BASIC ASSESSMENT FOR A PROSPECTING RIGHT APPLICATION FOR SOUTH AFRICAN SEA AREAS 4C AND 5C, WEST COAST, SOUTH AFRICA

South African Sea Areas 4C and 5C

Prepared for: De Beers Marine (Pty) Ltd on behalf of De Beers Consolidated Mines (Pty Ltd

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BASIS OF REPORT

EXECUTIVE SUMMARY

1 INTRODUCTION

On 22 November 2022, the Department of Mineral Resources and Energy (DMRE) accepted an application lodged by De Beers Consolidated Mines (Pty) Ltd (DBCM) for a prospecting right to undertake offshore diamond prospecting activities in South African Sea Areas 4C and 5C, off the West Coast of South Africa (see Figure 1). 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 terms of the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended), promulgated in terms of the National Environmental Management Act (No. 107 of 1998; NEMA), an application for a prospecting right requires Environmental Authorisation (EA) from the competent authority, the Minister of Mineral Resources and Energy (or delegated authority), to carry out the proposed prospecting activities. An application for EA, in terms of NEMA, was submitted to the DMRE at the same time as the prospecting right application. In order for DMRE to consider an application for EA, a Basic Assessment (BA) process must be undertaken.

SLR Consulting (South Africa) (Pty) Ltd (SLR) has been appointed by De Beers Marine (Pty) Ltd (DBM) on behalf of DBCM, as the independent Environmental Assessment Practitioner (EAP) to meet the relevant requirements of NEMA and the EIA Regulations, 2014 (as amended) and undertake an application for EA.

The draft BAR and Environmental Management Programme (EMPr) was made available for a 30-day public review and comment period from 4 June to 5 July 2021. Subsequently the application for EA was suspended pending an internal appeal process regarding the application for a prospecting right itself under the MPRDA. As noted above, the Prospecting Right Application has since been accepted by the DMRE and the original Application for EA was acknowledged on 29 November 2022.

As the project proposal remains unchanged, the previous distribution of the draft BAR for public review and comment is regarded as a pre-application process for the Application for EA. The written submissions received during the previous draft BAR review and comment period have been collated, and responded to, in a Comments and Responses Report, which is appended to this report (refer to Appendix C4).

The updated draft BAR and EMPr was made available for a 30-day public review and comment period from 4 February to 6 March 2023 in order to provide Interested and/or Affected Parties (I&APs) and authorities the opportunity to comment on the proposed project and the BAR. The compilation of this report has taken due consideration of the comments received from I&APs during the above-mentioned review and comment periods, as necessary. It should be noted that all significant changes to the draft BAR are underlined and in a different font (Times New Roman) to the rest of the text.

This report presents the process followed and the findings of the BA process. After DMRE has reached a decision, all registered I&APs will be notified of the outcome of the application and the reasons for the decision. A statutory appeal period in terms of the National Appeal Regulations, 2014 will follow the issuing of the decision.

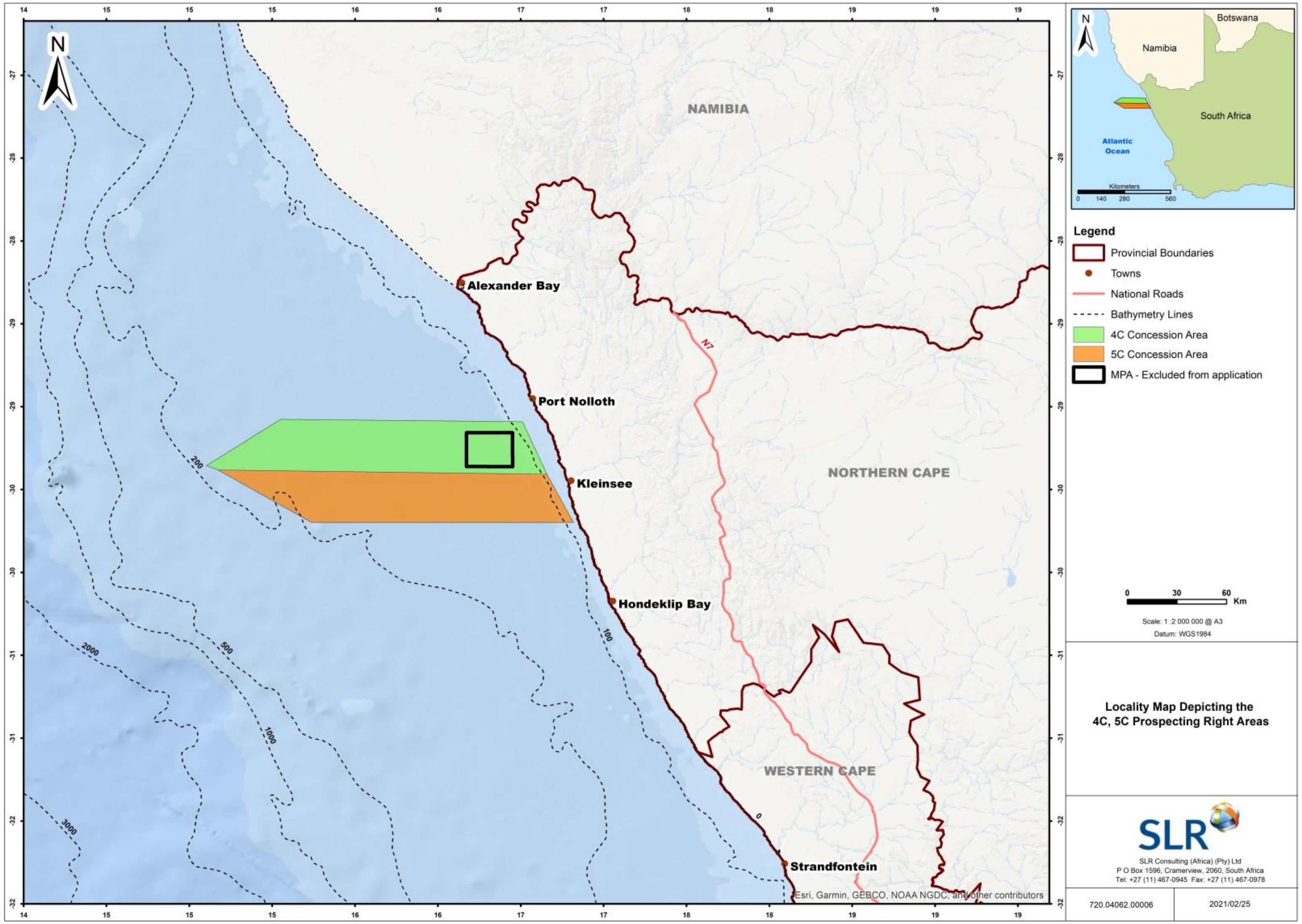

Figure 1: Location of the 4C and 5C Prospecting Right Area, off the West Coast of South Africa, showing exclusion of the Namaqua Fossil Forest Marine Protected Area.

3 BASIC ASSESSMENT PROCESS

3.1 Application for EA and Prospecting Right

DBCM lodged an application for a prospecting right, in terms of the MPRDA, with the DMRE on 9 February 2021. An application for EA, in terms of NEMA, was submitted to the DMRE at the same time. Following an internal appeal process, the Prospecting Right Application was accepted by the DMRE on 22 November 2022. The Application for EA was then accepted on 29 November 2022.

3.2 Specialist Studies

Two specialist studies were commissioned to address potential key issues and impacts that may arise as a result of the proposed project. These specialist studies were: 1) Marine Fauna and 2) Fisheries. An Underwater Heritage specialist was previously commissioned by DBM to investigate the Sea Areas and this information has been included in this report. The specialist studies involved the gathering of data relevant to identifying and assessing environmental impacts. The impacts were assessed according to pre-defined scaled and appropriate mitigation and / or enhancement measures to minimise potential impacts or enhance potential benefits, respectively, were provided.

3.3 Compilation of draft BAR for Review

This draft BAR is compiled in compliance with Appendix 1 of the EIA Regulations, 2014 (as amended). The specialist findings and other relevant information were integrated into this draft BAR, which includes an Environmental Management Programme (EMPr).

This report aims to present all information in a clear and understandable format suitable for easy interpretation by I&APs and authorities and provides an opportunity for I&APs to comments on all aspects of the proposed project, as well as findings of the impact assessment.

3.4 Public Participation

The tasks undertaken as part of the previous public participation process entailed the following steps:

- A preliminary I&AP database was compiled consisting of authorities (including state departments with jurisdiction in the area, municipal offices and ward councillors), Non-Governmental Organisations, Community-Based Organisations and other key stakeholders with a potential interest in the proposed project.
- Copies of the full BAR and Executive Summary were placed on the SLR website (www.slrconsulting.com/debeers-4c5c), as well as on a zero-data rated website that I&APs could use to access the draft BAR (via internet-capable devices) at no charge (https://www.slrpublicdocs.datafree.co/public-documents/debeers-4c5c).
- Advertisements were placed in local newspapers in English and Afrikaans.
- Posters have been placed at public locations within Port Nolloth.
- A notification letter was sent to all registered I&APs on the project database via email and post (where email addresses were not provided) to inform them of the public participation process (PPP). The letter also announced the availability of the draft BAR for 30-day comment period and invited I&APs to submit comments on any aspect of the BA process and the proposed project. The notification letter provided a

link to the SLR websites that I&APs could use to access and download the Executive Summary and draft BAR.

The most recent public participation tasks undertaken as part of the release of the updated Draft BAR entailed the following steps:

- A notification letter was sent to all registered I&APs on the project database via email to inform them of the public participation process (PPP) and availability of the updated Draft BAR for the 30-day review and comment period. The notification letter provided a link to the SLR websites (see below) that I&APs could use to access and download the Executive Summary and draft BAR (see Appendix C1).
- Copies of the full updated Draft BAR were placed at the Port Nolloth and Kleinsee Public Libraries and on the SLR website (https://www.slrconsulting.com/en/public-documents/debeers-4c5c), as well as on a zero-data rated website that I&APs could use to access the draft BAR (via internet-capable devices) at no charge (https://www.slrpublicdocs.datafree.co/en/public-documents/debeers-4c5c). The Executive Summary (in English and Afrikaans) was also uploaded.
- Newspapers advertisements were placed in Die Namakwalander (in English and Afrikaans) and Die Burger (in Afrikaans) (see Appendix C2).
- Site notices were placed at various public locations within Port Nolloth, Kleinsee and Hondeklipbaai (see Appendix C3).
- Radio adverts were aired to notify coastal users, including vulnerable and disadvantaged communities, of the proposed project, Basic Assessment process and planned public meetings (see below). The notices were aired multiple times per day on NFM in English and Afrikaans over a period of a few days (see Appendix C4).
- Public and Focus Group Meetings: Three public meetings (at Port Nolloth, Kleinsee and Hondeklipbaai) were arranged during the updated Draft BAR review and comment period. Two online focus-group meetings were also held with the Oceans and Coasts Branch of the Department of Fisheries, Forestry and Environment (DFFE) and the Northern Cape Department of Agriculture, Environmental Affairs, Land Reform and Rural Development (DAEALRD). Minutes of the meetings are appended to this final report (see Appendix C5).
- All issues raised by I&APs during the updated Draft BAR comment and review period have been consolidated and responded to in the Comments and Responses Report (see Appendix C6).

4 PROJECT DESCRIPTION

4.1 General Information

Information for the project description was provided by De Beers. The proposed prospecting activities would be undertaken within Sea Areas 4C and 5C, located off the West Coast of South Africa. The Sea Areas are situated approximately 470 km north of Cape Town; with the inshore boundary located between 2.5 and 5 km seaward of the coast. Operations will however typically be focussed in areas where the water depth ranges from 70 m – 160 m. Port Nolloth is located 10 km north of Sea Area 4C and Hondeklip Bay is located 50 km south of Sea Area 5C. The offshore boundary is located between approximately 140 to 180 km offshore (refer to Figure 1). **Given the location of the Sea Areas and nature of the proposed activities, no effect on coastal activities are anticipated as a result of the prospecting operations.**

The Prospecting Right area is 926 468.017 ha in extent and excludes the Namaqua Fossil Forest Marine Protected Area in Sea Areas 4C.

4.2 Need and Desirability

In the recently published DMRE 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 identify economically viable diamond deposits on the continental shelf off the coast of the Northern Cape with the intention of deriving value from the identified offshore mineral resources and contributing to the existing diamond mining sector in the Northern Cape.

4.3 Project Overview

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

Phase 1 entails exploration sampling (e.g. coring and / or wide spaced sampling) in target features of interest, enabling refinement of the definition of the target features. Geophysical survey may also be undertaken. Should the result of the survey(s) / exploration sampling indicate potential exists, then further follow-up sampling and infill survey may be undertaken to establish the distribution of the diamondiferous material.

Should geological features of interest be identified, then a decision will be made regarding the feasibility of proceeding to Phase II of the prospecting activities. Phase II consists of a techno-economic assessment study that will be undertaken, utilising available sampling and geophysical data to assess the economic viability of mining the deposits in Sea Areas 4C and 5C. Phase II is a desktop study and therefore not discussed any further in this report.

4.3.1 Geophysical Surveys

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 2D geophysical systems could be deployed from various platforms (see Figure 3-1), such as towed systems, vessel mounted, pole mounted, Autonomous Underwater Vehicles (AUV) or Autonomous Surface Vehicle (ASV). The AUV (see Figure 3-2) is used for survey in areas where survey line spacing is generally <100 m apart. The towed 2D surveys will involve a single towed streamer (hydrophone array). 3D surveys for DBM are acquired using the AUV, with all the sensors on the platform. This contrasts with 3D survey used for petroleum exploration, which uses multiple towed streamers.

The following tools are available for proposed regional geophysical surveys:

- Multibeam Swath bathymetry (including backscatter);
- Sub-bottom profiler systems;
- Side scan sonar systems;
- Electrical, Magnetic and Electro-Magnetic systems.

4.3.2 Sampling

Exploration sampling would be undertaken using a fit-for-purpose tool and vessel of opportunity in water depths ranging from 70 m to 160 m. The planned sampling methodology will take advantage of the latest technologies available to DBM.

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. Possible sampling tool technologies that could be employed include coring, the use of a subsea sampling tool and a vertically mounted sampling tool.

For the purposes of this assessment it is assumed that up to 22 500 samples would be obtained within the potential deposit area(s) during the 5 years of prospecting. The sample spacing for the initial wide spaced exploration sampling / coring, will be dependent on the geological feature size. The follow-up sample spacing is expected to typically vary between 50 and 200 m apart. The maximum potential cumulative area of disturbance would be approximately 0.225 km^2 (which is an insignificant percentage (0.002%) of the overall prospecting right area) but would not be contiguous.

4.4 Consideration of Alternatives

4.4.1 Location Alternatives

The intention of the proposed prospecting operations is to determine the presence of economically viable diamond deposits that occur within Sea Areas 4C and 5C. It follows that no location alternatives are considered in the BA process.

4.4.2 The No-Go alternatives

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.

5 AFFECTED ENVIRONMENT

5.1 Physical Environment

Sea Areas 4C and 5C lie within the southern zone of the Benguela Current region and is characterised by the cool Benguela upwelling system. The dominant southerly and south-easterly winds in summer drive the massive offshore movement of surface water, resulting in strong upwelling of nutrient-rich bottom waters. Nutrient-rich upwelled water enhances primary production, and the West Coast region consequently supports substantial pelagic fisheries.

5.2 Biological Oceanography

Sea Areas 4C and 5C fall into one of the nine bioregions, namely the cold temperate Namaqua Bioregion. 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 fish species likely to be present in this area comprise primarily the large pelagic species (e.g. tunas, snoek, billfish and pelagic sharks), which migrate throughout the southern oceans, between surface and deep waters (>300 m).

Most seabirds in the region reach highest densities offshore of the shelf break (200 to 500 m depth), however some species may be encountered in the Sea Areas. Marine mammals likely to be present include seals, Heaviside's dolphins, dusky dolphins, migrating humpback whales and southern right whales.

5.3 Human Utilisation

The Sea Areas have limited overlap, or are situated adjacent to, fishing grounds associated with the demersal long-line, traditional line-fish and pole-and-line commercial fisheries. Demersal fisheries overlap only in the extreme offshore portions of Sea Areas 4C and 5C beyond the depth of current interest for prospecting activities. Traditional line-fishing effort has not been reported within the Sea Areas. Pole-and-line commercial fisheries take place inshore of the 100 m with low fishing effort reported within Sea Areas 4C and 5C. Small-scale fishery rights are located in the nearshore. Grounds fished by the nearshore rock lobster sector are situated inshore of the Sea Areas. Small-scale line-fish activities may potentially extend into the shallow water areas of Sea areas 4C and 5C, however are unlikely to extend beyond 3 nm. Sea Areas 4C and 5C do not overlap with any of the other fishing sectors.

The majority of shipping traffic is located on the outer edge of the continental shelf with traffic inshore of the continental shelf along the South-West Coast largely comprising fishing vessels, especially between Kleinsee and Oranjemund. The majority of the shipping traffic would be limited to the western portions of the Sea Areas. Exploration for oil and gas is currently undertaken in a number of licence blocks off the West Coast. There is no current development or production from the South African West Coast offshore. A number of proposed prospecting areas for glauconite and phosphorite / phosphate are located off the South-West Coast, all of which are located south of Sea Areas 4C and 5C. A number of marine diamond prospecting and mining sea areas are also located in proximity to Sea Areas 4C and 5C.

Sea Areas 4C and 5C overlap with the Namaqua Fossil Forest MPA, however, the MPA has been excluded from the prospecting right application and no geophysical surveying and sampling activities will occur there. The Namaqua Fossil Forest EBSA (a portion of which comprises the Namaqua Fossil Forest MPA) lies within Sea Areas 4C and 5C.

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="4">Impact of the Vessel Discharges / Disposal to Sea</td></tr>
<tr><td colspan="2">Deck Drainage</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Machinery Space Drainage</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Sewage</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Galley Waste</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Solid Waste</td><td>INSIG</td><td>INSIG</td></tr>
<tr><td colspan="4">Impact on Marine Fauna:</td></tr>
<tr><td colspan="4">Acoustic Impacts:</td></tr>
<tr><td colspan="2">Geophysical Surveys</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Sampling Operations</td><td>VL</td><td>N/A</td></tr>
<tr><td colspan="2">Electromagnetic Impacts of Geophysical Surveys</td><td>INSIG</td><td>INSIG</td></tr>
<tr><td colspan="2">Disturbance and Loss of Benthic Fauna</td><td>VL to L</td><td>VL</td></tr>
<tr><td colspan="2">Crushing of Benthic Fauna During Sampling Operations</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Generation of Sediment Plumes</td><td>VL</td><td>N/A</td></tr>
<tr><td colspan="4">Smothering of Benthos in Redepositing Sediments:</td></tr>
<tr><td colspan="2">Redeposition of discarded sediments on soft-sediment macrofauna</td><td>VL</td><td>N/A</td></tr>
<tr><td colspan="2">Redeposition of discarded sediments on rocky outcrop communities</td><td>L</td><td>VL</td></tr>
<tr><td colspan="2">Vessel lighting on pelagic fauna</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Collisions with Project Vessels and Equipment</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Potential loss of Equipment</td><td>VL</td><td>VL</td></tr>
<tr><td colspan="2">Noise from Helicopters</td><td>VL</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="4">Fishing industry</td><td>Exclusion of the traditional line-fish, pole-and-line, small-scale fishers</td><td>INSIG</td><td>INSIG</td></tr>
<tr><td>Exclusion of the fisheries research</td><td>VL</td><td>NO IMPACT</td></tr>
<tr><td>Potential Impact of Survey Noise on Catch Rates</td><td>VL</td><td>N/A</td></tr>
<tr><td>Sediment plume impact on fish stock recruitment</td><td>VL - INSIG</td><td>N/A</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>
</table>

Potential impact	Significance	
	Without mitigation	With mitigation
Socio-Economic Impact		
Impact on Cultural Heritage Material	M	**INSIG**
Impact related to job creation and business opportunities	*VL+*	***VL+***
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	**N/A**
Cumulative Impact:		
Benthic environment	**INSIG**	
Acoustic Impacts	**L**	
Fishing activity	**VL**	
Impact related to job creation and business opportunities	***VL+ - 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 survey or sampling vessels are considered to be of **INSIGNIFICANT** to **VERY LOW** significance after mitigation.

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

The proposed prospecting operations would potentially impact upon the demersal longline, pole-and-line, traditional linefish and small-scale fishery sectors, as well as fishery research surveys through the implementation of the required safety exclusion zones around the survey/sampling vessel. The probability of this impact is however improbable and would be of short-term duration and limited to the small portions of the overall 4C and 5C Sea Areas. As a result, the activities are expected to be **INSIGNIFICANT**. By liaising with the DFFE to ensure that the proposed prospecting activities avoid the planned research surveys there would be **NO IMPACT**. There is no impact expected on the remaining commercial fisheries sectors.

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 operations, the impact would be at the national level, and of high intensity. Without mitigation this is of **Medium** significance. However, with the implementation of mitigation, cultural heritage sites can largely be avoided and if sampling is temporarily terminated in the unlikely event of encountering a shipwreck, archaeological investigations can be held and the impact regarded as **INSIGNIFICANT**.

The implications of not going ahead with the proposed prospecting operations 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 attached as Appendix F; and
- The sampling and support vessels must ensure compliance with MARPOL 73/78 standards.

7.2 Notification and communication with key stakeholders

- Prior to the commencement of the proposed activities, DBCM or the appointed operator should consult with the managers of the Department of Forestry, Fisheries and the Environment (DFFE) 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 activities, notify overlapping and neighbouring petroleum rights holders, as well as any neighbouring mineral prospecting or mining rights holders, to ensure that there is no overlapping of activities in the same area over the same time period;
- Notify relevant government departments and other key stakeholders of the commencement of sampling 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;
    - South African Deepsea Trawling Industry Association (SADSTIA);
    - South African Linefish Associations;
    - SA Marine Linefish Management Association (SAMLMA);
    - Hake Longline Association;
    - National Small, Medium and Micro-Enterprise (SMME) Fishing Forum; and
    - West Coast Rock Lobster Sea Management Association (if any activities are activated in shallower water depths than the 100 m contour line).
  - Representatives of small-scale local fishing co-operatives;
  - South African Maritime Safety Authority (SAMSA);
  - DFFE, including the fisheries research managers and the Vessel Monitoring, Control and Surveillance (VMS) Unit;
  - Transnet National Ports Authority (ports of Cape Town or Saldanha Bay, as may be applicable); and

- Prior to commencement of activities notify the SAN Hydrographic Office, requesting a Notice to Mariners be issued with the co-ordinates of the geophysical or sampling areas with the required safety zones around the survey or sampling vessel for the duration of the operations.
- Notify the SAN Hydrographic office when the programme is complete so that the Navigational Warning can be cancelled.

7.3 Discharges

- Ensure that hydrocarbons are stored in such a way as to prevent release of pollutants overboard;
- Ensure all crew are trained in spill management;
- Low-toxicity biodegradable detergents and suitable absorbents (where possible reusable absorbent cloths), should be used in cleaning of all deck spillage; and
- 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.

7.5 Vessel Transit

- Vessel operators should keep a watch for marine mammals and turtles in the path of the vessel.
- Ensure vessel transit speed of 10 knots (18 km/hr) when sensitive marine fauna are present in the vicinity.

7.6 Geophysical Surveys

- A MMO should be appointed to ensure compliance with mitigation measures during geophysical surveying.
- Onboard 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. Equipment of source levels greater than 210 dB re 1 µPa at 1 m not capable of "soft starts" would be run concurrently with equipment that can be soft started and only switched on once the soft-start has been completed.
- 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 possible, 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 passive acoustic monitoring (PAM) is incorporated into any surveying taking place between June and November.
- Use standard operational procedure to warm up the electromagnetic source transmitter (i.e. equivalent to ramp-up of current in electric source). It is recommended that the electromagnetic source should be ramped up over a minimum period of 20 minutes.
- Turn off electromagnetic source when not collecting data.
- Use lowest field strengths required to successfully complete the electrical, magnetic and/or electro-magnetic survey.
- A non-dedicated marine mammal observer (MMO) must keep watch for marine mammals behind the vessel when tension is lost on the towed equipment. Either retrieve or regain tension on towed gear as rapidly as possible.
- Should a cetacean become entangled in towed gear, contact the South African Whale Disentanglement Network (SAWDN) formed under the auspices of DFFE to provide specialist assistance in releasing entangled animals.

7.7 Sampling Activities

- Remote sensing data should be used to conduct a pre-sampling analysis of the seabed to identify high-profile, rocky-outcrop areas without a sediment veneer. Exploration sampling targets gravel bodies in unconsolidated sediments and does not target these high-profile rocky-outcrops without a sediment veneer.

