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

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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).

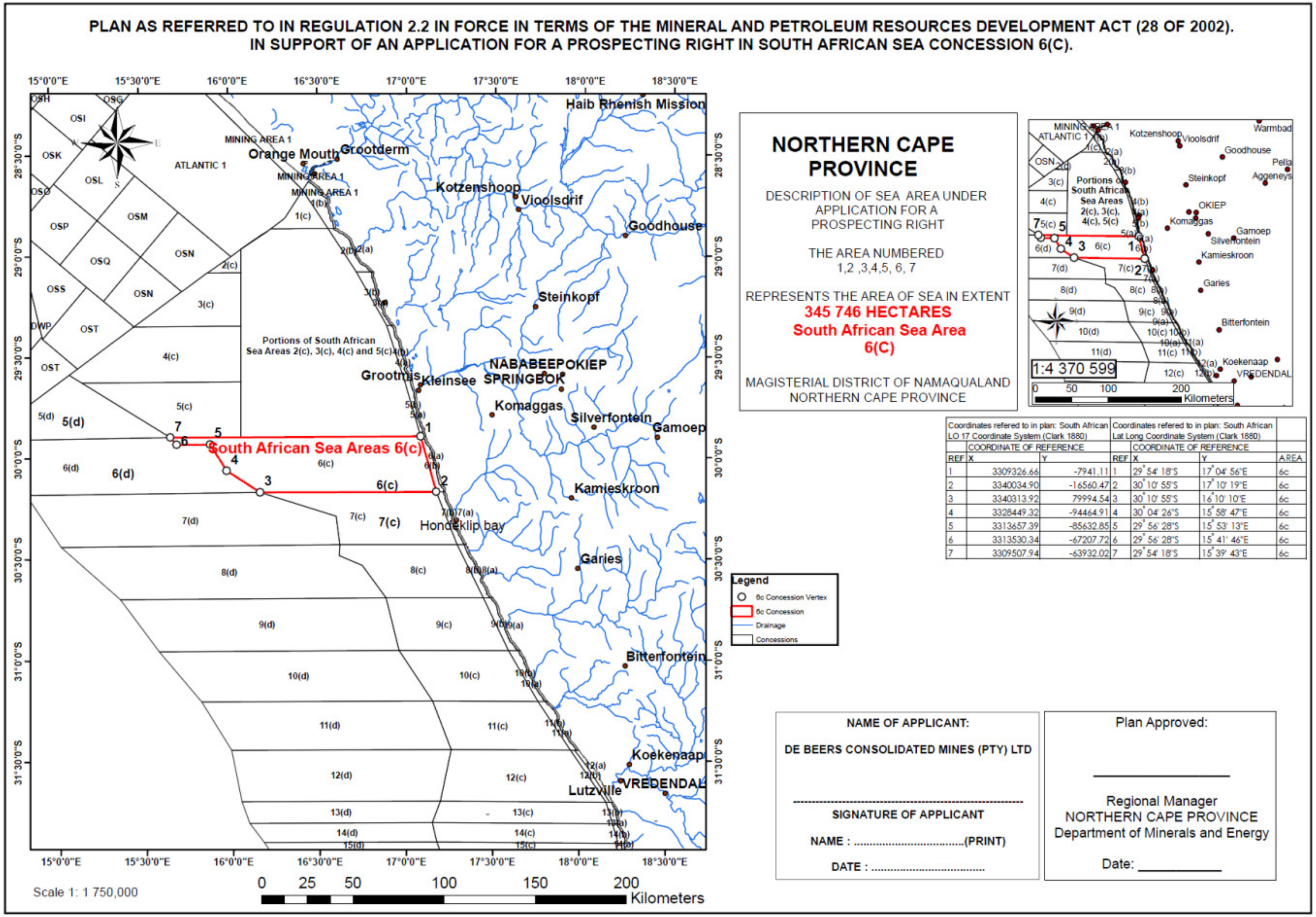
The proposed prospecting activities require authorisation in terms of the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA), as amended, and a Prospecting Right has to be obtained in terms of the MPRDA. In terms of the Environmental Impact Assessment (EIA) Regulations 2014 (as amended), 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.

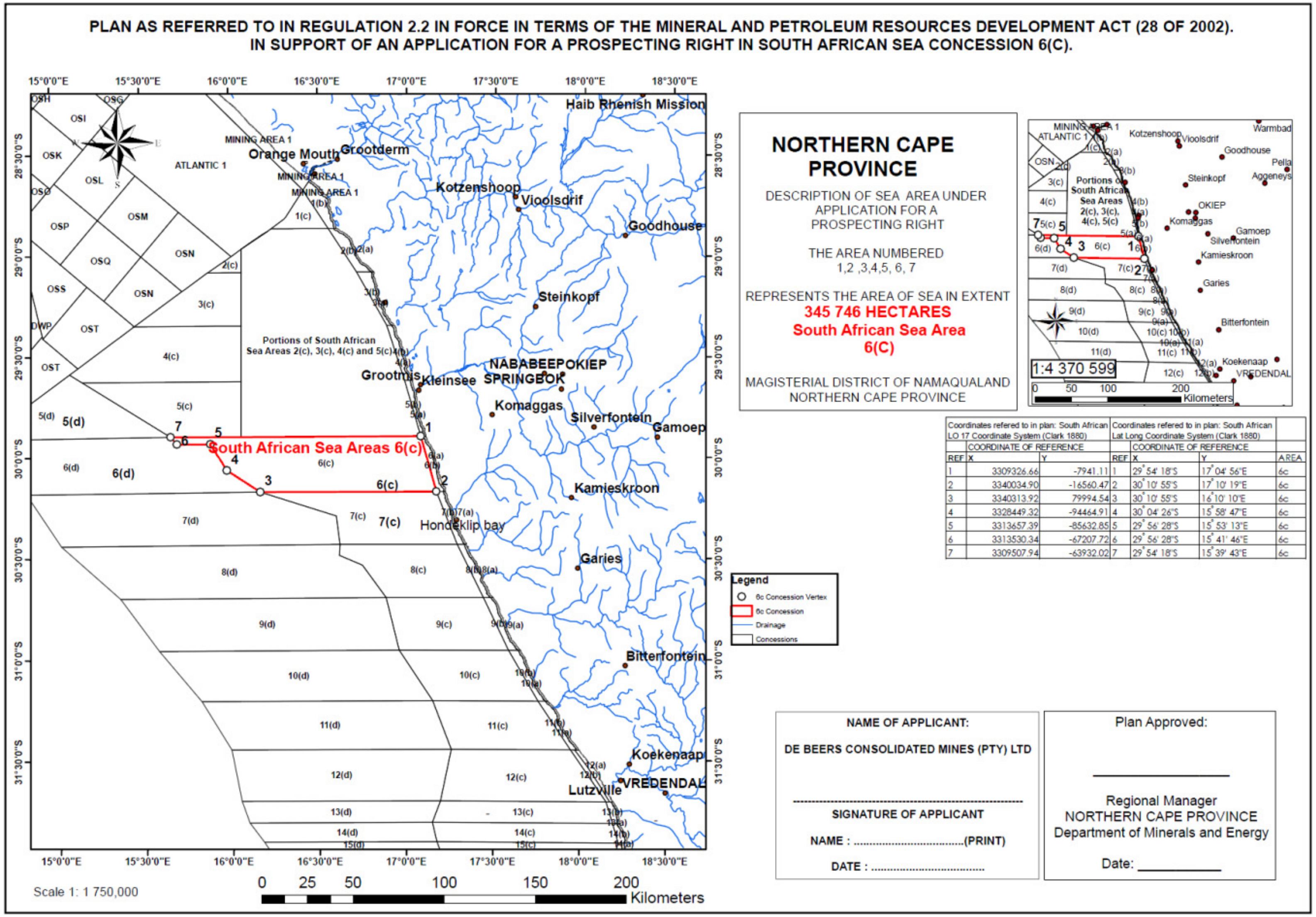
Sea Concession 6C is situated approximately 400 km north of Cape Town, with the inshore boundary located 5 km seaward of the coast between Hondeklip Bay in the south and Kleinzee in the north and the offshore boundary located between approximately 70 to 100 km offshore (see Figure 1-1). Sea Concession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



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 1-1: 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.

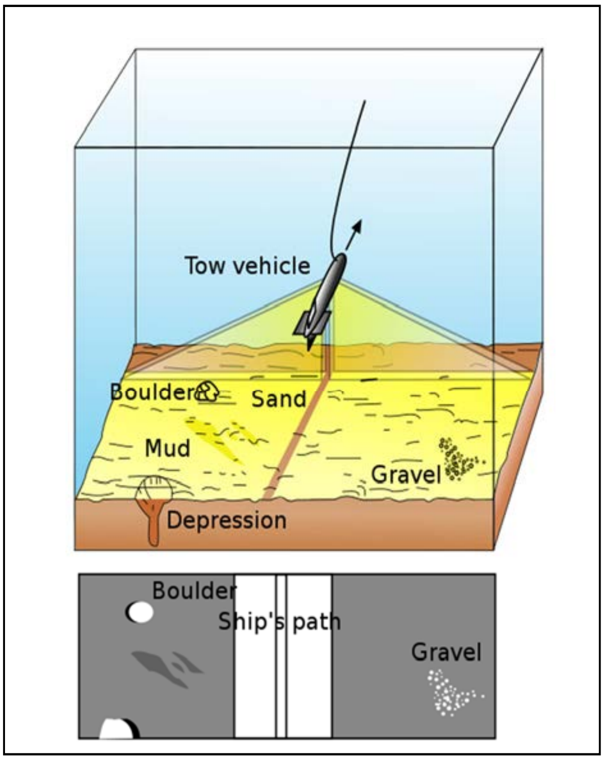


FIGURE 3-1: SCHEMATIC OF A TYPICAL SIDE SCAN SONAR DEVICE AND RESULTING INFORMATION.

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).

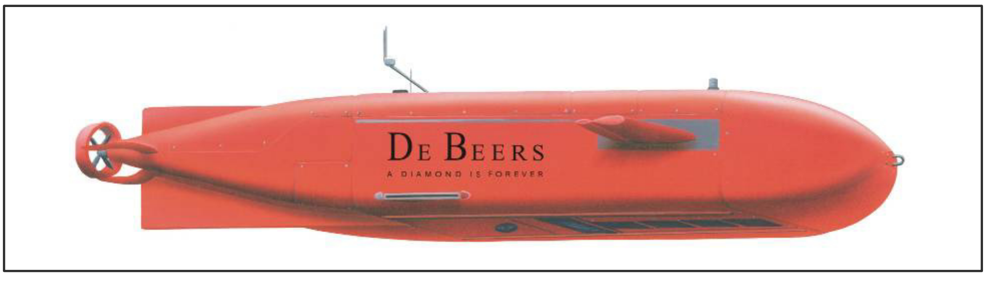


FIGURE 3-2: AN AUTONOMOUS UNDERWATER VEHICLE (AUV).

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.

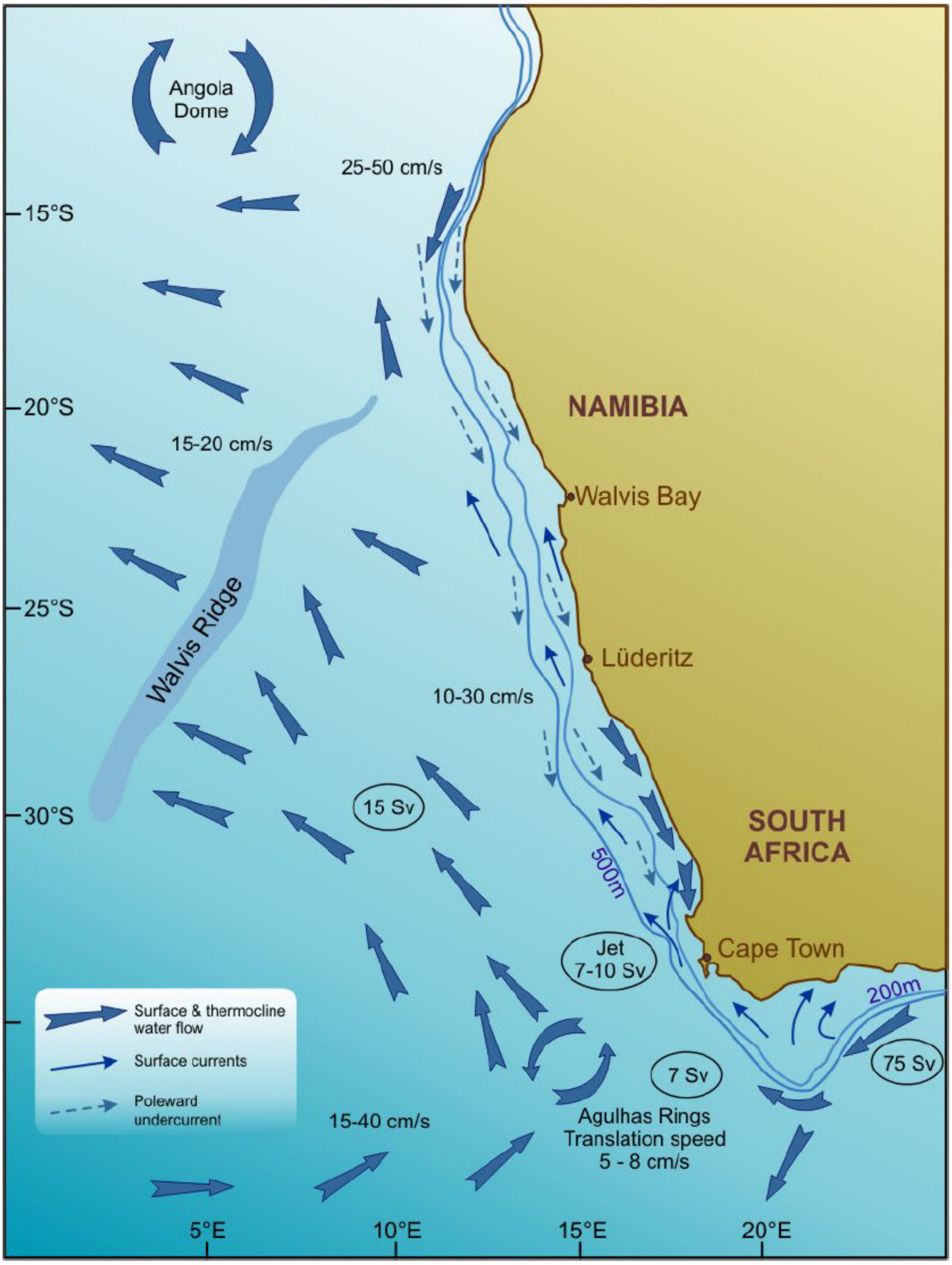


FIGURE 4-1: CIRCULATION AND VOLUME FLOWS OF THE BENGUELA CURRENT (AFTER SHANNON & NELSON, 1996).

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).

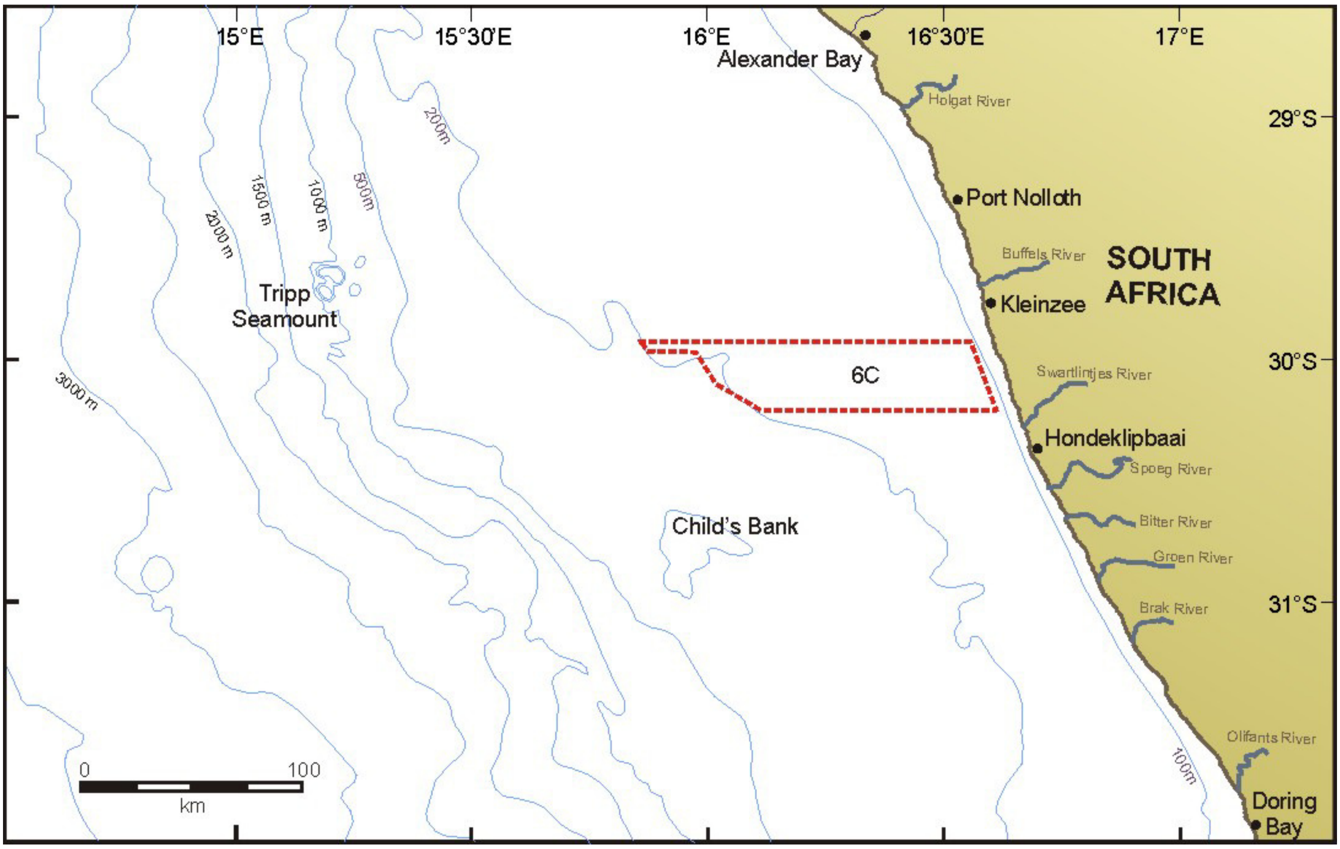


FIGURE 4-2: SEA CONCESSION 6C IN RELATION TO THE REGIONAL BATHYMETRY AND SHOWING PROXIMITY OF PROMINENT SEABED FEATURES.

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.

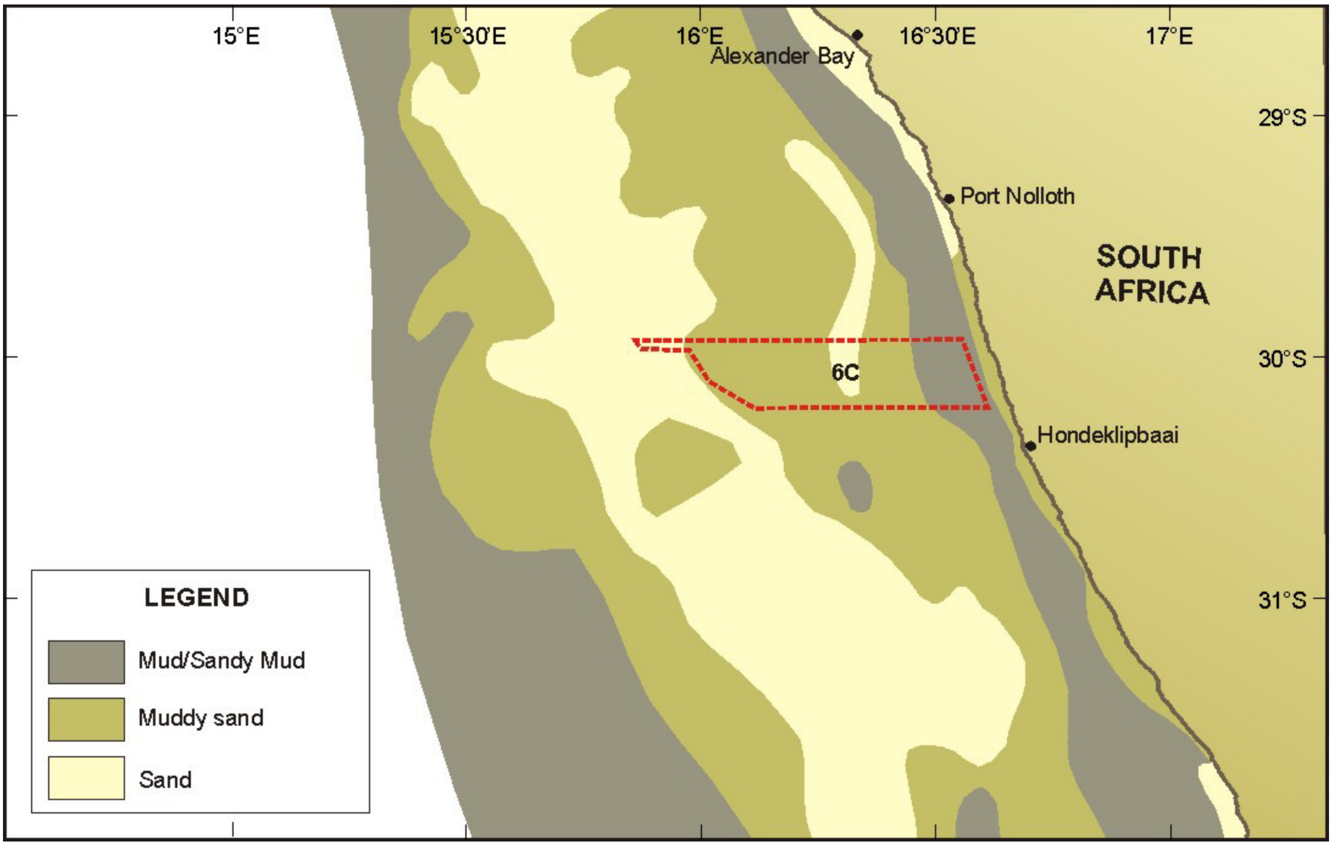


FIGURE 4-3: SEA CONCESSION 6C IN RELATION TO SEDIMENT DISTRIBUTION ON THE CONTINENTAL SHELF (ADAPTED FROM ROGERS 1977).

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.

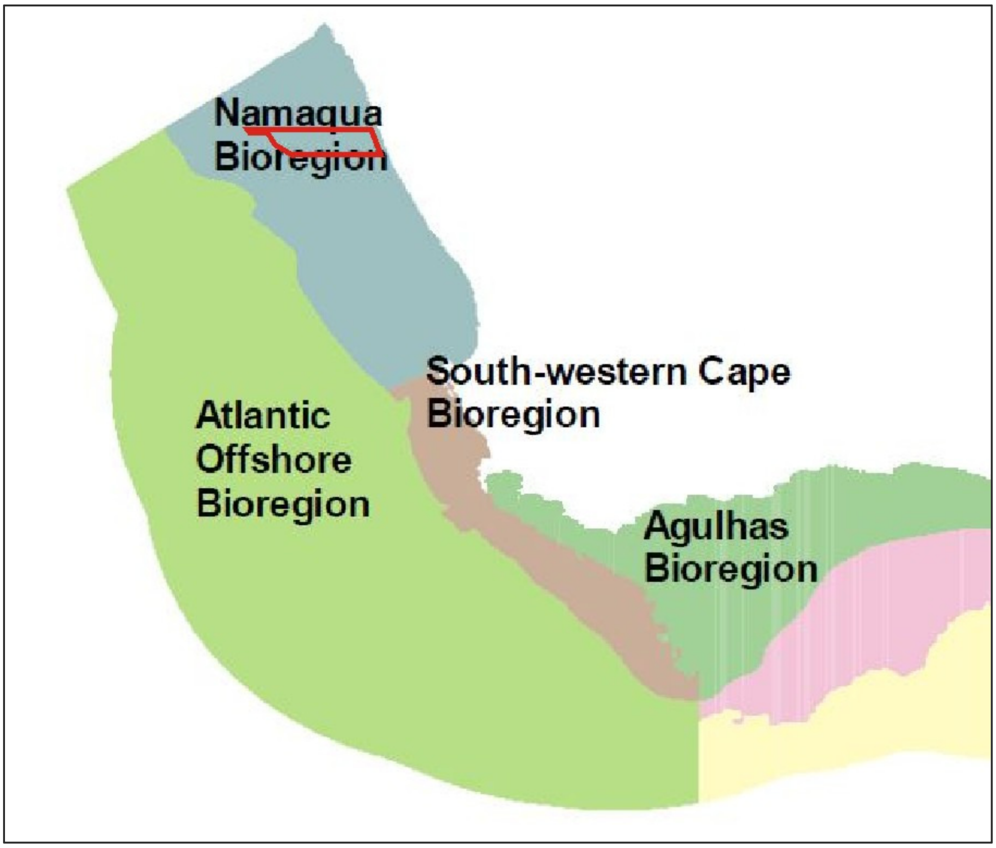


FIGURE 4-4: SEA CONCESSION 6C (RED POLYGON) IN RELATION TO THE SOUTH AFRICAN INSHORE AND OFFSHORE BIOREGIONS (ADAPTED FROM LOMBARD *ET AL.* 2004).

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.

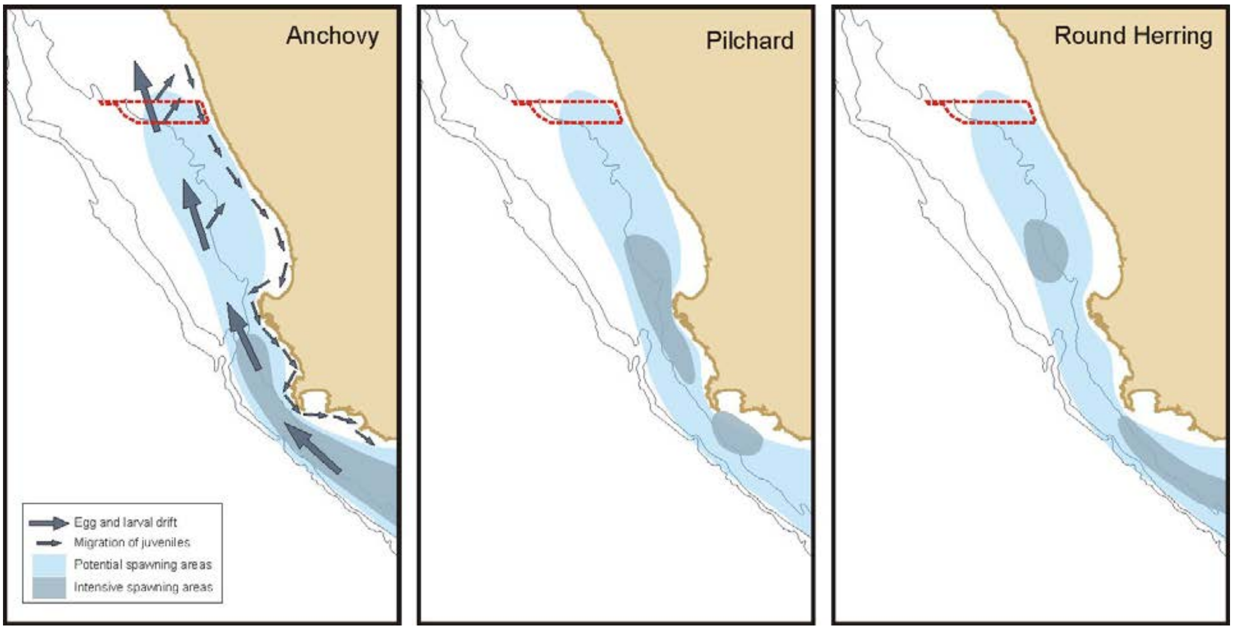


FIGURE 4-5: SEA CONCESSION 6C (RED POLYGON) IN RELATION TO MAJOR SPAWNING AREAS IN THE SOUTHERN BENGUELA REGION (ADAPTED FROM CRUIKSHANK 1990).

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.

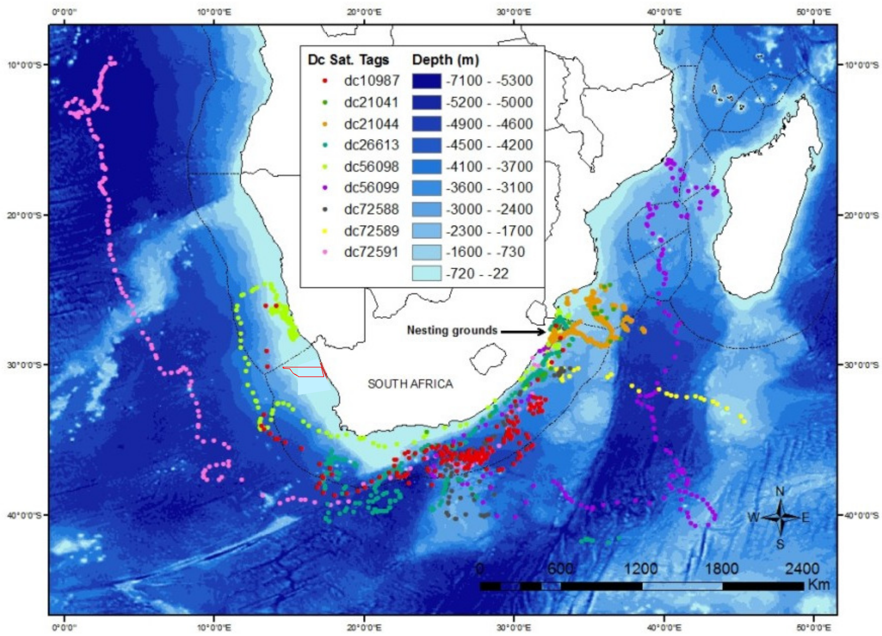


FIGURE 4-6: THE POST-NESTING DISTRIBUTION OF NINE SATELLITE TAGGED LEATHERBACK FEMALES (1996 – 2006; OCEANS AND COAST, UNPUBLISHED DATA). THE APPROXIMATE LOCATION OF CONCESSION 6C IS INDICATED (RED POLYGON).

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.

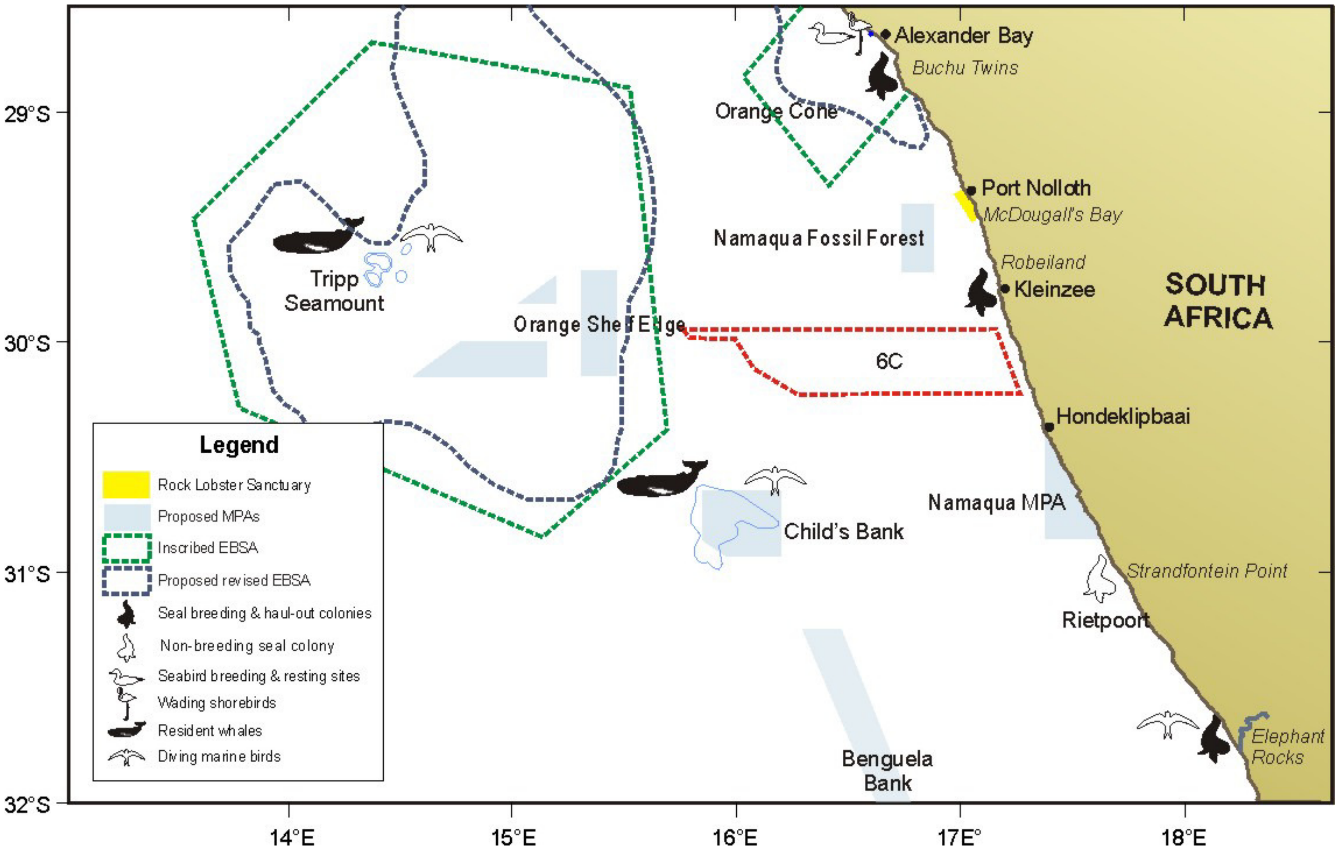


FIGURE 4-7: PROJECT - ENVIRONMENT INTERACTION POINTS ON THE WEST COAST, ILLUSTRATING THE LOCATION OF SEA CONCESSION 6C (RED POLYGON) IN RELATION TO SEABIRD AND SEAL COLONIES AND RESIDENT WHALE POPULATIONS.

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.

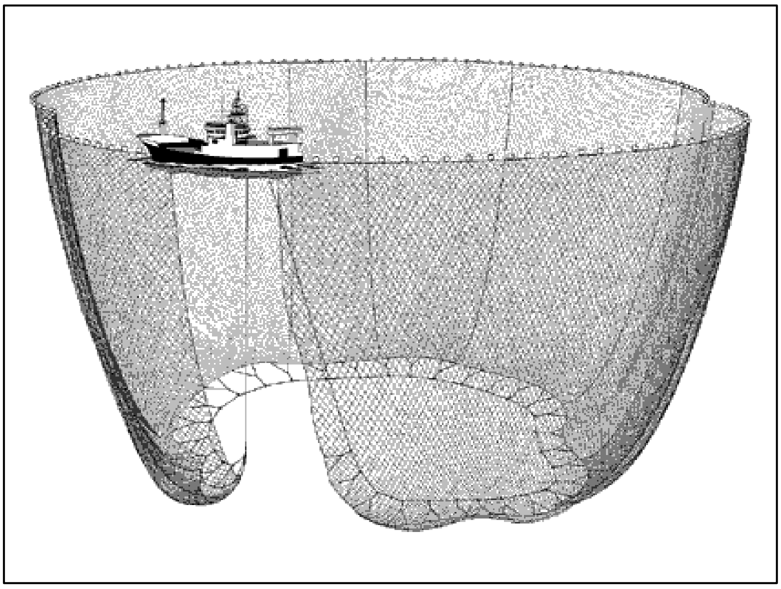


FIGURE 4-8: PELAGIC PURSE-SEINE GEAR CONFIGURATION.

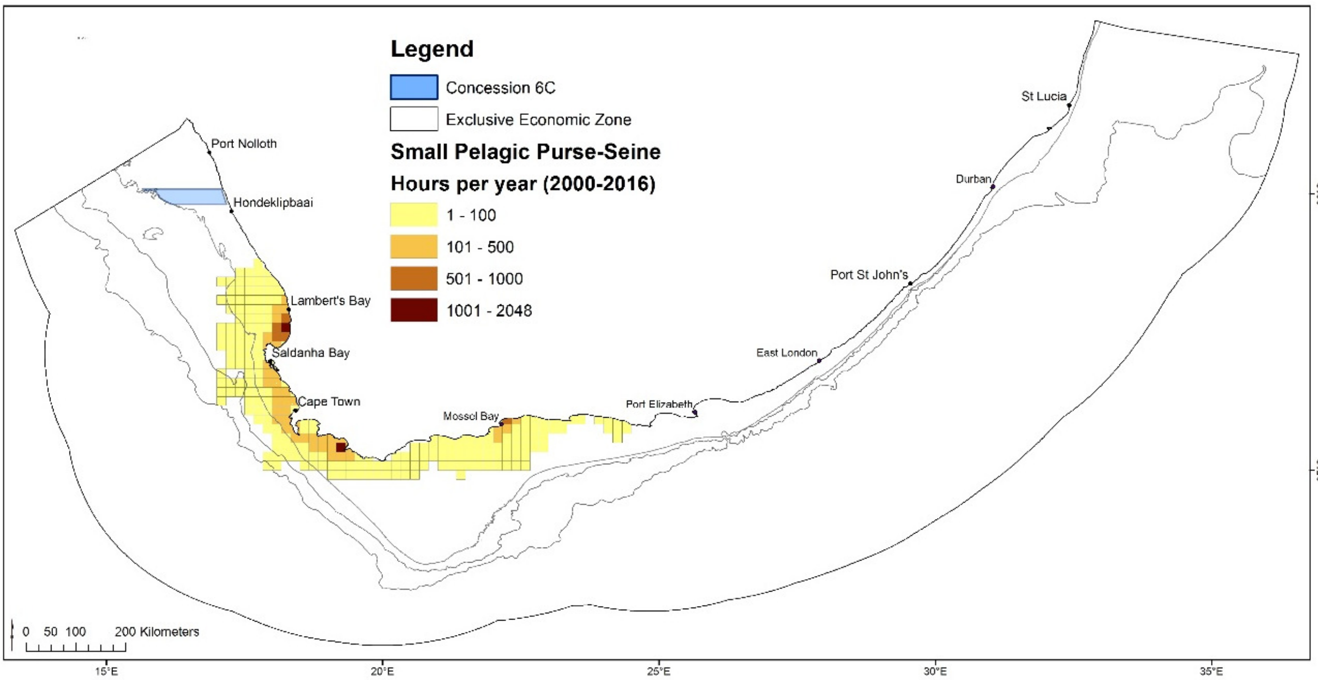


FIGURE 4-9: SEA CONCESSION 6C IN RELATION TO THE SPATIAL DISTRIBUTION OF EFFORT REPORTED BY THE SOUTH AFRICAN SMALL PELAGIC PURSE-SEINE FISHERY (2000 – 2016).

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.

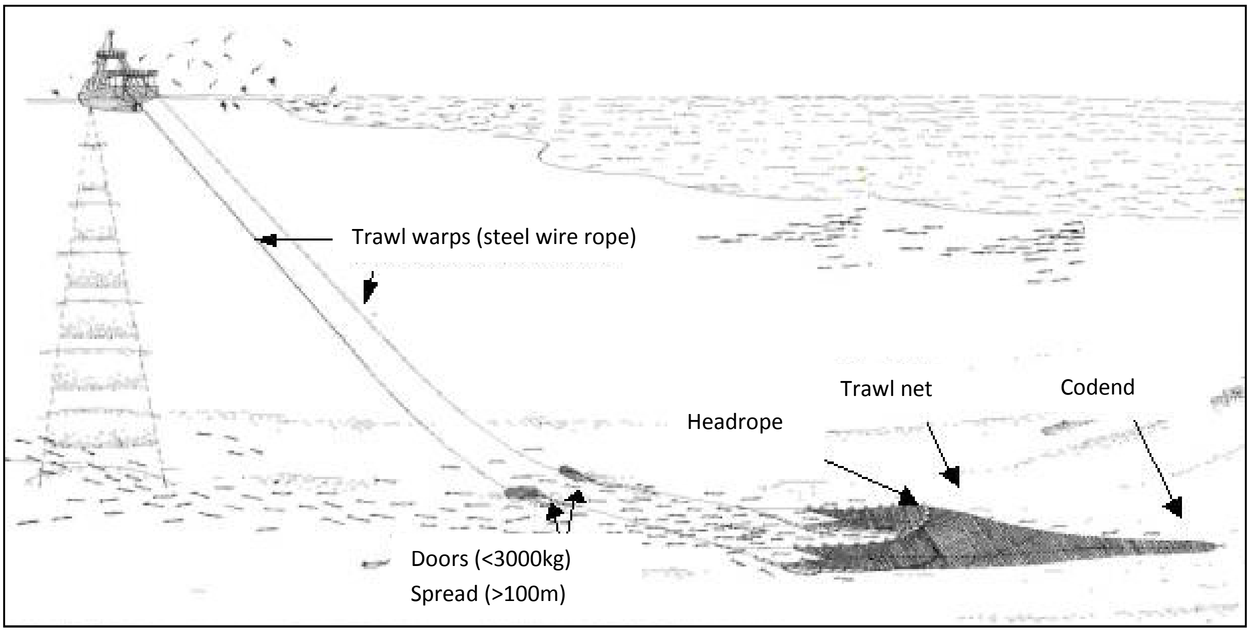


FIGURE 4-10: TYPICAL GEAR CONFIGURATION USED BY DEMERSAL TRAWLERS (OFFSHORE) TARGETING HAKE.

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.

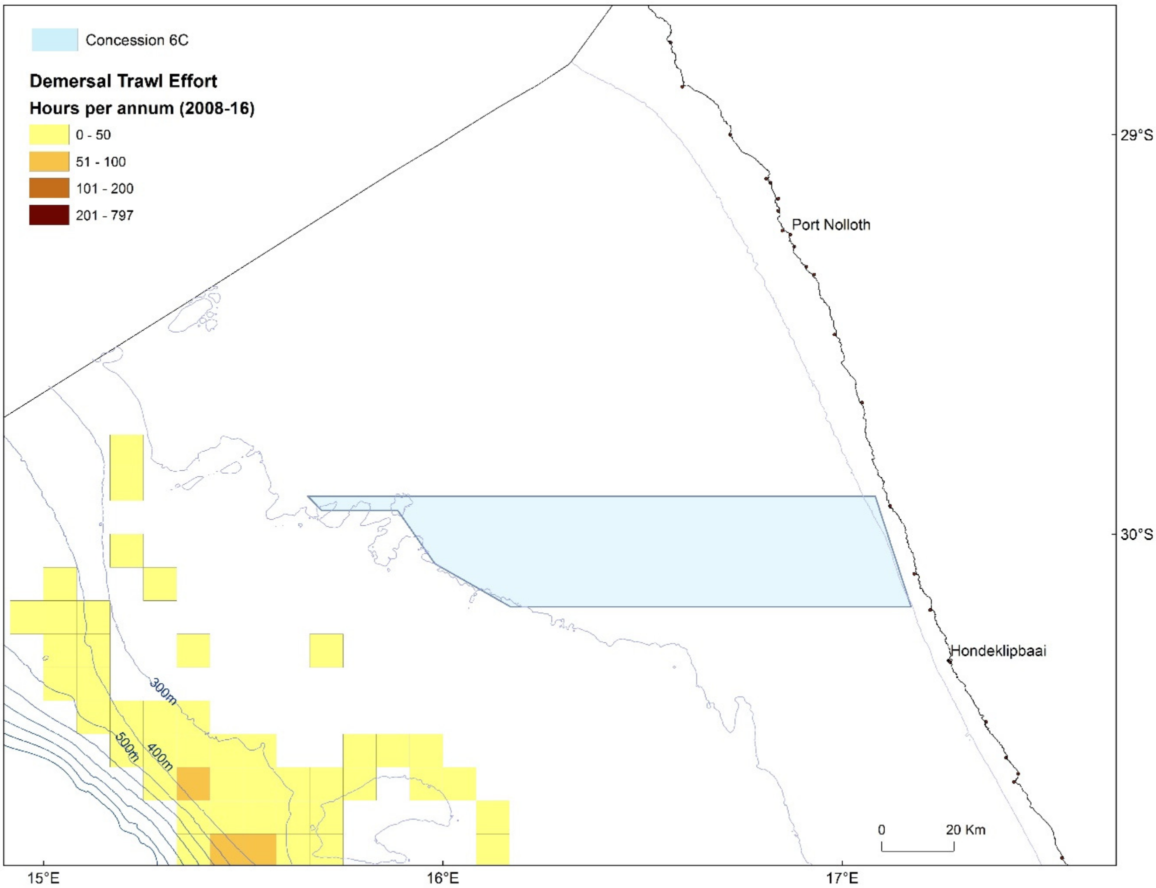


FIGURE 4-11: SEA CONCESSION 6C IN RELATION TO THE SPATIAL DISTRIBUTION OF TRAWLING EFFORT EXPENDED BY THE DEMERSAL TRAWL SECTOR (2008 TO 2016).

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.

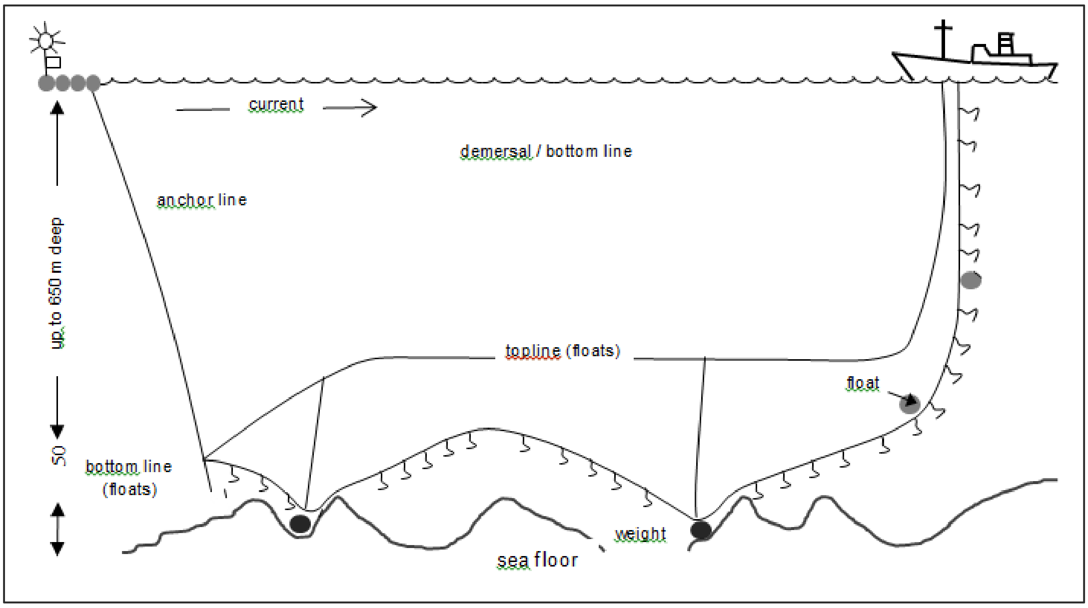


FIGURE 4-12: TYPICAL CONFIGURATION OF DEMERSAL (BOTTOM-SET) HAKE LONG-LINE GEAR USED IN SOUTH AFRICAN WATERS.

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.

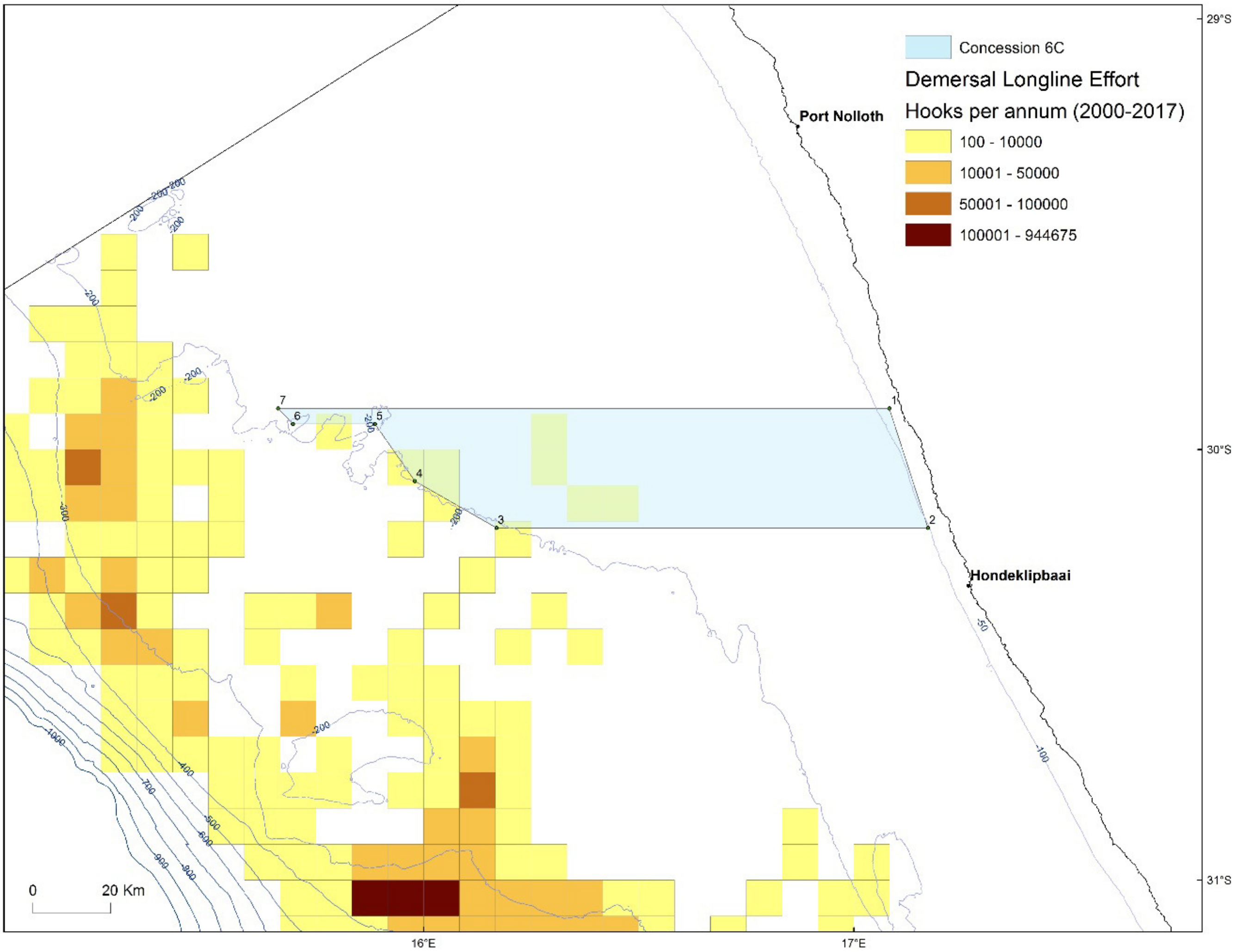


FIGURE 4-13: SEA CONCESSION 6C IN RELATION TO THE SPATIAL DISTRIBUTION OF EFFORT EXPENDED BY DEMERSAL LONG-LINE FISHERY (2000 – 2017).

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.

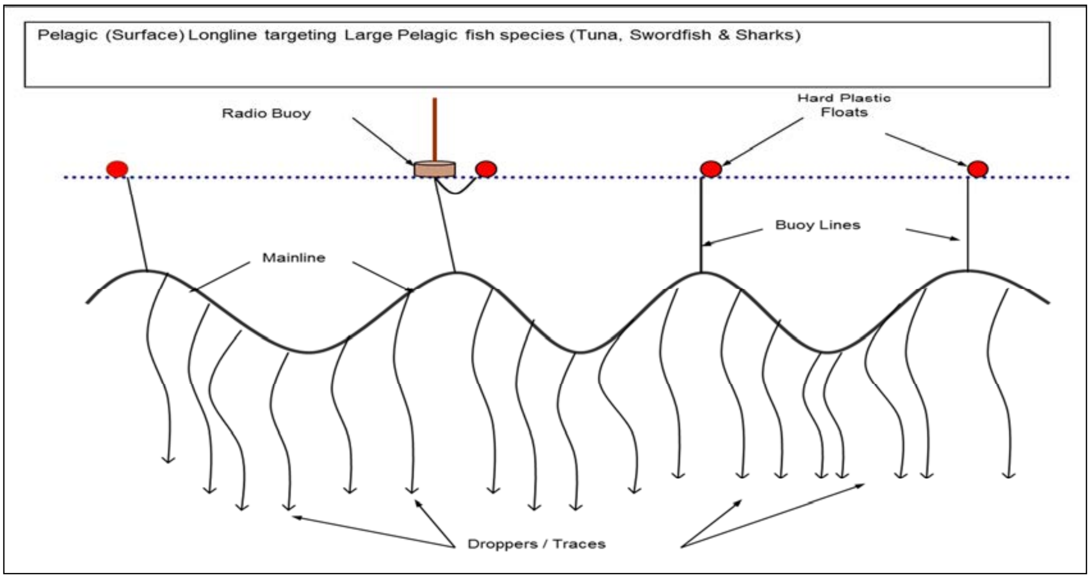


FIGURE 4-14: TYPICAL PELAGIC LONG-LINE CONFIGURATION TARGETING TUNA, SWORDFISH AND SHARK SPECIES

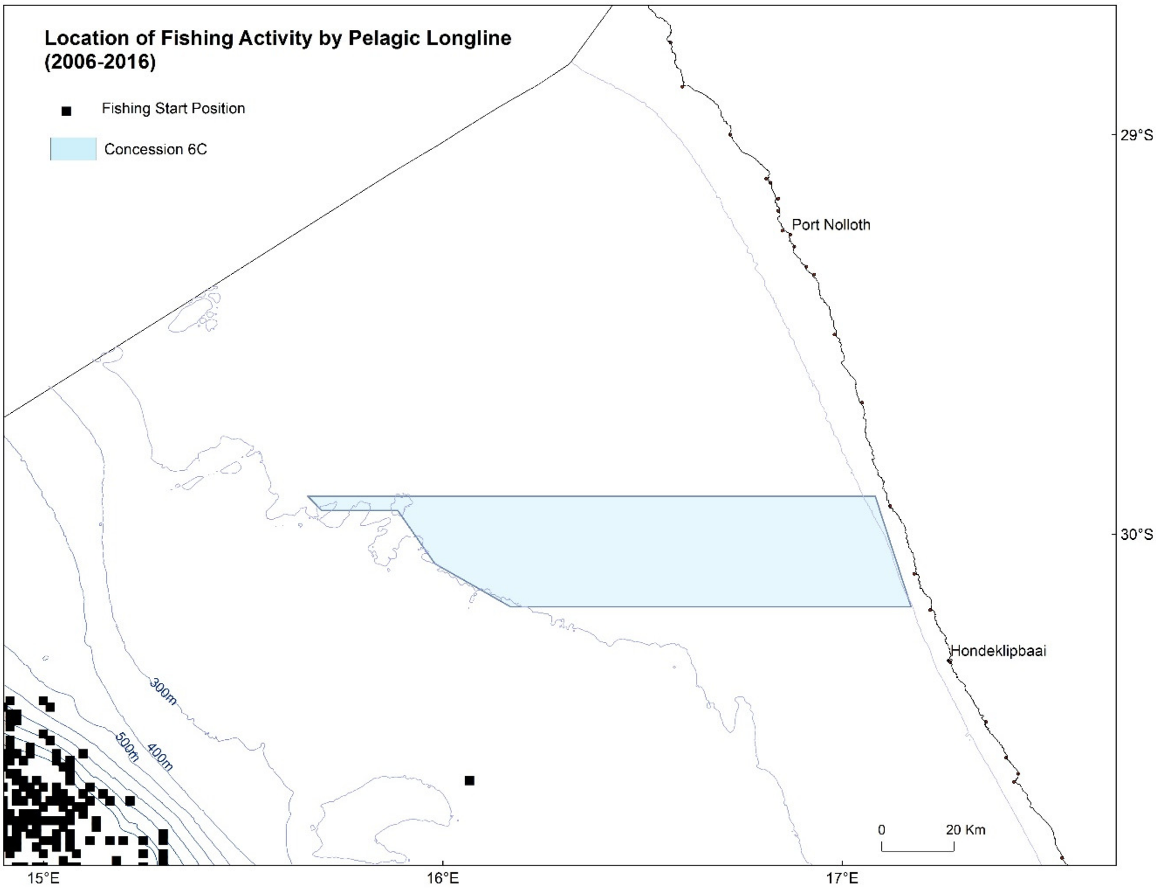


FIGURE 4-15: SEA CONCESSION 6C IN RELATION TO SPATIAL DISTRIBUTION OF FISHING POSITIONS RECORDED BETWEEN 2006 AND 2016 BY THE SOUTH AFRICAN LARGE PELAGIC LONGLINE SECTOR.

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).

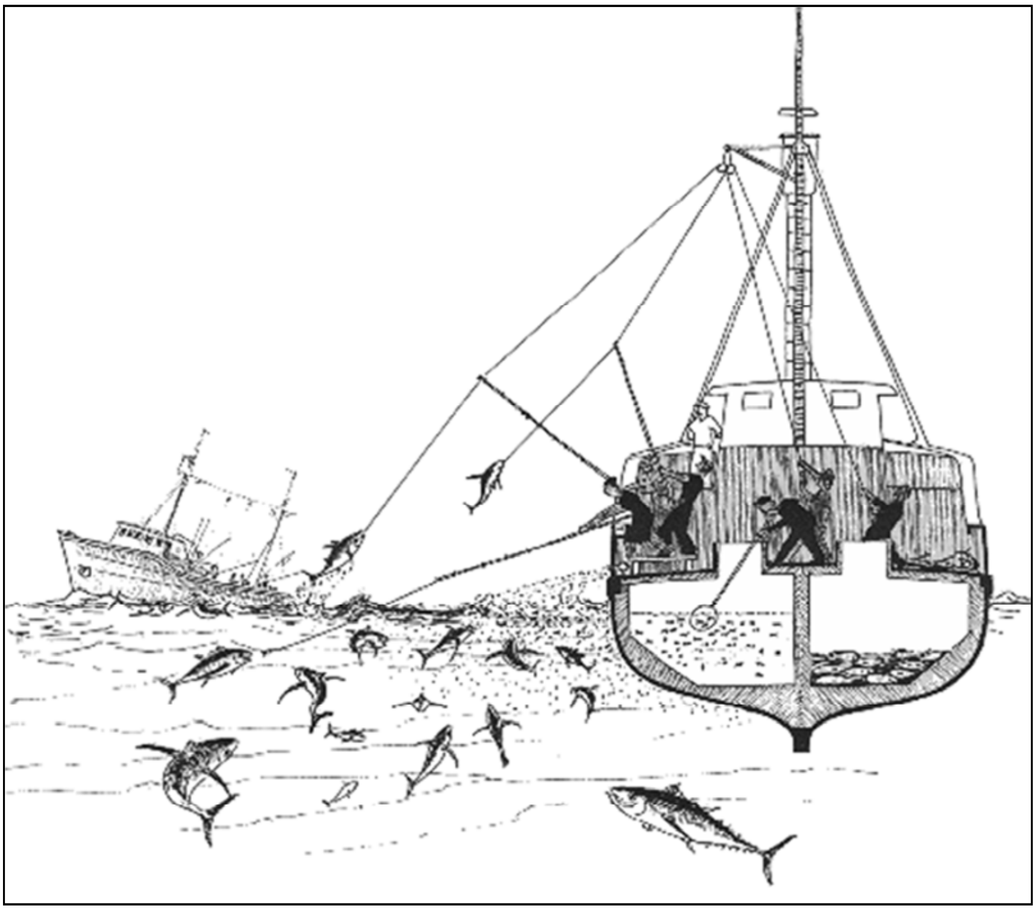


FIGURE 4-16: SCHEMATIC DIAGRAM OF POLE AND LINE OPERATION (WWW.FAO.ORG/FISHERY).

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).

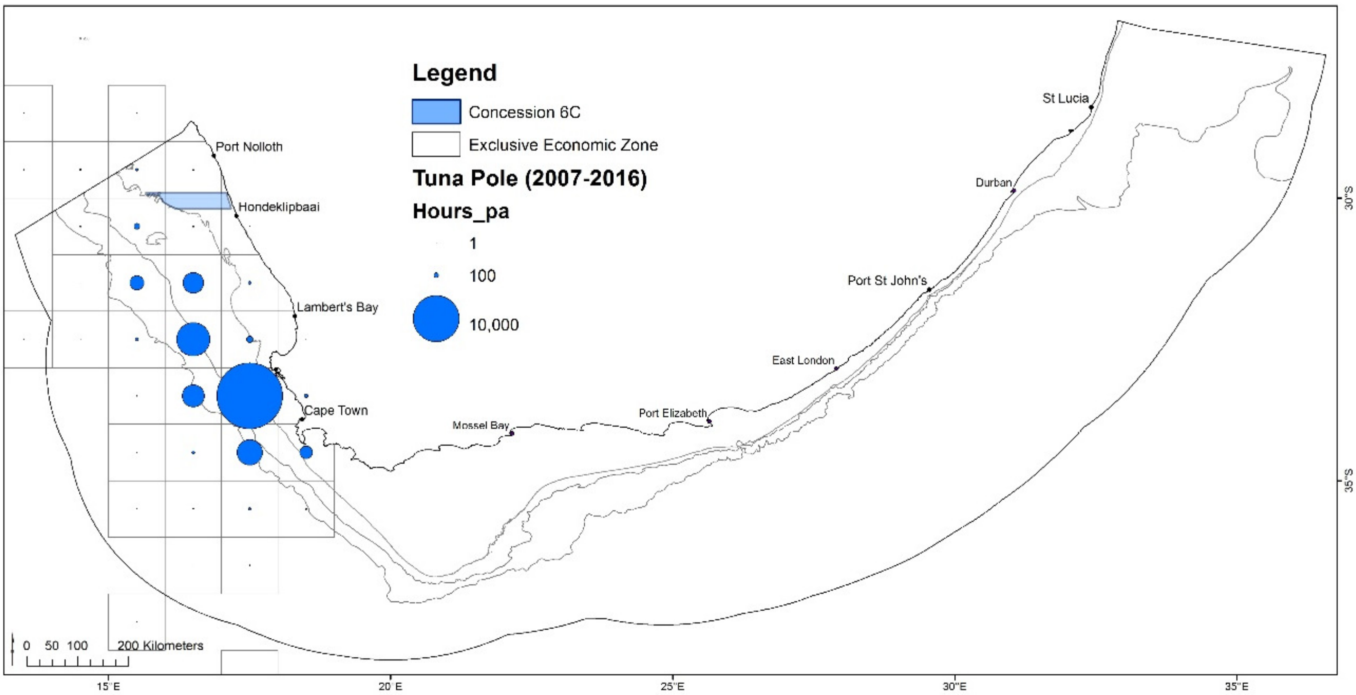


FIGURE 4-17: SEA CONCESSION 6C IN RELATION TO THE SPATIAL DISTRIBUTION OF TUNA POLE CATCH (2007 TO 2016).

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.

