting gullies and potholes in the sub-tidal area just behind the surf-zone. A typical boat-based operation consists of a 10 - 15 m vessel, with the duration of their activities limited to daylight hours for 3 - 10 diving days per month. Estimated mining rates for vessel-based operations range from 300 m^2 – 1 000 m^2/year. However, over the past few years there has been a substantial decline in small-scale diamond mining operations due to the global recession and depressed diamond prices, although some vessels do still operate out of Alexander Bay and Port Nolloth.

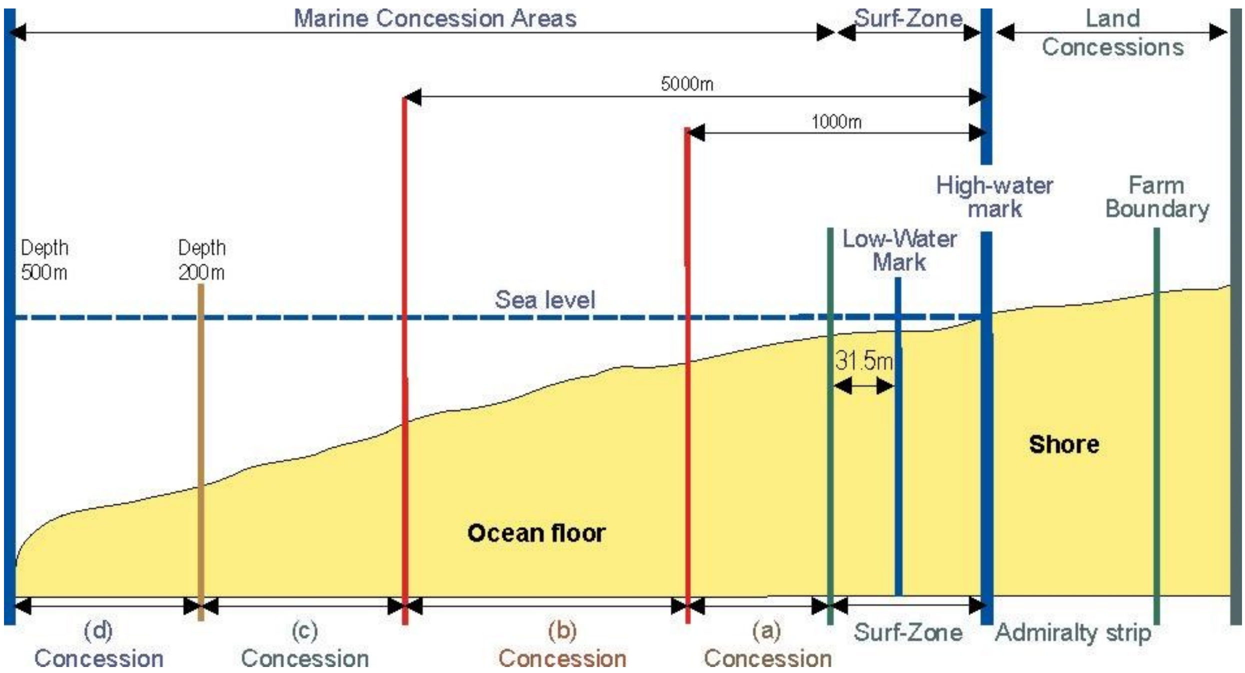

FIGURE 4-27: DIAGRAM OF THE ONSHORE AND OFFSHORE BOUNDARIES OF THE SOUTH AFRICAN (A) TO (D) MARINE DIAMOND MINING CONCESSION AREAS.

Deep-water diamond mining and exploration is currently limited to operations by Belton Park Trading 127 (Pty) Ltd in concession 2C for mining and 3C -5C for exploration and De Beers Marine (Pty) Ltd for exploration in concessions 7c- 10c. In Namibian waters, deep-water diamond mining by Debmarine Namibia is currently operational in the Atlantic 1 Mining Licence Area.

These mining operations are typically conducted in water depths of 70 m to 160 m from fully self-contained mining vessels with on board processing facilities, using either large-diameter drill or seabed crawler technology. The vessels operate as semi-mobile mining platforms, anchored by a dynamic positioning system, commonly on a three to four anchor spread. Computer-controlled positioning winches enable the vessels to locate themselves precisely over a mining block of up to 400 m x 400 m. These mining vessels thus have limited manoeuvrability and other vessels should remain at a safe distance.

4.1.4.5 Prospecting and mining of other minerals

4.1.4.5.1 Heavy minerals

Heavy mineral sands containing, amongst other minerals, zircon, ilmenite, garnet and rutile may be found offshore of the West Coast. Although a literature search has not identified any published studies that detail the distribution of heavy minerals offshore, concentrations are known to exist onshore. Tronox's Namakwa Sands is currently exploiting heavy minerals from onshore deposits near Brand-se-Baai (approximately 385 km north of Cape Town).

De Beers Consolidated Mines (Pty) Ltd also currently hold Prospecting Rights for heavy minerals, gold platinum group elements, sapphire and other minerals within Sea Concessions 2C - 5C and 7C - 10C.

4.1.4.5.2 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 Table 4-6 and Figure 4-28), although none overlap with the proposed mining area. Green Flash Trading received their prospecting rights for Areas 251 and 257 in 2012/2013. The prospecting rights for Agrimin1, Agrimin2 and SOM1 have expired (Jan Briers, DMR pers. comm., December 2013).

TABLE 4-6: LIMITS OF PROSPECTING BLOCKS FOR GLAUCONITE AND PHOSPHORITE WITHIN THE WEST COAST REGION. IN EACH CASE THE BLOCK IS A POLYGON OF POINTS LABELLED A, B, C, D, ETC.

Block Title	Corner points	Latitude (S):	Longitude (E):
Agrimin1	A	32º 49' 40.11''	17º 19' 57.12"
	B	32º 49' 39.93"	16º 44' 23.13"
	C	33º 17' 40.92"	17º 01' 11.70"
	D	33º 13' 59.88"	17º 07' 59.99"

Block Title	Corner points	Latitude (S):	Longitude (E):
Agrimin2	A	33º 56’ 23.4654”	17º 27’ 23.9975”
	B	34º 54’ 31.9601”	18º 07’ 40.2233”
	C	34º 53’ 59.5830”	18º 27’ 34.4074”
	D	33º 55’ 43.0337”	17º 57’ 58.6973”
SOM1	A	32º 49’ 39.00”	16º 50’ 9.66”
	B	33º 10’ 24.74”	16º 53’ 29.30”
	C	33º 40’ 00.00’’	17º 50’ 00.00”
	D	33º 23’ 30.00”	17º 50’ 00.00”
	E	33º 19’ 00.00”	17º 24’ 00.00”
	F	33º 29’ 00.00”	17º 41’ 00.00”
	G	33º 16’ 00.00”	17º 41’ 00.00”
	H	32º 49’ 00.00”	17º 20’ 08.08”

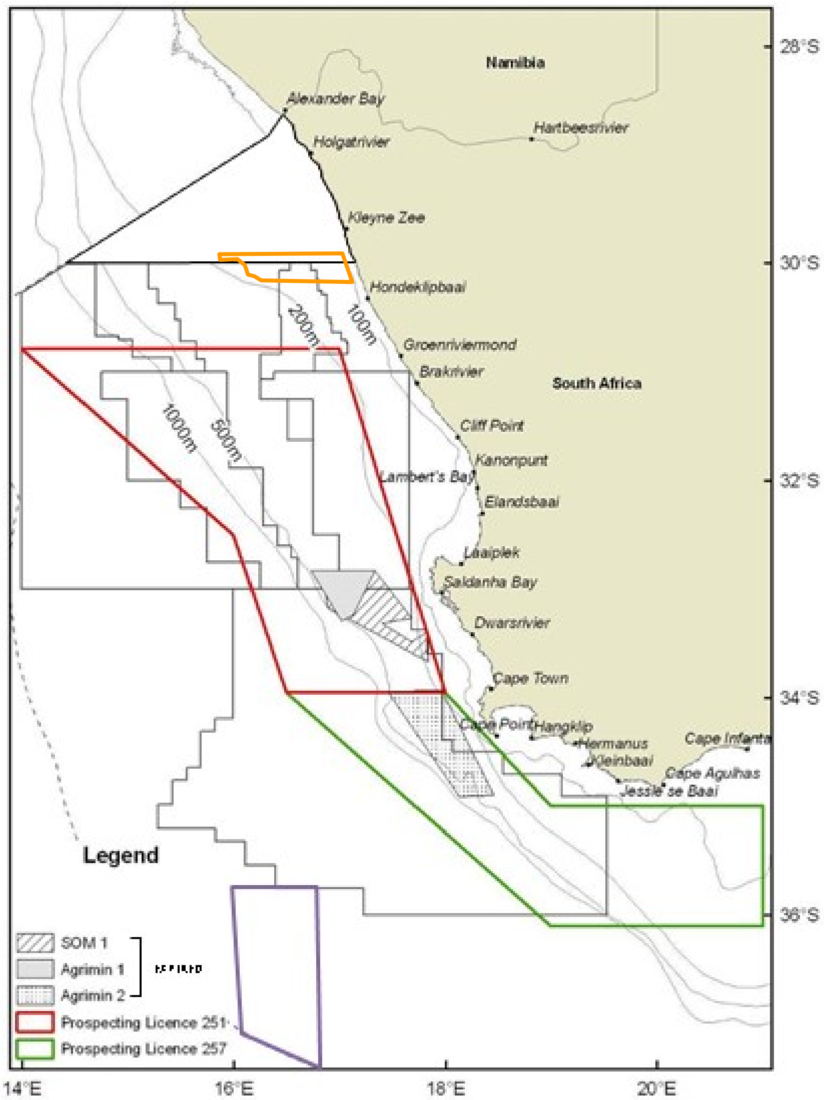

FIGURE 4-28: APPROXIMATE LOCATION OF SEA CONCESSION 6C (ORANGE) IN RELATIONS TO GLAUCONITE AND PHOSPHORITE PROSPECTING AREAS (AGRIMIN1, AGRIMIN2 AND SOM1).

4.1.4.5.3 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. 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

4.1.4.6.1 Anthropogenic marine hazards

Human use of the marine environment has resulted in the addition of numerous hazards on the seafloor. Readers are referred to the Annual Summary of South African Notices to Mariners No. 5 or charts from the South African Navy or Hydrographic Office for the location of different underwater hazards along the West Coast.

4.1.4.6.2 Undersea cables

There are a number of submarine telecommunications cable systems across the Atlantic and the Indian Ocean (see Figure 4-29), including inter alia:

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

There is an exclusion zone applicable to the telecommunication cables 1 nm (approximately 1.9 km) each side of the cable in which no anchoring is permitted.