7.8 Cultural Heritage Material

- Areas where shipwreck sites are identified during the geophysical surveys must be excluded prior to undertaking sampling activities;
- Objects of cultural significance, including fossils, recovered during sample processing will be recorded and addressed in accordance with the requirements of the National Heritage Resources Act, 1999.
- The onboard DBCM/DBM 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 vessel operator 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; and
- If shipwreck material is encountered during the course of sampling in the prospecting area, 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 DBM 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 with 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. The EMPr is attached as Appendix F to the main report.

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ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
AEL	Atmospheric Emissions Licence
ASV	Autonomous Surface Vehicle
AUV	Autonomous Underwater Vehicle
BAR	Basic Assessment Report
BCC	Benguela Current Commission
CBA	Critical Biodiversity Area
CITES	Convention on International Trade in Endangered Species
CMS	Convention on Migratory Species
CoM	Chamber of Mines South Africa
CUD	Cumulative Utilisation Distribution
DBCM	De Beers Consolidated Mines (Pty) Ltd
DBM	De Beers Marine (Pty) Ltd
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
EA	Environmental Assessment
EBSA	Ecologically and Biologically Significant Area
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EM	Electro-Magnetic
EMPr	Environmental Management Programme
ESA	Ecological Support Area
FAMDA	Fishing and Mariculture Development Association
GDP	Gross Domestic Product
GN	Government Notice
HAB	Harmful Algal Bloom
I&APs	Interested and Affected Parties
IAIAsa	International Association for Impact Assessment South Africa
IBA	Important Bird Areas
IDP	Integrated Development Plan

Acronym / Abbreviation	Definition
IEM	Integrated Environmental Management
IUCN	International Convention for Conservation of Nature
JNCC	Joint Nature Conservation Committee
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 (No 28 of 2002)
NBA	National Biodiversity Assessment
NDP	National Development Plan
NEM: AQA	National Environmental Management: Air Quality Act (No 39 of 2004)
NEM: WA	National Environmental Management: Waste Act (No 59 of 1008)
NEMA	National Environmental Management Act (No 107 of 1998)
NNW	North-North-West
NSDF	National Spatial Development Framework
NTS	Non-Technical Summary
NW	North-Westerly
OPRC	International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990
PAM	Passive Acoustic Monitoring
PIM	Particulate Inorganic Matter
POM	Particulate Organic Matter
PPP	Public participation process
Pr. Sci. Nat.	Registered Professional Natural Scientist
PSDF	Provincial Spatial Development Framework
ROV	Remote Operated Vehicle
SACW	South Atlantic Central Water
SADSTIA	South African Deepsea Trawling Industry Association
SAHRA	South African Heritage Resources Agency
SAMSA	South African Maritime Safety Authority
SAN	South African Navy
SANBI	South African National Biodiversity Institute

Acronym / Abbreviation	Definition
SBP	Sub-bottom profiler
SDP	Spatial Development Plan
SE	South-Easterly
SSE	South-South-East
SSW	South-South-West
SW	South-Westerly
TAC	Total Allowable Catch
TAE	Total Allowable Effort
TSPM	Total Suspended Particulate Matter
UCT	University of Cape Town
UNCLOS	United Nations Convention on Law of the Sea, 1982
VME	Vulnerable Marine Ecosystem

1. INTRODUCTION

This chapter describes the purpose of this report, presents the assumptions and limitations of the report, provides the terms of reference and describes the structure of the report. It also provides information on the public participation process (PPP) and invites Interested and Affected Parties (I&APs) to submit comments on the draft Basic Assessment Report (BAR).

1.1 PURPOSE OF THIS REPORT

On 22 November 2022, the Department of Mineral Resources and Energy (DMRE) accepted an application lodged by De Beers Consolidated Mines (Pty) Ltd (DBCM) for a prospecting right to undertake offshore diamond prospecting activities in South African Sea Areas 4C and 5C, off the West Coast of South Africa (see Figure 1-1). 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 terms of the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended), promulgated in terms of the National Environmental Management Act (No. 107 of 1998; NEMA), an application for a prospecting right requires Environmental Authorisation (EA) from the competent authority, the Minister of Mineral Resources and Energy (or delegated authority), to carry out the proposed prospecting activities. An application for EA, in terms of NEMA, was submitted to the DMRE at the same time as the prospecting right application. In order for DMRE to consider an application for EA, a Basic Assessment (BA) process must be undertaken.

SLR Consulting (South Africa) (Pty) Ltd (SLR) has been appointed by De Beers Marine (Pty) Ltd (DBM) on behalf of DBCM, as the independent Environmental Assessment Practitioner (EAP) to undertake a BA process to meet the relevant requirements of NEMA and the EIA Regulations, 2014 (as amended). The draft BAR and Environmental Management Programme (EMPr) was made available for a 30-day public review and comment period from 4 June to 5 July 2021. Subsequently the application for EA was suspended pending an internal appeal process regarding the application for a prospecting right itself under the MPRDA. As noted above, the Prospecting Right Application has since been accepted by the DMRE and the original Application for EA was acknowledged on 29 November 2022.

As the project proposal remains unchanged, the previous distribution of the draft BAR for public review and comment is regarded as a pre-application process for the Application for EA. The written submissions received during the previous draft BAR review and comment period have been collated, and responded to, in a Comments and Responses Report, which is appended to this report (refer to Appendix B4).

The updated draft BAR and EMPr was made available for a 30-day public review and comment period from 4 February to 6 March 2023 in order to provide Interested and/or Affected Parties (I&APs) and authorities the opportunity to comment on the proposed project and the BAR. The compilation of this report has taken due consideration of the comments received from I&APs during the above-mentioned review and comment periods, as necessary. It should be noted that all significant changes to the draft BAR are underlined and in a different font (Times New Roman) to the rest of the text.

This report presents the process followed and the findings of the BA process. After DMRE has reached a decision, all registered I&APs will be notified of the outcome of the application and the reasons for the decision. A statutory appeal period in terms of the National Appeal Regulations, 2014 will follow the issuing of the decision.

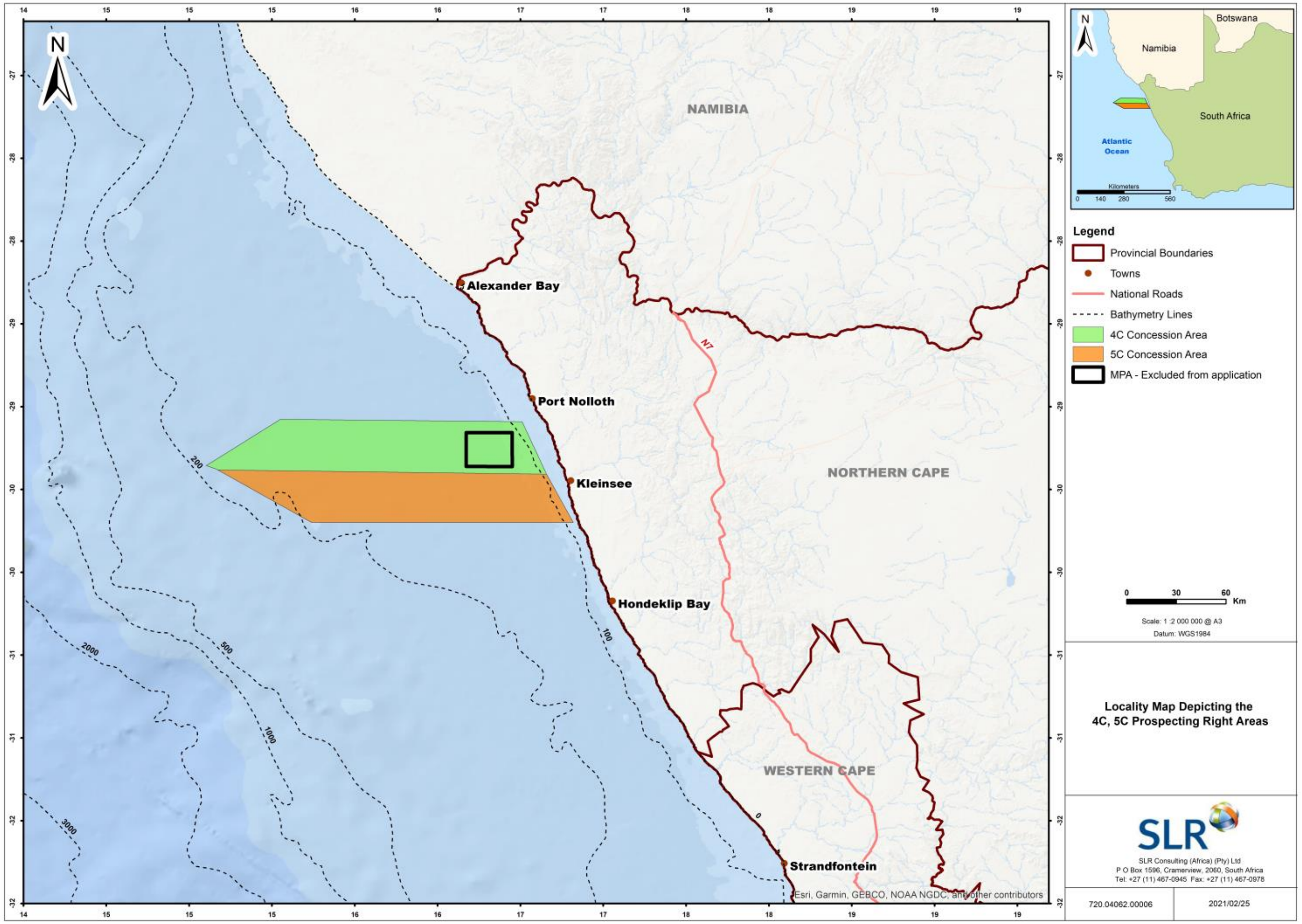

Figure 1-1: Location of the 4C and 5C Prospecting Right Area, off the West Coast of South Africa, showing exclusion of the Namaqua Fossil Forest Marine Protected Area.

1.2 ASSUMPTIONS AND LIMITATIONS

The assumptions and limitations of this BA process are provided below:

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

1.3 TERMS OF REFERENCE

The terms of reference of the BA process are as follows:

- To ensure that the BA is undertaken in accordance with the requirements of NEMA and the EIA Regulations, 2014 (as amended);
- To ensure that the BA process is undertaken in an open, participatory manner to ensure that all potential impacts are identified;
- To undertake a formal PPP which includes the fair, just and appropriate distribution of information to I&APs and to provide I&APs the opportunity to raise any issues / concerns, as well as an opportunity to comment on all project documentation;
- To commission the undertaking of specialist assessments / studies to assess key issues and impacts arising from the proposed project; and
- To integrate all information, including findings of specialist studies, into this report to allow an informed decision to be taken on the proposed project by the Competent Authority.

1.4 STRUCTURE OF THIS REPORT

This report consists of seven sections and six appendices, the contents of which are outlined in Table 1-1 below.

Table 1-1: Report Structure

Section	Contents
Executive Summary	Provides an overview of the main findings of the BAR.
Chapter 1	**Introduction** Describes the purpose of this report, presents the assumptions and limitations of the study, provides the Terms of reference and describes the structure of the report. It also provides information on the PPP and invites I&APs to submit comments on the draft BAR.
Chapter 2	**Basic Assessment Approach and Methodology**

Section	Contents
	Covers the legislative requirements of the BA process, presents the project team, describes the BA process undertaken to date and presents the way forward in the BA process.
Chapter 3	**Project Description** Provides the details of the applicant, presents a description of the proposed project and the affected areas, provides information on the project alternatives considered, as well as the need and desirability of the proposed project.
Chapter 4	**Description of the Affected Environment** Provides a description of the biophysical and socio-economic environment likely to be affected by the proposed project in the study area.
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.
Chapter 6	**Conclusion and Recommendations** Provides conclusions to the BAR and summarises the recommendations for the proposed project.
Chapter 7	**References** Provides a list of the references used in compiling this report.
Appendices	**Appendix A:** **EAP Declaration and Curriculum Vitae Project Team** **Appendix B:** **Previous Public Participation Process** Appendix B1: Newspaper Advertisements Appendix B2: Site Notices Appendix B3: Notification Letter Appendix B4: Comments and Responses Report **Appendix C:** **Current Public Participation** Appendix C1: Notification Letter Appendix C2: Newspaper Advertisements Appendix C3: Site Notices Appendix C4: Radio Notices Appendix C5: Minutes of Focus Group and Public Meetings Appendix C6: Comments and Responses Report **Appendix D:** **Specialist Studies** Appendix D1: Marine Faunal Specialist Assessment Appendix D2: Fisheries Assessment Appendix D3: Underwater Heritage Impact Assessment **Appendix E:** **SLR Impact Assessment Methodology** **Appendix F:** **Environmental Management Programme**

2. APPROACH AND METHODOLOGY

In accordance with the EIA Regulations, 2014 (as amended), all legislation and guidelines that have been considered in the BA process must be documented. This section outlines the legislative requirements of the BA process, presents the project team, describes the BA process undertaken to date and presents the way forward in the BA process.

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).

DBCM lodged an application for a prospecting right in terms of the MPRDA and an application for EA in terms of NEMA with the DMRE on 9 February 2021. In order for DMRE to consider an application for EA, a BA process must be undertaken.

Following an internal appeal process, the Prospecting Right Application was accepted by the DMRE on 22 November 2022. The Application for EA was then accepted on 29 November 2022.

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 EAs. 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 EA has been obtained from the competent authority. Such EA, 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 EA. A BA 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 Listing Activities 19A, 20 and 22 contained in Listing Notice 1 (see Table 2-1), thus a BA process must be undertaken in order for the DMRE to consider the application in terms of NEMA and make a decision as to whether to grant EA or not.

Table 2-1: List of Applicable Listing 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 prospecting 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 prospecting activities would trigger this listed activity.
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*	On completion of the proposed prospecting operation, DBCM would be required to apply to the DMRE for a closure certificate. The process of applying for a Closure Certificate would trigger this listed activity.

Activity No.	Activity Description	Description of activity in relation to the proposed project
	(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."	

2.1.4 National Environmental Management: Air quality Act, 2004

The National Environmental Management: Air Quality Act, 2004 (No. 39 of 2004; NEM:AQA) regulates all aspects of air quality, including prevention of pollution, providing for national norms and standards and including a requirement for an Atmospheric Emissions Licence (AEL) for listed activities, which result in atmospheric emissions and have or may have a significant detrimental effect on the environment.

Activities that require an AEL are listed in GN No. 893 (22 November 2013), published in terms of Section 21(1) ((b) of the NEM:AQA. In terms of Section 22 of NEM:AQA no person may conduct a listed activity without an AEL. The incineration of waste is a listed activity (Category 8.1 – Thermal treatment of Hazardous and General Waste) and requires an AEL for all installations treating 10 kg or more of waste per day.

In terms of Section 36 of the Act, the metropolitan and district municipalities are charged with implementing the AEL system. However, as the offshore area of activity and the Exclusive Economic Zone (EEZ) does not fall within the borders of any municipality or province of South Africa as set out in the Constitution, there is no formal means in terms of NEM: AQA by which application can be made for incineration from vessels in the offshore. Furthermore, the on-board incineration of waste is permitted in terms of the International Convention for the Prevention of Pollution from Ships, 1973/1978 (MARPOL), to which South Africa is a signatory. Thus, there is uncertainty of the applicability of NEM:AQA to offshore operations, given that MARPOL, an international convention, allows for the on-board incineration of waste and there is no formal implementing authority for AEL applications associated with offshore operations.

2.1.5 National Environmental Management: Waste Act, 2008

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

The Department of Forestry, Fisheries and the Environment (DFFE) has indicated that NEM: WA is not applicable to offshore activities. Thus, a Waste Management Licence would not be required for offshore waste management activities, such as those related to sewage. These aspects would be managed in terms of and comply with the requirements of MARPOL.

2.1.6 Other Relevant Legislation

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

- International Marine Pollution Conventions;

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

Other South African legislation:

- Carriage of Goods by Sea Act, 1986 (No. 1 of 1986);
- Hazardous Substances Act, 1983 and Regulations (No. 85 of 1983);
- Marine Living Resources Act, 1998 (No. 18 of 1998);
- Marine Spatial Planning Act, 2018 (No. 16 of 2018);
- Marine Traffic Act, 1981 (No. 2 of 1981);
- Marine Pollution (Control and Civil Liability) Act, 1981 (No. 6 of 1981);
- Marine Pollution (Prevention of Pollution from Ships) Act, 1986 (No. 2 of 1986);
- Marine Pollution (Intervention) Act, 1987 (No. 65 of 1987);
- Maritime Safety Authority Act, 1998 (No. 5 of 1998);
- Maritime Safety Authority Levies Act, 1998 (No. 6 of 1998);
- Maritime Zones Act 1994 (No. 15 of 1994);
- Merchant Shipping Act, 1951 (No. 57 of 1951);
- Mine Health and Safety Act, 1996 (No. 29 of 1996);
- National Environmental Management: Biodiversity Act, 2004 (No. 10 of 2004);
- National Environmental Management: Integrated Coastal Management Act, 2008 (No. 24 of 2008);
- National Environmental Management: Protected Areas Act, 2003 (No. 57 of 2003)
- National Heritage Resources Act, 1999 (No. 25 of 1999);
- National Ports Act, 2005 (No. 12 of 2005);
- National Water Act, 1998 (No. 36 of 1998);
- Occupational Health and Safety Act, 1993 (No. 85 of 1993) and Major Hazard Installation Regulations;
- Sea Birds and Seals Protection Act, 1973 (No. 46 of 1973);
- Ship Registration Act, 1998 (No. 58 of 1998); and
- Wreck and Salvage Act, 1995 (No. 94 of 1995).

2.2 GUIDELINES

The guidelines listed in Table 2-2 below have been or will be taken into account during the BA process.

Table 2-2: Guidelines Applicable to the BA process

Applicable legislation and guidelines	Governing Body	Relevance or reference
Public Participation Guideline in terms of NEMA (2017)	DFFE	The purpose of these guidelines is to ensure that an adequate public participation process was undertaken during the BA Process.
Guideline for consultation with communities and I&APs (2014)	DMRE	
Integrated Environmental Management Guideline Series Guideline 7: Public participation in the EIA process (2012)	DFFE	
Guideline on need and desirability in terms of the EIA Regulations (2017)	DFFE	These guidelines informed the consideration of the need and desirability aspects of the proposed project.
Guideline on need and desirability in terms of the EIA Regulations (2014)	DFFE	
Cumulative Effects Assessment, IEM, Information Series 7 (2004)	DFFE	This guideline was consulted to inform the consideration of potential cumulative effects of the proposed project.
Criteria for determining Alternatives in EIA, IEM, Information Series 11 (2004)	DFFE	This guideline was consulted to inform the consideration of alternatives.
Environmental Management Plans (EMP), IEM, Information Series 12 (2004)	DFFE	This guideline was consulted to ensure that the EMPr has been adequately compiled.
Environmental Impact Reporting, IEM, Information Series 15 (2004)	DFFE	This guideline was consulted to inform the approach to impact reporting.
Specialist Studies, IEM, Information Series 4 (2002)	DFFE	This guideline was consulted to ensure adequate development of terms of reference for specialist studies.
Impact significance, IEM, Information Series 5 (2002)	DFFE	This guideline was consulted to inform the assessment of significance of impacts of the proposed project.

2.3 DETAILS OF THE EAP

2.3.1 Details of the Project Team

As noted in Section 1, SLR has been appointed as the independent EAP to undertake the BA process for the proposed prospecting activities. The details of the project team that were involved in the preparation of this BAR are provided in Table 2-3 below.

Table 2-3: Details of the BA Project Team

General	
Organisation	SLR Consulting (South Africa) (Pty) Ltd
Postal address	PO Box 798, Rondebosch, 7701
Tel No.	+27 (0)21 461 1118 / 9

General				
Name	**Qualifications**	**Professional registrations**	**Experience (Years)**	**Tasks and roles**
Edward Perry	M.Sc. (Applied Hydrobiology), Cardiff University B.Sc. Hons (Environmental Science), Plymouth University	Registered EAP	28	Project Director, including Quality Control and process and report review
Nicholas Arnott	Hons. (Earth & Geog. Sci.), University of Cape Town (UCT)	Registered EAP Registered Professional Natural Scientist (Pr.Sci.Nat.)	16	Project Manager, including the management of the BA process and specialist studies and report compilation

SLR has no vested interest in the proposed project other than fair renumeration for consulting services rendered as part of the BA process. The EAP declaration, as required by the EIA Regulations, 2014 (as amended), is provided in Appendix A, together with the Project Team curriculum vitae and professional registrations.

2.3.2 Project Team Experience

Edward Perry: Edward is the Operations Manager for the SLR Environmental Management, Planning and Approvals team in Africa. Edward is a registered Environmental Auditor and has over 28 years of consulting experience for a wide range of projects including the oil and gas, mining, renewables and water storage. He is a registered South African Environmental Assessment Practitioner with the Environmental Assessment Practitioners Association of South Africa.

Nicholas Arnott: Nicholas 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 BAs, EIAs and EMPs. He has gained experience in a wide range of projects relating to mining, infrastructure projects (e.g. roads), housing and industrial developments.

2.4 BASIC ASSESSMENT PROCESS

2.4.1 Objectives

In accordance with Appendix 1 of the EIA Regulations, 2014 (as amended), the objectives of the BA process are to:

- Identify the relevant policies and legislation relevant to the activity and determine how the activity complies with and responds to the policy and legislative context;
- Present the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
- Identify and confirm the preferred activity, technology and sites related to the project proposal;

- Undertake an impact assessment, inclusive of cumulative impacts, to determine the biophysical and socio-economic sensitivity of the project sites and assess the nature, significance, consequence, extent, duration and probability of impacts occurring;
- Assess the degree to which impacts can be reversed, may cause irreplaceable loss of resources and can be avoided, managed or mitigated; and
- Identify suitable measures to avoid, manage or mitigate identified impacts and to determine the extent of residual risks that need to be managed and monitored.

The BA process consists of a series of steps to ensure compliance with these objectives and the EIA Regulations, 2014, as set out in GN No. R 982 (as amended by GN No. 326). The process involves an open, participatory approach to ensure that all potential impacts are identified, and that decision-making takes place in an informed, transparent and accountable manner.

2.4.2 Pre-Application Public Participation Process

A preliminary I&AP database was compiled consisting of authorities (including state departments with jurisdiction in the area, municipal offices and ward councillors), Non-Governmental Organisations, Community-Based Organisations and other key stakeholders with a potential interest in the proposed project.

2.4.3 Application for EA and Prospecting Right

As mentioned previously, DBCM lodged an application for a prospecting right, in terms of the MPRDA, with the DMRE on the 9 February 2021. An application for EA, in terms of NEMA, was submitted to the DMRE at the same time. DMRE correspondence will be provided in the Final BAR.

2.4.4 National Screening Tool

In terms of Regulation 16 (1)(b)(v) of the EIA Regulations 2014 (as amended), a Screening Report for Sea Areas 4C and 5C was generated using the DFFE National Screening Tool and attached to the Application for EA form. The related specialist assessments identified by the Screening Tool and the rationale for why they will or will not be undertaken as part of this BA is provided in Table 2-4 below.

Table 2-4: Specialist assessments identified by the national screening tool

Specialist Assessment Identified by National Screening Tool	Rationale for inclusion/ exclusion
Agricultural Impact Assessment	No assessment would be undertaken as the proposed project is located 5 km offshore and would not have any impact on agricultural activities.
Archaeological and Cultural Heritage Impact Assessment	An Underwater Heritage Impact Assessment has been undertaken for the Sea Areas (see Section 4.3).
Palaeontology Impact Assessment	
Terrestrial Biodiversity Impact Assessment	No assessment would be undertaken as the proposed project is located approximately 2.5 - 5 km offshore and would not have any impact on terrestrial vegetation.

Specialist Assessment Identified by National Screening Tool	Rationale for inclusion/ exclusion
Aquatic Biodiversity Impact Assessment	A Marine Fauna Impact Assessment has been undertaken (see Section 4.1.3).
Noise Impact Assessment	An assessment of the potential impacts of geophysical survey noise and noise from the proposed sampling activities has been undertaken as part of the Marine Fauna Impact Assessment.
Radioactivity Impact Assessment	No assessment would be undertaken as the target mineral resources are not naturally radioactive.
Plant Species Assessment	No assessment would be undertaken as the proposed project is located approximately 2.5 - 5 km offshore and the associated protocol is related to impacts on terrestrial plant species.
Animal Species Assessment	No assessment would be undertaken as the proposed project is located approximately 2.5 - 5 km offshore and the associated protocol is related to impacts on terrestrial animal species.

2.4.5 Specialist Studies

Two specialist studies were commissioned to address potential key issues and impacts that may arise as a result of the proposed project (see Appendix D). These specialist studies were: 1) Marine Fauna and 2) Commercial Fisheries. An Underwater Heritage specialist was previously commissioned by DBM to investigate Sea Areas 4C and 5C and this information has been included in this report. The specialist studies involved the gathering of data relevant to identifying and assessing environmental impacts. The impacts were assessed according to pre-defined scaled and appropriate mitigation and / or enhancement measures to minimise potential impacts or enhance potential benefits, respectively, were provided. Details of the specialist studies, as well as the specialist that undertook the studies are provided in Table 2-5 below.