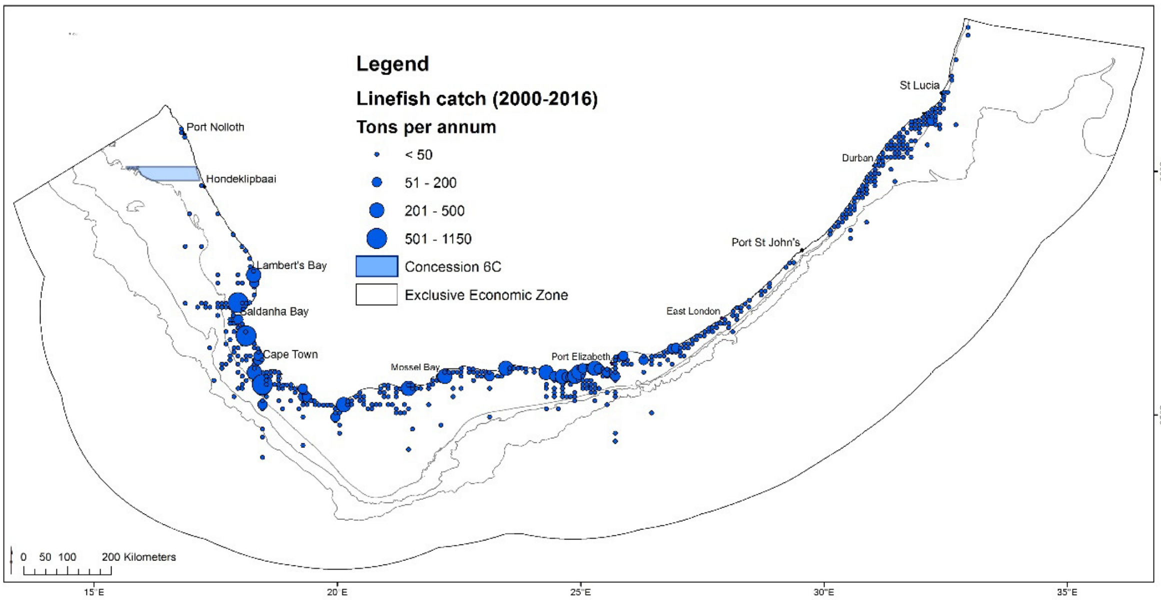


FIGURE 4-18: SEA CONCESSION 6C IN RELATION TO SPATIAL DISTRIBUTION OF CATCH LANDED BY THE SOUTH AFRICAN TRADITIONAL LINE-FISH SECTOR (2000 – 2016).

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.

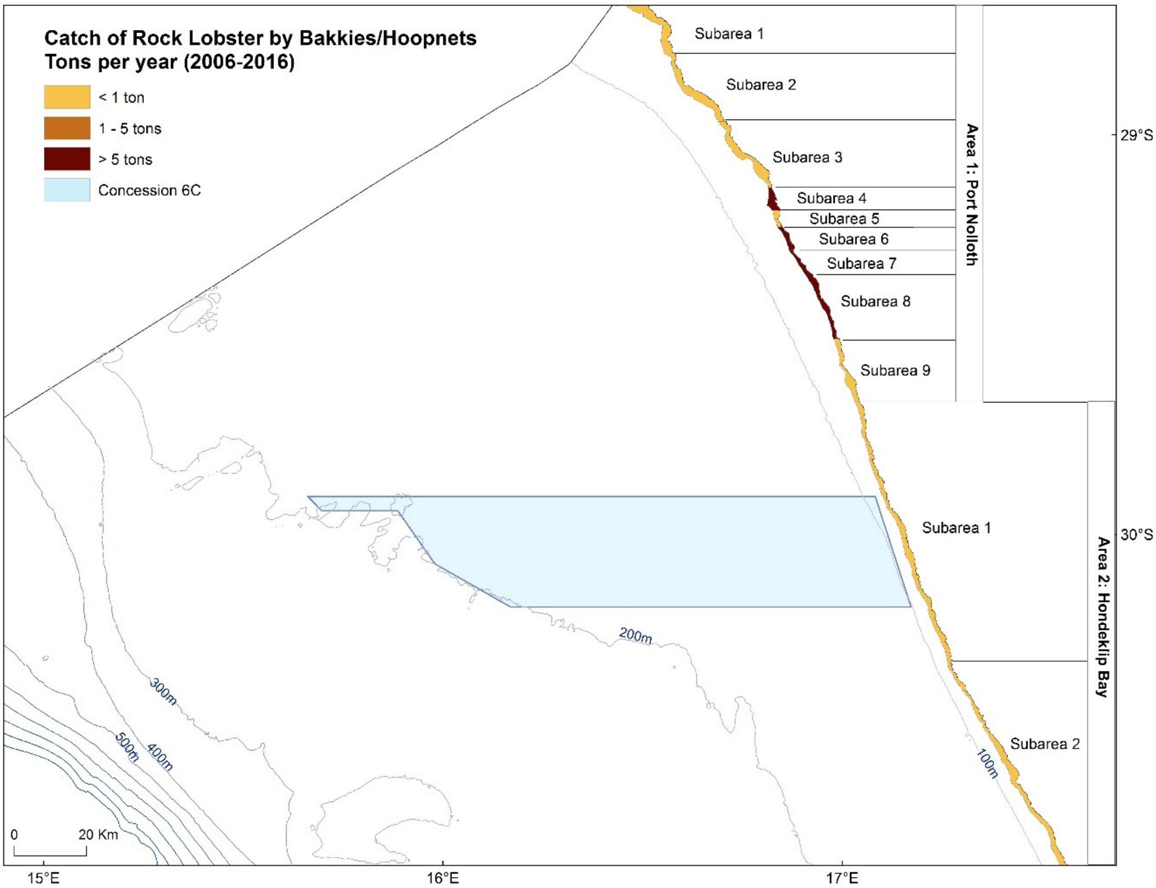


FIGURE 4-19: SEA CONCESSION 6C IN RELATION TO THE AVERAGE CATCH PER SEASON (TONS WHOLE WEIGHT) BY THE NEARSHORE (BAKKIE) SECTOR OF THE WEST COAST ROCK LOBSTER FISHERY (2006 TO 2016).

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).

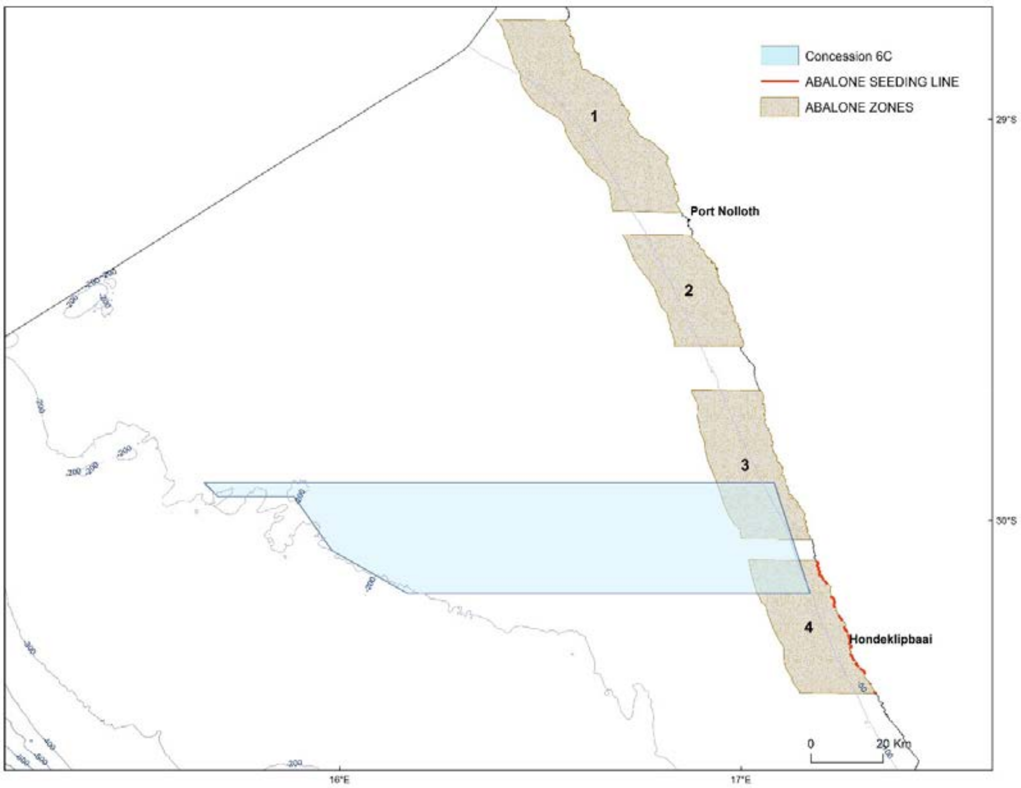


FIGURE 4-20: LOCATION OF SEA CONCESSION 6C IN RELATION TO OF ABALONE RANCHING ZONES.

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.

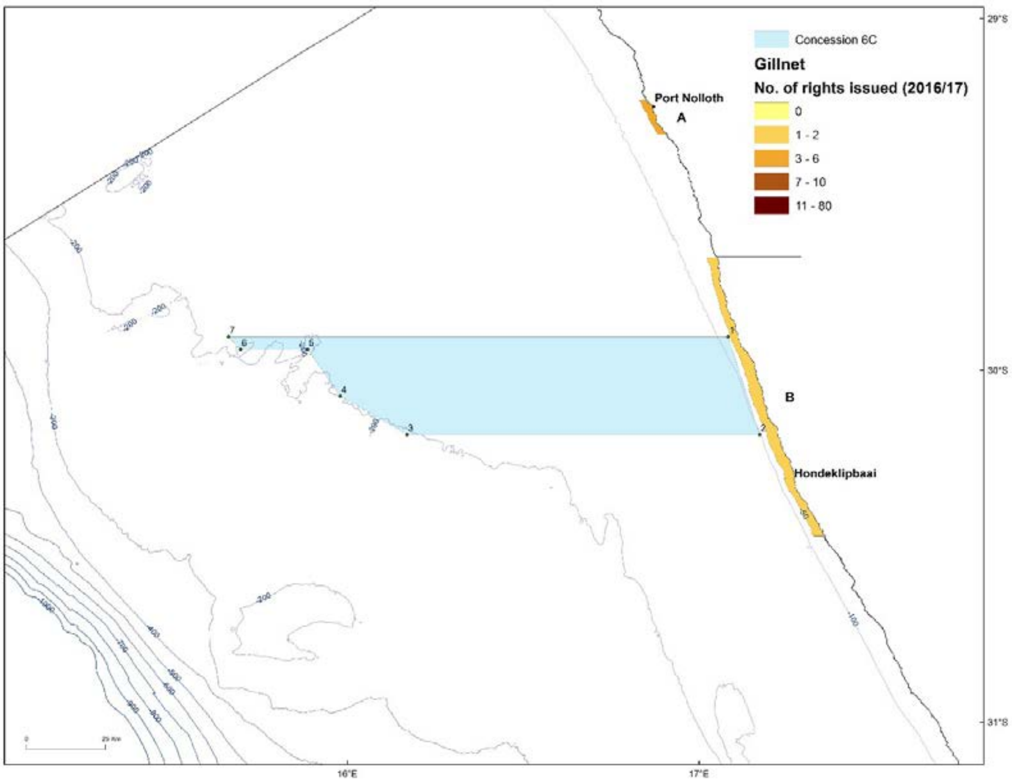


FIGURE 4-21: SEA CONCESSION 6C IN RELATION TO THE RIGHTS ISSUED FOR GILLNET FISHING AREAS A AND B.

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.

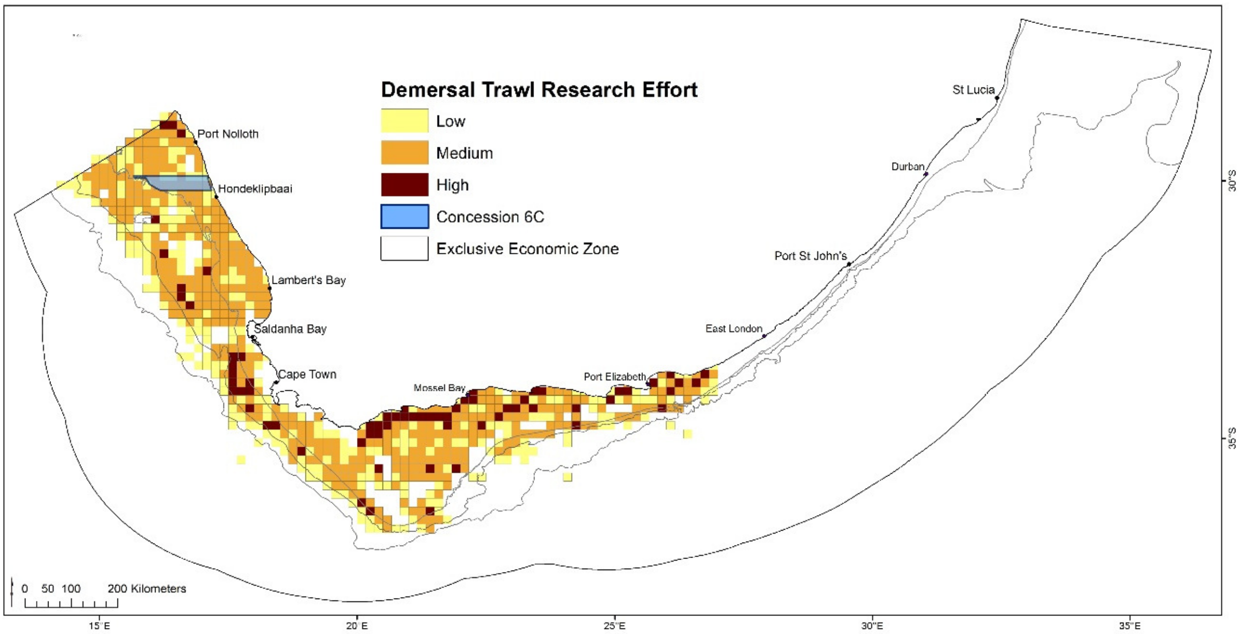


Figure 4-22: Sea Concession 6C in relation to the spatial distribution of trawling effort expended during research surveys undertaken by DAFF between 1985 and 2012.

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.

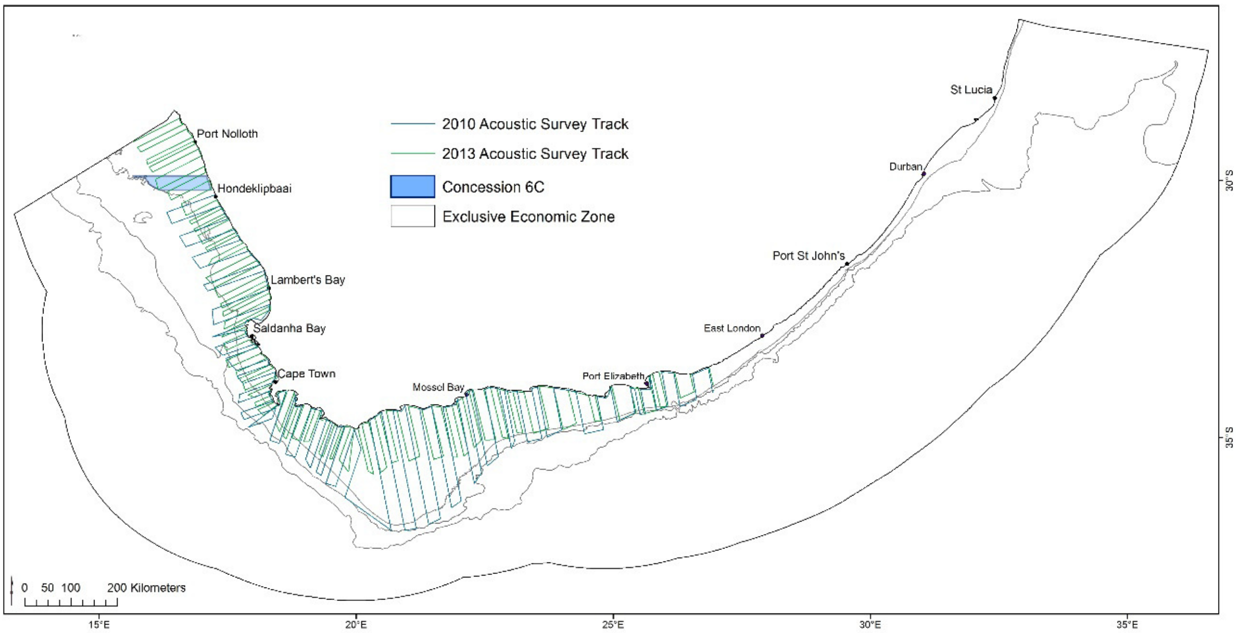


Figure 4-23: Sea Concession 6C in relation to the spatial distribution of tracks undertaken during biomass surveys of small pelagic species undertaken by DAFF during 2010 and 2013..

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.

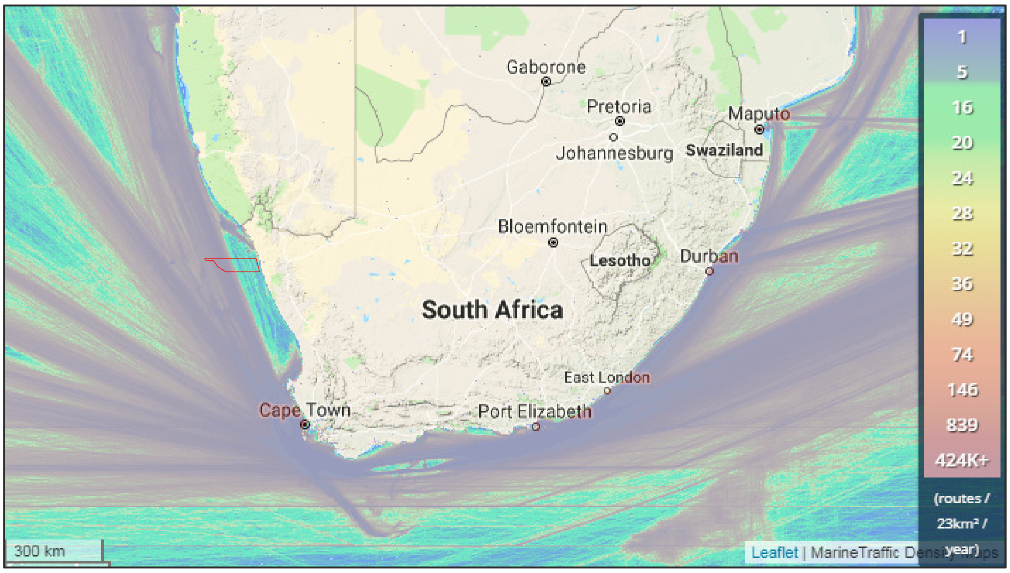


FIGURE 4-24: THE MAJOR SHIPPING ROUTES ALONG THE WEST COAST OF SOUTH AFRICA SHOWING PETROLEUM LICENSE BLOCKS (DATA FROM THE SOUTH AFRICAN CENTRE FOR OCEANOGRAPHY). APPROXIMATE LOCATION OF SEA CONCESSION AREA 6C IS ALSO SHOWN.

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.

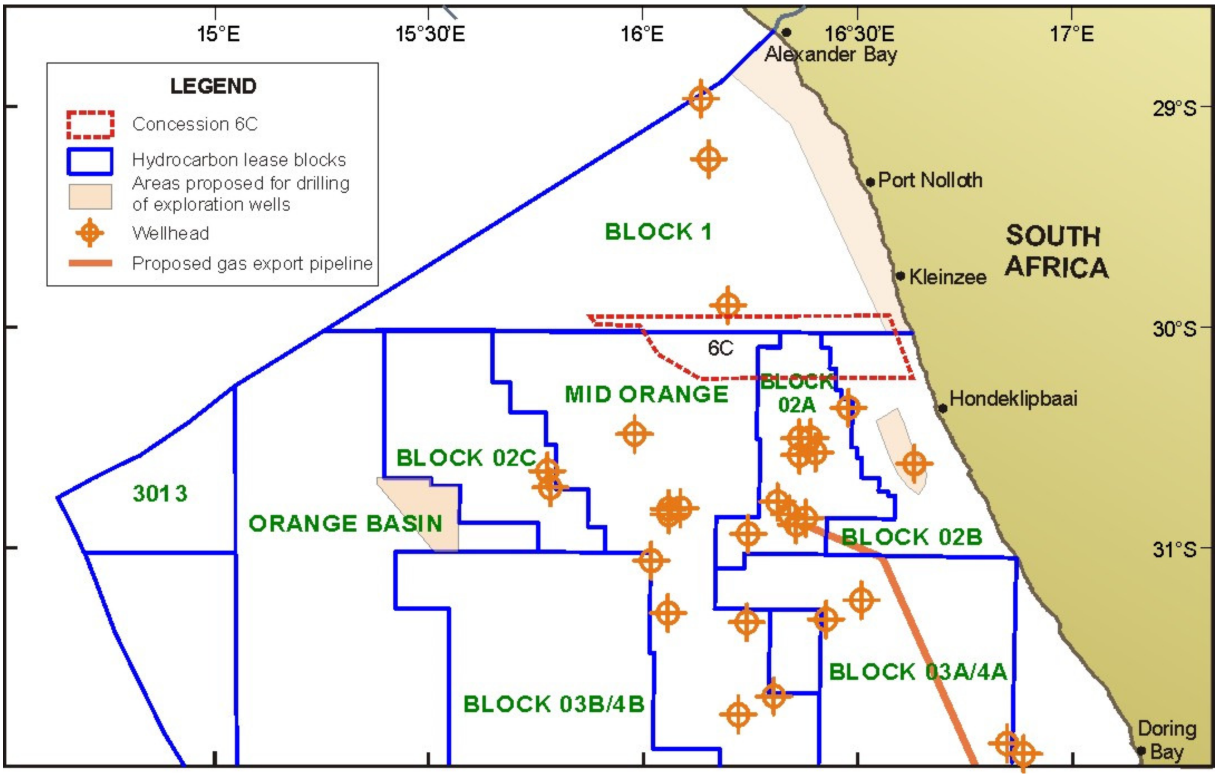


FIGURE 4-25: SEA CONCESSION AREAS 6C IN RELATION TO THE LOCATION OF HYDROCARBON LEASE BLOCKS, EXISTING WELL HEADS, PROPOSED AREAS FOR EXPLORATORY WELLS AND THE ROUTING OF THE PROPOSED IBHUBESI GAS EXPORT PIPELINE.

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).

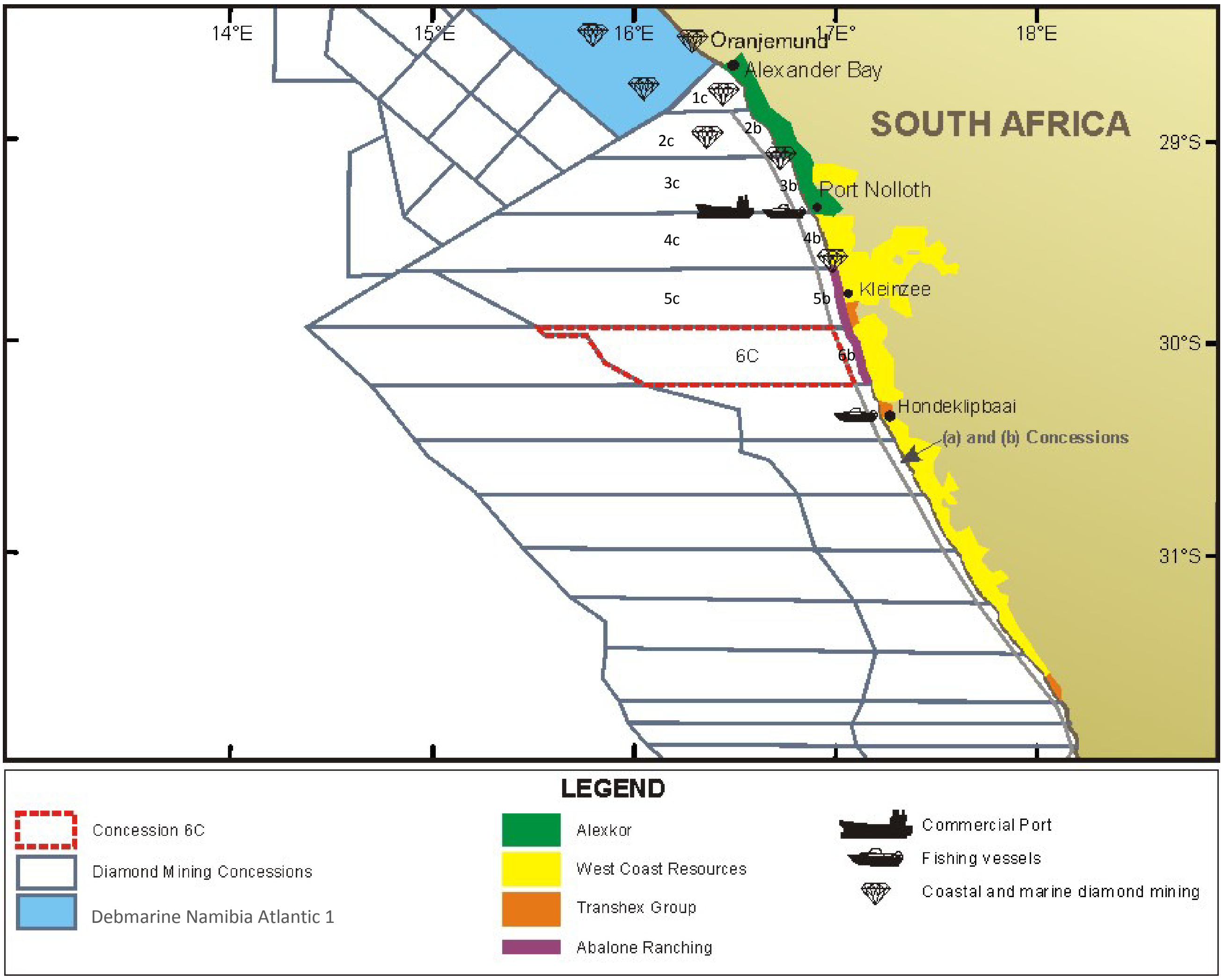


FIGURE 4-26: LOCATION OF SEA CONCESSION 6C IN RELATION TO MARINE DIAMOND MINING CONCESSIONS AND PORTS FOR COMMERCIAL AND FISHING VESSELS AND THE PROPOSED SAMPLING TARGET AREA.

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.

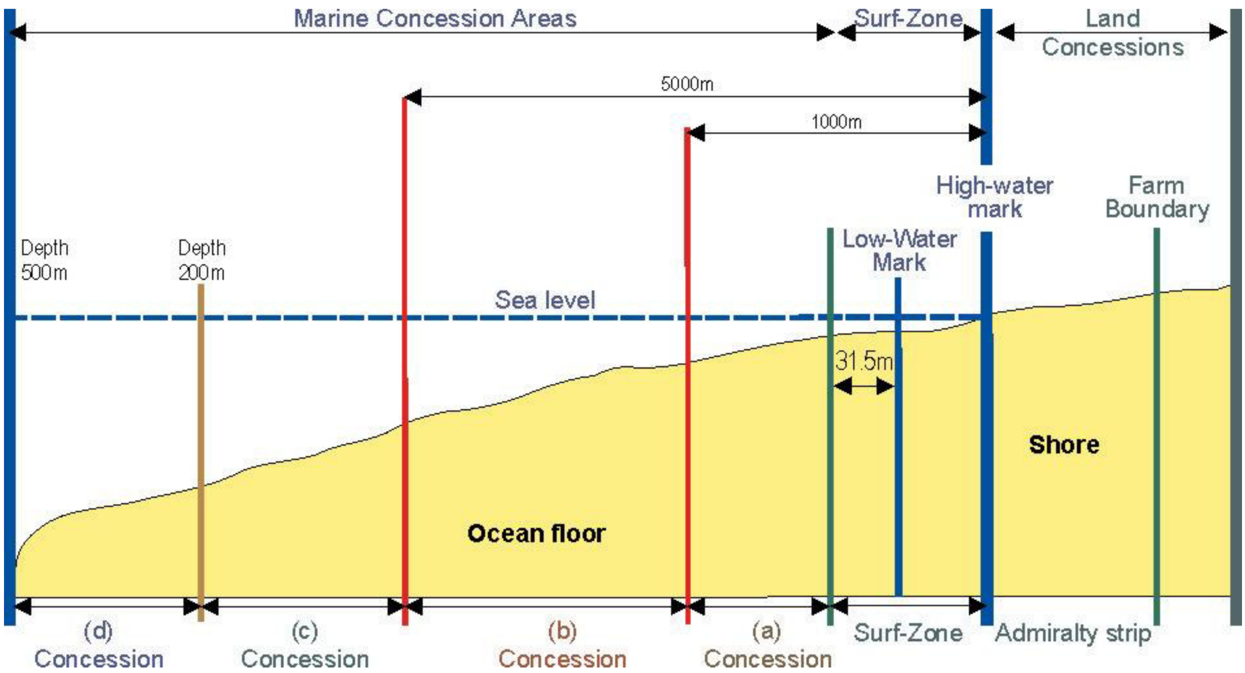


FIGURE 4-27: DIAGRAM OF THE ONSHORE AND OFFSHORE BOUNDARIES OF THE SOUTH AFRICAN (A) TO (D) MARINE DIAMOND MINING CONCESSION AREAS.

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”

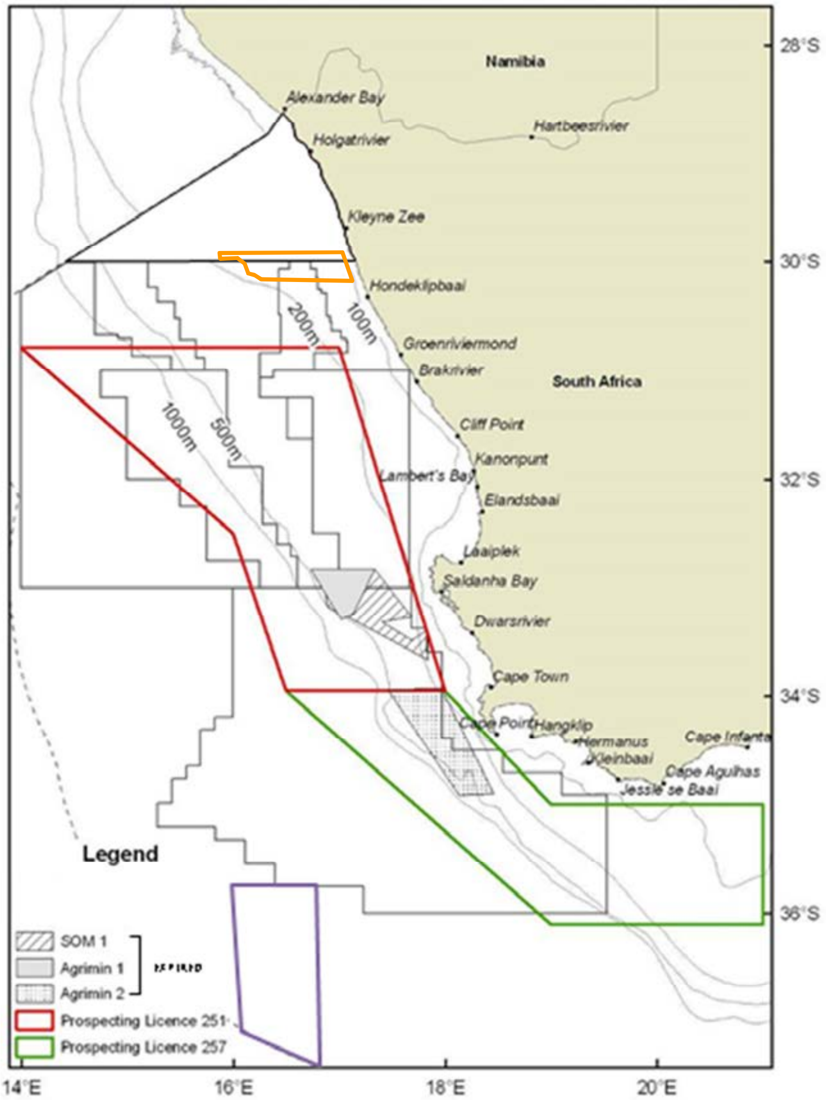


FIGURE 4-28: APPROXIMATE LOCATION OF SEA CONCESSION 6C (ORANGE) IN RELATIONS TO GLAUCONITE AND PHOSPHORITE PROSPECTING AREAS (AGRIMIN1, AGRIMIN2 AND SOM1).

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.

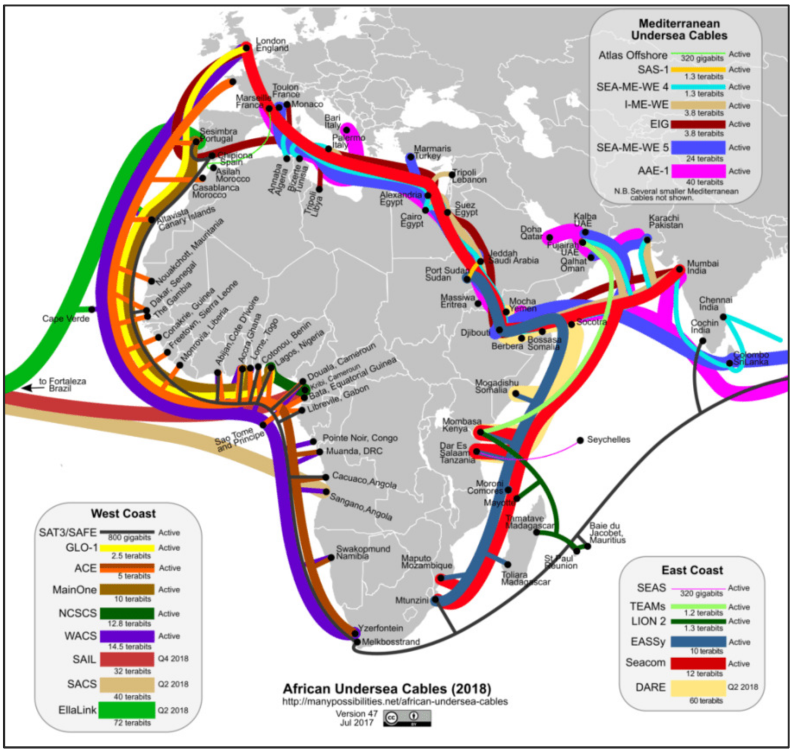


FIGURE 4-29: CONFIGURATION OF THE CURRENT AFRICAN UNDERSEA CABLE SYSTEMS, JULY 2018 (FROM HTTP://WWW.MANYPOSSIBILITIES.NET).

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.

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

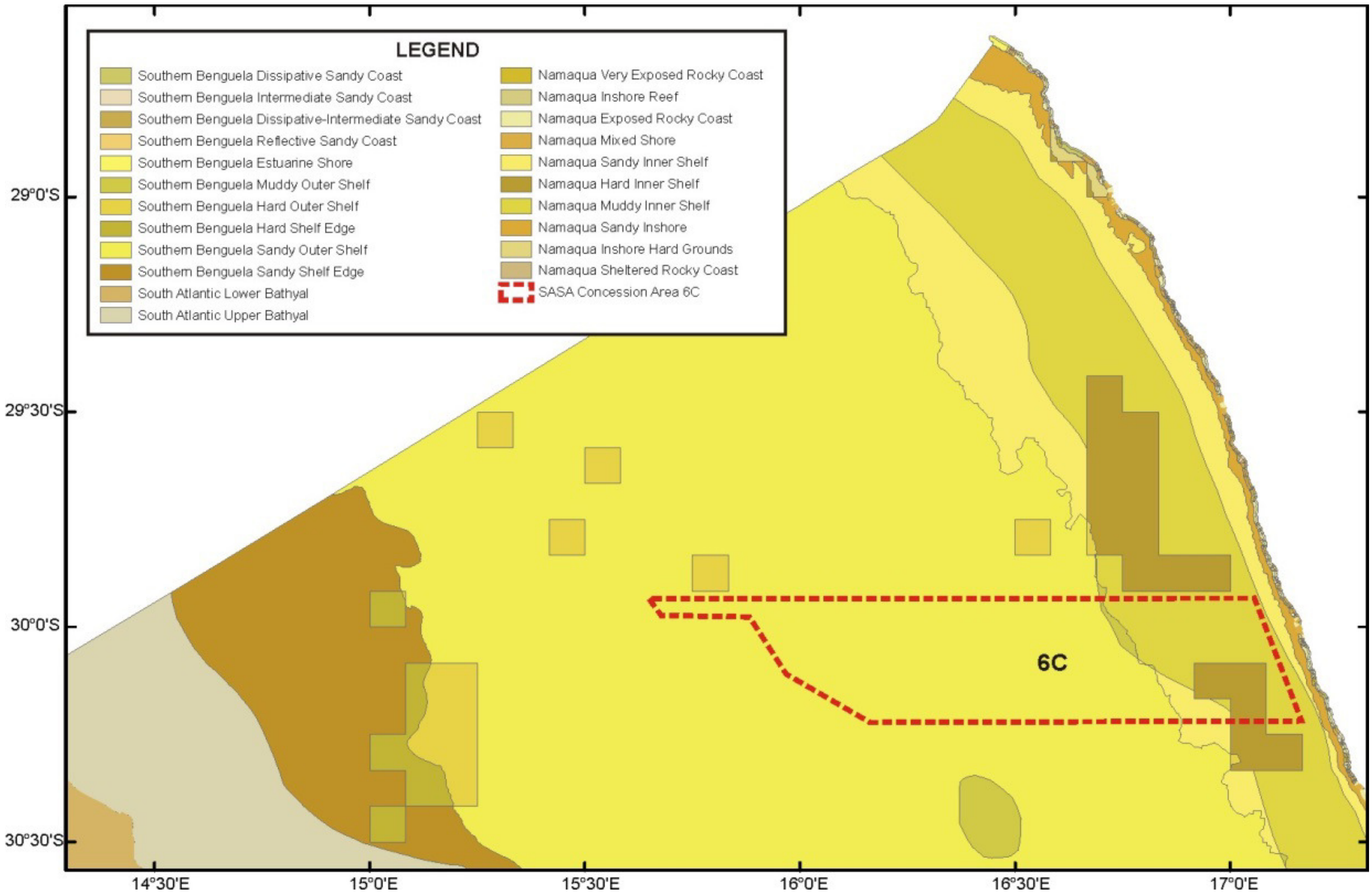

FIGURE 4-30: BENTHIC AND COASTAL HABITAT TYPES IN SEA CONCESSION 6C.

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

<u>Description of impact</u>

Sewage poses an organic and bacterial loading on the natural degradation processes of the sea, resulting in an increased biological oxygen demand.

<u>Assessment</u>

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).

<u>Mitigation</u>

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).

Mitigation

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

Description of impact

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	

<u>Mitigation</u>

- 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

<u>Description of impact</u>
Sampling activities could disturb cultural heritage material on the seabed, particularly historical shipwrecks and other palaeontological or rare geological objects.

<u>Assessment</u>
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).

<u>Mitigation</u>
- 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.

<table>
<tr><th rowspan="2" colspan="2">Potential impact</th><th colspan="2">Significance</th></tr>
<tr><th>Without mitigation</th><th>With mitigation</th></tr>
<tr><td colspan="2">Vessel operations:</td><td></td><td></td></tr>
<tr><td colspan="2">Deck drainage into the sea</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Machinery space drainage into the sea</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Sewage effluent into the sea</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Galley waste disposal into the sea</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Solid waste disposal into the sea</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Impact on marine fauna:</td><td></td><td></td></tr>
<tr><td colspan="2">Noise associated with geophysical surveys and sampling</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Sediment removal</td><td>L</td><td>L</td></tr>
<tr><td colspan="2">Physical crushing of benthic biota</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Generation of suspended sediment plumes</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Smothering of benthos in redepositing tailings</td><td>VL - L</td><td>VL</td></tr>
<tr><td colspan="2">Impact on other users of the sea:</td><td></td><td></td></tr>
<tr><td rowspan="2">Fishing industry</td><td>Exclusion of the demersal long-line, traditional line-fish, tuna pole and fisheries research</td><td>VL</td><td>VL</td></tr>
<tr><td>Sediment plume impact on fish stock recruitment</td><td>Insig</td><td>INSIG</td></tr>
<tr><td colspan="2">Marine mining and prospecting</td><td>Insig</td><td>INSIG</td></tr>
<tr><td colspan="2">Petroleum exploration</td><td>VL-L</td><td>VL</td></tr>
<tr><td colspan="2">Marine transport routes</td><td>Insig</td><td>INSIG</td></tr>
<tr><td colspan="2">Impact on cultural heritage material:</td><td></td><td></td></tr>
<tr><td colspan="2">Impact on historical shipwrecks</td><td>H</td><td>INSIG</td></tr>
<tr><td colspan="2">No-Go Alternative:</td><td></td><td></td></tr>
<tr><td colspan="2">Lost opportunity to establish whether or not a viable offshore diamond resources exists off the West Coast and the lost economic opportunities.</td><td>L</td><td>-</td></tr>
<tr><td colspan="2">Cumulative Impact:</td><td></td><td></td></tr>
<tr><td colspan="2">Benthic environment</td><td>L</td><td>L</td></tr>
</table>

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

BASIC ASSESSMENT REPORT

SUBMITTED FOR ENVIRONMENTAL AUTHORISATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED).

NAME OF APPLICANT:	De Beers Consolidated Mines (Pty) Ltd
TEL NO:	053 839 4243
FAX NO:	053 839 4880
POSTAL ADDRESS:	PO Box 616, Kimberley, Northern Cape, South Africa, 8300
PHYSICAL ADDRESS:	36 Stockdale Street, Kimberley, 8301
FILE REFERENCE NUMBER SAMRAD:	NC30/5/1/1/2(12189PR)

IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (No. 28 of 2002, as amended), the Minister must grant a prospecting or mining right if among others the mining "will not result in unacceptable pollution, ecological degradation or damage to the environment".

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment and an Environmental Management Programme report in terms of the National Environmental Management Act (No. 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the Environmental Impact Assessment (EIA) Regulations, 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of Section 17(1)(c) the competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

It is therefore an instruction that the prescribed reports required in respect of applications for an environmental authorisation for listed activities triggered by an application for a right or a permit are submitted in the exact format of, and provide all the information required in terms of, this template. Furthermore please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the information required is placed correctly in the relevant sections of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with un-interpreted information and that it unambiguously represents the interpretation of the applicant.

OBJECTIVE OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The objective of the environmental impact assessment process is to, through a consultative process—

(a) determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
(b) identify the alternatives considered, including the activity, location, and technology alternatives;
(c) describe the need and desirability of the proposed alternatives;
(d) through the undertaking of an impact and risk assessment process inclusive of cumulative impacts which focused on determining the geographical, physical, biological, social, economic, heritage and cultural sensitivity of the sites and locations within sites and the risk of impact of the proposed activity and technology alternatives on these aspects to determine:
    i. The nature, significance, consequence, extent, duration, and probability of the impacts occuoccurring to; and
    ii. The degree to which these impacts –
        a. Can be reversed
        b. May cause irreplceable loss of resources; and
        c. Can be managed, avoided or mitigated
(e) Through a ranking of the site sensitivities and possible impacrs the activity and techonology alternatives will impose on the sites and location identified through the life of the activity to –
    i. Identify and motivate a preferred site, activity and tehnology alternative;
    ii. Identify suitab;e measures to manage, avoid or mitigate identified impacts; and
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PART A
SCOPE OF BASIC ASSESSMENT REPORT

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1. CONTACT PERSON AND CORRESPONDENCE ADDRESS

DETAILS OF THE EAP WHO PREPARED THE REPORT

The details and role of the Environmental Assessment Practitioner (EAP) that were involved in the preparation of this Basic Assessment Report (BAR) are provided in Table 1-1 below.

Neither SLR Consulting (South Africa) (Pty) Ltd (SLR) nor any of the specialists involved in the environmental assessment process have any interest in the proposed project other than fair payment for consulting services rendered as part of the environmental assessment process.

Table 1-1: Details of the EAP.

NAME OF THE PRACTITIONER	Jonathan Crowther
TEL NO.:	021 461 1118/9
FAX NO.:	021 461 1120
E-MAIL ADDRESS	jcrowther@slrconsulting.com

EXPERTISE OF THE EAP

NAME	Jonathan Crowther
RESPONSIBILITY ON PROJECT	Project leader and quality control.
DEGREE	B.Sc. Hons (Geol.), M.Sc. (Env. Sci.)
PROFESSIONAL REGISTRATION	Pr.Sci.Nat., CEAPSA
EXPERIENCE IN YEARS	30
EXPERIENCE	Jonathan Crowther has been involved in environmental consulting since 1988 and is currently Technical Director of SLR Consulting (Pty) Ltd. He has expertise in a wide range of environmental disciplines, including Environmental Impact Assessments (EIA), Environmental Management Plans/Programmes, Environmental Planning & Review, Environmental Control Officer services, and Public Consultation & Facilitation. He has project managed a number of offshore oil and gas EIAs for various exploration and production activities in South Africa and Namibia. He also has extensive experience in projects related to roads, property developments and landfill sites.

NAME	Nicholas Arnott
RESPONSIBILITY ON PROJECT	Project consultant and report writing.
DEGREE	B.Sc. Hons (Earth and Geographical Science)
PROFESSIONAL REGISTRATION	Pr.Sci.Nat.
EXPERIENCE IN YEARS	12
EXPERIENCE	Nicholas Arnott has worked as an environmental assessment practitioner since 2006 and has been involved in a number of projects covering a range of environmental disciplines, including Basic Assessments, Environmental Impact Assessments and Environmental Management Programmes. He has gained experience in a wide range of projects relating to mining, infrastructure projects (e.g. roads), housing and industrial developments.

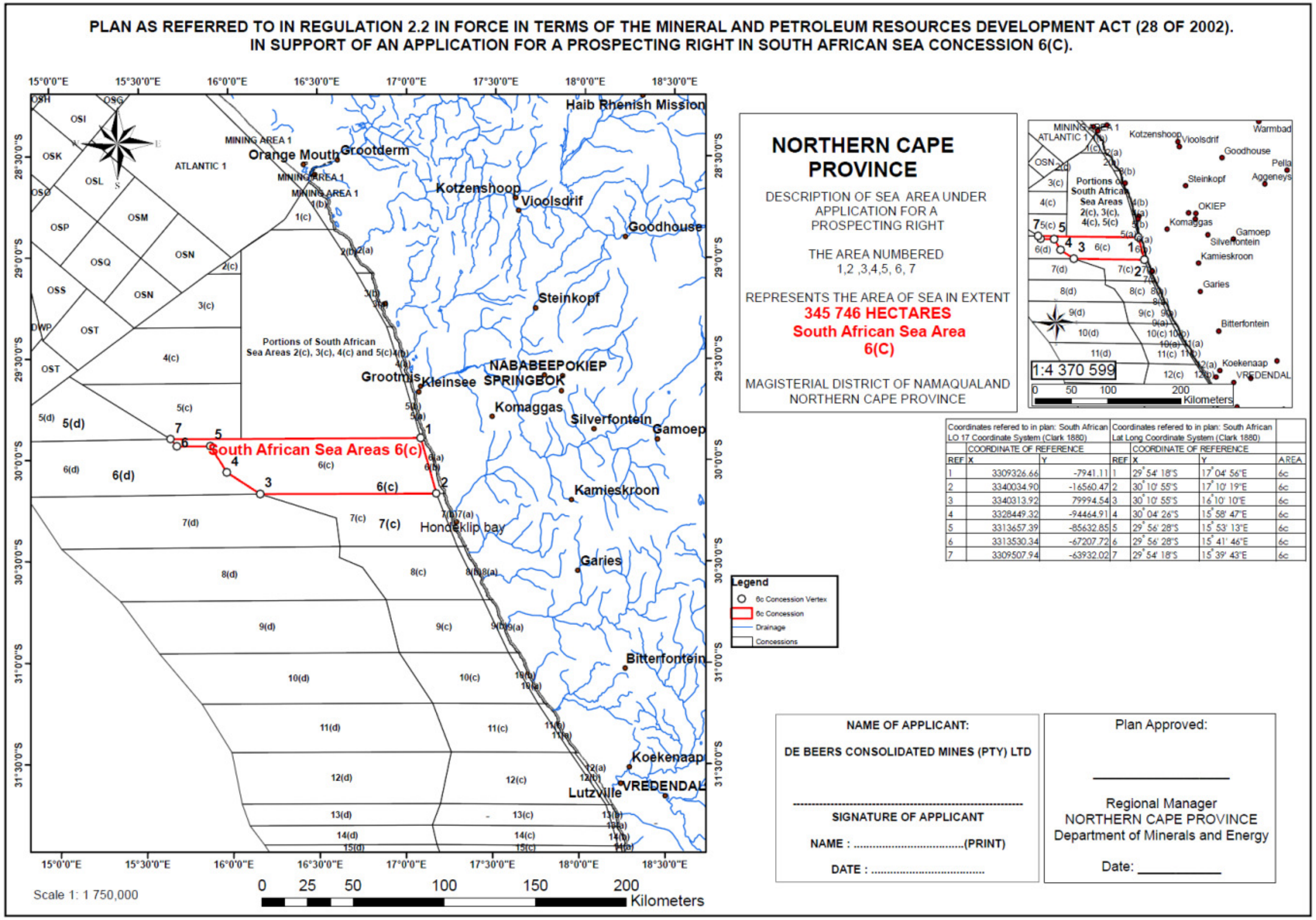
2. DESCRIPTION OF THE PROPERTY

The diamond prospecting activities would be undertaken within Sea Concession 6C, which is located off the West Coast of South Africa.

Farm Name	N/A - Sea Concession 6C is an offshore area located approximately 5 km seaward off the West Coast of South Africa.		
Corner of property point co-ordinates	1	29° 54’ 18’’ S	17° 04’ 56’’ E
	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
Application area (Ha)	3 457.46 km^2		
Magisterial district	N/A		
Distance and direction from nearest town	The inshore boundary of Sea Concession 6C is approximately 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. It is situated approximately 400 km north of Cape Town.		
21 digit Surveyor General Code for each farm portion	N/A - the proposed project is located offshore.		

3. LOCALITY MAP

A map showing the locality of Sea Concession 6C is provided in Figure 3-1.



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 3-1: Location of the Prospecting Rights Area, off the West Coast of South Africa (taken from draft application).

4. DESCRIPTION OF THE SCOPE OF THE PROPOSED OVERALL ACTIVITY

4.1 LISTED AND SPECIFIED ACTIVITIES

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 a Scoping ann 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 4.1), 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 4-1: List of activities/infrastructure associated with the proposed project

NAME OF ACTIVITY	APPROXIMATE AERIAL EXTENT OF THE ACTIVITY (m^2)	LISTED ACTIVITY NUMBER AND APPLICABLE LISTING NOTICE
For prospecting ***"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. …"***	Extent of Sea Concession 6C (3 457 460 000 m^2)	Activity 19A of GN No. R983 (Listing Notice 1)
For prospecting ***"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."***	Extent of Sea Concession 6C (3 457 460 000 m^2)	Activity 20 of GN No. R983 (Listing Notice 1)

NAME OF ACTIVITY	APPROXIMATE AERIAL EXTENT OF THE ACTIVITY (m^2)	LISTED ACTIVITY NUMBER AND APPLICABLE LISTING NOTICE
Decommissioning of the mining activities following the completion of mine operations ***"The decommissioning of any activity requiring -*** ***(i) a closure certificate in terms of section 43 of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002); or*** ***(ii) a …mining 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***."	Extent of Sea Concession 6C (3 457 460 000 m^2)	Activity 22 of GN No. R983 (Listing Notice 1)

4.2 DESCRIPTION OF THE ACTIVITIES TO BE UNDERTAKEN

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.

A detailed description of proposed prospecting activities is provided in Section 3 of the Main Report.

5. POLICY AND LEGISLATIVE CONTEXT

An overview of the key legislative requirements applicable to the proposed mining operations followed in the Basic Assessment process is provided in Section 2.1 of the Main Report. In summary, 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. As noted above, a Basic Assessment process must be undertaken in order for DMR to consider an application for Environmental Authorisation for prospecting.

5.1 GUIDELINES AND POLICIES

The guidelines taken into account during the Basic Assessment process have been listed in Section 2.3.

6. NEED AND DESIRABILITY OF THE PROPOSED ACTIVITIES

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.

7. MOTIVATION FOR THE PREFERRED DEVELOPMENT FOOTPRINT WITHIN THE APPROVED SITE

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

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

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

7.1 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 is that there would be no effect on the biophysical environment in the area proposed for the exploration activities.

7.2 DETAILS OF THE PUBLIC PARTICIPATION PROCESS TO BE FOLLOWED

The proposed project is located offshore off the West Coast of South Africa. The following interested and affected parties will be consulted:

- The Northern Cape Department of Environment and Nature Conservation (DENC);
- The South African Maritime Safety Authority (SAMSA);
- Regulatory authorities responsible for the offshore environment:
    - Department of Environmental Affairs (DEA) Oceans and Coasts;
    - Petroleum Agency of South Africa (PASA);
    - Department of Agriculture, Forestry and Fisheries (DAFF);
    - South African Heritage Resources Agency (SAHRA); and
    - South African Navy (SAN) Hydrographic office.
- Other users (e.g. fishing industry / associations); and
- Adjacent prospecting / exploration right holders.

7.2.1 STEPS TO NOTIFY INTERESTED AND AFFECTED PARTIES

The public consultation process was undertaken in accordance with the requirements of Chapter 6 of the EIA Regulations 2014, as amended and included the following steps:

- A preliminary Interested and Affected Party (I&AP) database was compiled consisting of overlapping and neighbouring petroleum exploration operators and mineral prospecting rights holders, authorities (local and regional), Non-Governmental Organisations, Community-based Organisations and other key stakeholders. To date 69 I&APs have been registered on the project database (see Appendix G1);
- A notification letter was sent to all registered I&APs on the project database to inform them: (i) of the NEMA EIA Regulations 2014 (as amended) compliance process; (ii) that the draft BAR was available for a 30-day review and comment period from 10 August to 10 September 2018 (see Appendix G2);
- An advertisement was published in Die Namakwalander on 10 August 2018 (see Appendix G3); and
- One submission was received during the Basic Assessment process which has been included in a Comments and Responses Report together with responses provided to the issues raised (see Appendix G4). The comments were duly taken into consideration in the process of updating the draft BAR into the revised BAR, as necessary, and submitted to DMR for consideration and decision-making.

It was requested that this application be allowed to deviate from the requirements of Regulation 41(2)(a)(i) and (ii) which pertain to the placement of a notice board on the site boundary as well as the boundary of any alternative site. The request for the deviation has been made given that the Prospecting Right area is located in the offshore marine environment and as such, it would not be feasible to erect a notice board at the boundary of the site.

7.2.2 INFORMATION TO BE PROVIDED TO INTERESTED AND AFFECTED PARTIES

The following compulsory information was provided to I&APs as part of the draft BAR:

- the site plan;
- list of activities to be authorised;
- scale and extent of activities to be authorised;
- typical impacts of activities to be authorised; and
- the duration of the activity.

7.2.3 INFORMATION TO BE REQUIRED FROM INTERESTED AND AFFECTED PARTIES

As noted above, one written submission was received during the public participation process. The comments raised have been collated, and responded to in a Comments and Responses Report which has been attached to the Main Report (see Appendix G4).

7.2.4 SUMMARY OF ISSUES RAISED BY I&APS

Interested and Affected Parties	**Date Comments Received**	**Issues raised**	**EAPs response to issues**
South African Heritage Resource Agency	20 August 2018	SAHRA understands from the report that there are two planned stages of work. The first is the non-invasive geophysical surveys that will aim to identify features of interest for further exploration. The second stage would include more localised geophysical surveys and exploration sampling. The exploration sampling will be invasive and therefore mitigation measures must be taken to avoid the damage or destruction of any underwater cultural heritage. The need for a specialist heritage study for the underwater cultural heritage had been identified early in the project and the Draft Basic Assessment Report includes an Underwater Heritage Impact Assessment report. The UHIA has concluded that there are no known wrecks recorded as being lost in Sea Concession 6C. However, it states that scant historical reporting, poor navigational methods and the dynamic nature of the environment can lead to inaccurate location information, therefore there is the potential, however small, for shipwrecks to lie unrecorded in the area. SAHRA supports the recommendations set out in the UHIA regarding the management measures that should be implemented during the two phases of work to mitigate the possible impact on any underwater cultural heritage. The geophysical surveys in particular have the potential to identify any possible sites of interest therefore the data must be reviewed by a suitably qualified person and be made available to a maritime heritage specialist for review if further interpretation is needed. Should anything of archaeological or palaeontological significance be noted during the proposed project, the management measures set out in the UHIA must be followed and SAHRA must be informed of its discovery without delay. An exclusion zone would then be applied to the site and no invasive work would be permitted in this area.	Support for the proposed mitigation measures is noted. In the event that any sites of archaeological or palaeontological significance are detected during the proposed prospecting operations, De Beers will comply with the requirements specified by SAHRA.

8. THE ENVIRONMENTAL ATTRIBUTES ASSOCIATED WITH THE DEVELOPMENT FOOTPRINT ALTERNATIVES

A detailed description of the biophysical and socio-economic environment likely to be affected by the proposed project in the study area is provided in Section 4 of the Main Report. It 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 mining activities.

8.1 ENVIRONMENTAL AND CURRENT LAND USE MAP

Various maps showing the environmental features of Sea Concession 6C are included in Section 4 of the Main Report. It is noted that as the project area is located offshore there are no associated land use features. However, as noted above, an overview of the human utilisation of the South African West Coast is also provided in Section 4.1.4 of the Main Report.

9. IMPACTS AND RISKS IDENTIFIED INCLUDING THE NATURE, SIGNIFICANCE, CONSEQUENCE, EXTENT, DURATION AND PROBABILITY OF THE IMPACTS, INCLUDING THE DEGREE TO WHICH THESE IMPACTS

The Main Report describes and assesses the significance of potential impacts related to the proposed offshore mining activities in Sea Concession 6C (see Section 5). All impacts are systematically assessed in terms of their extent, duration, intensity and probability and presented according to predefined rating scales (see Appendix F of the Main Report). The degree to which the impacts can be reversed, may cause irreplaceable loss of resources, and can be avoided, managed or mitigated is also provided. Mitigation or optimisation measures are also proposed which could ameliorate the negative impacts or enhance potential benefits, respectively. The significance of impacts with and without mitigation is also assessed. A summary of the identified impacts, together with their significance, is provided in Table 9-1 below.

Specialist input was provided in order to address the likely effect of the proposed prospecting activities on marine fauna (Appendix C of the Main Report), fisheries (Appendix D of the Main Report) and Underwater Heritage (Appendix E). In addition, this assessment used as a basis the issues identified in the Generic EMP prepared for marine diamond mining off the West Coast of South Africa (Lane and Carter 1999) and similar studies.

Table 9-1: Summary of the significance of the potential impacts associated with the proposed mining operations 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**

Potential impact		Significance	
		Without mitigation	With mitigation
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 related to costs already incurred in the initial prospecting phase.		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

9.1 METHODOLOGY USED IN DETERMINING AND RANKING THE NATURE, SIGNIFICANCE, CONSEQUENCES, EXTENT, DURATION AND PROBABILITY OF POTENTIAL ENVIRONMENTAL IMPACTS AND RISKS

Refer to Appendix F of the Main Report.

9.2 THE POSITIVE AND NEGATIVE IMPACTS THAT THE PROPOSED ACTIVITY (IN TERMS OF THE INITIAL SITE LAYOUT) AND ALTERNATIVES WILL HAVE ON THE ENVIRONMENT AND THE COMMUNITY THAT MAY BE AFFECTED

As mentioned in Section 7, the preferred site location has been determined by De Beers' application for a Prospecting Right in Sea Concession 6C and the identification of mineable resource deposits within the concession area. Thus, no further site alternatives can be considered. A summary of the identified impacts for the site, together with their significance, is provided in Table 9-1 above.

9.3 THE POSSIBLE MITIGATION MEASURES THAT COULD BE APPLIED AND THE LEVEL OF RISK

Mitigation measures to avoid, reduce, remediate or compensate for potential impacts are provided, as are optimisation measures to enhance the potential benefits. Refer to Section 6.2 of the Main Report.

9.4 MOTIVATION WHERE NO ALTERNATIVE SITES WERE CONSIDERED

A discussion of why no alternative site locations could be considered for the proposed mining activities is provided in Section 7.

9.5 STATEMENT MOTIVATING THE ALTERNATIVE DEVELOPMENT LOCATION WITHIN THE OVERALL SITE

The motivation as to why no alternative site locations could be considered for the proposed mining activities is provided in Section 7.

10. FULL DESCRIPTION OF THE PROCESS UNDERTAKEN TO IDENTIFY, ASSESS AND RANK THE IMPACTS AND RISKS THE ACTIVITY WILL IMPOSE ON THE PREFERRED SITE

As noted above, a description of methodology to be used to determine the significance of environmental impacts is detailed in Appendix F of the Main Report. A description and assessment of the environmental issues and risks identified during the Basic Assessment process, as well as the proposed mitigation measures for each impact, is included in Chapter 5 of the Main Report.

10.1 SUMMARY OF SPECIALIST REPORTS

Study Undertaken	Recommendations of specialist reports	Recommendations included in the EIA report (mark with an x where applicable)	Reference to applicable section of report
Marine Faunal Assessment	Marine sampling mitigation: • 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. • Use existing geophysical data to conduct a pre-mining geohazard analysis of the seabed, and near-surface substratum to map potentially vulnerable habitats and prevent potential conflict with the sampling targets. • The positions of all lost equipment must be accurately recorded in a hazards database, and reported to maritime authorities. Every effort should be made to remove lost equipment. • Adhere strictly to best management practices recommended in the relevant Environmental Impact Report and EMPr and that of MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships, 1973) for all necessary disposals at sea. • Develop a waste management plan using waste hierarchy. Geophysical survey mitigation: • A designated onboard Marine Mammal Observers (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 any 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	X	Sections 5, 6 and 7 of the Main Report

Study Undertaken	Recommendations of specialist reports	Recommendations included in the EIA report (mark with an x where applicable)	Reference to applicable section of report
	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.		
Fisheries Assessment	• 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 minimises or avoid disruptions to both parties, where required. • Prior to the commencement of the proposed prospecting activities 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. • 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.	**X**	Sections 5, 6 and 7 of the Main Report
Underwater Heritage Assessment	• 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. • 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	**X**	Sections 5, 6 and 7 of the Main Report

Study Undertaken	Recommendations of specialist reports	Recommendations included in the EIA report (mark with an x where applicable)	Reference to applicable section of report
	> Under no circumstances may any artefacts be removed, destroyed or interfered on the site, unless under permit from SAHRA.		

Copies of specialist reports have been attached as appendices of the Main Report.

11. ENVIRONMENTAL IMPACT STATEMENT

11.1 SUMMARY OF THE KEY FINDINGS OF THE BASIC ASSESSMENT

A summary of the assessment of potential environmental impacts associated with the proposed mining activities and No-Go Alternative is provided in Table 9-1 above.

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 related to costs already incurred in the initial prospecting phase. 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.

11.2 FINAL SITE MAP

A map showing the locality of Sea Concession 6C is provided in Figure 3-1.

11.3 SUMMARY OF THE POSITIVE AND NEGATIVE IMPLICATIONS AND RISKS OF THE PROPOSED ACTIVITY AND IDENTIFIED ALTERNATIVES

As mentioned previously, the preferred site location has been determined by De Beers' application for a Mining Right in Sea Concession 6C and the identification of mineable resource deposits within the concession area. Thus, no further site alternatives can be considered. A summary of the identified impacts for the site, together with their significance, is provided in Table 9-1 above.