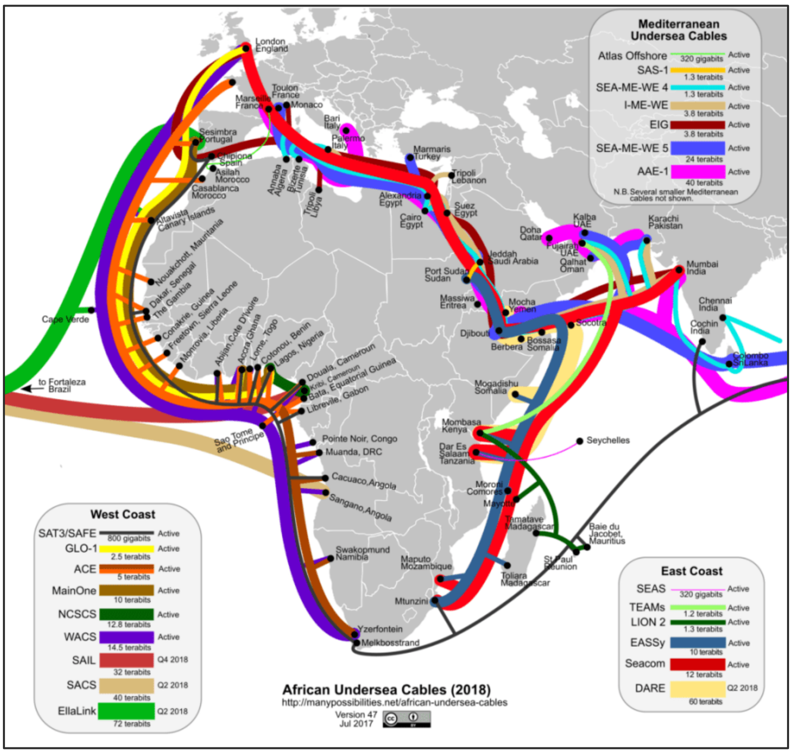

FIGURE 4-29: **CONFIGURATION OF THE CURRENT AFRICAN UNDERSEA CABLE SYSTEMS, JULY 2018 (FROM HTTP://WWW.MANYPOSSIBILITIES.NET).**

4.1.4.6.3 Archaeological sites

As the West Coast contains a wealth of shell middens, cave deposits, historical artefacts, palaeontological sites and shipwrecks close to the shore, the occurrence of such sites further offshore cannot be excluded.

(a) Palaeontological sites

Stevenson & Bamford (2003) describe an abundance of in-situ fossilised yellowwood tree trunks in an approximate 2 km^2 area of seabed outcrop in 136-140 m depth located within Sea Concession 4C. The fossilized wood and accompanying cold water coral colonies are considered vulnerable to any activities that could impact on the seabed (FAO 2006; Rogers *et al.* 2008; FAO 2009; Sink *et al.* 2012a,b). In addition, there are other sites where fossilised yellowwood has been observed within Sea Concession 5C. These sites are located approximately 25 km north of Sea Concession 6C.

Following the application of the Conservation on Biological Diversity's (CBD) Ecologically or Biologically Significant Marine Areas (EBSA) criteria, the area (referred to as the Namaqua Fossil Forest) was identified as unique, and presented at the CBD Southeast Atlantic Ocean regional workshop for consideration as an EBSA warranting formal conservation (Sink & Kirkman 2013).

(b) Shipwrecks

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 60 years old have National Monument status.

Possible wrecks most likely to be encountered during the proposed marine sediment sampling are those most likely to fall outside of known shallow water wreck events. The majority of shipwreck locations are unknown as they have been documented only through survivor accounts, archival descriptions and eyewitness reports recorded in archives and databases. In the area under consideration, there are at least five vessels that could possibly have been wrecked in the vicinity of the concession area (see Table 4-7), as well as a further 28 vessels that may be somewhere in the area. For a description of these wrecks refer to Section 6 of the Underwater Heritage Impact Assessment (in Appendix E).

TABLE 4-7: SHIPWRECKS POTENTIALLY LOCATED WITHIN THE BROADER PROJECT AREA.

Vessel Name	Date	Comment
Eros	1918	This 174-ton steel steamer was wrecked either off Port Nolloth or off Lamberts Bay.
Haab	1897	This 861-ton wooden barque was abandoned near Concession 5C and therefore may be in or near 6C. Approximate co-ordinates: 29° 49.902'S 16° 40.070'E.
Jessie Smith	1853	This 226-ton British brig was wrecked somewhere off Alexander Bay, Orange River Mouth. The vessel was swept out to sea and it is possible that the wreck may be somewhere in the concession area 4C.
Ocean King	1881	This 419-ton barque apparently hit a reef about 3-4 miles (6.4 – 8 km) offshore and about 20 miles (32km) south of Port Nolloth. This vessel may be in the vicinity of Concession 4C. Approximate co-ordinates: 29.47567 S 16.89444 E.
Laporte / La Porte	1904	This 2448-ton steamer was on a voyage from Cardiff for Cape Town with coal when she foundered in a north-westerly gale approximately 160 km from shore and 80 km north of Port Nolloth. There are differing reports as to where the vessel sank. Approximate co-ordinates include: • Position 1: 28° 35.691'S 14° 48.532'E • Position 2: 28° 37.133'S 16° 24.555'E • Position 3: 29° 17.078'S 15° 55.764'E**

4.1.4.7 Ammunition dump sites

Details of ammunition dumped at the ammunition dumpsites on the West Coast are given on the respective SAN charts.

4.2 MARINE PROTECTED AREAS

4.2.1 Conservation Areas and Marine Protected Areas

Numerous conservation areas and a marine protected area (MPA) exist along the coastline of the Northern Cape, although none fall directly within the proposed Prospecting Rights area. The only conservation area in the vicinity of Concession 6C in which restrictions apply is the McDougall's Bay rock lobster sanctuary near Port Nolloth, which is closed to commercial exploitation of rock lobsters (refer to Figure 4-10). This area lies inshore and north of Concession 6C.

Using biodiversity data mapped for the 2004 and 2011 National Biodiversity Assessments a systematic biodiversity plan has been developed for the West Coast with the objective of identifying coastal and offshore priority focus areas for MPA expansion (Sink *et al.* 2011; Majiedt *et al.* 2013). Potentially vulnerable marine ecosystems (VMEs) that were explicitly considered during the planning included the shelf break, seamounts, submarine canyons, hard grounds, submarine banks, deep reefs and cold water coral reefs. The biodiversity data were used to identify nine focus areas for protection on the West Coast between Cape Agulhas and the South African – Namibian border. These focus areas were carried forward during Operation Phakisa, which identified potential MPAs. The draft regulations for the proposed MPAs were published in February 2016 and are currently under review. Those within the broad project area are shown in Figure 4-7. Sea Concession 6C does not overlap with any of these areas.

In the spatial marine biodiversity assessment undertaken for Namibia (Holness et al. 2014), the Orange Shelf Edge area, which includes Tripp Seamount and a shelf-indenting submarine canyon, was identified as being of high priority for place-based conservation measures. To this end, Ecologically or Biologically Significant Areas (EBSA) spanning the border between Namibia and South Africa were proposed and inscribed under the Convention of Biological Diversity (CBD). The proposed Orange Shelf Edge EBSA comprises shelf/shelf edge habitat with hard and unconsolidated substrates, including at least eleven offshore benthic habitat types of which four habitat types are 'Threatened', one is 'Critically Endangered' and one 'Endangered'. The proposed Orange Shelf Edge EBSA is one of few places where these threatened habitat types are in relatively natural/pristine condition. The local habitat heterogeneity is also thought to contribute to the Orange Shelf Edge being a persistent hotspot of species richness for demersal fish species. Although focussed primarily on the conservation of benthic biodiversity and threatened benthic habitats, the EBSA also considers the pelagic habitat, which is characterized by medium productivity, cold to moderate Atlantic temperatures and moderate chlorophyll levels related to the eastern limit of the Benguela upwelling on the outer shelf. A more focussed version of the EBSA has been submitted and is currently undergoing consideration for official recognition by the CBD. The principal objective of the EBSA is identification of features of higher ecological value that may require enhanced conservation and management measures. No specific management actions have been formulated for the Orange Shelf Edge area at this stage.

A further EBSA – the transbounday Orange Cone - is located to the north of the Sea Concession area, while the Benguela Upwelling System transboundary EBSA extends along the entire southern African West Coast from Cape Point to the Kunene River and includes a portion of the high seas beyond the Angolan EEZ.

The Orange River Mouth wetland located to the north of Concession 6C provides an important habitat for large numbers of a great diversity of wetland birds and is listed as a Global Important Bird Area (IBA) (ZA023/NA 019) (BirdLife International 2005). The area was designated a Ramsar site in June 1991, and processes are underway to declare a jointly-managed transboundary Ramsar reserve. Further IBAs south of the project area include the Olifants River Estuary (ZA078), Verlorenvlei (ZA082), the Lower Berg River wetlands (ZA083) and the West Coast National Park and Saldanha Bay Islands (ZA084). All of these are located well to the south and inshore of the Sea Concession area.

4.2.2 Threat Status and Vulnerable Marine Ecosystems

'No-take'[2] MPAs offering protection of the Namaqua biozones (sub-photic, deep-photic, shallow-photic, intertidal and supratidal zones) are absent northwards from Cape Columbine (Emanuel *et al.* 1992, Lombard *et al.* 2004). Rocky shore and sandy beach habitats are generally not particularly sensitive to disturbance and natural recovery occurs within 2-5 years. However, much of the Namaqualand coastline has been subjected to decades of disturbance by shore-based diamond mining operations (Penney *et al.* 2007). These cumulative impacts and the lack of biodiversity protection has resulted in most of the coastal habitat types in Namaqualand being assigned a threat status of 'critically endangered' (Lombard *et al.* 2004; Sink *et al.* 2012). Using the SANBI benthic and coastal habitat type GIS database (Figure 4-30), the threat status of the benthic habitats within Sea Concession 6C, and those potentially affected by proposed prospecting activities, were identified (Table 4-8).

4.2.3 Development Potential of the Marine Environment in the Project Area

The economy of the Namaqualand region is dominated by mining. However, with the decline in the mining industry and the closure of many of the coastal mines, the economy of the region is declining and jobs are being lost with potential devastating socio-economic impacts on the region. The Northern Cape provincial government has recognized the need to investigate alternative economic activities to reduce the impact of minerals downscaling and has commissioned a series of baseline studies of the regional economy (Britz & Hecht 1997, Britz *et al.* 1999, 2000, Mather 1999). These assessments concluded that fishing and specifically mariculture offer a significant opportunity for long term (10+ years) sustainable economic development along the Namaqualand coast. The major opportunities cited in these studies include hake and lobster fishing (although the current trend in quota reduction is likely to limit development potentials), seaweed harvesting and aquaculture of abalone, seaweeds, oysters and finfish. The Northern Cape provincial government is facilitating the development of the fishing and mariculture sectors by means of a holistic sector planning approach and has in partnership with a representative community and industry based Fishing and Mariculture Development Association (FAMDA), developed the Northern Cape Province Fishing and Mariculture Sector Plan. This plan forms part of the 'Northern Cape - Fishing and Mariculture Sector Development Strategy' (www.northern-cape.gov.za, accessed December 2013) whereby implementation of the plan will be coordinated and driven by FAMDA.

[2] *no-take* means that extraction of any resources is prohibited.