Table 2-5: Specialist Studies included in the Basic Assessment Report

Specialist Study	Company and Name
Marine Fauna	Pisces Environmental Services (Pty) Ltd Dr Andrea Pulfrich
Commercial Fisheries	Capricorn Marine Environmental (Pty) Ltd Mr. Dave Japp and Ms. Sarah Wilkinson
Underwater Heritage	Ms. Vanessa Maitland

2.4.6 Compilation of draft BAR for Review

This draft BAR is compiled in compliance with Appendix 1 of the EIA Regulations, 2014 (as amended). The specialist findings and other relevant information were integrated into this draft BAR, which includes an EMPr. The required steps and location of relevant information within this report are set out in Table 2-6 below.

This report aims to present all information in a clear and understandable format suitable for easy interpretation by I&APs and authorities, and provides an opportunity for I&APs to comments on all aspects of the proposed project, as well as findings of the impact assessment.

Table 2-6: Requirements of a BAR in terms of Appendix 1 of the EIA Regulations, 2014

Appendix 1	Content of BAR	Completed (Y/N or N/A)	Location in report
3(1)(a)	*(i & ii) Details and expertise of the Environmental Assessment Practitioner (EAP) who prepared the report, including a CV.*	Y	Section 2.3 and Appendix A
(b)	*The location of the activity, including:*		
	(i) the 21-digit Surveyor General code of each cadastral land parcel; or	N/A	N/A
	(ii) where available, the physical address and farm name		
	(iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	Y	Section 3.1.2
(c)	*A plan which locates the proposed activity or activities applied for at an appropriate scale, or, if it is:*		
	(i) a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or	N/A	N/A
	(ii) on land where the property has not been defined, the coordinates within which the activity is to be undertaken.	Y	Section 3.1.2
(d)	*A description of the scope of the proposed activity, including:*		
	(i) all listed and specified activities triggered;	Y	Table 2-1
	(ii) a description of the activities to be undertaken, including associated structures and infrastructure.	Y	Section 3
(e)	*(I & ii) A description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and that have been considered in the preparation of the report and how the proposed activity complies with these.*	Y	Section 2.1 and 3.5 and Table 2-2
(f)	*A motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location.*	Y	Section 3.5
(g)	*A motivation for the preferred site, activity and technology alternative.*	Y	Section 3.4
(h)	*A full description of the process followed to reach the proposed preferred alternative within the site, including:*		
	(i) details of all the alternatives considered;	Y	Section 3.4
	(ii) details of the public participation process undertaken in terms of Regulation 41 of the Regulations, including copies of the supporting documents and inputs;	Y	Section 2.4.7 and Appendix B
	(iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;	Y	Appendix B4 and Appendix C6

Appendix 1	Content of BAR	Completed (Y/N or N/A)	Location in report
	(iv) the environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Y	Section 4
	(v) the impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts *(aa) can be reversed;* *(bb) may cause irreplaceable loss of resources; and* *(cc) can be avoided, managed or mitigated.*	Y	Section 5
	(vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives;	Y	Appendix E
	(vii) positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Y	Section 5
	(viii) the possible mitigation measures that could be applied and level of residual risk;	Y	Section 5
	(ix) the outcome of the site selection matrix;	N/A	N/A
	(x) if no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such; and	Y	Section 3.4.1
	(xi) a concluding statement indicating the preferred alternatives, including preferred location of the activity.	Y	Section 6.1.2
(i)	*A full description of the process undertaken to identify, assess and rank the impacts the activity will impose on the preferred location through the life of the activity, including:* *(i) a description of all environmental issues and risks that were identified during the environmental impact assessment process; and* *(ii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.*	Y	Appendix E
(j)	*An assessment of each identified potentially significant impact and risk, including:* *(i) cumulative impacts;* *(ii) the nature, significance and consequences of the impact and risk;* *(iii) the extent and duration of the impact and risk;* *(iv) the probability of the impact and risk occurring;* *(v) the degree to which the impact and risk can be reversed;* *(vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and* *(vii) the degree to which the impact and risk can be avoided, managed or mitigated.*	Y	Section 5

Appendix 1	Content of BAR	Completed (Y/N or N/A)	Location in report
(k)	*Where applicable, a summary of the findings and impact management measures identified in any specialist report complying with Appendix 6 to the EIA Regulations 2014 and an indication as to how these findings and recommendations have been included in the final report.*	Y	Section 6
(l)	*An environmental impact statement which contains:*		
	(i) a summary of key findings of the environmental impact assessment;	Y	6.1.3
	(ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers; and	Y	Section 4
	(iii) a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives.	Y	Section 6.1
(m)	*Based on the assessment, and where applicable, impact management measures from specialist reports, the recording of the proposed impact management outcomes for the development for inclusion in the EMPr;*	Y	Section 6.2
(n)	*Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation.*	Y	Section 6.2
(o)	*A description of any assumptions, uncertainties, and gaps in knowledge which relate to the assessment and mitigation measures proposed.*	Y	Section 1.2
(p)	*A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation.*	Y	Section 6.1.3
(q)	*Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required, the date on which the activity will be concluded, and the post construction monitoring requirements once finalised.*	N/A	N/A
(r)	*An undertaking under oath or affirmation by the EAP in relation to:* *(i) the correctness of the information provided in the reports;* *(ii) the inclusion of comments and inputs from stakeholders and I&APs;* *(iii) the inclusion of inputs and recommendations from the specialist reports where relevant; and* *(iv) any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected parties.*	Y	Appendix A
(s)	[Deleted by amendments to the EIA Regulations, 2014]		
(t)	*Any specific information that may be required by the competent authority.*	N/A	N/A
(u)	*Any other matter required in terms of Section 24(4)(a) and (b) of the Act.*	N/A	N/A

2.4.7 Previously Undertaken Public Participation

The steps previously undertaken during the public participation process are provided below, with supporting information presented in appendices to this report:

- Copies of the full BAR and Executive Summary were placed on the SLR website, as well as on a zero-data rated website that I&APs could use to access the draft BAR (via internet-capable devices) at no charge.
- Advertisements were placed in local newspapers in English and Afrikaans. Proof of the placement of the newspaper advertisements is provided in Appendix B1.
- Posters have been placed at public locations within Port Nolloth. Proof of the placement of the posters is provided in Appendix B2.
- A notification letter was sent to all registered I&APs on the project database via email and post (where email addresses were not provided) to inform them of the PPP. The letter also announced the availability of the draft BAR for 30-day comment period and invited I&APs to submit comments on any aspect of the BA process and the proposed project. The notification letter provided a link to the SLR websites that I&APs could use to access and download the draft BAR and NTS. Proof of delivery of the notification letters to I&APs is provided in Appendix B3.
- The draft Basic Assessment Report (BAR) was distributed for a 30-day comment period from 4 June to 5 July 2021. All comments have been collated and responded into the Comments and Responses Report (see Appendix B4).

2.4.8 Current Public Participation

The steps undertaken as part of this public participation process are as follows:

- A notification letter was sent to all registered I&APs on the project database via email to inform them of the public participation process (PPP) and availability of the updated Draft BAR for the 30-day review and comment period. The notification letter provided a link to the SLR websites (see below) that I&APs could use to access and download the Executive Summary and draft BAR (see Appendix C1).
- Copies of the full updated Draft BAR were placed at the Port Nolloth and Kleinsee Public Libraries and on the SLR website (https://www.slrconsulting.com/en/public-documents/debeers-4c5c), as well as on a zero-data rated website that I&APs could use to access the draft BAR (via internet-capable devices) at no charge (https://www.slrpublicdocs.datafree.co/en/public-documents/debeers-4c5c). The Executive Summary (in English and Afrikaans) was also uploaded.
- Newspapers advertisements were placed in Die Namakwalander (in English and Afrikaans) and Die Burger (in Afrikaans) (see Appendix C2).
- Site notices were placed at various public locations within Port Nolloth, Kleinsee and Hondeklipbaai (see Appendix C3).
- Radio adverts were aired to notify coastal users, including vulnerable and disadvantaged communities, of the proposed project, Basic Assessment process and planned public meetings (see below). The notices were aired multiple times per day on NFM in English and Afrikaans over a period of a few days (see Appendix C4).
- Public and Focus Group Meetings: Three public meetings (at Port Nolloth, Kleinsee and Hondeklipbaai) were arranged during the updated Draft BAR review and comment period. Two online focus-group meetings were also held with the Oceans and Coasts Branch of the Department of Fisheries, Forestry and Environment (DFFE) and the Northern Cape Department of Agriculture, Environmental Affairs, Land Reform and Rural Development (DAEALRD). Minutes of the meetings are appended to this final report (see Appendix C5).

- All issues raised by I&APs during the updated Draft BAR comment and review period have been consolidated and responded to in the Comments and Responses Report (see Appendix C6).

2.4.9 Completion of the BA process

After closure of the comment period, all comments received on the draft report will be collated and responded to in a Comments and Responses Report. The draft report will then be updated to a final report, which will include the Comments and Responses Report, and will be submitted to DMRE for consideration and decision-making. After DMRE has reached a decision, all I&APs on the project database will be notified of the outcome of the application and the reasons for the decision. A statutory appeal period in terms of the National Appeal Regulations, 2014 (GN No. R993) will follow the issuing of the decision.

3. PROJECT DESCRIPTION

This chapter provides the details of the applicant, presents a description of the proposed project and the affected areas, provides information on the project alternatives considered, as well as the need and desirability of the proposed project.

3.1 GENERAL PROJECT INFORMATION

3.1.1 Applicant Details

The applicant details are provided in Table 3-1 below:

Table 3-1: Applicant Details.

Applicant:	De Beers Consolidated Mines (Pty) Ltd
Physical Address:	144 Oxford Street, Rosebank, Melrose, Johannesburg, 2196
Postal Address:	Private Bag X01, Southdale, 2135
Responsible Person:	Thembinkosi Moses Madondo
Contact Person:	Michelle Bossenger
Tel:	011 374 7203
Email:	Cosec.admin@debeersgroup.com

3.1.2 Details of Sea Areas 4C and 5C

The proposed prospecting activities would be undertaken within Sea Areas 4C and 5C, located off the West Coast of South Africa. The Sea Areas are situated approximately 470 km north of Cape Town; with the inshore boundary located approximately 2.5 - 5 km seaward of the coast. Geophysical surveys and sampling operations will however typically be focussed in areas where the water depth ranges from 70 m – 160 m. Port Nolloth is located 12 km north of Sea Area 4C and Hondeklip Bay is located 50 km south of Sea Area 5C. The offshore boundary is located between approximately 140 to 180 km offshore (refer to Figure 1-1). **Given the location of Sea Areas 4C and 5C and nature of the proposed activities, no effect on coastal activities are anticipated as a result of the prospecting operations.**

The Prospecting Right area in Sea Areas 4C and 5C is 926 468.017 ha in extent and excludes the Namaqua Fossil Forest Marine Protected Area in Sea Area 4C. Co-ordinates of the boundary points of Sea Areas 4C and 5C are provided in Table 3-2.

Table 3-2: Co-ordinates of the boundary points of Sea Areas 4C and 5C.

Point	Latitude	Longitude
A	29.356218° S	16.887995° E
B	29.628712° S	16.989122° E
C	29.905369° S	17.081361° E
D	29.905344° S	15.661006° E

Point	Latitude	Longitude
E	29.628333° S	15.163888° E
F	29.597777° S	15.075000° E
G	29.356139° S	15.459527° E
Excluding the Marine Protected Area:		
H	29.416667° S	16.500000° E
I	29.416667° S	16.750000° E
J	29.600933° S	16.750400° E
K	29.600000° S	16.500000° E

3.1.3 Financial Provision

In terms of Section 24 of NEMA, an application for EA for a prospecting right must comply with the prescribed financial provision for the rehabilitation, closure and ongoing post decommissioning management of negative environmental impacts.

DBCM would put in place the required financial provision for the proposed prospecting activities and the contracted vessels would maintain appropriate Protection and Indemnity 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, the wording to be in accordance with standard P&I insurance offered.

3.1.4 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 3-3.

Table 3-3: Proposed Work Programme

Activity	Timeframe
Phase I – Survey, Sampling and Desktop Studies	36 – 54 months (Years 1 - 5)
Phase II – Economic Assessment	12 – 36 months (Years 1 – 5)

Due to the dynamic nature of prospecting and evaluation, the work programme may have to be modified, extended or curtailed as data and results become available. The proposed prospecting activities in Sea Areas 4C and 5C will be undertaken in conjunction with proposed activities in other DBCM prospecting right areas within the South African Sea Areas. Results obtained from these prospecting activities will be used to develop the regional geological framework that will guide the prospecting work programme.

3.2 MARINE PROSPECTING OVERVIEW

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

- Phase I - Survey, Sampling and Desktop studies; and
- Phase II - Economic Assessment.

3.2.1 Phase I – Survey, Sampling and Desktop Studies

The next steps identified to advance the targets in Sea Areas 4C and 5C are exploration sampling (e.g. coring and / or wide spaced sampling) in target features of interest, enabling refinement of the definition of the target features. Geophysical survey may also be undertaken.

Should the result of the survey(s) / exploration sampling indicate potential exists, then further follow-up sampling and infill survey may be undertaken to establish the distribution of the diamondiferous material.

Using the results from the sampling, geostatistical methods can be applied to determine deposit distributions from which a mineral resource can be constituted. Initial phases of sampling are unlikely to yield sufficient information to determine a resource and more detailed follow-up work is generally required to improve the confidence of the mineral resource estimate.

A regional scale geological model has been developed by De Beers for the areas of interest offshore of the West Coast of South Africa. Desktop studies to refine this model in the areas of interest, incorporating the data acquired from the offshore survey and sampling campaigns, will be ongoing throughout the Prospecting Work Programme. Details of the potential Phase I offshore activities are provided below.

Geophysical Surveys

Wide spaced geophysical survey data (e.g. 100 – 2000 m line spacing) may be acquired to refine the geological model and to identify geological features of interest / targets for follow-up survey / sampling. Follow-up localised geophysical survey may be undertaken depending on results of the previous work.

The geophysical surveys will utilise similar equipment and will be deployed from a fit-for-purpose vessel suitable to the water depth and survey method. The 2D geophysical systems could be deployed from various platforms (see Figure 3-1), such as towed systems, vessel mounted, pole mounted, Autonomous Underwater Vehicles (AUV) or Autonomous Surface Vehicle (ASV). The AUV (see Figure 3-2) is used for survey in areas where survey line spacing is generally <100 m apart. The towed 2D surveys will involve a single towed streamer (hydrophone array). 3D surveys for DBM are acquired using the AUV, with all the sensors on the platform. This contrasts with 3D survey used for petroleum exploration, which uses multiple towed streamers.

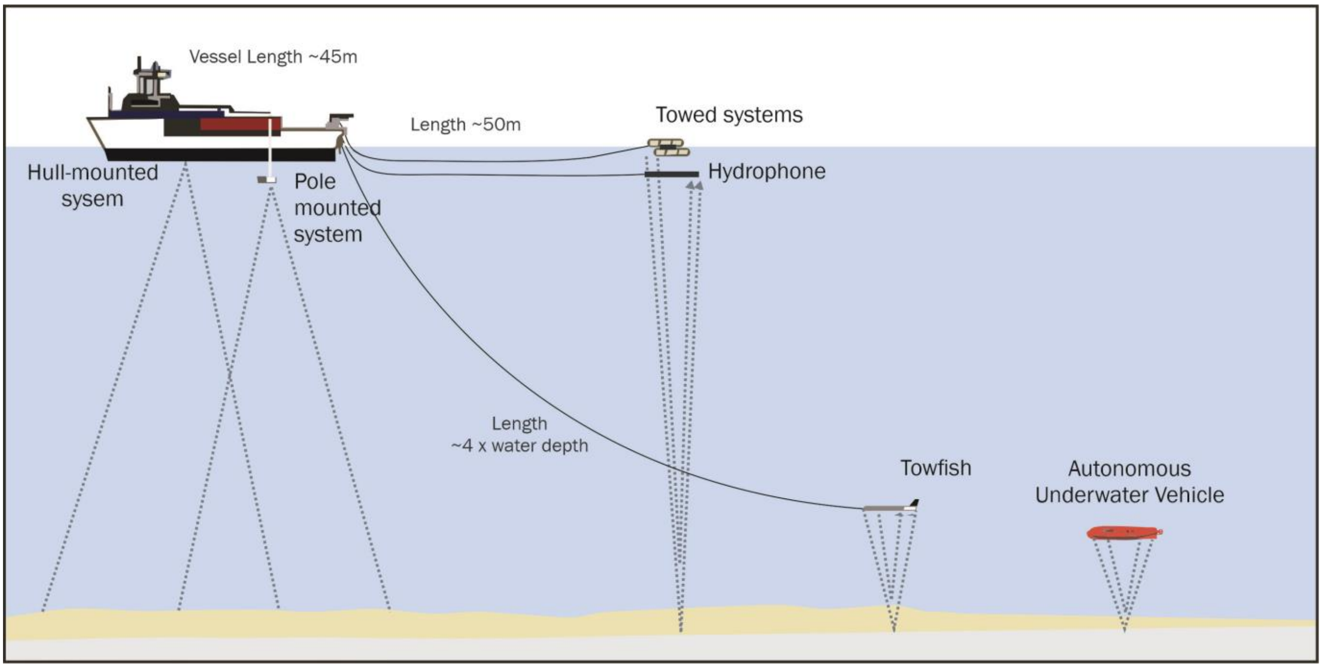

Figure 3-1: Diagram Illustrating examples of the Autonomous Underwater Vehicle, vessel-mounted, pole-mounted and towed systems that could be utilised for the surveys.

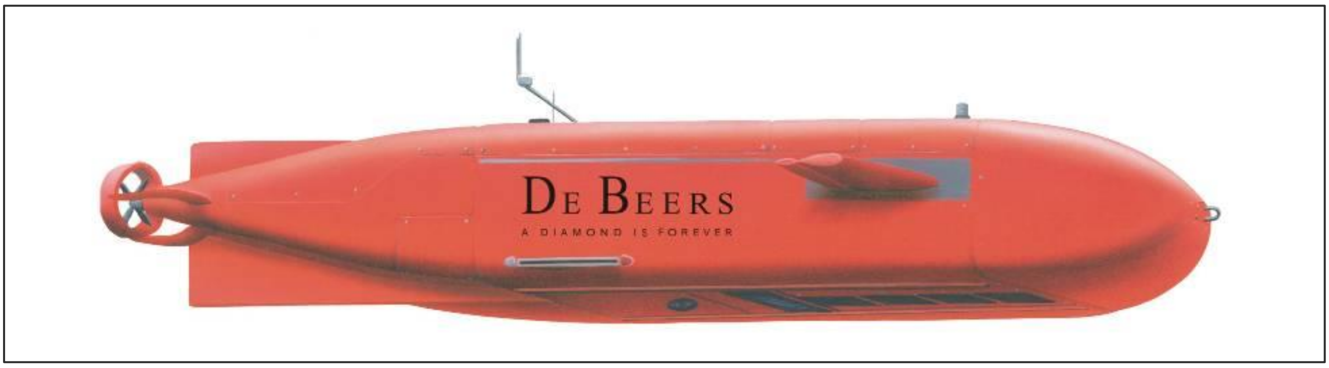

Figure 3-2: Diagram depicting an AUV.

All survey data collection is likely to be acquired by DBM survey and / or a survey service provider and geophysics professional technical staff to optimise data acquisition, processing and interpretation.

The geophysical and remote sensing systems that may be utilised for the proposed geophysical surveys are described below.

Multibeam Swath Bathymetry System (includes Backscatter)

The swath bathymetry system produces a digital terrain model of the seafloor and backscatter data may be acquired to determine textural models. 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. Typical multi-beam echo sounders emit a fan of acoustic beams from a transducer. This equipment has a variable power output and can therefore have the power ramped up in accordance with survey requirements and be contained within acceptable environmental noise levels. As a result, it is also capable of "soft starts".

The Multi-Beam Echo Sounders (MBES) used for seafloor mapping are High Frequency systems that transmit sound pulses in a fan shape beneath its transceiver. These High Frequency systems are available in a range of frequencies depending on the required water depth.

Lower frequency MBES (12 kHz) are intended for deep water surveys with water depths of 4000 – 6000 m. For shallow to intermediate water depths (200 – 1 000 m) MBES systems of 70-150 kHz are used, whereas for shallow to very shallow water depths (<200 m) higher frequency MBES systems of 200 kHz and above, are used (Lurton 2016).

The source level and pulse duration of the lower frequency MBES systems used for deep water surveys are higher than that of the higher frequency systems used for shallow water surveys. Lower frequency, 12 kHz systems, may emit sound levels as high as 240 dB re 1 µPa at 1 m and more, while higher frequency MBES systems of 100 kHz and above do not normally exceed 220 dB re 1 µPa at 1 m (Lurton 2016). Lower frequency systems have a typical pulse duration range of 2-20 ms, while higher frequency systems have ranges of 0.2 – 2 ms (Lurton 2016).

Sub-bottom profiler (SBP) systems (2D and 3D systems)

SBP systems (e.g. chirp and boomer) are lower frequency echo-sounders that provide profiles of the upper layers of the ocean floor. SBP systems use reflected or refracted sound energy to infer information of seabed conditions relating to depth and shallow sub-surface geology. The 2D survey involves transmitting acoustic energy to the seabed and recording energy reflected back from subsurface boundaries to acquire information on subsurface geology. These systems used for marine diamond exploration are focussed on the upper seabed layers, with penetrations typically varying between 5 - 100 m below the seabed, depending on the particular system being used. The frequency and power of the sound source determines the depth of penetration into the sediment or rock column. Low frequency sound penetrates deeper (100s to 1000s of meters) compared to higher frequency sound (up to 10s of meters penetration) (OTA, 2004).

Low frequency systems for deep penetration are in the range of 5 Hz to 1 kHz (OTA, 2004). These systems are used by the Oil and Gas Industry and include the large airguns and vibroseis systems, which are typically multi-channel systems (OTA, 2004; Kearey & Brooks, 1991).

In contrast, the mineral exploration industry typically uses shallow penetration systems as they require high resolution, shallow penetration data (OTA, 2004). Therefore higher frequency sources are used by this industry with frequencies falling in the 1-14 kHz range (Figure 3-3) (OTA, 2004). These systems are known as sub-bottom profilers and are typically single channel systems (OTA, 2004; Kearey & Brooks, 1991).

Two examples of potential SBPs that may be used for Phase 1 are given below. Further options are provided in Table 3-4.

- **Chirp** - Chirp systems operate around a central frequency which is swept across a range of frequencies typically between 1.5 – 12.5 kHz. Penetrations are typically <15 m below the seabed. This equipment is not capable of a "soft start". However, to mitigate this, one could start with turning on the equipment that has a soft start (e.g. Multibeam Echosounder) and then only once those are started, start the other equipment (such as the Chirp or Side Scan Sonar) that does not have a soft start.

- **Boomer -** The Boomer is an electromagnetically driven sound source. The source is usually mounted on a towed catamaran and a separate hydrophone array (single streamer) is used for a receiver. The sound is generated when a capacitor bank is discharged through one or more flat spiral coils and causes one or more copper or aluminium plates adjacent to the coil to flex away from the coil/s. This flexing creates an acoustic wave. The reflected signal from the transmitter is then received by a towed hydrophone streamer. Depending on the subsurface material types and Boomer source frequency levels selected, a penetration depth from 25 to 100 m may typically be achieved. This equipment has a variable power output allowing the power to be ramped up in accordance with survey requirements and to be contained within acceptable environmental noise levels. As a result, it is capable of "soft starts".