12. PROPOSED IMPACT MANAGEMENT OBJECTIVES AND THE IMPACT MANAGEMENT OUTCOMES FOR INCLUSION IN THE EMPR

Specific environmental objectives to control, remedy or stop potential impacts emanating from the proposed project are provided in the Environmental Management Programme (EMPr) prepared for the proposed project (see Section 7 of Main Report).

13. FINAL PROPOSED ALTERNATIVES

Not applicable (refer to Section 7 for a discussion as to why no alternative site locations could be considered).

14. ASPECTS FOR INCLUSION AS CONDITIONS OF AUTHORISATION

Recommendations for any aspects that must be made a condition of the Environmental Authorisation are included in Chapter 6 of the Main Report.

15. DESCRIPTION OF ANY ASSUMPTIONS, UNCERTAINTIES AND GAPS IN KNOWLEDGE

The assumptions and limitations are listed below:

- The Basic Assessment assumes that SLR has been provided with all relevant project information and that it was correct and valid at the time it was provided;
- Specialists will be provided with all the relevant project information in order to produce accurate and unbiased assessments;
- There will be no significant changes to the project description or surrounding environment between the completion of the Basic Assessment and implementation of the proposed project that could substantially influence findings, recommendations with respect to mitigation and management, etc.; and
- The assessment will be based, to a large extent, on a generic description of the proposed activities and an indicative Prospecting Works Programme, as the specific details were not available at the time of writing this report (e.g. exact timing and duration, sound levels, etc.).

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

15.1 REASONED OPINION AS TO WHETHER THE PROPOSED ACTIVITY SHOULD OR SHOULD NOT BE AUTHORISED

With the implementation of the proposed mitigation measures, the nature and extent of the proposed prospecting activities are anticipated to have generally **VERY LOW** to **LOW** significant impacts. Given this, as well as the findings of the specialist studies, it is the opinion of SLR that a positive decision being made by the Minister of Mineral Resources (or delegated authority) regarding the approval of the proposed project can be supported.

15.2 REASONS WHY THE ACTIVITY SHOULD BE AUTHORIZED OR NOT

See Section 15.1 above.

15.3 CONDITIONS THAT MUST BE INCLUDED IN THE AUTHORISATION

15.3.1 SPECIFIC CONDITIONS TO BE INCLUDED INTO THE COMPILATION AND APPROVAL OF EMPR

The general mitigation recommendations for the mining operations are provided in Section 6.2 of the Main Report.

15.3.2 REHABILITATION REQUIREMENTS

It has been observed that the depressions from previously mined areas in C-concession areas have become filled with natural sediment over time. It is understood that natural deposition and currents, together with the transportation of sediment which is discharged at the Orange River mouth, result in the observed infill. Given this no formal rehabilitation of the prospecting areas is proposed.

15.3.4 PERIOD FOR WHICH THE ENVIRONMENTAL AUTHORISATION IS REQUIRED

With regard to the validity period of the environmental authorisation (should it be granted), De Beers is requesting that it be issued and remain valid for a period of five years.

16. FINANCIAL PROVISION

16.1 EXPLAIN HOW THE AFORESAID AMOUNT WAS DERIVED

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

De Beers would put in place the required financial provision for the proposed prospecting activities and the contracted vessels would maintain appropriate insurance against operational risks. Such insurance would be held for and in relation to operations, against (inter alia) pollution damage, damage to property, the cost of removing wrecks or clean-up operations pursuant to an operational accident, injury to employees and other persons, in accord with good practice. A financial guarantee of R120 000 will be put in place. This value is aligned with financial guarantees for other existing marine prospecting areas.

16.2 CONFIRM THAT THIS AMOUNT CAN BE PROVIDED FOR FROM OPERATING EXPENDITURE.

The estimated cost for the proposed rehabilitation monitoring has been included in the Prospecting Works Programme as part of the Prospecting Right application.

17. OTHER INFORMATION REQUIRED BY THE COMPETENT AUTHORITY

17.1 IMPACT ON THE SOCIO-ECONOMIC CONDITIONS OF ANY DIRECTLY AFFECTED PERSON

Not Applicable. As the proposed project is located in the offshore environment there are no directly affected persons (i.e. landowners, occupiers of land, land claimants, etc.). The identified potential socio-economic impacts of the proposed project are described in Section 5 of the Main Report.

17.2 IMPACT ON ANY NATIONAL ESTATE REFERRED TO IN SECTION 3(2) OF THE NATIONAL HERITAGE RESOURCES ACT.

The identified potential impacts on cultural heritage material are described in Section 5 of the Main Report. The proposed mitigation measures to manage these impacts are provided in Section 7.

18. OTHER MATTERS REQUIRED IN TERMS OF SECTIONS 24(4)(A) AND (B) OF THE ACT

No other matters are required in terms of Section 24(4)(A) and (B) of the act.

PART B
DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

1. DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

1.1 DETAILS OF THE EAP

The details and role of the environmental assessment practitioner (EAP) that were involved in the preparation of this scoping report are provided in Table 1-1 above.

2. DESCRIPTION OF THE ASPECTS OF THE ACTIVITY

It is confirmed that the activities covered by this EMPr are fully described in Part A and Section 3 of the Main Report.

3. COMPOSITE MAP

A map showing the locality of Sea Concession 6C is provided in Figure 4-1.

4. DESCRIPTION OF IMPACT MANAGEMENT OBJECTIVES

4.1 DETERMINATION OF CLOSURE OBJECTIVES

As noted previously, due to the nature of the proposed prospecting operations no formal backfilling of the removed seabed sediments would take place. The majority of the removed material that is pumped to the surface would be returned directly to the sea (via moon pools) in approximately the same location as it was removed. It has been shown (from monitoring undertaken by De Beers in other sea concession areas) that the sampled areas become filled with natural sediment over time. Natural deposition and currents, together with the transportation of sediment which is discharged by the Orange River, result in this observed infill.

Given that the proposed mining areas would be naturally rehabilitated over time, the closure objectives for the proposed mining operations relate to monitoring the efficacy of this natural rehabilitation. It is recommended that a monitoring plan be developed with the principal objective of demonstrating that the natural recovery process is effective.

4.2 THE PROCESS FOR MANAGING ANY ENVIRONMENTAL DAMAGE, POLLUTION, PUMPING AND TREATMENT OF EXTRANEOUS WATER OR ECOLOGICAL DEGRADATION AS A RESULT OF UNDERTAKING A LISTED ACTIVITY

The management measures outlined in Section 10.1 and the EMPR (see Chapter 7 of the Main Report) have been identified in order to manage and reduce impacts and prevent unnecessary damage to the environment as a result of the proposed project. In the event that incidents occur that may result in environmental damages the emergency response procedure as outlined in the EMPR will be implemented to avoid pollution or degradation. It is noted that due to the nature of the proposed prospecting operations, the “treatment of extraneous water“ is not relevant.

4.3 POTENTIAL RISK OF ACID MINE DRAINAGE. (INDICATE WHETHER OR NOT THE MINING CAN RESULT IN ACID MINE DRAINAGE)

Not applicable. The proposed project does not include any activities which would result in acid mine drainage.

4.3.1 STEPS TAKEN TO INVESTIGATE, ASSESS, AND EVALUATE THE IMPACT OF ACID MINE DRAINAGE

Not applicable.

4.3.2 ENGINEERING OR MINE DESIGN SOLUTIONS TO BE IMPLEMENTED TO AVOID OR REMEDY ACID MINE DRAINAGE

Not applicable.

4.3.3 MEASURES THAT WILL BE PUT IN PLACE TO REMEDY ANY RESIDUAL OR CUMULATIVE IMPACT THAT MAY RESULT FROM ACID MINE DRAINAGE

Not applicable.

4.4 VOLUMES AND RATE OF WATER USE REQUIRED FOR THE MINING, TRENCHING OR BULK SAMPLING OPERATION

Not applicable.

4.5 HAS A WATER USE LICENCE HAS BEEN APPLIED FOR?

Not applicable.

4.6 IMPACTS TO BE MITIGATED IN THEIR RESPECTIVE PHASES

The impacts to be mitigated (together with their respective phases) are provided in Section 10.1 above.

4.7 IMPACT MANAGEMENT ACTIONS

The impact management actions are provided in the EMPR (see Chapter 7 of the Main Report).

5. FINANCIAL PROVISION

5.1 DETERMINATION OF THE AMOUNT OF FINANCIAL PROVISION

5.1.1 DESCRIBE THE CLOSURE OBJECTIVES AND THE EXTENT TO WHICH THEY HAVE BEEN ALIGNED TO THE BASELINE ENVIRONMENT DESCRIBED UNDER REGULATION 22 (2) (D) AS DESCRIBED IN 2.4 HEREIN

The closure objective for the proposed project, including how the objective will align with the current baseline environment, includes the following:

- To allow for the infilling and smoothing of mined areas by natural sediment movement and deposition so as to emulate the pre-sampling topography, as far as possible, so as to allow for the natural recovery of benthic faunal communities over time; and
- Closure is achieved efficiently, cost effectively and in compliance with the law.

5.1.2 CONFIRM SPECIFICALLY THAT THE ENVIRONMENTAL OBJECTIVES IN RELATION TO CLOSURE HAVE BEEN CONSULTED WITH LANDOWNER AND INTERESTED AND AFFECTED PARTIES

The draft BAR was distributed for a 30-day review and comment period which afforded I&APs an opportunity for I&APs to review the closure objectives associated with the proposed project. No comments relating to these objectives were received. It is noted that there are no relevant landowners as the proposed project would be located offshore in the marine environment.

5.1.3 PROVIDE A REHABILITATION PLAN THAT DESCRIBES AND SHOWS THE SCALE AND AERIAL EXTENT OF THE MAIN MINING ACTIVITIES, INCLUDING THE ANTICIPATED MINING AREA AT THE TIME OF CLOSURE

As noted in Section 4.2.2 above, given the nature of the proposed operations, no formal backfilling of the removed seabed sediments would take place. The deposition of the tailings would partially infill the sampled areas leaving localised depressions where sediment is deposited unevenly. These depressions would then become filled with natural sediment over time as a result of natural deposition and currents, together with the transportation of sediment which is discharged at the Orange River mouth.

5.1.4 EXPLAIN WHY IT CAN BE CONFIRMED THAT THE REHABILITATION PLAN IS COMPATIBLE WITH THE CLOSURE OBJECTIVES

From previous activities in the C-concession areas, it has been observed that the depressions from previously mined areas have become filled with natural sediment over time. This natural process will allow for the topography of the mined areas to emulate the pre-mining topography and provide a suitable environment to allow for the natural recovery of benthic faunal communities over time.

5.1.5 CALCULATE AND STATE THE QUANTUM OF THE FINANCIAL PROVISION REQUIRED TO MANAGE AND REHABILITATE THE ENVIRONMENT IN ACCORDANCE WITH THE APPLICABLE GUIDELINE

The applicant will provide a bank guarantee of R120 000 to the DMR, which is aligned with other financial guarantees for sea prospecting concessions.

5.1.6 CONFIRM THAT THE FINANCIAL PROVISION WILL BE PROVIDED AS DETERMINED

The estimated costs have been included in the Prospecting Works Programme as part of the Prospecting Right application.

6. MECHANISMS FOR MONITORING COMPLIANCE WITH AND PERFORMANCE ASSESSMENT AGAINST THE ENVIRONMENTAL MANAGEMENT PROGRAMME AND REPORTING THEREON, INCLUDING

The mechanisms for monitoring and reporting on the compliance with the EMPR is provided in Chapter 7 of the Main Report.

INDICATE THE FREQUENCY OF THE SUBMISSION OF THE PERFORMANCE ASSESSMENT REPORT

The applicant would be required to undertake regular audits of the operations to determine the level of compliance with the EMPr requirements and conditions of the environmental authorisation. The outcome of the above-mentioned audits would be documented in an environmental audit report and submitted to the DMR every two years. The audit report would comply with legal requirements contained in Appendix 7 of the 2014 EIA Regulations, as amended (or any future amendments thereto).

7. ENVIRONMENTAL AWARENESS PLAN

The relevant requirements for Environmental Awareness are included in the EMPR (see Chapter 7 of the Main Report).

APPENDIX B: DMR CORRESPONDENCE

mineral resources
Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

Private Bag X 14, Springbok, 8240, Cnr Van der Stel & Van Riebeeck, Hopley Centre Building, Springbok, 8240
Tel: 027 712 8175 Fax: 027 712 1959 Email: Linda.Njemla@dmr.gov.za, Ref: NC30/5/1/1/2(12189PR)
From: Mineral Regulation **Enquiries:** Linda Njemla

De Beers Consolidated Mines (Pty) Ltd
P. O. Box 616
KIMBERLY
8300

Attention: Annette Basson Email: prospecting.rights@debeersgroup.com

ACKNOWLEDEGEMENT OF AN APPLICATION FOR ENVIRONMENTAL AUTHORISATION LODGED IN TERMS OF SECTION 24 OF NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT 107 OF 1998) READ WITH REGULATION 19 OF THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REGULATIONS, 2014 FOR PROSPECTING RIGHT AND RELATED INFRASTRUCTURAL ACTIVITIES FOR DIAMONDS ON A SEA CONCESSION 6C, SITUATED IN THE MAGISTERIAL DISTRICT OF NAMAQUALAND: NORTHERN CAPE REGION.

1. I refer to the abovementioned matter and confirm that your application for an Environmental Authorisation herein referred to as “EA’’ lodged on **14th June 2018** is hereby acknowledged.

2. During the scrutinisation of the application, it has been found that you intend to do bulk sampling once the tests of the survey indicate potential. You have to note that in terms of the NEMA listed activities; the inclusion of bulk sampling will constitute a listed or specified activity in terms of GN No. 984 in *GG* No. 38282 of 08 December 2014 and **GN 375** in ***GG* No. 38282 40772 of 7 April 2017** (latest Regs) under listing Notice 2.

3. The listing activities that are being triggered in listing Notice 2, is: Activity 19 which state that "*The removal and disposal of minerals contemplated in terms of section 20 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including associated infrastructure, structures and earthworks, directly related to prospecting of a mineral resource; 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 this Notice applies*."

4. You should be aware of the fact that activities listed in listing notice 2 requires scoping and environmental impact assessment which is subjected to a public participation process of at least 30 days and which reflects the incorporation of comments received, including any comments of the competent authority.

5. This application will be processed without the inclusion of bulk sampling. Therefore, you are also advised to submit a basis assessment report (BAR) within 90 days from the date that you have lodged this application. Your nighty (90) days will lapse on the **15th September 2018**. Please note that this is inclusive of weekends but exclusive of public holidays. If you intend to do bulk sampling after obtaining positive results, you have to apply for another environmental authorisation which will require you to do the full environmental impact assessment.

6. You are therefore advised to do your declaration under oath ass the one that you have submitted is not done under oath. For that reason a commissioner of oath stamp is required and please submit when submitting your BAR.

7. Acknowledgement of your application does not grant you permission to commence with Prospecting activities. Commencement of a listed activity without an EA constitutes an offence in terms of Section 49A (1) (a) of NEMA, 1998 (Act 107 of 1998) as amended and upon conviction for such an offence, a person is liable to a fine not exceeding R10 million or to imprisonment for a period not exceeding ten years, or to both such fine and such imprisonment.

Hope that this letter will receive your utmost attention. For any other queries regarding the content of this letter, please contact the above mentioned official.

……………………...

ASSISTANT DIRECTOR: MINE ENVIRONMENTAL MANAGEMENT
ON BEHALF OF THE REGIONAL MANAGER: MINERAL REGULATION
NORTHERN CAPE REGION
DATE: 18/06/2018

Please quote this office file number for any correspondence as reference

APPENDIX C: MARINE FAUNAL ASSESSMENT

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

Marine Faunal Assessment

Prepared for:

SLR

On behalf of:

De Beers Consolidated Mines Limited

July 2018

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

MARINE FAUNAL ASSESSMENT

Prepared for

SLR Consulting (South Africa) (Pty) Ltd

On behalf of:

De Beers Consolidated Mines Limited

Prepared by

Andrea Pulfrich
Pisces Environmental Services (Pty) Ltd

July 2018

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EXECUTIVE SUMMARY

De Beers Marine (DBM), as the marine operator of De Beers Consolidated Mines Limited, is proposing to undertake prospecting operations within Sea Concession 6C. Before these activities can be undertaken, authorisation is required in terms of the National Environmental Management Act (NEMA), 1998 (No. 107 of 1998), as amended, and a Prospecting Right has to be obtained in terms of the Mineral and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002).

SLR Consulting (South Africa) (Pty) Ltd has been appointed to undertake the necessary application processes and inturn have asked Pisces Environmental Services (Pty) Ltd to provide a specialist report on potential impacts of the proposed sampling operations on marine benthic fauna in the area.

During Phase 1 of the project, various exploration geophysical tools would be implemented including swathe bathymetry systems, sub-bottom profilers, side-scan sonars, magnetometer surveys. Follow-up localised geophysical surveys during Phase 2 may be undertaken using an Autonomous Underwater Vehicle (AUV) enabling refinement of the definition of the target features. Should the result of the survey(s) indicate potential, follow-up sampling may be undertaken to establish the distribution of the diamondiferous material. Future exploration sampling, may include bulk sampling using either vertical or horizontal mining methods

Sea Concession 6C is located off the northern West Coast of South Africa roughly between Kleinzee and Hondeklipbaai with water depths in the area targeted for sampling ranging between 100 m to 200 m. The seabed sediments comprise primarily muddy sands, with a north-south trending tongue of sand in the centre of the concession area and the innershelf mudbelt in the east. Winds come primarily from the southeast, whereas virtually all swells throughout the year come from the S and SSW direction. The bulk of the seawater in the study area is South Atlantic Central Water characterised by low oxygen concentrations, especially at depth. Inshore waters are turbid being influenced by coastal upwelling as well as discharges from the Orange River.

The concession falls into the cold temperate Namaqua Bioregion. The benthic habitats potentially affected by sampling operations have been classified as ‘least threatened’ and ‘vulnerable’. Two geological features of note in the vicinity of the proposed area of interest are Child’s Bank, situated at about 31°S ~60 km to the south of Concession 6C, and Tripp Seamount situated at about 29°40’S ~150 km, to the WNW of the concession. Features such as banks and seamounts often host deepwater corals and boast an enrichment of bottom-associated communities relative to the otherwise low profile homogenous seabed habitats.

The concession lies within the influence of the Namaqua upwelling cell and is characterised by seasonally high plankton abundance. The area is likely to host a variety of demersal fish species typical of the shelf community, including the Cape hake, jacopever and West Coast sole. The concession overlaps with various lease areas for hydrocarbon exploration. Numerous conservation areas, as well as existing and proposed marine protected areas(MPAs) exist along the coastline and offshore of the Northern Cape, but none fall directly within the concession area.

The potential environmental impacts to the marine environment of the proposed geophysical prospecting operations are:

- Disturbance of marine mammals by the sounds emitted by the geophysical survey equipment;
- Potential injury to marine mammals and turtles through vessel strikes;
- Marine pollution due to discharges such as deck drainage, machinery space wastewater, sewage, etc. and disposal of solid wastes from the survey vessel; and
- Marine pollution due to fuel spills during refuelling, or resulting from collision or shipwreck.

The potential environmental impacts to the marine environment of the sampling and future bulk sampling operations are:

- Disturbance and loss of benthic fauna in the drill sample footprints and crawler excavated trenches;
- Crushing of epifauna and infauna by the crawler tracks;
- Generation of suspended sediment plumes through discard of fine tailings;
- Smothering of benthic communities through re-settlement of discarded tailings;
- Potential loss of equipment on the seabed;
- Disturbance of marine biota by noise from the sampling vessel and sampling tools; and
- Marine pollution due to discharges such as deck drainage, machinery space wastewater, sewage, etc. and disposal of solid wastes from the sampling vessel.

The impacts before and after mitigation on marine habitats and communities associated with the proposed project are summarised below (Note: * indicates that no mitigation is possible and / or considered necessary, thus significance rating remains unchanged):

Impact	Probability	Significance (before mitigation)	Significance (after mitigation)
Noise from geophysical surveying on marine fauna	Probable	Very Low	Very Low
Noise from sampling operations on marine fauna	Definite	Very Low	Very Low*
Disturbance and loss of benthic macrofauna	Definite	Low	Low*
Crushing of benthic macrofauna	Definite	Very Low	Very Low
Generation of suspended sediment plumes	Definite	Very Low	Very Low*
Smothering of benthos in unconsolidated sediments by redepositing tailings	Probable	Very Low	Very Low*
Smothering of vulnerable reef communities by redepositing tailings	Probable	Low	Very Low
Potential loss of equipment	Improbable	Very Low	Very Low
Pollution of the marine environment through operational discharges to the sea from mining vessel	Probable	Very Low	Very Low

Mitigation measures proposed during geophysical surveying include:

- Onboard Marine Mammal Observers (MMOs) 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 limited to 15 minutes prior to the start of survey equipment.
- “Soft starts” should be carried out for any equipment of 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.
- 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. As no seasonal patterns of abundance are known for odontocetes occupying the proposed exploration area, a precautionary approach to avoiding impacts throughout the year is recommended.
- Ensure that PAM (passive acoustic monitoring) is incorporated into any surveying taking place between June and November.
- A MMO should be appointed to ensure compliance with mitigation measures during seismic geophysical surveying.

Mitigation measures proposed during exploration sampling include:

- 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.
- Implement dynamically positioned sampling vessels in preference to vessels requiring anchorage.
- Use geophysical data 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.
- The positions of all lost equipment must be accurately recorded in a hazards database, and reported to maritime authorities. Every effort should be made to remove lost equipment.
- Adhere strictly to best management practices recommended in the relevant Environmental Impact Report and EMPr and that of MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships, 1973) for all necessary disposals at sea.
- Develop a waste management plan using waste hierarchy.

If all environmental guidelines, and appropriate mitigation measures advanced in this report, and the EMPr for the proposed operations as a whole, are implemented, there is no reason why the proposed prospecting should not proceed.

ABBREVIATIONS and UNITS

AUV	Autonomous Underwater Vehicle
BCLME	Benguela Current Large Marine Ecosystem
cm	centimetres
cm/s	centimetres per second
CITES	Convention on International Trade in Endangered Species
CSIR	Council for Scientific and Industrial Research
dB	decibell
DBCM	De Beers Consolidated Mines
DBM	De Beers Marine
DEA	Department of Environmental Affairs
DMS	Dense Medium Separation
E	East
EBSA	Ecologically and Biologically Significant Area
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
FAMDA	Fishing and Mariculture Development Association
FAO	Food and Agricultural Organisation
FeSi	ferrosilicon
g/m^2	grams per square metre
$g\ C/m^2/day$	grams Carbon per square metre per day
GIS	Global Information System
HABs	Harmful Algal Blooms
Hz	Herz
IBA	Important Bird Area
IUCN	International Union for the Conservation of Nature
IWC	International Whaling Commission
JNCC	Joint Nature Conservation Committee
kHz	kiloHerz
km	kilometre
km^2	square kilometre
km/h	kilometres per hour
kts	knots
MFMR	Ministry of Fisheries and Marine Resources (Namibia)
MMOs	Marine Mammal Observers
MPA	Marine Protected Area
MPRDA	Mineral and Petroleum Resources Development Act
m	metres
m^2	square metres
m^3	cubic metre
mm	millimetres
m/s	metres per second

mg/ℓ	milligrams per litre
N	north
NDP	Namibian Dolphin Project
NEMA	National Environmental Management Act
NNW	north-northwest
nm	nautical mile
NMMU	Nelson Mandela Metropolitain University
NOAA	National Oceanic and Atmospheric Administration
NW	north-west
PAM	Passive Acoustic Monitoring
PIM	Particulate Inorganic Matter
PNSF	Port Nolloth Sea Farms
POM	Particulate Organic Matter
ppm	parts per million
ROVs	Remotely Operated Vehicles
S	south
SACW	South Atlantic Central Water
SADCO	Southern Africa Data Centre for Oceanography
SANBI	South African National Biodiversity Institute
SASTN	South Atlantic Sea Turtle Network
SFRI	Sea Fisheries Research Institute, Department of Environmental Affairs
SPRFMA	South Pacific Regional Fisheries Management Authority
SSW	South-southwest
SW	south-west
TSPM	Total Suspended Particlate Matter
UNEP	United Nations Environmental Programme
VMEs	Vulnerable Marine Ecosystems
VOS	Voluntary Observing Ships
μg	micrograms
μm	micrometre
μM	microMol
μg/l	micrograms per litre
μPa	micro Pascal
°C	degrees Centigrade
%	percent
‰	parts per thousand
~	approximately
<	less than
>	greater than

EXPERTISE AND DECLARATION OF INDEPENDENCE

This report was prepared by Dr Andrea Pulfrich of Pisces Environmental Services (Pty) Ltd. Andrea has a PhD in Fisheries Biology from the Institute for Marine Science at the Christian-Albrechts University, Kiel, Germany.

As Director of Pisces since 1998, Andrea has considerable experience in undertaking specialist environmental impact assessments, baseline and monitoring studies, and Environmental Management Programmes relating to marine diamond mining and dredging, hydrocarbon exploration and thermal/hypersaline effluents. She is a registered Environmental Assessment Practitioner and member of the South African Council for Natural Scientific Professions, South African Institute of Ecologists and Environmental Scientists, and International Association of Impact Assessment (South Africa).

This specialist report was compiled for SLR Environmental Consulting (Pty) Ltd on behalf of De Beers Consolidated Mines Limited for their use in preparing an Basic Impact Assessment for proposed offshore prospecting operations in Sea Concession 6C off the West Coast of South Africa. I do hereby declare that Pisces Environmental Services (Pty) Ltd is financially and otherwise independent of the Applicant and SLR.

Dr Andrea Pulfrich

1. GENERAL INTRODUCTION

De Beers Marine (DBM), as the marine operator of De Beers Consolidated Mines Limited (DBCM), is proposing to undertake prospecting operations within Sea Concession 6C. Before these activities can be undertaken, authorisation is required in terms of the National Environmental Management Act (NEMA), 1998 (No. 107 of 1998), as amended, and a Prospecting Right has to be obtained in terms of the Mineral and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002).

SLR Consulting (South Africa) (Pty) Ltd (SLR) has been appointed to undertake the necessary application processes in terms of the NEMA, as amended, and in turn have asked Pisces Environmental Services (Pty) Ltd to provide a specialist report on potential impacts of the proposed operations on marine benthic fauna in the area.

1.1. Scope of Work

This specialist report was compiled as a desktop study on behalf of SLR, for their use in preparing a Basic Assessment Report for the proposed prospecting activities off the South African West Coast.

The following general terms of reference apply to the specialist study:

- Describe the baseline conditions that exist in the study area and identify any sensitive areas that would need special consideration;
- Identify and assess potential impacts of the proposed operations;
- Identify and list all legislation and permit requirements that are relevant to the development proposal;
- Identify areas where issues could combine or interact with issues likely to be covered by other specialists, resulting in aggravated or enhanced impacts;
- Indicate the reliability of information utilised in the assessment of impacts as well as any constraints to which the assessment is subject (e.g. any areas of insufficient information or uncertainty);
- Where necessary consider the precautionary principle in the assessment of impacts;
- Identify feasible ways in which impacts could be mitigated and benefits enhanced giving an indication of the likely effectiveness of such mitigation and how these could be implemented in the management of the proposed operation;
- To ensure that specialists use a common standard, the determination of the significance of the assessed impacts will be undertaken in accordance with a common Convention (see Section 5.1);
- Comply with DEA guidelines as well as any other relevant guidelines on specialist study requirements for Environmental Impact Assessments (EIAs);
- Include specialist expertise and a signed statement of independence; and
- Comply with Regulation 12 and Appendix 6 of the EIA Regulations 2014, which specifies requirements for all specialist reports.

The terms of reference specific to the marine faunal assessment are:

- Provide a general description of the local marine fauna (including cetaceans, seals, turtles, seabirds, fish, invertebrates and plankton species) within Sea Concession 6C and greater West Coast. The description is to be based on, *inter alia*, a review of existing information and data from the international scientific literature, the Generic EMP prepared for marine diamond mining off the West Coast of South Africa (Lane & Carter 1999) and information sourced from the internet;
- Identify, describe and assess the significance of potential impacts of the proposed prospecting operations on the local marine fauna, including but not limited to:
  - physiological injury;
  - behavioural avoidance of the prospecting area;
  - masking of environmental sounds and communication; and
  - indirect impacts due to effects on prey.
- Identify practicable mitigation measures to avoid/reduce any negative impacts and indicate how these could be implemented in the start-up and management of the proposed project.

1.2. Approach to the Study

As determined by the terms of reference, this study has adopted a 'desktop' approach. The literature sources consulted are listed in the Reference chapter.

All identified marine impacts are summarised, categorised and ranked in appropriate impact assessment tables, to be incorporated into the Basic Assessment Report.

2. DESCRIPTION OF THE PROPOSED PROJECT

A phased approach is proposed for the prospecting. The initial phase would involve a regional scale geophysical survey to identify geological features of interest for further exploration.

2.1. Geophysical Surveys

Various exploration geophysical tools (Figure 1) could be deployed from a fit-for-purpose vessel, including:

- swathe bathymetry systems, which produces a digital terrain model of the seafloor; backscatter data may be acquired as part of the process to determine textural models;
- sub-bottom profiler seismic systems (e.g. boomer, chirp and sleeve gun), which generate profiles beneath the seafloor to give a cross section view of the sediment layers;
- side-scan sonar systems, which systems produce acoustic intensity images of the seafloor and are used to map the different sediment textures from associated lithology of the seafloor; and
- magnetometer surveys, which measures local variations in the intensity of the Earth's magnetic fields, which are caused by differences in composition of the sediment layers on or beneath the seafloor.

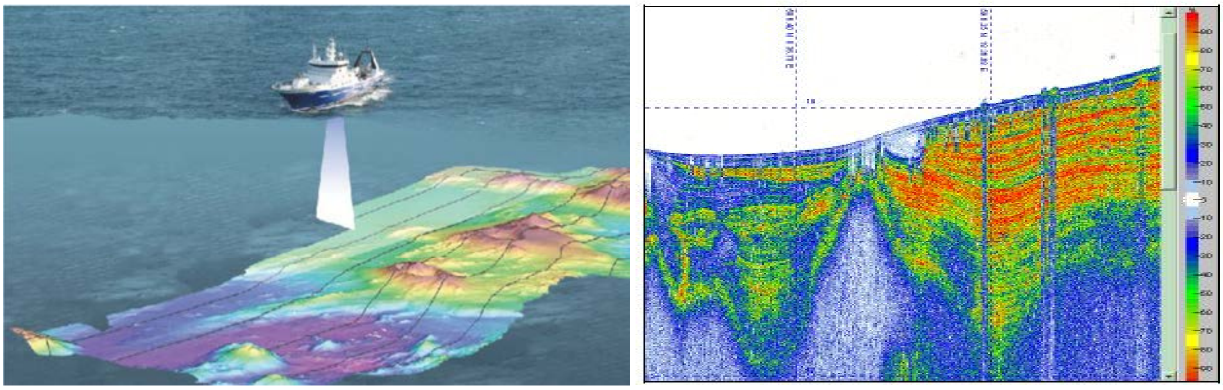

Figure 1: The geophysical survey techniques employed during Phase I of the proposed prospecting operations would include swath bathymetry (left) and sub-bottom profiling (right).

The line spacing for prospecting would be planned to enable full regional scale seabed coverage. All the systems are hull-mounted and no towed equipment will be used. Sound levels from the acoustic equipment would range from 190 to 230 dB re 1 μPa at 1 m.

Should geological features of interest be identified, a decision regarding the feasibility of proceeding to Phase 2 of the exploration will be made. During this phase follow-up localised geophysical surveys would be undertaken, enabling refinement of the definition of the target features. These detailed high resolution geophysical surveys will utilise similar tools with the likely inclusion of an Autonomous Underwater Vehicle (AUV), which is typically used for surveying in areas where survey line-spacing is generally <100 m apart.

2.2. Exploration Sampling

Should survey results indicate resource potential, subsequent exploration sampling to establish the distribution of diamondiferous material would be undertaken to determine mining performance characteristics (e.g. mining rate and metallurgical recovery information) that would be used in determining economic viability during feasibility studies. Sampling would be undertaken from a sampling vessel of opportunity (e.g. mv The Explorer and/or DBM's mv Coral Sea) using a fit-for-purpose tool and taking full advantage of the latest sampling technologies available. Sampling technologies selected would be appropriate to each target area and based on the results of the preceding stage. The sampling would likely be divided into stages with reviews and gate releases.

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. Typical sampling tool technologies that could be employed are described in more detail below.

2.2.1 Subsea Sampling Tool

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 2), 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 onboard mineral recovery plant. All oversized and undersized tailings are discharged back to the sea on site. The depth of sediment sampled would be from 0.5 to 4 m below the seafloor surface. Depending on sea and the subseabed geotechnical conditions, up to 60 samples can be successfully taken per day.

Figure 2: Illustrative example of a drill bit operated from a drill frame structure located onboard a vessel of opportunity.

2.2.2 Vertically Mounted Sampling Tool

Sampling would be undertaken using a vertically mounted Wirth drill suspended from a derrick mounted mid ships and deployed through a moon pool. 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, all oversized and undersized tailings are discharged back to the sea on site. The depth of sediment sampled would be from 0.5 to 4 m below the seafloor surface. Depending on sea and the subseabed geotechnical conditions, 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 could be taken within the potential deposit area(s). The sample spacings would be between 50 and 200 m apart. The total area of disturbance would be approximately 0.09 km^2.

2.3. Bulk Sampling

Based on the results of the sampling programme, future bulk sampling may also be undertaken.

Should bulk sampling be undertaken, this would be conducted by one of the marine mining vessels operated by DBM’s sister company De Beers Marine Namibia (Pty) Ltd, or a similar vessel of opportunity. The vessels available for bulk sampling adopt either the vertical or horizontal mining approach (Figure 3).

Vertical mining involves a vertically mounted, large-diameter drill-head (currently ranging from 5.2 - 6.8 m in diameter), used to excavate diamond-bearing gravel in a systematic pattern of overlapping circles in the target area. The drill-head consists of a large-diameter circular disc fitted with wheel cutters and hardened steel scrapers, and is lowered to the seabed on an extendable pipe ‘drill string’. Loosened rocks and sediment are fed along a semi-circular channel across the lower surface of the plate, extracted through a central aperture and pumped to the surface through the drill string for onboard processing. The drill is capable of penetrating about 2 - 3 m of sediment and partially consolidated conglomerate or calcareous sandstone in water depths down to 150 m.

Horizontal Mining involves the use of a track-mounted seabed crawler fitted with highly accurate acoustic seabed navigation and imaging systems, and equipped with an anterior suction system. The crawler is lowered to the seabed and is controlled remotely from the surface support vessel through power and signal umbilical cables. Water jets in the crawler's suction head loosen seabed sediments, and sorting bars filter out oversize boulders. The sampled sediments are pumped to the surface for shipboard processing. Crawlers are capable of working to 200 m depth.

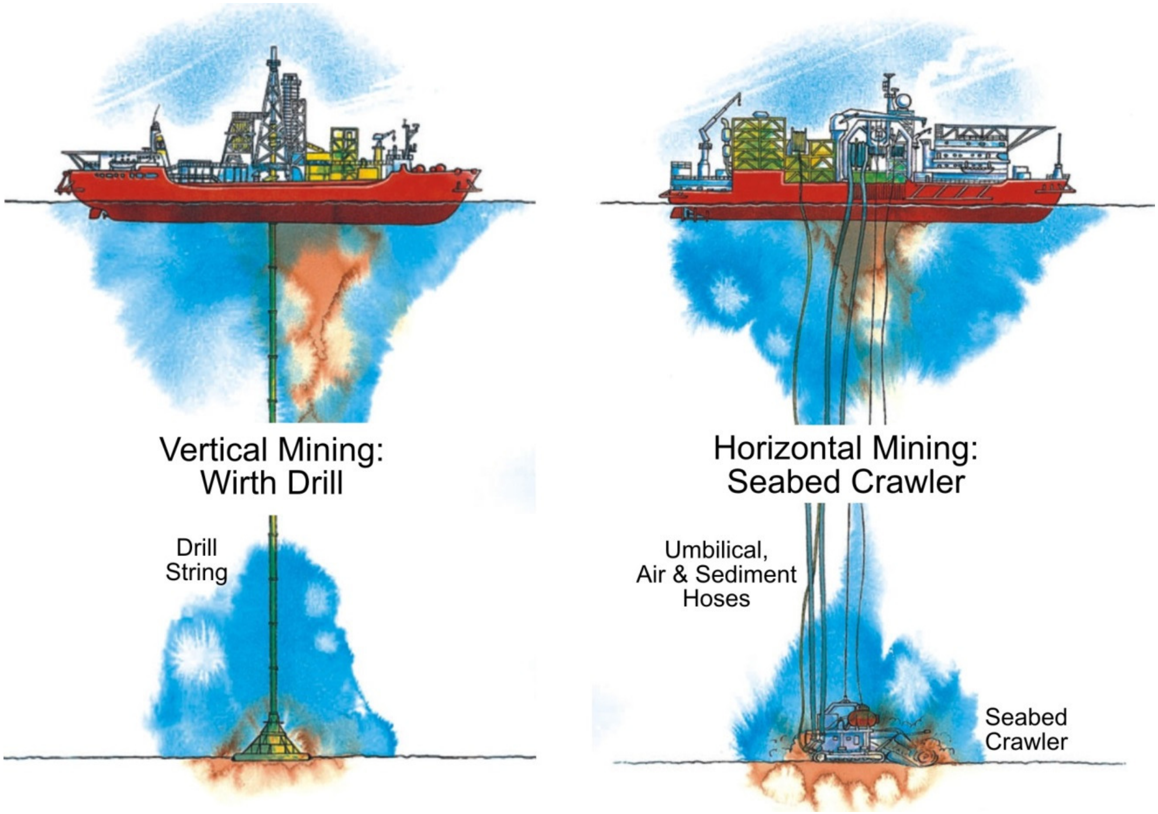

Figure 3: Illustration of the current mining methods used to mine diamond-bearing gravels; a) Vertical mining using large-diameter drills, and b) horizontal mining using seabed crawlers (Source: De Beers Marine).

2.4. Emissions and Discharges to Sea

During geophysical and sampling operations, normal discharges to the sea from ythe vessels can come from a variety of sources. These discharges are regulated by onboard waste management plans and shall be MARPOL compliant. For the sake of completeness they are discussed briefly below:

2.3.1 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 standard before discharge overboard. Drainage from marine (weather) deck spaces would wash directly overboard.

2.3.2 Sewage

Although South Africa is not yet a signatory to MARPOL Annex IV Regulations for the Prevention of Pollution by Sewage from Ships, the contracted vessels would be required to comply, wherever possible, with the requirements of this Annex.

2.3.3 Food (galley) wastes

The disposal into the sea of food waste is permitted in terms of MARPOL 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 when more than 12 nautical miles (approximately 22 km) from the coast. The daily discharge from the vessel would be approximately 0.15 m^3.

2.3.4 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 above).

2.5. Support and supply vessels

The exploration vessels typically have the capability to be fully autonomous and operational for long periods of time before bunkering. Spares, consumables and victuals can be supplied by support vessels while the exploration vessel is operational. It is envisioned that a supply vessel would call into port on a regular basis during the operations.

No crew change flights would be necessary during the exploration campaigns. Emergency equipment supplies and medical evacuations of injured personnelwould be undertaken from the Alexander Bay airport. Helicopter operations to and from the mining vessel would thus occur sporadically only.

3. DESCRIPTION OF THE BASELINE MARINE ENVIRONMENT

The descriptions of the physical and biological environments along the South African West Coast focus primarily on the study area between the Orange River mouth and Hondeklipbaai. The purpose of this environmental description is to provide the marine baseline environmental context within which the proposed exploration activities would take place. The summaries presented below are based on information gleaned from Lane & Carter (1999) and Penney *et al*. (2007).

3.1. Geophysical Characteristics

3.1.1 Bathymetry

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 NNW trend, widening north of Cape Columbine and reaching its widest off the Orange River (180 km) (Figure 4). 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 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 ~300 m.

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

3.1.2 Coastal and Inner-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 outer shelves to muddy sand and sandy mud in deeper water. However, this general pattern has been modified considerably by biological deposition (large areas of shelf sediments contain high levels of calcium carbonate) and localised river input (Figure 5). An ~500-km long mud belt (up to 40 km wide, and of 15 m average thickness) is situated over the inner edge of the middle shelf 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 from the Orange River. As these sediments are generally transported northward, most of the sediment in the project area is considered to be relict deposits by now ephemeral rivers active during wetter climates in the past. The Orange River, when in flood, still contributes largely to the mud belt as suspended sediment is carried southward by poleward flow. In this context, the absence of large sediment bodies on the inner shelf reflects on the paucity of terrigenous sediment being introduced by the few rivers that presently drain the South African West Coast coastal plain.

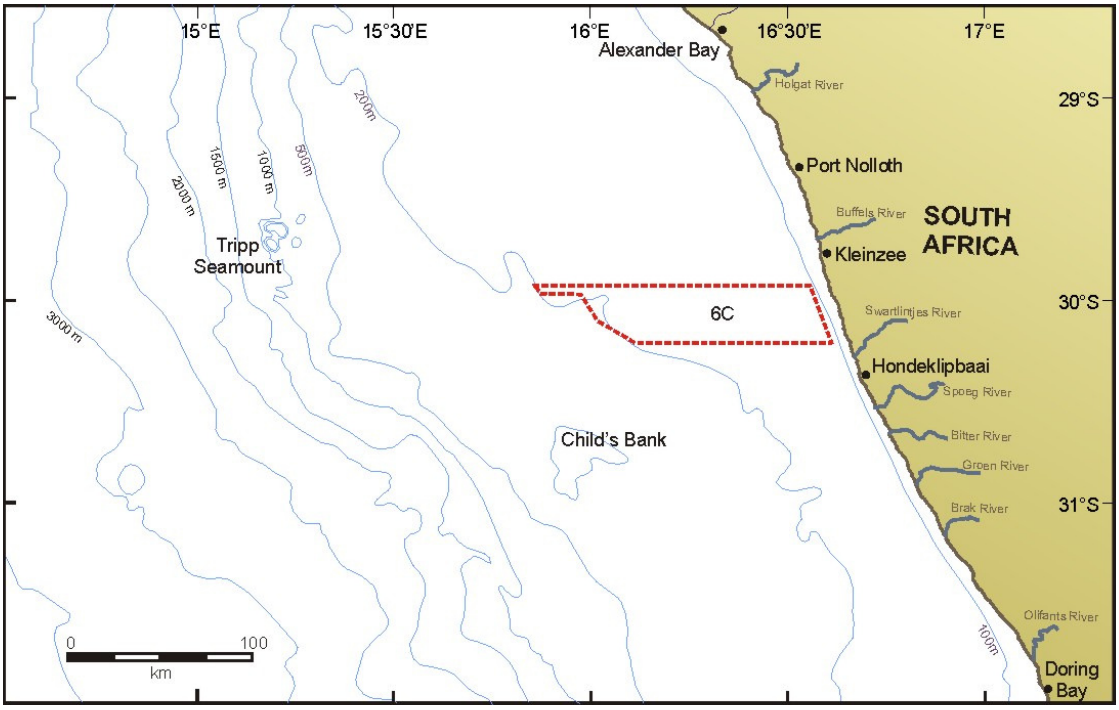

Figure 4: Sea Concession 6C (red polygon) in relation to the regional bathymetry and showing proximity of prominent seabed features.

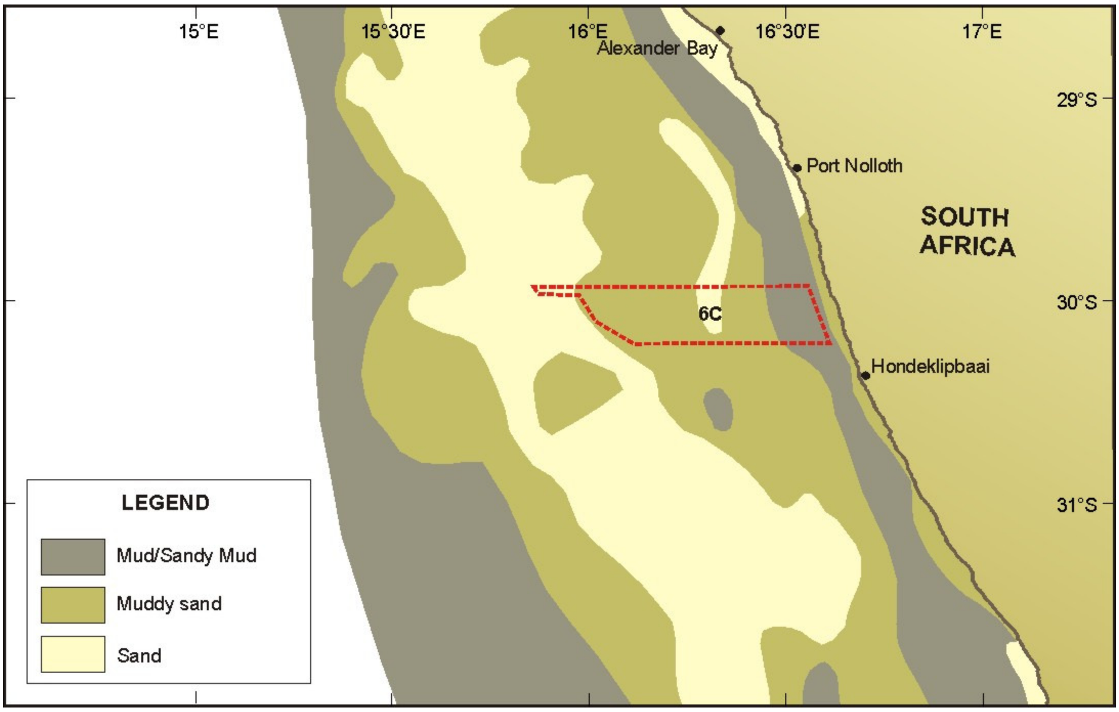

Figure 5: Concession 6C in relation to sediment distribution on the continental shelf (Adapted from Rogers 1977).

3.2. Biophysical Characteristics

3.2.1 Wind Patterns

Winds are one of the main physical drivers of the nearshore Benguela region, both on an oceanic scale, generating the heavy and consistent south-westerly swells that impact this coast, and locally, contributing to the northward-flowing longshore currents, and being the prime mover of sediments in the terrestrial environment. Physical processes are characterised by the average seasonal wind patterns, and substantial episodic changes in these wind patterns have strong effects on the entire Benguela region.

The prevailing winds in the Benguela region are controlled by the perennial South Atlantic subtropical anticyclone, the eastward moving mid-latitude cyclones south of southern Africa, and the seasonal atmospheric pressure field over the subcontinent. The south Atlantic anticyclone undergoes seasonal variations, being strongest in the austral summer, when it also attains its southernmost extension, lying south west and south of the subcontinent. In winter, the south Atlantic anticyclone weakens and migrates north-westwards.

These seasonal changes result in substantial differences between the typical summer and winter wind patterns in the region, as the southern hemisphere anti-cyclonic high-pressures system, and the associated series of cold fronts, moves northwards in winter, and southwards in summer. The strongest winds occur in summer, during which winds blow 99% of the time Virtually all winds in summer come from the southeast to south-west (Figure 6; supplied by CSIR), strongly dominated by southerlies which occur over 40% of the time, averaging 20 - 30 kts and reaching speeds in excess of 100 km/h (60 kts). South-easterlies are almost as common, blowing about one-third of the time, and also averaging 20 - 30 kts. The combination of these southerly/south-easterly winds drives the offshore movements of surface water, and the resultant strong upwelling of nutrient-rich bottom waters, which characterise this region.

Winter remains dominated by southerly to south-easterly winds, but the closer proximity of the winter cold-front systems results in a significant south-westerly to north-westerly component (Figure 6). This ‘reversal’ from the summer condition results in cessation of upwelling, movement of warmer mid-Atlantic water shorewards and breakdown of the strong thermoclines which develop in summer. There are more calms in winter, occurring about 3% of the time, and wind speeds generally do not reach the maximum speeds of summer. However, the westerlies winds blow in synchrony with the prevailing south-westerly swell direction, resulting in heavier swell conditions in winter.

3.2.2 Large-Scale Circulation and Coastal Currents

The West Coast is strongly influenced by the Benguela Current, with current velocities in continental shelf areas ranging between 10–30 cm/s (Boyd & Oberholster 1994). On its western side, flow is more transient and characterised by large eddies shed from the retroflection of the Agulhas Current. The Benguela current widens northwards to 750 km, with flows being predominantly wind-forced, barotropic and fluctuating between poleward and equatorward flow (Shillington *et al.* 1990; Nelson & Hutchings 1983). The long-term mean current residual is in an approximate northwest (alongshore) direction, whereas near-bottom shelf flow is mainly poleward (Nelson 1989) with low velocities of typically 5 cm/s.

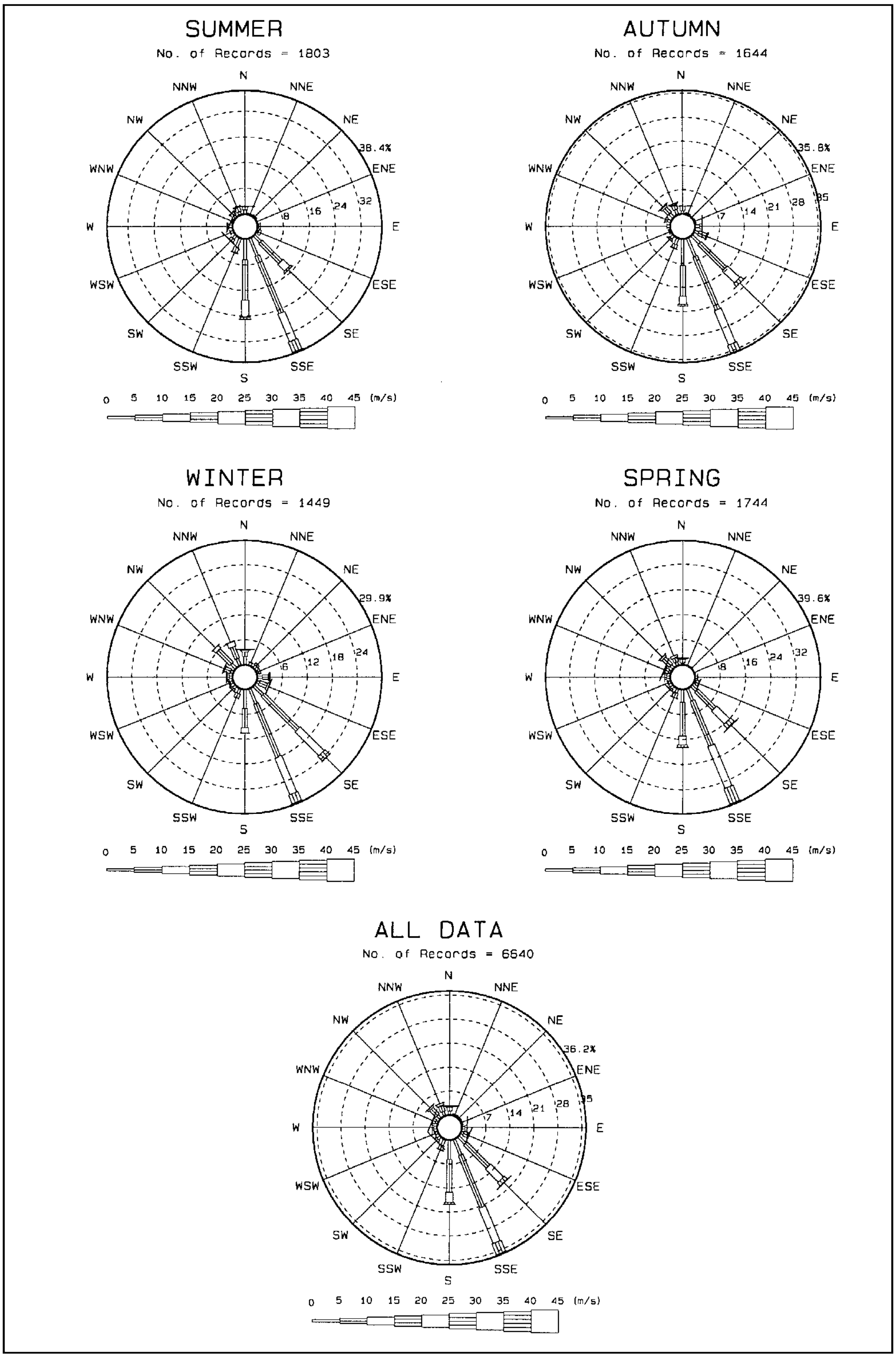

Figure 6: VOS Wind Speed vs Wind Direction data for the offshore area 28°-29°S; 15°-16°E (Oranjemund) (Source: Voluntary Observing Ship (VOS) data from the Southern Africa Data Centre for Oceanography (SADCO)).

The major feature of the Benguela Current Coastal is upwelling and the consequent high nutrient supply to surface waters leads to high biological production and large fish stocks. The prevailing longshore, equatorward winds move nearshore surface water northwards and offshore. To balance the displaced water, cold, deeper water wells up inshore. Although the rate and intensity of upwelling fluctuates with seasonal variations in wind patterns, the most intense upwelling tends to occur where the shelf is narrowest and the wind strongest. There are three upwelling centres in the southern Benguela, namely the Namaqua (30°S), Cape Columbine (33°S) and Cape Point (34°S) upwelling cells (Taunton-Clark 1985) (Figure 7; bottom left). Upwelling in these cells is seasonal, with maximum upwelling occurring between September and March. An example of one such strong upwelling event in December 1996, followed by relaxation of upwelling and intrusion of warm Agulhas waters from the south, is shown in the satellite images in Figure 7.

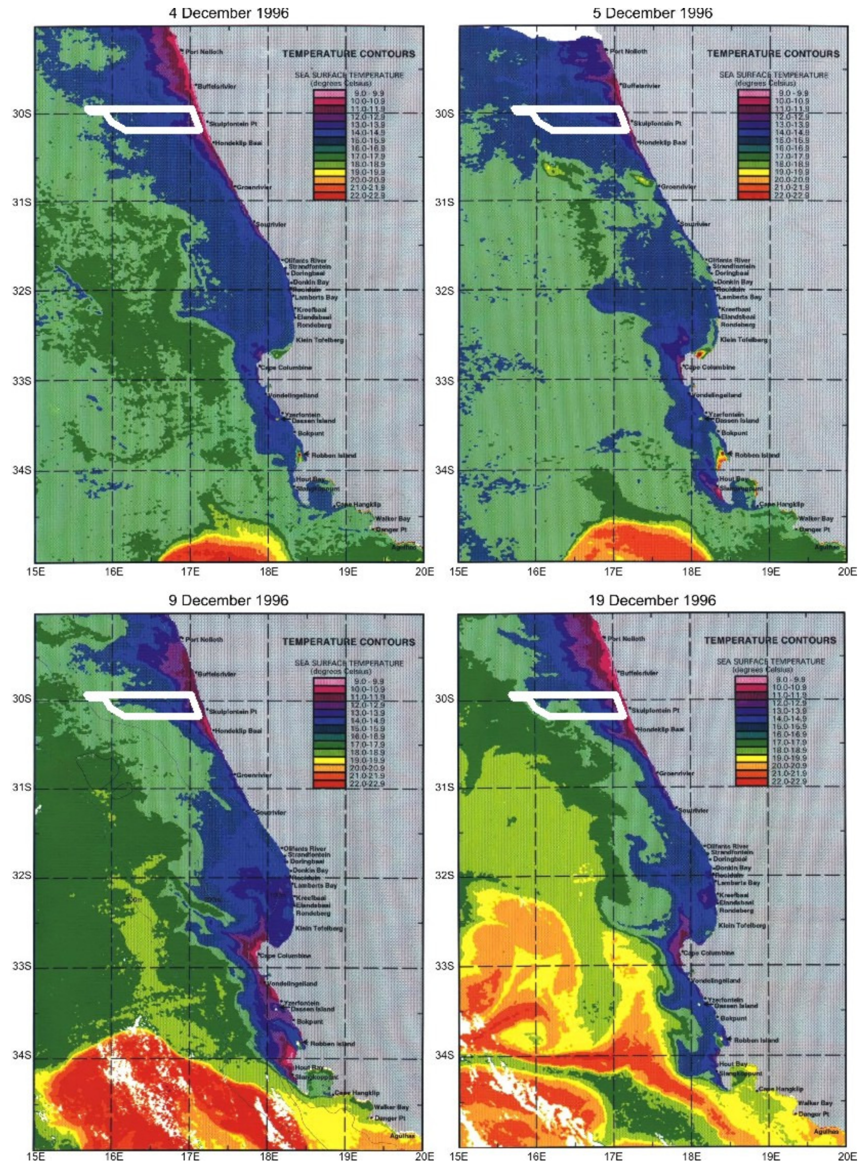

Figure 7: Satellite sea-surface temperature images showing upwelling intensity along the South African west coast on four days in December 1996 (from Lane & Carter 1999). The location of the Concession 6C (white polygon) is indicted.

3.2.3 Waves and Tides

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 SW - S direction (Figure 8). Winter swells are strongly dominated by those from the SW - SSW, which occur almost 80% of the time, and typically exceed 2 m in height, averaging about 3 m, and often attaining over 5 m. With wind speeds capable of reaching 100 km/h during heavy winter south-westerly storms, winter swell heights can exceed 10 m.

Summer swells tend to be smaller on average (~2 m), with a more pronounced southerly component. These southerly swells tend to be wind-induced, with shorter wave periods (~8 seconds), and are generally steeper than swell waves (CSIR 1996).

In common with the rest of the southern African coast, tides are semi-diurnal, with a total range of some 1.5 m at spring tide, but only 0.6 m during neap tide periods.

3.2.4 Water

South Atlantic Central Water (SACW) comprises the bulk of the seawater in the project area, either in its pure form in the deeper regions, or mixed with previously upwelled water of the same origin on the continental shelf (Nelson & Hutchings 1983). Salinities range between 34.5‰ and 35.5‰ (Shannon 1985).

Seawater temperatures on the continental shelf typically vary between 6°C and 16°C. Well-developed thermal fronts exist, demarcating the seaward boundary of the upwelled water. Upwelling filaments are characteristic of these offshore thermal fronts, occurring as surface streamers of cold water, typically 50 km wide and extending beyond the normal offshore extent of the upwelling cell. Such fronts typically have a lifespan of a few days to a few weeks, with the filamentous mixing area extending up to 625 km offshore.

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations, especially on the bottom. SACW itself has depressed oxygen concentrations (~80% saturation value), but lower oxygen concentrations (<40% saturation) frequently occur (Bailey *et al.* 1985; Chapman & Shannon 1985).

Nutrient concentrations of upwelled water attain 20 µM nitrate-nitrogen, 1.5 µM phosphate and 15-20 µM silicate, indicating nutrient enrichment (Chapman & Shannon 1985). This is mediated by nutrient regeneration from biogenic material in the sediments (Bailey *et al.* 1985). Modification of these peak concentrations depends upon phytoplankton uptake which varies according to phytoplankton biomass and production rate. The range of nutrient concentrations can thus be large but, in general, concentrations are high.

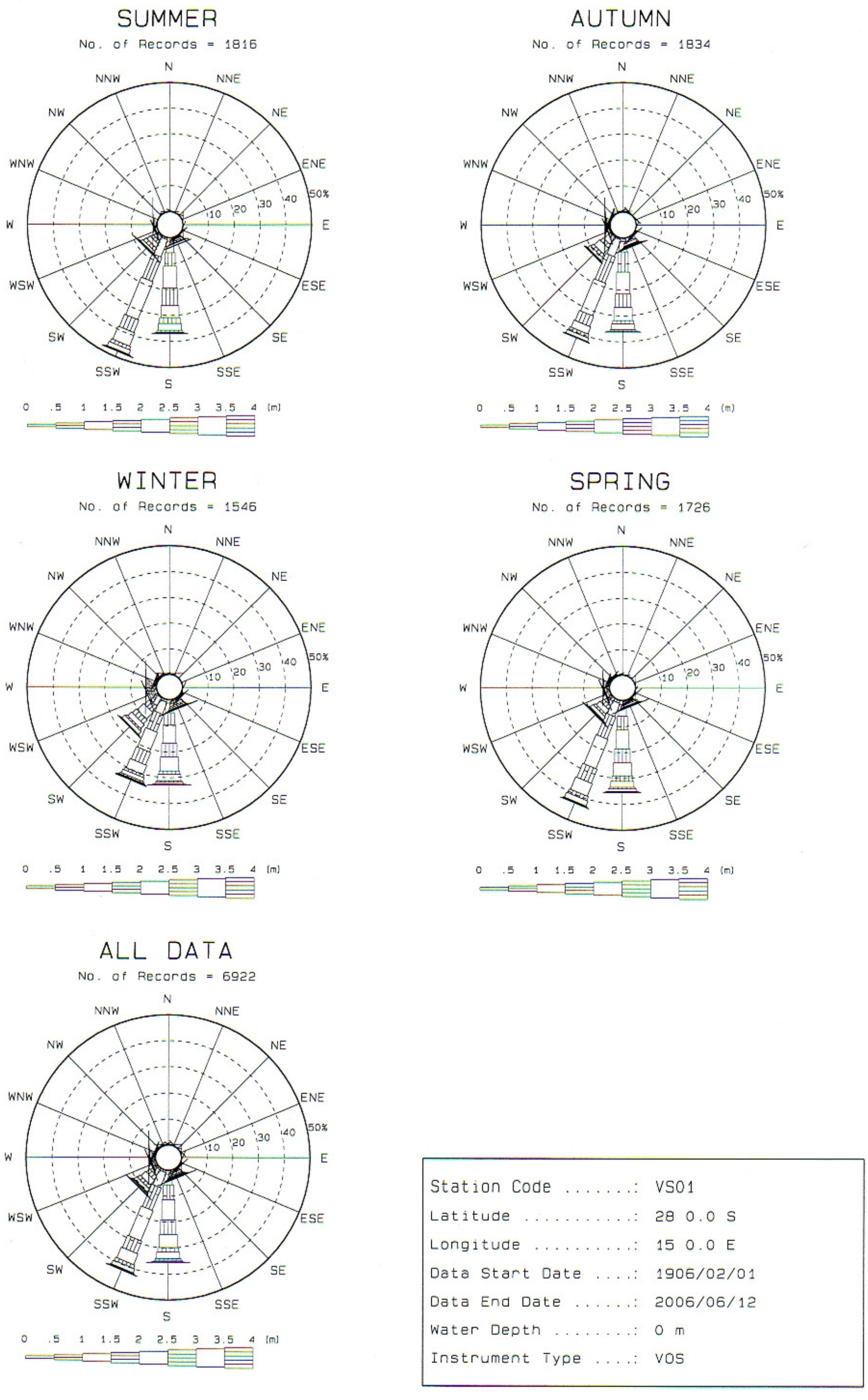

Figure 8: VOS Wave Height vs Wave Direction data for the offshore area (28°-29°S; 15°-16°E recorded during the period 1 February 1906 and 12 June 2006)) (Source: Voluntary Observing Ship (VOS) data from the Southern African Data Centre for Oceanography (SADCO)).

3.2.5 Upwelling & 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 (jackass 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.