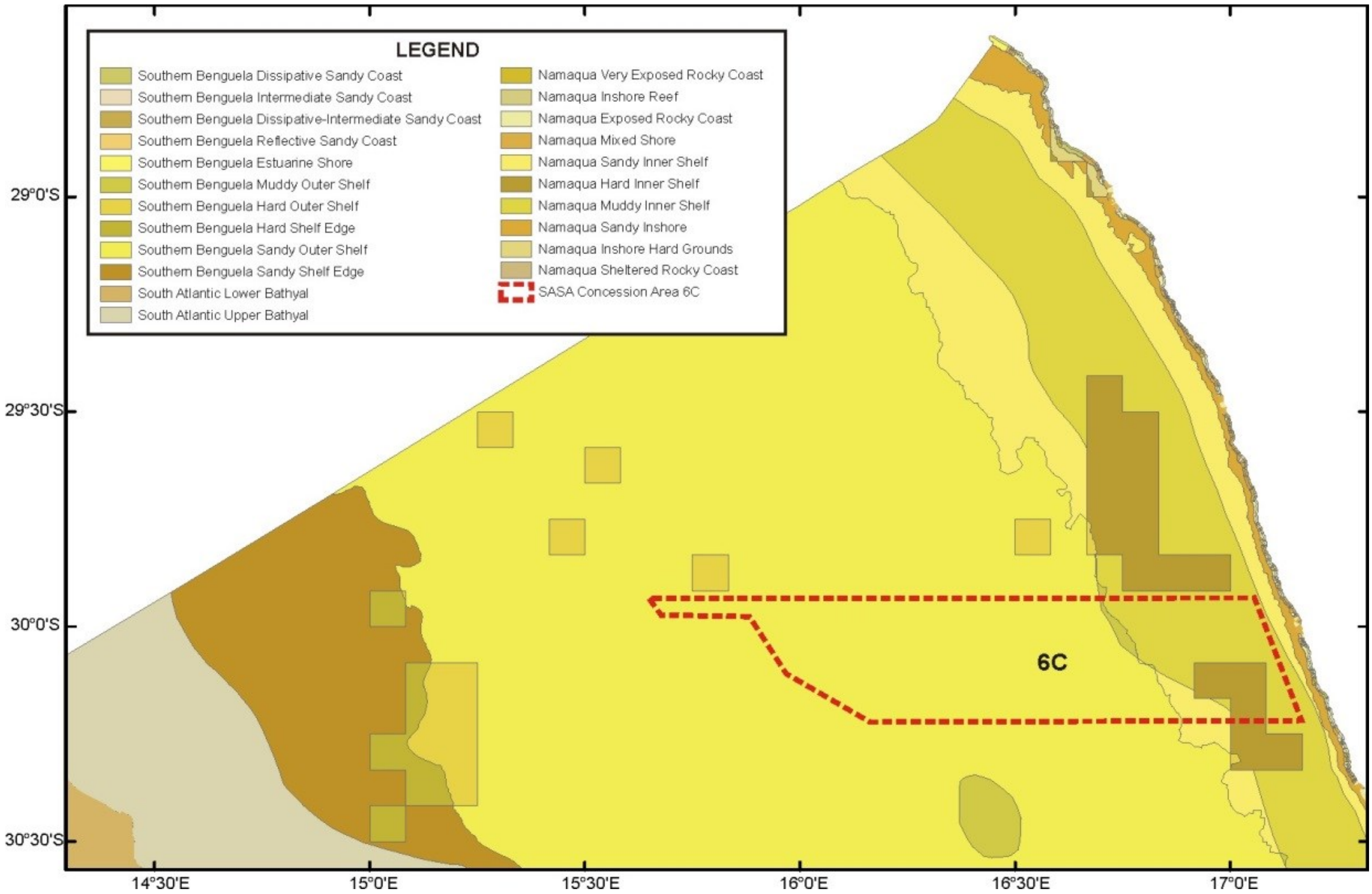

FIGURE 4-30: BENTHIC AND COASTAL HABITAT TYPES IN SEA CONCESSION 6C.

TABLE 4-8: ECOSYSTEM THREAT STATUS FOR MARINE AND COASTAL HABITAT TYPES IN SEA CONCESSION 6C (ADAPTED FROM SINK *ET AL.* 2011).

Habitat Type	Threat Status
Namaqua Hard Inner Shelf	Least Threatened
Namaqua Sandy Inner Shelf	Least Threatened
Namaqua Muddy Inner Shelf	Least Threatened
Southern Benguela Sandy Outer Shelf	Least Threatened
Southern Benguela Muddy Outer Shelf	Least Threatened

As discussed in Section 4.1.4.1.8, the creation of abalone ranching enterprises around Hondeklip Bay and Port Nolloth have been identified as part of the sector plan's development targets (www.northern-cape.gov.za). In the past, experimental abalone ranching concessions have been granted to Port Nolloth Sea Farms (PNSF) in sea mining areas 5 and 6, a 60-km strip of coastline, and to Ritztrade in the Port Nolloth area (www.northern-cape.co.za).

These experimental operations have shown that although abalone survival is highly variable depending on the site characteristics and sea conditions, abalone ranching on the Namaqualand coast has the potential for a lucrative commercial business venture (Sweijd *et al.* 1998, de Waal 2004).

Besides abalone sea-ranching, several other potential projects were identified in the sector plan. Most of these are land-based aquaculture projects (e.g. abalone and oyster hatcheries in Port Nolloth and abalone grow-out facility in Hondeklip Bay), but included was a pilot project to harvest natural populations of mussels and limpets in the intertidal coastal zone along the entire Northern Cape coast. The objective of the project was to determine the stock levels and to ascertain what percentage of the biomass of each species can be sustainably harvested, as well as the economic viability of harvesting the resource.

5. IMPACT DESCRIPTION AND ASSESSMENT

This section describes and assesses the significance of potential impacts related to the proposed prospecting activities in the study area. All impacts are systematically assessed and presented according to predefined rating scales (see Appendix F). 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.

Specialist input was provided in order to address the likely effect of the proposed prospecting activities on marine benthic fauna (Appendix C), fisheries (Appendix D) and underwater heritage (Appendix E). In addition, this assessment used as a basis the key issues identified from similar previous environmental assessment studies for projects on the West Coast. The project team has assessed the relevance of these issues to this project.

5.1 IMPACT OF THE SAMPLING VESSELS

5.1.1 DISCHARGES/DISPOSAL TO THE SEA

Discharges to the marine environment include deck drainage, machinery space drainage, sewage, galley wastes and solid wastes from the geophysical survey and sediment sampling vessels.

5.1.1.1 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 small volumes through spillage and drainage of deck areas. The potential impact of deck drainage on the marine environment would, due to the small volumes, be of low intensity across the prospecting area over the short-term, and is considered to be of **VERY LOW** significance with or without mitigation (see Table 5-1).

Mitigation

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

- All process areas should be bunded to ensure drainage water flows into the closed drainage system;
- Undertake training and awareness of crew in spill management to minimise contamination;
- Low-toxicity biodegradable detergents and reusable absorbent cloths should be used in cleaning of all deck spillage; and
- All hydraulic systems should be adequately maintained.

TABLE 5-1: IMPACT OF DECK DRAINAGE FROM VESSELS

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Probable	Probable
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Drainage of deck areas by other vessels may also result in the introduction of oils, solvents and cleaners into the marine environment. The cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible – deck drainage would be quickly dispersed and diluted by the high wind and wave energy of the offshore sea environment.	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	Very Low	

5.1.1.2 Machinery space drainage

Description of impact

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

Assessment

All operations would comply fully with international agreed standards regulated under MARPOL 73/78. All machinery space drainage would pass through an oil/water filter to reduce the oil in water concentration to 15 parts per million, 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 prospecting 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 5-2).

Mitigation

No mitigation measures are deemed necessary (assuming compliance with the MARPOL 73/78 standards).

TABLE 5-2: IMPACT OF MACHINERY SPACE DRAINAGE FROM VESSELS

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Probable	Probable
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Other vessels may also introduce small quantities of oil into the marine environment through drainage of machinery spaces. The cumulative impact is considered to be of VERY LOW significance.	
Degree to which impact can be reversed	Fully reversible – deck drainage would be quickly dispersed and diluted by the high wind and wave energy of the offshore sea environment.	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	Very Low	

5.1.1.3 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.

Assessment

The volumes of sewage wastes released from the vessels would be small and comparable to volumes produced by vessels of similar crew compliment. The high wind and wave energy of the West Coast offshore is expected to result in rapid dispersal of any released sewage wastes.

The potential impact of sewage effluent from the survey and sampling vessels on the marine environment is expected to be of low intensity and limited to the prospecting area over the short-term. The potential impact of sewage effluent is therefore considered to be of **VERY LOW** significance with or without mitigation (see Table 5-3).

Mitigation

The sampling vessels would be required to comply with the requirements of MARPOL 73/78 Annex IV.

TABLE 5-3: IMPACT OF SEWAGE EFFLUENT DISCHARGE FROM VESSELS

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Probable	Probable
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	The nominal quantity of sewage that would enter the sea would not result in a cumulative impact.	
Degree to which impact can be reversed	Fully reversible - sewage would be quickly dispersed and diluted by the high wind and wave energy of the offshore sea environment.	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	Very Low	

5.1.1.4 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 the survey or sampling vessel would be small and comparable to wastes from any vessel of a similar crew compliment. Discharges of galley wastes, according to MARPOL 73/78 Annex V 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 and 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 sampling 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 5-4).

Mitigation

Minimise the discharge of waste material should obvious attraction of marine fauna be observed.

TABLE 5-4: IMPACT OF GALLEY WASTE DISPOSAL FROM VESSELS

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Probable	Probable
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	The nominal quantity of galley waste that would enter the sea would not result in a cumulative impact.	
Degree to which impact can be reversed	Fully reversible – galley waste would be quickly dispersed and diluted by the high wind and wave energy of the offshore sea environment.	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	Very Low	

5.1.1.5 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 stored on board and then transported onshore for disposal on land, and consequently would have no impact on the marine environment. Waste containers would be transported to work boats for onward handling in port and removed by a waste contractor for disposal at a permitted landfill site. Recycling would occur on board and the solid waste would be sorted in separate containers before being taken to an appropriate onshore recycling facility. Specialist waste disposal contractors would dispose of hazardous waste. The potential impact of the disposal of solid waste on the marine environment is therefore expected to be **INSIGNIFICANT** (see Table 5 5).

Mitigation

No solid waste may be disposed to the marine environment and consequently no mitigation measures are required.

TABLE 5-5: IMPACT OF SOLID WASTE DISPOSAL FROM VESSELS

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Zero	Zero
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Probable	Probable
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	N/A	
Degree to which impact can be reversed	N/A	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	Very Low	

5.2 IMPACT ON MARINE FAUNA

5.2.1 NOISE ASSOCIATED WITH GEOPHYSICAL SURVEYS AND SAMPLING ACTIVITIES

Description of impact

Potential impacts associated with the proposed geophysical surveys on marine fauna (mainly cetaceans) could include physiological injury and behavioural avoidance of the survey area. During sampling operations, the sampling tool of choice could generate underwater noise, which may have an impact on macrobenthic communities, fish and marine mammals in the area.

Impact assessment

The various geophysical survey techniques considered for prospecting are outlined in Section 0. The acoustic equipment to be utilised during the proposed geophysical surveys operate at a frequency range from 1.5 to 850 kHz, producing levels of sound pressure ranging from between 190 to 242 dB re 1µPa. Sound levels generated by sampling operations would fall within the 120 - 190 dB re 1 µPa range at the sampling unit, with main frequencies between 3 and 10 kHz. These noise levels fall within the hearing range of most fish and marine mammals and, depending on the sea state, would be audible for up to 20 km from the survey vessel before attenuating to below threshold levels of marine fauna.

Unlike the noise generated by deeper penetration low frequency airguns during seismic surveys, underwater noise emitted during the proposed geophysical surveys is not considered to be of sufficient amplitude to cause auditory or non-auditory trauma in marine fauna. It is anticipated that only within meters of the source (i.e.

directly below the acoustic equipment) the sound pressure would be in the 242 dB range where exposure would result in trauma.

Noise sources from sampling activities would largely be stationary for the duration of the operations. As most pelagic species likely to be encountered are highly mobile, they would be expected to flee and move away from the either sound sources (geophysical survey vessel or sampling tool) before trauma could occur. The abundance of migratory cetaceans (particularly baleen whales) within the sea concession area is expected to be highest during the periods of June and November, as they move through the concession area on their way to and from their southern feeding grounds into low latitude waters.

While the underwater noise from the survey systems and/or sampling operations may induce localised behavioural changes in some marine mammals, it is unlikely that such behavioural changes would impact on the wider ecosystem. Noise from the geophysical surveys, sampling operations and associated vessels is not considered to be of sufficient amplitude to cause direct harm to marine life.

In light of the above, the impact of noise emissions from the proposed geophysical surveys on marine fauna is considered to be localised, short-term (for duration of survey i.e. weeks) and of medium intensity. The significance of the impact is considered of **VERY LOW** significance both without and with mitigation.