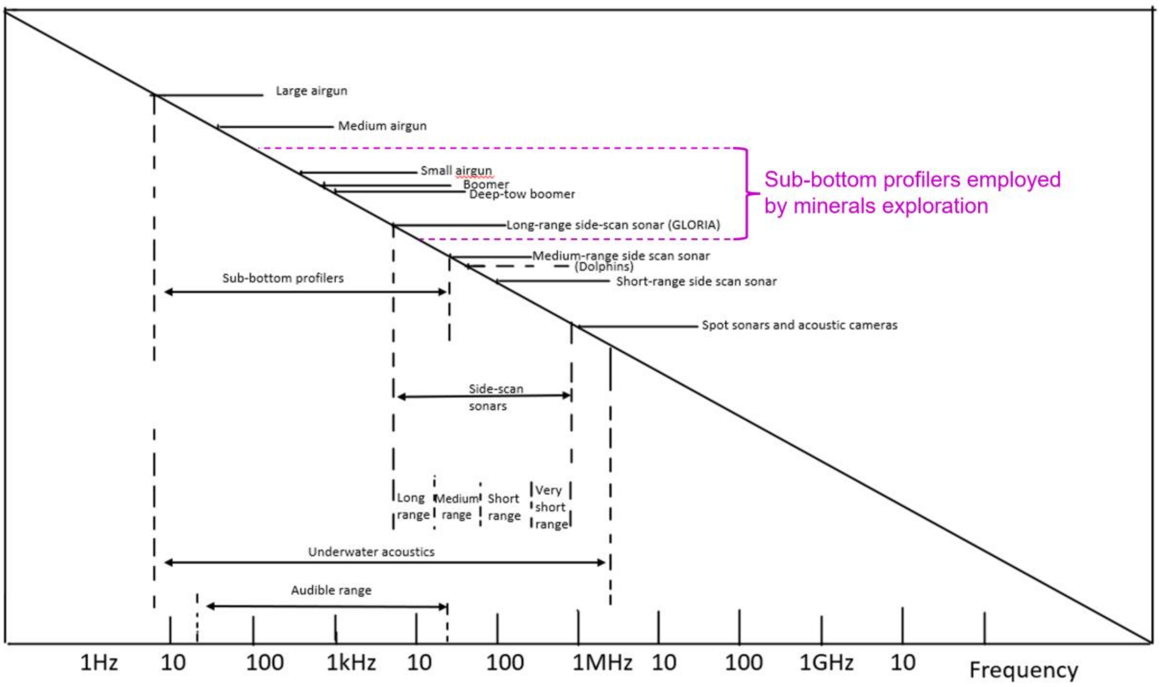

Figure 3-3: Frequency spectra of various acoustic imaging methods (Adapted from: OTA 2004).

Side scan sonar

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 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 3-4). 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. This equipment is not capable of a "soft start" however, as mentioned above for the Chirp system, to mitigate this one could start with turning on other equipment that is capable of a "soft start" and only turn on the side scan sonar equipment after completion of the soft-start procedure.

Electrical, Magnetic, Electro-Magnetic

Electrical, magnetic and / or electro-magnetic methods may possibly be used, some examples are given below:

- **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).
- **Electrical Resistivity** - Marine Resistivity surveys measure variations in the electrical resistance of layers in the seabed, through the application of electrical current into the seabed using current electrodes. Potential electrodes are then used to measure the resulting potential difference between them, which measures the electrical impedance of the seabed layers.
- **Electro-magnetic (EM)** - EM surveys measure variations in electrical properties of the seabed and bulk conductivity. In EM surveys, currents are induced into the seabed through the application of time-varying magnetic fields. A towed dipole-source transmits a time-varying electro-magnetic field into the seabed and an array of receivers placed on the seabed or behind the towed transmit array then measure the seabed layers response to changes in the field.

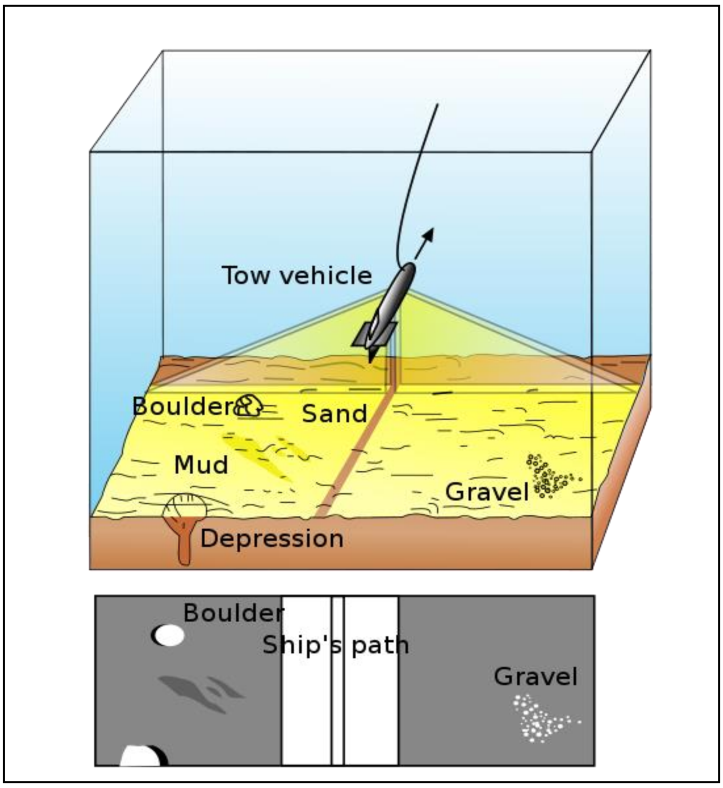

Figure 3-4: Schematic of a typical side scan sonar device and resulting information.

Other Equipment

Video and photographic equipment (such as ROVs, drop cameras, SkiMonkey, etc.) may be used for visualising the seabed as part of ground truthing studies.

Underwater manned submersibles may also be utilised for visualisation purposes.

Each and / or all of these techniques may be used during Phase I of the proposed prospecting operation. A summary of the possible geophysical survey equipment that would be used and its source frequencies, source noise levels and soft start capabilities are provided in Table 3-4 below.

Table 3-4: Specifications of Acoustic Equipment that may be Utilised in the Proposed Geophysical Surveys

Sound type	Frequency	Source level (dB re 1 μPa at 1m)	Soft Start Capability
Multibeam Echo Sounder	70 - 455 kHz	190-232	Yes
Sub Bottom Profiler - Chirp	1.5 – 12.5 kHz	195-220	No
Sub Bottom Profiler - IXSEA	1.7 – 5.5 kHz	224 - 227	No
Sub Bottom Profiler - Boomer	100 Hz – 5 kHz	200-222	Yes
	300 Hz – 3 kHz	Typically 215	
Sub Bottom Profiler - Sparker	200 Hz – 3 kHz	≤229	Yes
Sub Bottom Profiler - Sleeve gun system	100 – 800 Hz	≤225	Yes
Sub Bottom Profiler - Innomar	60 – 80 kHz (Primary) 1.5 – 15 kHz (Secondary)	<243	No
Sub Bottom Profiler - Parametric	35 – 45 kHz (Primary) 1 - 10 kHz (Secondary)	190-220	No
Side Scan Sonar	100 – 850 kHz	190 - 242	No
Magnetometer	Passive system - unchanged		

Sampling

Exploration sampling (including coring) will be undertaken using a fit-for-purpose vessel suitable to the water depth and sampling method (e.g. *MV The Explorer*, see Figure 3-5) in water depths ranging from 70 to 160 m. The planned sampling methodology will take advantage of the latest technologies available to DBM. The sampling may be divided into stages with reviews and gate releases. The 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.

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 to 500 m apart, with sample spacing based on the geological nature of the target area.

Once a decision is made on the sampling tool technology that will be chosen for taking samples from the seabed, the accompanying metallurgical sample processing technology onboard the vessel will then also be determined. Possible sampling tool technologies that could be employed include coring, the use of a subsea sampling tool and a vertically-mounted tool. Ground truthing studies may include the use of equipment such as box corers, van Veen grab samplers, etc.

Figure 3-5: Possible vessel of opportunity that could be used for sampling - *MV The Explorer.*

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

Coring (e.g. vibrocoring)

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 typically penetrate up to 6 m and typically have a diameter of approximately 11 cm.

Subsea Sampling Tool

Sampling could be undertaken using a subsea sampling tool operated from a drill frame structure (see Figure 3-6 below), which is launched through the moon pool of the support vessel and positioned on the seabed. The tool removes a discrete sample with a seabed surface footprint of approximately 5 - 10 m^2. 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 sediments 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.

Figure 3-6: Illustrative example of drill bit operated from a drill frame structure located onboard a vessel of opportunity.

Vertically Mounted Tool

Sampling could potentially be undertaken using a vertically mounted tool suspended from a derrick mounted on the ship. 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 tool to remain in contact with the seabed. The tool agitates the unconsolidated sediments and airlifts sediment particles of typically up to 250 mm in diameter to the vessel for processing. The tool removes a discrete sample with a seabed surface footprint of approximately 30 m^2. As with the Subsea Sampling Tool, all oversized and undersized sediments are discharged back to the sea on site. The depth of sediment sampled is expected to typically be between 0.5 and 5 m below the seafloor surface.

For the purposes of this assessment it is assumed that up to a maximum of 22 500 samples may be obtained within the potential deposit area(s) during the 5 years of prospecting. The sample spacing for the initial wide spaced exploration sampling / coring, will be dependent on the geological feature size. The follow-up sample spacing is expected to typically vary between 50 and 200 m apart. The cumulative area of disturbance would be approximately 0.225 km^2 but would not be contiguous.

3.2.2 Phase II – Economic Assessment

Should geological features of interest be identified, then a decision will be made regarding the feasibility of proceeding to Phase II of the prospecting activities. Phase II consists of a techno-economic assessment study that will be undertaken, utilising available sampling and geophysical data to assess the economic viability of the deposits in Sea Areas 4C and 5C. Phase II is a desktop study and therefore not discussed any further in this report.

3.3 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 prospecting 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.

3.3.1 Discharges to Sea

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 standards 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.

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.

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.

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 section above describing deck drainage.

Other

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

3.3.2 Waste Disposal to Land

A number of other types of wastes generated as part of the normal operation of the ship during the prospecting 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 prospecting operation is given below.

General Waste

This includes waste, paper, plastics, wood, glass, etc. Waste would be disposed of at an onshore landfill site in accordance with legal requirements.

Scrap metal

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

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.

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.

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.

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.

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. could be potentially toxic. Filters and media would be transported onshore and disposed of at a licensed landfill facility.

3.3.3 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.

3.4 CONSIDERATION OF ALTERNATIVES

3.4.1 Location Alternatives

The intention of the proposed prospecting operations is to determine the presence of economically viable diamond deposits that occur within Sea Areas 4C and 5C. It follows that no location alternatives are considered in the BA process.

3.4.2 Technology Alternatives

Technology alternatives considered for the proposed prospecting operations have been discussed in Section 3.2. The associated potential impacts associated with these alternative technologies have been assessed in Section 5.

3.4.3 The No-Go alternatives

The No-Go alternative is the non-occurrence of the proposed project. 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.

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;
- While job opportunities during the activities would be limited, the no-go alternative would not result any socio-economic benefits associated with the continuation of prospecting activities; and
- Lost economic opportunities in the context of the deepening economic crisis in South Africa, where it is expected that inequality would widen and poverty to deepen due to COVID-19.

3.5 NEED AND DESIRABILITY

The IEM Guideline on Need and Desirability (2017) notes that while addressing the growth of the national economy through the implementation of various national policies and strategies, it is also essential that these policies take cognisance of strategic concerns such as climate change, food security, livelihoods, as well as the sustainability in supply of natural resources and the status of our ecosystem services. Thus, the over-arching framework for considering the need and desirability of development in general is taken at the policy level through the identification and promotion of activities / industries / developments required by civil society as a whole. The DFFE guideline further notes that at a project level (as part of an impact assessment process), the need and desirability of the project should take into consideration the content of regional and local plans, frameworks and strategies.

In light of the above, and in alignment with the above-mentioned guideline (DFFE, 2017), this section aims to provide an overview of the need and desirability for the proposed project by highlighting how it is aligned with the strategic context of national development policy and planning, broader societal needs and regional and local planning, as appropriate.

3.5.1 National Policy and Planning Framework

National Development Plan 2030 (2012)

The National Development Plan (NDP) 2030 (2012) provides the context for all growth in South Africa, with the overarching aim of eradicating poverty and inequality between people in South Africa through the promotion of development. The NDP provides a broad strategic framework, setting out an overarching approach to confronting poverty and inequality based on the six focused and interlinked priorities. One of the key priorities is “faster and more inclusive economic growth”.

In order to transform the economy and create sustainable expansion for job creation, an average economic growth exceeding 5% per annum is required. One of the approaches to achieve this includes increasing exports by focusing on areas where South Africa already has natural endowments and comparative advantage, such as mining.

Notwithstanding the above, it is also acknowledged that environmental challenges are in conflict with some of these development initiatives. As such, it is emphasised that there is also a need to:

- Protect the natural environment;
- Enhance the resilience of people and the economy to climate change;
- Reduce carbon emissions in line with international commitments;
- Make significant strides toward becoming a zero-waste economy; and
- Reduce greenhouse gas emissions and improve energy efficiency.

The NDP identifies the "minerals and metals cluster" (which encompasses all mining and quarrying activities, supplier industries to the mining sector, and downstream beneficiation of mined minerals) as a sector with substantial potential for growth stimulation and / or employment. It is pointed out that South Africa must exploit its mineral resources to create employment and generate foreign exchange and tax revenue. Thus, 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 activities.

Operation Phakisa (2014)

Operation Phakisa was established in 2014 with the aim to accelerate execution of the NDP. The ultimate goal is to boost economic growth and create jobs in order to address poverty, unemployment and inequality. It also aims operate as a cross-sectoral programme for implementation of the NDP through improved cooperation between government, organised business and organised labour. Two programme areas identified under Operation Phakisa which are of relevance for the proposed project include the Oceans Economy programme and the Mining Phakisa programme. It is noted that offshore mining is not specifically addressed under the Oceans Economy Lab of Operation Phakisa, however, it was included under the Mining Lab of Operation Phakisa (also referred to as the Mining Phakisa). These are discussed in more detail below.

Oceans Economy programme

Operation Phakisa has identified the oceans economy as a key programme area, on the premise that it has the potential to contribute up to R 177 billion to Gross Domestic Product (GDP) by 2033 (compared to R 54 billion in 2010) and to create up to one million jobs (compared to 316 000 in 2010). The following six growth areas were identified as key priorities for growing the ocean economy:

- Marine Protection Services and Ocean Governance;
- Marine Transport and Manufacturing;
- Offshore Oil and Gas;
- Aquaculture;
- Small Harbours Development; and
- Coastal and Marine Tourism.

Under the Marine Protection Services and Ocean Governance work stream, Government developed an overarching governance plan with the aim to protect the ocean environment from illegal activities and promote its socio-economic benefits. A key output of this workstream is the proclamation of 22 new Marine Protected Areas (MPAs) covering an area of 68 578 km^2 of the EEZ. These areas have been set aside for the long-term protection of marine ecosystems (see Section 4.2.2).

As a result of the Marine Transport and Manufacturing workstream, the port of Port Nolloth has been upgraded as part of a rehabilitation project undertaken by the Transnet National Ports Authority. The infrastructure upgrade included the refurbishment of the jetty structure, concrete and quay infrastructure, as well as replacement of revetment works to address erosion of the shoreline. The aim of these improvements was to enable Port Nolloth to better support offshore activities. The port is now used as an offshore supply base of De Beers Group Services, who has held a five-year lease agreement to use the port as an offshore supply base for conducting diamond prospecting activity in Namibia, with Smit Amandla (now operating as African Marine Solutions Group) supply vessels stationed at the port used to transfer supplies to De Beers' offshore prospecting vessels. The refurbished port is intended to continue to serve as a support facility to the fishing and offshore mining industries in the future (Frankson, 2017).

Mining Phakisa

The goal of Mining Phakisa is to ensure that (1) the mining industry of South Africa remains economic sustainable during commodity price slumps, and (2) initiatives are put in place to position the mining cluster on a firm foundation to grow, transform, and optimize the contribution of the industry to the economic and social development of mining related communities and the country as a whole.

Five work streams were established as part of Mining Phakisa to address the challenges faced by the mining industry:

- Cluster Employment;
- Win-win Beneficiation;
- Sustainable Communities;
- Reviving Investment and Access to Affordable and Reliable Infrastructure; and
- Advancing the Cluster.

After the Phakisa Lab workshops, the Chamber of Mines South Africa (CoM) adopted an internal strategic framework for modernization - a process of transition and transformation of the mining industry. This process would, amongst others, involve using South Africa's mineral resources in the safest, most efficient, cost-effective, and sustainable manner possible, as well as promoting the conservation of natural resources, preservation and restoration of the environment.

3.5.2 Regional and Local Policy and Planning Framework

This section aims to provide an overview of the regional and local policy and planning context relating to the proposed project. The Constitution assigns Provincial and regional planning as exclusive responsibilities of Provincial Government and each province is required to publish a spatial development framework which coordinates, integrates and aligns provincial plans and development strategies with policies of National Government, Provincial departments and municipalities. Sea Areas 4C and 5C are located offshore of the Nama

Khoi and Richtersveld Local Municipalities, both located within the Namakwa District Municipality of the Northern Cape Province.

As pointed out in Section 2.1.4 above, the offshore area of activity, as well as the EEZ as a whole, do not fall within the borders of any municipality or province of South Africa as set out in the Constitution. Thus, the related planning documentation, especially at the District and Local Municipality level, typically does not directly address offshore areas and activities in a significant level of detail. Notwithstanding the above, a discussion of the provincial, district and local municipality planning context, where available, for the proposed project is considered below.

Northern Cape Provincial Spatial Development Framework (PSDF) (2012)

The Northern Cape PSDF aims to act as an enabling mechanism that responds and complies with the National Spatial Development Framework (NSDF). The latter encourages lower sphere spatial development plans and frameworks (such as the PSDF) to create an environment that promotes a developmental state. The Northern Cape PSDF aims to serve as a mechanism towards enhancing the future of the Province and its people.

The Northern Cape PSDF recognises the importance of the mining sector in the province's economic growth. However, it also aims to manage any direct detrimental impacts of resource use and promote positive socio-economic conditions once the resource use has reached the end of its productive life cycle.

The Northern Cape 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*". Thus, the proposed prospecting activities fall within the ambit of a well-established sector within the Province.

Namakwa District Municipality Integrated Development Plan (IDP) Revision (2017 – 2022)

The IDP prepared for the Namakwa District Municipality identifies mining as one of the major economic sectors within the District Municipality. It is noted that the municipality's economy is undiversified with heavy reliance on the primary sectors of mining, for sectoral contribution, and both mining and agriculture for employment.

In order to combat poverty, the need to promote productive employment opportunities is considered essential to achieve poverty reduction and sustainable economic and social development. The IDP identifies that those people living in underdeveloped rural areas are the most at risk and that unless programmes are implemented timeously to deal directly with the problems of rural poverty, these challenges would continue.

The IDP also sets out the various sectoral plans for the District to ensure alignment between the different organs of state and provide input in the overall strategic objectives of the Municipality. Of relevance to the proposed project are the following:

- The District Municipalities Climate Change Response Plan which identifies various impacts on the District's marine and aquatic systems as a result of climate change were identified, including impacts on coastal fishing communities. Various priority responses to climate change in the Coastal and Marine Environment Sector were identified and included, amongst others, delineation/refinement of the coastal protection zone and enforcing environmental legislation and EMPr in mining areas. While the proposed project would not have a direct impact on the coastal zone of the District Municipality, the management actions included in the EMPr would need to be adhered to.

- The Tourism Sector Plan includes the Northern Cape Coastal and Marine Tourism Development Strategy, which has an impact on the coastal towns of Port Nolloth, Hondeklipbay and Kleinsee. The strategy identifies development opportunities that would unlock the tourism economic potential of the Province's coastal towns in the region. As such, the plan aims to ensure the optimal use of environmental resources that constitute a key element in coastal tourism development, maintaining essential ecological processes and helping to conserve natural heritage and biodiversity. Due to the fact that the proposed prospecting activities would be undertaken a large distance far offshore, it is not foreseen that the proposed project would be in conflict with the Tourism Sector plan.

Nama Khoi Local Municipality Spatial Development Framework (SDF) (2014)

The Nama Khoi Local Municipality SDF provide the framework and strategy for future spatial (and economic) development within the municipality. The SDF identifies goals that are intended to inform the spatial objectives and SDF proposals for the municipality. Of relevance to the proposed project are the following:

- "Explore new economic and development opportunities and ventures, and to encourage and support local economic development and job creation strategies" (Goal 3). Under this goal low economic growth, a lack of economic diversification, high unemployment (especially amongst the youth) and escalating poverty are identified as issues of concern. Thus, the need to exploit new economic and development opportunities, and to create support for local economic development and job creation is identified. Possible job opportunities related to the coastal, marine and fishing industry are identified as means of addressing this issue.

Arising from the spatial analysis undertaken in developing the SDF, various broad development frameworks for various settlement areas within the local municipality were created. These broad development frameworks provide an overview of the general growth direction and vision for each area. With respect to the framework prepared for Kleinsee, support for the possible extraction of offshore resources (up to 9 km from the coastline) was deemed to be an activity that could boost the economy of Kleinsee. Notwithstanding this, it was also acknowledged that a strategy for rehabilitating the coastal line and degraded areas that have been severely transformed as a result of alluvial diamond mining activities was also required.

Nama Khoi Local Municipality IDP (2019 – 2020)

The IDP (2019 – 2020) of Nama Khoi Municipality creates the framework within which the municipality aims to deliver and create jobs and improve infrastructure and housing. The IDP identifies various spatial objectives for the municipality. Those of relevance to the proposed project include:

- Improving the sea connection between Saldanha, Kleinsee and Port Nolloth, in order to link the Coastal Development Corridor to the north and south and investigating the feasibility of direct boat access to the ocean at Kleinsee by means of a small harbour or port.
- Developing sustainable and diverse local economies by the utilisation of opportunities in the different spatial categories: investment is required to upgrade under-developed coastal infrastructure within the municipality. In addition, insufficient fish quotas must be addressed and accessibility to markets and to the coast should be improved.
- Investigating and exploiting known concentration of minerals around the Springbok area, as well as in a broad band along the south of the Orange River. It is acknowledged that while many of these sources have been depleted, there are still resources that can be exploited.

Richtersveld Local Municipality Integrated Development Plan (2020 / 2021)

The Richtersveld Local Municipality IDP provides the framework to guide the municipality's planning and budgeting over the course of a set legislative time frame. The IDP seeks to support sustainable development of the municipal area and its communities through integration and balancing of the economic, ecological and social factors which influence development. The IDP identifies the following as strategic goals / objectives:

- For every household to have access to clean water, electricity and sanitation;
- To treat all our people with pride and dignity;
- To be an effective and efficient local government;
- To be an effective instrument of change within our community;
- To be a local government that is accountable with community driven development; and
- To be the gateway for Local Economic Development (LED) and Tourism in the Northwestern Coast of the Northern Cape.

Richtersveld is located within an area of world class biodiversity and of a unique conservation value. This is a result of both the inland and terrestrial ecosystems as well as the diverse coastal and marine habitats. For this reason, Richtersveld Municipality promotes sustainable development in the following forms: sustainable use of resources, sustainable transport, energy efficiency, recycling, sustainable use of water resources, the use of renewable energy and other environmentally friendly practices. The Richtersveld Municipality thus forms part of the Working for the Coast Programme which aims for:

- Coastal economic development that makes the best use of available resources;
- Coastal development that promotes social equity through improved livelihoods of poor coastal communities; and
- A healthy coastal environment for the benefit of current and future generations.

3.5.3 Consistency with Policy and Planning Context

The previous sections have considered the policy and planning context at national and regional level which are relevant to the proposed project. There is a drive from national and provincial Government to stimulate development and grow the economy of South Africa with a strong focus on job creation in all sectors, whilst protecting the environment. Mining has been a long-term driver of economic growth and job creation for the country and still considered to be an important for the national economy.

The proposed prospecting activities would allow for the determination of the economic viability of the project in Sea Areas 4C and 5C. By gaining a better understanding of the extent, nature and economic feasibility of extracting these potential resources, the viability of undertaking future mining operations within the prospecting area would be better understood.

However, the promotion of the mining sector could also be considered a contradiction with some other plans and policies, which identify the need to reduce the reliance on the extraction of non-renewable resources as they contribute to Green-House Gas emissions. Nevertheless, due to the limited overall economic growth within the country there is still a need to undertake mineral exploration and mining activities within the country.

3.5.4 DFFE Guideline on Need and Desirability

When considering an application for EA, the competent authority must comply with Section 24O of NEMA and must have regard for any guideline published in terms of Section 24J of the Act and any minimum requirements for the application. This includes the DFFE's Guideline on Need and Desirability (March 2017). Additionally, the EIA Regulations, 2014 (as amended) require EAPs who undertake environmental assessments, to have knowledge and take into account relevant guidelines. A person applying for an EA must abide by the Regulations, which are binding on the applicant.

The DFFE's Guideline on Need and Desirability (March 2017) sets out a list of questions which should be addressed when considering need and desirability of a proposed development. These are divided into questions that relate to the aspects of ecological sustainability and justifiable economic and social development of the proposed project. Table 3-5 below sets out the list of questions as per the Guideline.

Table 3-5: Questions to be Engaged with when Considering Need and Desirability, as per the IEM Guideline on Need and Desirability (March 2019)

QUESTION		LOCATION IN REPORT
1.	**How will this development (and its separate elements / aspects) impact on the ecological integrity of the area?**	
1.1	How were the ecological integrity considerations taken into account? 1.1.1. Threatened Ecosystems, 1.1.2. Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure, 1.1.3. Critical Biodiversity Areas ("CBAs") and Ecological Support Areas ("ESAs"), 1.1.4. Conservation targets, 1.1.5 Ecological drivers of the ecosystem, 1.1.6. Environmental Management Framework, 1.1.7. Spatial Development Framework, and 1.1.8. Global and international responsibilities relating to the environment (e.g. RAMSAR sites, Climate Change, etc.)	See Sections 3.5.1, 3.5.2, 4 and 5.
1.2	How will this development disturb or enhance ecosystems and / or result in the loss or protection of biological diversity? What measures were explored to firstly avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	See Section 5 and Appendix F.
1.3	How will this development pollute and/or degrade the biophysical environment? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	See Section 5 and Appendix F.
1.4	What waste will be generated by this development? What measures were explored to firstly avoid waste, and where waste could not be avoided altogether, what measures were explored to minimise, reuse and/or recycle the waste? What measures have been explored to safely treat and/or dispose of unavoidable waste?	A description of the anticipated types of waste, associated volumes are provided in Section Vessel Emissions and Discharges. The proposed management measures are included in Appendix F.