3.2.6 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 in which all of the species are subject to natural mortality. A proportion of the annual production of all the trophic levels, particularly the plankton communities, die naturally and sink to the seabed.

Balanced multispecies ecosystem models have estimated that during the 1990s 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 off the southern African West Coast has a substantial effect on the ecosystems of the Benguela region. It provides most of the food requirements of the particulate and filter-feeding benthic communities that inhabit the sandy-muds 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 (Figure 9, left). 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 (Figure 9, right).

Figure 9: Red tides can reach very large proportions (Left, Photo: www.e-education.psu.edu) and can lead to mass stranding, or 'walk-out' of rock lobsters, such as occurred at Elands Bay in February 2002 (Right, Photo: www.waterencyclopedia.com)

3.2.7 Low Oxygen Events

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations with <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 5), 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) (see Figure 9, right). 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 where 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.

3.2.8 Turbidity

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulate matter. Total Suspended Particulate Matter (TSPM) can be divided into Particulate Organic Matter (POM) and Particulate Inorganic Matter (PIM), the ratios between them varying considerably. The POM usually consists of detritus, bacteria, phytoplankton and zooplankton, and serves as a source of food for filter-feeders. 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 sediment by the Orange River (Shannon & Anderson 1982; Zoutendyk 1992, 1995; Shannon & O'Toole 1998; Lane & Carter 1999). For example, a 'berg' wind event in May 1979 described by Shannon and Anderson (1982) was estimated to have transported in the order of 50 million tons of sand out to sea, affecting an area of 20,000 km^2 (Figure 10).

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 resuspending 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).

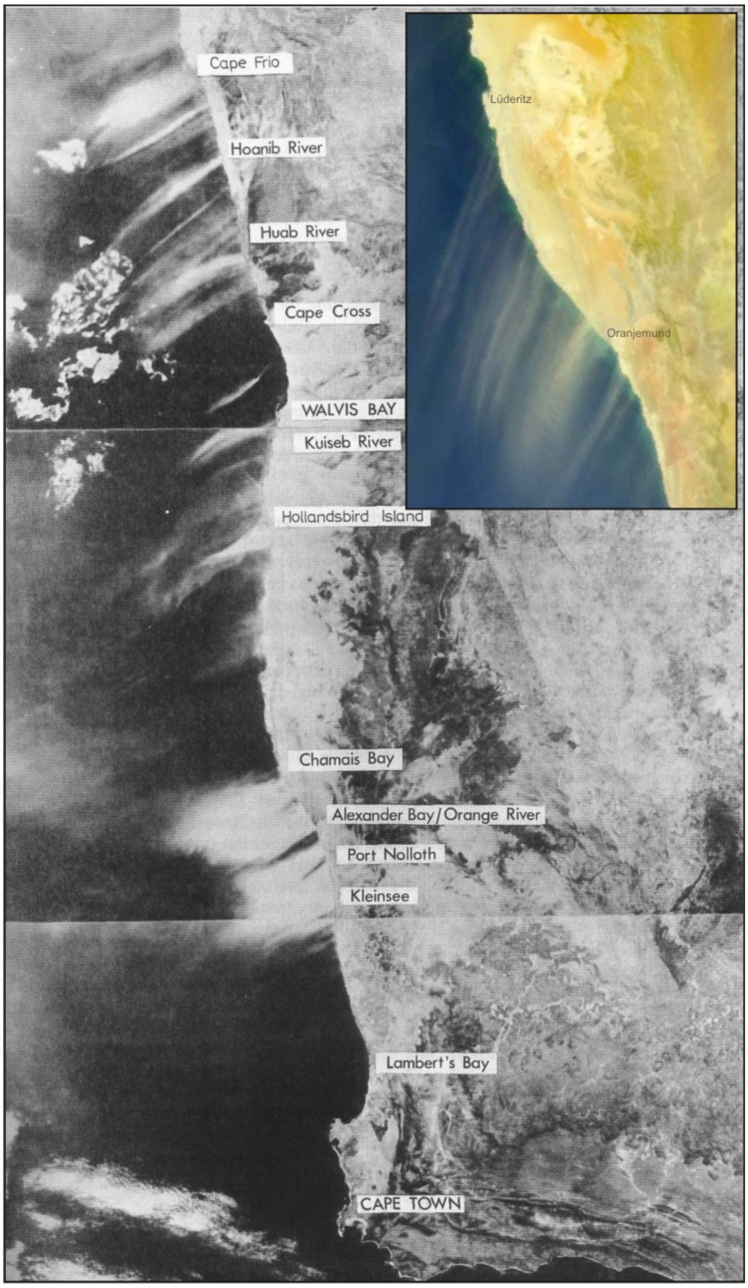

Figure 10: Aerosol plumes of sand and dust due to a 'berg' wind event: NIMBUS 7 CZCS orbit 2726, 9 May 1979 (690 nm) (Shannon & Anderson 1982).

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). 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 ~10 m depth, whilst 6 m waves achieve this at ~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, and discharges from terrestrial, coastal and marine mining operations (Airoldi 2003). Such increase of sediment loads has been recognised as a major threat to marine biodiversity at a global scale (UNEP 1995).

3.3. The Biological Environment

Biogeographically, Sea Concession 6C falls into the cold temperate Namaqua Bioregion, which extend from Sylvia Hill, north of Lüderitz in Namibia to Cape Columbine (Emanuel *et al*. 1992; Lombard *et al*. 2004) (Figure 11). 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 100 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.

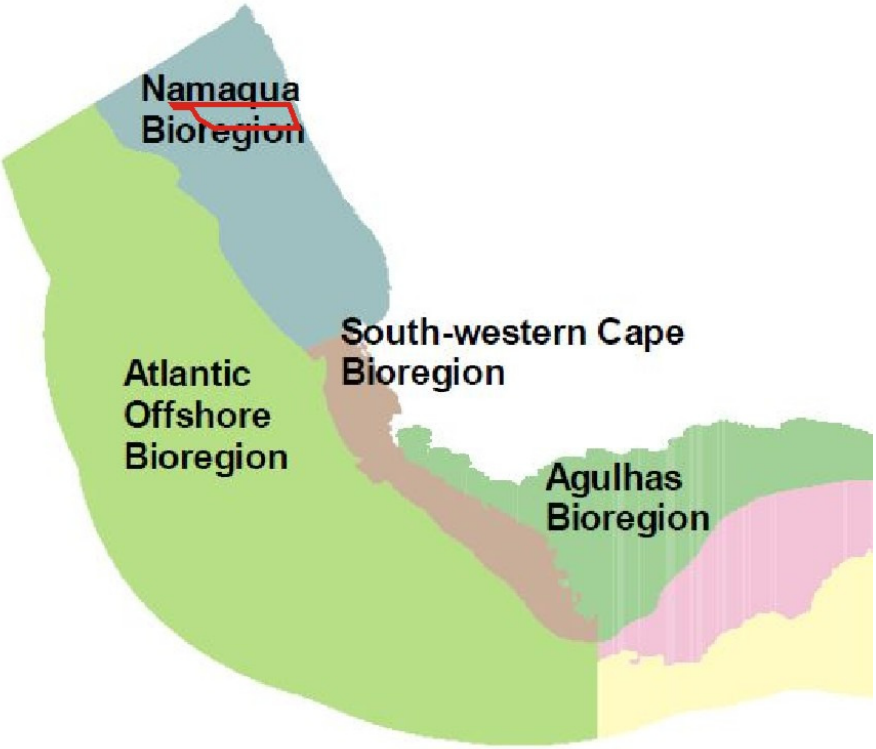

Figure 11: Sea Concession 6C (red polygon) in relation to the South African inshore and offshore bioregions (adapted from Lombard *et al*. 2004).

3.3.1 Demersal Communities

3.3.1.1 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). Numerous studies have been conducted on southern African West Coast continental shelf benthos, mostly focused on mining, pollution or demersal trawling impacts (Christie & Moldan 1977; Moldan 1978; Jackson & McGibbon 1991; Environmental Evaluation Unit 1996; Parkins & Field 1997; 1998; Pulfrich & Penney 1999; Goosen *et al*. 2000; Savage *et al*. 2001; Steffani & Pulfrich 2004a, 2004b; 2007; Steffani 2007a; 2007b; Steffani 2009, 2010; Atkinson *et al*. 2011; Steffani 2012). The description below is drawn from recent surveys by Karenyi (unpublished data), De Beers Marine Ltd surveys in 2008 and 2010 (unpublished data), and Atkinson *et al*. (2011).

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 in Sea Concession 6C 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

(Figure 12). 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' (Figure 13, left). However, none of these fall within Sea Concession 6C.

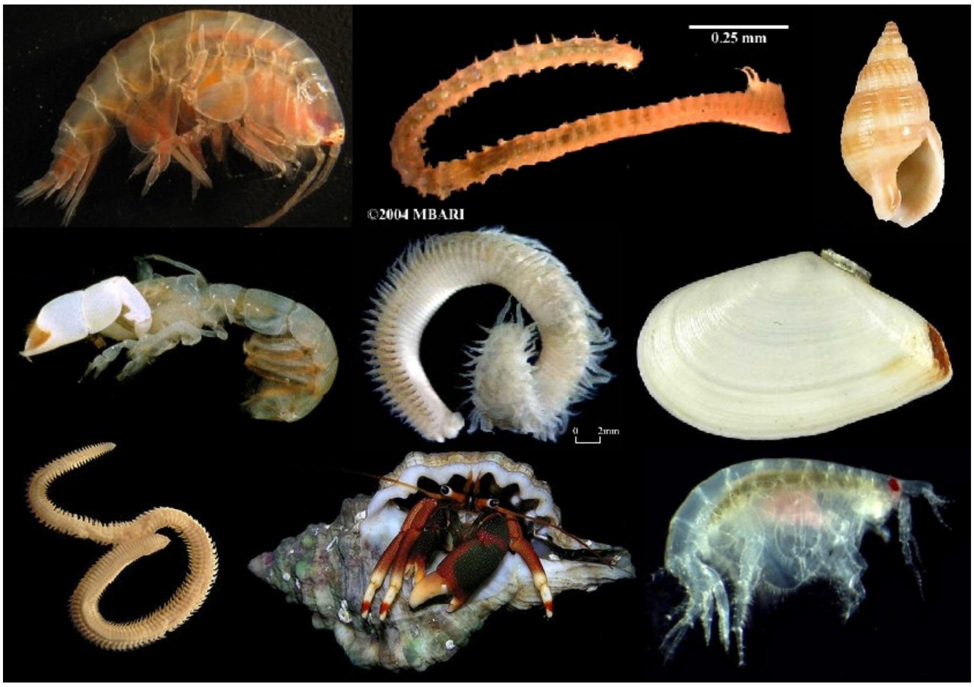

Figure 12: Benthic macrofaunal genera commonly found in nearshore sediments include: (top: left to right) *Ampelisca*, *Prionospio*, *Nassarius*; (middle: left to right) *Callianassa*, *Orbinia*, *Tellina*; (bottom: left to right) *Nephtys*, hermit crab, *Bathyporeia*.

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/m^2 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 Sea Concession 6C.

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 ~450 m depth) are very poorly known largely, due to limited opportunities for sampling as well as the lack of access to Remotely 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.

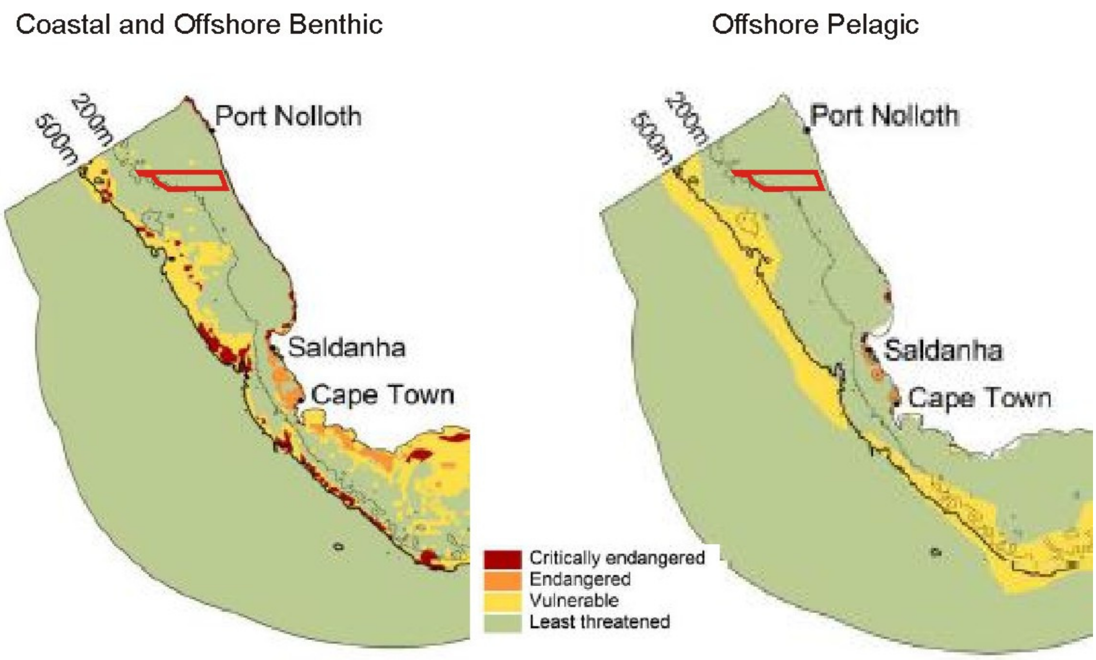

Figure 13: Concession 6C (red polygon) in relation to the South African inshore and offshore bioregions (adapted from Lombard *et al*. 2004).

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) and elsewhere in the world (e.g. Gray 1981; Ellingsen 2002; Bergen *et al*. 2001; Post *et al*. 2006). 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 over-ride 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.

3.3.1.2 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 at depths below 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) (Figure 14). 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.

Figure 14: Seamounts are characterised by a diversity of deep-water corals that add structural complexity to seabed habitats and offer refugia for a variety of invertebrates and fish (Photos: www.dfo-mpo.gc.ca/science/Publications/article/2007/21-05-2007-eng.htm, Ifremer & AWI 2003).

Two geological features of note in the vicinity of Sea Concession 6C are Child's Bank, situated ~150 km offshore at about 31°S and ~60 km due south of the concession area, and Tripp Seamount situated ~250 km offshore at about 29°40'S and ~150 km to the west-northwest of the concession area. Child's Bank was described by Dingel *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) (Figure 15, left) 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 (Figure 15, right) 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 (see below) 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 South Africa (De Beers Marine, unpublished data) (Figure 15) suggest that vulnerable 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.

Sediment samples collected at the base of Norwegian cold-water coral reefs revealed high interstitial concentrations of light hydrocarbons (methane, propane, ethane and higher hydrocarbons C4+) (Hovland & Thomsen 1997), which are typically considered indicative of localised light hydrocarbon micro-seepage through the seabed. Bacteria and other micro-organisms thrive on such hydrocarbon pore-water seepages, thereby providing suspension-feeders, including corals and gorgonians, with a substantial nutrient source. Some scientists believe there is a strong correlation between the occurrence of deep-water coral reefs and the relatively high values of light hydrocarbons (methane, ethane, propane and n-butane) in near-surface sediments (Hovland *et al*. 1998; Duncan & Roberts 2001; Hall-Spencer *et al*. 2002; Roberts & Gage 2003).

Figure 15: Gorgonians and bryozoans communities recorded on deep-water reefs (100-120 m) off the southern African West Coast (Photos: De Beers Marine).

3.3.1.3 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 concession area, and their approximate depth range, are listed in Table 1.

Table 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

Common Name	Scientific name	Depth Range
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
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

3.3.2 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.

3.3.2.1 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 (Figure 16).

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.

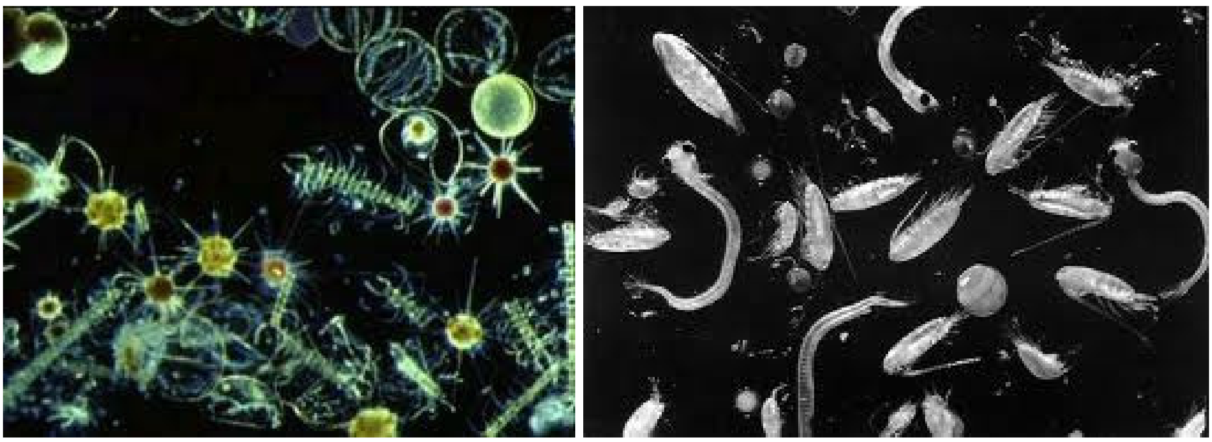

Figure 16: Phytoplankton (left, photo: hymagazine.com) and zooplankton (right, photo: mysciencebox.org) is associated with upwelling cells.

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 the Sea Concession area.

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. However, in the Orange River Cone area 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 Cone area, but not within it (Figure 17). Phytoplankton, zooplankton and ichthyoplankton abundances in the eastern portions of the Sea Concession area are thus expected to be comparatively high relative to the Orange River Cone area. In the offshore portions of the Sea Concession area plankton abundance is expected to be low, with the major fish spawning and migration routes occurring further inshore on the shelf.

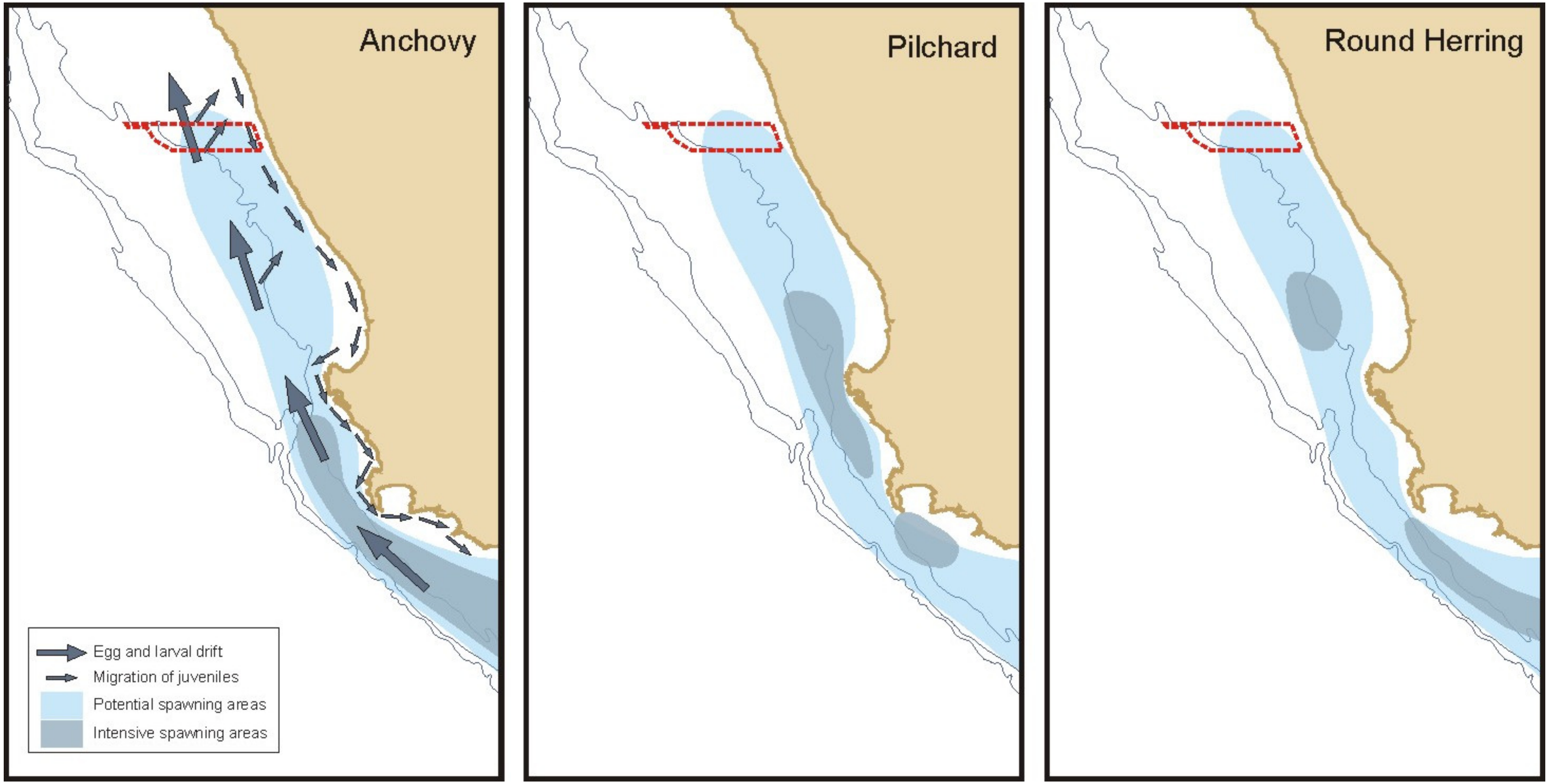

Figure 17: Concession 6C (red polygon) in relation to major spawning areas in the southern Benguela region (adapted from Cruikshank 1990).

3.3.2.2 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.

3.3.2.3 Pelagic Fish

Small pelagic species occurring beyond the surfzone and generally within the 200 m contour include the sardine/pilchard (*Sadinops ocellatus*) (Figure 18, left), anchovy (*Engraulis capensis*), chub mackerel (*Scomber japonicus*), horse mackerel (*Trachurus capensis*) (Figure 18, right) 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.

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.

Figure 18: Cape fur seal preying on a shoal of pilchards (left). School of horse mackerel (right) (photos: www.underwatervideo.co.za; www.delivery.superstock.com).

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* (Figure 19, right), yellowfin *T. albacares*, bigeye *T. obesus*, and skipjack *Katsuwonus pelamis tunas*, as well as the Atlantic blue marlin *Makaira nigricans* (Figure 19, left), the white marlin *Tetrapturus albidus* and the broadbill swordfish *Xiphias gladius* (Payne & Crawford 1989). The distributions 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).

Figure 19: Large migratory pelagic fish such as blue marlin (left) and longfin tuna (right) occur in offshore waters (photos: www.samathatours.com; www.osfimages.com).

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 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 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

3.3.2.4 Turtles

Three species of turtle occur along the West Coast, namely the Leatherback (*Dermochelys coriacea*) (Figure 20, left), and occasionally the Loggerhead (*Caretta caretta*) (Figure 20, right) and the Green (*Chelonia mydas*) turtle. Loggerhead and Green turtles are expected to occur only as occasional visitors along the West Coast.

Figure 20: Leatherback (left) and loggerhead turtles (right) occur along the West Coast of Southern Africa (Photos: Ketos Ecology 2009; www.aquaworld-crete.com).

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[1]). 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 21).

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.

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

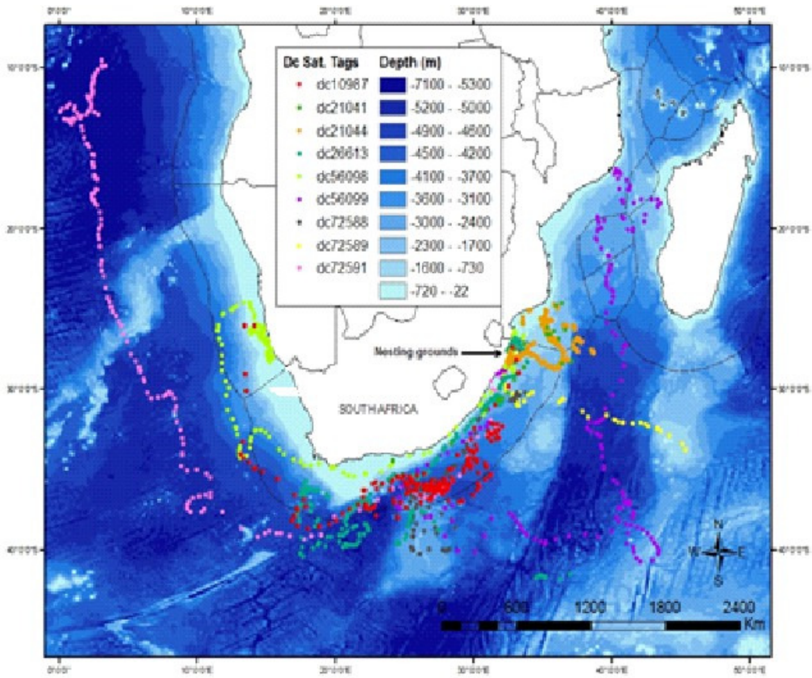

Figure 21: The post-nesting distribution of nine satellite tagged leatherback females (1996 – 2006; Oceans and Coast, unpublished data). The location of Concession 6C is indicated.

3.3.2.5 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 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.

14 species of seabirds breed in southern Africa; Cape Gannet (Figure 22, left), African Penguin (Figure 22, right), four species of Cormorant, White Pelican, three Gull and four Tern species (Table 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.

Figure 22: Cape Gannets *Morus capensis* (left) (Photo: NACOMA) and African Penguins *Spheniscus demersus* (right) (Photo: Klaus Jost) breed primarily on the offshore Islands.

Table 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: 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

3.3.2.6 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 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 within the Benguela Ecosystem. However, the warmer waters that occur offshore of the Benguela ecosystem (more than ~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 5: Cetaceans occurrence off the West Coast of South Africa, their seasonality, likely encounter frequency with proposed exploration operations and IUCN conservation status, based on the SA Red List Assessment (2014) (Child *et al*. 2016).

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 SONDJF	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 – 2,000 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 1,000s of km. As the project target areas are located on the continental shelf, cetacean diversity in the area can be expected to be high. In the offshore portions of 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 (typically those over 4 m in total length) 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.

Table 5 lists 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. 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.

<u>Mysticete (Baleen) whales</u>

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 (Figure 23, left) 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).

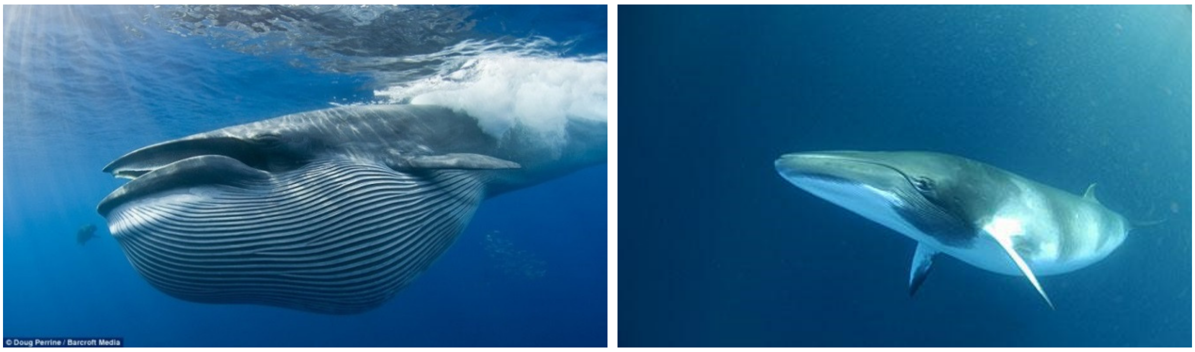

Figure 23: The Bryde's whale *Balaenoptera brydei* (left) and the Minke whale *Balaenoptera bonaerensis* (right) (Photos: www.dailymail.co.uk; www.marinebio.org).

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 1,000 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 (Figure 23, right) 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 ~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 (Figure 24). 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).

Figure 24: The Humpback whale *Megaptera novaeangliae* (left) and the Southern Right whale *Eubalaena australis* (right) are the most abundant large cetaceans occurring along the southern African West Coast (Photos: www.divephotoguide.com; www.aad.gov.au).

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.* 2015). The most recent abundance estimate for this population is available for 2017 which estimated the population at ~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 100m 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.

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 1,000 m depth, although they occasionally come onto the shelf in water 500 - 200 m deep (Best 2007) (Figure 25, left). 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 1,000-2,000 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.

Figure 25: Sperm whales *Physeter macrocephalus* (left) and killer whales *Orcinus orca* (right) are toothed whales likely to be encountered in offshore waters (Photos: www.onpoint.wbur.org; www.wikipedia.org).

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 (Figure 25 right) 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 (Figure 26, right) 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 ~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 (Figure 26, left) 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.

Figure 26: The endemic Heaviside's Dolphin *Cephalorhynchus heavisidii* (left) (Photo: De Beers Marine Namibia), and Dusky dolphin *Lagenorhynchus obscurus* (right) (Photo: scottelowitzphotography.com).

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*) (Figure 27) 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 28). 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).

Figure 27: Colony of Cape fur seals *Arctocephalus pusillus pusillus* (Photo: Dirk Heinrich).

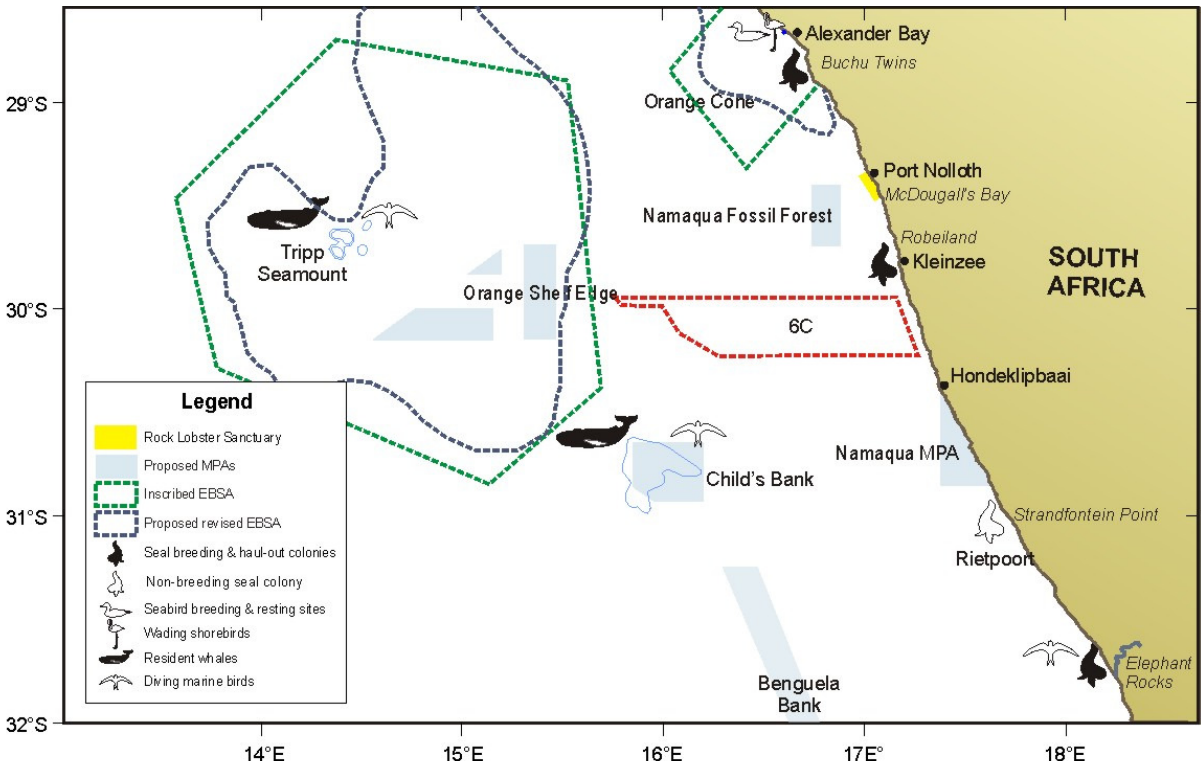

Figure 28: Project - environment interaction points on the West Coast, illustrating the location of Sea Concession 6C (red polygon) in relation to seabird and seal colonies and resident whale populations. Proposed MPAs identified by Operation Phakisa and enscribed EBSAs are also shown.

3.4. Other Uses in proximity to Sea Concession 6C

3.4.1 Beneficial Uses

The Sea Concesssion area is located offshore beyond the 100 m depth contour. Other users within and surrounding the Concession area include the commercial fishing industry (see Specialist Report on Fisheries), neighbouring marine diamond mining concession holders (see Figure 29) and hydrocarbon exploration and production licences (see Figure 31).

3.4.1.1 Diamond 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 licence areas lie adjacent to a number of marine diamond mining concession areas (Figure 29). 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 30). On the Namaqualand coast marine diamond mining

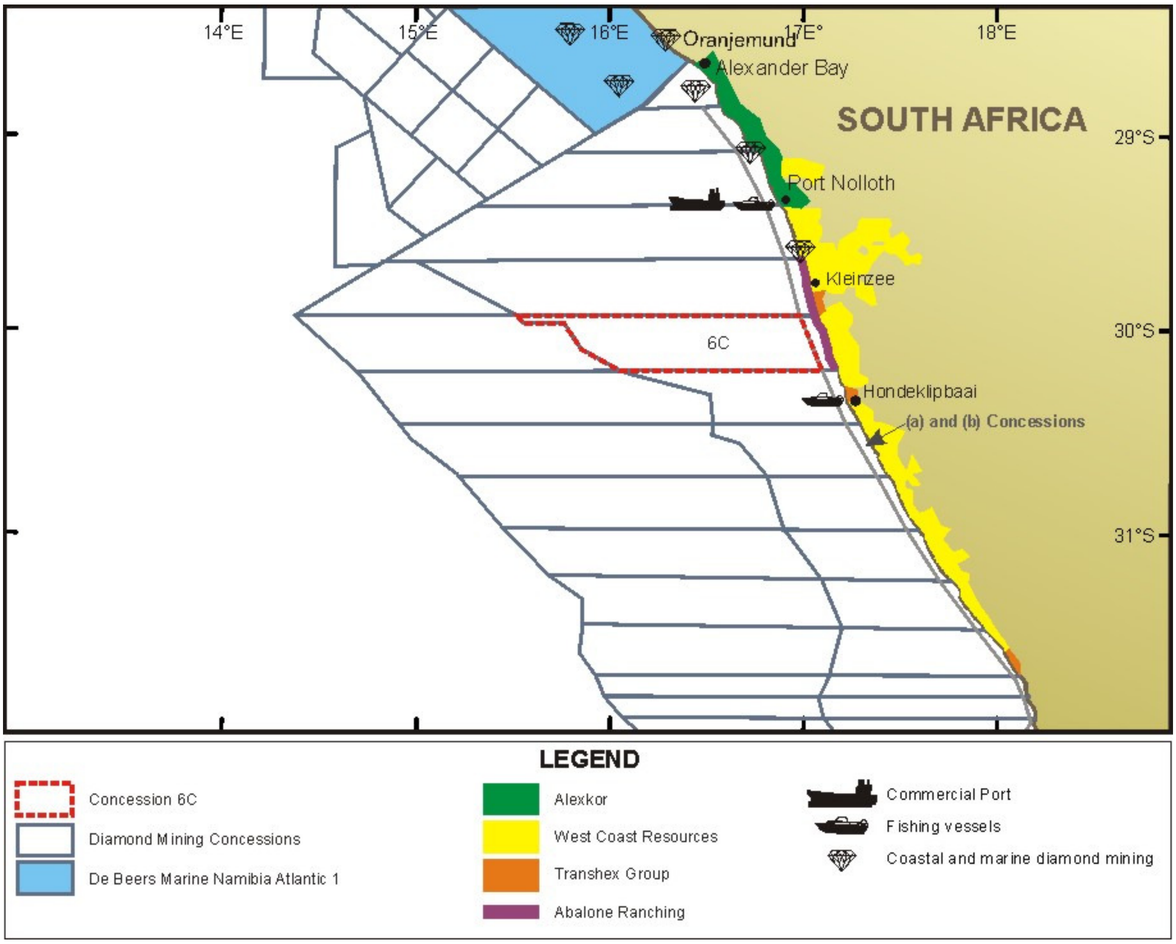

Figure 29: Project - environment interaction points on the West Coast, illustrating the location of marine diamond mining concessions and ports for commercial and fishing vessels, in relation to Sea Concession 6C.

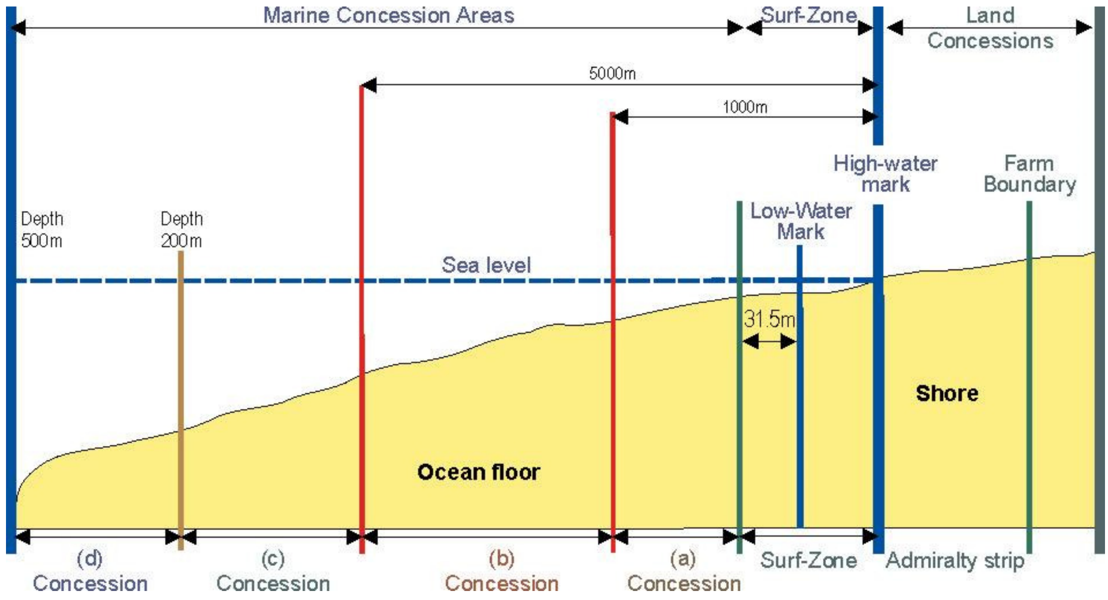

Figure 30: Diagram of the onshore and offshore boundaries of the South African (a) to (d) marine diamond mining concession areas.

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 in small bays or from converted fishing vessels out to ~30 m depth. 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.

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. In Namibian waters, deep-water diamond mining by De Beers Marine Namibia is currently operational in the Atlantic 1 Mining Licence Area.

De Beers Consolidated Mines (Pty) Ltd hold prospecting rights for diamonds, gold platinum group elements and other specific minerals in Concessions 7C – 10C and for gold and other specific minerals in Concessions 2C – 5C. There are also a number of proposed prospecting areas for glauconite and phosphorite / phosphate, all of which are located south of Sea Concession 6C.

3.4.1.2 Hydrocarbons

The South African continental shelf and economic exclusion zone (EEZ) have similarly been partitioned into Licence blocks for petroleum exploration and production activities. Exploration has included extensive 2D and 3D seismic surveys and the drilling of numerous exploration wells, with ~40 wells having been drilled in the Namaqua Bioregion since 1976 (Figure 31). The majority of these occur in the iBhubesi gas field in Block 2A. Prior to 1983, technology was not available to remove wellheads from the seafloor and currently 35 wellheads remain on the seabed.

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 02B and the Orange Basin. A subsea pipeline to export gas from the iBhubesi field to a location either on the Cape Columbine peninsula or to Ankerlig ~25 km north of Cape Town is also proposed.

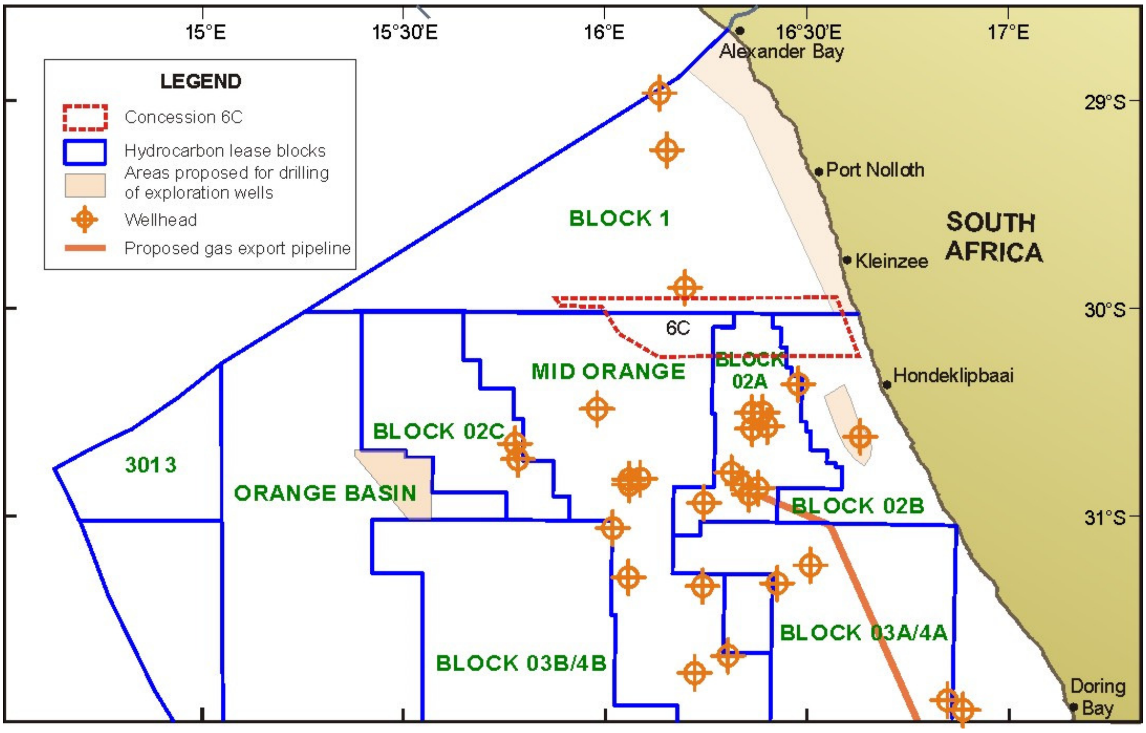

Figure 31: Project - environment interaction points on the West Coast, illustrating the location of hydrocarbon lease blocks, existing well heads, proposed areas for exploratory wells and the routing of the proposed iBhubesi gas export pipeline, in relation to Sea Concession 6C and the proposed mining target area.

3.4.1.3 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.

Abalone ranching (i.e. the release of abalone seeds into the wild for harvesting purposes after a growth period) has been identified as one of the key opportunities to develop in the short- to medium-term and consequently the creation of abalone ranching enterprises around Hondeklip Bay and Port Nolloth forms 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 Concession areas 5 and 6 (see Figure 31), effectively 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). As a result, the government publication 'Guidelines and potential areas for marine ranching and stock enhancement of abalone *Haliotis midae* in South Africa' (GG No. 33470, Schedule 2, April 2010) identified broad areas along the South African coastline that might be suitable for abalone ranching. Along the Northern Cape coast, four specific zones were marked, separated by 6-13 km wide buffer zones. Currently, applications for abalone ranching projects have been submitted and permits for pilot projects for some of the zones have been granted.

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.

3.4.2 Conservation Areas and Marine Protected Areas

Numerous conservation areas and a marine protected area (MPA) exist along the coastline of the Western Cape, although none fall 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 (see Figure 28). 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 out for review. Those proposed MPAs within the broad project area are shown in Figure 28. None fall within Concession 6C.

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 (SST mean = 18.3°C) 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 discussions at national and transboundary level, following which it will be submitted to the CBD for official recognition at the Review Workshop scheduled for early 2018. 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 area proposed Sea Concession area.

3.4.3 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) (

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

Table 6). Using the SANBI benthic and coastal habitat type GIS database (Figure 32), the threat status of the benthic habitats within Concession 6C, and those potentially affected by proposed prospecting operations, were identified (

Table 6).

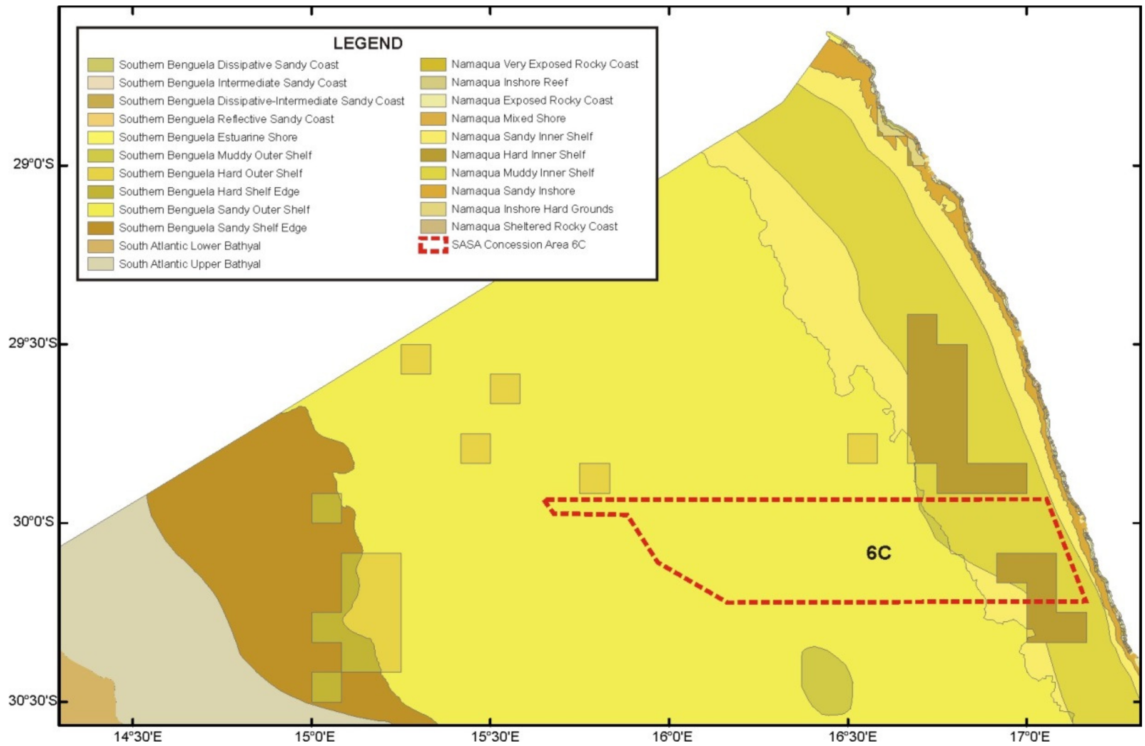

Figure 32: Benthic and coastal habitat types in Concession 6C (red polygon). The habitats affected by the proposed prospecting are identified in Table 6.

Table 6: Ecosystem threat status for marine 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

4. LEGISLATIVE REQUIREMENTS

Details of the legislative requirements are provided in Chapter 2 of the Basic Assessment Report. What follows below is a brief summary of the key legislative requirements that the proposed mining activities must comply with.

4.1. National Legislation

The key legislations include:

- Minerals and Petroleum Resources Development Act (No. 28 of 2002); and
- National Environmental Management Act (No. 107 of 1998) (NEMA).

4.2. International Marine Pollution Conventions

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

4.3. Other South African Legislation

- Carriage of Goods by Sea Act, 1986 (No. 1 of 1986);
- Dumping at Sea Control Act, 1980(No. 73 of 1980);
- Hazardous Substances Act, 1983 and Regulations (No. 85 of 1983);
- Marine Living Resources Act, 1998 (No. 18 of 1998);
- Marine Traffic Act, 1981 (No. 2 of 1981);
- Marine Pollution (Control and Civil Liability) Act, 1981 (No. 6 of 1981);
- Marine Pollution (Prevention of Pollution from Ships) Act, 1986 (No. 2 of 1986);
- Marine Pollution (Intervention) Act, 1987 (No. 65 of 1987);
- Maritime Safety Authority Act, 1998 (No. 5 of 1998);
- Maritime Safety Authority Levies Act, 1998 (No. 6 of 1998);
- Maritime Zones Act 1994 (No. 15 of 1994);

- Merchant Shipping Act, 1951 (No. 57 of 1951);
- National Environmental Management: Integrated Coastal Management Act, 2008 (No. 24 of 2008);
- National Heritage Resources Act, 1999 (No. 25 of 1999);
- Occupational Health and Safety Act, 1993 (No. 85 of 1993);
- Sea-Shore Act, 1935 (No. 21 of 1935);
- Sea Birds and Seals Protection Act, 1973 (No. 46 of 1973);
- Ship Registration Act, 1998 (No. 58 of 1998); and
- Wreck and Salvage Act, 1995 (No. 94 of 1995).

5. ASSESSMENT OF IMPACTS OF OFFSHORE MINING ON MARINE FAUNA

This chapter describes and assesses the significance of potential impacts related to the proposed exploration activities in Concession 6C. All impacts are assessed according to the rating scale defined in Section 5.1. Where appropriate, mitigation measures are proposed, which could ameliorate the negative impacts or enhance potential benefits, respectively. The status of all impacts should be considered negative unless otherwise stated. The significance of impacts with and without mitigation is assessed.

5.1. Assessment Procedure

The following convention was used to determine significance ratings in the assessment:

Rating	Definition of Rating
Intensity *– establishes whether the magnitude of the impact is destructive or benign in relation to the sensitivity of the receiving environment*	
Zero to Very Low	Negligible change, disturbance or nuisance. The impact affects the environment in such a way that natural functions and processes are not affected.
Low	Minor (Slight) change, disturbance or nuisance. The impact on the environment is not detectable.
Medium	Moderate change, disturbance or discomfort. Where the affected environment is altered, but natural functions and processes continue, albeit in a modified way.
High	Prominent change, disturbance or degradation. Where natural functions or processes are altered to the extent that they will temporarily or permanently cease.
Duration *– the time frame over which the impact will be experienced*	
Short-term	<5 years
Medium-term	5 – 15 years
Long-term	>15 years, but where the impact will eventually cease either because of natural processes or by human intervention
Permanent	Where mitigation either by natural processes or by human intervention would not occur in such a way or in such time span that the impact can be considered transient
Extent *– defines the physical extent or spatial scale of the impact*	
Local	Extending only as far as the activity, limited to the site and its immediate surroundings
Regional	Impacts are confined to the region; e.g. coast, basin, etc.
National	Limited to the coastline of South Africa
International	Extending beyond the borders of South Africa
Reversibility - *defines the potential for recovery to pre-impact conditions*	
Irreversible	Where the impact is permanent
Partially Reversible	Where the impact can be partially reversed
Fully Reversible	Where the impact can be completely reversed

Probability *– the likelihood of the impact occurring*	
Improbable	Where the possibility of the impact to materialise is very low either because of design or historic experience, i.e. ≤ 30% chance of occurring.
Possible	Where there is a distinct possibility that the impact would occur, i.e. > 30 to ≤ 60% chance of occurring.
Probable	Where it is most likely that the impact would occur, i.e. > 60 to ≤ 80% chance of occurring.
Definite	Where the impact would occur regardless of any prevention measures, i.e. > 80% chance of occurring.
Degree of confidence in predictions *– in terms of basing the assessment on available information and specialist knowledge*	
Low	Less than 35 % sure of impact prediction.
Medium	Between 35 % and 70 % sure of impact prediction.
High	Greater than 70 % sure of impact prediction
Degree to which impact can be mitigated - the degree to which an impact can be reduced / enhanced	
None	No change in impact after mitigation.
Very Low	Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact.
Low	Where the significance rating drops by one level, after mitigation.
Medium	Where the significance rating drops by two to three levels, after mitigation.
High	Where the significance rating drops by more than three levels, after mitigation.
Loss of resources - the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable	
Low	Where the activity results in a loss of a particular resource but where the natural, cultural and social functions and processes are not affected.
Medium	Where the loss of a resource occurs, but natural, cultural and social functions and processes continue, albeit in a modified way.
High	Where the activity results in an irreplaceable loss of a resource.

Using the core criteria above (namely *extent, duration and intensity)*, the consequence of the impact is determined:

Consequence *– attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity*	
VERY HIGH	Impacts could be EITHER: of high intensity at a regional level and endure in the long term; OR of high intensity at a national level in the medium term; OR of medium intensity at a national level in the long term.

***Consequence** – attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity*	
HIGH	Impacts could be EITHER: of high intensity at a regional level enduring in the medium term; OR of high intensity at a national level in the short term; OR of medium intensity at a national level in the medium term; OR of low intensity at a national level in the long term; OR of high intensity at a local level in the long term; OR of medium intensity at a regional level in the long term.
MEDIUM	Impacts could be EITHER: of high intensity at a local level and endure in the medium term; OR of medium intensity at a regional level in the medium term; OR of high intensity at a regional level in the short term; OR of medium intensity at a national level in the short term; OR of medium intensity at a local level in the long term; OR of low intensity at a national level in the medium term; OR of low intensity at a regional level in the long term.
LOW	Impacts could be EITHER of low intensity at a regional level, enduring in the medium term; OR of low intensity at a national level in the short term; OR of high intensity at a local level and endure in the short term; OR of medium intensity at a regional level in the short term; OR of low intensity at a local level in the long term; OR of medium intensity at a local level, enduring in the medium term.
VERY LOW	Impacts could be EITHER of low intensity at a local level and endure in the medium term; OR of low intensity at a regional level and endure in the short term; OR of low to medium intensity at a local level, enduring in the short term; OR Zero to very low intensity with any combination of extent and duration.
UNKNOWN	Where it is not possible to determine the significance of an impact.

The consequence rating is considered together with the probability of occurrence in order to determine the overall significance using the table below.

		PROBABILITY			
		IMPROBABLE	POSSIBLE	PROBABLE	DEFINITE
CONSEQUENCE	VERY LOW	INSIGNIFICANT	INSIGNIFICANT	VERY LOW	VERY LOW
	LOW	VERY LOW	VERY LOW	LOW	LOW
	MEDIUM	LOW	LOW	MEDIUM	MEDIUM
	HIGH	MEDIUM	MEDIUM	HIGH	HIGH
	VERY HIGH	HIGH	HIGH	VERY HIGH	VERY HIGH

Nature of the Impact *– describes whether the impact would have a negative, positive or zero effect on the affected environment*	
Positive	The impact benefits the environment
Negative	The impact results in a cost to the environment
Neutral	The impact has no effect

Type of impacts assessed:

Type of impacts assessed	
Direct (Primary)	Impacts that result from a direct interaction between a proposed project activity and the receiving environment.
Secondary	Impacts that follow on from the primary interactions between the project and its environment as a result of subsequent interactions within the environment (e.g. loss of part of a habitat affects the viability of a species population over a wider area).
Indirect	Impacts that are not a direct result of a proposed project, often produced away from or as a result of a complex impact pathway.
Cumulative	*Additive*: impacts that may result from the combined or incremental effects of future activities (i.e. those developments currently in planning and not included as part of the baseline).
	In-combination: impacts where individual project-related impacts are likely to affect the same environmental features. For example, a sensitive receptor being affected by both noise and drill cutting during drilling operations could potentially experience a combined effect greater than the individual impacts in isolation.

The relationship between the significance ratings after mitigation and decision-making can be broadly defined as follows:

Significance of residual impacts after Mitigation - *considering changes in intensity, extent and duration after mitigation and assuming effective implementation of mitigation measures*	
Very Low; Low	Activity could be authorised with little risk of environmental degradation.
Medium	Activity could be authorised with conditions and inspections.
High	Activity could be authorised but with strict conditions and high levels of compliance and enforcement.
Very High	Potential fatal flaw

5.2. Identification of Impacts

The potential environmental impacts to the marine environment of the proposed geophysical prospecting operations are:

- Disturbance of marine mammals by the sounds emitted by the geophysical survey equipment;
- Potential injury to marine mammals and turtles through vessel strikes;
- Marine pollution due to discharges such as deck drainage, machinery space wastewater, sewage, etc. and disposal of solid wastes from the survey vessel; and
- Marine pollution due to fuel spills during refuelling, or resulting from collision or shipwreck.

The potential environmental impacts to the marine environment of the sampling operations are:

- Disturbance and loss of benthic fauna in the drill sample footprints and crawler excavated trenches;
- Crushing of epifauna and infauna by the crawler tracks;
- Generation of suspended sediment plumes through discard of fine tailings;
- Smothering of benthic communities through re-settlement of discarded tailings;
- Potential loss of equipment on the seabed;
- Disturbance of marine biota by noise from the sampling vessel and sampling tools; and
- Marine pollution due to discharges such as deck drainage, machinery space wastewater, sewage, etc. and disposal of solid wastes from the sampling vessel.

5.3. Assessment of Impacts

5.3.1 Acoustic Impacts of Geophysical Prospecting and Sampling

Description of Impact

The ocean is a naturally noisy place and marine animals are continually subjected to both physically produced sounds from sources such as wind, rainfall, breaking waves and natural seismic noise, or biologically produced sounds generated during reproductive displays, territorial defence, feeding, or in echolocation (see references in McCauley 1994). Such acoustic cues are thought to be important to many marine animals in the perception of their environment as well as for navigation purposes, predator avoidance, and in mediating social and reproductive behaviour. Anthropogenic sound sources in the ocean may thus interfere directly or indirectly with such activities. Of all human-generated sound sources, the most persistent in the ocean is the noise of shipping. Depending on size and speed, the sound levels radiating from vessels range from 160 to 220 dB re 1 μPa at 1 m (NRC 2003). Especially at low frequencies between 5 to 100 Hz, vessel traffic is a major contributor to noise in the world's oceans, and under the right conditions, these sounds can propagate 100s of kilometres thereby affecting very large geographic areas (Coley 1994, 1995; NRC 2003; Pidcock *et al.* 2003). Other forms of anthropogenic noise include 1) aircraft flyovers, 2) multi-beam sonar systems, 3) seismic acquisition, 4) hydrocarbon and mineral exploration and recovery, and 5) noise associated with underwater blasting, pile driving, and construction (Figure 33).

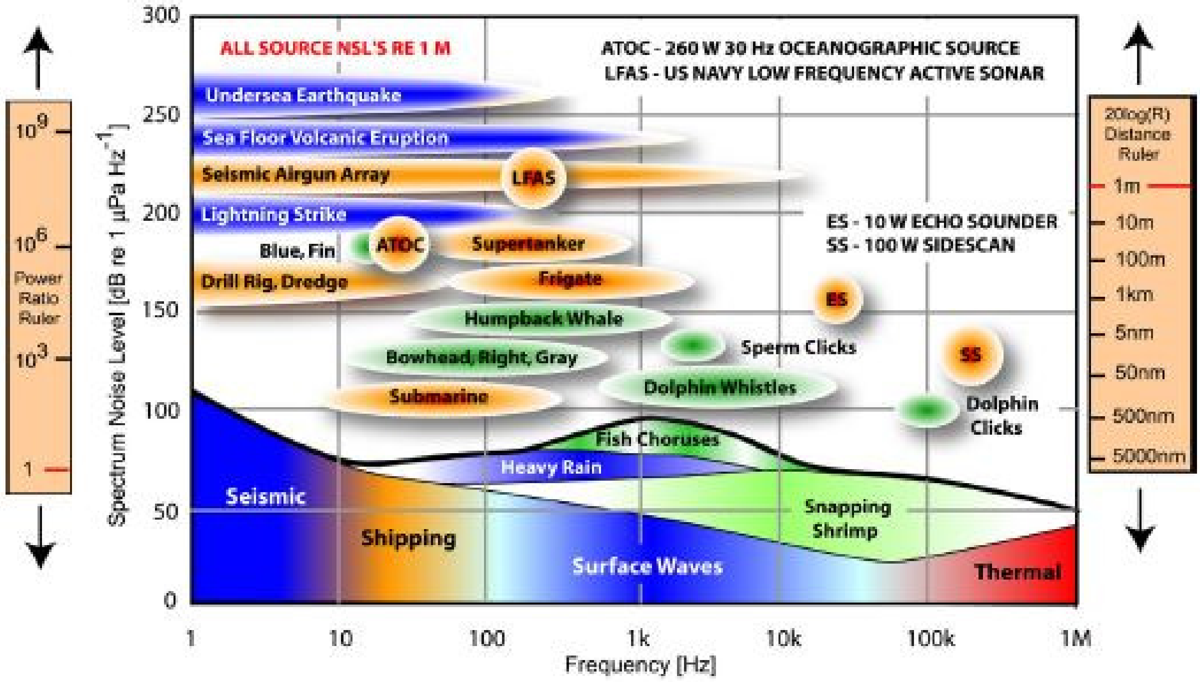

Figure 33: Comparison of noise sources in the ocean (Goold & Coates 2001).

The cumulative impact of increased background anthropogenic noise levels in the marine environment is an ongoing and widespread issue of concern (Koper & Plön 2012), as such sound sources interfere directly or indirectly with the animals' biological activities. Reactions of marine mammals to anthropogenic sounds have been reviewed by McCauley (1994), Richardson *et al*. (1995), Gordon & Moscrop (1996) and Perry (1998), who concluded that anthropogenic sounds could affect marine animals in the surrounding area in the following ways:

- Physiological injury and/or disorientation;
- Behavioural disturbance and subsequent displacement from key habitats;
- Masking of important environmental sounds and communication;
- Indirect effects due to effects on prey.

It is the received level of the sound, however, that has the potential to traumatise or cause physiological injury to marine animals. As sound attenuates with distance, the received level depends on the animal's proximity to the sound source and the attenuation characteristics of the sound. The noise generated by the acoustic equipment utilized during geophysical surveys falls within the hearing range of most fish and marine mammals (Table 7), and at sound levels of between 190 to 230 dB re 1 µPa at 1 m, will be audible for considerable distances (in the order of tens of km) before attenuating to below threshold levels (Findlay 2005). However, unlike the noise generated by airguns during seismic surveys, the emission of underwater noise from geophysical surveying and vessel activity is not considered to be of sufficient amplitude to cause auditory or non-auditory trauma in marine animals in the region. Only directly below the systems (within metres of the sources) would sound levels be in the 230 dB range where exposure result in trauma. As most pelagic species likely to be encountered within the concessions are highly mobile, they would be expected to flee and move away from the sound source before trauma could occur. Whereas the underwater noise from the survey systems may induce localised behavioural changes in some marine mammal, there is no evidence of significant behavioural changes that may impact on the wider ecosystem (Perry 2005).