The impact of underwater noise generated during sampling operations is considered to be of low intensity in the target area and for the duration of the sampling campaign. Thus, the significance of the impact of underwater noise is considered of **VERY LOW** significance without and with mitigation.

Mitigation

No mitigation measures are possible, or considered necessary for the generation of noise by the sampling tools and vessels.

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 geophysical surveys:

- A designated onboard Marine Mammal Observer (MMO) must ensure compliance with mitigation measures during geophysical surveying.
- The MMO should conduct visual scans for the presence of cetaceans around the survey vessel prior to the initiation of any acoustic impulses.
- Pre-survey scans should be of at least a 15-minute duration prior to the start of survey equipment.
- Where equipment permits, “soft starts” should be carried out for equipment with source levels greater than 210 dB re 1 µPa at 1 m over a period of 20 minutes to give adequate time for marine mammals to leave the vicinity. 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.
- Terminate the survey if any marine mammals show affected behaviour within 500 m of the survey vessel or equipment until the mammal has vacated the area.
- Avoid planning geophysical surveys during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (beginning of June to end of November), and ensure that migration paths are not blocked by sonar operations.

- For the months of June and November ensure that Passive Acoustic Monitoring (PAM) is incorporated into any survey programme.

TABLE 5-6: IMPACT OF NOISE ASSOCIATED WITH THE GEOPHYSICAL SURVEYS

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Medium	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Probable	Probable
Significance	Very Low	**VERY LOW**
Status	Negative	Negative
Confidence	Medium	Medium
Nature of Cumulative impact	As geophysical survey activities have recently been conducted in the area, some cumulative impacts could be anticipated. However, any direct impact is likely to be at individual level rather than at species level.	
Degree to which impact can be reversed	Fully reversible – any disturbance of behaviour, auditory "masking" or reductions in hearing sensitivity that may occur as a result of survey noise below 220 dB would be temporary.	
Degree to which impact may cause irreplaceable loss of resources	Negligible	
Degree to which impact can be mitigated	Very Low	

TABLE 5-7: IMPACT OF NOISE ASSOCIATED WITH THE SAMPLING

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Definite	Probable
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	None.	
Degree to which impact can be reversed	Fully reversible.	
Degree to which impact may cause irreplaceable loss of resources	N/A	

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Degree to which impact can be mitigated	Very Low	

5.2.2 DISTURBANCE OF BENTHIC BIOTA BY SEDIMENT REMOVAL

Description of impact

The proposed sampling activities are expected to result in the disturbance and loss of benthic macrofauna through removal of sediments by the sampling tool. Benthic fauna typically inhabit the top 20 to 30 cm of sediment. Therefore, the proposed sampling activities would eliminate any benthic infaunal and epifaunal biota in the sampling footprints, resulting in a loss of some benthic biodiversity.

Assessment

The proposed sampling campaign would result in the removal of up to 9 000 drill samples across the sea concession area. Each drill sample covers a surface area of 10 m^2. The volume of sediment removed which would impact on the benthic biota would be 3 m^3, as the biota mostly occupy the top 0.3 m of sediment. The total volume of sediment containing benthic biota that would be removed from the seabed is thus in the order of 27 000 m^3 and would cover an area of approximately 0.09 km^2. This equates to approximately 0.003 % of the overall area of Sea Concession 6C. Considering the available area of similar habitat on the continental shelf of the West Coast, the reduction in benthic biodiversity through sediment removal can be considered negligible.

The impact on the offshore benthos as a result of the cumulative removal of sediments from sampling is considered to be of medium intensity at a local scale (i.e. sampling locations). Full recovery is expected to take place within the short to medium term (i.e. 6 - 15 years), as the sampled areas are expected to have slow infill rates and may persist for extended periods (years). Furthermore, biomass often remains reduced for several years as long-lived species like molluscs and echinoderms need longer to re-establish the natural age and size structure of the population. This impact is assessed to be of **LOW** significance (see Table 5-8).

Mitigation

No direct mitigation measures are possible, or considered necessary for the indirect loss of benthic macrofauna due to crushing by the drill-frame structure. However, the following is recommended:

- Exploration sampling targets gravel bodies and would thus avoid known sensitive habitats and high-profile, predominantly rocky-outcrop areas without a sediment veneer. Prior to bulk sampling, a visual sampling programme must be undertaken in rocky-outcrop areas to identify sensitive communities.
- Where possible, dynamically positioned sampling vessels are used in preference to vessels requiring anchorage.

TABLE 5-8: IMPACT OF SEDIMENT REMOVAL ON OFFSHORE BENTHIC COMMUNITIES

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Medium	Medium
Duration	Short- to Medium-term	Short- to Medium-term
Extent	Local	Local
Consequence	Low	Low
Probability	Definite	Definite
Significance	**Low**	**LOW**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	The relatively small area impacted by sediment removal over the entire extent of the sea concession area during sampling activities would not result in a cumulative impact.	
Degree to which impact can be reversed	Irreversible – the removal of sediments and associated macrofaunal communities would be irreversible. However, the recovery of excavations through sediment influx and recolonisation will occur over the medium term.	
Degree to which impact may cause irreplaceable loss of resources	Negligible considering the total surface area of seabed affected.	
Degree to which impact can be mitigated	No possible mitigation identified.	

5.2.3 PHYSICAL CRUSHING OF BENTHIC BIOTA

Description of impact

Some disturbance or loss of benthic biota adjacent to the sample footprint can also be expected as a result of the placement on the seabed of the drill-frame structure. Epifauna and infauna beneath the footprint of the drill frame would be crushed by the weight of the equipment resulting in a reduction in benthic biodiversity.

Assessment

Crushing is likely to primarily affect soft-bodied species as some molluscs and crustaceans may be robust enough to survive. Considering the available area of similar habitat on the continental shelf of the West Coast, the reduction in benthic biodiversity through crushing can be considered negligible. The impacts would be of medium intensity but highly localised, and short-term as recolonization would occur rapidly from adjacent undisturbed sediments. The potential impact is consequently deemed to be of **VERY LOW** significance (see Table 5-9).

Mitigation

The mitigation for this impact would be the same as for the impact of disturbance of benthic biota by sediment removal discussed above.

TABLE 5-9: IMPACT OF CRUSHING ON BENTHIC BIOTA

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Medium	Medium
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Definite	Definite
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	No cumulative impacts are anticipated.	
Degree to which impact can be reversed	Irreversible – the loss of epifauna and infauna as a result of crushing would be irreversible. However, the recovery would occur over the short term through recruitment and immigration from adjacent areas.	
Degree to which impact may cause irreplaceable loss of resources	Negligible considering the total surface area of seabed affected.	
Degree to which impact can be mitigated	No possible mitigation identified.	

5.2.4 GENERATION OF SUSPENDED SEDIMENT PLUMES

Description of impact

As part of the sampling process, the sampled seabed sediments are pumped to the surface and discharged onto sorting screens on the sampling vessel for screening. The unwanted material is discarded overboard where it forms a suspended sediment plume in the water column which dissipates with time. Furthermore, fine sediment re-suspension by the sampling tools will generate suspended sediment plumes near the seabed.

The main effect of sediment plumes is an increase in water column turbidity, leading to a reduction in light penetration with potential adverse effects on the photosynthetic capability of phytoplankton. Other potential impacts include inhibiting pelagic visual predators due to poor visibility, egg and/or larval development impairment and reduction of benthic bivalve filter-feeding efficiencies. Negative impacts may also occur when heavy metals or contaminants associated with fine sediments are remobilised.

Assessment

The distribution and re-deposition of suspended sediments are the result of a complex interaction between oceanographic processes, sediment characteristics and engineering variables that ultimately dictate the distribution and dissipation of the plumes in the water column. Ocean currents, both as part of the meso-scale circulation and due to local wind forcing, are important in distribution of suspended sediments. Turbulence generated by surface waves can also increase plume dispersion by maintaining the suspended sediments in the upper water column.

In general though, suspended sediments in plumes settle fairly rapidly and water sampling undertaken by De Beers Marine in the MPT 25/2011 area has confirmed that contaminant levels in plumes are well below water quality guideline levels (Carter 2008).

The impact of suspended sediment plumes in the water column would thus be of low intensity, persist only over the short-term, and would be extremely localised around the sampling vessel. The impact from suspended sediment plumes is rated as being **VERY LOW** (see Table 5-10).

Mitigation

No mitigation measures are possible, or considered necessary for the generation of sediment plumes.

TABLE 5-10: IMPACT OF THE GENERATION OF SUSPENDED SEDIMENT PLUMES

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Definite	Definite
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	None	
Degree to which impact can be reversed	Fully Reversible	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	Very Low	

5.2.5 SMOTHERING OF BENTHOS IN REDEPOSITING TAILINGS

Description of impact

The sampled seabed sediments are pumped to the surface and discharged onto sorting screens, which separate the large gravel, cobbles and boulders and fine silts from the 'plantfeed'. The oversize and undersize tailings are discarded overboard and settle back onto the seabed beneath the vessel where they can result in smothering of benthic communities adjacent to the sampled areas.

Assessment

Smothering-related impacts on benthic communities involve physical crushing, a reduction in nutrients and oxygen, clogging of feeding apparatus, as well as affecting choice of settlement site, and post-settlement survival. Generally, rapid deposition of coarser material is likely to have more of an impact on the soft-bottom benthic community than gradual sedimentation of fine sediments to which benthic organisms are adapted and able to respond. In contrast, sedentary communities may be adversely affected by both rapid and gradual deposition of sediment.

Of greater concern is that sediments discarded during sampling operations may impact rocky-outcrop communities adjacent to sampling target areas potentially hosting sensitive deep-water coral communities (see Section 4.1.3.1.2). As deep-water corals tend to occur in areas with low sedimentation rates, these benthic suspension-feeders and their associated faunal communities are likely to show particular sensitivity to increased turbidity and sediment deposition associated with tailings discharges.

Discarding overboard of excess sediment may result in limited smothering effects on the seabed. However, considering the available area of unconsolidated seabed habitat, the reduction in biodiversity of macrofauna, associated with unconsolidated sediments, as a result of smothering-related impacts can be considered negligible. The impacts would be of low intensity but highly localised and short-term, as recolonization would occur rapidly. The potential impact of smothering on communities in unconsolidated habitats is consequently deemed to be of **VERY LOW** significance (see Table 5-11).

In the case of rocky-outcrop communities, however, impacts would be of medium intensity and highly localised, and potentially enduring over the medium-term due to the slow recovery rates of these communities. The potential impact of smothering on rocky-outcrop communities is consequently deemed to be of **low** significance without mitigation. If the rock outcrop areas are avoided, there would be no direct impact, however the tailings plume may still result in possible smothering impacts. This is deemed to be of **VERY LOW** significance (see Table 5-12).

<u>Mitigation</u>

No mitigation measures are possible, or considered necessary for the loss of macrobenthos due to smothering of unconsolidated seabed habitats.

Exploration sampling targets gravel bodies and would thus avoid known sensitive habitats and high-profile, predominantly rocky-outcrop areas without a sediment veneer. Prior to bulk sampling, a visual sampling programme must be undertaken in rocky-outcrop areas to identify sensitive communities.

Existing geophysical data should be used to conduct a pre-sampling geohazard analysis of the seabed, and near-surface substratum to map potentially vulnerable habitats and prevent potential conflict with the sampling targets.