QUESTION	LOCATION IN REPORT
1.5 How will this development disturb or enhance landscapes and/or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	See Section 5 and Appendix F.
1.6 How will this development use and/or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	The purpose of the proposed prospecting operations is to determine the economic viability of the mineral deposits in Sea Areas 4C and 5C for future exploitation. Thus, the proposed project could facilitate the future extraction of non-renewable mineral resources. Notwithstanding the above, due to the high-costs of undertaking prospecting (and possible future mining) operations in the offshore environment, the location and extent of disturbed areas would be limited to only those areas targeted by the planned activities.
1.7 How will this development use and/or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and/or impact on the ecosystem jeopardise the integrity of the resource and/or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impacts? 1.7.1. Does the proposed development exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource dependency (i.e. de-materialised growth)? (note: sustainability requires that settlements reduce their ecological footprint by using less material and energy demands and reduce the amount of waste they generate, without compromising their quest to improve their quality of life) 1.7.2. Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used (i.e. what are the opportunity costs of using these resources this the proposed development alternative?) 1.7.3. Do the proposed location, type and scale of development promote a reduced dependency on resources?	
1.8 How were a risk-averse and cautious approach applied in terms of ecological impacts? 1.8.1. What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)? 1.8.2. What is the level of risk associated with the limits of current knowledge? 1.8.3. Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	See Section 1.2.
1.9. How will the ecological impacts resulting from this development impact on people's environmental right in terms following:	See Section 5.

QUESTION	LOCATION IN REPORT
1.9.1. Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts? 1.9.2. Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	
1.10. Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socioeconomic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	See Sections 4 and 5.
1.11. Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives/targets/considerations of the area?	See Section 5.
1.12. Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations?	See Section 3.4.
1.13. Describe the positive and negative cumulative ecological/biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and existing and other planned developments in the area?	See Section 5.
2.1. What is the socio-economic context of the area, based on, amongst other considerations, the following considerations?: 2.1.1. The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks of policies applicable to the area, 2.1.2. Spatial priorities and desired spatial patterns (e.g. need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc.), 2.1.3. Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and 2.1.4. Municipal Economic Development Strategy ("LED Strategy").	See Sections 3.5.2.
2.2. Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area? 2.2.1. Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	See Sections 3.5.2.
2.3. How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	See Sections 3.5.1, 3.5.2, 4 and 5.

QUESTION	LOCATION IN REPORT
2.4. Will the development result in equitable (intra- and inter-generational) impact distribution, in the short and long-term? Will the impact be socially and economically sustainable in the short- and long-term?	See Section 5.
2.5. In terms of location, describe how the placement of the proposed development will: 2.5.1. Result in the creation of residential and employment opportunities in close proximity to or integrated with each other, 2.5.2. Reduce the need for transport of people and goods, 2.5.3. Result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms public transport), 2.5.4. Compliment other uses in the area, 2.5.5. Be in line with the planning for the area, 2.5.6. For urban related development, make use of underutilised land available with the urban edge, 2.5.7. Optimise the use of existing resources and infrastructure, 2.5.8. Opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement), 2.5.9. Discourage "urban sprawl" and contribute to compaction/densification, 2.5.10. Contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current needs, 2.5.11. Encourage environmentally sustainable land development practices and processes, 2.5.12. Take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.), 2.5.13. The investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential), 2.5.14. Impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area, and 2.5.15. In terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	Due to the offshore nature of the proposed project, these are not applicable.
2.6. How were a risk-averse and cautious approach applied in terms of socio-economic impacts?: 2.6.1. What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)? 2.6.2. What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge? 2.6.3. Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	See Section 1.2.

QUESTION	LOCATION IN REPORT
2.7. How will the socio-economic impacts resulting from this development impact on people's environmental right in terms following: 2.7.1. Negative impacts: e.g. health (e.g. HIV-Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts? 2.7.2. Positive impacts. What measures were taken to enhance positive impacts?	See Section 5 and Appendix F.
2.8. Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socio-economic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	See Section 5 and Appendix F.
2.9. What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	See Section 5 and Appendix F.
2.10. What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)? Considering the need for social equity and justice, do the alternatives identified, allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered?	Due to the offshore nature of the proposed project, these are not applicable.
2.11. What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination?	Due to the offshore nature of the proposed project no such issues are deemed to be likely to arise as a result of the proposed survey and sampling operations.
2.12. What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development's life cycle?	See Section 5 and Appendix F.
2.13. What measures were taken to: 2.13.1. Ensure the participation of all interested and affected parties, 2.13.2. Provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation, 2.13.3. Ensure participation by vulnerable and disadvantaged persons, 2.13.4. Promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means, 2.13.5. Ensure openness and transparency, and access to information in terms of the process,	See Sections 2.4.7 and 2.4.9.

QUESTION	LOCATION IN REPORT
2.13.6. Ensure that the interests, needs and values of all interested and affected parties were taken into account, and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge, and 2.13.7. Ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein were be promoted?	
2.14. Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)?	Due to the offshore nature of the proposed project no such opportunities are deemed to be likely as a result of the proposed project.
2.15. What measures have been taken to ensure that current and/or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected?	Project activities would comply with the De Beers internal occupational health and safety policies and/or standards as well as national legislation.
2.16. Describe how the development will impact on job creation in terms of, amongst other aspects: 2.16.1. The number of temporary versus permanent jobs that will be created, 2.16.2. Whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area), 2.16.3. The distance from where labourers will have to travel, 2.16.4. The location of jobs opportunities versus the location of impacts (i.e. equitable distribution of costs and benefits), and 2.16.5. The opportunity costs in terms of job creation (e.g. a mine might create 100 jobs, but impact on 1000 agricultural jobs, etc.).	See Section 5.4.2.
2.17. What measures were taken to ensure: 2.17.1. That there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment, and 2.17.2. That actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures?	See Section 3.5.3.
2.18. What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage?	See Appendix F.
2.19. Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	See Appendix F.

QUESTION	LOCATION IN REPORT
2.20. What measures were taken to ensure that the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects will be paid for by those responsible for harming the environment?	See Appendix F.
2.21. Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable environmental option in terms of socio-economic considerations?	See Section 1.2.
2.22. Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and other planned developments in the area?	See impact assessment included in Section 5.

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.

4.1 MARINE ENVIRONMENT

This section provides a general overview of the meteorology, geophysical, biophysical and biological oceanography and human utilisation along the South African West Coast with the focus primarily on the study area between the Orange River Mouth and Lamberts Bay. The purpose is to provide the marine baseline environmental context within which the proposed prospecting activities would take place.

The information presented below is based on information gleaned from Lane & Carter (1999), Morant (2006), and Penney *et al.* (2007). The description of benthic macrofaunal communities was provided by Natasha Karenyi of the South African National Biodiversity Institute (SANBI), and the section on marine mammals was provided by Dr Simon Elwen of the Namibian Dolphin Project and Mammal Research Institute (University of Pretoria) for other projects undertaken previously in the region.

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, 5° 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.

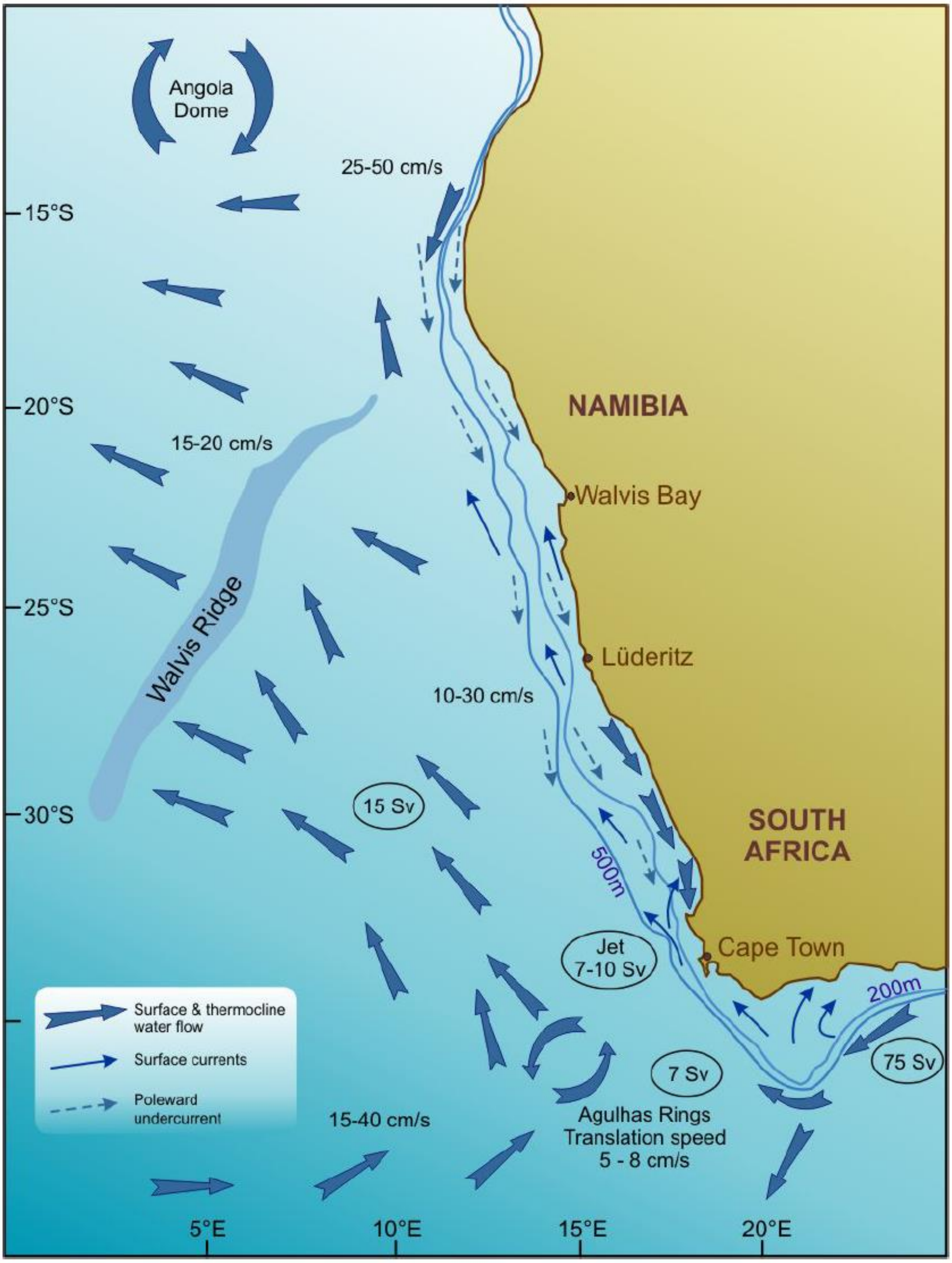

Figure 4-1: Circulation and Volume Flows of the Benguela Current (After Shannon & Nelson (1996)).

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.

4.1.2 Geophysical Oceanography

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 north-north-west (NNW) trend, widening north of Cape Columbine and reaching its widest off the Orange River (180 km) (see Figure 4-2). The nature of the shelf break varies off the South African West Coast. 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 inshore[1] area consists mainly of a narrow (about 8 km wide) rugged rocky zone and slopes steeply seawards to a depth of around 80 m. The middle (-50 to -150 m) and outer shelf (-150 to -350 m) normally lacks relief and slopes gently seawards reaching the shelf edge at a depth of between -350 to -500 m (Sink *et al.* (2019)). The three shelf zones characterising the West Coast are recognised following both abiotic (de Wet (2013)) and biotic (Karenyi *et al.* (2016)) patterns.

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, and ~75 km south of Sea Areas 4C and 5C. Child's Bank is a major feature on the West Coast margin and is the only known submarine bank within South Africa's EEZ, rising from a depth of 350 - 400 m water to less than -200 m at its shallowest point. It is a rounded, flat topped, sandy plateau, which lies at the edge of the continental shelf. The bank has a gentle northern, eastern and southern margin but a steep, slump-generated outer face (Birch & Rogers 1973; Dingle *et al.* 1983; de Wet 2013). At its southwestern edge, the continental slope drops down steeply from -350 to -1 500 m over a distance of less than 60 km (de Wet (2013)) creating precipitous cliffs at least 150 m high (Birch & Rogers (1973)). The bank consists of resistant, horizontal beds of Pliocene sediments, similar to that of the Orange Banks, and represents another perched erosional outlier formed by Post-Pliocene erosion (Dingle 1973; Siesser *et al.* (1974)). The top of this feature has been estimated to cover some 1 450 km^2 (Sink *et al.* 2012). Tripp Seamount is a geological feature ~50 km to the west of the Licence Area, which rises from the seabed at ~1 000 m to a depth of 150 m. It is a roughly circular feature with a flat apex that drops steeply on all sides.

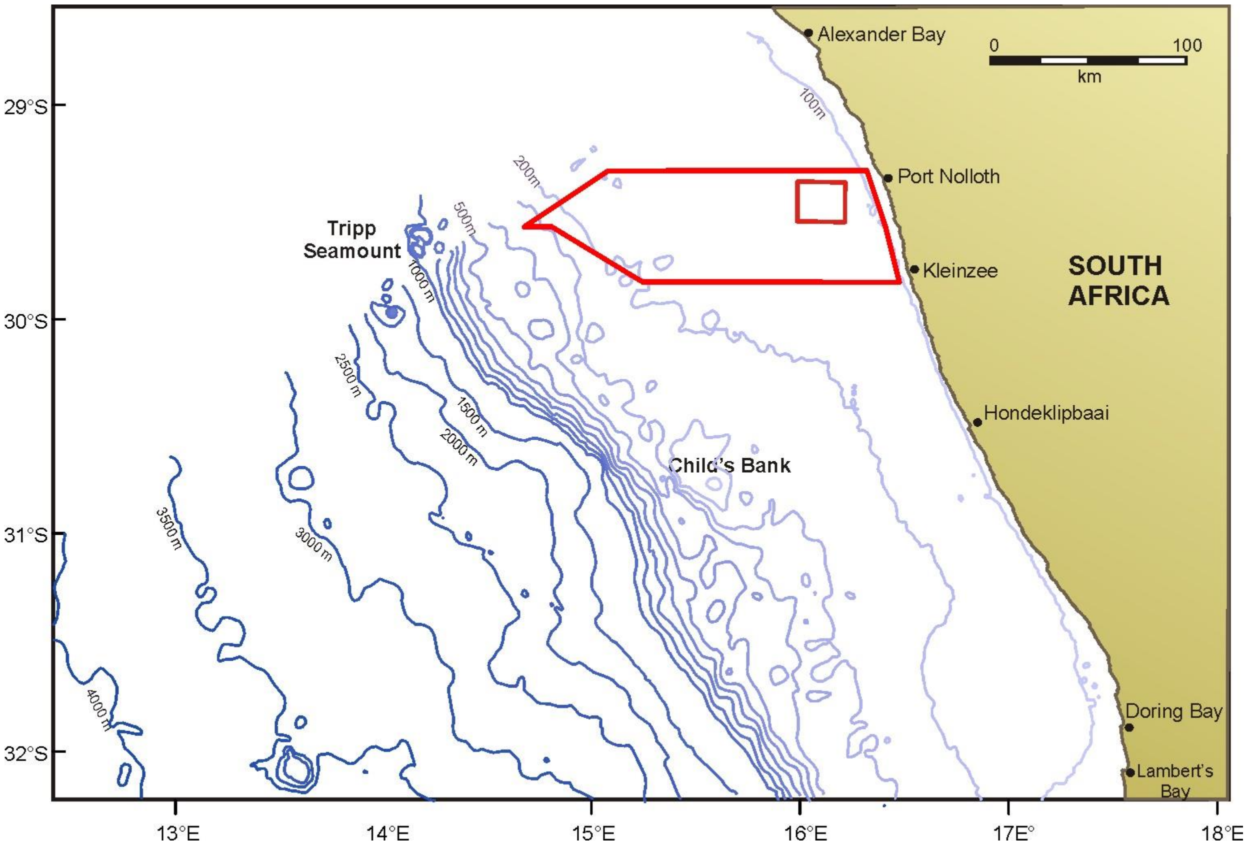

Figure 4-2: Map indicating the location of Sea Areas 4C and 5C in relation to bathymetric features off the West Coast.

Coastal and Inner-Shelf Geology and Geomorphology

The inner shelf is underlain by Precambrian bedrock (Pre-Mesozoic basement), whilst the middle and outer shelf areas are composed of Cretaceous and Tertiary sediments (Dingle (1973); Dingle *et al.* (1987); Birch *et al.* (1976); Rogers (1977); Rogers & Bremner (1991)). As a result of erosion on the continental shelf, the unconsolidated sediment cover is generally thin, often less than 1 m. Sediments are finer seawards, changing from sand on the inner and outer shelves to muddy sand and sandy mud in deeper water. However, this general pattern has been modified considerably by biological deposition (large areas of shelf sediments contain high levels of calcium carbonate) and localised river input. A ~500 km long mud belt (up to 40 km wide, and of 15 m average thickness) is situated over the inner-shelf shelf between the Orange River and St Helena Bay (Birch *et al.* (1976)). Further offshore and within Sea Areas 4C and 5C, sediment is dominated by muddy sands and sand. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze. The distribution of seabed surface sediment types off the South African West Coast is provided in Figure 4-3.

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

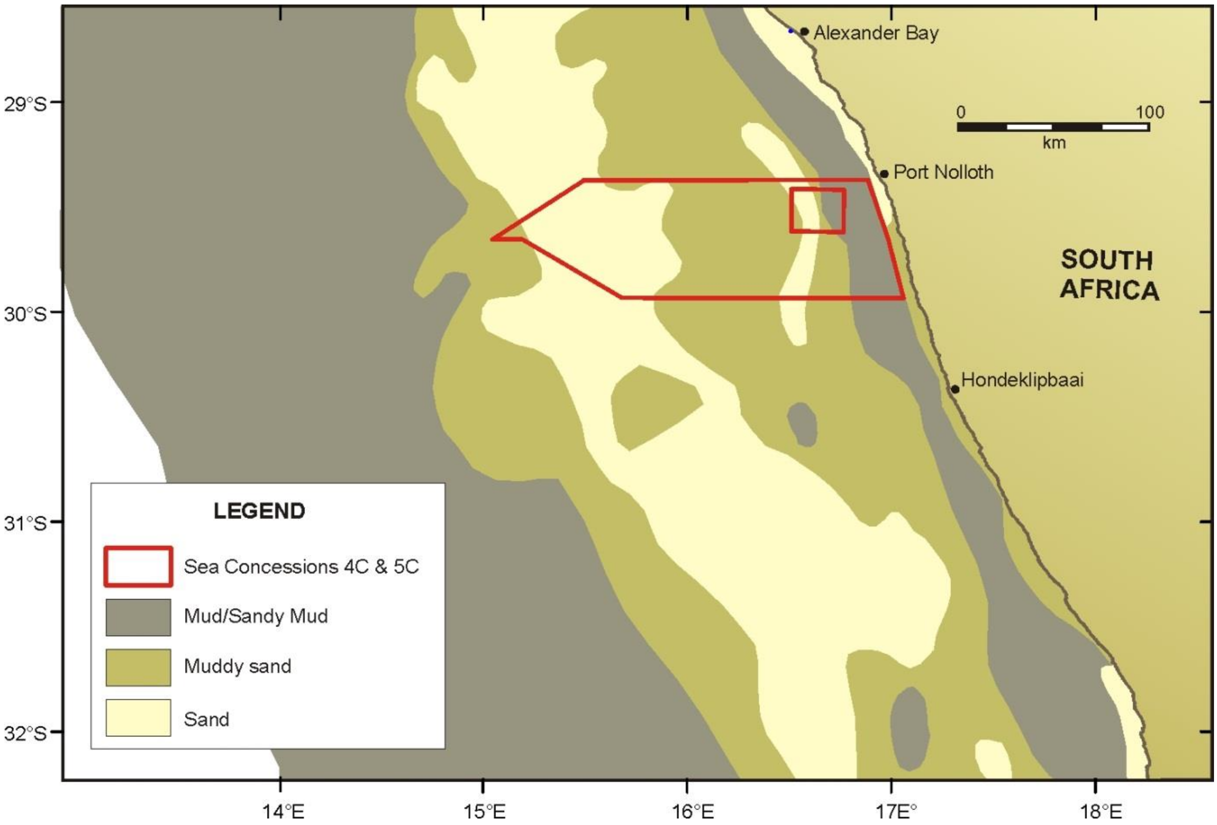

Figure 4-3: Sediment distribution on the continental shelf of the South African West Coast (adapted from Rogers (1977)). Based on information in Holness *et al.* (2014) and Sink *et al,* (2019)

The benthic habitat types of the South African West Coast were classified and mapped in detail through the 2011 NBA (Sink *et al.* (2012a)). These were refined in the 2018 NBA (Sink *et al.* (2019)) to provide substratum types (see Figure 4-4).

In Sea Areas 4C and 5C the water depth ranges from approximately 50 m up to ~200 m. The Southern Benguela Muddy Shelves substratum dominates across the block, with the deepest portions in the west being characterised by Southern Benguela Sandy Shelves. Southern Benguela Sandy Shelves substratum is also present as a narrow band in the eastern third of Sea Areas 4C and 5C and Namaqua Mid-Shelf Fossils present in the omitted section covering the Namaqua Fossil Forest MPA. Only four ecosystem types are represented in the block, these being Namaqua Muddy Mid-Shelf Mosaic, Namaqua Sandy Mid-Shelf, Namaqua Muddy Sands, and Southern Benguela Sandy Outer Shelf (Sink *et al.* (2019)) (see Figure 4-5).

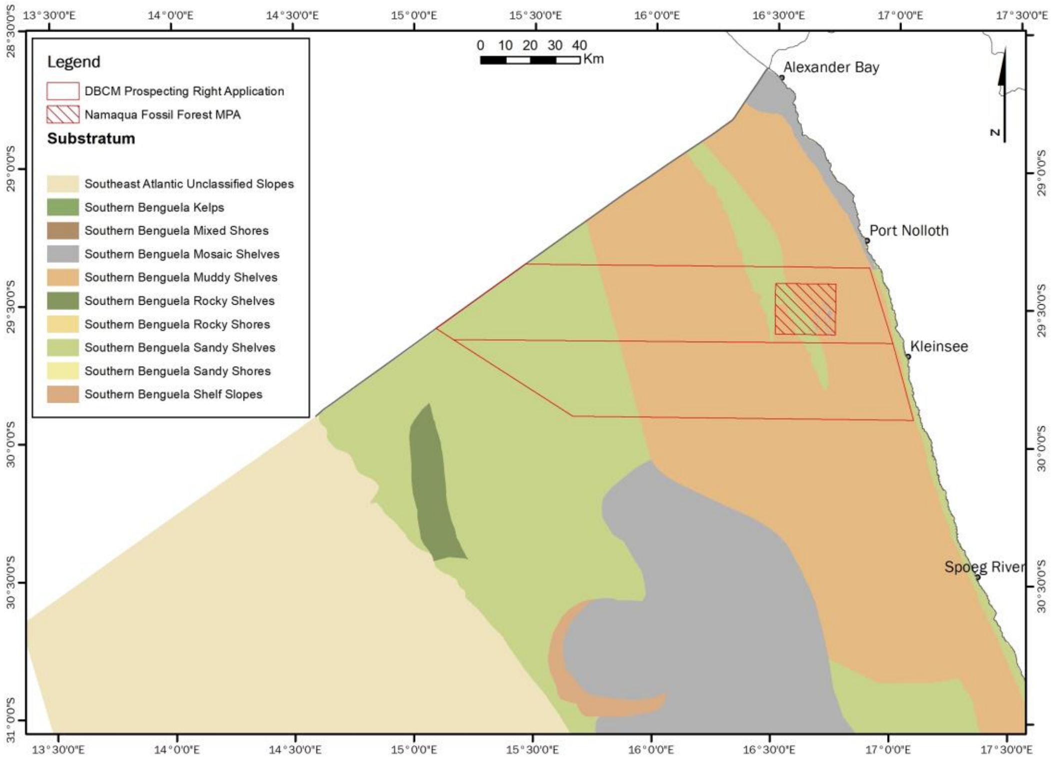

Figure 4-4: Sea Areas 4C and 5C in relation to the distribution of seabed substratum types along the West Coast (adapted from Sink *et al.* (2019)).