Similarly, the sound level generated by drilling and seabed crawler operations fall within the 120-190 dB re 1 µPa range at the sampling unit, with main frequencies between 3 – 10 Hz. The noise generated by sampling operations thus falls within the hearing range of most fish and marine mammals, and depending on sea state would be audible for up to 20 km around the vessel before attenuating to below threshold levels (Table 7). In a study evaluating the potential effects of vessel-based diamond mining on the marine mammals community off the southern African West Coast, Findlay (1996) concluded that the significance of the impact is likely to be minimal based on the assumption that the radius of elevated noise level would be restricted to ~20 km around the mining vessel. Whereas the underwater noise from sampling operations may induce localised behavioural changes in some marine mammal, it is unlikely that such behavioural changes would impact on the wider ecosystem (see for example Perry 2005). The responses of cetaceans to noise sources are often also dependent on the perceived motion of the sound source as well as the nature of the sound itself. For example, many whales are more likely to tolerate a stationary source than one that is approaching them (Watkins 1986; Leung-Ng & Leung 2003), or are more likely to respond to a stimulus with a sudden onset than to one that is continuously present (Malme *et al.* 1985).

Table 7: Known hearing frequency and sound production ranges of various marine taxa (adapted from Koper & Plön 2012).

Taxa	Order	Hearing frequency (kHz)	Sound production (kHz)
Shellfish	Crustaceans	0.1 - 3	
Snapping shrimp	*Alpheus/ Synalpheus* spp.		0.1 - >200
Ghost crabs	*Ocypode* spp.		0.15 - 0.8
Fish	Teleosts		0.4 - 4
Hearing specialists		0.03 - >3	
Hearing generalists		0.03 - 1	
Sharks and skates	Elasmobranchs	0.1 - 1.5	Unknown
African penguins	Sphenisciformes	0.6 - 15	Unknown
Sea turtles	Chelonia	0.1 - 1	Unknown
Seals	Pinnipeds	0.25 - 10	1 - 4
Northern elephant seal	*Mirounga agurostris*	0.075 - 10	
Manatees and dugongs	Sirenians	0.4 - 46	4 - 25
Toothed whales	Odontocetes	0.1 - 180	0.05 - 200
Baleen whales	Mysticetes	0.005 - 30	0.01 - 28

Assessment

The effects of high frequency sonars on marine fauna is considered to be localised, short-term (for duration of survey i.e. weeks) and of medium intensity. The significant 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. The impact of underwater noise is considered of **VERY LOW** significance without mitigation.

Mitigation

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

Despite the low significance of impacts for geophysical surveys, the Joint Nature Conservation Committee (JNCC) provides a list of guidelines to be followed by anyone planning marine sonar operations that could cause acoustic or physical disturbance to marine mammals (JNCC 2010). These have been revised to be more applicable to the southern African situation.

- Onboard Marine Mammal Observers (MMOs) 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 limited to 15 minutes prior to the start of survey equipment.
- “Soft starts” should be carried out for any equipment of 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.
- 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. As no seasonal patterns of abundance are known for odontocetes occupying the proposed exploration area, a precautionary approach to avoiding impacts throughout the year is recommended.
- Ensure that PAM (passive acoustic monitoring) is incorporated into any surveying taking place between June and November.
- A MMO should be appointed to ensure compliance with mitigation measures during seismic geophysical surveying.

Impacts of multi-beam and sub-bottom profiling sonar on marine fauna		
	Without Mitigation	**Assuming Mitigation**
Intensity	Medium	Low
Duration	Short-term: for duration of survey	Short-term
Extent	Local: limited to survey area	Local
Consequence	Very Low	Very Low
Probability	Probable	Probable
Significance	Very Low	Very Low
Status	Negative	Negative
Confidence	Medium	Medium

Nature of Cumulative impact	Considering the number of seismic surveys recently conducted in the area, some cumulative impacts can be anticipated. However, any direct impact is likely to be at individual level rather than at species level.
Reversibility	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.
Loss of resources	Negligible
Mitigation potential	Low

Impacts of noise from sampling operations on marine fauna		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	No mitigation is proposed
Duration	Short-term: for duration of sampling operations	
Extent	Local: limited to target area	
Consequence	Very Low	
Probability	Definite	
Significance	Very Low	
Status	Negative	
Confidence	High	

Nature of Cumulative impact	None
Reversibility	Fully Reversible - any disturbance of behaviour, auditory “masking” or reductions in hearing sensitivity that may occur would be temporary.
Loss of resources	N/A
Mitigation potential	None

5.3.2 Disturbance and loss of benthic fauna during sampling

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 drill bit and crawler suction head. As the number of samples required can only be determined once the geophysical data have been analysed, and the sampling drill technology has not yet been finalised, the volume of sediment likely to be removed and disturbed, or the area of seabed impacted during the sampling campaign(s) cannot be provided at this stage. Similarly, the area of seabed disturbed during bulk sampling by crawler can only be determined following analysis of drill samples and development of the inferred resource model.

As benthic fauna typically inhabit the top 20 - 30 cm of sediment, the sample operations would result in the elimination of the benthic infaunal and epifaunal biota in the sample footprints. As many of the macrofaunal species serve as a food source for demersal and epibenthic fish, cascade effects on higher order consumers may result. However, considering the available area of similar habitat on the continental shelf of the West Coast, this reduction in benthic biodiversity can be considered negligible and impacts on higher order consumers are thus unlikely.

The ecological recovery of the disturbed seafloor is generally defined as the establishment of a successional community of species that achieves a community similar in species composition, population density and biomass to that previously present (Ellis 1996). The rate of recovery (recolonisation) depends largely on the magnitude of the disturbance, the type of community that inhabits the sediments in the sampling area, the extent to which the community is naturally adapted to high levels of sediment disturbances, the sediment character (grain size) that remains following the disturbance, and physical factors such as depth and exposure (waves, currents) (Newell *et al.* 1998). Generally, recolonisation starts rapidly after a sampling/mining disturbance, and the number of individuals (*i.e.* species density) may recover within short periods (weeks). Opportunistic species may recover their previous densities within months. Long-lived species like molluscs and echinoderms, however, need longer to re-establish the natural age and size structure of the population. Biomass therefore often remains reduced for several years (Kenny & Rees 1994, 1996; Kenny *et al.* 1998).

The structure of the recovering communities is typically also highly spatially and temporally variable reflecting the high natural variability in benthic communities at depth. The community developing after an impact depends on (1) the nature of the impacted substrate, (2) differential re-settlement of larvae in different areas, (3) the rate of sediment movement back into the disturbed areas and (4) environmental factors such as near-bottom dissolved oxygen concentrations etc. For the current project, the proposed sampling would be undertaken in depths beyond the wave base (>40 m) and near-bottom sediment transport is thus expected to be less than in shallower waters affected by swell. Excavations are therefore expected to have slow infill rates and may persist for extended periods (years). Long-term or permanent changes in grain size characteristics of sediments may thus occur, potentially resulting in a shift in community structure if the original community is unable to adapt to the new conditions. Depending on the texture of the sediments at the sampling target sites, slumping of adjacent unconsolidated sediments into the excavations can, however, be expected over the very short-term. Although this may result in localised disturbance of macrofauna associated with these sediments and alteration of sediment structure, it also serves as a means of natural recovery of the excavations.

Natural rehabilitation of the seabed following sampling operations, through a process involving influx of sediments and recruitment of invertebrates, has been demonstrated on the southern African continental shelf (Penney & Pulfrich 2004; Steffani 2007, 2009, 2010, 2012). Recovery rates of impacted communities were variable and dependent on the sampling /mining approach, sediment influx rates and the influence of natural disturbances on succession communities. Results of on-going research on the southern African West Coast suggest that differences in biomass, biodiversity or community composition following mining with drill ships or crawlers below the wave base may endure beyond the medium term (6-15 years) (Parkins & Field 1998; Pulfrich & Penney 1999; Steffani 2012). Savage *et al*. (2001), however, noted similarities in apparent levels of disturbance between mined and unmined areas off the southern African west coast, and areas of the Oslofjord in the NE Atlantic Ocean, which is known to be subject to periodic low oxygen events. Similarly, Pulfrich & Penney (1999) provided evidence of significant recruitments and natural disturbances in recovering succession communities off southern Namibia. These authors concluded that the lack of clear separation of impacted from reference samples suggests that physical disturbance resulting from sampling or mining may be no more stressful than the regular naturally occurring anoxic events typical of the West Coast continental shelf area.

Assessment

The medium-intensity negative impact of sediment removal during sampling operations and its effects on the associated communities is unavoidable, but as it will be extremely localised amounting to only 0.09 km^2 should all anticipated 9,000 samples be taken. The area disturbed constitutes ~ 0.003% of the overall area of Concession 6C, the impact can confidently be rated as being of **LOW** significance without mitigation.

Mitigation

No mitigation measures are possible, or considered necessary for the direct loss of macrobenthos due to drill and bulk sampling. However, sampling activities of any kind should avoid rocky outcrop areas or other identified sensitive habitats in the concession area.

Disturbance and loss of benthic fauna during sampling		
	Without Mitigation	**Assuming Mitigation**
Intensity	Medium	Medium
Duration	Short- to Medium-term	Short- to Medium-term
Extent	Local: limited to target area	Local
Consequence	Low	Low
Probability	Definite	Definite
Significance	Low	Low
Status	Negative	Negative
Confidence	High	High

Nature of Cumulative impact	No cumulative impacts are anticipated during the sampling phase
Reversibility	Fully Reversible
Loss of resources	N/A
Mitigation potential	None

5.3.3 Crushing of benthic fauna during sampling

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 (during sampling) and the seabed crawler tracks (during bulk sampling). Epifauna and infauna beneath the footprint of the drill frame or crawler tracks 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 (see for example Savage *et al*. 2001). 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.

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 and the seabed crawler tracks. However, it is recommended that:

- sampling activities of any kind avoid rocky outcrop areas or other identified sensitive habitats in the concession areas;
- dynamically positioned sampling vessels are implemented in preference to vessels requiring anchorage.

Crushing of benthic fauna during sampling		
	Without Mitigation	**Assuming Mitigation**
Intensity	Medium	Medium
Duration	Short-term	Short-term
Extent	Local: limited to target area	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 during the sampling phase	
Reversibility	Fully Reversible	
Loss of resources	N/A	
Mitigation potential	None	

5.3.4 Generation of suspended sediment plumes during sampling

Description of Impact

The sampled seabed sediments are pumped to the surface and discharged onto sorting screens on the sampling vessel. The screens separate the fine sandy silt and large gravel, cobbles and boulders from the size fraction of interest, the 'plantfeed' (usually 2 - 20 mm). The fine tailings are immediately discarded overboard where they form a suspended sediment plume in the water column which dissipates with time. The 'plantfeed' is mixed with a high density ferrosilicon (FeSi) slurry and pumped under pressure into a Dense Medium Separation (DMS) plant resulting in a high density concentrate. The majority of the ferrosilicon is magnetically recovered for re-use in the DMS plant and the fine tailings (-2 mm) from the DMS process are similarly deposited over board. Furthermore, fine sediment re-suspension by the sampling tools will generate suspended sediment plumes near the seabed.

Assessment

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. The main effect of 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. Poor visibility may also inhibit pelagic visual predators. Egg and/or larval development may be impaired through high sediment loading. Benthic species that may be impacted by near-bottom plumes include bivalves and crustaceans. Suspended sediment effects on juvenile and adult bivalves occur mainly at the sublethal level with the predominant response being reduced filter-feeding efficiencies at concentrations above about 100 mg/ℓ. Lethal effects are seen at much higher concentrations (>7,000 mg/ℓ) and at exposures of several weeks. Negative impacts may also occur when heavy metals or contaminants associated with fine sediments are remobilised.

In general though, the low-intensity negative impact of suspended sediments generated during sampling and onboard processing operations and its effects on the associated communities is extremely localised and short-term. The 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 impacts from suspended sediment plumes can confidently be rated as being **VERY LOW**.

Mitigation

No mitigation measures are possible, or considered necessary for the discharge of fine tailings from the sampling vessel.

<table>
<tr><td colspan="3">Suspended sediment plumes</td></tr>
<tr><td></td><td>Without Mitigation</td><td>Assuming Mitigation</td></tr>
<tr><td>Intensity</td><td>Low</td><td rowspan="8">No mitigation is proposed</td></tr>
<tr><td>Duration</td><td>Short-term</td></tr>
<tr><td>Extent</td><td>Local: limited to around the vessel</td></tr>
<tr><td>Consequence</td><td>Very Low</td></tr>
<tr><td>Probability</td><td>Definite</td></tr>
<tr><td>Significance</td><td>Very Low</td></tr>
<tr><td>Status</td><td>Negative</td></tr>
<tr><td>Confidence</td><td>High</td></tr>
<tr><td>Nature of Cumulative impact</td><td colspan="2">None</td></tr>
<tr><td>Reversibility</td><td colspan="2">Fully Reversible</td></tr>
<tr><td>Loss of resources</td><td colspan="2">N/A</td></tr>
<tr><td>Mitigation potential</td><td colspan="2">None</td></tr>
</table>

5.3.5 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 tailings are discarded overboard and settle back onto the seabed beneath the vessel.

Assessment

Following discharge overboard of the fine and coarse tailings, these settle back onto the seabed where they can result in smothering of benthic communities adjacent to the sampled areas. Smothering involves physical crushing, a reduction in nutrients and oxygen, clogging of feeding apparatus, as well as affecting choice of settlement site, and post-settlement survival. In general terms, the rapid deposition of the coarser fraction from the water column 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. However, this response depends to a large extent on the nature of the receiving community. Studies have shown that some mobile benthic animals are capable of actively migrating vertically through overlying sediment thereby significantly affecting the recolonization of impacted areas and the subsequent recovery of disturbed areas of seabed (Maurer *et al.* 1979, 1981a, 1981b, 1982, 1986; Ellis 2000; Schratzberger *et al.* 2000; but see Harvey *et al.* 1998; Blanchard & Feder 2003). In contrast, sedentary communities may be adversely affected by both rapid and gradual deposition of sediment. Filter-feeders are generally more sensitive to suspended solids than deposit-feeders, since heavy sedimentation may clog the gills. Impacts on highly mobile invertebrates and fish are likely to be negligible since they can move away from areas subject to redeposition.

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. Within the sampling target areas, such communities would be expected in the Namaqua Hard Inner Shelf habitats (see Figure 32). Rocky seabed outcrops are known to host fragile, habitat forming scleractinian corals. As deep-water corals tend to occur in areas with low sedimentation rates (Mortensen *et al.* 2001), 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. Exposure of elevated suspended sediment concentrations can result in mortality of the colony due to smothering, alteration of feeding behaviour and consequently growth rate, disruption of polyp expansion and retraction, physiological and morphological changes, and disruption of calcification. While tolerances to increased suspended sediment concentrations will be species specific, concentrations as low as 100 mg/ℓ have been shown to have noticeable effects on coral function (Roger 1999). As high proportions of hard ground have been identified between 180 m and 480 m depth to the north of Concession 6C, and video footage from southern Namibia and to the south-east of Childs Bank has identified vulnerable communities including gorgonians, bryozoans and octocorals, the potential occurrence of such sensitive deep-water ecosystems in Concession 6C cannot be excluded.

Considering the available area of unconsolidated seabed habitat on the continental shelf of the West Coast, the reduction in biodiversity of macrofauna associated with unconsolidated sediments through smothering 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. In the case of rocky outcrop communities, however, impacts would be of medium intensity and highly localised, but potentially enduring over the medium-term due to their slow recovery rates. The potential impact of smothering on rocky outcrop communities is consequently deemed to be of **LOW** significance.

Mitigation

No mitigation measures are possible, or considered necessary for the loss of macrobenthos due to smothering by redepositing sediments. However, sampling activities of any kind should avoid rocky outcrop areas or other identified sensitive habitats in the concession area. Use should be made of geophysical data 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.

Redeposition of discarded sediments on soft-sediment macrofauna		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	No mitigation is proposed
Duration	Short-term	
Extent	Local	
Consequence	Very Low	
Probability	Probable	
Significance	Very Low	
Status	Negative	
Confidence	High	
Nature of Cumulative impact	None	
Reversibility	Fully Reversible	
Loss of resources	N/A	
Mitigation potential	Very Low	

Redeposition of discarded sediments: smothering effects on rocky outcrop communities		
	Without Mitigation	**Assuming 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	
Reversibility	Fully Reversible	
Loss of resources	N/A	
Mitigation potential	Very Low	

5.3.6 Potential loss of Equipment

Description of Impact

Equipment such as anchors and sampling tools are occasionally lost on the seabed, although every effort is usually made to retrieve them.

Assessment

If left on the seabed, large items such as anchors and sampling tools would form a hazard to other users. Although they would eventually be colonised by benthic organisms typical of hard seabeds, every effort should be made to remove such foreign objects. The low-intensity negative impact of lost equipment would be extremely localised but if not retrieved would endure permanently and would thus be rated as being of **VERY LOW** significance.

Mitigation

The positions of all lost equipment must be accurately recorded in a hazards database, and reported to maritime authorities. Every effort should be made to remove lost equipment.

Equipment lost to the seabed		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	Low
Duration	Permanent	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Improbable	Improbable
Significance	Very Low	Very Low
Status	Negative	Negative
Confidence	High	High

Nature of Cumulative impact	None
Reversibility	Fully Reversible
Loss of resources	N/A
Mitigation potential	Very Low

5.3.7 Pollution of the marine environment through Operational Discharges from the Sampling Vessel(s)

During the geophysical surveying and seabed sampling, normal discharges to the sea can come from a variety of sources (from sampling unit and sampling vessel) potentially leading to reduced water quality in the receiving environment. These discharges are regulated by onboard waste management plans and shall be MARPOL compliant. For the sake of completeness they are listed and briefly discussed below:

- **Deck drainage**: all deck drainage from work spaces is collected and piped into a sump tank on board the drilling unit to ensure MARPOL compliance (15 ppm oil in water). The fluid would be analysed and any hydrocarbons skimmed off the top prior to discharge. The oily substances would be added to the waste (oil) lubricants and disposed of on land.

- **Sewage**: sewage discharges would be comminuted and disinfected. In accordance with MARPOL Annex IV, the effluent must not produce visible floating solids in, nor causes discolouration of, the surrounding water. The treatment system must provide primary settling, chlorination and dechlorination before the treated effluent can be discharged into the sea. The discharge depth is variable, depending upon the draught of the drilling unit / support vessel at the time, but would not be less than 5 m below the surface.
- **Vessel machinery spaces and ballast water**: the concentration of oil in discharge water from vessel machinery space or ballast tanks may not exceed 15 ppm oil in water. If the vessel intends to discharge bilge or ballast water at sea, this is achieved through use of an oily-water separation system. Oily waste substances must be shipped to land for treatment and disposal.
- **Food (galley) wastes**: food wastes may be discharged after they have been passed through a comminuter or grinder, and when the vessel is located more than 12 nautical miles from land. For vessels outside of special areas, discharge of comminuted food wastes is permitted when >3 nautical miles from land and *en route*. Discharge of food wastes not comminuted may be discharged from vessels *en route* when >12 nautical miles from shore. The ground wastes must be capable of passing through a screen with openings <25 mm. The daily volume of discharge from a standard drilling unit is expected to be <0.5 m^3.
- **Detergents**: detergents used for washing exposed marine deck spaces are discharged overboard. The toxicity of detergents varies greatly depending on their composition, but low-toxicity, biodegradable detergents are preferentially used. Those used on work deck spaces would be collected with the deck drainage and treated as described for deck drainage above.
- **Cooling Water:** electrical generation on sampling vessels is typically provided by large diesel-fired engines and generators, which are cooled by pumping water through a set of heat exchangers. The cooling water is then discharged overboard. Other equipment is cooled through a closed loop system, which may use chlorine as a disinfectant. Such water would be tested prior to discharge and would comply with relevant Water Quality Guidelines[3].

The potential impact on the marine environment of such operational discharges from the sampling vessel would be limited to the sampling target areas over the short-term. As volumes discharged would be low, they would be of low intensity, and are therefore considered to be of **VERY LOW** significance, both without or with mitigation.

Mitigation

The following mitigation measures are recommended:

- Ensure compliance with MARPOL 73/78 standards,

[3] No South African guideline exists for residual chlorine in coastal waters. The Australian/New Zealand (ANZECC 2000) guidelines give a value of 3 µg Cl/ℓ, wheras the World Bank (1998) guidelines stipulate 0.2 mg/ℓ at the point of discharge prior to dilution

- Develop a waste management plan using waste hierarchy.

Impacts of operational discharges to the sea from the sampling vessel		
	Without Mitigation	**Assuming Mitigation**
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Local: limited to immediate area around exploration vessel	Local
Consequence	Very Low	Very Low
Probability	Probable	Probable
Significance	Very Low	Very Low
Status	Negative	Negative
Confidence	High	High

Nature of Cumulative impact	None
Reversibility	Fully Reversible
Loss of resources	N/A
Mitigation potential	High

5.3.8 Cumulative impacts

The primary impacts associated with the geophysical exploration and sediment sampling in the Namaqua Bioregion on the West Coast of South Africa, relate to cumulative anthropogenic noise, physical disturbance of the seabed, discharges of tailings to the benthic environment, and associated vessel presence. Considering the number of seismic surveys recently conducted in the general project area, some cumulative impacts can be anticipated. However, any direct noise impact is likely to be at individual level rather than at species level. The sampling operations likely to result as part of the proposed exploration activities would impact an area of <0.1 km^2 in the Namaqua Bioregion, which can be considered an insignificant percentage of the bioregion as a whole.

The area of seabed disturbed during bulk sampling by crawler can only be determined following analysis of drill samples and development of the inferred resource model. Once bulk sampling and mining commence, it is recommended that detailed records of annual and cumulative areas sampled and mined be maintained, and that these be submitted to the authorities should future informed decisions need to be made regarding disturbance limits to benthic habitat types in the Namaqua Bioregion.

Cumulative impacts to the benthic environment also include the development of hydrocarbon wells. Since 1976~40 wells have been drilled in the Namaqua Bioregion. The majority of these occur in the iBhubesi Gas field in Block 2A to the south of Concession 5C. Prior to 1983, technology was not available to remove wellheads from the seafloor. Of the approximately 40 wells drilled on the West Coast, 35 wellheads remain on the seabed. The total area impacted by 40 petroleum exploration wells is estimated at around 10 km^2, or ~0.038% of the Namaqua bioregion. Cumulative impacts from other hydrocarbon ventures in the area are likely to increase in future, particularly with the planned development of the iBhubesi Gas Field. Further exploratory drilling has also being proposed in Block 2B.

Other activities that may have contributed to cumulative impacts to the benthic environment in the licence area include limited historical deep water trawling in the offshore portions of Concession 6C.

6. RECOMMENDATIONS AND CONCLUSIONS

The impacts on marine habitats and communities associated with the proposed exploration activities in Concession 6C are summarised in the Table below (Note: * indicates that no mitigation is possible, thus significance rating remains). The total area to be impacted by the proposed sampling operations can be considered negligible with respect to the total area of the Namaqua Bioregion, although at full-scale mining cumulative impacts must be kept in mind.

Impact	Probability	Significance (before mitigation)	Significance (after mitigation)
Noise from geophysical surveying on marine fauna	Probable	Very Low	Very Low
Noise from sampling operations on marine fauna	Definite	Very Low	Very Low*
Disturbance and loss of benthic macrofauna	Definite	Low	Low*
Crushing of benthic macrofauna	Definite	Very Low	Very Low
Generation of suspended sediment plumes	Definite	Very Low	Very Low*
Smothering of benthos in unconsolidated sediments by redepositing tailings	Probable	Very Low	Very Low*
Smothering of vulnerable reef communities by redepositing tailings	Probable	Low	Very Low
Potential loss of equipment	Improbable	Very Low	Very Low
Pollution of the marine environment through operational discharges to the sea from mining vessel	Probable	Very Low	Very Low

6.1. Recommended Mitigation Measures

The following mitigation measures are proposed during geophysical surveying:

- Onboard Marine Mammal Observers (MMOs) 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 limited to 15 minutes prior to the start of survey equipment.
- "Soft starts" should be carried out for any equipment of 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.
- 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. As no seasonal patterns of abundance are known for odontocetes occupying the proposed exploration area, a precautionary approach to avoiding impacts throughout the year is recommended.

- Ensure that PAM (passive acoustic monitoring) is incorporated into any surveying taking place between June and November.
- A MMO should be appointed to ensure compliance with mitigation measures during seismic geophysical surveying.

The following mitigation measures are proposed during exploration sampling:

- 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.
- Implement dynamically positioned sampling vessels in preference to vessels requiring anchorage.
- Use geophysical data 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.
- The positions of all lost equipment must be accurately recorded in a hazards database, and reported to maritime authorities. Every effort should be made to remove lost equipment.
- Adhere strictly to best management practices recommended in the relevant Basic Assessment Report and EMPr and that of MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships, 1973) for all necessary disposals at sea.
- Develop a waste management plan using waste hierarchy.

6.2. Recommended Environmental Management Actions

Most potential environmental impacts resulting from the proposed exploration activities would be integrally managed in such a way as to prevent or minimise them. This is particularly the case for waste management, pollution control, equipment recovery and disaster prevention. Other potential but unlikely impacts (e.g. occurrence / behaviour of marine mammals around survey and mining vessels) should be closely monitored to ensure that adequate responses can be implemented, should a significant impact be detected.

The only impact which cannot be prevented or minimised through these integrated environmental management measures is the primary impact resulting from the removal of seabed sediments as part of the sampling itself. As there is no practical way of actively 'rehabilitating' these excavations other than discarding tailings back into the sampled area, recovery of the impacted habitats must rely on the gradual but continuous natural movement and deposition of fine sediments onto the seabed. Considering the comparatively small area of seabed impacted by sampling activities, the development of a monitoring plan to demonstrate natural recovery processes is not deemed necessary at the exploration stage.

Should exploration activities indicate economic viability of the resource, allowances for a well-designed benthic monitoring programme should be made during the feasibility phase of the project.

6.3. Conclusions

If all environmental guidelines, and appropriate mitigation measures and management actions advanced in this report, and the Basic Assessment and EMPr for the proposed prospecting operations as a whole, are implemented, there is no reason why the proposed prospecting activities should not proceed.

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APPENDIX A: SPECIALIST CV

Curriculum Vitae Dr Andrea Pulfrich

Personal Details

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Academic Qualifications

- BSc (Zoology and Botany), University of Natal, Pietermaritzburg, 1982
- BSc (Hons) (Zoology), University of Cape Town, 1983
- MSc (Zoology), University of Cape Town, 1987
- PhD, Department of Fisheries Biology of the Institute for Marine Science at the Christian-Albrechts University, Kiel, Germany, 1995

Membership in Professional Societies

- South African Council for Natural Scientific Professions (Pr.Sci.Nat. No: 400327/06)
- South African Institute of Ecologists and Environmental Scientists
- International Association of Impact Assessment (South Africa)
- Registered Environmental Assessment Practitioner (Certification Board for Environmental Assessment Practitioners of South Africa).

Employment History and Professional Experience

1998-present: Director: Pisces Environmental Services (Pty) Ltd. Specifically responsible for environmental impact assessments, baseline and monitoring studies, marine specialist studies, and environmental management plan reports.

1999: Senior researcher on contract to Namdeb Diamond Corporation and De Beers Marine South Africa, at the University of Cape Town; investigating and monitoring the impact of diamond mining on the marine environment and fisheries resources; experimental design and implementation of dive surveys; collaboration with fishermen and diamond divers; deep water benthic sampling, sample analysis and macrobenthos identification.

1996-1999: Senior researcher at the University of Cape Town, on contract to the Chief Director: Marine and Coastal Management (South African Department of Environment Affairs and Tourism); investigating and monitoring the experimental fishery for periwinkles on the Cape south coast; experimental design and implementation of dive surveys for stock assessments; collaboration with fishermen; supervision of Honours and Masters students.

1989-1994: Institute for Marine Science at the Christian-Albrechts University of Kiel, Germany; research assistant in a 5 year project to investigate the population dynamics of mussels and cockles in the Schleswig-Holstein Wadden Sea National Park (employment for Doctoral degree); extensive and intensive dredge sampling for stock assessments, collaboration with and mediation between, commercial fishermen and National Park authorities, co-operative interaction with colleagues working in the Dutch and Danish Wadden Sea, supervision of Honours and Masters projects and student assistants, diving and underwater scientific photography. Scope of doctoral study: experimental design and implementation of a regular sampling program including: (i) plankton sampling and identification of lamellibranch larvae, (ii) reproductive biology and condition indices of mussel populations, (iii) collection of mussel spat on artificial collectors and natural substrates, (iv) sampling of recruits to the established populations, (v) determination of small-scale recruitment patterns, and (vi) data analysis and modelling. Courses and practicals attended as partial fulfilment of the degree: Aquaculture, Stock Assessment and Fisheries Biology, Marine Chemistry, and Physical and Regional Oceanography.

1988-1989: Australian Institute of Marine Science; volunteer research assistant and diver; implementation and maintenance of field experiments, underwater scientific photography, digitizing and analysis of stereo-photoquadrats, larval culture, analysis of gut contents of fishes and invertebrates, carbon analysis.

1985-1987: Sea Fisheries Research Institute of the South African Department of Environment Affairs and Tourism: scientific diver on deep diving surveys off Cape Agulhas; censusing fish populations, collection of benthic species for reef characterization.

South African National Research Institute of Oceanography and Port Elizabeth Museum: technical assistant and research diver; quantitative sampling of benthos in Mossel Bay, and census of fish populations in the Tsitsikamma National Park.

University of Cape Town, Department of Zoology and Percy Fitzpatrick Institute of African Ornithology; research assistant; supervisor of diving survey and collection of marine invertebrates, Prince Edward Islands.

1984-1986: University of Cape Town, Department of Zoology; research assistant (employment for MSc Degree) and demonstrator of first year Biological Science courses. Scope of MSc study: the biology, ecology and fishery of the western Cape linefish species *Pachymetopon blochii*, including (i) socio-economic survey of the fishery and relevant fishing communities, (ii) collection and analysis of data on stomach contents, reproductive biology, age and growth, (iii) analysis of size-frequency and catch statistics, (iv) underwater census, (v) determination of hook size selectivity, (vi) review of historical literature and (vii) recommendations to the Sea Fisheries Research Institute of the South African Department of Environment Affairs and Tourism for the modification of existing management policies for the hottentot fishery.

APPENDIX D: FISHERIES IMPACT ASSESSMENT

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

Fisheries Assessment

July 2018

PREPARED FOR:

SLR

ON BEHALF OF:

DE BEERS CONSOLIDATED MINES (PTY) LIMITED

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Capricorn Marine Environmental

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19 July 2018

This report was prepared by Sarah Wilkinson and David Japp of CapMarine (Pty) Ltd. David Japp has a BSC in Zoology, University of Cape Town (UCT) and an MSc degree in Fisheries Science from Rhodes University. Sarah Wilkinson has a BSc (Hons) degree in 7Botany from UCT. Both are professional natural scientists registered with the SA Council for Natural Scientific Professions (SACNASP).

Mr Japp has worked in the field of Fisheries Science and resource assessment since 1987 and has considerable experience in undertaking specialist environmental impact assessments relating to fishing and fish stocks. His work has included environmental economic assessments and the evaluation of the environmental impacts on fishing. Sarah Wilkinson has worked on marine resource assessments, specializing in spatial and temporal analysis (GIS) as well as the economic impacts of fisheries exploitation in the southern African region.

This specialist report was compiled for SLR Consulting (South Africa) (Pty) Ltd on behalf of De Beers Consolidated Mines (Pty) Limited for their use in preparing a Basic Impact Assessment for proposed offshore prospecting operations in Sea Concession 6C off the West Coast of South Africa.. We do hereby declare that we are financially and otherwise independent of the Applicant and of SLR.

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1. Introduction

De Beers Consolidated Mines (Pty) Limited (De Beers) is proposing to undertake prospecting operations within Sea Concession 6C. Before these activities can be undertaken, authorisation is required in terms of the National Environmental Management Act (NEMA), 1998 (No. 107 of 1998), as amended, and a Prospecting Right have to be obtained in terms of the Mineral and Petroleum Resources Development Act (MPRDA), 2002 (Act 28 of 2002).

The first step will be to conduct a regional scale geophysical survey in order to identify geological features of interest for further exploration. Should geological features of interest be identified with the geophysical data, then a decision will be made regarding the feasibility of proceeding to Phase 2 of the exploration. Geophysical survey equipment will be deployed from a fit-for-purpose vessel suitable to the water depth and survey method. The line spacing for this phase of prospecting is planned such as to enable full regional scale seabed coverage.

Various exploration geophysical tools are available to DBM, including swathe bathymetry systems, sub-bottom profilers, side-scan sonars, magnetometer surveys, Autonomous Underwater Vehicle (AUV), etc. The swathe bathymetry system produces a digital terrain model of the seafloor and backscatter data may be acquired to determine textural models. The sub-bottom profiler seismic systems generate profiles beneath the seafloor to give a cross section view of the sediment layers. Side scan sonar systems produce acoustic intensity images of the seafloor and are used to map the different sediment textures from associated lithology of the seafloor. The magnetometer measures local variations in the intensity of the Earth's magnetic fields, which are caused by differences in composition of the sediment layers on or beneath the seafloor. Each and/or all of these techniques may be used during prospecting.

Follow-up localised geophysical surveys may be undertaken during Phase 2, enabling refinement of the definition of the target features. These detailed high resolution geophysical surveys will utilise similar tools with the likely inclusion of an AUV survey. The AUV is used for survey in areas where survey line spacing is generally <100m apart.

Should the result of the survey(s) indicate potential, follow-up sampling may also be undertaken to establish the distribution of the diamondiferous material. Exploration sampling, which may include bulk sampling, will be undertaken using a fit-for-purpose Tool using a vessel of opportunity (e.g. *mv* The Explorer and/or DBM's *mv* Coral Sea) sampling vessel. Sampling methodology will take advantage of the latest technologies available to DBM. The sampling may be divided into stages with reviews and gate releases. A decision will be made to select the fit-for-purpose sampling technology appropriate to each target area based on the results of the preceding stage.

Bulk sampling may be undertaken using one of the marine mining vessels operated by DBM's sister company De Beers Marine Namibia (Pty) Ltd or a similar vessel. There are two basic configurations of mining vessel available: the vertical mining method, utilising a large diameter drill bit and the horizontal mining method, using a seabed crawler. The decision to undertake bulk sampling is dependent on the outcomes of the previous phase of work, and will be undertaken in order to determine mining performance characteristics such as mining rate and metallurgical recovery information that will be used in determining economic viability during feasibility studies.

SLR Consulting (South Africa) (Pty) Ltd (SLR) has been appointed to undertake the Basic Assessment process in terms of the NEMA, and in turn have commissioned CapMarine (Pty) Ltd to provide a spatial assessment on the distribution of commercial fisheries off the West Coast in the vicinity of the sea concession areas.

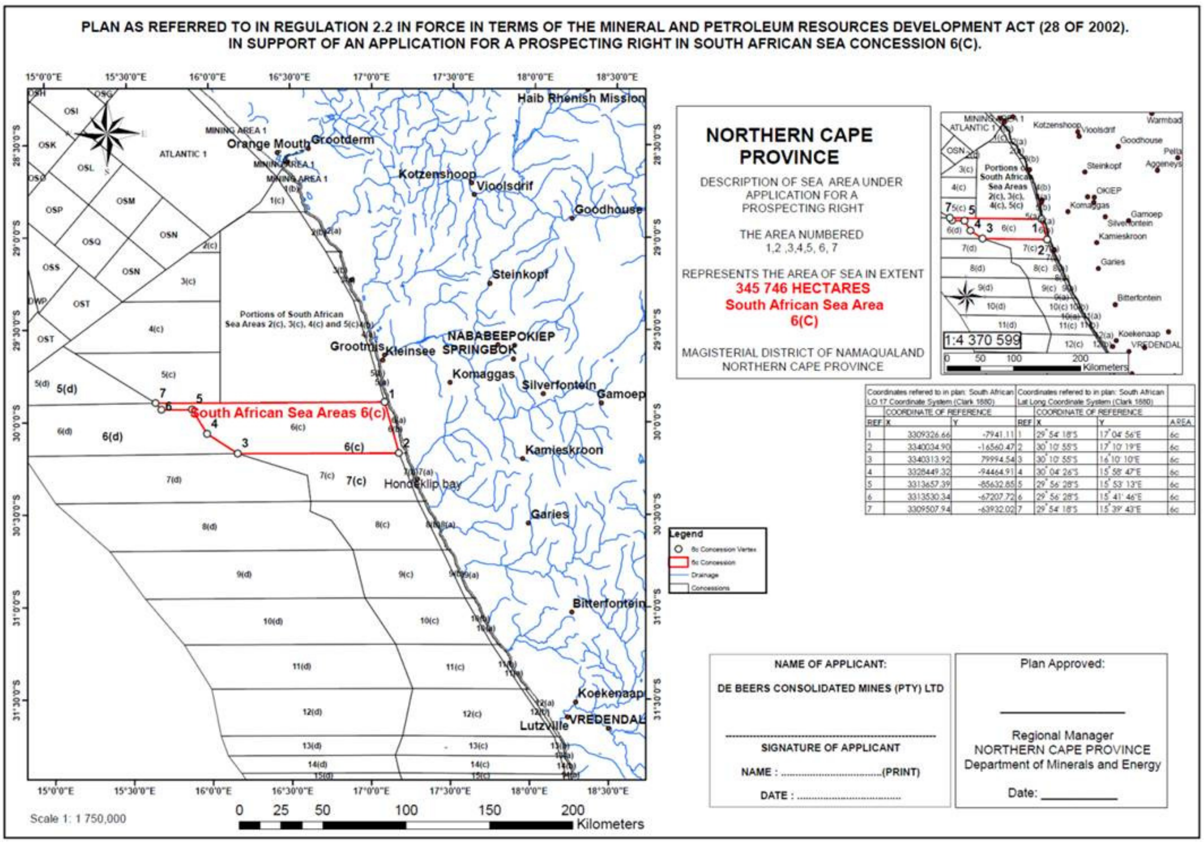

Figure 1.1: *Location of Sea Concession 6C (Source: De Beers Consolidated Mines (Pty) Ltd).*

2. Scope of Work

This specialist report was compiled as a desktop study on behalf of SLR, for their use in preparing a Basic Assessment Report for the proposed prospecting activities off the South African West Coast.

The following general terms of reference apply to the specialist study:

- Provide a description of the existing baseline fisheries characteristics within Sea Concession 6C (distribution of fish stocks and commercial, subsistence and recreational fishing activities).
- An introduction presenting a brief background to the study and an appreciation of the requirements stated in the specific terms of reference for the study.
- Details of the approach to the study where activities performed and methods used are presented.
- The specific identified sensitivity of fishing sectors related to the proposed activity.
- Map/s superimposing Concession 6C on the spatial distribution of effort expended by each fishing sector.
- Calculation of the proportion of fishing ground that coincides with the proposed affected area.
- Assessment of potential impacts on fisheries using prescribed impact rating methodology.
- A description of any assumptions made and any uncertainties or gaps in knowledge.
- Recommendation of mitigation measures, where appropriate.

3. Description of the Proposed Project

A phased approach is proposed for the prospecting. The initial phase would involve a regional scale geophysical survey to identify geological features of interest for further exploration.

3.1 Geophysical Surveys

Various exploration geophysical tools (**Error! Reference source not found.**) could be deployed from a fit-for-purpose vessel, including:

- swathe bathymetry systems, which produces a digital terrain model of the seafloor; backscatter data may be acquired as part of the process to determine textural models;
- sub-bottom profiler seismic systems, which generate profiles beneath the seafloor to give a cross section view of the sediment layers;
- side-scan sonar systems, which systems produce acoustic intensity images of the seafloor and are used to map the different sediment textures from associated lithology of the seafloor; and
- magnetometer surveys, which measures local variations in the intensity of the Earth's magnetic fields, which are caused by differences in composition of the sediment layers on or beneath the seafloor.

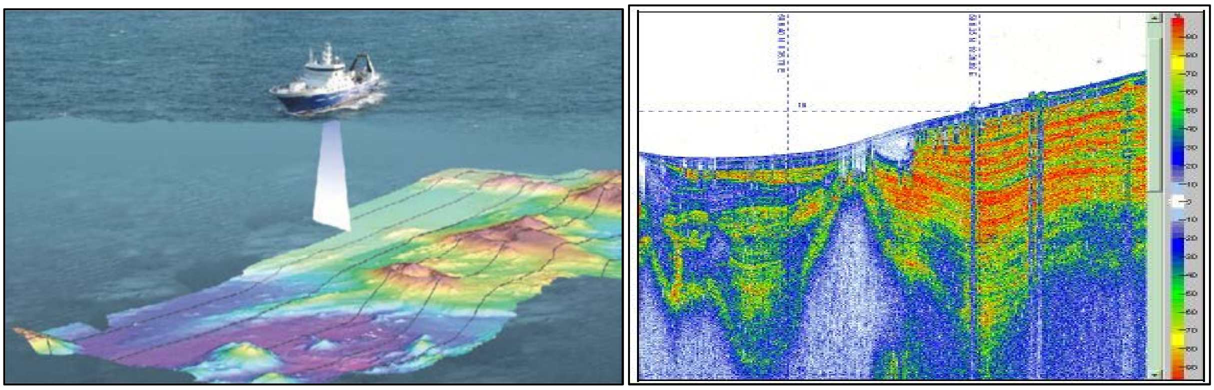

Figure 3.1: The geophysical survey techniques employed during Phase I of the proposed prospecting operations would include swath bathymetry (left) and sub-bottom profiling (right).

The line spacing for prospecting would be planned to enable full regional scale seabed coverage. All the systems are hull-mounted and no towed equipment will be used. Sound levels from the acoustic equipment would range from 190 to 220 dB re 1 μPa at 1 m.

Should geological features of interest be identified, a decision regarding the feasibility of proceeding to Phase 2 of the exploration will be made. During this phase follow-up localised geophysical surveys would be undertaken, enabling refinement of the definition of the target features. These detailed high resolution geophysical surveys will utilise similar tools with the likely inclusion of an Autonomous Underwater Vehicle (AUV), which is typically used for surveying in areas where survey line-spacing is generally <100 m apart.

3.2 Exploration Sampling

Should survey results indicate resource potential, subsequent exploration sampling to establish the distribution of diamondiferous material would be undertaken to determine mining performance characteristics (e.g. mining rate and metallurgical recovery information) that would be used in determining economic viability during feasibility studies. Sampling would be undertaken in water depths ranging from 70 m to 160 m from a sampling vessel of opportunity (e.g. *mv The Explorer* and/or DBM's *mv Coral Sea*) using a fit-for-purpose tool and taking full advantage of the latest sampling technologies available. Sampling technologies selected would be appropriate to each target area and based on the results of the preceding stage. The sampling would likely be divided into stages with reviews and gate releases.

3.3 Bulk Sampling

Based on the results of the sampling programme, future bulk sampling may also be undertaken. Should bulk sampling be undertaken, this would be conducted by one of the marine mining vessels operated by DBM's sister company De Beers Marine Namibia (Pty) Ltd, or a similar vessel of opportunity. The vessels available for bulk sampling adopt either the vertical or horizontal mining approach (**Error! Reference source not found.**).

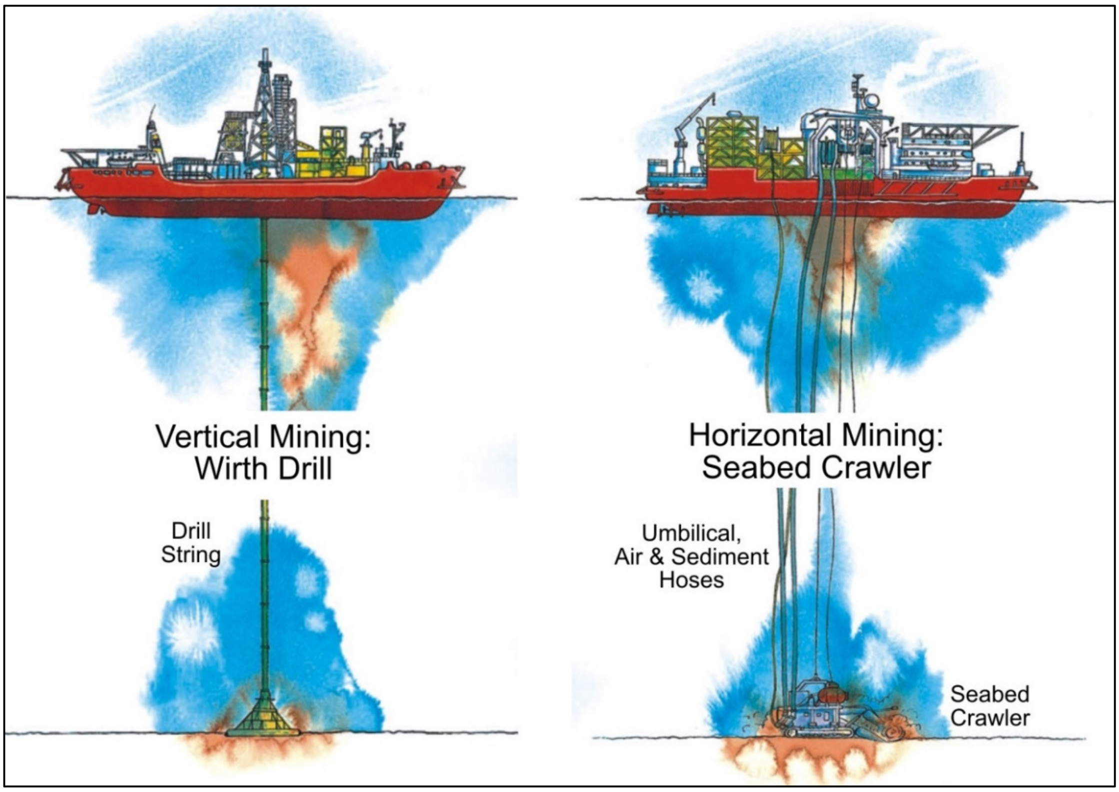

Figure 3.2: Illustration of the current mining methods used to mine diamond-bearing gravels; a) Vertical mining using large-diameter drills, and b) horizontal mining using seabed crawlers (Source: De Beers Marine).

Vertical Mining involves a vertically mounted, large-diameter drill-head (currently ranging from 5.2 - 6.8 m in diameter), used to excavate diamond-bearing gravel in a systematic pattern of overlapping circles in the target area. The drill-head consists of a large-diameter circular disc fitted with wheel cutters and hardened steel scrapers, and is lowered to the seabed on an extendable pipe 'drill string'. Loosened rocks and sediment are fed along a semi-circular channel across the lower surface of the plate, extracted through a central aperture and pumped to the surface through the drill string for onboard processing. The drill is capable of penetrating about 2 - 3 m of sediment and partially consolidated conglomerate or calcareous sandstone in water depths down to 150 m.

Horizontal Mining involves the use of a track-mounted seabed crawler fitted with highly accurate acoustic seabed navigation and imaging systems, and equipped with an anterior suction system. The crawler is lowered to the seabed and is controlled remotely from the surface support vessel through power and signal umbilical cables. Water jets in the crawler's suction head loosen seabed sediments, and sorting bars filter out oversize boulders. The sampled sediments are pumped to the surface for shipboard processing. Crawlers are capable of working to 200 m depth.

3.4 Emissions and Discharges to Sea

During geophysical and sampling operations, normal discharges to the sea from the vessels can come from a variety of sources. These discharges are regulated by onboard waste management plans and shall be MARPOL compliant. For the sake of completeness they are discussed briefly below:

3.4.1 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 standard before discharge overboard. Drainage from marine (weather) deck spaces would wash directly overboard.

3.4.2 Sewage

Although South Africa is not yet a signatory to MARPOL Annex IV Regulations for the Prevention of Pollution by Sewage from Ships, the contracted vessels would be required to comply, wherever possible, with the requirements of this Annex.

3.4.3 Food (galley) wastes

The disposal into the sea of food waste is permitted in terms of MARPOL 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 when more than 12 nautical miles (approximately 22 km) from the coast. The daily discharge from the vessel would be approximately 0.15 m^3.

3.4.4 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 above).

3.5 Support and supply vessels

The exploration vessels typically have the capability to be fully autonomous and operational for long periods of time before bunkering. Spares, consumables and victuals can be supplied by support vessels while the exploration vessel is operational. It is envisioned that a supply vessel would call into port on a regular basis during the operations.

Crew changes and food supplies would be undertaken by helicopter (similarly for emergency equipment supplies, medical evacuations of injured personnel) from Kleinzee airport. The mining vessel would accommodate in the order of 70 personnel. Crew changes would be staggered, and in combination with *ad hoc* personnel requirements. Helicopter operations to and from the mining vessel would thus occur on a regular basis.

4. Fisheries Baseline Environment

South Africa has a coastline that spans two ecosystems over a distance of 3,623 km, extending from the Orange River in the west on the border with Namibia, to Ponta do Ouro in the east on the Mozambique border. The western coastal shelf has highly productive commercial fisheries similar to other upwelling ecosystems around the world, while the East Coast is considerably less productive but has high species diversity, including both endemic and Indo-Pacific species. South Africa's fisheries are regulated and monitored by the Department of Agriculture, Forestry and Fisheries (DAFF) and are managed either as commercial, small-scale or recreational sector. All fisheries in South Africa, as well as the processing, sale in and trade of almost all marine resources, are regulated under the Marine Living Resources Act, 1998 (No. 18 of 1998) (MLRA).

Approximately 14 different commercial fisheries sectors currently operate within South African waters. Table 4.1 lists these along with ports and regions of operation, catch landings and number of active vessels and rights holders (2016). Figure 4.1 shows the proportional volume of catch landed by each of these sectors (2016). 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-directed purse-seine fishery targeting pilchard (*Sardinops sagax)*, anchovy (*Engraulis encrasicolus*) and red-eye round herring (*Etrumeus whitheadii*). Highly migratory tuna and tuna-like species are caught on the high seas and seasonally within the South African waters by the pelagic long-line and pole fisheries. Targeted species include albacore (*Thunnus alalunga*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacares*) and swordfish (*Xiphias gladius*). The traditional line fishery targets a large assemblage of species close to shore including snoek (*Thyrsites atun*), Cape bream (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)*, yellowtail (*Seriola lalandi)* and other reef fish. Crustacean fisheries comprise a trap and hoop net fishery targeting West Coast rock lobster (*Jasus lalandii*), a line trap fishery targeting the South Coast rock lobster (*Palinurus gilchristi*) and a trawl fishery based solely on the East Coast targeting penaeid prawns, langoustines (*Metanephrops andamanicus* and *Nephropsis stewarti*), deep-water rock lobster (*Palinurus delagoae*) and red crab (*Chaceon macphersoni*). Other fisheries include a mid-water trawl fishery targeting horse mackerel (*Trachurus trachurus capensis*) predominantly on the Agulhas Bank, South Coast and a hand-jig fishery targeting chokka squid (*Loligo vulgaris reynaudii*) exclusively on the South Coast. In addition to commercial sectors, recreational fishing occurs along the coastline comprising shore angling and small, open boats generally less than 10 m in length. The commercial and recreational fisheries are reported to catch over 250 marine species, although fewer than 5% of these are actively targeted by commercial fisheries, which comprise 90% of landed catch.

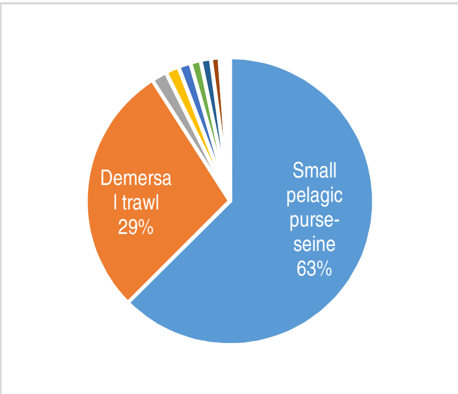

Figure 4.1: Pie chart showing percentage of landings by weight of each commercial fishery sector as a contribution to the landings for all commercial fisheries sectors combined (2016).

Most commercial fish landings must take place at designated fishing harbours. For the larger industrial vessels targeting hake, only the major ports of Saldanha Bay, Cape Town, Mossel Bay and Port Elizabeth are used. On the West Coast, St. Helena Bay and Saldanha Bay are the main landing sites for the small pelagic fleets. These ports also have significant infrastructure for the processing of anchovy into fishmeal as well as canning of sardine. Smaller fishing harbours on the West / South-West Coast include Port Nolloth, Hondeklip and Laaiplek, Hout Bay and Gansbaai harbours. On the East Coast, Durban and Richards Bay are deployment ports for the crustacean trawl and large pelagic longline sectors. There are more than 230 small-scale fishing communities on the South African coastline, ranging in size from small villages to towns (DAFF, 2016).

Only the sectors operational on the West Coast will be further described in the current report.

Table 4.1: South African offshore commercial fishing sectors, base ports, areas of operation, landed catch, number of active vessels and rights holders by sector (Source: DAFF).

Sector	Areas of Operation	Main Ports in Priority	No. of Vessels	Rights Holders (2016)	Landed Catch (2016)	Target Species
Small pelagic purse-seine	West Coast, South Coast	St Helena Bay, Saldanha, Hout Bay, Gansbaai, Mossel Bay	101	111	399 612 t	Anchovy (*Engraulis encrasicolus*), sardine (*Sardinops sagax*), Redeye (*Etrumeus whiteheadi*)
Demersal trawl (offshore)	West Coast, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth	45	50	151 456 t	Deepwater hake (*Merluccius paradoxus*), shallow-water hake (*Merluccius capensis*)
Demersal trawl (inshore)	South Coast	Cape Town, Saldanha, Mossel Bay	31	18	6 956 t	East coast sole (*Austroglossus pectoralis*), shallow-water hake (*Merluccius capensis*), juvenile horse mackerel (mackerel (*Trachurus capensis*)
Mid-water trawl	West Coast, South Coast	Cape Town, Port Elizabeth	6	34	9 674 t	Adult horse mackerel (*Trachurus capensis*)
Demersal longline	West Coast, South Coast	Cape Town, Saldanha, Mossel Bay, Port Elizabeth, Gansbaai	64	146	9 027 t	Shallow-water hake (*Merluccius capensis*)
Large pelagic longline	West Coast, South Coast, East Coast	Cape Town, Durban, Richards Bay, Port Elizabeth	31	30	7 492 t	Yellowfin tuna (*T. albacares*), big eye tuna (*T. obesus*), Swordfish (*Xiphius gladius), s*outhern bluefin tuna (*T. maccoyii*)
Tuna pole	West Coast, South Coast	Cape Town, Saldanha	128	170	2 809 t	Albacore tuna (*T. alalunga*)
Traditional line fish	West Coast, South Coast, East Coast	All ports, harbours and beaches around the coast	450	422	6 445 t	Snoek (*Thyrsites atun*), Cape bream (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)*, yellowtail (*Seriola lalandi),* Sparidae, Serranidae, Carangidae, Scombridae, Sciaenidae
South coast rock lobster	South Coast	Cape Town, Port Elizabeth	12	13	735 t	*Palinurus gilchristi*
West coast rock lobster	West Coast	Hout Bay, Kalk Bay, St Helena	105	240	1 033 t	*Jasus lalandii*
KwaZulu-Natal prawn trawl	East Coast	Durban, Richards Bay	5	6	181 t	Tiger prawn (*Panaeus monodon*), white prawn (*Fenneropenaeus indicus*), brown prawn (*Metapenaeus monoceros*), pink prawn (*Haliporoides triarthrus*)
Squid jig	South Coast	Port Elizabeth, Port St Francis	138	92	8 500 t	Squid/chokka (*Loligo vulgaris reynaudii)*
Gillnet	West Coast	False Bay to Port Nolloth	N/a	162	634 t	
Beach seine	West, South, East Coast	N/a	N/a	28	1 600 t	
Seaweeds	West, South, East Coast	N/a	N/a	14	6 172 t	Mixed beach-cast seaweeds including kelp, *Gelidium* spp and *Gracilaria* spp
Abalone	West Coat	N/a	N/a	N/a	86 t	*Haliotis midae*

Spawning and Migration

The South African coastline is dominated by seasonally variable and sometimes strong currents and most species have evolved highly selective reproductive patterns to ensure that eggs and larvae can enter suitable nursery grounds situated along the coastline. The principle commercial fish species undergo a critical migration pattern in the Benguela and Agulhas ecosystems. This migration is central to the sustainability of the West Coast small pelagic and hake fisheries.

The process is as follows (Refer to Figure 4.2):

- Adults spawn on the central Agulhas Bank in spring (September to November);
- Spawn drifts northwards in the Benguela current across the shelf;
- As eggs drift northwards, hatching takes place followed by larval development;
- Settlement of larvae occurs in the inshore areas, in particular the bays that are used as nurseries. This takes place from October through to March (see Figure 4.3); and
- Juveniles shoal and begin a southward migration. This is the main period during which the anchovy and sardine are targeted by the small pelagic purse seine fishery. The demersal species such as hake migrate offshore into deeper water.

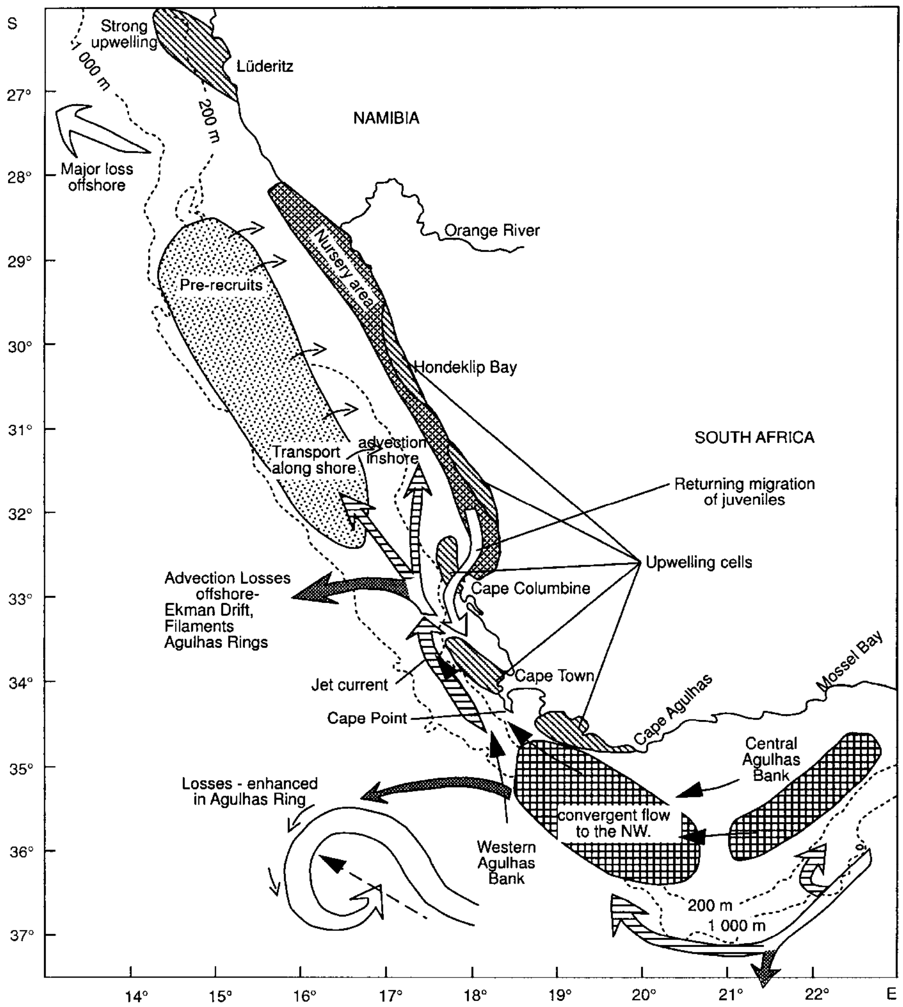

Figure 4.2: Generalised figure of the main fish recruiting process for species caught on the West Coast of South Africa (after Hutchings et al., 2002). Figure shows the West Coast nursery area and the western/central Agulhas Bank spawning grounds. Light stippled area on the West Coast marks the main recruiting area for the small pelagic fishery and dark stippled area on the Agulhas Bank marks the main spawning grounds for small pelagic fish.

Figures 4.3 and 4.4 show the distribution of hake eggs and larvae on the west and south-west coasts, with typically higher abundance evident in September and October (spring) compared with March and April (autumn).

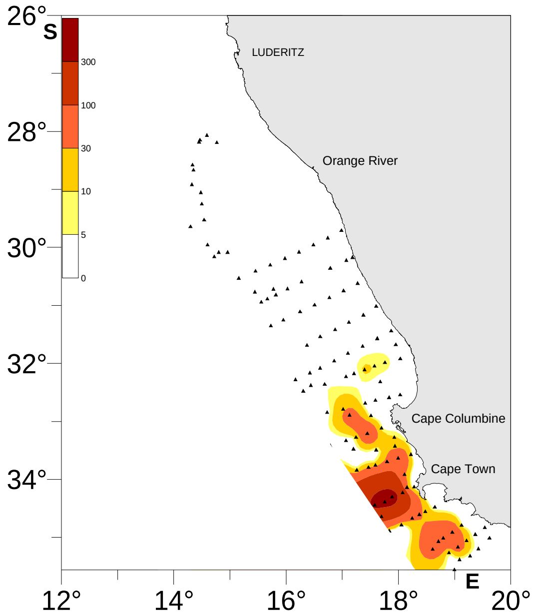

Figure 4.3: *Distribution of hake eggs (left) and larvae (right) off the West Coast of South Africa between September and October 2005 (source: Institute of Marine Research Bergen, Norway).*

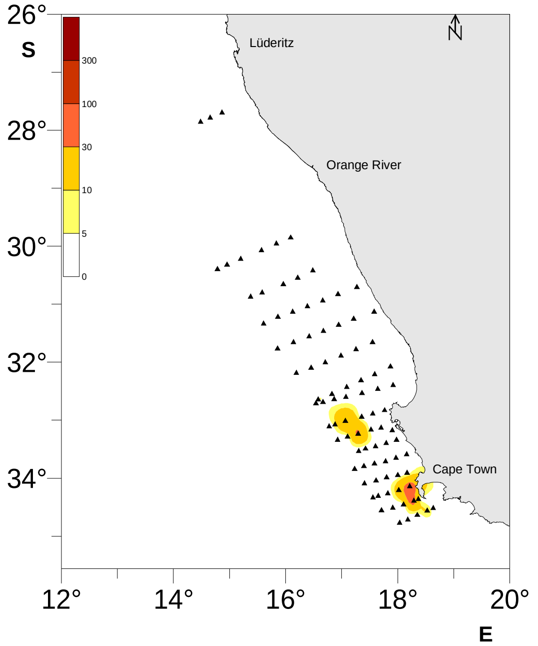

Figure 4.4: *Distribution of hake eggs (left) and larvae (right) off the West Coast of South Africa between March and April 2007 (source: Institute of Marine Research Bergen, Norway).*

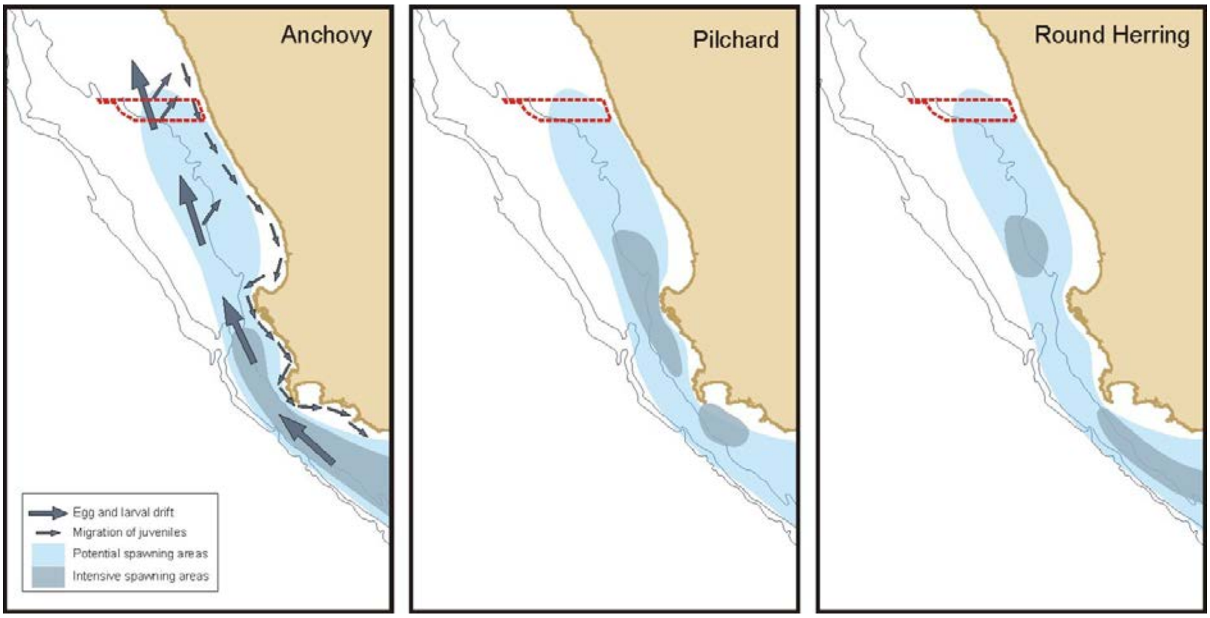

Figure 4.5: Sea Concession 6C (red polygon) in relation to major spawning areas of small pelagic species in the southern Benguela region (Source: Pisces 2018 adapted from Cruikshank 1990).