TABLE 5-11: SMOTHERING OF SOFT-SEDIMENT MACROFAUNA

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Probable	Probable
Significance	**Very Low**	**VERY LOW**

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	None	
Degree to which impact can be reversed	Fully Reversible	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	Very Low	

TABLE 5-12: SMOTHERING OF ROCKY-OUTCROP COMMUNITIES

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Medium	Local
Duration	Medium-term	Short-term
Extent	Local	Low
Consequence	Low	Very Low
Probability	Probable	Improbable
Significance	**Low**	**VERY LOW**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	None	
Degree to which impact can be reversed	Fully Reversible	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	Very Low	

5.3 IMPACT ON OTHER USERS OF THE SEA

5.3.1 POTENTIAL IMPACT ON FISHING INDUSTRY

5.3.1.1 Exclusion of Fishing and Research Operations

Description of impact

Prospecting activities could impact on some sectors within the fishing industry as a result of the presence of the survey vessel or a stationary sampling vessel within established fishing grounds.

Assessment

The extent of commercial fishing in and around Sea Concession areas 6C is described in detail in Section 4.1.4.1. The only commercial sector that could be affected by the proposed prospecting operations are the demersal long-line, traditional line-fish and tuna pole fisheries.

For the demersal long-line fishery, there are records of sporadic activity within the concession area that amount to to an average of one line set per year and a catch of approximately 4 tons of hake. This is equivalent to approximately 0.05% of the total landing of hake by the sector per year during this period. For the traditional line-fishery, the reported combined catch at Hondeklipbaai (with an average landing of 182 kg) and Port Nolloth (with an average of 2.5 tons of catch) over the period 2000 to 2016 is equivalent to approximately 0.03% of the overall national landings of the sector.

For the tuna pole fishery, although the main targeted fishing grounds off the West Coast are situated south of the concession area, there are records of fishing activity which coincide with the north-western extent of the concession area which is most likely due to vessels fishing en route to favoured grounds off Tripp Seamount on the Namibian side of the maritime border. Over the period 2007 to 2016, 32 fishing events were reported within the concession area (this is comparable to 32 days of fishing effort) with a cumulative catch of 58.3 tons of albacore over this period. This amounts to 5.8 tons per year, which is equivalent to 0.2% of the total albacore landed by the sector (nationally) over this period.

Both demersal research trawls and acoustic surveys could be affected by exclusion from Sea Concession 6C. An average of three trawls per survey have been recorded within the concession area, therefore it is likely that demersal fisheries research could be affected by exclusion from this area. The nature of the random selection of survey trawl sites is such that if a selected sampling station coincided with an exclusion area, an alternative survey area could be randomly selected. Acoustic transects are pre-determined and liaison between DAFF and the client would be necessary in order to avoid disruption to acoustic survey activity.

Given that fishing effort for the above-mentioned fisheries is very limited within the concession area, the potential impact of the proposed prospecting activities on these fisheries and fisheries research would be of local extent, short term and of medium intensity. The significance of impact is thus considered to be **VERY LOW** with and without mitigation (see Table 5-13).

The proposed prospecting activities would have **NO IMPACT** on small pelagic purse-seine, the demersal trawl, large pelagic long-line, West Coast rock lobster and beach-seine and gillnet fisheries sectors, as either, the concession area does not overlap with the fishing grounds associated with these fisheries.

Mitigation

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

- The most effective means of mitigation would be to ensure that the proposed prospecting activities do not coincide with the research surveys between January and March. It is recommended that prior to the commencement of the proposed activities, De Beers consult with the managers of the DAFF research survey programmes to discuss their respective programmes and the possibility of altering the prospecting programme in order to minimise or avoid disruptions to both parties, where required.

- Prior to the commencement of the proposed prospecting activities the following key stakeholders should be consulted and informed of the proposed activities (including navigational co-ordinates of the sampling areas, timing and duration of proposed activities) and the likely implications thereof:
  - Fishing industry / associations (these include South African Tuna Association, South African Tuna Longline Association, Fresh Tuna Exporters Association, South African Commercial Linefish Association, Hake Longline Association, National SMME Fishing Forum); and
  - Other: Department of Agriculture, Forestry and Fisheries (DAFF), South African Maritime Safety Authority (SAMSA), South African Navy (SAN) Hydrographic office, overlapping and neighbouring exploration right holders and applicants, and Transnet National Ports Authority (ports of Cape Town and Saldanha Bay).
- The required safety zones around the sampling vessels should be communicated via the issuing of Daily Navigational Warnings for the duration of the sampling operations through the South African Naval Hydrographic Office; and
- The SAN Hydrographic office should be notified when the programme is complete so that the Navigational Warning can be cancelled.

TABLE 5-13: ASSESSMENT OF THE POTENTIAL IMPACT ON THE DEMERSAL LONG-LINE, TRADITIONAL LINE-FISH, TUNA POLE FISHERIES AND FISHERIES RESEARCH DUE TO EXCLUSION.

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Medium	Low to Medium
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Possible	Possible
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Confidence	Medium	Medium
Nature of Cumulative impact	None.	
Degree to which impact can be reversed	Fully reversible.	
Degree to which impact may cause irreplaceable loss of resources	Negligible	
Degree to which impact can be mitigated	Very Low	

5.3.1.2 Impact of Sediment Plume on Fish Stock Recruitment

<u>Description of impact</u>

Sediment plumes generated during benthic sampling could have an impact on fish stock recruitment.

Assessment

Typically fisheries stock recruitment is highly variable spatially and temporally. Spawning and recruitment of small pelagic species, as well as of many demersal species, occurs primarily well to the south of Sea Concession 6C.

The spawn from these fisheries typically drift northwards with the prevailing Benguela Current and larval development mainly occurs nearshore and in bays along the West Coast of South Africa. Sampling in Sea Concession 6C would occur offshore of the 70 m depth contour. Relative to the location of the nursery areas, the sediment plumes generated during benthic sampling would be predominantly dispersed northwards and offshore of the nursery areas. The impact on fish recruitment is considered to be improbable, localised (due to the localised nature of the proposed sampling events in relation to fish nursery areas) and of medium intensity over the short-term. The impact is thus considered to be **INSIGNIFICANT** without mitigation (see Table 5-14). Since the impact is unlikely to cause any significant impact on fish stock recruitment, mitigation is not considered necessary.

TABLE 5-14: ASSESSMENT OF THE POTENTIAL IMPACT ON TH FISH STOCK RECRUITMENT DUE TO SEDIMENT PLUMES.

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Medium	Medium
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Improbable	Improbable
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Confidence	Medium	Medium
Nature of Cumulative impact	None.	
Degree to which impact can be reversed	Fully reversible.	
Degree to which impact may cause irreplaceable loss of resources	Negligible	
Degree to which impact can be mitigated	None	

5.3.2 POTENTIAL IMPACT ON MARINE PROSPECTING / MINING

Description of impact

The presence of the geophysical survey and/or sampling vessel(s) could interfere with other marine mining or prospecting operations in the neighbouring concession areas.

Assessment

Diver-assisted diamond mining is concentrated around Port Nolloth and Alexander Bay and typically confined to the inshore areas in the A-concessions, in depths less than 20 m. Further offshore, diamond mining and prospecting is conducted by Belton Park Trading 127 in Sea Concessions 2C and 3C, respectively. No activities are currently taking place in the 'D' concession areas, located to the west of the study area.

As the 6C concession area does not overlap with any other marine mining operations, the impact of the planned prospecting operations on other mining activities would be localised, in the short term and of low intensity. The significance of impact is consequently **INSIGNIFICANT** with or without mitigation.

Mitigation

- Contact any companies undertaking marine prospecting or mining activities within the study area prior to prospecting in order to notify them of the planned activities.

TABLE 5-15: ASSESSMENT OF THE POTENTIAL IMPACT ON MARINE PROSPECTING / MINING.

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Improbable	Improbable
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	No cumulative impacts are anticipated	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	Very Low	

5.3.3 POTENTIAL IMPACT ON PETROLEUM EXPLORATION

Description of impact

The proposed prospecting activities could affect petroleum exploration activities overlapping with the concession area, and vice versa.

Assessment

The proposed prospecting area overlaps with Block 1 held by Cairn South Africa (Pty) Ltd (Cairn) (the Petroleum Oil and Gas Corporation of South Africa (Pty) Ltd (PetroSA) has a 40 % interest in the block), Mid Orange held by Sungu Sungu, Block 2A held by Sunbird (PetroSA has a 24 % interest in the block) and Block 2B held by Africa Energy Corp and Simbo (refer to Figure 4-24 in Section 4). The proposed prospecting activities could affect and disrupt activities in these blocks if survey/sampling activities occur coincidentally in the same area. However, the likelihood of this happening is low.

The impact on petroleum exploration would be localised, short term and of low to medium intensity. The significance of impact is consequently very low to low, without mitigation and **VERY LOW** with mitigation (see Table 5-16).

Mitigation

- Notify Cairn, PetroSA, Sungu Sungu, Sunbird, Africa Energy Corp and Simbo and their contractors, as well as any other neighbouring petroleum exploration rights holders, prior to the commencement of activities; and
- Liaise with all petroleum exploration operators and any overlapping mineral prospecting rights holders to ensure that there is no overlapping of activities in the same area over the same time period.

TABLE 5-16: ASSESSMENT OF THE POTENTIAL IMPACT ON PETROLEUM EXPLORATION ACTIVITIES.

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low to Medium	Low
Duration	Short-term	Short-term
Extent	Low	Low
Consequence	Very Low to Low	Very Low
Probability	Probable	Probable
Significance	**Very Low to Low**	**Very Low**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	No cumulative impacts are expected.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	Low	

5.3.4 POTENTIAL IMPACT ON MARINE TRANSPORT ROUTES

Description of impact

The presence of the survey and/or sampling vessel(s) could interfere with shipping in the area.

Assessment

The majority of shipping traffic is located on the outer edge of the continental shelf, which is limited to the western portions of the concession area. The inshore traffic of the continental shelf along the West Coast is largely comprised of fishing and mining vessels, especially between Kleinzee and Oranjemund (see Figure 4-24 in Chapter 4).

While it is unlikely that shipping transport routes would be affected by the proposed prospecting activities, interaction with fishing and mining vessels is possible. The impact on shipping traffic is considered to be localised, of low intensity in the short-term. The significance of this impact is therefore assessed to be **INSIGNIFICANT** with and without mitigation (Table 5-17).

TABLE 5-17: ASSESSMENT OF INTERFERENCE WITH MARINE TRANSPORT ROUTES

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Improbable	Improbable
Significance	**Insignificant**	**Insignificant**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	No cumulative impacts are expected.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	Very Low	

Mitigation

- Prior to the commencement of activities, the vessel operator must notify relevant bodies including: DMR, DEA, SAMSA, the SAN Hydrographic Office, relevant Port Captains and DAFF: MRM, providing the navigational coordinates of the survey and/or sampling areas;
- The survey and sampling 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 should be taken to minimise the possibility of an offshore accident. Collision prevention equipment should include radar, multi-frequency radio, foghorns, etc. Safety equipment and training of personnel to ensure the safety and survival of the crew in the event of an accident is a further legal requirement; and
- A Notice to Mariners should provide the co-ordinates of the survey and/or sampling areas.

5.3.5 IMPACT ON CULTURAL HERITAGE MATERIAL

Description of impact

Sampling activities could disturb cultural heritage material on the seabed, particularly historical shipwrecks and other palaeontological or rare geological objects.

Assessment

As the known seabed outcrops of in-situ fossilised yellowwood tree trunks occur in Sea Concession Areas 4C and 5C (see Section 4.1.4.6.3), it is anticipated that the proposed sampling activities would not have any impact on the known locations of palaeontological material/in situ fossilised yellowwood tree trunks.