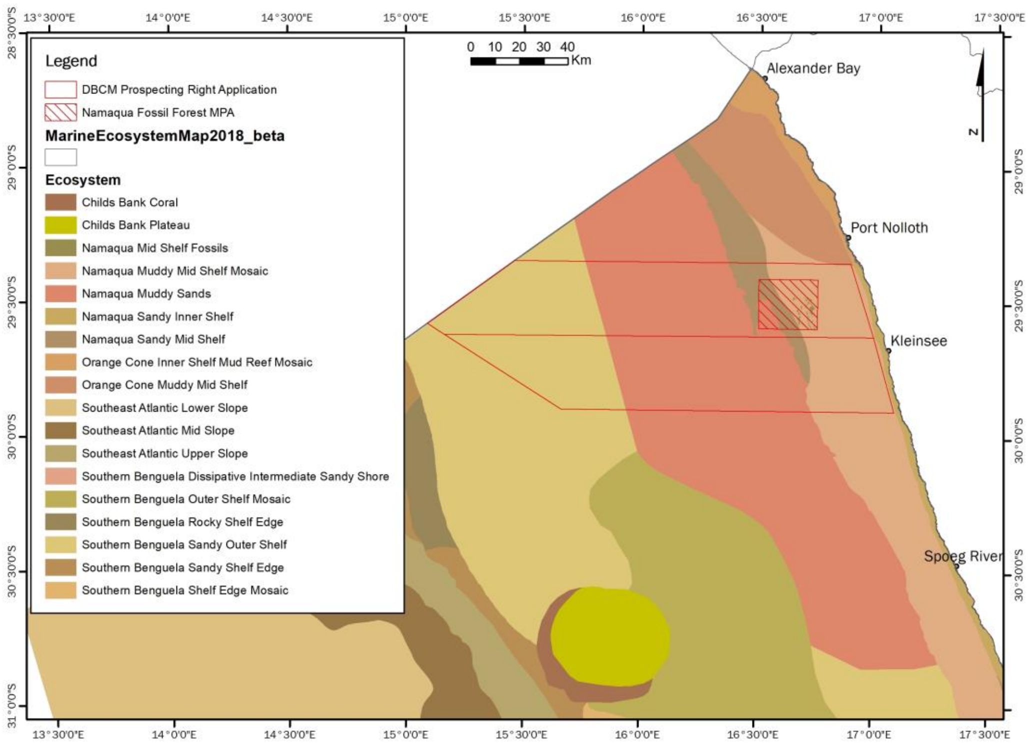

Figure 4-5: Sea Areas 4C and 5C in relation to the distribution of benthic ecosystem types along the West Coast (adapted from Sink *et al.* (2019)).

4.1.3 Biophysical Oceanography

Wind

Winds are one of the main physical drivers of the nearshore Benguela region, both on an oceanic scale, generating the heavy and consistent SW 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. Consequently, 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 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 is a perennial feature that forms part of a discontinuous belt of high-pressure systems which encircle the subtropical southern hemisphere. This 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 (October to March), during which winds blow 98% of the time (PRDW (2013)), with a total of 226 gales (winds exceeding 18 m/s or 35 kts) being recorded over the period (CSIR (2006)). Virtually all winds in summer come from the south to south-south-east (SSE) (see Figure 4-6). These southerlies occur over 40% of the time, averaging 20 – 30 knots and reaching speeds in excess of 60 knots, bringing cool, moist air into the coastal region and driving the massive offshore movements of surface water, and the resultant strong upwelling of nutrient-rich bottom waters, which characterise this region in summer. The winds also play an important role in the loss of sediment from beaches. These strong equator-wards winds are interrupted by the passing of coastal lows with which are associated periods of calm or north or NW wind conditions. These northerlies occur throughout the year but are more frequent in winter.

Winter remains dominated by southerly to SE winds, but the closer proximity of the winter cold-front systems results in a significant SW to NW component (see Figure 4-6). 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 typically develop in summer. There are also more calms in winter, occurring about 6% of the time, and wind speeds generally do not reach the maximum speeds of summer. However, the westerly winds blow in synchrony with the prevailing south-westerly swell direction, resulting in heavier swell conditions in winter.

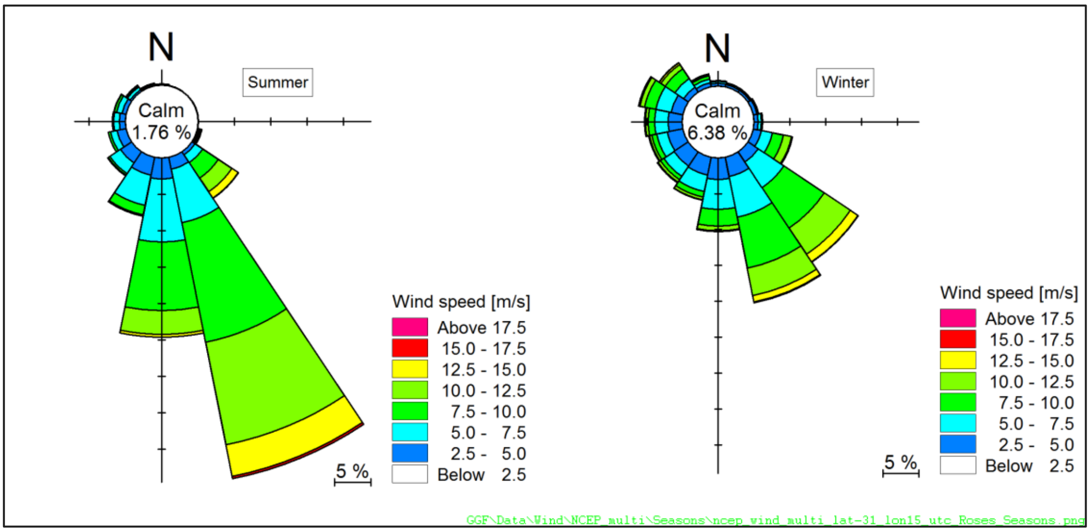

Figure 4-6: Wind speed and direction for NCEP hind cast data at location 15° E, 31° S (from PRD (2013)).

During autumn and winter, katabatic, or easterly 'berg' winds can also occur. These powerful offshore winds can exceed 50 km/h, producing sandstorms that considerably reduce visibility at sea and on land. Although they occur intermittently for about a week at a time, they have a strong effect on the coastal temperatures, which often exceed 30 °C during 'berg' wind periods (Shannon & O'Toole (1998)). The winds also play a significant role in sediment input into the coastal marine environment with transport of the sediments up to 150 km offshore (see Figure 4-7).

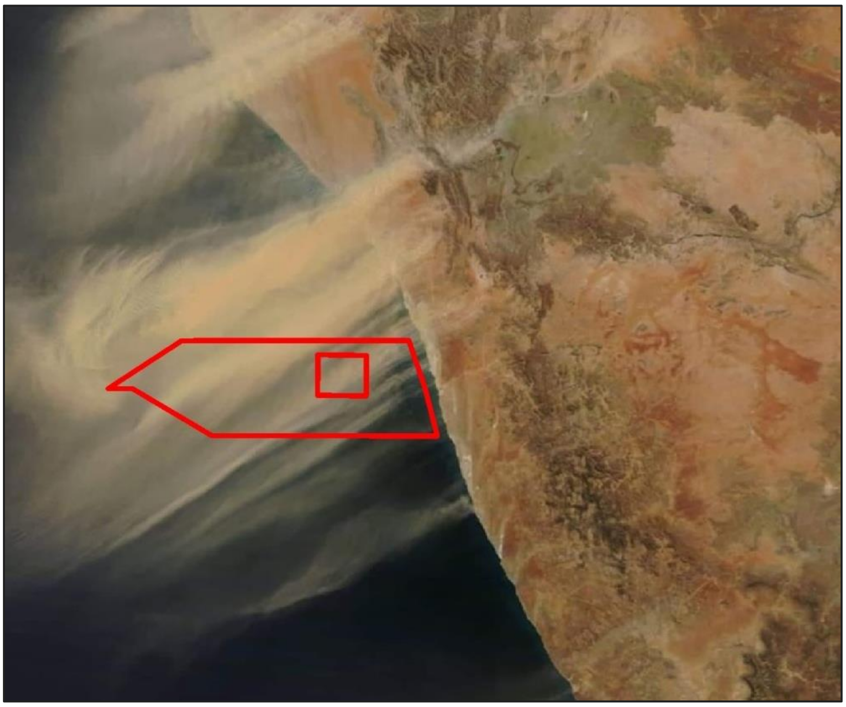

Figure 4-7: Sea Areas 4C and 5C in relation to aerosol plumes of sand and dust due to 'berg' wind event on the South African West Coast in October 2019 (source: LandWaterSA).

Large-Scale Circulation and Coastal Currents

The South African West Coast is strongly influenced by the Benguela Current. Current velocities in continental shelf areas generally range between 10–30 cm/s (Boyd & Oberholster (1994)), although localised flows in excess of 50 cm/s occur associated with eddies (PRDW (2013)). On its western side, flow is more transient and characterised by large eddies shed from the retroflection of the Agulhas Current. This results in considerable variation in current speed and direction over the domain (PRDW (2013)). In the south the Benguela current has a width of 200 km, widening rapidly northwards to 750 km. The surface flows are predominantly wind-forced, barotropic and fluctuate between poleward and equatorward flow (Shillington *et al.* 1990; Nelson & Hutchings 1983) (refer to Figure 4-1). Fluctuation periods of these flows are 3 - 10 days, although the long-term mean current residual is in an approximate northwest (alongshore) direction. Current speeds decrease with depth, while directions rotate from predominantly NW at the surface to SE near the seabed. Near bottom shelf flow is mainly poleward with low velocities of typically <5 cm/s (Nelson (1989); PRDW (2013)). The poleward flow becomes more consistent in the southern Benguela.

The major feature of the Benguela Current is coastal upwelling and the consequent high nutrient supply to surface waters leads to high biological production and large fish stocks. The prevailing longshore, equator-ward 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)) (see Figure 4-8 (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 4-8. Sea Areas 4C and 5C overlap with the Namaqua upwelling cell.

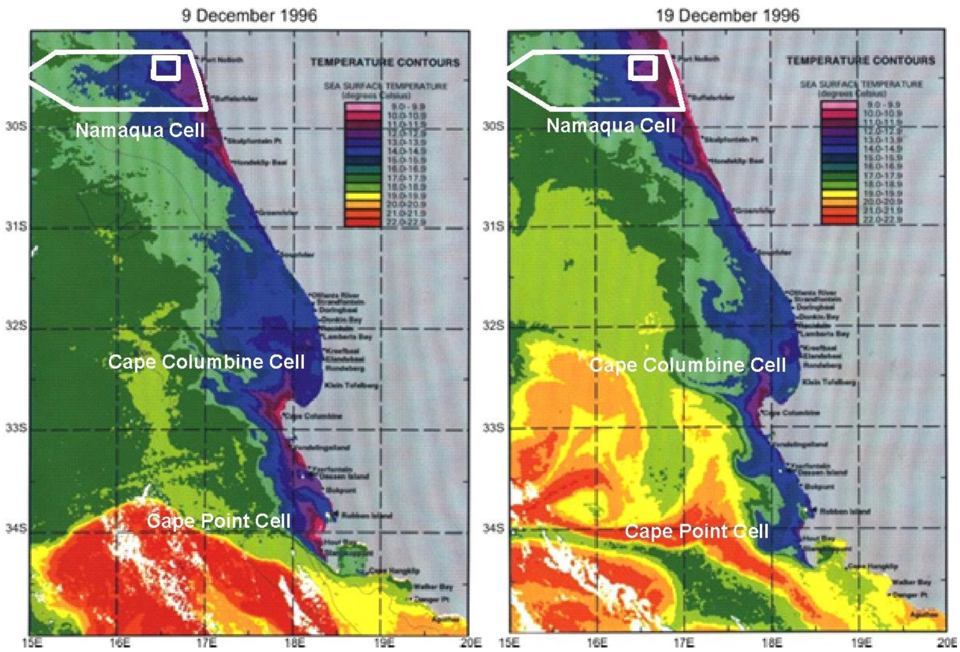

Figure 4-8: Satellite sea-surface temperature images showing Sea Areas 4C and 5C in relation to upwelling along the South African West Coast on four days in December 1996 (from Lane and Carter (1999)).

Where the Agulhas Current passes the southern tip of the Agulhas Bank (Agulhas Retroflection area), it may shed a filament of warm surface water that moves NW along the shelf edge towards Cape Point and Agulhas Rings, which similarly move NW into the South Atlantic Ocean (refer to Figure 4-8 (right)). These rings may extend to the seafloor and west of Cape Town they may split, disperse or join with other rings. During the process of ring formation, intrusions of cold subantarctic water moves into the South Atlantic. The contrast in warm (nutrient-poor) and cold (nutrient-rich) water is thought to be reflected in the presence of cetaceans and large migratory pelagic fish species (Best (2007)).

Waves

Most of the West Coast of southern Africa is classified as exposed, experiencing strong wave action with a rating between 13-17 on the 20-point exposure scale (McLachlan (1980)). Much of the coastline is therefore impacted by heavy SW swells generated in the roaring forties, as well as significant sea waves generated locally by strong to moderate prevailing southerly winds characteristic of the region (see Figure 4-9). The peak wave energy periods fall in the range 9.7 – 15.5 seconds.

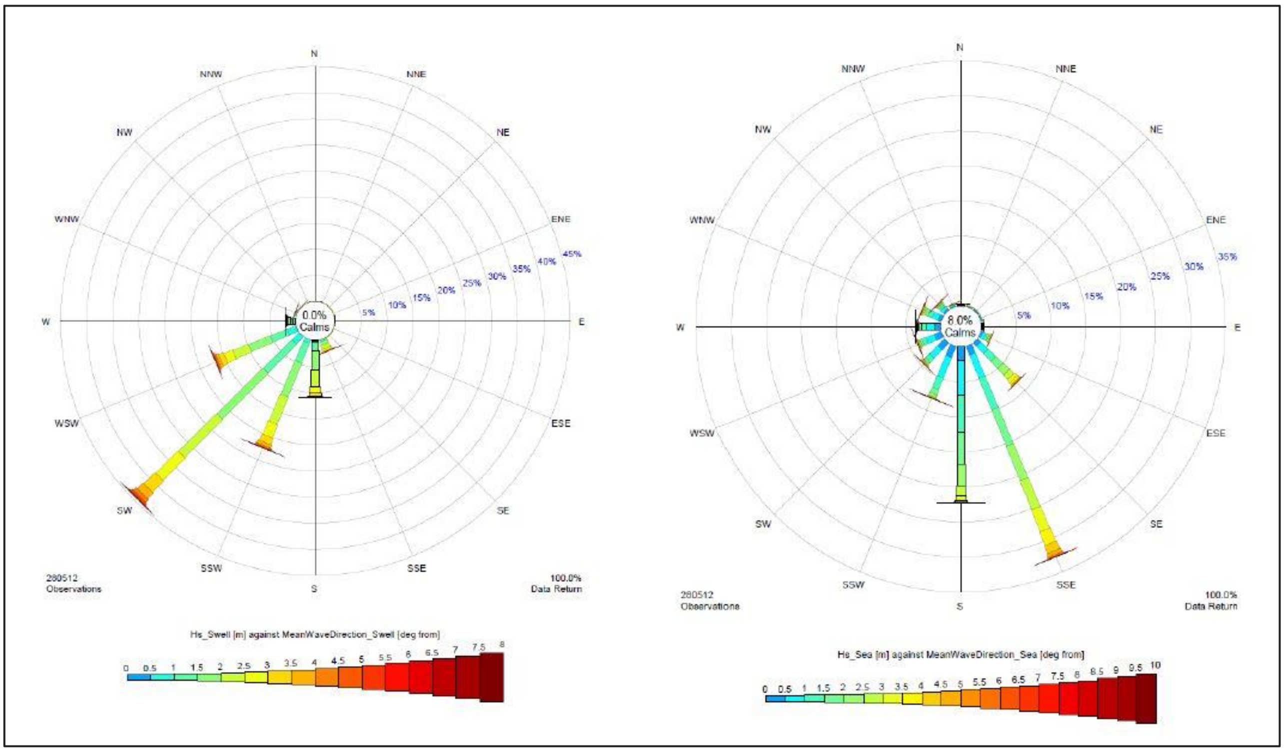

Figure 4-9: Annual rose plots of significant wave height partitions of swell (left) and wind-sea (right) for GROW1012 hind cast data at location 15° E, 31° S.

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 and south-south-west (SSW) direction. Winter swells are strongly dominated by those from the S and 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 SW storms, winter swell heights can exceed 10 m.

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

Tides

Tides along the West Coast are subject to a simple semi-diurnal tidal regime with a total range of 1.5 m at spring tide, but only 0.6 m during neap tide periods.

Water

South Atlantic Central Water (SACW) comprises the bulk of the seawater in the study 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 of the southern Benguela Current 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 Current 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 of the Benguela system 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.

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 NNW 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.

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 (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. Sea Areas 4C and 5C are located within the Namaqua upwelling cell and waters are expected to be cold and nutrient rich (refer to Figure 4-8).

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 (jackass 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 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 Current 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 (see Figure 4-10 (left)). Toxic dinoflagellate species can cause extensive mortalities of fish and shellfish through direct poisoning (see Figure 4-10 (right)), while degradation of organic-rich material derived from both toxic and non-toxic blooms results in oxygen depletion of subsurface water. Associated primarily with upwelling cells, HABs could occur in Sea Areas 4C and 5C.

Figure 4-10: Images depicting a red tide (left) and a mass stranding or "walk out" of rock lobsters at Elands Bay in March 2022 (right) (sources: www.e-education.psu.edu and www.waterencyclopedia.com).

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 (refer to 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 phytoplankton 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.

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 (refer to Figure 4-7). Although highly variable, annual discharge rates of sediments by the Orange River is estimated to vary from 8 - 26 million tons/yr (Rogers (1979)). '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.

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 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. 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 equator-wards. 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 SW 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)). Data from a Waverider buoy at Port Nolloth have indicated that 2 m high waves are capable of re-suspending medium sands (200 µm diameter) at ~10 m depth, whilst 6 m high 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)).

Offshore of the continental shelf, the oceanic waters are typically clear as they are beyond the influence of aeolian and riverine inputs. The waters in the offshore portions of Sea Areas 4C and 5C are thus expected to be comparatively clear.

4.1.4 Biological Oceanography

Biogeographically, the study area 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)). Sea Areas 4C and 5C fall within the Southern Benguela Ecoregion (Sink *et al.* (2019)) (see Figure 4-11), which extends from Namibia to the southern tip of the Agulhas Bank. 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.

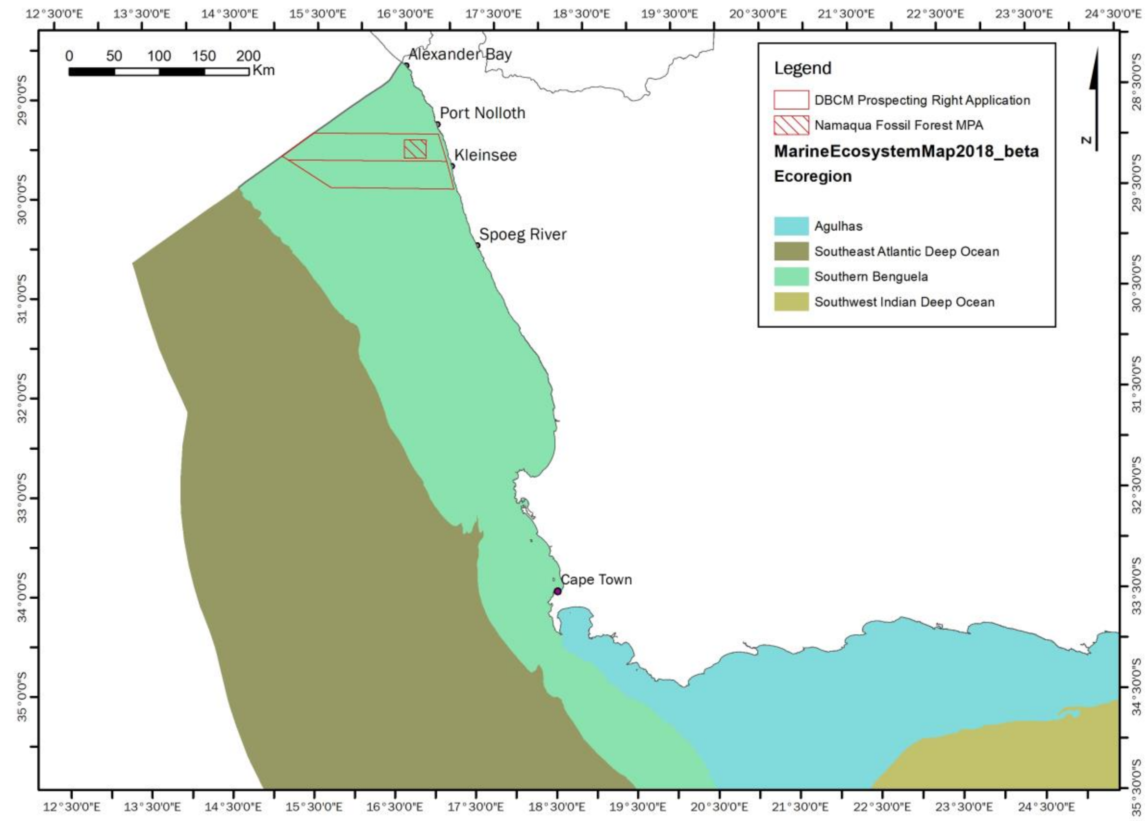

Figure 4-11: Sea Areas 4C and 5C in relation to the inshore and offshore ecoregions of the South African West Coast (adapted from Sink *et al.* (2019)).

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 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 exploration activities.

Demersal Communities

Benthic Invertebrate Macrofauna

The seabed communities in Sea Areas 4C and 5C lie within the Namaqua sub-photic and continental slope biozones, which extend from a 30 m depth to the shelf edge. The benthic habitats of South Africa were mapped as part of the 2018 NBA (Sink *et al.* (2019)) to develop assessments of the ecosystem threat status and ecosystem protection level. The benthic ecosystem types were subsequently mapped (refer to Figure 4-5) and assigned an ecosystem threat status based on their level of protection (see Figure 4-12). Sea Areas 4C and 5C are characterised by only four ecosystem types, namely, Namaqua Muddy Mid-Shelf Mosaic, Namaqua Sandy Mid-Shelf, Namaqua Muddy Sands, and Southern Benguela Sandy Outer Shelf (Sink *et al.* (2019)).

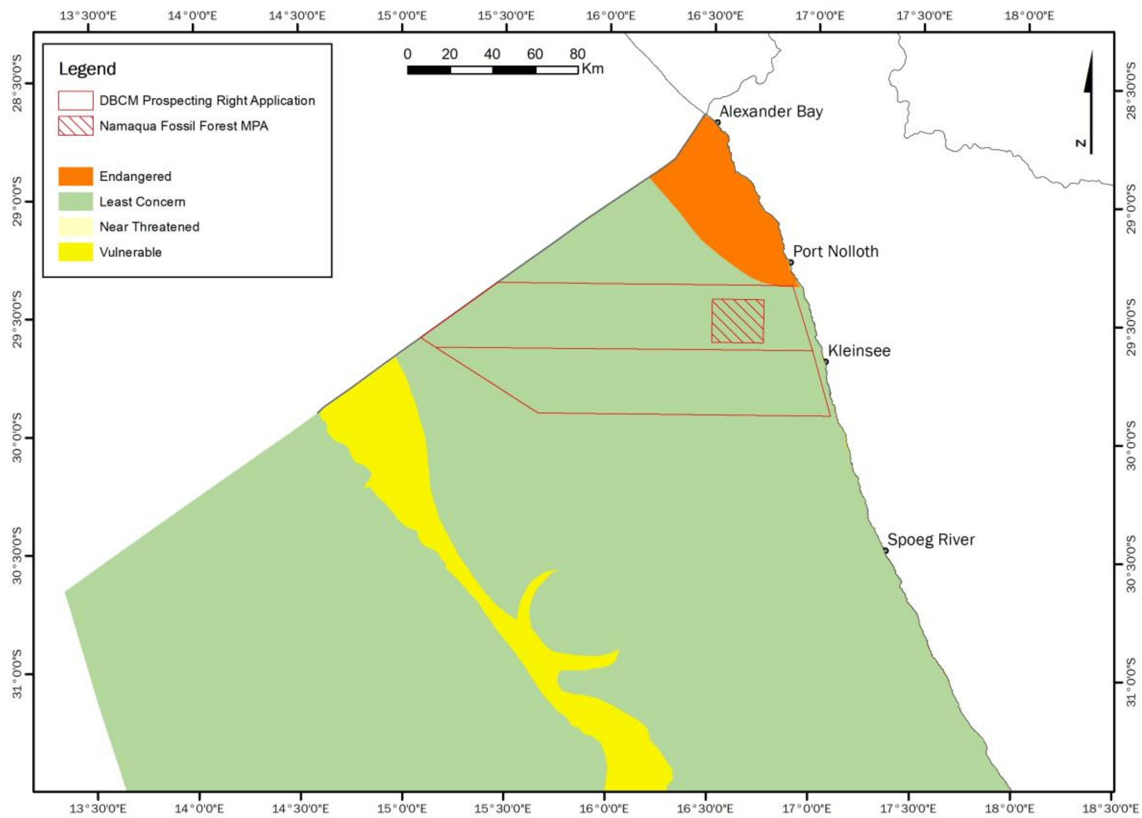

Figure 4-12: Sea Areas 4C and 5C in relation to the inshore and offshore ecoregions of the South African West Coast (adapted from Sink *et al.* (2019)).