4.1 Small pelagic purse-seine

*The pelagic-directed purse-seine fishery targeting pilchard (*Sardinops sagax*), anchovy (*Engraulis encrasicolus*) and red-eye round herring (*Etrumeus whitheadii*) is the largest South African fishery by volume (tonnes landed) and the second most important in terms of economic value. The abundance and distribution of these small pelagic species fluctuates considerably in accordance with the upwelling ecosystem in which they exist. Fish are targeted in inshore waters, primarily along the West and South Coasts of the Western Cape and the Eastern Cape coast, up to a maximum offshore distance of about 100 km. The majority of the fleet of 101 vessels operate from St Helena Bay, Laaiplek, Saldanha Bay and Hout Bay with fewer vessels operating on the South Coast from the harbours of Gansbaai, Mossel Bay and Port Elizabeth. Ports of deployment correspond to the location of canning factories and fish reduction plants along the coast.*

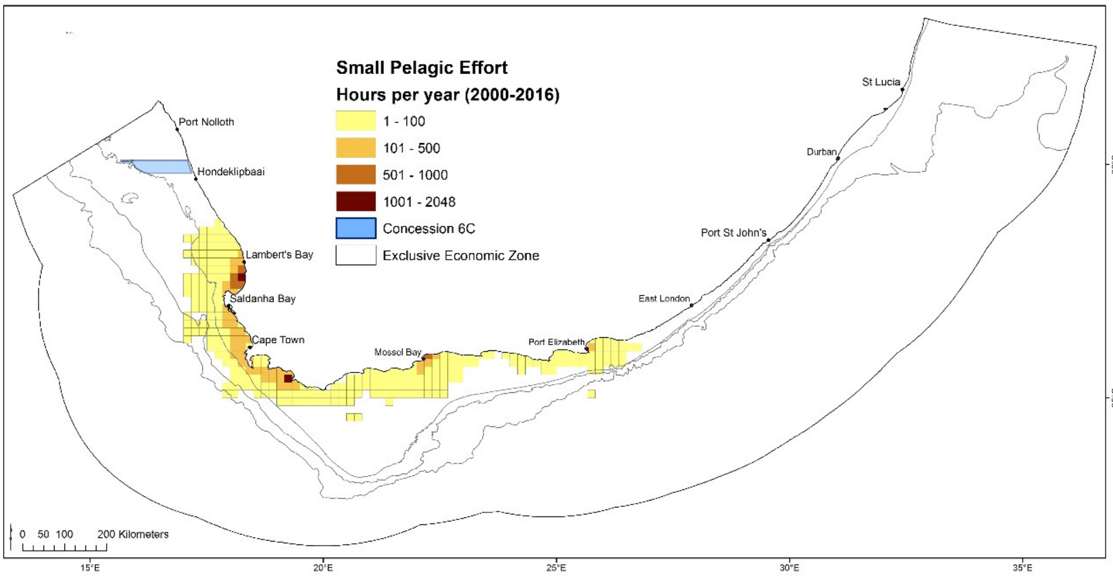

Figure 4.66 shows that there has been no significant reported effort within the concession area between the years 2000 to 2016. However, it is noted that the map omits fishing grid blocks which have less than one hour of fishing effort per year (average values for the period 2000 to 2016), as sporadic 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.

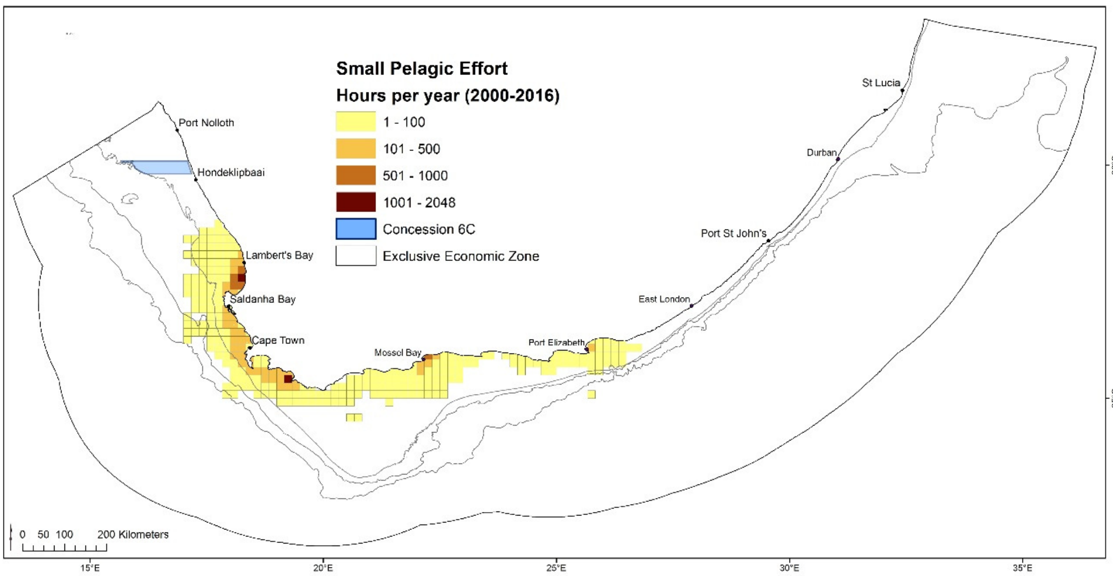

Figure 4.6: Spatial distribution of fishing grounds of the small pelagic purse-seine sector in relation to the location of Sea Concession 6C. Fishing activity is reported by 10 x 10 nautical minute grid

block and average annual effort is shown for the period 2000 to 2016. Bathymetric contours are shown for 200m, 500m and 2000m.

4.2 Demersal trawl

South Africa's primary fisheries in terms of highest economic value are the trawl and long-line sectors targeting Cape hakes (*Merluccius paradoxus* and *M. capensis*). Secondary species include a large assemblage of demersal fish of which monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*) are the most commercially important. The demersal trawl fishery comprises an offshore and inshore fleet, which differ primarily in terms of vessel capacity and the areas in which they operate. Approximately 45 offshore vessels operate from most major harbours on both the West and South Coasts. Trawlers target fish at an approximate depth range of 300 m to 1 000 m with fishing grounds extending in an almost continuous band along the shelf edge from the Namibian maritime border in the north to Port Elizabeth in the East. The inshore fleet comprises approximately 30 vessels which operate off the South Coast from the harbours of Mossel Bay and Port Elizabeth. Inshore grounds are located on the Agulhas Bank and extend eastward towards the Great Kei River. Sole is targeted at a water depth range of between 50 m and 80 m, while hake is targeted at depths of between 100 m and 160 m.

Figure 4.164.7a and b show the demersal trawling grounds in relation to Concession 6c. The 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 Concession 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.

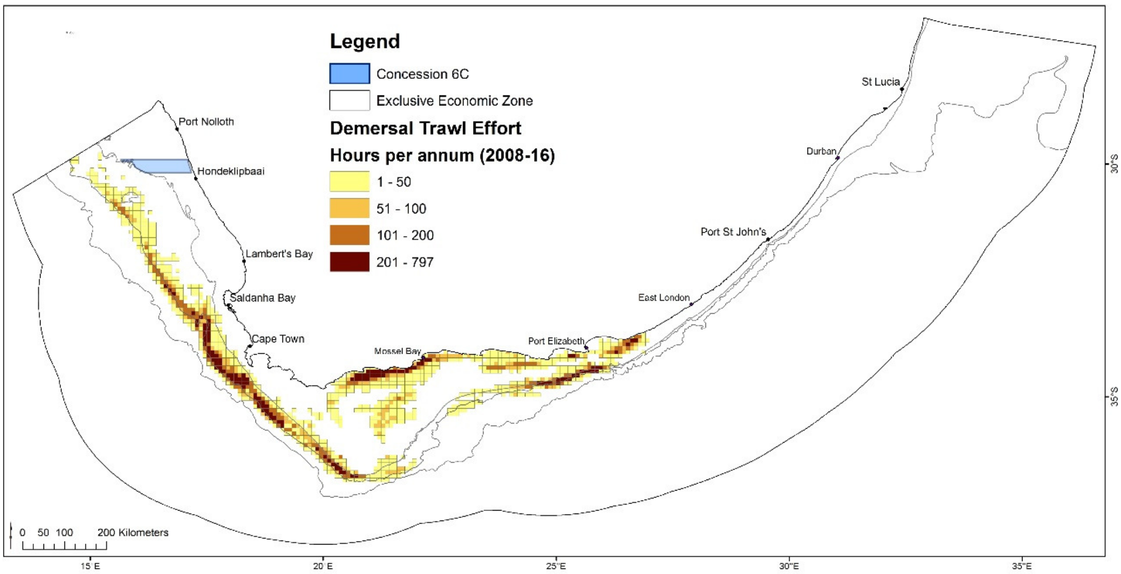

Figure 4.7a: Spatial distribution of fishing grounds of the demersal trawl sector in relation to the location of Sea Concession 6C. Fishing activity is shown at a grid block resolution of 5 x 5 nautical minutes and average annual effort is shown for the period 2008 to 2016. Bathymetric contours are shown for 200m, 500m and 2000m.

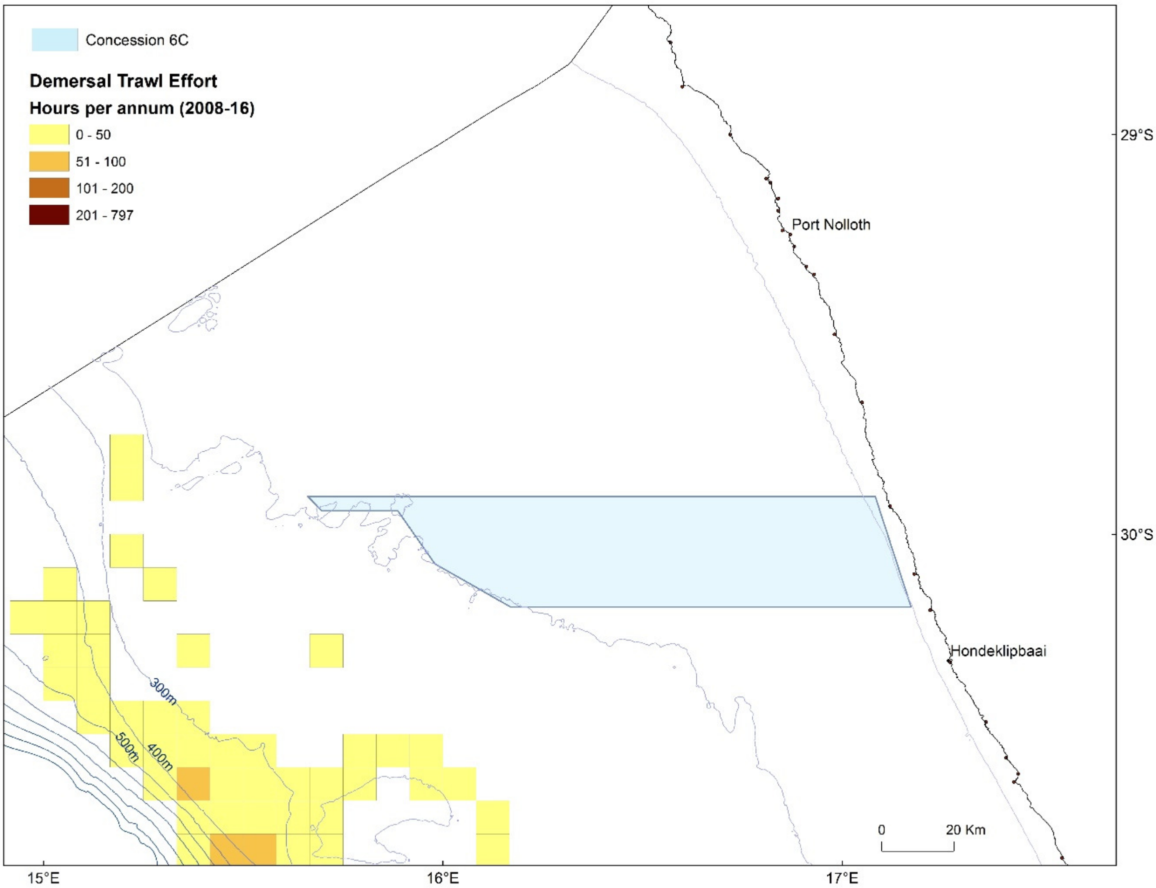

Figure 4.8b: Spatial distribution of fishing grounds of the demersal trawl sector in relation to the location of Sea Concession 6C. Fishing activity is shown at a grid block resolution of 5 x 5 nautical minutes and average annual effort is shown for the period 2008 to 2016.

4.3 Demersal longline

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. Currently 64 hake-directed vessels are active within the fishery, most of which operate from the harbours of Cape Town and Hout Bay. The targeting of demersal sharks (soupfin and smoothhound shark) by longline is managed as a separate sector.

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. 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. Since the top-line (polyethylene, 10 – 16 mm diameter) is more buoyant than the bottom line, it is raised off the seafloor and minimizes the risk of snagging or fouling. The purpose of the top-line is to aid in gear retrieval if the bottom line breaks at any point along the length of the line. 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. Long-line vessels vary in length from 18 m to 50 m and remain at sea for four to seven days at a time.

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). Lines are set parallel to bathymetric contours and to a maximum depth of 1 000 m in places. Figures 4.9a and b show demersal longline grounds in relation to Concession 6C. 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 reported between 2000 and 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 4.9). There have, however, been records of sporadic fishing activity within the concession area during this time, amounting to an average of one line set per year and a catch of ~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. There is no overlap of the concession area with fishing grounds for demersal shark species.

The concession area overlaps spawning and recruitment areas for hake and other demersal species.

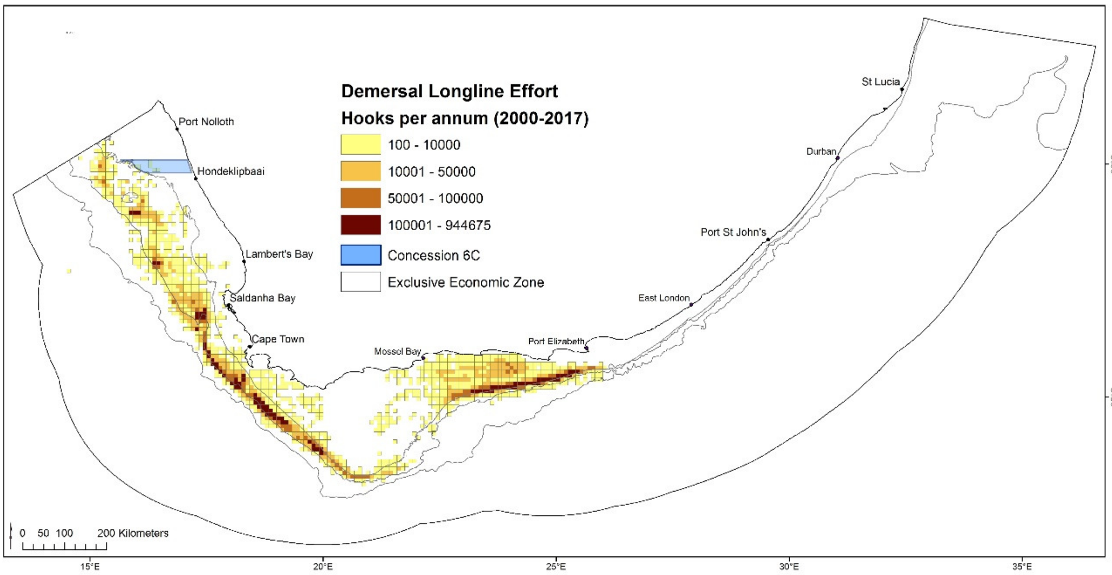

Figure 4.9a: *Spatial distribution of fishing effort expended by the demersal longline sector (2000 – 2017) in relation to Sea Concession 6C. The 200m, 500m and 2000m bathymetric contours are shown.*

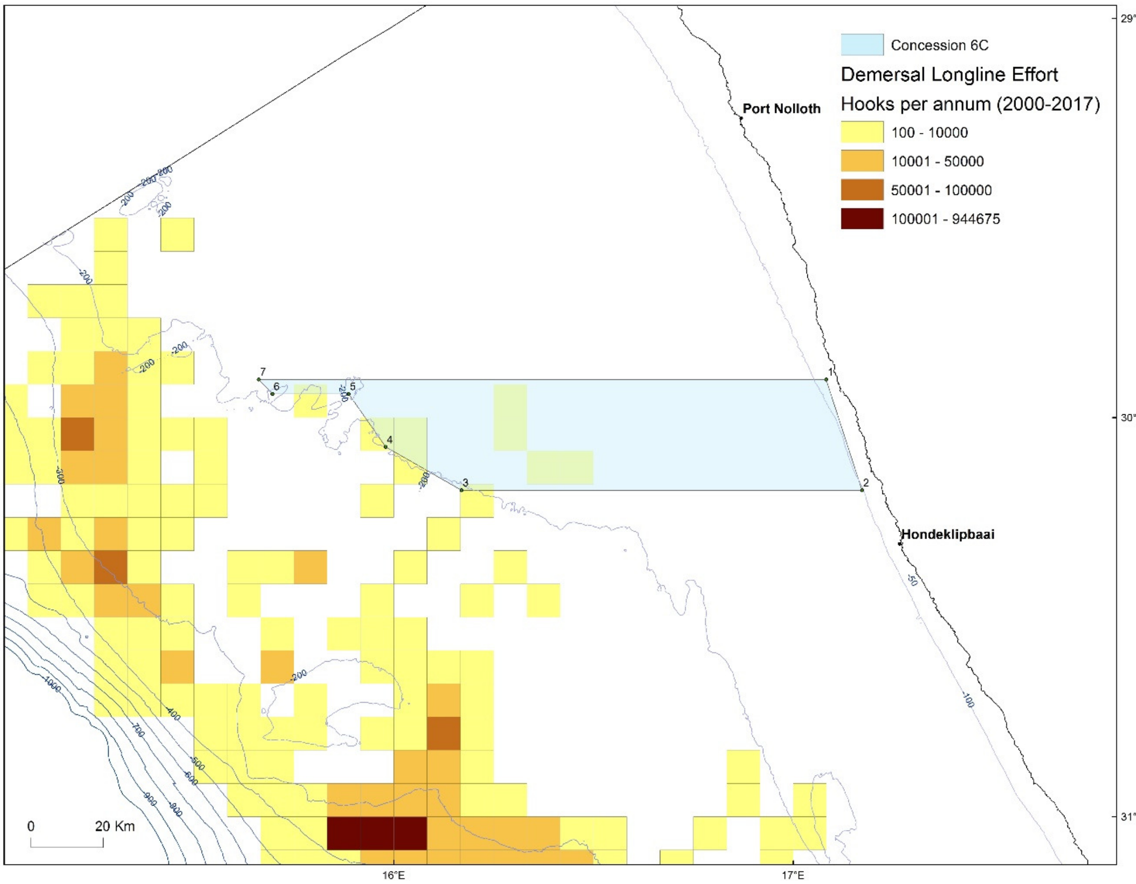

Figure 4.10b: Spatial distribution of fishing effort expended by the demersal longline sector (2000 – 2017) in relation to Sea Concession 6C. Bathymetric contours are shown at depth intervals of 100m from 100m to 1000m.

4.4 Large pelagic longline

Migratory tuna are caught on the high seas and seasonally within the South African Exclusive Economic Zone (EEZ) by longline and pole fisheries. Targeted species include albacore (*Thunnus alalunga*), bigeye tuna (*T. obesus*), yellowfin tuna (*T. albacares*) and swordfish (*Xiphias gladius*). Since tuna, tuna-like species and billfishes are migratory stocks, they are managed as a shared resource amongst various countries under the jurisdiction of the International Commission for the Conservation of Atlantic Tunas (ICCAT) and the Indian Ocean Tuna Commission (IOTC). In the 1970s to mid-1990s the fishery was exclusively operated by Asian fleets (up to 130 vessels) under bilateral agreements with South Africa. From the early 1990s these vessels were banned from South African waters and South Africa went through a period of low fishing activity as fishing rights issues were resolved. Thereafter a domestic fishery developed and 50 fishing rights were allocated to South African companies only. Rights holders now include a small fleet of local longliners although the fishery is still undertaken primarily with Japanese vessels fishing in joint ventures with South African companies. There are currently 30 commercial large pelagic fishing rights issued and 21 active vessels. The fishery operates extensively within the South African EEZ, primarily along the continental shelf break and further offshore.

Figure 4.10 shows the spatial distribution of fishing activity in the South African EEZ and in relation to Concession 6C. 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 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 4.11). There is no direct overlap of the concession area with either fishing ground or spawning and recruitment areas of large pelagic species.

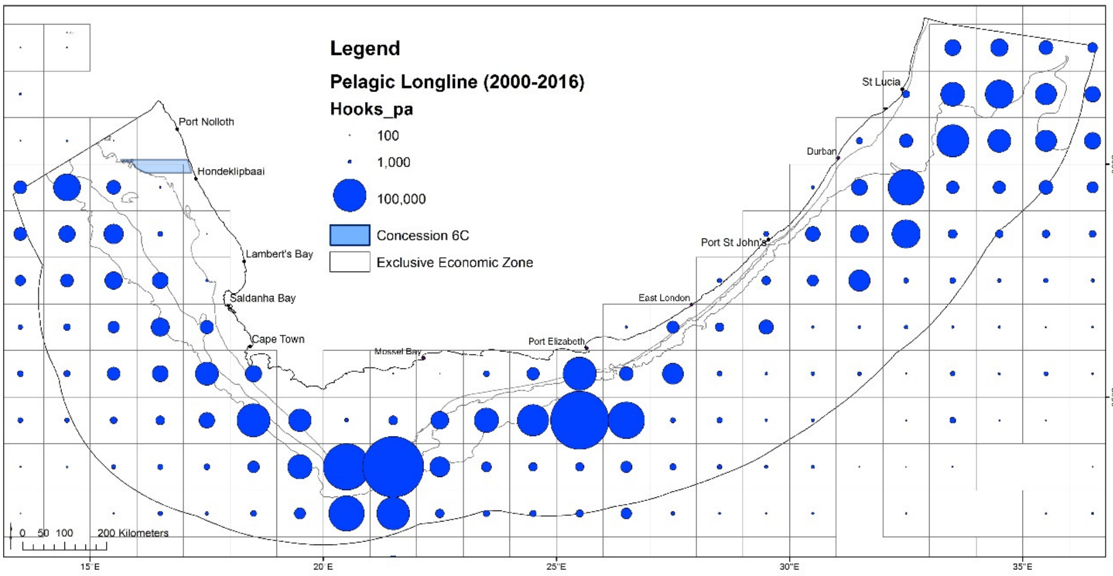

Figure 4.11: *Spatial distribution of fishing grounds of the large pelagic longline sector in relation to the location of Sea Concession 6C. Fishing activity is shown at a grid block resolution of 60 x 60 nautical minutes (due to the spatial extent covered by drifting longline gear) and average annual effort is shown for the period 2000 to 2016. The bathymetric contours shown are 200m, 500m and 2000m.*

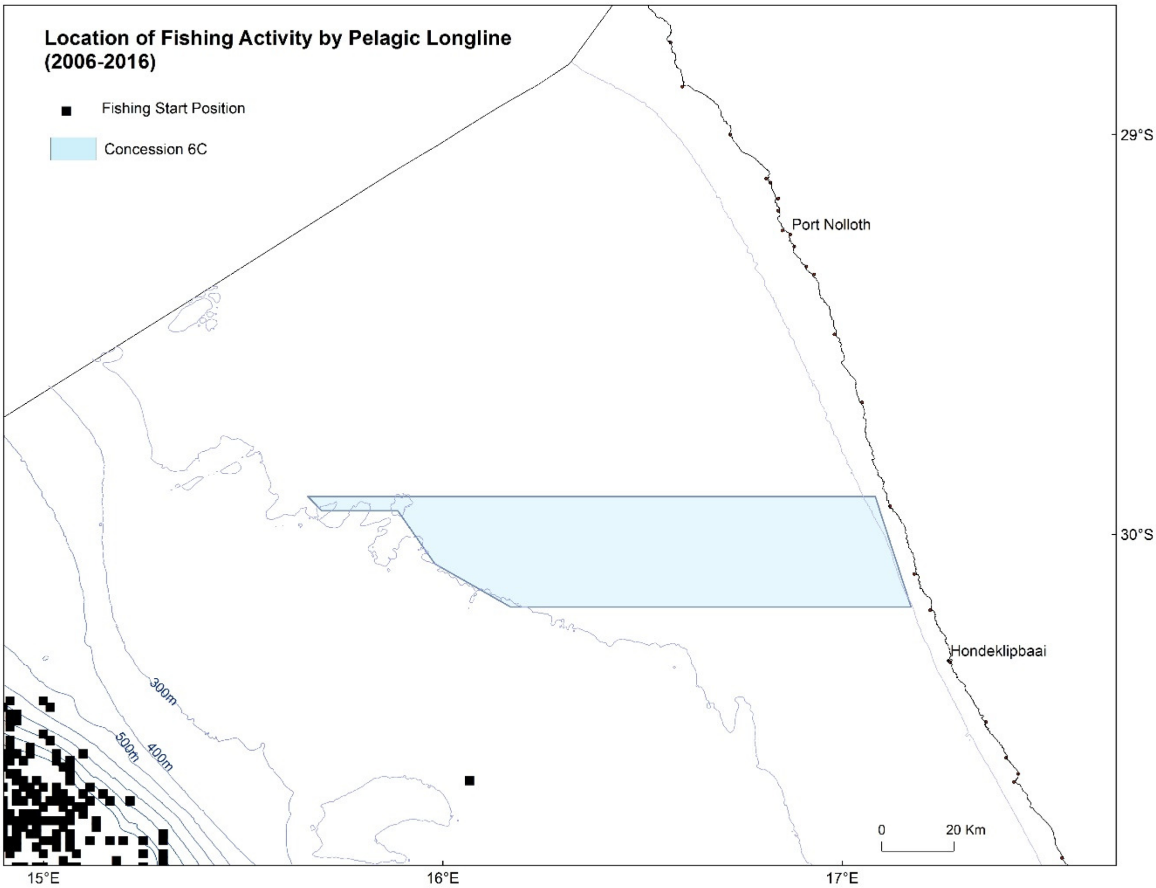

Figure 4.12: *Spatial distribution of fishing positions recorded between 2006 and 2016 by the South African large pelagic longline sector in relation to Sea Concession 6C. Bathymetric contours are shown at depth intervals of 100m depth from 100m to 1000m.*

4.5 Tuna pole

Poling for tuna is predominantly based on the southern Atlantic longfin tuna stock also referred to as albacore (*T. alalunga*). Other catch species include yellowfin tuna, bigeye tuna, skipjack tuna (*Katsuwonus pelamis*), snoek and yellowtail. The South African fleet is currently comprised of 128 vessels based at the ports of Cape Town, Hout Bay and Saldanha Bay. Fishing occurs along the entire West Coast, along the shelf break and beyond the 200 m isobath. Targeted fishing areas are situated north of Cape Columbine and between 60 km and 120 km offshore from Saldanha Bay and the Cape Canyon. Within southern Namibian waters albacore is targeted at Tripp Seamount, located south of Lüderitz. The fishery is seasonal with vessels active predominantly between November and May and peak catches recorded from November to January. Effort fluctuates according to the availability of fish in the area, but once a shoal of tuna is located a number of vessels will move into the area and target a single shoal which may remain in the area for days at a time.

Figure 4.12 shows the spatial distribution of fishing activity off the West Coast of South Africa and in relation to Concession 6C. 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. There is no expected overlap of the concession area with spawning and recruitment areas of large pelagic species.

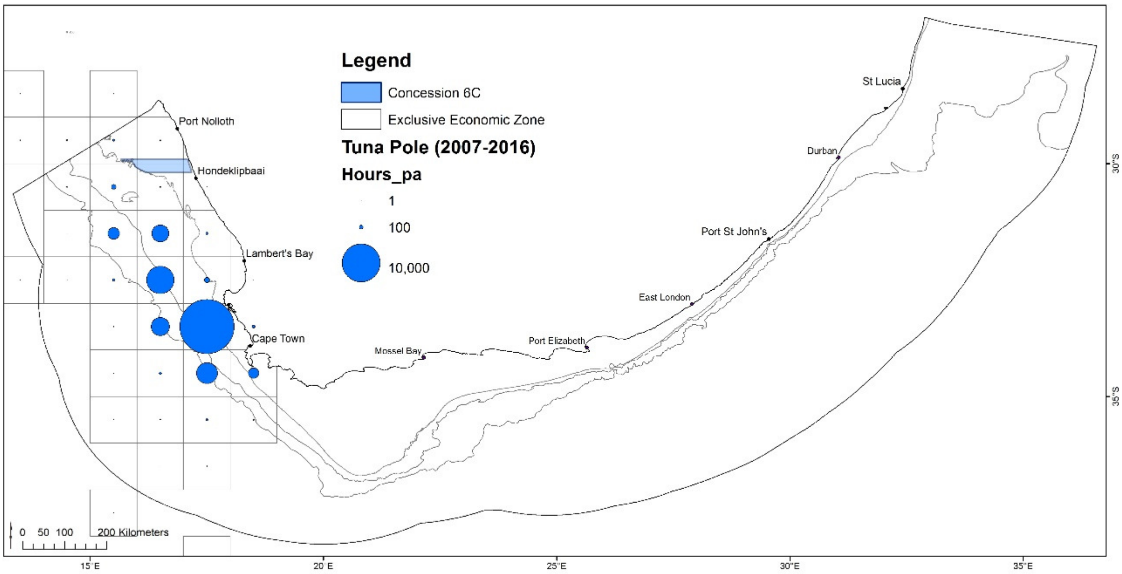

Figure 4.13: Spatial distribution of fishing grounds of the tuna pole sector in relation to the location of Sea Concession 6C. Fishing activity is shown at a grid block resolution of 60 x 60 nautical minutes and average annual effort is shown for the period 2007 to 2016. The bathymetric contours shown are 200m, 500m and 2000m.

4.6 Traditional line fishery

The linefishery 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. It is a long-standing, nearshore fishery based on a large assemblage of different species. Within the Western Cape the predominant catch species is snoek (*Thyrsites atun*) while other species such as Cape bream (hottentot) (*Pachymetopon blochii)*, geelbek (*Atractoscion aequidens)*, kob (*Argyrosomus japonicus)* and yellowtail (*Seriola lalandi)* are also important. Towards the East Coast the number of catch species increases and includes resident reef fish (Sparidae and Serranidae), pelagic migrants (Carangidae and Scombridae) and demersal migrants (Sciaenidae and Sparidae). The fishery operates along almost the entire coastline (excluding certain protected areas) from Port Nolloth on the West Coast to Cape Vidal on the East Coast (see Figure 4.13). Effort is managed geographically with the spatial effort of the fishery divided into three zones. Most of the catch (up to 95%) is landed by the Cape commercial fishery, which operates on the continental shelf from the Namibian border on the West Coast to the Kei River in the Eastern Cape. Sea Concession 6C coincides with linefish 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 linefish species for subsistence purposes is now managed under South Africa's small-scale fishery policy which was implemented in 2016 (DAFF 2016).

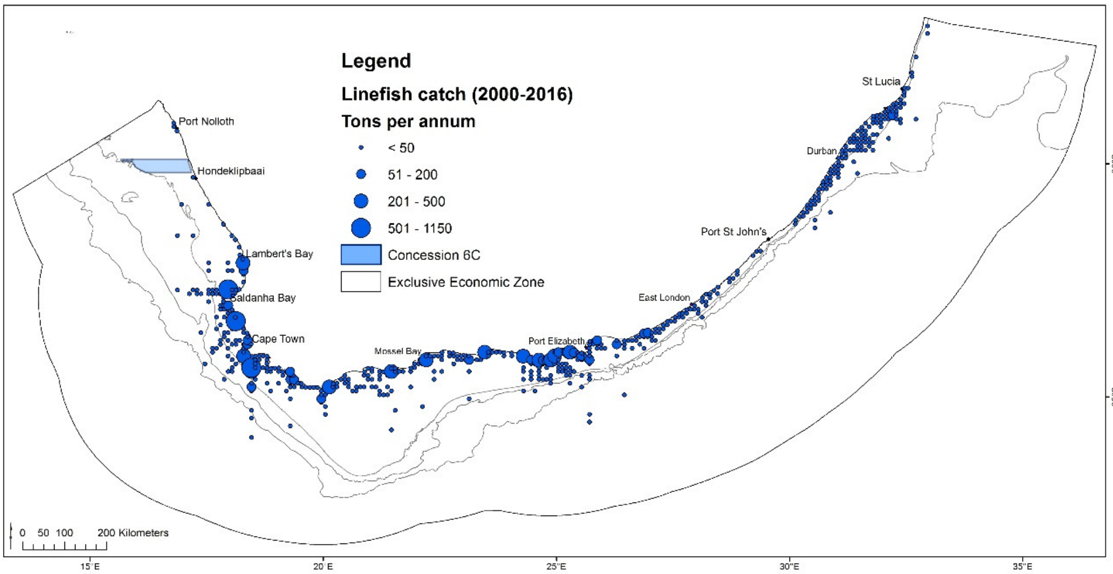

Figure 4.14: Spatial distribution of fishing effort expended by the South African traditional linefish sector (2000 – 2016) in relation to Sea Concession 6C. The bathymetric contours shown are 200m, 500m and 2000m.

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 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 ~ 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.

4.7 West coast rock lobster

The West Coast rock lobster *Jasus lalandii* is a valuable resource of the South African West Coast and consequently an important income source for West Coast fishermen. Following the collapse of the rock-lobster resource in the early 1990s, fishing has been controlled by a Total Allowable Catch (TAC), a minimum size, restricted gear, a closed season and closed areas (Crawford *et al.* 1987, Melville-Smith *et al.* 1995). The fishery is divided into an offshore sector comprised of trap boats that operate at a depth range of approximately 30 m to 100 m and a near-shore sector which makes use of hoopnets to a maximum fishing depth of about 30 m. The resource is managed geographically, with TACs set annually for different management areas. The fishery operates seasonally, with closed seasons applicable to different management zones. Figure 4.15 and Figure 4.164.15 show a summary of the overall national catch and effort data by fishing season and month, respectively.

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 mining operations which would be located offshore of the 100 m depth contour. The areas fished by bakkies (using hoopnets) in the vicinity of Sea Concession 6C are shown in

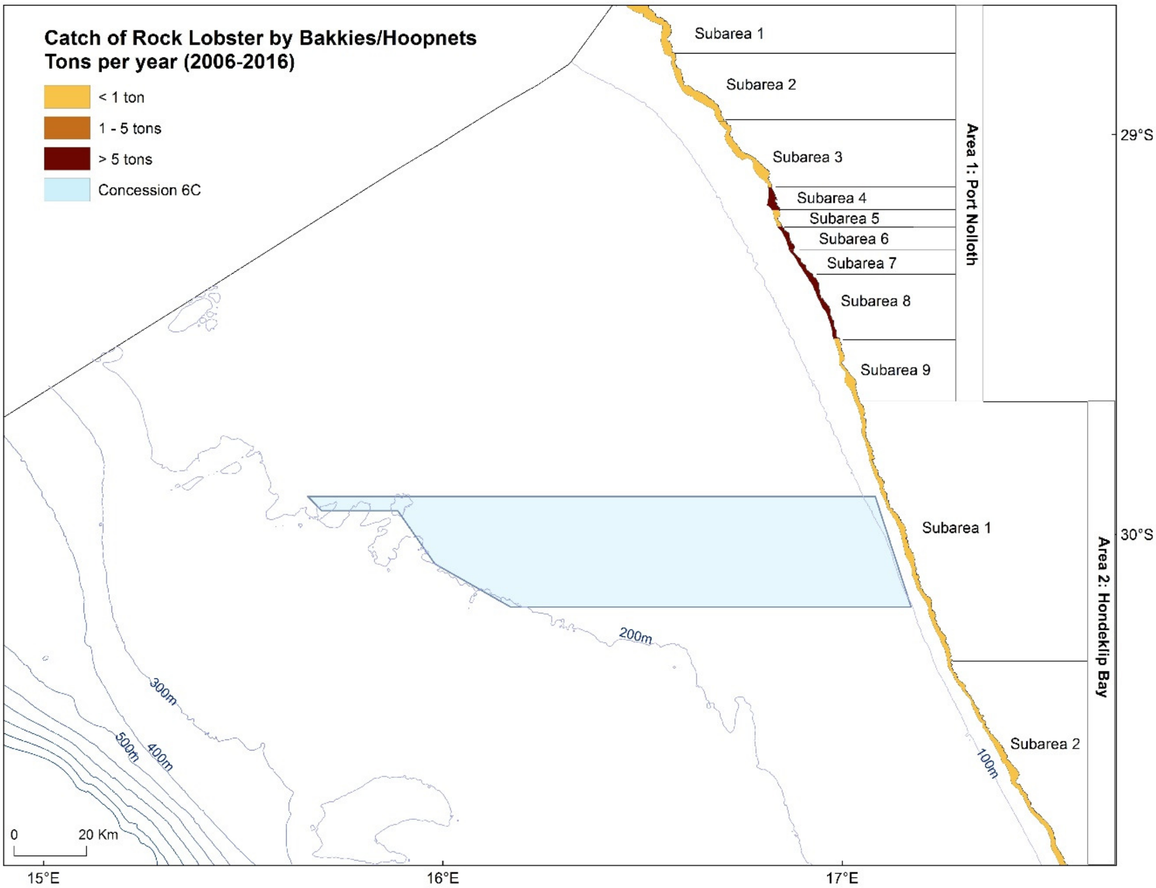

Figure 4.17.

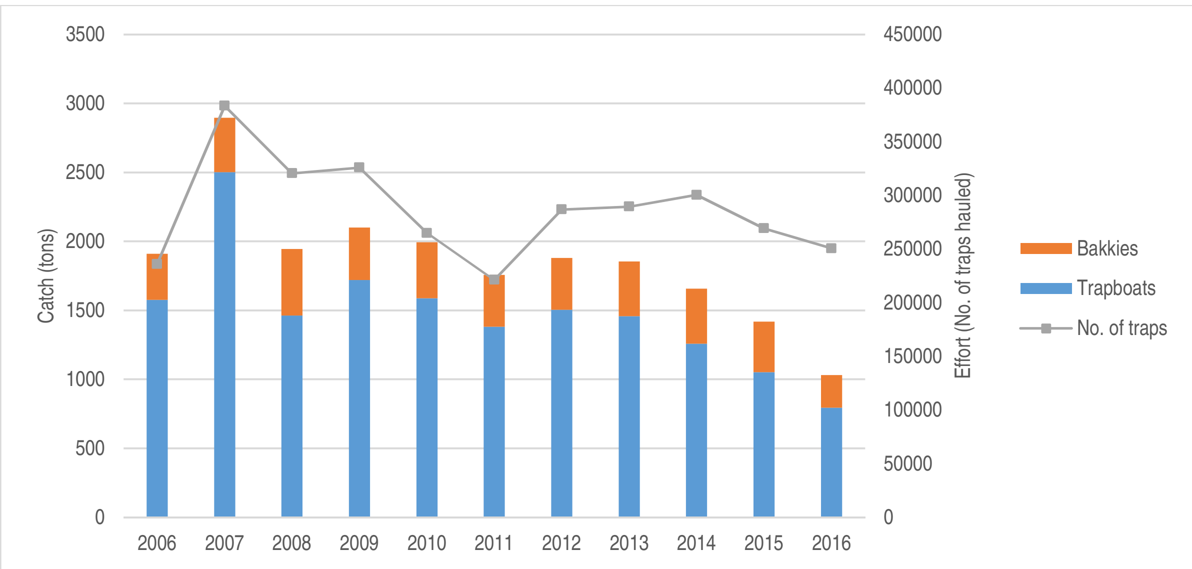

Figure 4.15: *Graph showing national catch recorded by the west coast rock lobster sectors for the period 2006 to 2016. Annual effort expenditure is indicated as the number of traps hauled.*

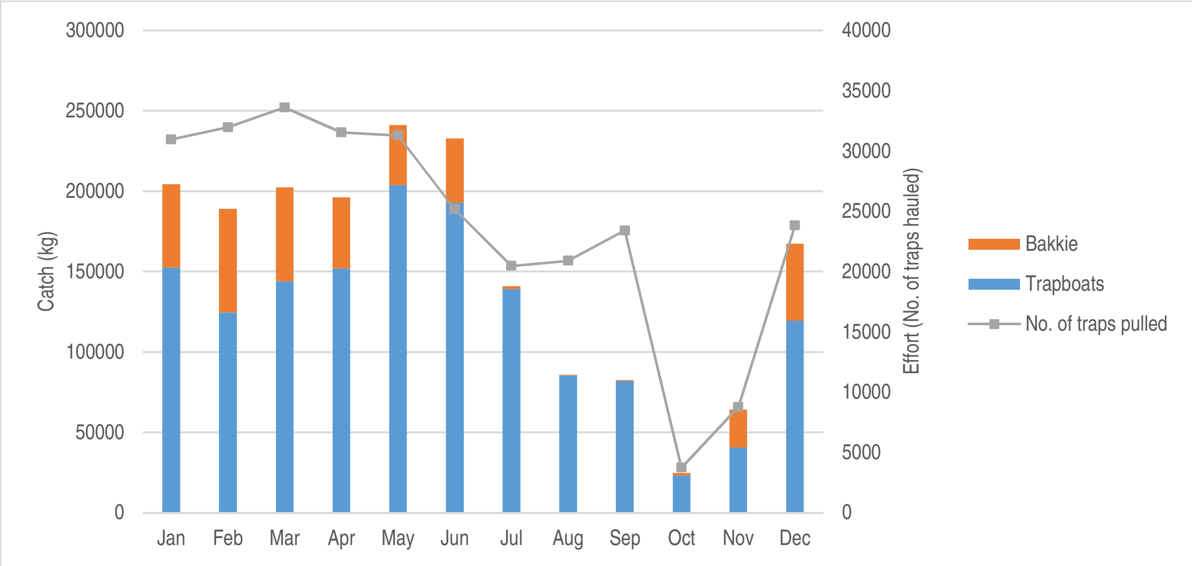

Figure 4.16: *Graph showing average monthly catch (kg) and effort (number of traps hauled) reported by the trapboat and bakkie sectors for west coast rock lobster over the period 2006 to 2016.*

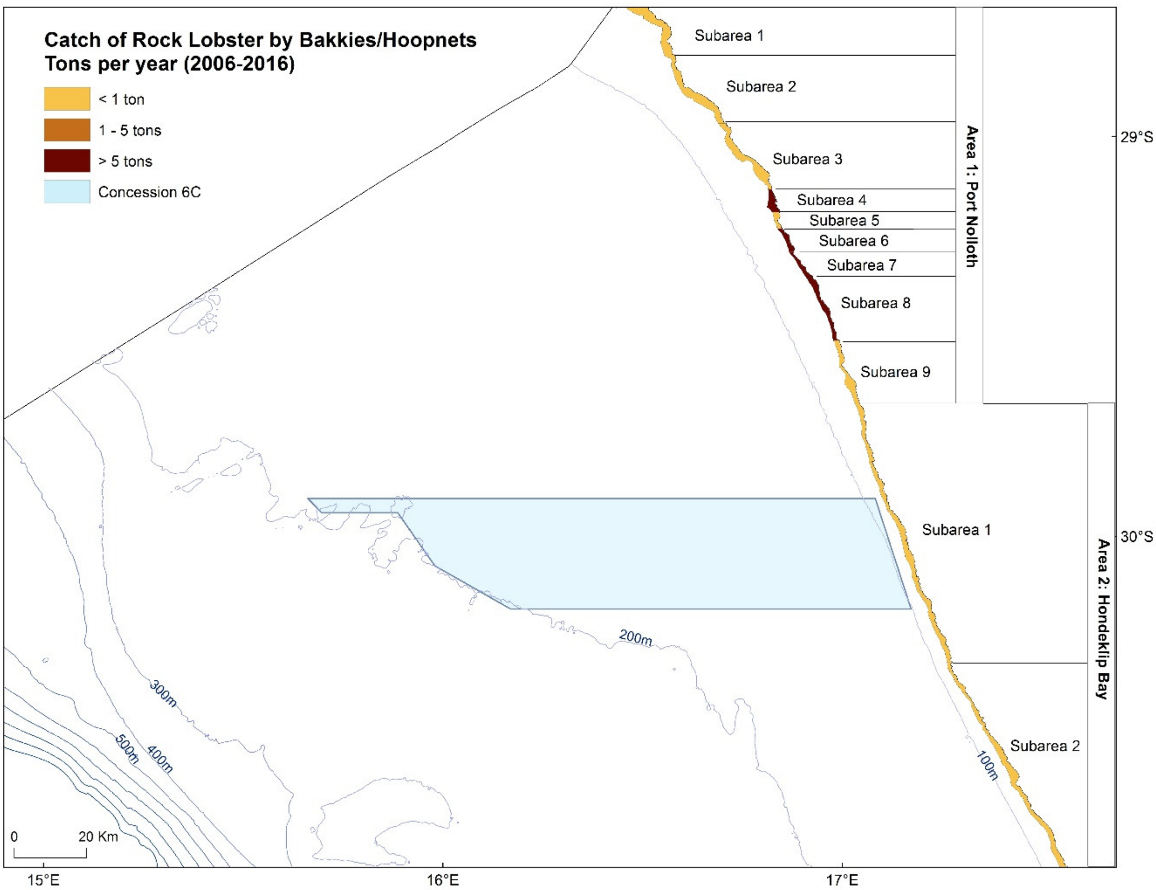

Figure 4.17: *Average catch per season (tons whole weight) of Jasus lalandii recorded by the nearshore (bakkie) sector for the years 2006 to 2016. Catch is shown by management subarea in relation to Sea Concession 6C.*

4.8 Abalone ranching

The Abalone *Haliotus midae*, is endemic to South Africa. The natural population extends along 1500 km of coastline 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). Translocation of abalone occurs along roughly 50 km of the Namaqualand coast in the Northern Cape due to the seeding of areas using cultured spat specifically for seeding of abalone in designated areas (ranching) (Anchor Environmental, 2012). The potential to increase this to seeded area to 175 km has been made possible through the issuing of "Abalone Ranching Rights" (Government Gazette, 20 August 2010 No. 729) in four concession zones for abalone ranching between Alexander Bay and Hondeklipbaai (Diamond Coast Abalone 2016).

H. midae inhabits intertidal and subtidal rocky reefs, with the highest densities found in kelp forests (Branch et al., 2010). 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 10m on the Namaqualand coast (Anchor Environmental, 2012).

Habitat preferences change as abalone develop. Larvae settle on encrusted coralline substrate and feed on benthic diatoms and bacteria (Shepherd and Turner, 1985). Juveniles of 3-10 mm are almost entirely dependent on sea urchins for their survival, beneath which they conceal themselves from predators such as the West Coast rock lobster (Sweijd, 2008; Tarr et al., 1996). Juveniles may remain under sea urchins until they reach 21-35 mm in size, after which they move to rocky crevices in the reef. Adult abalone remain concealed in crevices, emerging nocturnally to feed on kelp fronds and red algae (Branch et al., 2010). 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).

South Africa is the largest producer of abalone outside of Asia (Troell et al., 2006). For example, in 2001, 12 abalone farms existed, generating US$12 million at volumes of 500-800 tons per annum (Sales & Britz, 2001). By 2006, this number had almost doubled, with 22 permits granted and 5 more being scheduled for development (Troell et al., 2006). Until recently, abalone cultivation has been primarily onshore, but abalone ranching provides more cost effective opportunities for production (Anchor Environmental, 2012).

Abalone ranching is "where hatchery-produced seed are stocked into kelp beds outside the natural distribution" (Troell et al., 2006). 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 DAFF issued rights for each of four Concession Area Zones.

Abalone ranching includes the spawning, larval development, seeding and harvest. An onshore hatchery supports the ranching in the adjacent sea (Anchor Environmental, 2012). Two hatcheries exist in Port Nolloth producing up to 250 000 spat. To date, there has been no seeding in Zones 1 or 2. Seeding has taken place in Zones 3 and 4, both of which are situated inshore of Sea Concession 6C. See Figure 4.17 for a map showing Zones 1 – 4 in relation to Sea Concession 6C.

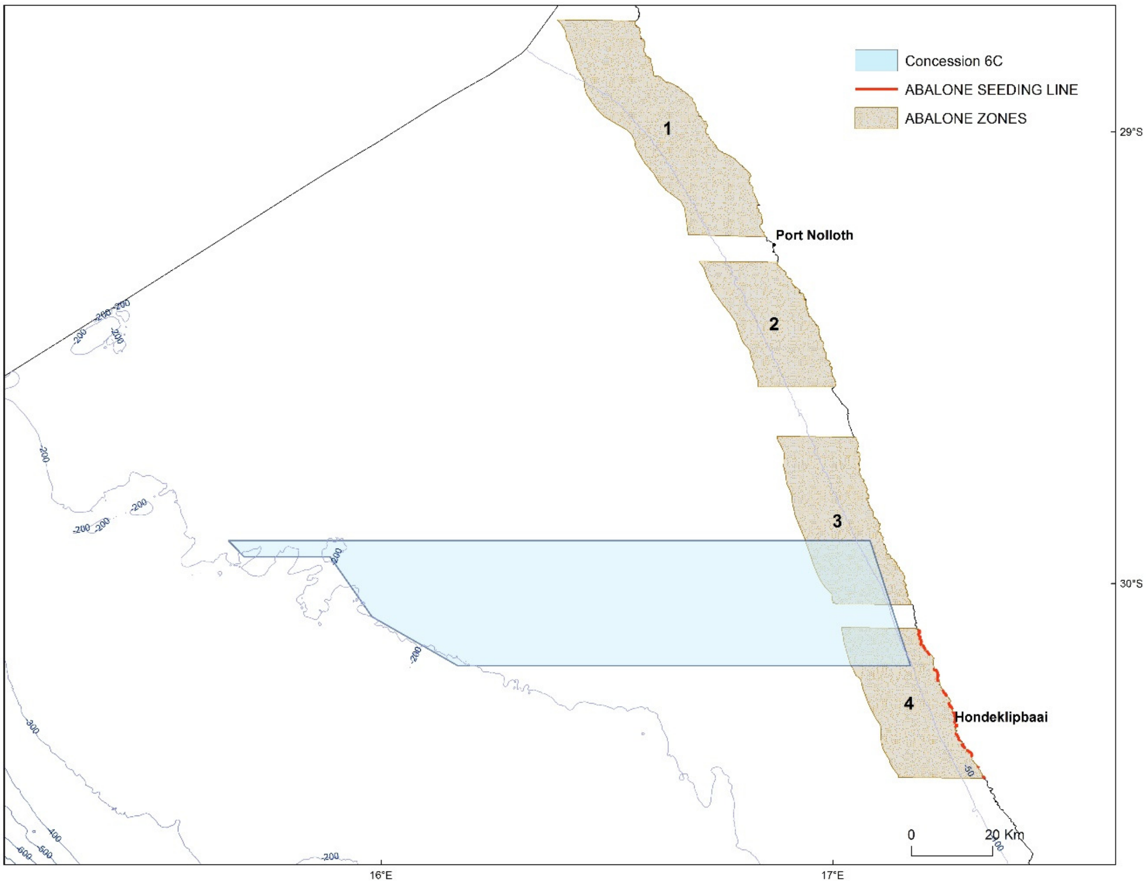

Figure 4.18: Location of abalone ranching concession areas in relation to Sea Concession 6C.

4.9 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. However, this group of people was not recognised in terms of the Marine Living Resources Act and were further marginalised through commercial fishing rights allocation processes. In 2007 government was compelled to redress the inequality suffered by the small scale fishers by means of an order from the Equality Court. Through extensive consultative processes the small-scale fisheries policy was finalised in 2012 with the implementation plan approved in 2013. 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. The equipment used by small-scale fishers includes rowing boats in some areas, motorized boats on the south and west coast and simple fishing gear including hands, feet, screw drivers, hand lines, prawn pumps, rods with reels, gaffs, hoop nets, gill nets, seine/trek nets and semi-permanently fixed kraal traps. Small-scale fishers are an integral part of the rural and coastal communities in which they reside and this is reflected in the socio-economic profile of such communities. 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 recommends 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 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.

4.10 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 utilize 1 373 registered and 458 illegal 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*). Catch-per-unit-effort declines eastwards from 294 and 115 $kg{\cdot}net{\cdot}day^{-1}$ for the beach-seine and gill-net fisheries respectively off the West Coast to 48 and 5 $kg{\cdot}net{\cdot}day^{-1}$ off KwaZulu-Natal. Consequently, the fishery changes in nature from a largely commercial venture on the West Coast to an artisanal/subsistence fishery on the East Coast (Lamberth *et al*. 1997).

The fishery is managed on a Total Allowable Effort (TAE) basis with a fixed number of operators in each of 15 defined areas (see Table 4.2 for the number of rights issued and Figure 4.18 for the fishing 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 linefish 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).

Table 4.2: Recommended Total Allowable Effort (TAE, number of rights and exemption holders) and rights allocated in 2016-17 for each netfish area. Levels of effort are based on the number of fishers who could maintain a viable income in each area (DAFF 2017).

Area	Locality	Beach-seine	Gill/drift	Total	Rights allocated
A	Port Nolloth	3	4	7	4
B	**Hondeklipbaai** The area between Kleinsee and the security fence at Mitchell's Bay nearby the mouth of the Spoeg River.	**0**	**2**	**2**	**0**
C	Olifantsriviermond-Wadrifsoutpansmond	2	8	10	4
D	Wadrifsoutpansmond-Elandsbaai-Draaihoek	3	6	9	6
E	Draaihoek, (Rochepan)-Cape Columbine, including Paternoster	4	80	84	84
F	Saldhana Bay	1	5	6	5
G	Langebaan Lagoon	0	10	10	10
H	Yzerfontein	2	2	4	1
I	Bokpunt (Melkbos)-Milnerton	3	0	3	1
J	Houtbay beach	2	0	2	0
K	Longbeach-Scarborough	3	0	3	1
L	Smitswinkel Bay, Simonstown, Fishoek	2	0	2	2
M	Muizenberg-Strandfontein	2	0	2	2
N	Macassar*	0	0	0	(1)
OE	Olifants River Estuary	0	45	45	45

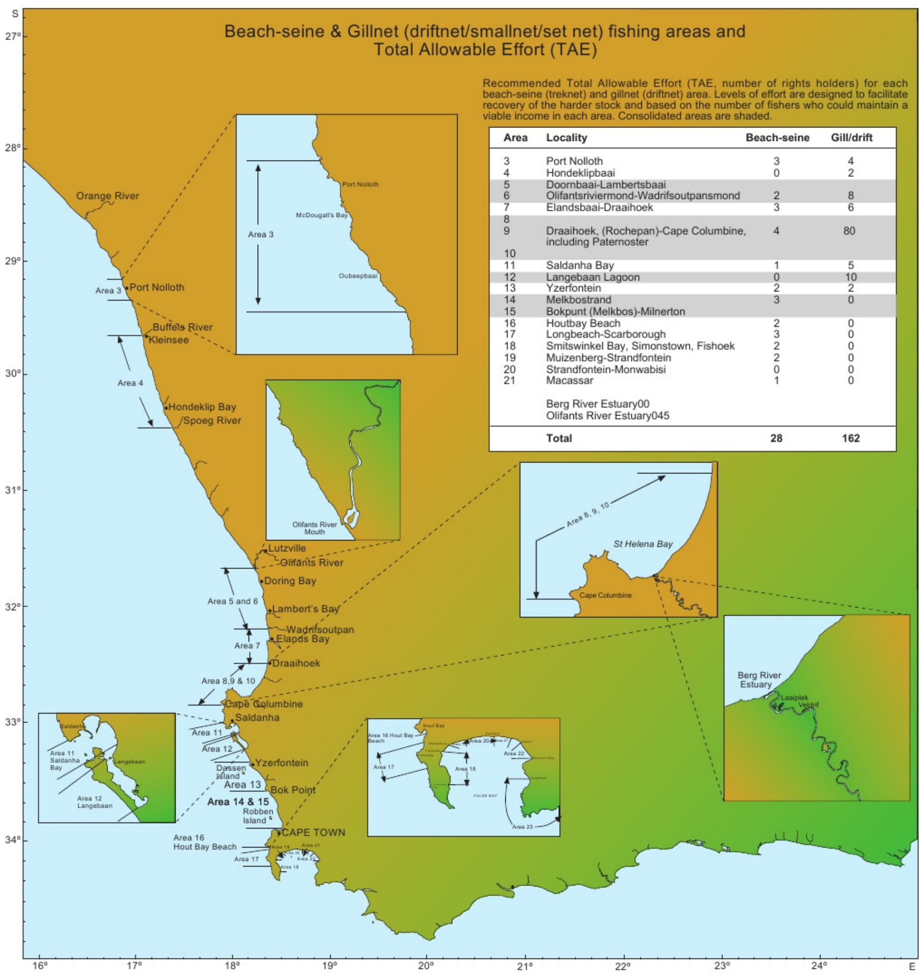

Figure 4.19: Beach-seine and gillnet fishing areas and TAE (DAFF, 2014).

Sea Concession 6C is situated offshore of management area B, however the range of gillnets (50 m) and that of beach-seine activity (20 m) is not likely to directly overlap with the concession area which is situated in waters deeper than 100 m. Figure 4.19 shows the expected range of gillnet fishing activity in relation to the concession area.

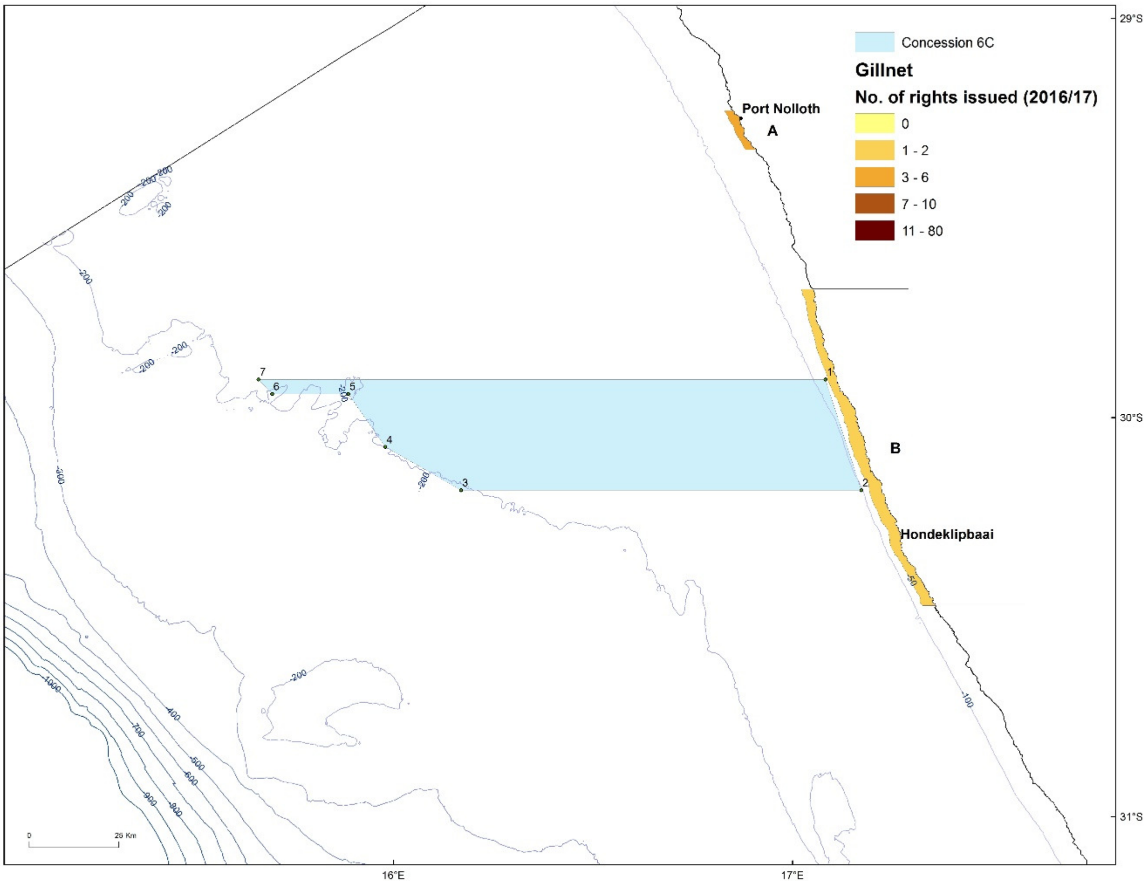

Figure 4.20: Number of rights issued for gillnet fishing areas A and B to a maximum depth of 50m (DAFF, 2016/17) in relation to Sea Concession 6C.

4.11 Seaweed

The South African seaweed industry is based on the commercial collection of kelps (*Ecklonia maxima* and *Laminaria pallida*) and red seaweed (*Gelidium* spp.) as well as small quantities of several other species. In the Northern and Western Cape, the industry is currently based on the collection of beach-cast kelps and harvesting of fresh kelps. Beach-cast red seaweeds were collected in Saldanha Bay and St Helena Bay, but there has been no commercial activity there since 2007. *Gelidium* species are harvested in the Eastern Cape (DAFF, 2014a).

The seaweed sector employs approximately 1 700 people, 92% of whom are historically disadvantaged persons. Much of the harvest is sun-dried, milled and exported for the extraction of alginate. Fresh kelp is also harvested in large quantities in the Western Cape as feed for farmed abalone. This resource, with a market value of about R6 million is critically important to local abalone farmers. Fresh kelp is also harvested for high-value plant-growth stimulants that are marketed locally and internationally.