The likelihood of disturbing a shipwreck is expected to be very small considering the vast size of the South African offshore area. In the area under consideration, there are at least five vessels that could possibly have been wrecked in the vicinity of the concession area (see Table 4-7), as well as a further 28 vessels that may be somewhere in the area. However, the precise location of all these wrecks is unknown as they have been documented only through survivor accounts, archival descriptions and eyewitness reports recorded in archives and databases. In the event that these shipwreck sites are disturbed during sampling activities, the impact would be at the national level, permanent and of high intensity. The significance of impact is consequently **High**, without mitigation. With the implementation of mitigation, shipwreck sites can be largely avoided and if sampling is terminated in the unlikely event of encountering a shipwreck, the impact is regarded as **INSIGNIFICANT** (see Table 5-18).

Mitigation

- Areas where shipwreck sites are identified during the geophysical surveys must be excluded prior to undertaking sampling activities.
- It is recommended that the onboard De Beers representative must undergo a short induction on archaeological site and artefact recognition, as well as the procedure to follow should archaeological material be encountered during sampling.
- The contractor must be notified that archaeological sites could be exposed during sampling activities, as well as the procedure to follow should archaeological material be encountered during sampling.
- If shipwreck material is encountered during the course of sampling in any of the concession areas, the following mitigation measure should be applied:
  - Cease work in the directly affected area to avoid damage to the wreck until the South African Heritage Resources Agency (SAHRA) has been notified and the contractor/De Beers has complied with any additional mitigation as specified by SAHRA; and
  - Where possible, take photographs of them, noting the date, time, location and types of artefacts found. Under no circumstances may any artefacts be removed, destroyed or interfered on the site, unless under permit from SAHRA.

TABLE 5-18: ASSESSMENT OF POTENTIAL IMPACT ON SHIPWRECKS

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Medium	Low
Duration	Short-term	Short-term
Extent	National	National
Consequence	Medium	Low
Probability	Improbable	Improbable
Significance	**High**	**INSIGNIFICANT**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	No cumulative impacts are expected.	
Degree to which impact can be reversed	Irreversible	
Degree to which impact may cause irreplaceable loss of resources	Medium	
Degree to which impact can be mitigated	High	

5.4 NO-GO ALTERNATIVE

Description of impact

The implications of not going ahead with the proposed prospecting activities are as follows:

- Loss of opportunity to establish whether or not a viable offshore diamond resource exists off the West Coast of South Africa;
- Prevention of any socio-economic benefits associated with the continuation of prospecting activities; and
- Lost economic opportunities.

Assessment

The potential impact related to the lost opportunity to further delineate the offshore diamond resource on the west coast and maximise the use of South Africa's own resources is considered to be of **LOW** significance (see Table 5-19).

The positive implications on the no-go option are that there would be no effects on the biophysical environment in the area proposed for the prospecting activities.

TABLE 5-19: ASSESSMENT OF IMPACT RELATED TO NO-GO ALTERNATIVE.

CRITERIA	WITHOUT MITIGATION
Intensity	Low
Duration	Permanent
Extent	Regional
Consequence	Medium
Probability	Improbable
Significance	**Low**
Status	**Negative**
Confidence	Low
Nature of Cumulative impact	Potential loss of opportunity to expand South Africa's own heavy mineral resources.
Degree to which impact can be reversed	Reversible
Degree to which impact may cause irreplaceable loss of resources	N/A
Degree to which impact can be mitigated	N/A

5.5 CUMULATIVE IMPACTS

Description of impact

Historical and future mining activities, together with trawl fisheries and hydrocarbon exploration activities in the West Coast offshore has had and will continue to have an impact on benthic faunal communities. Impacts on benthic faunal communities include physical disturbance of the seabed and discharges to the benthic environment.

Assessment

Biological communities within marine habitats are largely ubiquitous throughout the southern African West Coast region. The West Coast is characterised by low marine species richness and low endemicity. Unique environments in the vicinity of the concession areas include Child's Bank (located 150 km due south of the concession areas) and Tripp Seamount (situated approximately 70 km west north-west), however no sampling will be undertaken in these areas.

It has been noted (Penney et al. 2007) that the current mining rates off the West Coast are comparable to the natural disturbances inherent in the Benguela ecosystem. Given this, as well as the uniformity of marine habitats offshore of the West Coast, it is considered unlikely that there will be any enduring cumulative impacts as a result of the sampling activities in relation to other offshore activities.

The proposed sediment sampling activities would, in the short-term, impact an additional area of 0.09 km^2. This is considered an insignificant percentage of the sea floor as a whole. The cumulative impact as a result of the proposed sampling activities is, thus considered to be **LOW**.

6. CONCLUSIONS AND RECOMMENDATIONS

De Beers is proposing to undertake geophysical surveys and sediment sampling activities within Sea Concession 6C, off the West Coast of South Africa.

SLR was appointed to act as the independent environmental consultant to undertake the necessary Basic Assessment and associated public consultation process for the proposed project. The Basic Assessment process has been undertaken so as to comply with the requirements of the EIA Regulations 2014 (as amended), NEMA and the MPRDA.

Specialist input was provided on the likely impact on the benthic environment and fisheries by the proposed prospecting activities. The findings of the specialist input and other relevant information have been integrated and synthesised into this draft BAR. The two main objectives of this draft BAR are, firstly, to assess the environmental significance of impacts resulting from the proposed prospecting activities and to suggest ways of mitigating negative impacts and enhancing benefits, and secondly to provide I&APs with an opportunity to comment on the proposed project.

This chapter summarises the key findings of the study and presents the recommendations in terms of mitigation measures that should be implemented if the proposed prospecting activities are authorised.

6.1 CONCLUSIONS

A summary of the assessment of potential environmental impacts associated with the proposed prospecting activities and No-Go Alternative is provided in Table 6-1.

The majority of the impacts associated with the vessel operations would be of short-term duration and limited to the immediate sampling areas. As a result, the majority of the impacts associated with the sampling vessels are considered to be of **INSIGNIFICANT** to **LOW** significance after mitigation.

Potential impacts on marine fauna as a result of the proposed marine sediment sampling activities would be of medium- to short-term duration and limited to the immediate sampling areas. As a result, the impacts on marine fauna associated with the sampling activities are considered to be of **VERY LOW** to **LOW** significance after mitigation.

The likelihood of disturbing a shipwreck is expected to be very low considering the vast size of the South African offshore area. In the event that any cultural heritage material is disturbed during sampling activities, the impact would be at the national level, and of high intensity. Without mitigation this is of **High** significance. However, with the implementation of mitigation, cultural heritage sites can largely be avoided and if sampling is terminated in the unlikely event of encountering a shipwreck, the impact is regarded as **INSIGNIFICANT**.

The implications of not going ahead with the proposed marine sediment sampling activities relate to the lost opportunity to establish whether or not a viable offshore diamond resource exists off the West Coast and the lost economic opportunities. This potential impact of the No-Go Alternative is considered to be of **LOW** significance. The positive implications on the no-go option are that there would be no effects on the biophysical environment in the area proposed for the prospecting activities.

TABLE 6-1: SUMMARY OF THE SIGNIFICANCE OF THE POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED PROSPECTING ACTIVITIES AND NO-GO ALTERNATIVE.

Potential impact		Significance	
		Without mitigation	With mitigation
Vessel operations:			
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		VL	**VL**
Impact on marine fauna:			
Noise associated with geophysical surveys and sampling		VL	**VL**
Sediment removal		L	**L**
Physical crushing of benthic biota		VL	**VL**
Generation of suspended sediment plumes		VL	**VL**
Smothering of benthos in redepositing tailings		VL - L	**VL**
Impact on other users of the sea:			
Fishing industry	Exclusion of the demersal long-line, traditional line-fish, tuna pole and fisheries research	VL	**VL**
	Sediment plume impact on fish stock recruitment	Insig	**INSIG**
Marine mining and prospecting		Insig	**INSIG**
Petroleum exploration		VL-L	**VL**
Marine transport routes		Insig	**INSIG**
Impact on cultural heritage material:			
Impact on historical shipwrecks		H	**INSIG**
No-Go Alternative:			
Lost opportunity to establish whether or not a viable offshore diamond resources exists off the West Coast and the lost economic opportunities.		L	**-**
Cumulative Impact:			
Benthic environment		L	**L**

VH=Very High	H=High	M=Medium	L=Low	VL=Very low	Insig = insignificant	N/A= Not applicable

6.2 RECOMMENDATIONS

6.2.1 Compliance with Environmental Management Programme and MARPOL 73/78 standards

- All phases of the proposed project must comply with the Environmental Management Programme presented in Chapter 7.
- Vessels used during prospecting must ensure compliance with MARPOL 73/78 standards.

6.2.2 Notification and communication with key stakeholders

- Prior to the commencement of the proposed activities, De Beers should consult with the managers of the DAFF research survey programmes to discuss their respective programmes and the possibility of altering the prospecting programme in order to minimise or avoid disruptions to both parties, where required.
- Notify Cairn, PetroSA, Sungu Sungu, Sunbird, Africa Energy Corp and Simbo and their contractors, as well as any other neighbouring petroleum exploration rights holders, as well as any companies undertaking marine prospecting or mining activities in the study area, prior to the commencement of activities.
- Liaise with all petroleum exploration operators and any overlapping mineral prospecting rights holders to ensure that there is no overlapping of activities in the same area over the same time period.
- Prior to the commencement of the proposed survey and/or sampling activities the following key stakeholders should be consulted and informed of the proposed activities (including navigational co-ordinates of the sampling areas, timing and duration of proposed activities) and the likely implications thereof:
  - Fishing industry / associations (these include South African Tuna Association, South African Tuna Longline Association, Fresh Tuna Exporters Association, South African Commercial Linefish Association, Hake Longline Association, National SMME Fishing Forum); and
  - Other: Department of Agriculture, Forestry and Fisheries (DAFF), South African Maritime Safety Authority (SAMSA), South African Navy (SAN) Hydrographic office, overlapping and neighbouring exploration right holders and applicants, and Transnet National Ports Authority (ports of Cape Town and Saldanha Bay).
- The required safety zones around the sampling vessels should be communicated via the issuing of Daily Navigational Warnings for the duration of the sampling operations through the South African Naval Hydrographic Office.
- The SAN Hydrographic office should be notified when the programme is complete so that the Navigational Warning can be cancelled.

6.2.3 Discharges

- All process areas should be bunded to ensure drainage water flows into the closed drainage system.
- Undertake training and awareness of crew in spill management to minimise contamination.
- Low-toxicity biodegradable detergents and reusable absorbent cloths should be used in cleaning of all deck spillage.

- All hydraulic systems should be adequately maintained.
- Minimise the discharge of galley waste material should obvious attraction of marine fauna be observed.

6.2.4 Vessel seaworthiness and safety

- Vessels used during prospecting must be certified for seaworthiness through an appropriate internationally recognised marine certification programme (e.g. Lloyds Register, Det Norske Veritas).
- Collision prevention equipment should include radar, multi-frequency radio, foghorns, etc. Safety equipment and training of personnel to ensure the safety and survival of the crew in the event of an accident is a further legal requirement.
- A Notice to Mariners should provide the co-ordinates of the sampling areas.

6.2.5 Recommendations specific to the geophysical surveys

- A designated onboard Marine Mammal Observer (MMO) to ensure compliance with mitigation measures during geophysical surveying.
- The MMO should conduct visual scans for the presence of cetaceans around the survey vessel prior to the initiation of any acoustic impulses.
- Pre-survey scans should be of least a 15-minute duration prior to the start of survey equipment.
- Where equipment permits, "soft starts" should be carried out for equipment with source levels greater than 210 dB re 1 µPa at 1 m over a period of 20 minutes to give adequate time for marine mammals to leave the vicinity. 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.
- Terminate the survey if any marine mammals show affected behaviour within 500 m of the survey vessel or equipment until the mammal has vacated the area.
- Avoid planning geophysical surveys during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (beginning of June to end of November), and ensure that migration paths are not blocked by survey operations.
- For the months of June and November ensure that Passive Acoustic Monitoring (PAM) is incorporated into any survey programme.