The benthic biota of unconsolidated marine sediments constitutes invertebrates that live on (epifauna) or burrow within (infauna) the sediments and are generally divided into macrofauna (animals >1 mm) and meiofauna (<1 mm). 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); Field *et al.* (1996); Field & Parkins (1997); Parkins & Field (1998); Pulfrich & Penney (1999); Goosen *et al.* (2000); Savage *et al.* (2001); Steffani & Pulfrich (2004a, 2004b; 2007); Steffani (2007a; 2007b); Atkinson (2009); Steffani (2009a, 2009b, 2010a, 2010b, 2010c); Atkinson *et al.* (2011); Steffani (2012a, 2012b, 2014); Karenyi (2014); Steffani *et al.* (2015); Biccard & Clark (2016); Biccard *et al.* (2016); Duna *et al.* (2016); Karenyi *et al.* (2016); Biccard *et al.* (2017, 2018); Gihwala *et al.* (2018); Biccard *et al.* (2019); Giwhala *et al.* (2019)). These studies, however, concentrated on the continental shelf and nearshore regions, and consequently the benthic fauna of the outer shelf and continental slope (beyond ~450 m depth) are very poorly known. This is primarily due to limited opportunities for prospecting as well as the lack of access to Remote Operated Vehicles (ROVs) for visual sampling of hard substrata.

To date, very few areas on the continental slope off the West Coast have been biologically surveyed. Although sediment distribution studies (Rogers & Bremner (1991)) suggest that the outer shelf is characterised by unconsolidated sediments (refer to Figure 4-3), recent surveys conducted between 180 m and 480 m depth revealed high proportions of hard ground rather than unconsolidated sediment, although this requires further verification (Karenyi unpublished data).

The description below from the continental shelf of the project area is drawn from recent surveys by Karenyi (2014), Duna *et al.* (2016), Mostert *et al.* (2016), and Giwhala *et al.* (2018, 2019).

Three macro-infauna communities have been identified on the inner- (0-30 m depth) and mid-shelf (30-150 m depth, Karenyi *et al.* (2016)). Polychaetes, crustaceans and molluscs make up the largest proportion of individuals, biomass and species on the West Coast. The inner-shelf community, which is affected by wave action, is characterised by various mobile gastropod and polychaete predators and sedentary polychaetes and isopods. The mid-shelf community inhabits the mudbelt and is characterised by mud prawns. A second mid-shelf community occurring in sandy sediments, is characterised by various deposit-feeding polychaetes. 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)) (see Figure 4-13).

Despite the current lack of knowledge of the community structure and endemicity of South African macro-infauna on the continental shelf, the marine component of the 2018 NBA (Sink *et al.* (2019)), rated the habitat types that characterise Sea Areas 4C and 5C, as being of ‘Least concern’ (refer to Figure 4-11) with only those communities occurring along the shelf edge (-500 m) beyond the western extreme of Sea Areas 4C and 5C as ‘Vulnerable’. This primarily reflects the great extent of these habitats in the South African EEZ. The Orange Cone Muddy Mid-Shelf and Inner Shelf Mud Reef Mosaic, which lie adjacent to the north eastern corner of Sea Area 4C has however, been rated as ‘Endangered’ (Sink *et al.* (2019)).

Generally, species richness increases from the inner-shelf across the mid-shelf and is influenced by sediment type. 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/m² wet weight. This is contrary to Christie (1974) who found that biomass was greatest in the mudbelt at 80 m depth off Lamberts Bay, where the sediment characteristics and the impact of environmental stressors (such as low oxygen events) are likely to differ from those off the northern Namaqualand coast.

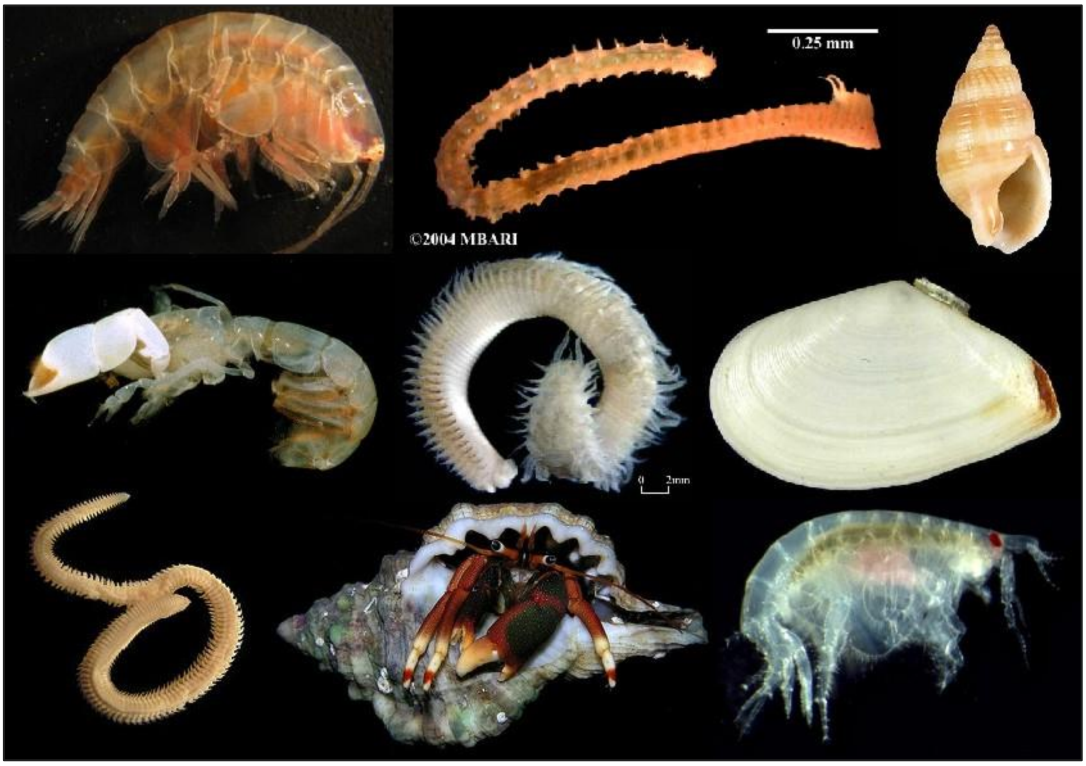

Figure 4-13: Benthic macrofaunal genera commonly found in nearshore sediments include: (top: left to right) *Ampelisca*, *Prionospio*, *Nassarius*; (middle: left to right) *Callianassa*, *Orbinia*, *Tellina*; (bottom: left to right) *Nephtys*, hermit crab, *Bathyporeia*.

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, 2013)), 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 deep water 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) the continental shelf on the West Coast between depths of 100 m and 250 m, contained a single epifaunal community 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.

The 2018 NBA for the marine environment (Sink *et al.* (2019)) points out that very few national International Union for Conservation of Nature (IUCN) Red List assessments have been conducted for marine invertebrate species to date owing to inadequate taxonomic knowledge, limited distribution data, a lack of systematic surveys and limited capacity to advance species red listing for these groups.

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)). 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)). Cold water corals have been observed at shallower depths in high profile rocky outcrop areas without a sediment veneer at shallower depths within the Namaqua Fossil Forest MPA and to the south-east of Child's Bank. In the productive Benguela region, areas of similar habitat types on and off the edge of the shelf could thus potentially be capable of supporting cold water, benthic, filter-feeding communities.

Seamount Communities

Two seamount features are found off the West Coast of southern Africa. The Tripp Seamount situated at about 29° 40'S, approximately 70 km west of the western tip of Sea Area 4C and Child's Bank, situated approximately 75 km south of the southern boundary of Sea Areas 5C at about 31°S (see Figure 4-2).

Child's Bank was described by Dingle *et al.* (1987) to be a carbonate mound (bioherm) and now forms part of a Marine Protected Area (see Section 4.2.2). Tripp Seamount is a roughly circular feature with a flat apex that rises from the seabed at ~1 000 m to a depth of 150 m. Features such as banks, knolls and seamounts (referred to collectively here as "seamounts"), which protrude into the water column, are subject to, and interact with, the water currents surrounding them. The effects of such seabed features on the surrounding water masses can include the upwelling of relatively cool, nutrient-rich water into nutrient-poor surface water thereby resulting in higher productivity (Clark *et al.* (1999)), which can in turn strongly 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.

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

Deep- and cold-water corals (including stony corals, black corals and soft corals) (see Figure 4-14 (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.

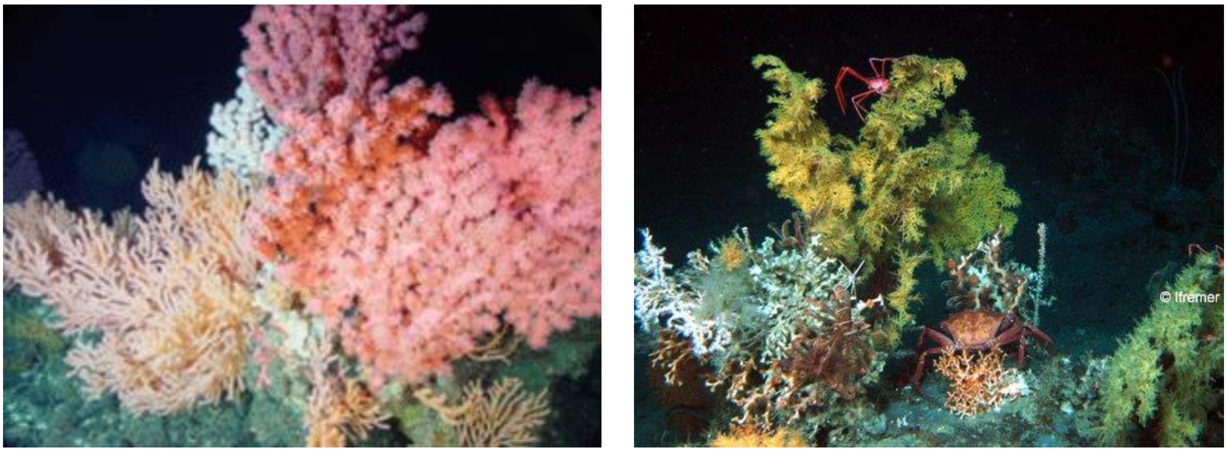

Figure 4-14: Seamounts are characterised by a diversity of deep water corals that add structural complexity to seabed habitats and offer refugia for a variety of invertebrates and fish (sources: www.dfo-mpo.gc.ca/science/Publications/article/2007/21-05-2007-eng.htm, Ifremer & AWI (2003)).

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). As a result of conservative life histories (*i.e*. very slow growing, slow to mature, high longevity, low fecundity and unpredictable 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)).

The concept of a VME centres upon the presence of distinct, diverse benthic assemblages that are limited and fragmented in their spatial extent, and dominated (in terms of biomass and / or spatial cover) by rare, endangered or endemic component species that are physically fragile and vulnerable to damage (or structural/biological alteration) by human activities (Parker *et al.* (2009); Auster *et al.* (2011); Hansen *et al.* (2013)).

South Africa's seamounts and their associated benthic communities have not been extensively sampled by either geologists or biologists (Sink & Samaai (2009)). While it is not always the case that seamount habitats are VMEs, some of the deep water habitats on the West Coast are thought to be characterised by a number of VME indicator species such as sponges, soft corals and hard corals (Table 4-1). The distribution of 22 potential VME indicator taxa for the South African EEZ were recently mapped, with those from the northern West Coast listed in Table 4-1 (Atkinson & Sink (2018); Sink *et al.* (2019)). Of these only the sponge *Suberites dandelenae* has been recorded from the 4C and 5C Sea Areas, with all others recorded from deeper waters only (Atkinson & Sink (2018)).

Table 4-1: Potential VME species from the continental shelf and shelf edge on the West Coast (Atkinson & Sink 2018).

Phylum	Name	Common Name
Porifera	*Suberites dandelenae*	Amorphous solid sponge
	Rossella cf. antarctica	Glass sponge
Cnidaria	*Melithaea* spp.	Colourful sea fan
	Thouarella spp.	Bottlebrush sea fan
Family: Isididae	?	Bamboo coral
	Anthoptilum grandiflorum	Large sea pen*
	Lophelia pertusa	Reef-building cold water coral
	Stylaster spp.	Fine-branching hydrocoral
Bryozoa	*Adeonella* spp.	Sabre bryozoan
	Phidoloporidae spp.	Honeycomb false lace coral
Hemichordata	*Cephalodiscus gilchristi*	Agar animal

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 both latitudinally (Shine (2006, 2008); Yemane *et al.* (2015)) and with increasing depth (Roel (1987); Smale *et al.* (1993); Macpherson & Gordoa (1992); Bianchi *et al.* (2001); Atkinson (2009); Yemane *et al.* (2015)), 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 cartilaginous fishes on the West Coast is discussed by Compagno *et al.* (1991). The species that may occur in the general project area and on the continental shelf inshore thereof, and their approximate depth range, are listed in Table 4-2.

Table 4-2: 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 (m)	IUCN Conservation Status
Frilled shark	*Chlamydoselachus anguineus*	200 - 1 000	LC
Six gill cowshark	*Hexanchus griseus*	150 - 600	NT
Gulper shark	*Centrophorus granulosus*	480	EN
Leafscale gulper shark	*Centrophorus squamosus*	370 - 800	EN
Bramble shark	*Echinorhinus brucus*	55 - 285	EN
Black dogfish	*Centroscyllium fabricii*	> 700	LC
Portuguese shark	*Centroscymnus coelolepis*	> 700	NT
Longnose velvet dogfish	*Centroscymnus crepidater*	400 - 700	NT
Birdbeak dogfish	*Deania calcea*	400 - 800	NT
Arrowhead dogfish	*Deania profundorum*	200 - 500	NT
Longsnout dogfish	*Deania quadrispinosum*	200 - 650	VU
Sculpted lanternshark	*Etmopterus brachyurus*	450 - 900	DD
Brown lanternshark	*Etmopterus compagnoi*	450 - 925	LC
Giant lanternshark	*Etmopterus granulosus*	> 700	LC
Smooth lanternshark	*Etmopterus pusillus*	400 - 500	LC
Spotted spiny dogfish	*Squalus acanthias*	100 - 400	VU
Shortnose spiny dogfish	*Squalus megalops*	75 - 460	LC
Shortspine spiny dogfish	*Squalus mitsukurii*	150 - 600	EN
Sixgill sawshark	*Pliotrema warreni*	60 - 500	LC
Goblin shark	*Mitsukurina owstoni*	270 - 960	LC
Smalleye catshark	*Apristurus microps*	700 - 1 000	LC
Saldanha catshark	*Apristurus saldanha*	450 - 765	LC
“grey/black wonder” catsharks	*Apristurus spp.*	670 - 1 005	LC
Tigar catshark	*Halaelurus natalensis*	50 - 100	VU
Izak catshark	*Holohalaelurus regani*	100 - 500	LC
Yellowspotted catshark	*Scyliorhinus capensis*	150 - 500	NT

Common Name	Scientific name	Depth Range (m)	IUCN Conservation Status
Soupfin shark/Vaalhaai	*Galeorhinus galeus*	< 10 - 300	CR (EN)
Houndshark	*Mustelus mustelus*	< 100	EN (DD)
Whitespotted houndshark	*Mustelus palumbes*	> 350	LC
Little guitarfish	*Rhinobatos annulatus*	> 100	VU (LC)
Atlantic electric ray	*Torpedo nobiliana*	120 - 450	LC
African softnose skate	*Bathyraja smithii*	400 - 1 020	LC
Smoothnose legskate	*Cruriraja durbanensis*	> 1 000	DD
Roughnose legskate	*Crurirajaparcomaculata*	150 - 620	LC
African dwarf skate	*Neoraja stehmanni*	290 - 1 025	LC
Thorny skate	*Raja radiata*	50 - 600	VU
Bigmouth skate	*Raja robertsi*	> 1 000	LC
Slime skate	*Raja pullopunctatus*	15 - 460	LC
Rough-belly skate	*Raja springeri*	85 - 500	LC
Yellowspot skate	*Raja wallacei*	70 - 500	VU
Roughskin skate	*Raja spinacidermis*	1 000 - 1 350	EN
Biscuit skate	*Raja clavata*	25 - 500	NT
Munchkin skate	*Raja caudaspinosa*	300 - 520	LC
Bigthorn skate	*Raja confundens*	100 - 800	LC
Ghost skate	*Raja dissimilis*	420 - 1 005	LC
Leopard skate	*Raja leopardus*	300 - 1 000	LC
Smoothback skate	*Raja ravidula*	500 - 1 000	LC
Spearnose skate	*Raja alba*	75 - 260	EN
St Joseph	*Callorhinchus capensis*	30 - 380	LC (LC)
Cape chimaera	*Chimaera sp.*	680 - 1 000	LC
Brown chimaera	*Hydrolagus sp.*	420 - 850	LC
Spearnose chimaera	*Rhinochimaera atlantica*	650 - 960	LC

LC	Least Concern	VU	Vulnerable	NT	Near Threatened
EN	Endangered	CR	Critically Endangered	DD	Data Deficient

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. These aspects are discussed below.

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 (see Figure 4-15).

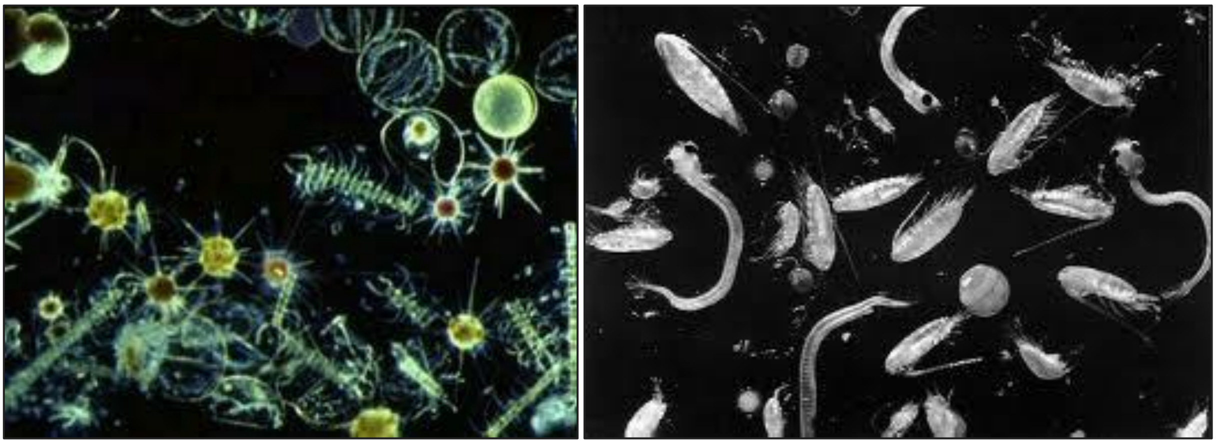

Figure 4-15: Phytoplankton (left) and zooplankton (right) are associated with upwelling cells (sources: www.hymagazine.com and www.mysciencebox.org).

Phytoplankton are the principle primary producers with mean productivity ranging from 2.5 - 3.5 g C/m^2/day for the mid-shelf 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.

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. Localised peaks in biomass may, however, occur in the vicinity of Child's Bank and Tripp seamount in response to topographically steered upwelling around such seabed features.

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.

Although ichthyoplankton (fish eggs and larvae) comprise a minor component of the overall plankton, it remains significant due to the commercial importance of the overall fishery in the region. Various pelagic and demersal fish species are known to spawn in the inshore regions of the southern Benguela, (including pilchard, round herring, chub mackerel lanternfish and hakes (Crawford *et al.* (1987)) (see Figure 4-16), and their eggs and larvae form an important contribution to the ichthyoplankton in the region.

Spawning of key fish species is illustrated in Figures 4-16 to 4-19 and described below:

- Hake, snoek and round herring move to the western Agulhas Bank and southern west coast to spawn in late winter and early spring (key period), when offshore Ekman losses are at a minimum and their eggs and larvae drift northwards and inshore to the west coast nursery grounds. Figure 4-17 and Figure 4-18 highlight the temporal variation in hake eggs and larvae with there being a greater concentration of eggs and larvae between September - October compared to March - April. However, hake are reported to spawn throughout the year (Strømme *et al.* 2015). Snoek spawn along the shelf break (150 400 m) of the western Agulhas Bank and the West Coast between June and October (Griffiths 2002).
- Horse mackerel spawn over the east/central Agulhas Bank during winter months.
- Sardines spawn on the whole Agulhas Bank during November, but generally have two spawning peaks, in early spring and autumn, on either side of the peak anchovy spawning period (Figure 4-19, left).
- Anchovies spawn on the whole Agulhas Bank (Figure 4-19, right), with spawning peaking during mid-summer (November–December) and some shifts to the west coast in years when Agulhas Bank water intrudes strongly north of Cape Point.

The eggs and larvae are carried around Cape Point and up the coast in northward flowing surface waters. At the start of winter every year, the juveniles recruit in large numbers into coastal waters across broad stretches of the shelf between the Orange River and Cape Columbine 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. Following spawning, the eggs and larvae of snoek are transported to inshore (<150 m) nursery grounds north of Cape Columbine and east of Danger Point, where the juveniles remain until maturity. There is limited overlap of Sea Areas 4C and 5C with the northward egg and larval drift of commercially important species, and the return migration of recruits (Figure 4-16). Ichthyoplankton abundance in Sea Areas 4C and 5C may, therefore, be seasonally high, especially in the 5C area.

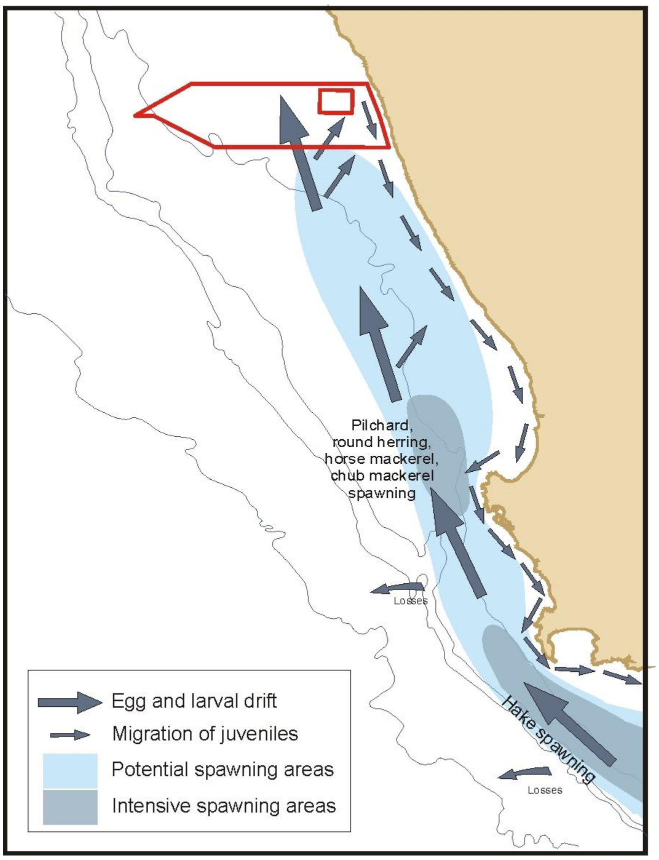

Figure 4-16: Sea Areas 4C and 5C in relation to major spawning areas in the southern Benguela region (adapted from Cruikshank, 1990; Hutchings 1994; Hutchings *et al.* 2002).