Annual yields of commercial seaweeds over the period 2001 to 2015 are shown in Table 1.3. Harvesting rights are issued by management area. Whilst the Minister annually sets both a TAC and TAE for the sector, the principle management tool is effort control and the number of right holders in each *seaweed harvesting area is restricted. Fourteen commercial seaweed harvesting rights are currently allocated and each concession area is limited to one right-holder for each functional group of seaweed (e.g. kelps,* Gelidium *spp. and Gracilarioids). In certain areas there are also limitations placed on the amounts that may be harvested. The South African coastline is divided between Port Nolloth and Port St Johns into 23 harvesting areas (see*

Table 4.4 for yield of kelp by area for the 2012/13 season).

Table 1.3: Annual yields of commercial seaweeds in South Africa (2001 – 2015). "Kelp beach cast' refers to material that is collected in a semi-dry state, whereas 'kelp fresh beach cast' refers to clean, wet kelp fronds that, together with 'kelp fronds harvest', are supplied as abalone feed (DAFF).

Year	*Gelidium* (kg dry weight)	Gracilarioids (kg dry weight)	Kelp beach cast (kg dry weight)	Kelp fronds harvest (kg fresh weight)	Kelp fresh beach cast (kg fresh weight)	Kelpak (kg fresh weight)
2001	144 997	247 900	845 233	5 924 489	0	641 375
2002	137 766	65 461	745 773	5 334 474	0	701 270
2003	113 869	92 215	1 102 384	4 050 654	1 866 344	957 063
2004	119 143	157 161	1 874 654	3 119 579	1 235 153	1 168 703
2005	84 885	19 382	590 691	3 508 269	126 894	1 089 565
2006	104 456	50 370	440 632	3 602 410	242 798	918 365
2007	95 606	600	580 806	4 795 381	510 326	1 224 310
2008	120 247	0	550 496	5 060 148	369 131	809 862
2009	115 502	0	606 709	4 762 626	346 685	1 232 760
2010	103 903	0	696 811	5 336 503	205 707	1 264 739
2011	102 240	0	435 768	6 023 935	249 651	1 617 915
2012	108 060	0	871 139	5 226 258	1 396 227	1 788 881
2013	106 182	0	590 741	4 881 136		2 127 659
2014	81 500	0	676 301	5 235 800		1 911 263
2015	94 700	0	265 895	3 080 049		1 162 594

Table 4.4: Maximum sustainable yield of harvested kelp for all areas for the 2012 season (1 April 2012 – 30 March 2013).

Area Number	Whole kelp (t fresh weight)	Kelp fronds (t fresh weight)
5	2840	1420
6	0	4592
7	1421	710
8	2048	1024
9	2060	1030
10	188	94
11	3085	1543
12	50	25
13	113	57
14	620	310
15	**2200**	**1100**
16	620	310
18	2928	1464
19	765	383
Total	18 938	14 062

Concession 6C lies offshore of Kelp collection area 15. Permit conditions stipulate that within this area kelp may be harvested using a diver deployed from a boat or the shore but is not expected to coincide with the depth range at which divers could harvest kelp. No kelp plants with a stipe less than 50 cm long may be cut or harmed. Beach cast plants may be collected by hand. Over the period 2000 to 2017, an average of 40.33 tons per annum of dry harvested kelp (beach cast) and 34.67 tons per annum of wet harvested kelp were reported within collection area 15.

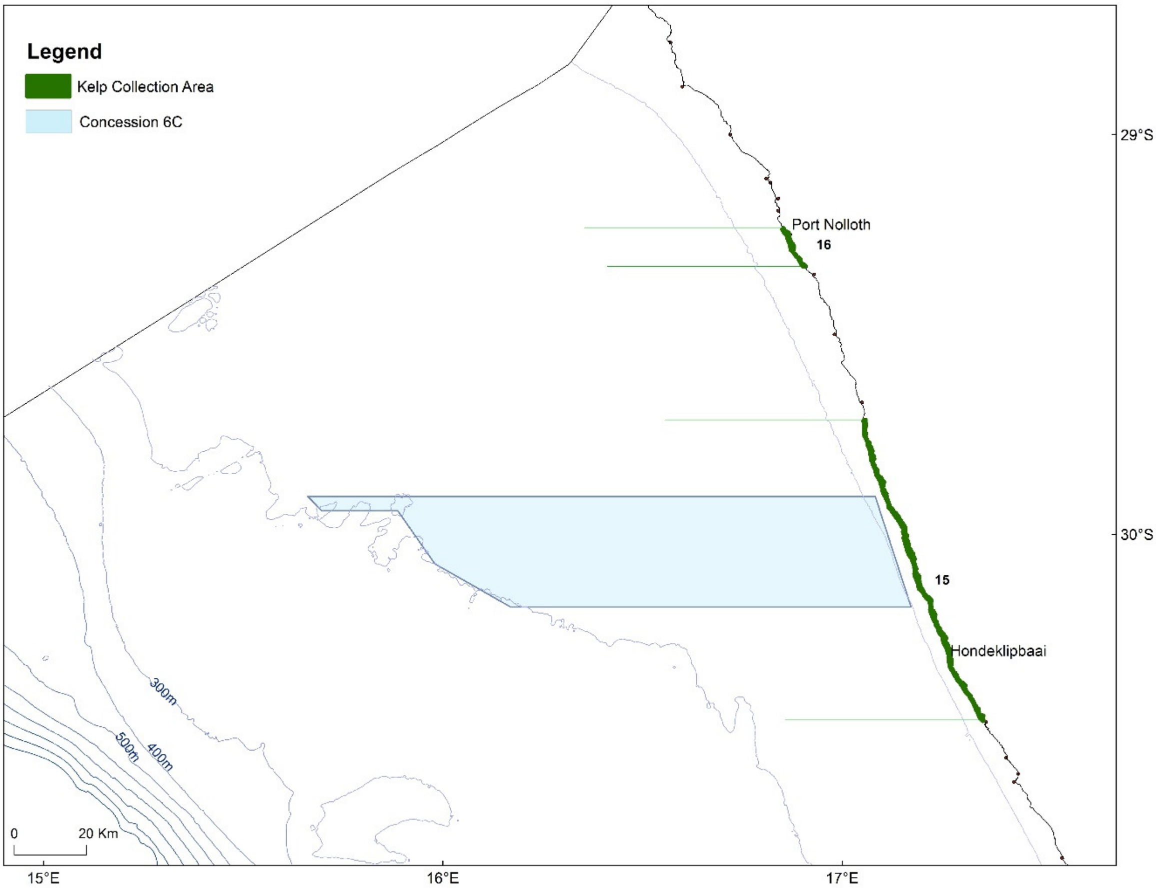

Figure 4.21: Location of seaweed rights areas in relation to Sea Concession 6C.

4.12 Fisheries research surveys

Swept-area trawl surveys of demersal fish resources are carried out twice a year by DAFF in order to assess stock abundance. Results from these surveys are used to set the annual TACs for demersal fisheries. First started in 1985, the West Coast survey extends from Cape Agulhas (20°E) to the Namibian maritime boarder and takes place over the duration of approximately one month during January. The survey of the Southeast coast (20°E – 27°E longitude) takes place in April/May. Following a stratified, random design, 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. Trawl positions are randomly selected to cover specific depth strata that range from the coast to the 1 000 m isobath. Approximately 120 trawls are conducted during each survey and the location of these trawls is pre-determined usually a week before the cruise is scheduled to take place. Figure 4.21 shows the distribution of research trawls undertaken in relation to the Sea Concession 6C.

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 4.22**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. As acoustic biomass surveys take place inshore of the 200 m isobath.

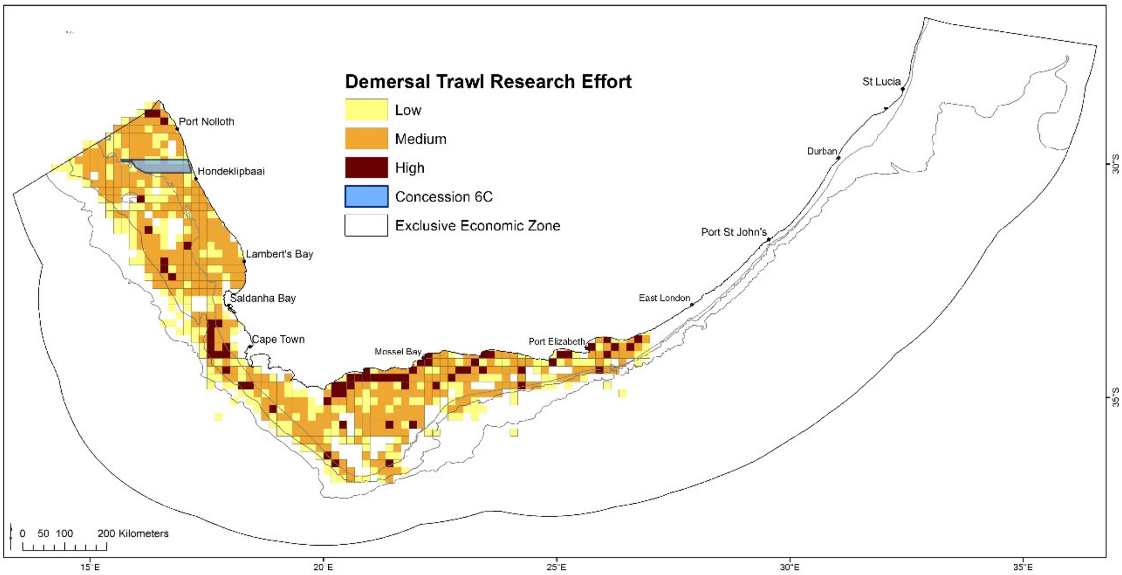

Figure 4.221: Spatial distribution of trawling effort expended during research surveys undertaken by DAFF to ascertain biomass of demersal fish species in relation to Sea Concession 6C. The bathymetric contours shown are 200m, 500m and 2000m.

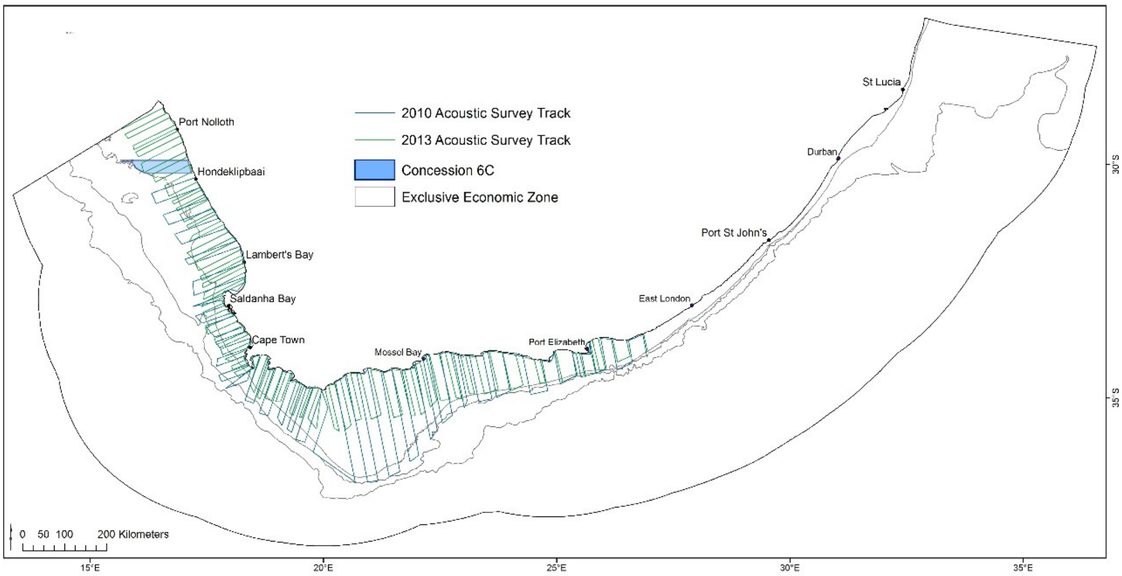

Figure 4.232: Spatial distribution of tracks undertaken during biomass surveys of small pelagic species undertaken by DAFF during 2010 and 2013. The survey transects are shown in relation to Sea Concession 6C. The bathymetric contours shown are 200m, 500m and 2000m.

5. Impact Assessment

This chapter describes and assesses the significance of potential impacts related to the proposed exploration activities in Sea Concession 6C. All impacts are assessed according to the rating scale defined in Section 5.1. Where appropriate, mitigation measures are proposed, which could ameliorate the negative impacts or enhance potential benefits, respectively. The status of all impacts should be considered negative unless otherwise stated. The significance of impacts with and without mitigation is assessed.

5.1 Assessment Procedure

The following convention was used to determine significance ratings in the assessment:

Rating	Definition of Rating
***Intensity** – establishes whether the magnitude of the impact is destructive or benign in relation to the sensitivity of the receiving environment*	
Zero to Very Low	Negligible change, disturbance or nuisance. The impact affects the environment in such a way that natural functions and processes are not affected.
Low	Minor (Slight) change, disturbance or nuisance. The impact on the environment is not detectable.
Medium	Moderate change, disturbance or discomfort. Where the affected environment is altered, but natural functions and processes continue, albeit in a modified way.
High	Prominent change, disturbance or degradation. Where natural functions or processes are altered to the extent that they will temporarily or permanently cease.
***Duration** – the time frame over which the impact will be experienced*	
Short-term	<5 years
Medium-term	5 – 15 years
Long-term	>15 years, but where the impact will eventually cease either because of natural processes or by human intervention
Permanent	Where mitigation either by natural processes or by human intervention would not occur in such a way or in such time span that the impact can be considered transient
***Extent** – defines the physical extent or spatial scale of the impact*	
Local	Extending only as far as the activity, limited to the site and its immediate surroundings
Regional	Impacts are confined to the region; e.g. coast, basin, etc.
National	Limited to the coastline of South Africa
International	Extending beyond the borders of South Africa
Reversibility – defines the potential for recovery to pre-impact conditions	
Irreversible	Where the impact is permanent
Partially Reversible	Where the impact can be partially reversed
Fully Reversible	Where the impact can be completely reversed
***Probability** – the likelihood of the impact occurring*	
Improbable	Where the possibility of the impact to materialise is very low either because of design or historic experience, i.e. ≤ 30% chance of occurring.
Possible	Where there is a distinct possibility that the impact would occur, i.e. > 30 to ≤ 60% chance of occurring.
Probable	Where it is most likely that the impact would occur, i.e. > 60 to ≤ 80% chance of occurring.
Definite	Where the impact would occur regardless of any prevention measures, i.e. > 80% chance of occurring.

Rating	Definition of Rating
***Degree of confidence in predictions** – in terms of basing the assessment on available information and specialist knowledge*	
Low	Less than 35 % sure of impact prediction.
Medium	Between 35 % and 70 % sure of impact prediction.
High	Greater than 70 % sure of impact prediction
Degree to which impact can be mitigated - the degree to which an impact can be reduced / enhanced	
None	No change in impact after mitigation.
Very Low	Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact.
Low	Where the significance rating drops by one level, after mitigation.
Medium	Where the significance rating drops by two to three levels, after mitigation.
High	Where the significance rating drops by more than three levels, after mitigation.
Loss of resources - the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable	
Low	Where the activity results in a loss of a particular resource but where the natural, cultural and social functions and processes are not affected.
Medium	Where the loss of a resource occurs, but natural, cultural and social functions and processes continue, albeit in a modified way.
High	Where the activity results in an irreplaceable loss of a resource.

Using the core criteria above (namely *extent, duration and intensity)*, the consequence of the impact is determined:

***Consequence** – attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity*	
VERY HIGH	Impacts could be EITHER: of high intensity at a regional level and endure in the long term; OR of high intensity at a national level in the medium term; OR of medium intensity at a national level in the long term.
HIGH	Impacts could be EITHER: of high intensity at a regional level enduring in the medium term; OR of high intensity at a national level in the short term; OR of medium intensity at a national level in the medium term; OR of low intensity at a national level in the long term; OR of high intensity at a local level in the long term; OR of medium intensity at a regional level in the long term.
MEDIUM	Impacts could be EITHER: of high intensity at a local level and endure in the medium term; OR of medium intensity at a regional level in the medium term; OR of high intensity at a regional level in the short term; OR of medium intensity at a national level in the short term; OR of medium intensity at a local level in the long term; OR of low intensity at a national level in the medium term; OR of low intensity at a regional level in the long term.
LOW	Impacts could be EITHER of low intensity at a regional level, enduring in the medium term; OR of low intensity at a national level in the short term; OR of high intensity at a local level and endure in the short term; OR of medium intensity at a regional level in the short term; OR of low intensity at a local level in the long term; OR of medium intensity at a local level, enduring in the medium term.

Consequence – attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity	
VERY LOW	Impacts could be EITHER of low intensity at a local level and endure in the medium term; OR of low intensity at a regional level and endure in the short term; OR of low to medium intensity at a local level, enduring in the short term; OR Zero to very low intensity with any combination of extent and duration.
UNKNOWN	Where it is not possible to determine the significance of an impact.

The consequence rating is considered together with the probability of occurrence in order to determine the overall significance using the table below.

		PROBABILITY			
		IMPROBABLE	**POSSIBLE**	**PROBABLE**	**DEFINITE**
CONSEQUENCE	**VERY LOW**	INSIGNIFICANT	INSIGNIFICANT	VERY LOW	VERY LOW
	LOW	VERY LOW	VERY LOW	LOW	LOW
	MEDIUM	LOW	LOW	MEDIUM	MEDIUM
	HIGH	MEDIUM	MEDIUM	HIGH	HIGH
	VERY HIGH	HIGH	HIGH	VERY HIGH	VERY HIGH

***Nature of the Impact** – describes whether the impact would have a negative, positive or zero effect on the affected environment*	
Positive	The impact benefits the environment
Negative	The impact results in a cost to the environment
Neutral	The impact has no effect

Type of impacts assessed:

Type of impacts assessed	
Direct (Primary)	Impacts that result from a direct interaction between a proposed project activity and the receiving environment.
Secondary	Impacts that follow on from the primary interactions between the project and its environment as a result of subsequent interactions within the environment (e.g. loss of part of a habitat affects the viability of a species population over a wider area).
Indirect	Impacts that are not a direct result of a proposed project, often produced away from or as a result of a complex impact pathway.
Cumulative	*Additive*: impacts that may result from the combined or incremental effects of future activities (i.e. those developments currently in planning and not included as part of the baseline).
	In-combination: impacts where individual project-related impacts are likely to affect the same environmental features. For example, a sensitive receptor being affected by both noise and drill cutting during drilling operations could potentially experience a combined effect greater than the individual impacts in isolation.

The relationship between the significance ratings after mitigation and decision-making can be broadly defined as follows:

Significance of residual impacts after Mitigation - *considering changes in intensity, extent and duration after mitigation and assuming effective implementation of mitigation measures*	
Very Low; Low	Activity could be authorised with little risk of environmental degradation.
Medium	Activity could be authorised with conditions and inspections.
High	Activity could be authorised but with strict conditions and high levels of compliance and enforcement.
Very High	Potential fatal flaw

5.2 Identification of Impacts

The potential impacts to the fishing industry of the proposed geophysical prospecting operations are changes to the catchability of fish related to the effects of noise generated during the survey.

The potential impacts to the fishing industry of the sampling operations relate to the temporary exclusion from fishing grounds due to a safety zone that would be effected around the mining vessel.

5.3 Assessment of Impacts

5.3.1 Impact of Exclusion of Fishing Operations

Description of Impact

While the mining vessel is operational at a given location, a temporary 500 m operational safety zone around the unit would be in force, i.e. no other vessels (except the support vessels) may enter this area. A vessel conducting marine mining operations would typically operate on a 3 or 4 anchor spread with unlit anchor mooring buoys. For the duration of mining operations a coastal navigational warning would be issued by the South African Navy Hydrographic Office (SANHO) requesting a 2 nautical mile clearance from the mining vessel. The safety zones aim to ensure the safety both of navigation and of the mining vessel, avoiding or reducing the probability of accidents caused by the interaction of fishing boats and gears and the vessel. This safety zone could impact fisheries through the exclusion of fishing vessels from localised areas of Sea Concession 6C for the duration of the activities.

The exclusion of vessels from entering the safety zone around a mining vessel poses a direct impact to fishing operations in the form of loss of access to fishing grounds. Although the concession area coincides with the designated management areas of the West Coast rock lobster, abalone ranching, netfish and seaweed sectors, the depths exploited by these fisheries are less than 100 m and therefore would not be expected to be affected. The following sectors could be affected by exclusion from fishing grounds:

Demersal longline

Based on the commercial catch and effort data submitted by the demersal longline fishery over the period 2000 and 2017, favoured fishing grounds are situated at least 20 km from the north-western and 40 km from the south-western extents of Sea Concession 6C. Sporadic fishing has been reported within the concession area during this time, amounting to an average of one line set per year and approximately 4 tons of catch. This is equivalent to some 0.05% of the total landing of hake by the sector per year over this period. There is no overlap of the concession area with fishing grounds for demersal shark species targeted by demersal longline.

Tuna pole

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.

Traditional linefish

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 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 ~ 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.

Fisheries research

Both demersal research trawls and acoustic surveys could be affected by exclusion from Sea Concession 6C. Demersal surveys are random depth-stratified and adaptable. 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.

Assessment

The impact of exclusion from fishing ground is expected to be of very low consequence for the demersal longline, tuna pole, traditional linefish and fisheries research sectors and the overall significance of the impact on these fisheries is expected to be very low. There is no impact expected on the small pelagic purse-seine, demersal trawl, large pelagic longline, west coast rock lobster, abalone, netfish or seaweed sectors.

Impacts of Preclusion from Fishing Ground		
	Without Mitigation	**Assuming Mitigation**
Intensity	Medium	Low to Medium
Duration	Short-term: for duration of survey	Short-term
Extent	Local: limited to sampling area	Local
Consequence	Very Low	Very Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Possible	Possible
Confidence	Medium	Medium
Nature of Cumulative impact	No cumulative impacts are anticipated during the sampling phase	
Reversibility	Fully reversible	
Loss of resources	Negligible	
Mitigation potential	Very Low	

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 minimises or avoid disruptions to both parties, where required.

- Prior to the commencement of the proposed 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.
- 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;
- Any fishing vessel targets at a radar range of 12 nautical miles from the sampling vessel should be called via radio and informed of the navigational safety requirements; and
- Affected parties should be notified through fishing industry bodies when the programme is complete.

5.3.2 Impact of Sediment Plume on Fish Stock Recruitment

Description of Impact

The sampled seabed sediments are pumped to the surface and discharged onto sorting screens on the sampling vessel. The screens separate the fine sandy silt and large gravel, cobbles and boulders from the size fraction of interest, the ‘plantfeed’ (usually 2 - 20 mm). The fine tailings are immediately discarded overboard where they form a suspended sediment plume in the water column which dissipates with time. The ‘plantfeed’ is mixed with a high density ferrosilicon (FeSi) slurry and pumped under pressure into a Dense Medium Separation (DMS) plant resulting in a high density concentrate. The majority of the ferrosilicon is magnetically recovered for re-use in the DMS plant and the fine tailings (-2 mm) from the DMS process are similarly deposited over board. Furthermore, fine sediment re-suspension by the sampling tools will generate suspended sediment plumes near the seabed. The main effect of plumes is an increase in water column turbidity. The relevance of this in terms of effects on fisheries is the potential impairment of egg and/or larval development through high sediment loading.

Assessment

Typically fisheries stock recruitment is highly variable and shows a strong spatial and temporal signal. For example, this variability would apply to the small pelagic species that comprise the largest commercial fishery by volume on the West Coast of South Africa. Spawning and recruitment of these small pelagic species as well as of many demersal species occurs primarily well to the south of Concession 6C.

The spawn products 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, referred to as nursery areas. These areas provide a suitable niche for development of juveniles of these species. Most of the species potentially impacted are broadcast spawners, with large volumes of spawn products being dispersed over large areas. This would apply equally, for example, to west coast rock lobster, hake and sardine.

Sea Concession 6C is situated offshore of the 100 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. Whereas sediment plumes would result in a negative impact on stock recruitment, the impact on fish recruitment is considered to be of very low consequence and of overall insignificance due to the localised nature of the proposed sampling events in relation to fish nursery areas. Since the impact is unlikely to result in a significant impact on fish stock recruitment, mitigation against this impact is not considered necessary.

Impacts of Sediment Plume on Fish Stock Recruitment		
	Without Mitigation	**Assuming Mitigation**
Intensity	Medium	Medium
Duration	Short-term: for duration of sampling	Short-term
Extent	Local: limited to sampling area	Local
Consequence	Very Low	Very Low
Significance	Insignificant	Insignificant
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium
Nature of Cumulative impact	No cumulative impacts are anticipated during the sampling phase	
Reversibility	Fully reversible	
Loss of resources	Negligible	
Mitigation potential	None	

5.3.3 Acoustic Impacts of Geophysical Surveying

Description of Impact

The ocean is a naturally noisy place and marine animals are continually subjected to both physically produced sounds from sources such as wind, rainfall, breaking waves and natural seismic noise, or biologically produced sounds generated during reproductive displays, territorial defence, feeding, or in echolocation (see references in McCauley 1994). Such acoustic cues are thought to be important to many marine animals in the perception of their environment as well as for navigation purposes, predator avoidance, and in mediating social and reproductive behaviour. Anthropogenic sound sources in the ocean may thus interfere directly or indirectly with such activities. Of all human-generated sound sources, the most persistent in the ocean is the noise of shipping. Depending on size and speed, the sound levels radiating from vessels range from 160 to 220 dB re 1 µPa at 1 m (NRC 2003). Especially at low frequencies between 5 to 100 Hz, vessel traffic is a major contributor to noise in the world's oceans, and under the right conditions, these sounds can propagate 100s of kilometres thereby affecting very large geographic areas (Coley 1994, 1995; NRC 2003; Pidcock *et al.* 2003). Other forms of anthropogenic noise include 1) aircraft flyovers, 2) multi-beam sonar systems, 3) seismic acquisition, 4) hydrocarbon and mineral exploration and recovery, and 5) noise associated with underwater blasting, pile driving, and construction.

The cumulative impact of increased background anthropogenic noise levels in the marine environment is an ongoing and widespread issue of concern (Koper & Plön 2012). Recent international research has shown that noise energy generated during seismic surveys may cause physiological damage and/or behavioural responses from fish and invertebrates (Caroll et al 2017). Threshold levels for underwater noise impacts on fish have focused on the potential for physiological effects (injury or mortality) rather than on quantifying noise levels with behavioural effects. A review of the literature and guidance on appropriate thresholds for assessment of underwater noise impacts are provided in the 2014 Acoustical Society of America (ASA) Technical Report *Sound Exposure*

Guidelines for Fishes and Sea Turtles (ASA, 2014). Reactions of fish to different types of anthropogenic sounds have been reviewed by Hawkins et al. (2015), who concluded that more information is required on the effects of man-made sounds on the distribution of fishes and their capture by different fishing gears as effects differ across species, fishing ground and habitat type.

The acoustic impact of the proposed geophysical surveying on marine fauna has been assessed by Pisces (2018). The findings of the Marine Fauna Assessment report are that the noise generated by the acoustic equipment utilized during geophysical surveys would fall within the hearing range of most fish, and at sound levels of between 190 to 220 dB re 1 µPa at 1 m, would be audible for considerable distances (in the order of tens of km) before attenuating to below threshold levels (Findlay 2005). However, unlike the noise generated by airguns during seismic surveys, the emission of underwater noise from geophysical surveying and vessel activity would not be considered to be of sufficient amplitude to cause auditory or non-auditory trauma in marine fauna in the region. Only directly below the systems (within metres of the sources) would sound levels be in the 220 dB range where exposure could result in trauma. As most pelagic species likely to be encountered within the concessions are highly mobile, they would be expected to flee and move away from the sound source before trauma could occur.

Similarly, the sound level generated by seabed crawler operations would fall within the 120-190 dB re 1 µPa range at the sampling unit, with main frequencies less than 0.2 kHz. The noise generated by sampling operations would therefore fall within the hearing range of most fish, and would be audible for considerable ranges (in the order of tens of kms) before attenuating to below threshold levels (Table 5.1). In a study evaluating the potential effects of vessel-based diamond mining on the marine mammals community off the southern African West Coast, Findlay (1996) concluded that the significance of the impact is likely to be minimal based on the assumption that the radius of elevated noise level would be restricted to ~20 km around the mining vessel.

Table 5.1: Known hearing frequency and sound production ranges of various marine taxa (Pisces, 2018 adapted from Koper & Plön 2012).

Taxa	Order	Hearing frequency (kHz)	Sound production (kHz)
Shellfish	Crustaceans	0.1 – 3	-
Snapping shrimp	*Alpheus/ Synalpheus* spp.	-	0.1 - >200
Ghost crabs	*Ocypode* spp.	-	0.15 – 0.8
Fish	Teleosts	-	0.4 – 4
Hearing specialists	-	0.03 - >3	-
Hearing generalists	-	0.03 – 1	-
Sharks and skates	Elasmobranchs	0.1 – 1.5	Unknown

<u>Assessment</u>

The effects of high frequency sonars on catchability of fish is considered to be localised, short-term (for duration of survey i.e. weeks) and of medium intensity. The significant of the impact is considered to be very low 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. The impact of underwater noise is considered of very low significance without mitigation.

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

Impacts of multi-beam and sub-bottom profiling sonar on catchability of fish		
	Without Mitigation	**Assuming Mitigation**
Intensity	Medium	Low
Duration	Short-term: for duration of survey	Short-term
Extent	Local: limited to survey area	Local
Consequence	Very Low	Very Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium
Nature of Cumulative impact	Any direct impact is likely to be at individual level rather than at species level.	
Reversibility	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.	
Loss of resources	Negligible	
Mitigation potential	Low	

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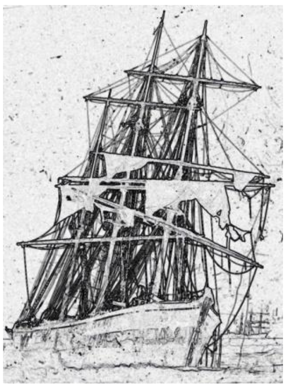
APPENDIX E: UNDERWATER HERITAGE IMPACT ASSESSMENT

Underwater Heritage Impact Assessment for Marine Prospecting Areas off the West Coast of South Africa



UNDERWATER HERITAGE IMPACT ASSESSMENT FOR MARINE PROSPECTING AREAS OFF THE WEST COAST OF SOUTH AFRICA

NORTHERN CAPE

SOUTH AFRICA

Report #:	2017/WC/001
Status:	Interim
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Declaration:

I, Vanessa Maitland, declare that I have no financial or personal interest in the proposed development, nor its developers or any of their subsidiaries, apart from the provision of heritage assessment and management services.

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GLOSSARY OF ACRONYMS

ASAPA	Association of Southern African Professional Archaeologists
DBCM	De Beers Consolidated Mines
EIA	Environmental Impact Assessment
HIA	Heritage Impact Assessment
MPA	Marine Prospecting Area
MUCH	Maritime and Underwater Cultural Heritage (Includes underwater and land maritime heritage)
NHRA	National Heritage Resources Act (No. 25 of 1999)
NM	Nautical Mile
SASA	South African Sea Areas Marine Diamond Concessions
UHIA	Underwater Heritage Impact Assessment

1. INTRODUCTION

De Beers Consolidated Mines (DBCM) holds prospecting rights, under the Mineral and Petroleum Resources Development Act (2002) within the South African Seas Areas (SASA). These include the specific areas, inshore portion of 4C, inshore portion of 5C and 6C. The South African Heritage Resources Agency has requested a Heritage Impact Assessment (HIA) or more specifically an Underwater Heritage Impact Assessment (UHIA) on the designated area.

This report fulfils Section 38 of the National Heritage Resources Act (NHRA) (25 of 1999) which states that an assessment of potential heritage resources in the development area needs to be done. It is a desktop survey of existing shipwreck databases in the areas, as delineated in Section 5. It concludes with recommended management measures for the area, in terms of cultural heritage resources.

2. TERMS OF REFERENCE

The aim of this desktop survey is to determine if there are any known shipwrecks within the defined areas.

The scope of work consisted of the following:

- Desktop study, consisting of a database of known and suspected wrecks in the area ascertained through study of available written and oral resources

The objectives were to:

- Identify potential MUCH sites within the designated area
- Recommend management measures for sites before and during development

3. HERITAGE RESOURCES

3.1. The Legislation

According to Section 32 (1) of the NHRA (No. 25 of 1999), heritage objects consist of:
"An object or collection of objects, or a type of object or list of objects, whether specific or generic, that is part of the national estate and the export of which SAHRA deems it necessary to control, may be declared a heritage object, including— *(a)* objects recovered from the soil or waters of South Africa, including archaeological and paleontological objects, meteorites and rare geological specimens."

The Act further stipulates that the term "archaeological" includes:
"wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation."

Section 35 of the Act states:
"(1) Subject to the provisions of section 8, the protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority: Provided that the protection of any wreck in the territorial waters and the maritime cultural zone shall be the responsibility of SAHRA.
(2) Subject to the provisions of subsection (8)*(a)*, all archaeological objects, palaeontological material and meteorites are the property of the State. The responsible heritage authority must, on behalf of the State, at its discretion ensure that such objects are lodged with a museum or other public institution that has a collection policy acceptable to the heritage resources authority and may in so doing establish such terms and conditions as it sees fit for the conservation of such objects.
(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.
(4) No person may, without a permit issued by the responsible heritage resources authority—

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;"
(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or
(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites."

Furthermore Section 38 of the Act states:
"(1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as—
(a) the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
(b) the construction of a bridge or similar structure exceeding 50 m in length;
(c) any development or other activity which will change the character of a site—
(i) exceeding 5 000 m2 in extent; or
(ii) involving three or more existing erven or subdivisions thereof; or
(iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
(iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
(d) the re-zoning of a site exceeding 10 000 m2 in extent; or
(e) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.
(2) The responsible heritage resources authority must, within 14 days of receipt of a notification in terms of subsection (1)—
(a) if there is reason to believe that heritage resources will be affected by such development, notify the person who intends to undertake the development to submit an impact assessment report. Such report must be compiled at the cost of the person proposing the development, by a person or persons approved by the responsible heritage resources authority with relevant qualifications and experience and professional standing in heritage resources management; or
(b) notify the person concerned that this section does not apply.
(3) The responsible heritage resources authority must specify the information to be provided in a report required in terms of subsection (2)*(a)*: provided that the following must be included:
(a) The identification and mapping of all heritage resources in the area affected;
(b) an assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6(2) or prescribed under section 7;
(c) an assessment of the impact of the development on such heritage resources;
(d) an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
(e) the results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;
(f) if heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and
(g) plans for mitigation of any adverse effects during and after the completion of the proposed development.
(4) The report must be considered timeously by the responsible heritage resources authority which must, after consultation with the person proposing the development, decide—
(a) whether or not the development may proceed;
(b) any limitations or conditions to be applied to the development;

(c) what general protections in terms of this Act apply, and what formal protections may be applied, to such heritage resources;

(d) whether compensatory action is required in respect of any heritage resources damaged or destroyed as a result of the development; and

(e) whether the appointment of specialists is required as a condition of approval of the proposal.

(5) A provincial heritage resources authority shall not make any decision under subsection (4) with respect to any development which impacts on a heritage resource protected at national level unless it has consulted SAHRA.

(6) The applicant may appeal against the decision of the provincial heritage resources authority to the MEC, who—

(a) must consider the views of both parties; and

(b) may at his or her discretion—

(i) appoint a committee to undertake an independent review of the impact assessment report and the decision of the responsible heritage authority; and

(ii) consult SAHRA; and

(c) must uphold, amend or overturn such decision.

(7) The provisions of this section do not apply to a development described in subsection (1) affecting any heritage resource formally protected by SAHRA unless the authority concerned decides otherwise.

(8) The provisions of this section do not apply to a development as described in subsection (1) if an evaluation of the impact of such development on heritage resources is required in terms of the Environment Conservation Act, 1989 (Act No. 73 of 1989), or the integrated environmental management guidelines issued by the Department of Environment Affairs and Tourism, or the Minerals Act, 1991 (Act No. 50 of 1991), or any other legislation: Provided that the consenting authority must ensure that the evaluation fulfils the requirements of the relevant heritage resources authority in terms of subsection (3), and any comments and recommendations of the relevant heritage resources authority with regard to such development have been taken into account prior to the granting of the consent.

(9) The provincial heritage resources authority, with the approval of the MEC, may, by notice in the *Provincial Gazette*, exempt from the requirements of this section any place specified in the notice.

(10) Any person who has complied with the decision of a provincial heritage resources authority in subsection (4) or of the MEC in terms of subsection (6) or other requirements referred to in subsection (8), must be exempted from compliance with all other protections in terms of this Part, but any existing heritage agreements made in terms of section 42 must continue to apply."

3.2. Conclusion – The legislation in terms of the project

There is extensive national legislation covering MUCH sites. Within the scope of this project, Section 38 of the NHRA (25 of 1999), states that an assessment of potential heritage resources in the concession area needs to be done. This is the purpose of the desktop study. These processes identify potential MUCH sites. If a potential MUCH site is uncovered during the work, a maritime archaeologist needs to be contacted to assess the find. Thereafter, in conjunction with SAHRA, a decision will be made regarding the significance of the site. If it is deemed to be culturally significant, the prospector can apply to the Maritime Unit of SAHRA for a permit for removal, excavation or destruction in terms of Section 35 of the NHRA.

4. STUDY APPROACH AND METHODOLOGY

4.1. Extent of the Assessment

This desktop survey is concerned with MUCH and covers the area as described in Section 5. However, as shipwrecks are a difficult cultural resource to pin to a specific area, this UHIA covers the entire SASA area, excluding the 5km wide coastal zone.

4.2. Methodology

4.2.1. Desktop Survey

A shipwreck database was compiled from the available written and oral sources and is available in Section 6.

Limitations

- The database is a research tool that is constantly evolving as information is uncovered and added.
- The solitary nature of many wrecks means that information may be scarce and/or inaccurate. Therefore, without definitive information, shipwrecks are allocated to an area, based on limited information and certain assumptions regarding the dynamic nature of the environment.
- Shipwrecks that may initially be considered outside of the area, may drift more many miles on the surface or just under the water surface after being abandoned. Therefore, these are also included in the Desktop Survey.

5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

Site Location and Description

The concessions, 4C, 5C and 6C are situated on the west coast of South Africa, approximately between alexander Bay in the north and Hondeklip Bay in the south. The areas start 5km offshore and stretch for between 80 and 130km offshore. The bathymetry of the seabed varies from 60m and 180m below mean sea level (De Beers Marine 2017).

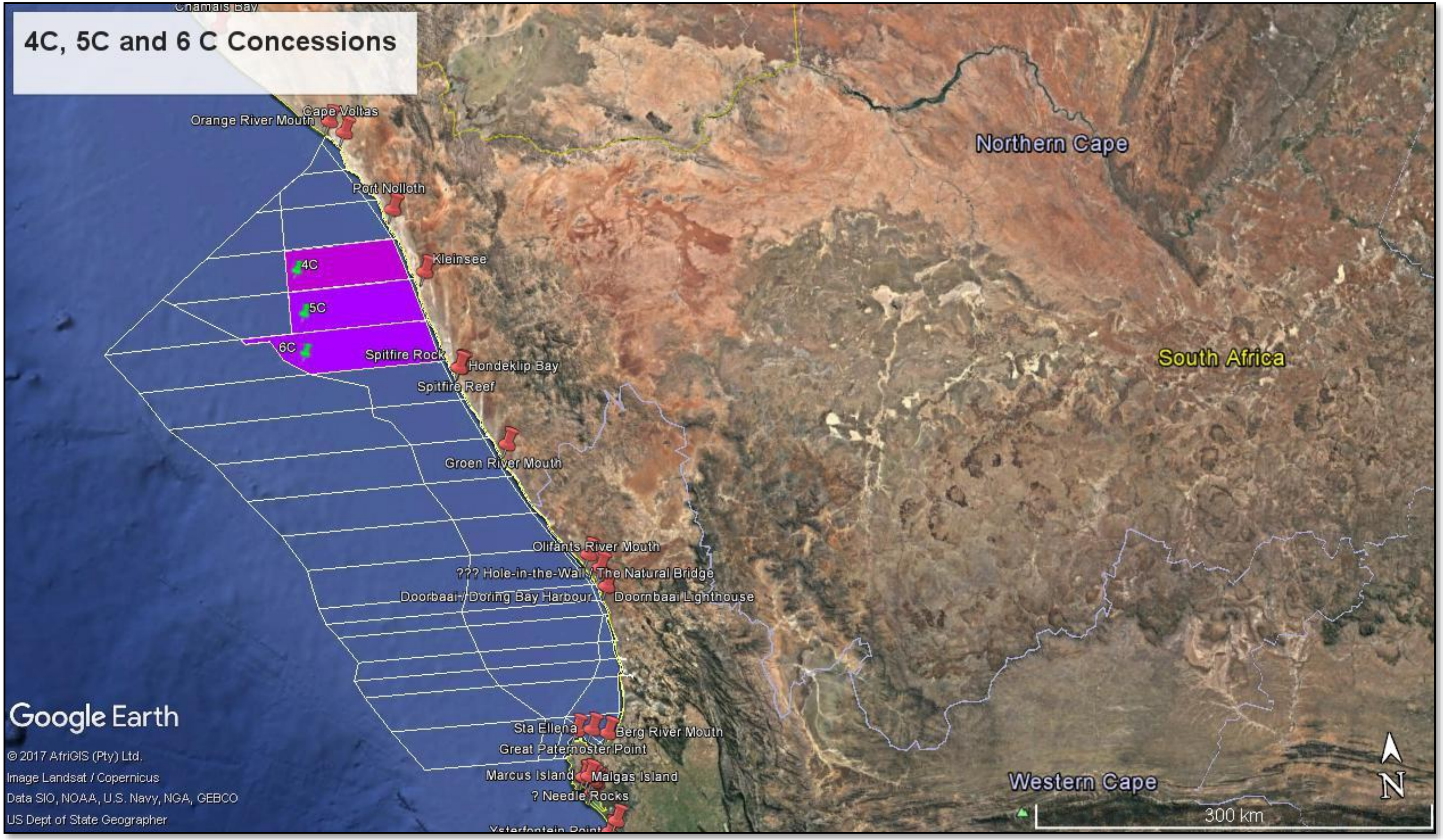

Figure 1: SASA showing concessions 4C – 6C marked (De Beers Marine 2017; Google Earth 2017)

6. SHIPWRECK DATABASE

The nature of the environment, poor historical reporting and the length of time since the wrecks occurred means that underwater cultural heritage sites may literally be anywhere and are thus hard to pinpoint with any accuracy beforehand. It is important to have a database because if MUCH sites are uncovered during the project, it will be easier to identify the wreck and thus assess its cultural and historical significance.

There are several points to bear in mind when compiling and making use of any shipwreck database.

- The first recorded European voyages down the west coast of Africa were by the Portuguese. When the Portuguese first sent out their explorers, they stuck close to the coastline, in order to map the land. The present-day Cape Voltas may be a survival of the Portuguese name Volta das Angras. Dias and his fleet passed the Orange River Mouth in 1487/1488 (Axelson 1973). Thereafter, the rate of exploration and trade increased exponentially, as is evidenced by the increase in shipwrecks over the centuries.
  These early voyages were not well documented, and the archives often merely report that a fleet of a certain number of vessels left and only a certain amount returned, with only vague references to their place and manner of loss.
  Therefore, there are many undocumented wrecks. This statement is borne out by the Cabral Fleet of 1500 (#11-14 below).
- There is some anecdotal evidence that the Phoenicians circumnavigated Africa (Herodotus 1954). However, if this is true, these ships had to stick right to the coastline and therefore are unlikely to be far offshore.
- There's increasing evidence that the Chinese voyages of the 1400s explored parts if not all of the African coast (Paine 2013). However, once again the archival evidence to date, and availability to Western researchers, limits this knowledge.
- The term, "off", used in reference to a shipwreck location was often merely the nearest known land location and could be 200km from that landmark, in any direction.
- Databases can vary considerably in their locations and information regarding shipwrecks. Where there are discrepancies, I try to track the source of the information to verify the data. Where this is not possible, certain databases are, in general, more accurate and reliable than others. If at all possible, I always try to independently verify database information.
- There are many wrecks within the unsure category. These are ships that were abandoned or last seen in the Atlantic. An abandoned vessel did not necessarily sink after abandonment. There are numerous historical accounts of captains noting the presence of "hulks", these are abandoned vessels, usually half sunk, that drift on the currents, a danger to seaworthy vessels. There are also several accounts of captains coming across abandoned vessels that were then boarded and sailed to the nearest port. Ergo, I have included vessels that were abandoned in certain latitudes that may have caught currents that pushed them towards the west coast of Africa where they may have washed ashore.

The Shipwreck Database uses a number of conventions to assess the impact of projects on heritage resources (Appendix I). The important ones, in terms of this project are:

Certainty of prediction:

- **Definite:** More than 90% sure of a particular fact. Substantial supportive data to verify assessment
- **Probable:** More than 70% sure of a particular fact, or of the likelihood of that impact occurring
- **Possible:** Only more than 40% sure of a particular fact, or of the likelihood of an impact occurring
- **Unsure:** Less than 40% sure of a particular fact, or the likelihood of an impact occurring

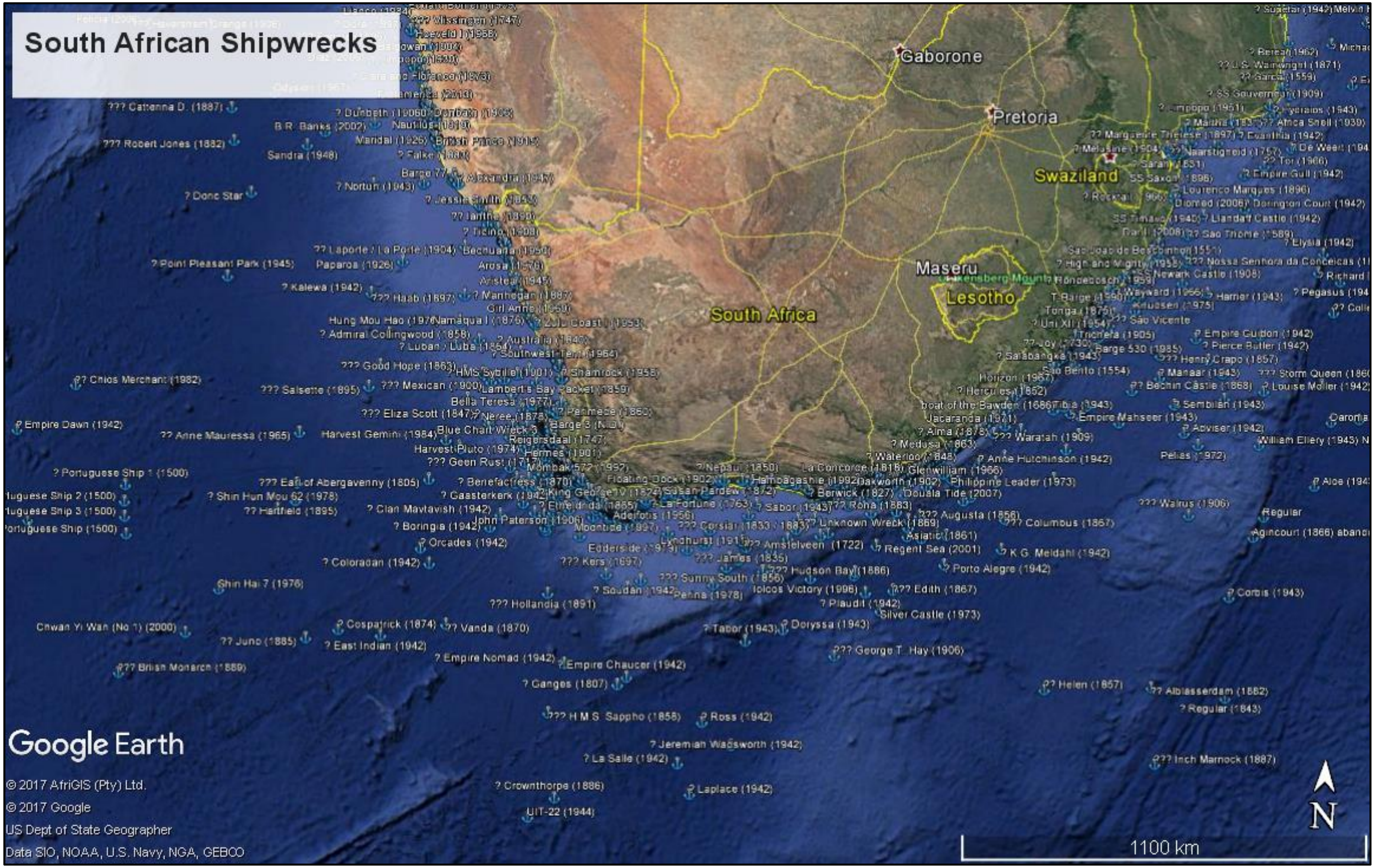

Figure 2: South African Shipwrecks (Google Earth 2017; Wallace 1929; Turner 1988; Levine 1989; van den Bosch 2009; SAHRIS 2017; Reocities 2017; Maitland 2017; u-boat.net 2017)

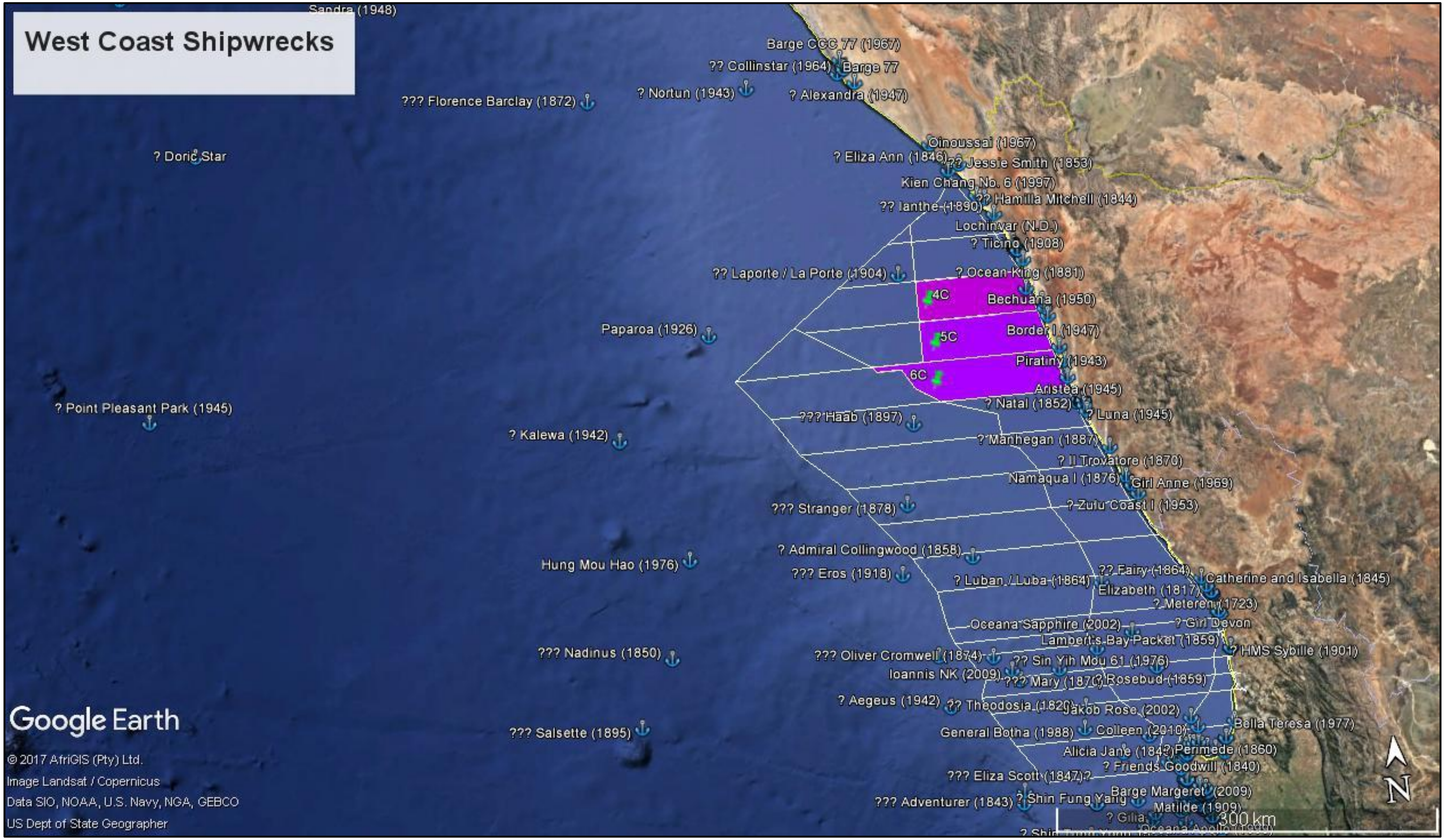

Figure 3: West Coast Shipwrecks (Google Earth 2017; De Beers Marine 2017; Wallace 1929; Turner 1988; Levine 1989; van den Bosch 2009; SAHRIS 2017; Reocities 2017; Maitland 2017; u-boat.net 2017)

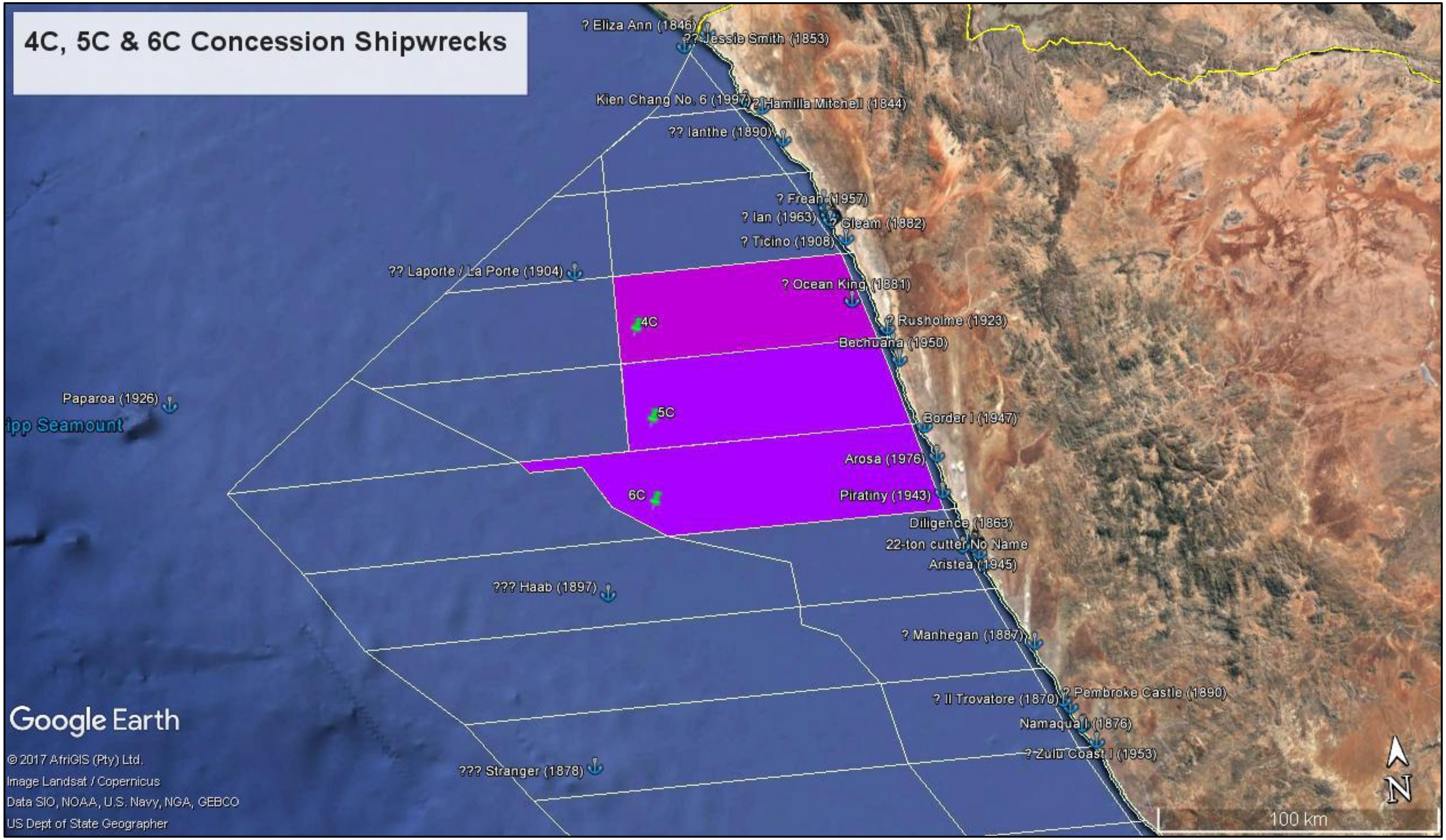

Figure 4: Concessions 4C, 5C and 6C Shipwrecks (Google Earth 2017; De Beers Marine 2017; Wallace 1929; Turner 1988; Levine 1989; van den Bosch 2009; SAHRIS 2017; Reocities 2017; Maitland 2017; u-boat.net 2017)

#	Name	Events	Nation	Date	History	Location
6.1 Shipwrecks definitely in the Concessions 4C-6C						
Not Applicable						
6.2 Shipwrecks possibly in the Concessions 4C-6C						
1	*Eros*	Foundered	Britain	1918	This 174-ton steel steamer had been sent to the Cape for the Namaqua Copper Company. After several voyages, she was laid up in order to alter her specifications. On 25 May, she left Table Bay for Port Nolloth under Captain Robert Brooks. However, she foundered en-route and one man died. (Levine 1989) According to van den Bosch (2009), the vessel is off Port Nolloth and according to the Miramar Ship Index (2009), she is off Lambert's Bay The information is contradictory and further research may show that she grounded on the coast. However, she is included here for the moment.	Either off Port Nolloth or "off' Lamberts Bay (see Section 6 above)
2	*Haab*	Abandoned	Norway	1897	This 861-ton wooden barque was according to Levine (1989) grounded on Dassen Island. However, according to van den Bosch (2009), she was abandoned 260.5 NM off Table Bay and may be off Dassen Island. The problem with this assumption, is that Dassen Island is only c. 35 NM from Table Bay (i.e the Port). 260.5 NM means that the vessel was abandoned in the SASA, near concession 5C and therefore may be in or near 5C.	Co-ordinates worked out on 260.5 NM, however this is an **approximation**. 29° 49.902'S 16° 40.070'E**
3	*Jessie Smith*	Swept out, sank	Britain	1853	Owned by J.O. Smith, built in 1845, this 226-ton British brig under Captain W. Baxter was engaged in the copper trade from the Namaqualand coast. She was anchored in Alexander Bay when a storm drove her from her anchorage. Four men were drowned but the owner, captain and some of the crew managed to reach shore with "great difficulty". (Levine 1989). One may surmise from the above that the vessel was swept out to sea and that the men left the brig before she sank. Therefore, it is possible that the wreck may be somewhere in the concession area 4C.	Somewhere off Alexander Bay, Orange River Mouth
4	*Ocean King*	Grounded, sank	Britain	1881	This 419-ton barque, built in 1859, under Captain Evans was bound from Swansea with a cargo of coal. She apparently hit a reef about 3-4 miles (6.4 – 8km) offshore and about 20 miles (32km) south of Port Nolloth. Although the barque sank within 20 minutes, all aboard survived. The Board of Trade Wreck Report of 1881 (van den Bosch 2009) states that their charts do not record a reef in this area. The Blue Chart Marine Maps also do not record a reef within this vicinity. However, the BlueChart (2016) maps do note that this is a Crayfish Trap Fishing Area. According to the Two Oceans Aquarium website (2017), the West Coast rock lobster (*Jasus lalandii*) are shallow water (up to 50m) lobsters that are caught using baited lobster pots. They inhabit rock reefs and kelp	**Approximate** area 29.47567 S 16.89444 E*, potentially uncharted rocky reefs. *Note: These co-ordinates are estimates based on the reported position of the wreck by the survivors

#	Name	Events	Nation	Date	History	Location
					forests. According to BlueChart (2016), the depth in this area is 78 – 110m deep. Therefore, although there may be an uncharted rocky reef within this area that rises near the surface of the sea, it is more likely that the wreck occurred closer inshore. This vessel may be in the 4C concession.	
5	*Laporte / La Porte*		London	1904	This 2448-ton steamer belonging to the Colorado Steamship Company, was built in 1902 at the Grangemouth & Greenock Dockyard Company. Under Captain H.J. Hill, she was on a voyage from Cardiff for Cape Town with coal when she foundered in a north-westerly gale. The surviving crew report that she was approximately 160km from shore and 80km north of Port Nolloth. Of the 23 crew, only 12 made it to Port Nolloth in a lifeboat. (Levine 1989). According to van den Bosch (2009), the vessel suffered an explosion 43.2 NM north of Port Nolloth and 100m from shore. According to the Miramar Ship Index (2009), she sank 50 NM west of Port Nolloth. As can be seen, although the available information is contradictory, it is possibly within the Port Nolloth area.	All **approximations** 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**

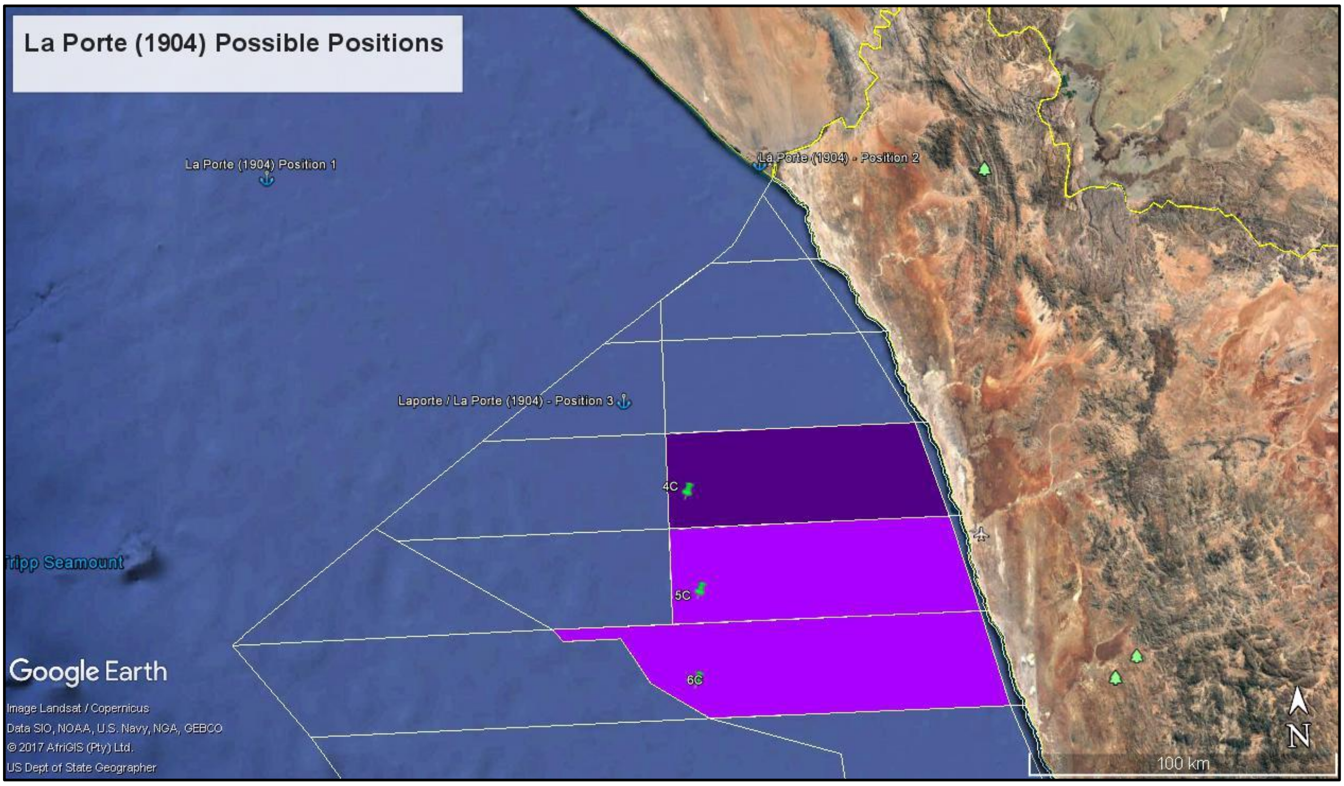

Figure 5: La Porte (1904) Possible Positions (Google Earth 2017)