6.2.6 Sampling activities

- Exploration sampling targets gravel bodies and would thus avoid known sensitive habitats and high-profile, predominantly rocky-outcrop areas without a sediment veneer. Prior to bulk sampling, a visual sampling programme must be undertaken in rocky-outcrop areas to identify sensitive communities.
- Existing geophysical data should be used to conduct a pre-sampling geohazard analysis of the seabed, and near-surface substratum to map potentially vulnerable habitats and prevent potential conflict with the sampling targets.
- Where possible, dynamically positioned sampling vessels should be used in preference to vessels requiring anchorage.

6.2.7 CULTURAL HERITAGE MATERIAL

- Areas where shipwreck sites are identified during the geophysical surveys must be excluded prior to undertaking sampling activities.
- The onboard De Beers representative must undergo a short induction on archaeological site and artefact recognition, as well as the procedure to follow should archaeological material be encountered during sampling.
- The contractor must be notified that archaeological sites could be exposed during sampling activities, as well as the procedure to follow should archaeological material be encountered during sampling.
- If shipwreck material is encountered during the course of sampling in any of the concession areas, the following mitigation measure should be applied:
  - Cease work in the directly affected area to avoid damage to the wreck until SAHRA has been notified and the contractor/De Beers has complied with any additional mitigation as specified by SAHRA; and
  - Where possible, take photographs of artefacts found, noting the date, time, location and types. Under no circumstances may any artefacts be removed, destroyed or interfered on the site, unless under permit from SAHRA.

7. ENVIRONMENTAL MANAGEMENT PROGRAMME

The Environmental Management Programme (EMPr) compiled for the proposed prospecting activities is set out in Table 7.1. Specific issues are addressed under each of the following sections:

7.1.	PLANNING PHASE	7.1.1.	Preparation of subsidiary plans
		7.1.2.	Stakeholder consultation and notification
		7.1.3.	Permits / Exemptions
		7.1.4.	Financial Provision
7.2.	ESTABLISHMENT PHASE	7.2.1.	Compliance with the EMPr
		7.2.2.	Environmental Awareness Training
		7.2.3.	Notifying other users of the sea
		7.2.4.	Onboard observer or MMO and PAM operator, where required
7.3.	OPERATIONAL PHASE	7.3.1.	Adherence to the EMPr and Environmental Awareness
		7.3.2.	Prevention of emergencies
		7.3.3.	Communication with other users of the sea and resource managers
		7.3.4.	Dealing with emergencies including major oil spills
		7.3.5.	Survey Activities
		7.3.6.	Sampling Activities
		7.3.7.	Pollution control and waste management
		7.3.8.	Equipment loss
		7.3.9.	Oil bunkering / refuelling at sea
		7.3.10.	Acoustic Emissions
		7.3.11.	Vessel Lighting
		7.3.12.	Monitoring and Auditing
7.4.	DECOMMISSIONING AND CLOSURE PHASE	7.4.1.	Survey/sampling vessel to leave area
		7.4.2.	Inform key stakeholders of survey completion
		7.4.3.	Final waste disposal
		7.4.4.	Rehabilitation and closure
		7.4.5.	Information sharing

The fundamental elements of this management programme are to be implemented at all times, as and when appropriate.

7.1 PLANNING PHASE					
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PROGRAMME OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**
7.1.1 PREPARATION OF SUBSIDIARY PLANS	Preparation for any emergency that could result in an environmental impact	Ensure the following plans are prepared and in place: • Shipboard Oil Pollution Emergency Plan (SOPEP) for the survey and sampling vessels, as required by MARPOL; • Emergency Response Plan (including MEDIVAC plan); • Waste Management Plan (see contents in Section 7.3.8). In addition to the above, ensure that: • An adequate system is in place to address oil pollution incidents; and • The survey and sampling vessel's seaworthiness certificate and/or classification stamp are in place.		De Beers	Prior to commencement of operation
7.1.2 FINALISATION OF SAMPLING AREA	Protection of heritage and cultural features	Exclude any areas where shipwrecks are identified (during geophysical surveys) from a planned sampling area.		De Beers	Prior to commencement of sampling
7.1.3 STAKEHOLDER CONSULTATION AND NOTIFICATION	DMR notification	Compile the specific details of the prospecting operations into a Notification and submit to the Department of Mineral Resources (DMR). The notification should provide, *inter alia*, the details on the following: • Prospecting programme (timing, co-ordinates and duration) • Contractor details; and • Other information on request.		De Beers and sampling contractor	30 days prior to commencement of operations or as required by DMR
	Stakeholder notification	• Consult with the managers of the DAFF research survey programmes to discuss their respective programmes and the possibility of altering the prospecting programme in order to minimise or avoid disruptions to both parties, where required. • Notify relevant government departments and other key stakeholders of the commencement of mining operations (including navigational co-ordinates, timing and duration of proposed activities) and the restrictions related to the operation. Stakeholders include: > Fishing industry / associations: - South African Tuna Association; - South African Tuna Longline Association; - Fresh Tuna Exporters Association; - South African Commercial Linefish Association;		De Beers	30 days prior to commencement of operations

7.1 PLANNING PHASE					
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PROGRAMME OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**
		- Hake Longline Association; and - National SMME Fishing Forum. > Local fishing operators; > SAMSA; > South African Navy (SAN) Hydrographic office; > Department of Agriculture, Forestry and Fisheries (DAFF), including the fisheries research managers; > Transnet National Ports Authority (ports of Cape Town and / or Saldanha Bay); and > Overlapping and/or adjacent prospecting / mining/ exploration right holders. • Any dispute arising with adjacent prospecting / exploration right holders should be referred to the Department of Mineral Resources or PASA for resolution.			
7.1.4 PERMITS / EXEMPTIONS	Compliance with legislative requirements	If necessary, apply to DEA for an exemption to approach or remain within 300 m of whales (see note below). The request for an exemption must be submitted to DEA. Note: In terms of the Marine Living Resources Act, 1998 (No. 18 of 1998): • No person may approach within 300 metres of a whale by vessel, aircraft or other means without a permit; • A vessel approached by a whale is required to distance itself at 300 m from the whale, unless in possession of a permit; • A vessel may not proceed directly through a school of dolphins or porpoises; and • No person shall attempt to feed, harass, disturb or kill great white sharks, dolphins, seals or turtles.		De Beers and Appointed contractor	Prior to commencement of operations
7.1.5 FINANCIAL PROVISION	Compliance with legislative requirements	• Ensure that the requirements of NEMA in terms of financial provision for remediation of environmental damage are met by: - Allocating operational costs to meet EMPr requirements; - Maintaining adequate Protection and Indemnity (P&I) Insurance Cover to allow for clean-ups in the event of a hydrocarbon spill and other eventualities; and - Providing sufficient funds to execute the EMPr in the event of premature closure or in the event that, on closure, the EMPr has not been successfully executed.		De Beers	Prior to commencement of operations

7.2 ESTABLISHMENT PHASE					
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PROGRAMME OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**
7.2.1 COMPLIANCE WITH EMPr	Operator and contractor to commit to adherence to EMPr	• Verify that a copy of the approved EMPr is supplied to the appointed contractor and is on board the survey and sampling vessels during the operation. • Verify procedures and systems for compliance are in place. • Verify correct equipment and personnel are available to meet the requirements of the EMPr.		De Beers and appointed contractor	Prior to commencement of operation
7.2.2 ENVIRONMENTAL AWARENESS TRAINING	Ensure personnel are appropriated trained	• Undertake Environmental Awareness Training to ensure the vessel's personnel are appropriately informed of the purpose and requirements of the EMPr. • Verify responsibilities are allocated to the relevant personnel.		Appointed contractor	Prior to commencement of operation
7.2.3 NOTIFYING OTHER USERS OF THE SEA	Ensure that other users are aware of the survey/sampling programme	• Request, in writing, the SAN Hydrographic office to release Radio Navigation Warnings and Notices to Mariners throughout the survey/sampling period. The Notice to Mariners should give notice of (1) the co-ordinates of the surveying/sampling, (2) an indication of the proposed surveying/sampling timeframes, (3) an indication of the 500 m safety zone around the sampling vessel, and (4) provide details on the movements of support vessels servicing the operation. • A copy of the Notices to Mariners should be distributed to local fishing operators.		De Beers	7 days prior to start
7.2.4 ONBOARD OBSERVER OR MMO AND PAM OPERATOR, WHERE REQUIRED	Ensure impacts associated with the survey operations are kept to a minimum	• A designated onboard Marine Mammal Observer (MMO) shall ensure compliance with mitigation measures during geophysical surveying. • For the months of June and November appoint a Passive Acoustic Monitoring (PAM) operator.		De Beers	Prior to commencement of operations

7.3 OPERATIONAL PHASE					
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PROGRAMME OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**
7.3.1 ADHERENCE TO THE EMPr AND ENVIRONMENTAL AWARENESS	Operate in an environmentally responsible manner	• Undertake Environmental Awareness Training (including spill management) to ensure the vessel's personnel are appropriately informed of the purpose and requirements of the EMPr. • Ensure the onboard De Beers representative undergoes a short induction on archaeological site and artefact recognition, as well as the procedure to follow should archaeological material be encountered during sampling. • Comply fully with the EMPr (compliance would mean that all activities were undertaken successfully and details recorded).		De Beers and Appointed contractor	Prior to and throughout operation
7.3.2 PREVENTION OF EMERGENCIES	Minimise the chance of emergency and subsequent damage to the environment occurring	• Prevent collisions by ensuring that the survey and sampling vessels display correct signals by day and lights by night (including twilight), by visual radar watch and standby vessel(s). • Maintain 500 m safety zone around mining vessel through Notices to Mariners and Navigation Warnings. • Call any fishing vessels that are deemed to be a risk to the survey and / or survey vessel via radio and inform them of the navigational safety requirements. • Ensure all hazardous materials are correctly labelled, stored, packed and sealed with proper markings for shipping.		Appointed contractor	Throughout operation
		• Establish lines of communication with the following emergency response agencies / facilities: SAMSA, SAN Hydrographic Office (Silvermine), DEA (Directorate of Marine Pollution) and DMR.		Appointed contractor	During operations as required
7.3.3 CONTINUE TO COMMUNICATE WITH OTHER USERS OF THE SEA AND RESOURCE MANAGERS	Promote co-operation and successful multiple use of the sea, including promotion of safe navigation	• Through normal communication channels, Radio Navigation Warnings and Notices to Mariners, keep relevant government departments and other key stakeholders (see Section 7.1.2) updated on the prospecting programme.		Appointed contractor	During operations as required
		• Co-operate with other legitimate users of the sea to minimise disruption to other marine activities. • Keep constant watch for approaching vessels during the prospecting operation and warn by radio and support vessel, if required. • Keep a record of any interaction with other vessels.		Appointed contractor	During operations as required

7.3 OPERATIONAL PHASE					
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PROGRAMME OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**
7.3.4 DEALING WITH EMERGENCIES INCLUDING OIL SPILLS (owing to collision, vessel break-up, refuelling etc.)	Minimise damage to the environment by implementing response procedures efficiently	• Adhere to obligations regarding other vessels in distress. • Notify SAMSA about wrecked vessels (safety and pollution) and the Department of Finance with regard to salvage, customs and royalties). Provide location details to SAN hydrographer. • In the event of an oil spill immediately implement emergency plans (see Section 7.1.1). In the case of an oil spill to sea with serious potential consequences to marine and human life notify (a) the Principal Officer of the nearest SAMSA office, (b) the DEA's Chief Directorate of Marine & Coastal Pollution Management in Cape Town, and (c) PASA. Information that should be supplied when reporting a spill includes: > Name and contact details of person reporting the incident; > The type and circumstances of incident, ship type, port of registry, nearest agent representing the ships company; > Date and time of spill; > Location (co-ordinates), source and cause of pollution; > Type and estimated quantity of oil spilled and the potential and probability of further pollution; > Weather and sea conditions; > Action taken or intended to respond to the incident; and > Supply vessels must have the necessary spill response capability to deal with accidental spills in a safe, rapid, effective and efficient manner. • Where diesel, which evaporates relatively quickly, has been spilled, the water should be agitated or mixed using a propeller boat/dinghy to aid dispersal and evaporation. This is only to be undertaken where it does not pose a health and safety risk. • Dispersants should not be used without authorisation of DEA. Dispersants should not be used: > On diesel or light fuel oil. > On heavy fuel oil. > On slicks > 0.5 cm thick. > On any oil spills within 5 nautical miles off-shore or in depths less than 30 metres. > In areas far offshore where there is little likelihood of oil reaching the shore. • Dispersants are most effective:		De Beers and Appointed contractor	In event of spill

7.3 OPERATIONAL PHASE					
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PROGRAMME OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**
		> On fresh crude oils; under turbulent sea conditions (as effective use of dispersants requires mixing). > When applied within 12 hours or at a maximum of 24 hours. • The volume of dispersant application should not exceed 20-30% of the oil volume.			
7.3.5 SURVEY ACTIVITIES		• Ensure that geophysical survey activities are conducted in compliance with the following: – Avoid planning geophysical surveys during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (beginning of June to end of November), and ensure that migration paths are not blocked by survey operations. – The MMO should conduct visual scans for the presence of cetaceans around the survey vessel prior to the initiation of any acoustic impulses. – Pre-survey visual scans should be of least a 15-minute duration prior to the start of survey equipment. – Terminate the survey if any marine mammals show affected behaviour within 500 m of the survey vessel or equipment until the mammal has vacated the area. – Where equipment permits, "soft starts" should be carried out for equipment with source levels greater than 210 dB re 1 µPa at 1 m over 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. – Ensure that PAM (passive acoustic monitoring) is incorporated into any surveying taking place in June and / or November.		Appointed contractor	Throughout surveying operations
7.3.6 SAMPLING ACTIVITIES	Reduce disturbance of sampling activities on heritage resources and benthic biodiversity	• Avoid sampling in any areas where identified shipwrecks (during geophysical surveying) are located. • Exploration sampling targets gravel bodies and would thus avoid known sensitive habitats and high-profile, predominantly rocky-outcrop areas without a sediment veneer. Prior to bulk sampling, a visual sampling programme must be undertaken in rocky-outcrop areas to identify sensitive communities. • Where possible make available non-confidential data to relevant agencies / regional or national programmes involved in biodiversity conservation / evaluation and management of marine ecosystems.		Appointed contractor	Throughout sampling operations

7.3 OPERATIONAL PHASE					
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PROGRAMME OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**
	Protection of heritage and cultural features	• If shipwreck material is encountered during the course of sampling in any of the concession areas, the following mitigation measure will be apply: – Cease work in the directly affected area to avoid damage to the wreck until SAHRA has been notified and the contractor/De Beers has complied with any additional mitigation as specified by SAHRA; and – Where possible, take photographs of artefacts found, noting the date, time, location and types. Under no circumstances may any artefacts be removed, destroyed or interfered on the site, unless under permit from SAHRA.		De Beers and Appointed contractor	In the event a shipwreck is encountered
7.3.7 POLLUTION CONTROL AND WASTE MANAGEMENT of products disposed of: into the air (exhausts, CFCs and incinerators), to sea (sewage, food, oils), to land (used oils etc, metals, plastics, glass, etc.)	Minimise pollution, and maximise recycling by implementing and maintain pollution control and waste management procedures at all times	• Implement a Waste Management Plan (see Section 7.1.1). The plan must comply with legal requirements (including MARPOL) for waste management and pollution control (for air and water quality levels at sea) and ensure "good housekeeping" and monitoring practices: > General solid waste: - Initiate a waste minimisation system. - No waste should be disposed overboard. - Ensure on-board solid waste storage is secure. - No waste is to be incinerated unless an Atmospheric Emission Licence is obtained from DEA: Air Quality Management Services. > Galley (food) waste: - No disposal within 3 nm of the coast. - Disposal between 3 nm and 12 nm of the coast shall to be comminuted to particle sizes smaller than 25 mm. - Minimise the discharge of waste material should obvious attraction of fauna be observed. > Deck drainage: - Deck drainage should be routed to a separate drainage system (oily water catchment system). - Ensure all process areas are bunded to ensure drainage water flows into the closed drainage system. - Use drip trays to collect run-off from equipment that is not contained within a bunded area and route contents to the closed drainage system. - Ensure that weather decks are kept free of spillage.		Appointed contractor	Throughout prospecting operations

7.3 OPERATIONAL PHASE					
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PROGRAMME OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**
		- Mop up any spills immediately. - Low-toxicity biodegradable detergents should be used in cleaning of all deck spillage. - Ensure compliance with MARPOL standards. > Machinery space drainage: Vessels must comply with international agreed standards regulated under MARPOL. All machinery space drainage would pass through an oil/water filter to reduce the oil in water concentration to less than 15 ppm. > Sewage: - Use approved treatment plants to MARPOL standards. - No disposal within 4 nm of the coast. - Disposal further than 4 nm of the coast needs to be comminuted and disinfected prior to disposal into the sea.1 > Medical waste: Seal in aseptic containers for appropriate disposal onshore. > Metal: Send to shore for recycling or disposal. > Other waste: Dispose of remaining solid waste at a licensed landfill facility or an alternative approved facility. Ensure waste disposal is carried out in accordance with appropriate laws and ordinances. > Waste oil: Return used oil to a port with a registered facility for processing or disposal. > Minor oil spill: Use oil absorbent. > Emissions to the atmosphere: - Properly tune and maintain all engines, motors, generators and all auxiliary power to contain the minimum of soot and unburned diesel. - Implement leak detection and repair programmes for valves, flanges, fittings, seals, etc. > Other hazardous waste: - Record types and volumes of chemical and hazardous wastes (e.g. radioactive devices/materials, neon lights, fluorescent tubes, toner cartridges, batteries, etc.) and destination thereof. - Send to designated onshore hazardous disposal site. Retain waste receipts. • Ensure all crew is trained in spill management.			

7.3 OPERATIONAL PHASE					
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PROGRAMME OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**
7.3.8 **EQUIPMENT LOSS**	Minimise hazards left on the seabed or floating in the water column, and inform relevant parties	• Where possible, attempt the recovery of any items lost overboard. • Keep a record of lost equipment and all items lost overboard and not recovered. • When any items that constitute a seafloor or navigational hazard are lost on the seabed, or in the sea: > Complete a standard form / record sheet, which records the location, date and cause of loss, details of equipment type, weather, sea state, etc. > Notify SAMSA and SAN Hydrographer. > Request that SAN Hydrographer send out a Notice to Mariners with this information.		Appointed contractor	Throughout mining operation
7.3.9 **USE OF HELICOPTERS for crew changes, servicing, etc.**	Minimise disturbance / damage to marine and coastal fauna.	• Use flight paths that do not pass over coastal reserves (MacDougall's Bay) and seal colonies (Buchu Twins and Kleinzee). • Report deviations from set flight plans. • Low altitude coastal flights (< 762 m [2 500 ft] and within 1 nm of the shore) should also be avoided, particularly during the winter/spring (June to November inclusive) whale migration period and during the November to January seal breeding season. The flight path between the onshore logistics base in Kleinzee and mining vessel should be more or less perpendicular to the coast. • Brief all pilots on ecological risks associated with flying at a low level along the coast or above marine mammals. • Comply with aviation and authority guidelines and rules.		De Beers and aircraft/helicopter contractor	As required
7.3.10 **OIL BUNKERING / REFUELLING AT SEA**	Minimise disturbance / damage to marine life.	• No discharge of any oil whatsoever is permitted. • Offshore bunkering is not permitted within the economic zone (i.e. 200 nm from the coast) without permission from SAMSA. • Submit an application in terms of Regulation 14 of GN R1276 under the Marine Pollution (Control and Civil Liability) Act, 1981 (No. 6 of 1981) to the Principal Officer at the port nearest to where the transfer is to take place. • Inform SAMSA of location, supplier and timing, 5 days prior to refuelling at sea.		Appointed contractor / Vessel Captain	As required, 5 days prior to refuelling
7.3.11 **VESSEL LIGHTING**	Minimise attraction of marine fauna to drilling unit.	• Lighting on-board prospecting vessels should be reduced to the minimum required for safety levels to minimise stranding of pelagic seabirds on the vessels at night. • Any stranded seabirds must be retrieved and released during daylight hours.		Appointed contractor	

7.3 OPERATIONAL PHASE					
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PROGRAMME OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**
7.3.12 MONITORING AND AUDITING	Ensure compliance with monitoring and auditing requirements for prospecting operations.	• Undertake regular audits of the sampling operations as part of the Company's ISO14001 Environmental Management System to determine the level of compliance with the EMPr requirements and conditions of the environmental authorisation. • Prepare an environmental audit report and submitted to the DMR every two years. The audit report must comply with legal requirements contained in Appendix 7 of the 2014 EIA Regulations, as amended (or any amendments thereto). • Calculate and report on annual and cumulative sampled areas.		De Beers must appoint an independent auditor to prepare the Environmental Audit Report	Audit annually. Submit to DMR every 2 years.

7.4 DECOMMISSIONING AND CLOSURE PHASE					
PROJECT PHASE AND ACTIVITIES:	**ENVIRONMENTAL OBJECTIVES:**	**AUDITABLE MANAGEMENT ACTIONS TO BE TAKEN TO MEET THE ENVIRONMENTAL MANAGEMENT PROGRAMME OBJECTIVES:**	✓	**RESPONSI-BILITY:**	**TIMING:**
7.4.1 SURVEY/SAMPLING VESSEL TO LEAVE AREA	Leave area as it was prior to operation	Ensure that no debris or dropped equipment that may be detrimental to environment or other users of the sea is left on the seafloor. The benefits of retrieval of debris or equipment must first be weighed up against the potential health and safety risks.		Appointed contractor	On completion of surveying / sampling
7.4.2 INFORM RELEVANT PARTIES OF MINING COMPLETION	Ensure that relevant parties are aware that the prospecting operation is complete	• Inform all key stakeholders (see Section 7.2.1.2) that the mining vessel is off location. • Notify the SAN Hydrographic office when the programme is complete so that the Navigational Warning can be cancelled.		De Beers	Within four weeks after completion of prospecting
7.2.3 FINAL WASTE DISPOSAL	Minimise pollution and ensure correct disposal of waste	• Dispose all waste retained onboard at a licensed waste site using a licensed waste disposal contractor.		Appointed contractor	When vessel is in port
7.2.4 REHABILITATION AND CLOSURE	Ensure corrective action and compliance and contribute towards improvement of EMPr implementation	• Apply for closure, submit the following documentation to the DMR: – A final layout plan; – A Closure Plan; – An Environmental Risk Report; – A Final Audit Report; and – A completed application form to transfer environmental responsibilities and liabilities, if such transfer has been applied for.		De Beers	On completion of prospecting
7.2.4.5 INFORMATION SHARING	Expand knowledge base	Take steps to share data collected during the sampling programme (e.g. ROV video footage of the benthic environment), if requested, to resource managers (including DEA, South African National Biodiversity Institute and appropriate research institutes).		De Beers	On completion of prospecting

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APPENDIX A: DMR BASIC ASSESSMENT REPORT TEMPLATE

APPENDIX B: DMR CORRESPONDENCE

APPENDIX C: MARINE FAUNAL ASSESSMENT

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APPENDIX G2: I&AP NOTIFICATION

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