6.3 Shipwrecks in the Concessions 4C-6C that have an unsure prediction certainty

6	*Adventurer*	Wrecked	Britain?	1843	From Sandown Bay (Isle of Wright?) to Table Bay or Algoa Bay. The Reocities website states the vessel was lost west of Saldanha. But the newspaper states lost in Sandown Port. I e-mailed Ann Barrett (Isle of Wright) to see if she can confirm or not that the wreck is there. The vessel is not listed in Lloyds as per Levine	West of Saldanha, along the west coast or Sandown Bay (RSA) or Isle of Wright

#	Name	Events	Nation	Date	History	Location
					(1989). Ann Barret responded that the wreck is not on their local lists. The wreck may be in the South African Sandown Bay near Kleinmond, Western Cape. All that is known for sure is that it was lost between Britain and one of the South African ports. Therefore, I am leaving it in the database pending further research	
7	*Admiral Collingwood*	Foundered	Britain	1858	This 360-ton barque under Captain Smith was bound from London for Algoa Bay when she apparently foundered 320km off St Helena Bay. (Levine 1989) This may put her somewhere in the SASA.	West Coast
8	*Aegeus*	Torpedoed, sank	Greece	1842	This 3 792-ton steamship left Trinidad for Saldanha Bay and then Durban. She never arrived. After WWII, German records indicated that she was torpedoed by the U-177 at 32º 30´ s 16º 00´ E. (Levine 1989; van den Bosch 2009) These co-ordinates are just west of the SASA and is where the U-boat reports torpedoing the vessel, not necessarily where she sank. In addition, the co-ordinates mentioned are subject to the technical limitations of the period.	West Coast
9	*Australia*	Fire, sank	Britain?	1840	This 250-ton brig, under Capt. A. Yule was built in Dundee, Scotland in 1839. She was on her maiden voyage to Australia with passengers and cargo when the vessel caught fire and sank, apparently 9.6 nautical miles (NM), north of the Olifants River Mouth. However, she was 800 km west of the Cape of Good Hope when the fire broke out. The twenty-eight passengers and crew entered the lifeboats shortly before she was overwhelmed by the flames. A boy died at sea and a man died after they made land at Olifants River after nine days at sea. Farmers helped the survivors to reach Cape Town. (van den Bosch 2009) Ergo this vessel could be in the concession area.	West Coast
10	*British Monarch*	Fire, abandoned	Britain	1889	The 1262-ton iron barque under Captain Morrow was on a voyage from Hamburg to Sydney with a general cargo. She was abandoned at 37º58´ S 05º20´ E. The crew took to the boats and stayed with the burning vessel until she exploded and sank. One of the boats with six crew aboard disappeared. Two days later some of the surviving crew were picked up by an American whaler, the *Canton*. The whaler took them to within 50km of Cape Town, where apparently, they were reloaded into their boats and had to make their own way to Cape Town. Their entire ordeal lasted 18 days. (Levine 1989; van den Bosch 2009) This vessel is left in the database as the co-ordinates are not necessarily very accurate and by staying with the burning vessel, drift needs to be taken into account.	West Coast

#	Name	Events	Nation	Date	History	Location
11 – 14	*Cabral Fleet*	Lost	Portugal	1500	Levine (1989) states: "Thirteen vessels under command of Pedro Alvares Cabral – the first Portuguese fleet which sailed annually to the Indies – and found Brazil. Twenty days after the fleet sailed from Brazil, it was struck by storms and four ships, including the one under command of Bartolomeu Dias, foundered. Duffy [Shipwrecks and Empire, 1955] writes that the ships were lost off the Cape of Good Hope, but, according to Axelson [Levine cites personal correspondence], the fleet could not have been off the Cape of Good Hope then; they would have been in the vicinity of the shortly-to-be-discovered islands of Tristao da Cunha." There is such scant and contradictory information regarding the loss of these four vessels that I am including them in this database.	Disappeared
15	*Catterina D.*	Fire, abandoned	Austria	1887	This 610-ton barque from Liverpool for Cape Town with a cargo of coal caught fire. She was apparently abandoned before she sank, 480km west of Hottentot Point. The Captain and crew reached Walvis Bay in the lifeboats. (Levine 1989) As she was abandoned before she sank, this vessel is included in the database.	West Coast
16	*Columbine*	Torpedoed, sank	South Africa	1944	This 3 268-ton steamship owned by the South African government was initially a German vessel. She was seized at the start of WWII. On 16 June 1944, she had 52 people on board when she was torpedoed by the U-198. 23 people died when their lifeboat capsized, including two naval officer wives. The co-ordinates for her torpedoing are 32º 44´ S and 17º 22´ E. (Levine 1989; van den Bosch 2009) These co-ordinates are in the southern end of the SASA and is where the U-boat reports torpedoing the vessel, not necessarily where she sank. In addition, the co-ordinates mentioned are subject to the technical limitations of the period.	West Coast
17	*Earl of Abergavenny*	Lost	Britain	1805	This English East Indiaman, under Captain J. Wordsworth was lost "off the Cape Coast" (van den Bosch 2009).	Disappeared off Cape Coast
18	*Juno*	Fire, abandoned	Sweden	1885	The 1274-ton schooner, under Captain T. Keyller was bound from Norway for Melbourne with a cargo of deals (timber). She caught fire and was abandoned at approximately 37 24.00S,11 30.00E. the 22-man crew took to the lifeboats and set off towards the Cape. The currents washed them towards the Orange River. They attempted to beach the lifeboat 32km south of the river but capsized and there were only four survivors. These four were picked up by the *Namaqua* and taken to Cape Town. (Levine 1989; van den Bosch 2009). It follows that if the current brought the lifeboat towards the Orange River, that the same	Abandoned

#	Name	Events	Nation	Date	History	Location
					principle could apply to the abandoned schooner.	
19	*Florence Barclay*	Fire, abandoned	Britain	1872	This 243-ton barque was built in 1866. Under Captain J.H. Voller, she was bound from Hull for Table Bay and Mauritius. Somewhere off the west coast, the vessel caught fire and was abandoned. The crew were in three lifeboats, one of which disappeared during the first night at sea. The other two boats arrived at Pomona Island (Namibia) three days later. The survivors were taken to Table Bay by the *Lilla*. (Levine 1989) As the crew beached only 120km north of the concession areas, I have included this vessel.	West Coast
20	*Glenogle*	Fire, abandoned	Britain	1901	According to van den Bosch (2009), this 914-ton steel barque caught fire and was abandoned at 34 38.00S,03 40.00E. The Equatorial current which runs west to east here could have pulled the abandoned vessel into the Benguela current and up the west coast.	Abandoned
21	*Good Hope*	Fire, sank	Cape?	1863	I have very little information on this wreck. Only that she was a Cape trader and burned at sea. (van den Bosch 2009)	Burnt at Sea
22	*Hartfield*	Fire, sank	Britain	1895	According to van den Bosch (2009) and Levine (1989), this 852-ton iron barque caught fire at 34 30.00S,11 30.00E, 259 NM west of Table Bay. The Equatorial current which runs west to east here could have pulled the abandoned vessel into the Benguela current and up the west coast.	West Coast
23	*Joachim*	Fire, abandoned	German	1868	Apparently the 763-ton barque under Captain Helenmeyer was on a voyage from Bremen to Rangoon with a cargo of coal. When she “burnt off the Cape”. Her crew were rescued by the American vessel, *China* and brought to Cape Town (Levine 1989).	Off the Cape
24	*Kalewa*	Collision, sank	Britain	1942	This 4389-ton steamship collided with the *Boringa*. Hocking’s (1969) co-ordinates are 30º 16´ S 13º 38´ E; van den Bosch’s (2009) co-ordinates are 30 14.00S,12 50.00E. As this position is near the SASA, and due to the inaccuracy of geographic positioning in the middle of the 20th century, I have included this vessel in the database.	**Approximately**: 30º 16´ S 13º 38´ E **or** 30 14.00S,12 50.00E**
25	*Luba / Luban*	Fire, abandoned	Cape	1864	This barque was on her way from Leith for Cape Town with a cargo of coal and coal tar when she caught fire and sank 86.3 NM off Table Bay. Her crew were rescued. (Levine 1989; van den Bosch 2009) This puts the wreck in the SASA.	West Coast
26	*Mariner*	Leaking, abandoned	Britain?	1826	This vessel was having a hard time of it, the month before she was abandoned, she lost her topmasts and a man was swept overboard. Two weeks later she lost her rudder and started leaking. Despite pumping the water from her holds continuously, the water continued to rise.	Abandoned

#	Name	Events	Nation	Date	History	Location
					When it was over a metre deep, the vessel hoisted a distress signal. The *Harriet* came to their rescue and the vessel was abandoned in “the latitude of the Cape of Good Hope”. The crew were landed in Mauritius. (Levine 1989) As the vessel was abandoned near the Cape Peninsula, it could have drifted north on the currents into the SASA.	
27	*Mary*	Disappeared	Britain	1870	Under Captain Anderson, this vessel left Simon’s Bay for Falmouth and disappeared. (Levine 1989) As the intended route goes up the west coast, I have included this vessel.	Disappeared
28	*Mistress of the Seas*	Fire, lost	?	1869	Built in 1863, this 1241-ton ship, on a voyage from India to Havre with a cargo of cotton, was reported as “lost by fire off the Cape”. (Levine 1989). However, an entry in Record of Canadian Shipping (Wallace 1929: 191), “…ship, 1241 tons, 190.0 x 38.0 x 24.0 Built 1863, Miramichi, N.B. Sold Greenock. Foundered Indian Ocean, 1870, ten drowned.” This vessel could be anywhere off the Cape Coast. More probably the southern Cape coast.	Off the Cape
29	*Mona*	Fire, abandoned	Britain	1887	The 1045-ton barque under Captain Pearson was on a voyage from Grimsby to Durban with coal when she caught fire at 27º 14´ S 24º 55´ W. The following day the crew took to the lifeboats. After a week, the crew were picked up by the German barque, *Livingstone* and landed at Mossel Bay. (Levine 1989) The current was clearly pushing the survivors towards the Cape coast and, so it follows that their vessel, abandoned before sinking, may also have been pulled by the currents towards the west coast.	Abandoned
30	*Nortun*	Torpedoed	Panama	1943	This 3 663-ton ship was bound from Table Bay to Bahia when she was torpedoed and sunk by the U-516 about 130km south-west of Lüderitz at 28º 00´ S 14º 55´ E. (Levine 1989; van den Bosch 2009). These co-ordinates are just north of the SASA and is where the U-boat reports torpedoing the vessel, not necessarily where she sank. In addition, the co-ordinates mentioned are subject to the technical limitations of the period.	**Approximately:** 28º 00´ S 14º 55´ E.**
31	*Oliver Cromwell*	Fire, abandoned	Britain	1874	This vessel, on a voyage from Newcastle to Aden with a cargo of coal, caught fire. The crew were rescued by the barque *Saxon* and brought to Table Bay. (Levine 1989). There is very little information on this vessel, so she is included in the database.	Abandoned
32	*Orissa*	Fire, abandoned	Britain	1869	This 634-ton, three-masted, wooden ship was built in 1862. Under Captain R. Adams, bound for Mauritius with a cargo of coal, she caught fire and was abandoned 343.2 NM west of Table Bay. (Levine 1989; van den Bosch 2009).	Abandoned

#	Name	Events	Nation	Date	History	Location
					The Equatorial current which runs west to east here could have pulled the abandoned vessel into the Benguela current and up the west coast.	
33	*Oswin*	Leaking, abandoned	Britain	1819	According to Captain Ray, the commander of the vessel, the ship had sprung a leak in the vicinity of Cape Agulhas and while the pumps were working 24 hours a day, they were unable to make any headway on the leak. By the next day, there was 1.5m of water in the hold and this was increasing. The crew launched the longboat and filled her with supplies. "Embarking in the boat the commander and crew steered for Saint Helena, and were from the 31st Jan. to the 12th Feb. exposed to great sufferings and anxiety, until they reached Saint Helena. During this time they ran about 1400 miles and were particularly fortunate in making the Island to a mile." (The Asiatic Journal 1820: 388) Depending on whether this newspaper report was using nautical miles or statute miles, makes a difference to the location of the wreck. Statute miles puts the vessel near Lüderitz, nautical miles puts the wreck in the vicinity of the SASA.	West Coast
34	*Stranger*	Fire, abandoned	Britain	1878	This 288-ton barque was built in 1872. Under Captain Bendon, it was bound from London to Port Nolloth with a general cargo. The vessel caught on fire and was abandoned at sea. Two days after taking to the lifeboats, the crew arrived at Port Nolloth. (Levine 1989) The location of the abandonment puts this vessel firmly in the SASA.	Abandoned
35	*Typhoon*	Leaking, abandoned	Britain	1860	Built in 1852 by Cannon & sons in Glasgow, this 965-ton ship under Captain J. Brown was bound for India from Liverpool when she was abandoned in a leaking condition, "off the Cape". (Levine 1989; van den Bosch 2009).	Abandoned
36	*U-179*	Depth charges	Germany	1942	U-179 was responsible for torpedoing the British steamship *City of* Athens, about 45km to the south-east on the same day as the U-boat was surprised on the surface by *H.M.S. Active*. As she dived, the British vessel launched depth charges. Van den Bosch (2009) gives her co-ordinates as 33 25.00S,17 10.00E. All hands were lost (61 crew). (Levine 1989; U-boat.net 2017) These co-ordinates are just south of the SASA and is where the vessel reports depth charging the U-boat, not necessarily where she sank. In addition, the co-ordinates mentioned are subject to the technical limitations of the period.	**Approximately:** 33 25.00S,17 10.00E.**
6.4 Modern shipwrecks						
37	*Chios Merchant*	Leaking, sank	Greek	1982	It was leaking but under control when the leak worsened dramatically. After sending out an SOS, the crew abandoned the vessel in a sinking condition at 520.9 NM west of the Orange River Mouth. (van den Bosch 2009)	Approximately 520.9 NM west of the Orange River Mouth

#	Name	Events	Nation	Date	History	Location
					It may have drifted quite far from its original reported position.	
38	*Sin Yih Mou 61*	Exploded, sank	China	1976	Fishing vessel, exploded and sank possibly in the vicinity of Port Nolloth (van den Bosch 2009).	129.5 NM north west of Cape Town, near Port Nolloth

6.5 Shipwrecks along the coast – North to South

Location	Date	Name
Orange River	1846	*Eliza Ann*
	1853	*Jessie Smith*
Orange River – Port Nolloth	1844	*Hamilla Mitchell*
	1890	*Ianthe*
	1997	*Kien Chang No. 5*
Port Nolloth	1909	*Celestial Empire*
	1859	*Florence*
	1855	*Flying Fish*
	1957	*Frean*
	1882	*Freda*
	1882	*Gleam*
	1963	*Ian*
	1892	*Lieutenant Maury*
	1878	*Lion*
	1874	*Lizzie*
	N.D.	*Lochinvar*
	1889	*Namaqua I*
	1869	*Rosalind*
	1889	*S.T.*
	1886	*Veronica*
Port Nolloth - Kleinsee	1985	*Poseidon Cape*
	1923	*Rusholme*
	1908	*Ticino*
Kleinsee – Hondeklip Bay	1976	*Arosa*
	1950	*Bechuana*
	1947	*Border I*
	1943	*Piratiny*
Hondeklip Bay	1873	*Clipper*
	1863	*Diligence*
	1853	*Espiegle*
	2003	*Jahleel*
	1866	*Jonquille*
	1862	*Maria*
	1858	*Maria Smith*
	1852	*Natal*
	1882	*Queen*
	1854	*Rachel*
	1867	*Robert Brown*
	1859	Unknown Cutter

** Please note these co-ordinates are all approximations. The datums and methods used through time and within various areas, to record latitude and longitude, change. This can cause large deviations in real-world locations. Without knowing the datum and method that was used to record the co-ordinates, they cannot be converted accurately. In addition, the recording of co-ordinates has become much more accurate in the 21st century. All co-ordinates here WGS84.

7. CONCLUSIONS

There may be at least one wreck in the 4C concession, with a possibility of another four being located within the 4C – 6C concession areas. In addition, as can be seen in the database, there are at least five vessels that wrecked in the SASA as well as a further 28 vessels that may be somewhere in the area.

8. RECOMMENDED MANAGEMENT MEASURES

Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible. Those resources that cannot be avoided and that are directly impacted by the proposed development can be excavated / recorded and a management plan can be developed for future action. Those sites that are not impacted on can be written into the management plan, whence they can be avoided or cared for in the future.

A meeting was held on 13 October 2017 with Lesley Roos, Michele Kruse and myself. At which the De Beers Marine prospecting methodology was explained and the company's commitment to compliance with legal requirements was confirmed. Bearing this in mind, in conjunction with the company's excellent geophysical survey techniques, De Beers Marine is in a prime position to report on suspected wrecks within their concessions. Any discovery would need to follow the legal reporting requirements.

Objectives

- Protection of heritage sites within the project boundary against vandalism, destruction and theft.
- The preservation and appropriate management of new discoveries in accordance with the NHRA, should these be discovered during development activities.

The following shall apply:

- Normally, the Environmental Control Officer should be given a short induction, by the heritage practitioners, on archaeological site and artefact recognition. Whilst, I have been assured that the De Beers Marine geophysical technicians are well-versed in geophysical data interpretation, it may be worthwhile to arrange a short induction on decoding anomalies by a heritage practitioner.
- The contractors and workers should be notified that archaeological sites might be exposed during the prospecting activities.
- Should any heritage artefacts be exposed during prospecting, work on the area where the artefacts were discovered, shall cease immediately and the Environmental Control Officer shall be notified as soon as possible;
- All discoveries shall be reported immediately to a heritage practitioner so that an investigation and evaluation of the finds can be made. Acting upon advice from these specialists, the Environmental Control Officer will advise the necessary actions to be taken;
- Under no circumstances shall any artefacts be removed, destroyed or interfered with by anyone on the site; and
- Contractors and workers shall be advised of the penalties associated with the unlawful removal of cultural, historical, archaeological or palaeontological artefacts, as set out in the NHRA (Act No. 25 of 1999), Section 51. (1).

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APPENDIX I: CONVENTIONS USED TO ASSESS THE IMPACT OF PROJECTS ON HERITAGE RESOURCES

Significance
According to the NHRA, Section 2(vi) the **significance** of heritage sites and artefacts is determined by it aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technical value in relation to the uniqueness, condition of preservation and research potential. It must be kept in mind that the various aspects are not mutually exclusive, and that the evaluation of any site is done with reference to any number of these.

Matrix used for assessing the significance of each identified site/feature

1. **Historic value**
   - Is it important in the community, or pattern of history
   - Does it have strong or special association with the life or work of a person, group or organisation of importance in history
   - Does it have significance relating to the history of slavery
2. **Aesthetic value**
   - It is important in exhibiting particular aesthetic characteristics valued by a community or cultural group
3. **Scientific value**
   - Does it have potential to yield information that will contribute to an understanding of natural or cultural heritage
   - Is it important in demonstrating a high degree of creative or technical achievement at a particular period
4. **Social value**
   - Does it have strong or special association with a particular community or cultural group for social, cultural or spiritual reasons
5. **Rarity**
   - Does it possess uncommon, rare or endangered aspects of natural or cultural heritage
6. **Representivity**
   - Is it important in demonstrating the principal characteristics of a particular class of natural or cultural places or objects
   - Importance in demonstrating the principal characteristics of a range of landscapes or environments, the attributes of which identify it as being characteristic of its class
   - Importance in demonstrating the principal characteristics of human activities (including way of life, philosophy, custom, process, land-use, function, design or technique) in the environment of the nation, province, region or locality.

7. Sphere of Significance	High	Medium	Low
International			
National			
Provincial			
Regional			
Local			
Specific community			

8. **Significance rating of feature**
   1. Low
   2. Medium
   3. High

Significance of impact:
- low: where the impact will not have an influence on or require to be significantly accommodated in the project design
- medium: where the impact could have an influence which will require modification of the project design or alternative mitigation
- high: where it would have a "no-go" implication on the project regardless of any mitigation

Certainty of prediction:
- Definite: More than 90% sure of a particular fact. Substantial supportive data to verify assessment
- Probable: More than 70% sure of a particular fact, or of the likelihood of that impact occurring
- Possible: Only more than 40% sure of a particular fact, or of the likelihood of an impact occurring
- Unsure: Less than 40% sure of a particular fact, or the likelihood of an impact occurring

Recommended management action:
For each impact, the recommended practically attainable mitigation actions which would result in a measurable reduction of the impact, must be identified. This is expressed according to the following:

1 = no further investigation/action necessary
2 = controlled sampling and/or mapping of the site necessary
3 = preserve site if possible, otherwise extensive salvage excavation and/or mapping necessary
4 = preserve site at all costs
5 = retain graves

Legal requirements:
Identify and list the specific legislation and permit requirements which potentially could be infringed upon by the proposed project, if mitigation is necessary.

APPENDIX F: CONVENTION FOR ASSIGNING SIGNIFICANCE RATINGS TO IMPACTS

1 METHOD OF ASSESSING IMPACT SIGNIFICANCE

The identification and assessment of environmental impacts is a multi-faceted process, using a combination of quantitative and qualitative descriptions and evaluations. It involves applying scientific measurements and professional judgement to determine the significance of environmental impacts associated with the proposed project. The process involves consideration of, *inter alia*: the purpose and need for the project; views and concerns of I&APs; social and political norms, and general public interest.

1.1 IDENTIFICATION AND DESCRIPTION OF IMPACTS

Identified impacts will be described in terms of the nature of the impact, compliance with legislation and accepted standards, receptor sensitivity and the significance of the predicted environmental change (before and after mitigation). Mitigation measures may be existing measures or additional measures that were identified through the impact assessment and associated specialist input. The impact rating system considers the confidence level that can be placed on the successful implementation of mitigation.

1.2 EVALUATION OF IMPACTS AND MITIGATION MEASURES

1.2.1 Introduction

Specialists are to use SLR's standard convention for assessing the significance of impacts, a summary of which is provided below.

In assigning significance ratings to potential impacts before and after mitigation the approach presented below is to be followed.

1. **Determine the impact consequence rating:** This is a function of the "intensity", "duration" and "extent" of the impact (see Section 1.2.2). The consequence ratings for combinations of these three criteria are given in Section 1.2.3.

2. **Determine impact significance rating:** The significance of an impact is a function of the consequence of the impact occurring and the probability of occurrence (see Section 1.2.2). Significance is determined using the table in Section 1.2.4.

3. **Modify significance rating (if necessary):** Significance ratings are based on largely professional judgement and transparent defined criteria. In some instances, therefore, whilst the significance rating of potential impacts might be "low", the importance of these impacts to local communities or individuals might be extremely high. The importance/value which interested and affected parties attach to impacts will be highlighted, and recommendations should be made as to ways of avoiding or minimising these perceived negative impacts through project design, selection of appropriate alternatives and / or management.

4. **Determine degree of confidence of the significance assessment:** Once the significance of the impact has been determined, the degree of confidence in the assessment will be qualified (see Section 1.2.2). Confidence in the prediction is associated with any uncertainties, for example, where information is insufficient to assess the impact.

1.2.2 Criteria for Impact Assessment

The criteria for impact assessment are provided below.

Criteria	Rating	Description
Criteria for ranking of the INTENSITY (SEVERITY) of environmental impacts	**ZERO TO VERY LOW**	Negligible change, disturbance or nuisance. The impact affects the environment in such a way that natural functions and processes are not affected. People / communities are able to adapt with relative ease and maintain pre-impact livelihoods.
	LOW	Minor (Slight) change, disturbance or nuisance. The impact on the environment is not detectable or there is no perceptible change to people's livelihood.
	MEDIUM	Moderate change, disturbance or discomfort. Where the affected environment is altered, but natural functions and processes continue, albeit in a modified way. People/communities are able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support.
	HIGH	Prominent change, disturbance or degradation. Where natural functions or processes are altered to the extent that they will temporarily or permanently cease. Affected people/communities will not be able to adapt to changes or continue to maintain-pre impact livelihoods.
Criteria for ranking the DURATION of impacts	**SHORT TERM**	< 5 years.
	MEDIUM TERM	5 to < 15 years.
	LONG TERM	> 15 years, but where the impact will eventually cease either because of natural processes or by human intervention.
	PERMANENT	Where mitigation either by natural processes or by human intervention will not occur in such a way or in such time span that the impact can be considered transient.
Criteria for ranking the EXTENT / SPATIAL SCALE of impacts	**LOCAL**	Impact is confined to project or study area or part thereof, e.g. limited to the area of interest and its immediate surroundings.
	REGIONAL	Impact is confined to the region, e.g. coast, basin, catchment, municipal region, etc.
	NATIONAL	Impact is confined to the country as a whole, e.g. South Africa, etc.
	INTERNATIONAL	Impact extends beyond the national scale.

Criteria	Rating	Description
Criteria for determining the PROBABILITY of impacts	**IMPROBABLE**	Where the possibility of the impact to materialise is very low either because of design or historic experience, i.e. ≤ 30% chance of occurring.
	POSSIBLE	Where there is a distinct possibility that the impact would occur, i.e. > 30 to ≤ 60% chance of occurring.
	PROBABLE	Where it is most likely that the impact would occur, i.e. > 60 to ≤ 80% chance of occurring.
	DEFINITE	Where the impact would occur regardless of any prevention measures, i.e. > 80% chance of occurring.
Criteria for determining the DEGREE OF CONFIDENCE of the assessment	**LOW**	≤ 35% sure of impact prediction.
	MEDIUM	> 35% and ≤ 70% sure of impact prediction.
	HIGH	> 70% sure of impact prediction.
Criteria for the DEGREE TO WHICH IMPACT CAN BE MITIGATED - the degree to which an impact can be reduced / enhanced	**NONE**	No change in impact after mitigation.
	VERY LOW	Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact.
	LOW	Where the significance rating drops by one level, after mitigation.
	MEDIUM	Where the significance rating drops by two to three levels, after mitigation.
	HIGH	Where the significance rating drops by more than three levels, after mitigation.
Criteria for LOSS OF RESOURCES - the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable	**LOW**	Where the activity results in a loss of a particular resource but where the natural, cultural and social functions and processes are not affected.
	MEDIUM	Where the loss of a resource occurs, but natural, cultural and social functions and processes continue, albeit in a modified way.
	HIGH	Where the activity results in an irreplaceable loss of a resource.

1.2.3 Determining Consequence

Consequence attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity. The ratings and description for determining consequence are provided below.

Rating	Description
VERY HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***long term***; OR of ***high intensity*** at a ***national level*** in the ***medium term***; OR of ***medium intensity*** at a ***national level*** in the ***long term.***
HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***high intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***medium term;***

Rating	Description	
	OR	of ***low intensity*** at a ***national level*** in the ***long term***;
	OR	of ***high intensity*** at a ***local level*** in the ***long term***;
	OR	of ***medium intensity*** at a ***regional level*** in the ***long term.***
MEDIUM	Impacts could be EITHER:	
		of ***high intensity*** at a ***local level*** and endure in the ***medium term***;
	OR	of ***medium intensity*** at a ***regional level*** in the ***medium term***;
	OR	of ***high intensity*** at a ***regional level*** in the ***short term***;
	OR	of ***medium intensity*** at a ***national level*** in the ***short term***;
	OR	of ***medium intensity*** at a ***local level*** in the ***long term***;
	OR	of ***low intensity*** at a ***national level*** in the ***medium term;***
	OR	of ***low intensity*** at a ***regional level*** in the ***long term.***
LOW	Impacts could be EITHER	
		of ***low intensity*** at a ***regional level*** and endure in the ***medium term***;
	OR	of ***low intensity*** at a ***national level*** in the ***short term***;
	OR	of ***high intensity*** at a ***local level*** and endure in the ***short term***;
	OR	of ***medium intensity*** at a ***regional level*** in the ***short term***;
	OR	of ***low intensity*** at a ***local level*** in the ***long term***;
	OR	of ***medium intensity*** at a ***local level*** and endure in the ***medium term.***
VERY LOW	Impacts could be EITHER	
		of ***low intensity*** at a ***local level*** and endure in the ***medium term***;
	OR	of ***low intensity*** at a ***regional level*** and endure in the ***short term***;
	OR	of ***low to medium intensity*** at a ***local level*** and endure in the ***short term.***
	OR	**Zero to very low intensity** with any combination of extent and duration.

1.2.4 Determining Significance

The consequence rating is considered together with the probability of occurrence in order to determine the overall significance using the table below.

		PROBABILITY			
		IMPROBABLE	POSSIBLE	PROBABLE	DEFINITE
CONSEQUENCE	VERY LOW	INSIGNIFICANT	INSIGNIFICANT	VERY LOW	VERY LOW
	LOW	VERY LOW	VERY LOW	LOW	LOW
	MEDIUM	LOW	LOW	MEDIUM	MEDIUM
	HIGH	MEDIUM	MEDIUM	HIGH	HIGH
	VERY HIGH	HIGH	HIGH	VERY HIGH	VERY HIGH

In certain cases it may not be possible to determine the significance of an impact. In these instances the significance is **UNKNOWN**.

APPENDIX G: PUBLIC PARTCIPATION

APPENDIX G1: I&AP DATABASE

DB02BA - DATABASE

Africa Energy Corp	Mr J Maier
Alexkor SOC Limited	Ms L Swartbooi
Anadarko Petroleum Corporation	Mr M Ranoszek
Baggers (Pty) Ltd	Mrs L Labuschagne
Belton Park Trading 127 (Pty) Ltd	Mr P Esposito
Cairn South Africa (Pty) Ltd	Mr S Karthik
Cairn South Africa (Pty) Ltd	Mr A Pattnaik
Capricon Marine Environment (CapMarine)	Mr D Japp
Capricon Marine Environment (CapMarine)	Ms S Wilkinson
De Beers Marine (Pty) Ltd	Ms M Kruse
De Beers Marine (Pty) Ltd	Ms L Roos
Department of Agriculture, Forestry and Fisheries	Ms J Coetzee
Department of Agriculture, Forestry and Fisheries	Mr D Durholtz
Department of Environmental Affairs	Dr A Boyd
Department of Environmental Affairs	Mr S Malaza
Department of Environmental Affairs	Ms T Mboweni
Department of Environmental Affairs	Mr A Share
Department of Mineral Resources	Ms D Karstern
Department of Mineral Resources	Ms L Njemla
Department of Mineral Resources	Mr N Ravhugoni
Irvin & Johnson Limited	Mr G Nassar
Kamiesberg Municipality	Mr J Cloete
Lusitania Trawling Services	Mr L De Freitas
N. Cape: Department of Env. Affairs & Nature Cons.	Mr B Cornelissen
N. Cape: Department of Env. Affairs & Nature Cons.	Mr B Fisher
N. Cape: Department of Env. Affairs & Nature Cons.	Ms T Leburu
N. Cape: Department of Env. Affairs & Nature Cons.	Ms D Moleko
N. Cape: Department of Env. Affairs & Nature Cons.	Ms E Swart
N.Cape: Dept. of Agriculture Forestry & Fisheries	Mr L October
Nama Khoi Local Municipality	Ms S Titus
Namagroen Prospecting	Mrs I Visser
Namakwa District Municipality	Ms G Bezuidenhout
Namakwa District Municipality	Mr C Fortuin
Namakwa District Municipality	Mr J Loubser
NC: Department of Mineral Resource	Mr K Mutheiwana
Oceana Group Limited	Mr M Copeland
Oceana Group Limited	Ms K Koen
Panda Marine	Mr K Pansegrouw
Petra Diamonds	Mr A Hendricks
Petroleum Agency SA	Mr S Mushwana
Petroleum Agency SA	Ms P Ngesi
Petroleum Agency SA	Mr D van der Spuy
Pisces Environmental Services	Dr A Pulfrich
Sea Harvest Corporation Ltd	Mr R Hall
South African Commercial Fisherman Corp	Ms C Attwood
South African Commercial Line Fishing Association	Mnr W Croome
South African Commercial Line Fishing Association	The Manager
South African Deep Sea Trawling Industry Ass.	Dr J Augustyn
South African Hake Longline Association	Mr C Bodenham
South African Heritage Resources Agency	Ms L Le Grange
South African Heritage Resources Agency	Mr R Timothy
South African Heritage Resources Agency	Ms B Williams
South African Maritime Safety Authority (SAMSA)	Mr G Louw
South African National Biodiversity Institute	Dr K Sink
South African Navy Hydrographic Office	Lieutenant I Coetzer
South African Navy Hydrographic Office	Mr M Nelson
South African Navy Hydrographic Office	Commander TJ van Niekerk
South African Pelagic Fishing Industry Association	Mr D de Villiers
South African Pelagic Fishing Industry Association	Mr P Foley
South African Tuna Longline Association	Mr D Lucas
Spectrum ASA	Mr J Hall
Sunbird Energy Ltd	Ms A Friedrichs
Sunbird Energy Ltd	Mr N Rayner
Sungu Sungu Petroleum (Pty) Ltd	Mr S Lephoto
Sungu Sungu Petroleum (Pty) Ltd	Mr S Lunn
Thombo Petroleum Limited	Mr T Ridley
Trans Hex Group Limited	Mr L Delport
Trans Hex Group Limited	Ms L Morule
Viking Fishing	Mr N Bacon

APPENDIX G2: I&AP NOTIFICATION

global **environmental** and **advisory** solutions

Project Reference: 720.04062.00001 File Ref. DB02 DBAR (Aug 2018)

10 August 2018

Northern Cape Government: Department of Mineral Resources
Cnr Van der Stel & Van Riebeeck
Hopley Centre Building
SPRINGBOK
8240

ATTENTION: MS LINDA NJEMLA

Dear Madam

DE BEERS CONSOLIDATED MINES LIMITED - BASIC ASSESSMENT PROCESS FOR PROPOSED PROSPECTING ACTIVITIES IN (OFFSHORE SEA CONCESSION 6C, WEST COAST (DMR REF NO: NC30/5/1/1/2(12189PR)) NOTIFICATION OF PUBLIC PARTICIPATION PROCESS IN TERMS OF THE EIA REGULATIONS 2014 (AS AMENDED)

This letter provides information regarding a Basic Assessment process being undertaken for the above-mentioned project.

De Beers Consolidated Mines Limited (De Beers) has submitted an application for a Prospecting Right over Sea Concession 6C off the West Coast of South Africa. The application was lodged with the Department of Mineral Resources (DMR) in terms of Section 16 of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) (MPRDA), as amended. The proposed prospecting activities would be conducted in a phased approach and would entail: (i) regional scale geophysical surveys (Phase I); and (ii) high resolution geophysical surveys and exploration sampling (Phase II) over the concession area.

SLR Consulting (South Africa) (Pty) Ltd (SLR) has been appointed as the independent environmental assessment practitioner to undertake a Basic Assessment process as part of an Application for Environmental Authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended, promulgated under the National Environmental Management Act, 1998 (No. 107 of 1998), as amended, for the above-mentioned proposed project.

In accordance with the EIA Regulations 2014, you and/or your organisation are hereby invited to comment on the draft Basic Assessment Report (BAR) prepared for the proposed project. The draft BAR has been made available for a 30-day public and authority review and comment period from **10 August to 10 September 2018**.

An electronic copy of the Draft BAR (on CD) is enclosed for your reference. Any comment on the draft BAR should reach the SLR Cape Town office (contact details below) by **no later than 10 September 2018** for inclusion in the final BAR.

Should you have any queries on the above, or require any further information, please do not hesitate to contact our Mandy Kula (mkula@slrconsulting.com) or the undersigned.

Yours sincerely

Nicholas Arnott Pr.Sci.Nat.
SLR CONSULTING (SOUTH AFRICA) (Pty) Ltd

global environmental and advisory solutions

SLR

Project Reference: 720.04062.00001 File Ref. DB02 DBAR (Aug 2018)

10 August 2018

Northern Cape Government: Department of Environmental Affairs and Nature Conservation
90 Long Street
KIMBERLEY
8300

ATTENTION: MR BRIAN FISHER

Dear Sir

DE BEERS CONSOLIDATED MINES LIMITED - BASIC ASSESSMENT PROCESS FOR PROPOSED PROSPECTING ACTIVITIES IN (OFFSHORE SEA CONCESSION 6C, WEST COAST (DMR REF NO: NC30/5/1/1/2(12189PR)) NOTIFICATION OF PUBLIC PARTICIPATION PROCESS IN TERMS OF THE EIA REGULATIONS 2014 (AS AMENDED)

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Yours sincerely

Nicholas Arnott Pr.Sci.Nat.
SLR CONSULTING (SOUTH AFRICA) (Pty) Ltd

Project Reference: 720.04062.00001 File Ref. DB02 DBAR (Aug 2018)

10 August 2018

Department of Environmental Affairs
Oceans and Coasts
Shed 2, East Pier Road
V&A Water Front
CAPE TOWN
8001

ATTENTION: DR ALAN BOYD

Dear Sir

DE BEERS CONSOLIDATED MINES LIMITED - BASIC ASSESSMENT PROCESS FOR PROPOSED PROSPECTING ACTIVITIES IN (OFFSHORE SEA CONCESSION 6C, WEST COAST (DMR REF NO: NC30/5/1/1/2(12189PR)) NOTIFICATION OF PUBLIC PARTICIPATION PROCESS IN TERMS OF THE EIA REGULATIONS 2014 (AS AMENDED)

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Yours sincerely

Nicholas Arnott Pr.Sci.Nat.
SLR CONSULTING (SOUTH AFRICA) (Pty) Ltd

Project Reference: 720.04062.00001

File Ref. DB02 DBAR (Aug 2018)

10 August 2018

Department of Agriculture, Forestry and Fisheries
Private Bag X2
ROGGEBAAI
8012

ATTENTION: MS JANET COETZEE

Dear Madam

DE BEERS CONSOLIDATED MINES LIMITED - BASIC ASSESSMENT PROCESS FOR PROPOSED PROSPECTING ACTIVITIES IN (OFFSHORE SEA CONCESSION 6C, WEST COAST (DMR REF NO: NC30/5/1/1/2(12189PR)) NOTIFICATION OF PUBLIC PARTICIPATION PROCESS IN TERMS OF THE EIA REGULATIONS 2014 (AS AMENDED)

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Yours sincerely

Nicholas Arnott Pr.Sci.Nat.
SLR CONSULTING (SOUTH AFRICA) (Pty) Ltd

Project Reference: 720.04062.00001

File Ref. DB02 DBAR (Aug 2018)

10 August 2018

Namakwa District Municipality
HJ Visser Building
Van Riebeeck Street
SPRINGBOK
8240

ATTENTION: MR CHRISTIAAN FORTUIN

Dear Sir

DE BEERS CONSOLIDATED MINES LIMITED - BASIC ASSESSMENT PROCESS FOR PROPOSED PROSPECTING ACTIVITIES IN (OFFSHORE SEA CONCESSION 6C, WEST COAST (DMR REF NO: NC30/5/1/1/2(12189PR)) NOTIFICATION OF PUBLIC PARTICIPATION PROCESS IN TERMS OF THE EIA REGULATIONS 2014 (AS AMENDED)

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Yours sincerely

Nicholas Arnott Pr.Sci.Nat.
SLR CONSULTING (SOUTH AFRICA) (Pty) Ltd

Project Reference: 720.04062.00001

File Ref. DB02 DBAR (Aug 2018)

10 August 2018

Nama Khoi Municipality
4 Namakwa Street
SPRINGBOK
8240

ATTENTION: MS SAMANTHA TITUS

Dear Madam

DE BEERS CONSOLIDATED MINES LIMITED - BASIC ASSESSMENT PROCESS FOR PROPOSED PROSPECTING ACTIVITIES IN (OFFSHORE SEA CONCESSION 6C, WEST COAST (DMR REF NO: NC30/5/1/1/2(12189PR)) NOTIFICATION OF PUBLIC PARTICIPATION PROCESS IN TERMS OF THE EIA REGULATIONS 2014 (AS AMENDED)

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SLR Consulting (South Africa) (Pty) Ltd (SLR) has been appointed as the independent environmental assessment practitioner to undertake a Basic Assessment process as part of an Application for Environmental Authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended, promulgated under the National Environmental Management Act, 1998 (No. 107 of 1998), as amended, for the above-mentioned proposed project.

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Should you have any queries on the above, or require any further information, please do not hesitate to contact our Mandy Kula (mkula@slrconsulting.com) or the undersigned.

Yours sincerely

Nicholas Arnott Pr.Sci.Nat.
SLR CONSULTING (SOUTH AFRICA) (Pty) Ltd

Project Reference: 720.04062.00001

File Ref. Let I&APs - Db02 DBAR (Aug2018).docx

10 August 2018

ATTENTION: INTERESTED AND AFFECTED PARTY

Dear Sir / Madam

DE BEERS CONSOLIDATED MINES LIMITED OFFSHORE SEA CONCESSION 6C, WEST COAST (DMR REF NO: NC30/5/1/1/2(12189PR)) - BASIC ASSESSMENT PROCESS FOR PROPOSED PROSPECTING ACTIVITIES: NOTIFICATION OF PUBLIC PARTICIPATION PROCESS IN TERMS OF NEMA EIA REGULATIONS 2014 (AS AMENDED)

This letter provides information regarding a Basic Assessment process for the above-mentioned project.

De Beers Consolidated Mines Limited (De Beers) has submitted an application for a Prospecting Right over Sea Concession 6C off the West Coast of South Africa. The application was lodged with the Department of Mineral Resources (DMR) in terms of Section 16 of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002) (MPRDA), as amended. The proposed prospecting activities would be conducted in a phased approach and would entail: (i) regional scale geophysical surveys (Phase I); and (ii) high resolution geophysical surveys and exploration sampling (Phase II) over the concession area.

SLR Consulting (South Africa) (Pty) Ltd (SLR) has been appointed as the independent environmental assessment practitioner to undertake a Basic Assessment process as part of an Application for Environmental Authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended, promulgated under the National Environmental Management Act (Act 107 of 1998), as amended, for the above-mentioned proposed project.

In accordance with the EIA Regulations 2014, you and/or your organisation are hereby invited to register as an Interested and Affected Party (I&AP) for the proposed project and/or comment on the Basic Assessment Report (BAR) for the proposed project. The BAR has been made available for a 30-day public and authority review and comment period from **10 August to 10 September 2018**.

If you or your organisation would like to register on the project database, comment on the proposed project and/or if you know of any other stakeholders interested in, or affected by, the proposed project please submit such comments and/or information to SLR at the contact details shown below (Cape Town office) or to our Mandy Kula (mkula@slrconsulting.com) by no later than **10 September 2018**.

Yours sincerely

Nicholas Arnott Pr.Sci.Nat.
SLR CONSULTING (SOUTH AFRICA) (PTY) LTD

SLR Consulting (South Africa) (Proprietary) Limited

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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.

2. OPPORTUNITY TO COMMENT ON THE BAR

This draft BAR has been distributed for a 30-day comment period from 10 August to 10 September 2018 in order to provide I&APs with an opportunity to comment on any aspect of the Basic Assessment process and the proposed project. Copies of the full report have been made available at the following locations:

1. Offices of SLR; and
2. On the SLR website www.slrconsulting.com.

Any comments should be forwarded to SLR at the address, telephone/fax numbers or e-mail address shown below. For comments to be included in the Final BAR, comments should reach SLR no later than **10 September 2018**.

Mandy Kul
SLR Consulting (South Africa) (Pty) Ltd
Unit 39 Roeland Square, 30 Drury Lane, Cape Town, 8001
PO Box 10145, Caledon Square, 7905

Tel: (021) 461 1118 / 9   Fax: (021) 461 1120
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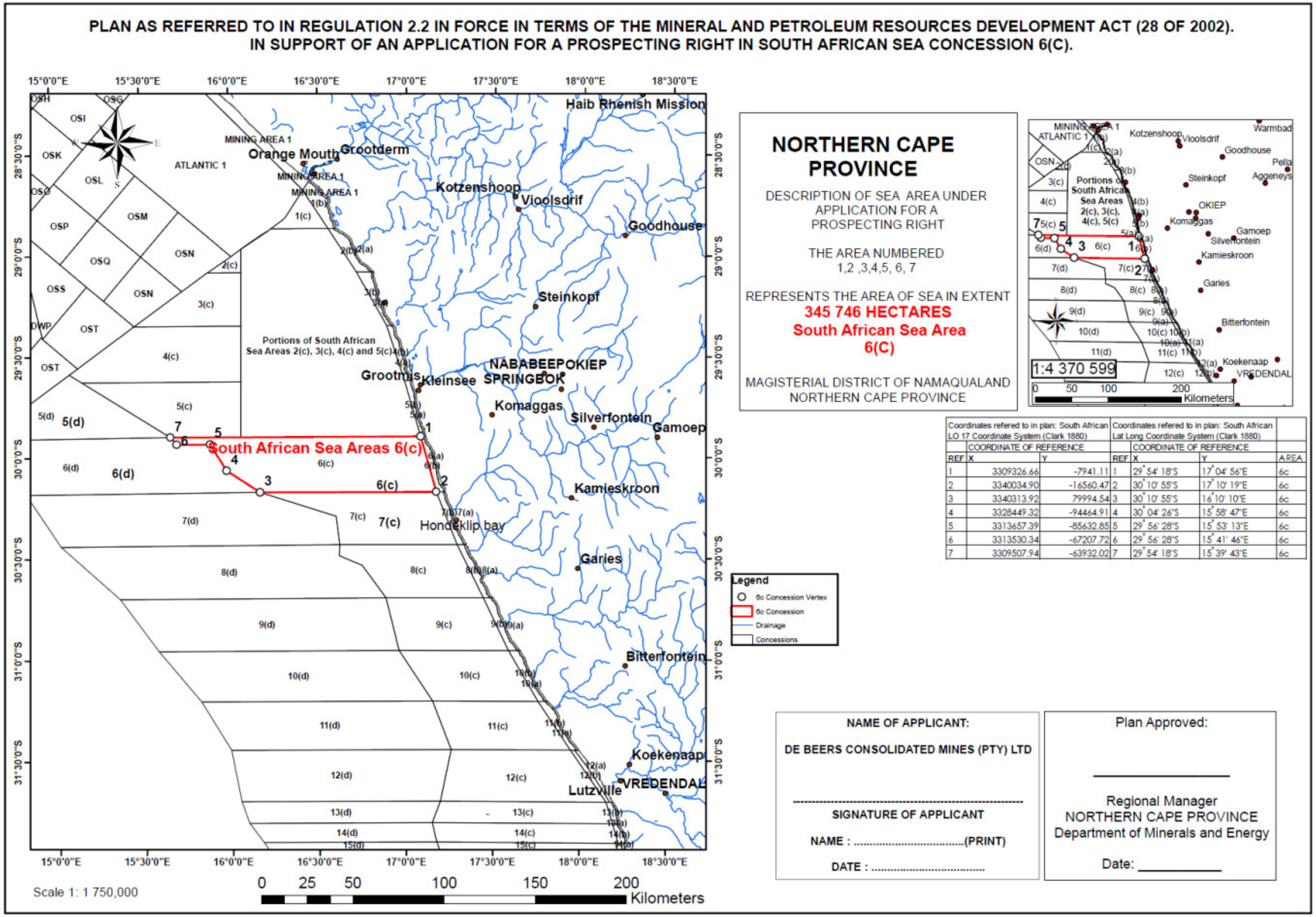

Coordinates refered to in plan: South African LO 17 Coordinate System (Clark 1880)			Coordinates refered to in plan: South African Lat Long Coordinate System (Clark 1880)			
	COORDINATE OF REFERENCE			COORDINATE OF REFERENCE		
REF	X	Y	REF	X	Y	AREA
1	3309326.66	-7941.11	1	29° 54' 18"S	17° 04' 56"E	6c
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.

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.

<table>
<tr><th colspan="2" rowspan="2">Potential impact</th><th colspan="2">Significance</th></tr>
<tr><th>Without mitigation</th><th>With mitigation</th></tr>
<tr><td colspan="2">Vessel operations:</td><td></td><td></td></tr>
<tr><td colspan="2">Deck drainage into the sea</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Machinery space drainage into the sea</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Sewage effluent into the sea</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Galley waste disposal into the sea</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Solid waste disposal into the sea</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Impact on marine fauna:</td><td></td><td></td></tr>
<tr><td colspan="2">Noise associated with geophysical surveys and sampling</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Sediment removal</td><td>L</td><td>L</td></tr>
<tr><td colspan="2">Physical crushing of benthic biota</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Generation of suspended sediment plumes</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Smothering of benthos in redepositing tailings</td><td>VL - L</td><td>VL</td></tr>
<tr><td colspan="2">Impact on other users of the sea:</td><td></td><td></td></tr>
<tr><td rowspan="2">Fishing industry</td><td>Exclusion of the demersal long-line, traditional line-fish, tuna pole and fisheries research</td><td>VL</td><td>VL</td></tr>
<tr><td>Sediment plume impact on fish stock recruitment</td><td>Insig</td><td>INSIG</td></tr>
<tr><td colspan="2">Marine mining and prospecting</td><td>Insig</td><td>INSIG</td></tr>
<tr><td colspan="2">Petroleum exploration</td><td>VL-L</td><td>VL</td></tr>
<tr><td colspan="2">Marine transport routes</td><td>Insig</td><td>INSIG</td></tr>
<tr><td colspan="2">Impact on cultural heritage material:</td><td></td><td></td></tr>
<tr><td colspan="2">Impact on historical shipwrecks</td><td>H</td><td>INSIG</td></tr>
<tr><td colspan="2">No-Go Alternative:</td><td></td><td></td></tr>
<tr><td colspan="2">Lost opportunity to establish whether or not a viable offshore diamond resources exists off the West Coast and the lost economic opportunities.</td><td>L</td><td>-</td></tr>
<tr><td colspan="2">Cumulative Impact:</td><td></td><td></td></tr>
<tr><td colspan="2">Benthic environment</td><td>L</td><td>L</td></tr>
</table>

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.

From:	Mandy Kula
To:	Mandy Kula
Bcc:	Share email; dave@capfish.co.za; salome@livefishtanksec.co.za; vanderspuyd@petroleumagencysa.com; marek.ranoszek@anadarko.com; info@petradiamonds.com; dan@new.co.za; safish@new.co.za; russellh@seaharvest.co.za; info@vikingfishing.co.za; nassarg@ij.co.za; cattwood@mweb.co.za; hydrosan@iafrica.com; lindam@transhex.co.za; bronwen.dtec@gmail.com; Deidre.Karsten@dmr.gov.za; unitaf@transhex.co.za; johann@sadstia.co.za; don@comfish.co.za; ladymfishing@telkomsa.net; sarah@capfish.co.za; k.sink@sanbi.org.za; mcopeland@ob.co.za; visserina49@gmail.com; laudene@telkomsa.net; info@pandamarine.co.za; lesley.roos@debeersgroup.com; afriedrichs@sunbirdenergy.com; ntsundeni.ravhugoni@dmr.gov.za; apulfrich@pisces.co.za; boating@telkomsa.net; ngesip@petroleumagencysa.com; ajboyd@environment.gov.za; mushwanas@petroleumagencysa.com; trevor@thombopetroleum.com; ratha.timothy@gmail.com; solomon@sungusungugroup.com; john.hall@spectrumasa.com; clyde@molimoman.co.za; DeonD@daff.gov.za; JanetC@daff.gov.za; lunn.sean@gmail.com; dmoleko@ncpg.gov.za; anurag.pattnaik@cairnindia.com; nrayner@sunbirdenergy.com.au; chrisf@namakwa-dm.gov.za; janniel@namakwa-dm.gov.za; Glouw@samsa.org.za; gerdavdh@namakwa-dm.gov.za; ashare@environment.gov.za; mm@kamiesberg.co.za; pe@imdhgroup.com; s.karthik@cairnindia.com; bfisher@ncpg.gov.za; elsabe.dtec@gmail.com; nvanolmen@ncpg.go; Michele.Kruse@debeersgroup.com; tmakaudi@ncpg.gov.za; karenk@oceana.co.za; leilanis@alexkor.co.za; smalaza@environment.gov.za; jan.maier@africaenergycorp.com; municipal.manager@namakhoi.gov.za; llagrange@sahra.org.za; tmboweni@environment.gov.za; bwilliams@sahra.org.za; linda.njemla@dmr.gov.za; mmboneni.mutheiwana@dmr.gov.za; loctober@ncpg.gov; Nicholas Arnott
Subject:	DE BEERS CONSOLIDATED MINES LIMITED - OFFSHORE SEA CONCESSION 6C, WEST COAST (DMR REF NO: NC30/5/1/1/2(12189PR)) - BASIC ASSESSMENT PROCESS
Date:	10 August 2018 04:02:55 PM
Attachments:	De_Beers_DBAR_Executive_Summary_Aug_2018.pdf Let I&APs - Db02 DBAR (Aug2018).pdf imagee87065.PNG imaged3e267.PNG imageb0e8af.PNG imageb88883.PNG imagebc2233.PNG image7f4e58.PNG

Dear Sir/Madam

DE BEERS CONSOLIDATED MINES LIMITED - BASIC ASSESSMENT PROCESS FOR PROPOSED PROSPECTING ACTIVITIES IN OFFSHORE SEA CONCESSION 6C, WEST COAST (DMR REF NO: NC30/5/1/1/2(12189PR)): NOTIFICATION OF PUBLIC PARTICIPATION PROCESS IN TERMS OF NEMA EIA REGULATIONS 2014 (AS AMENDED)

This email and attached letter provides information regarding a Basic Assessment process that is being undertaken for the above-mentioned project and notification on the availability of the Basic Assessment Report (BAR) for review and comment from **10 August to 10 September 2018.**

An electronic copy of the report can be accessed on the SLR website (www.slrconsulting.com).

Should you have any queries in this regard please do not hesitate to contact us.

Kind Regards,

SLR

Mandy Kula
Technical Assistant

+27 21 461 1118
mkula@slrconsulting.com

SLR Consulting

APPENDIX G3: ADVERTISEMENT

HOËRSKOOL ALEXANDERBAAI WIL ARMOEDE DEUR LANDBOU AANSPREEK

"Die skool fokus daarop om leerders te leer hoe om hulself te bemagtig in terme van landbou projekte soos groente-verbouing asook veeboerdery..."

Hoërskool Alexanderbaai in die Richtersveld het homself onderskei as 'n skool met 'n buitengewone visie.

Dié skool is in die proses om sosio-ekonomiese probleme soos werkloosheid en armoede aan te spreek deur hul leerders landbou georiënteerd te maak.

Hulle fokus daarop om leerders te leer hoe om hulself te bemagtig in terme van landbou projekte soos groente-verbouing asook veeboerdery. Voedselsekuriteit kan hierdeur aangespreek word en kan daar volhoubaar geboer word in die Richtersveld.

Armoede is 'n groot werklikheid in die area en die skool poog hierdeur om volhoubare landbou boere te kweek onder die leerders sodat hulle hulself kan onderhou.

Die NR het die WEMA-saad geskenk aan die skool om navorsing te doen in dié area. Die skool het 'n 30m by 10m tonnel aangekom om landbou te bevorder, veral op skoolvlak en die begeerte is daar dat gemeenskappe in die Richtersveld baat moet vind by landbou opleiding.

Die skool het 'n totale leerderstal van 325 wat wissel vanaf graad 8 tot 12. Sowat 68 leerders is betrokke in die landbou program en grade wissel vanaf 10 tot 12.
Die Richtersveld Grondeis was een van die land se grootste eise waarvan daar so baie probleme ondervind word. Plase was toegemaak, mense het hul werk verloor en dis waarom die skool die inisiatief geneem het om hierdie probleem aan te spreek deur die nageslag van die Richtersveld op te lei in landbou op skoolvlak.

Die SABC Nuus/Fokus-program gaan die skool op 28 Augustus 2018 besoek rakende andbouontwikkeling in die Richtersveld gebied.

Foto: Leerders druk besig in hul groente-projek.

APPENDIX G4: COMMENTS AND RESPONSES REPORT

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

COMMENTS AND RESPONSES REPORT

The following Interested and Affected Parties (I&APs) submitted written comments on the draft Basic Assessment Report (BAR) for the proposed project, which was made available for public review and comment from 10 August to 10 September 2018.

Submitted by		Date	Method
1.	South African Heritage Resources Agency	20 August 2018	Letter received on 20 August 2018

Copies of the written submissions are included in Attachment A.

The comments received are presented, and responded to, in Table 1 below. No importance should be given to the order in which the comments are presented. As far as possible, comments are presented verbatim from written submissions.

Table 1: Summary table of comments received, with responses from SLR and the project technical team, as appropriate

Note: = *Letter/Fax* = *Telephone* = *E-mail*

NO.	ISSUE	NAME	METHOD	COMMENT	RESPONSE
1	**SOUTH AFRICAN HERITAGE RESOURCES AGENCY (SAHRA)**				
1.1	Legislative Requirements	South African Heritage Resources Agency (SAHRA) – Briege Williams	20 August 2018	In terms of the National Heritage Resources Act, No 25 of 1999 (NHRA), Sections 2 and 35 stipulates that any wreck, being any vessel or aircraft or any part thereof older than 60 years old lying in South Africa's territorial waters or maritime cultural zone is protected and falls under the jurisdiction of SAHRA's Maritime and Underwater Cultural Heritage Unit. These heritage sites or objects may not be disturbed without a permit from the relevant heritage resources authority.	This comment is noted.
1.2	Support for proposed mitigation measures			SAHRA understands from the report that there are two planned stages of work. The first is the non-invasive geophysical surveys that will aim to identify features of interest for further exploration. The second stage would include more localised geophysical surveys and exploration sampling. The exploration sampling will be invasive and therefore mitigation measures must be taken to avoid the damage or destruction of any underwater cultural heritage. The need for a specialist heritage study for the underwater cultural heritage had been identified early in the project and the Draft Basic Assessment Report includes an Underwater Heritage Impact Assessment report. The UHIA has concluded that there are no known wrecks recorded as being lost in Sea Concession 6C. However, it states that scant historical reporting, poor navigational methods and the dynamic nature of the environment can lead to inaccurate location information, therefore there is the potential, however small,	Support for the proposed mitigation measures is noted. In the event that any sites of archaeological or palaeontological significance are detected during the proposed prospecting operations, De Beers will comply with the requirements specified by SAHRA.

NO.	ISSUE	NAME	METHOD	COMMENT	RESPONSE
				for shipwrecks to lie unrecorded in the area. SAHRA supports the recommendations set out in the UHIA regarding the management measures that should be implemented during the two phases of work to mitigate the possible impact on any underwater cultural heritage. The geophysical surveys in particular have the potential to identify any possible sites of interest therefore the data must be reviewed by a suitably qualified person and be made available to a maritime heritage specialist for review if further interpretation is needed. Should anything of archaeological or palaeontological significance be noted during the proposed project, the management measures set out in the UHIA must be followed and SAHRA must be informed of its discovery without delay. An exclusion zone would then be applied to the site and no invasive work would be permitted in this area.	

ATTACHMENT A
WRITTEN COMMENTS

an agency of the
Department of Arts and Culture

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South African Heritage Resources Agency | 111 Harrington Street | Cape Town
P.O. Box 4637 | Cape Town | 8001
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Enquiries: Briege Williams
Tel: 021 462 4502
Email: bwilliams@sahra.org.za
CaseID: 12789

Date: Monday August 20, 2018

Interim Comment

In terms of Section 38(8) of the National Heritage Resources Act (Act 25 of 1999)

Attention: De Beers Consolidated Mines (Pty) Ltd

PO Box 616
Kimberley
8300

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 South African Heritage Resources Agency would like to thank you for submitting the Draft Basic Assessment for a Prospecting Right Application for Offshore Sea Concession 6C, West Coast, South Africa.

In terms of the National Heritage Resources Act, No 25 of 1999 (NHRA), Sections 2 and 35 stipulates that any wreck, being any vessel or aircraft or any part thereof older than 60 years old lying in South Africa's territorial waters or maritime cultural zone is protected and falls under the jurisdiction of SAHRA's Maritime and Underwater Cultural Heritage Unit. These heritage sites or objects may not be disturbed without a permit from the relevant heritage resources authority.

SAHRA understands from the report that there are two planned stages of work. The first is the non-invasive geophysical surveys that will aim to identify features of interest for further exploration. The second stage would include more localised geophysical surveys and exploration sampling. The exploration sampling will be invasive and therefore mitigation measures must be taken to avoid the damage or destruction of any underwater cultural heritage.

De Beers Prospecting Right Application offshore Sea Concession 6C, West Coast

Our Ref:

an agency of the
Department of Arts and Culture

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CaseID: 12789

Date: Monday August 20, 2018

The need for a specialist heritage study for the underwater cultural heritage had been identified early in the project and the Draft Basic Assessment Report includes an Underwater Heritage Impact Assessment report. The UHIA has concluded that there are no known wrecks recorded as being lost in Sea Concession 6C. However, it states that scant historical reporting, poor navigational methods and the dynamic nature of the environment can lead to inaccurate location information, therefore there is the potential, however small, for shipwrecks to lie unrecorded in the area.

SAHRA supports the recommendations set out in the UHIA regarding the management measures that should be implemented during the two phases of work to mitigate the possible impact on any underwater cultural heritage. The geophysical surveys in particular have the potential to identify any possible sites of interest therefore the data must be reviewed by a suitably qualified person and be made available to a maritime heritage specialist for review if further interpretation is needed. Should anything of archaeological or paleontological significance be noted during the proposed project, the management measures set out in the UHIA must be followed and SAHRA must be informed of its discovery without delay. An exclusion zone would then be applied to the site and no invasive work would be permitted in this area.

Should you have any further queries, please contact the designated official using the case number quoted above in the case header.

Yours faithfully

Briege Williams
Heritage Officer
South African Heritage Resources Agency

Lesa la Grange
Acting Manager: Maritime and Underwater Cultural Heritage

De Beers Prospecting Right Application offshore Sea Concession 6C, West Coast

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South African Heritage Resources Agency

ADMIN:
Direct URL to case: http://www.sahra.org.za/node/510704

Terms & Conditions:

1. This approval does not exonerate the applicant from obtaining local authority approval or any other necessary approval for proposed work.
2. If any heritage resources, including graves or human remains, are encountered they must be reported to SAHRA immediately.
3. SAHRA reserves the right to request additional information as required.

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