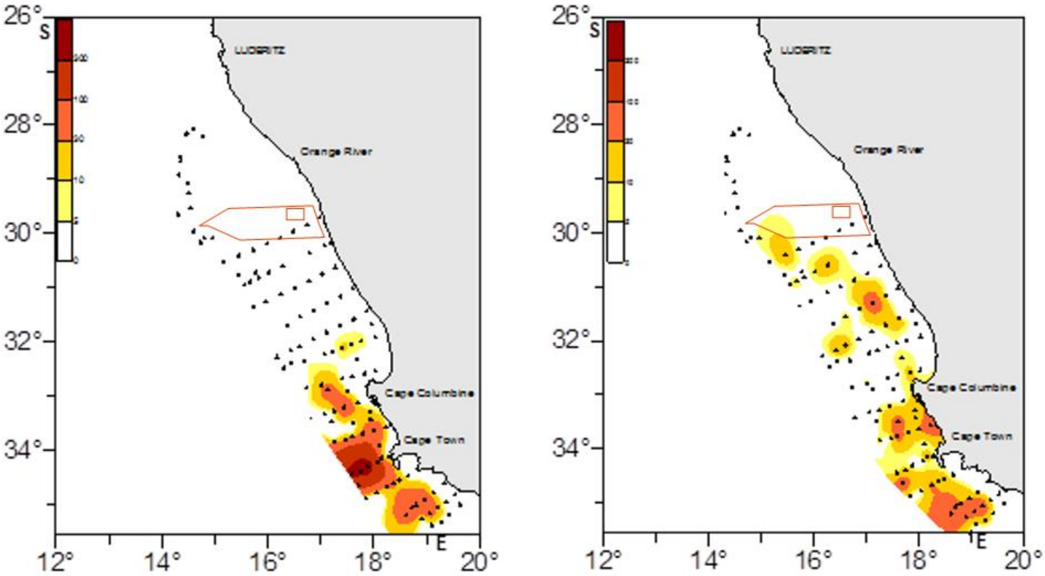

Figure 4-17: Sea Areas 4C and 5C in relation to the distribution of hake eggs (left) and larvae (right) off the West Coast of South Africa between September and October 2005 (adapted from Stenevik *et al.* 2008).

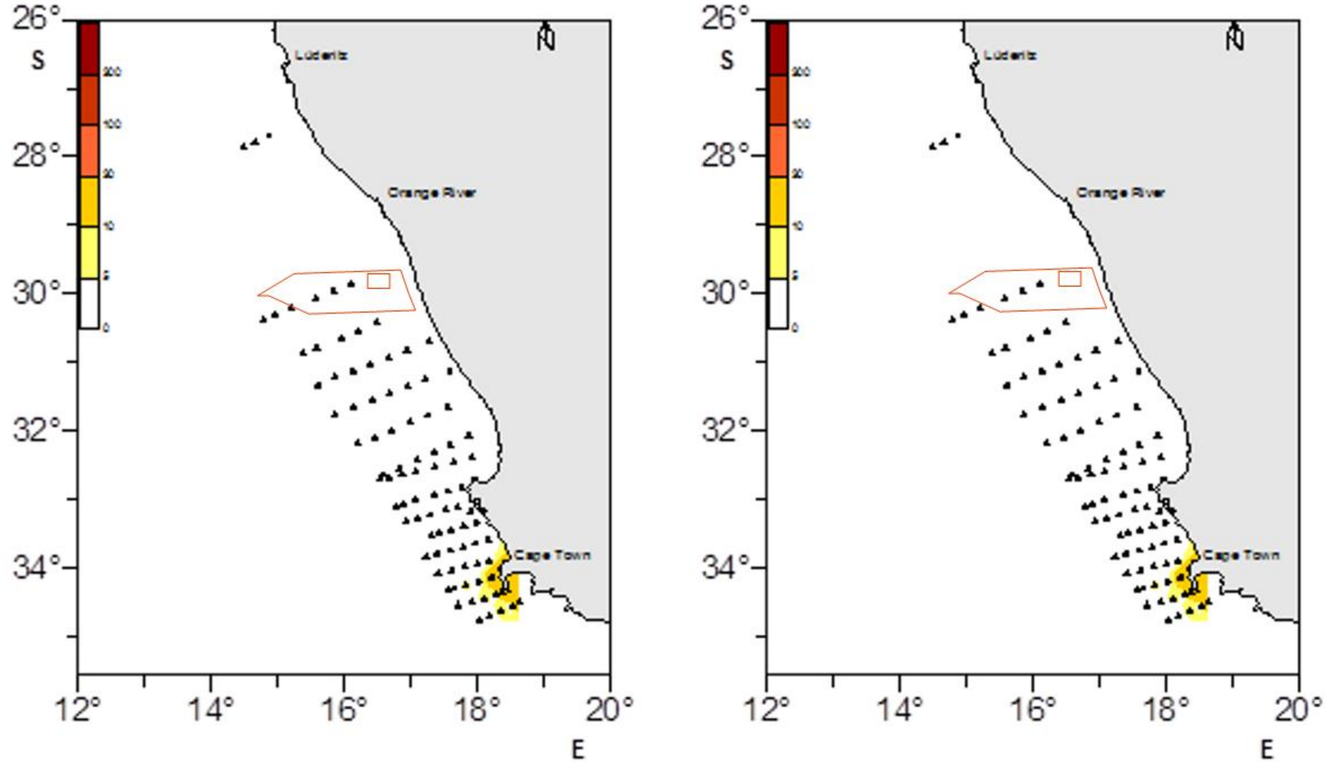

Figure 4-18: Sea Areas 4C and 5C in relation to the distribution of hake eggs (left) and larvae (right) off the West Coast of South Africa between March and April 2007 (adapted from Stenevik *et al.* 2008).

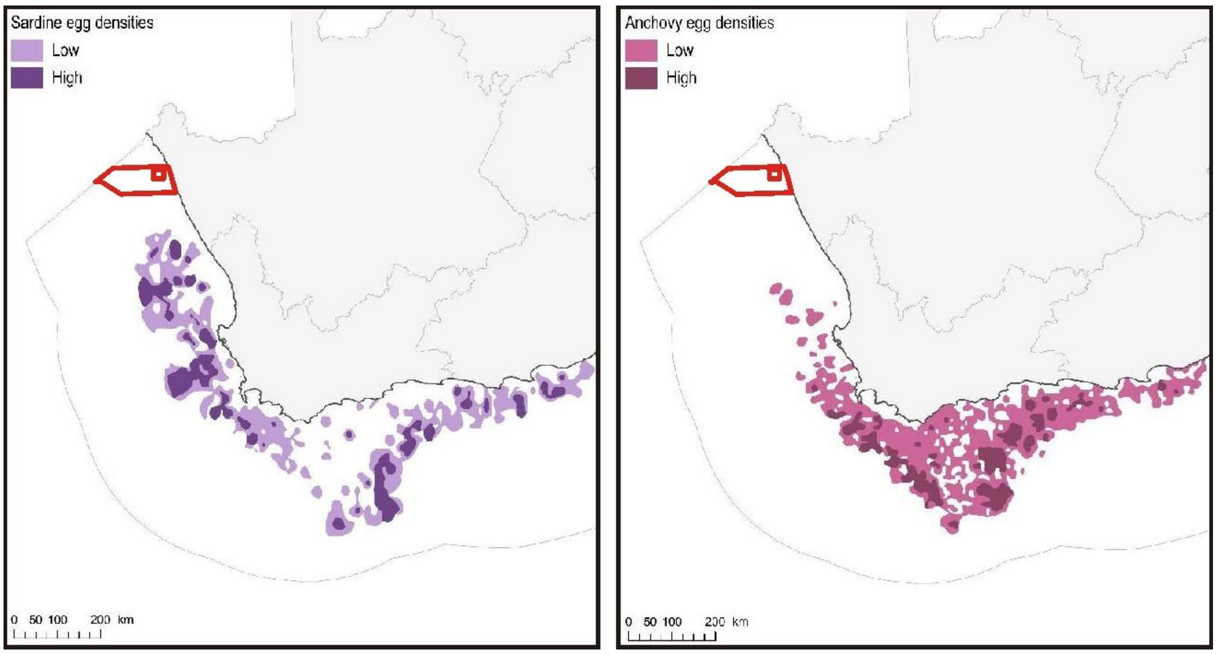

Figure 4-19: Sea Areas 4C and 5C in relation to the distribution of sardine (left) and anchovy (right) spawning areas off the West Coast, as measured by egg densities (adapted from Harris *et al.* 2022).

Cephalopods

Fourteen species of cephalopds have been recorded in the southern Benguela, the majority of which 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.

The colossal squid *Mesonychoteuthis hamiltoni* and the giant squid *Architeuthis* sp. may also be encountered in the project area. Both are deep dwelling species, with the colossal squid's distribution confined to the entire circum-Antarctic Southern Ocean (see Figure 4-20 (top)) while the giant squid is usually found near continental and island slopes all around the world's oceans (see Figure 4-20 (bottom)). Both species could thus potentially occur in the pelagic habitats of the project area, although the likelihood of encounter is extremely low.

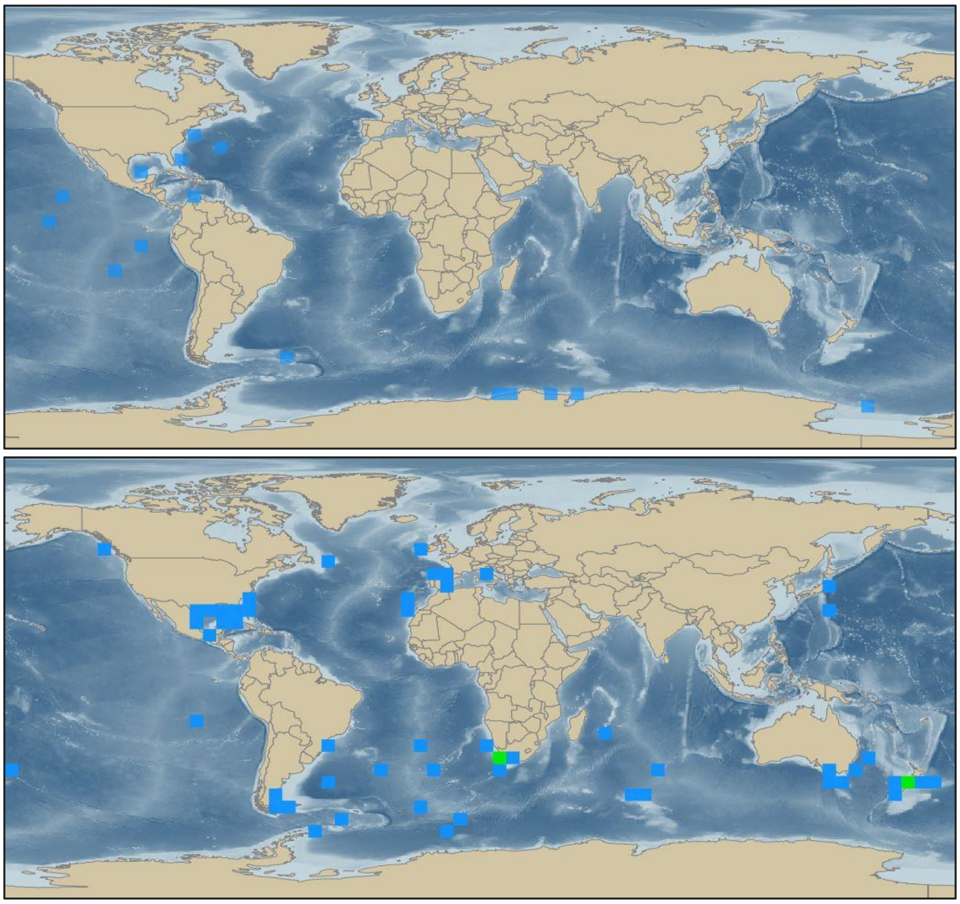

Figure 4-20: Distribution of colossal squid (top) and the giant squid (bottom). Blue squares = <5 records, green squares = 5 – 10 records (source: www.iobis.org).

Growing to in excess of 10 m in length, they are the principal prey of the sperm whale, and are also taken by beaked whaled, pilot whales, elephant seals and sleeper sharks. Nothing is known of their vertical distribution, but data from trawled specimens and sperm whale diving behaviour suggest they may span a depth range of 300 – 1 000 m. They lack gas-filled swim bladders and maintain neutral buoyancy through an ammonium chloride solution occurring throughout their bodies.

Pelagic Fish

Small pelagic species include the sardine / pilchard (*Sadinops ocellatus*) (see Figure 4-21 (left)), anchovy (*Engraulis capensis*), chub mackerel (*Scomber japonicus*), horse mackerel (*Trachurus capensis*) (see Figure 4-21 (right)) and round herring (*Etrumeus whiteheadi*). These species typically occur in mixed shoals of various sizes (Crawford *et al.* (1987)), and generally occur within the 200 m contour. Most of the pelagic species exhibit similar life history patterns involving seasonal migrations between the West and South coasts. The spawning areas of the major pelagic species are distributed on the continental shelf and along the shelf edge extending from south of St Helena Bay to Mossel Bay on the South Coast (Shannon & Pillar (1986)). 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 East Coast in northward flowing surface waters.

Figure 4-21: Cape fur seal preying on shoal of pilchards (left) and a school of horse mackerel (right) (sources: www.underwatervideo.co.za and www.delivery.superstock.com).

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*. Both these species have been rated as 'Least concern' on the national assessment (Sink *et al.* 2019). While the appearance of chub mackerel along the West and South-West coasts is highly seasonal, adult snoek are found throughout their distribution range and longshore movement are random and without a seasonal basis (Griffiths 2002). Initially postulated to be a single stock that undergoes a seasonal longshore migration from southern Angola through Namibia to the South African West Coast (Crawford & De Villiers 1985; Crawford *et al.* 1987), Benguela snoek are now recognised as two separate sub-populations separated by the Lüderitz upwelling cell (Griffiths 2003). On the West Coast, snoek move offshore to spawn and there is some southward dispersion as the spawning season progresses, with females on the West Coast moving inshore to feed between spawning events as spawning progresses. In contrast, those found further south along the western Agulhas Bank remain on the spawning grounds throughout the spawning season (Griffiths 2002). The spawning grounds for the species are therefore extensive ranging between the western edge of the Agulhas Bank and most of the South African west coast. There is also no single inshore or offshore migration of the snoek stock, rather numerous inshore-offshore movements during the spawning season. Snoek are serial batch spawners with females releasing batches of eggs at 10 – 40-day intervals on offshore spawning grounds (150 – 400 m depth). 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 & Crawford1989).

The distribution of snoek and chub mackerel therefore with Sea Areas 4C and 5C.

The fish most likely to be encountered on the shelf and in the offshore waters of Sea Areas 4C and 5C are the large migratory pelagic species, including various tunas, billfish and sharks, many of which are considered threatened by the IUCN, primarily due to overfishing (see Table 4-3). 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 4-3: A list of some of the more important large migratory pelagic fish likely to occur in the offshore regions of the West Coast. (TOPS list under NEMBA, Act 10 of 2004; Sink *et al.* 2019; www.iucnredlist.org;). The Global and National IUCN Conservation Status are also provided.

Common Name	Species	National Assessment	IUCN Conservation Status
Tunas			
Southern Bluefin Tuna	*Thunnus maccoyii*	Not Assessed	Endangered
Bigeye Tuna	*Thunnus obesus*	Vulnerable	Vulnerable
Longfin Tuna/Albacore	*Thunnus alalunga*	Near Threatened	Least concern
Yellowfin Tuna	*Thunnus albacares*	Near Threatened	Least concern
Frigate Tuna	*Auxis thazard*	Not Assessed	Least concern
Eastern Little Tuna	*Euthynnus affinis*	Least concern	Least concern

Common Name	Species	National Assessment	IUCN Conservation Status
Skipjack Tuna	*Katsuwonus pelamis*	Least concern	Least concern
Atlantic Bonito	*Sarda sarda*	Not Assessed	Least concern
Billfish			
Black Marlin	*Istiompax indica*	Data deficient	Data deficient
Blue Marlin	*Makaira nigricans*	Vulnerable	Vulnerable
Striped Marlin	*Kajikia audax*	Near Threatened	Least concern
Sailfish	*Istiophorus platypterus*	Least concern	Vulnerable
Swordfish	*Xiphias gladius*	Data deficient	Near Threatened
Pelagic Sharks			
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Not Assessed	Critically Endangered
Dusky Shark	*Carcharhinus obscurus*	Data Deficient	Endangered
Bronze Whaler Shark	*Carcharhinus brachyurus*	Data deficient	Vulnerable
Great White Shark	*Carcharodon carcharias*	Least concern	Vulnerable
Shortfin Mako	*Isurus oxyrinchus*	Vulnerable	Endangered
Longfin Mako	*Isurus paucus*	Not Assessed	Endangered
Whale Shark	*Rhincodon typus*	Not Assessed	Endangered
Blue Shark	*Prionace glauca*	Least concern	Near Threatened

These large pelagic species migrate throughout the southern oceans, between surface and deep waters (>300 m) and have a highly seasonal abundance in the Benguela System. Species occurring off western southern Africa include the albacore / longfin tuna *Thunnus alalunga* (see Figure 4-22 (right)), yellowfin *T. albacares*, bigeye *T. obesus*, and skipjack *Katsuwonus pelamis tunas*, as well as the Atlantic blue marlin *Makaira nigricans* (see Figure 4-22 (left)), the white marlin *Tetrapturus albidus* and the broadbill swordfish *Xiphias gladius* (Payne & Crawford (1989)). The distribution of these species is dependent on food availability in the mixed boundary layer between the Benguela and warm central Atlantic waters. Concentrations of large pelagic species are also known to occur associated with underwater features such as canyons and seamounts as well as meteorologically induced oceanic fronts (Penney *et al.* (1992)).

Figure 4-22: Large migratory pelagic fish such as blue marlin (left) and longfin tuna (right) occur in offshore waters (sources: www.samanthatours.com and www.odfimages.com).

A number of species of pelagic sharks are also known to occur on the West and South 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 of the continental shelf on the West Coast. Great whites *Carcharodon carcharias* and whale sharks *Rhincodon typus* may also be encountered in coastal and offshore areas, although the latter occurs more frequently along the South and East Coasts.

Turtles

Three species of turtle occur along the West Coast, namely the Leatherback *Dermochelys coriacea* (see Figure 4-23 (left), and occasionally the Loggerhead *Caretta caretta* (see Figure 4-23 (right) and the Green turtle *Chelonia mydas*. 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 the southern African West Coast.

Figure 4-23: Leatherback (left) and loggerhead turtles (right) occur along the southern African West Coast (sources: Ketos Ecology (2009) and www.aquaworld-crete.com).

The Benguela ecosystem, especially the northern Benguela where jellyfish 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 population on the South African East Coast have been satellite tracked swimming around the West Coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (Lambardi *et al.* (2008)) (see Figure 4-24). The global and regional conservation status of turtles occurring off the South Coast shows variation depending on the listing used and is provided in Table 4-4.

Table 4-4: Global and regional conservation status of turtles occurring off the South Coast.

Listing	Leatherback	Loggerhead	Green
IUCN Red List:			
Species (date)	V (2013)	V (2017)	E (2004)
Population (RMU)	CR (2013)	NT (2017)	*
Sub-Regional /National			

Listing	Leatherback	Loggerhead	Green
NEMBA TOPS (2017)	CR	E	E
Sink & Lawrence (2008)	CR	E	E
Hughes & Nel (2014)	E	V	NT

Note: NT = Near Threatened, V = Vulnerable, E = Endangered, CR = Critically Endangered, DD = Data Deficient, UR = Under Review, * = not yet assessed

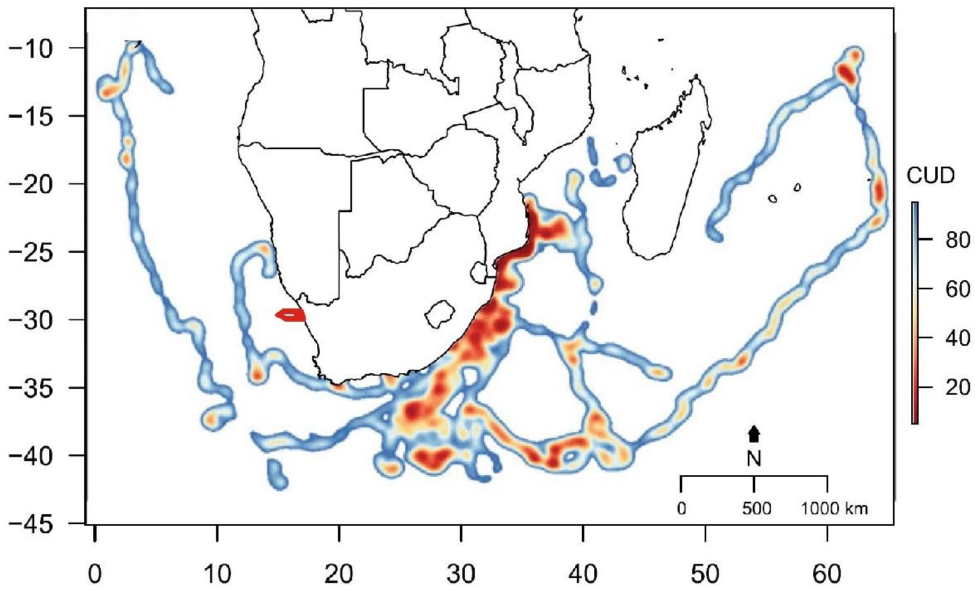

Figure 4-24: Sea Areas 4C and 5C in relation to the migration corridors of leatherback turtles in the south western Indian Ocean. Relative use (cumulative utilisation distribution (CUD) of corridors is shows through intensity of shading: light = low use, dark = high use (adapted from Harris *et al.* (2018)).

Leatherback turtles typically 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 the Convention on International Trade in Endangered Species (CITES) and the Convention on Migratory Species (CMS). The 2017 South African list of Threatened and Endangered Species similarly lists the species as ‘Critically endangered’, whereas on the National Assessment (Hughes & Nel (2014)) leatherbacks were listed as ‘Endangered’. Loggerhead and green turtles are listed globally as ‘Vulnerable’ and ‘Endangered’, respectively, whereas on the South African list of Threatened and Endangered Species both species are listed as ‘Endangered’. As a signatory of CMS, South Africa has endorsed and signed a CMS International Memorandum of Understanding specific to the conservation of marine turtles. South Africa is thus committed to conserve these species at an international level.

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 species classified as being common in the southern Benguela are listed in Table 4-5. 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), well offshore of the proposed study area, with highest population levels during their non-breeding season (winter). Pintado petrels and Prion spp. show the most marked variation here.

Table 4-5: Pelagic Seabirds Common in the Southern Benguela Region (Crawford *et al.* 1991; BirdLife 2021). IUCN Red List and Regional Assessment status are provided (Sink *et al.* 2019).

Common Name	Species name	Regional Assessment	Global IUCN
Shy Albatross	*Thalassarche cauta*	NT	NT
Black-browed Albatross	*Thalassarche melanophrys*	EN	LC
Atlantic Yellow-nosed Albatross	*Thalassarche chlororhynchos*	EN	EN
Indian Yellow-nosed Albatross	*Thalassarche carteri*	EN	EN
Wandering Albatross	*Diomedea exulans*	VU	VU
Southern Royal Albatross	*Diomedea epomophora*	VU	VU
Northern Royal Albatross	*Diomedea sanfordi*	EN	EN
Sooty Albatross	*Phoebetria fusca*	EN	EN
Light-mantled Albatross	*Phoebetria palpebrata*	NT	NT
Tristan Albatross	*Diomedea dabbenena*	CR EN	CR EN
Grey-headed Albatross	*Thalassarche chrysostoma*	EN	EN
Giant Petrel sp.	*Macronectes halli/giganteus*	NT	LC
Southern Fulmar	*Fulmarus glacialoides*	LC	LC
Pintado Petrel	*Daption capense*	LC	LC
Blue Petrel	*Halobaena caerulea*	NT	LC
Salvin's Prion	*Pachyptila salvini*	NT	LC
Arctic Prion	*Pachyptila desolata*	LC	LC
Slender-billed Prion	*Pachyptila belcheri*	LC	LC
Broad-billed Prion	*Pachyptila vittata*	LC	LC
Kerguelen Petrel	*Aphrodroma brevirostris*	NT	LC
Greatwinged Petrel	*Pterodroma macroptera*	NT	LC
Soft-plumaged Petrel	*Pterodroma mollis*	NT	LC
White-chinned Petrel	*Procellaria aequinoctialis*	VU	VU
Spectacled Petrel	*Procellaria conspicillata*	VU	VU
Cory's Shearwater	*Calonectris diomedea*	LC	LC

Common Name	Species name	Regional Assessment	Global IUCN
Sooty Shearwater	*Puffinus griseus*	NT	NT
Flesh-footed Shearwater	*Ardenna carneipes*	LC	NT
Great Shearwater	*Puffinus gravis*	LC	LC
Manx Shearwater	*Puffinus puffinus*	LC	LC
Little Shearwater	*Puffinus assimilis*	LC	LC
European Storm Petrel	*Hydrobates pelagicus*	LC	LC
Leach's Storm Petrel	*Oceanodroma leucorhoa*	CR EN	VU
Wilson's Storm Petrel	*Oceanites oceanicus*	LC	LC
Black-bellied Storm Petrel	*Fregetta tropica*	NT	LC
White-bellied Storm Petrel	*Fregetta grallaria*	LC	LC
Pomarine Jaeger	*Stercorarius pomarinus*	LC	LC
Subantarctic Skua	*Catharacta antarctica*	EN	LC
Parasitic Jaeger	*Stercorarius parasiticus*	LC	LC
Long-tailed Jaeger	*Stercorarius longicaudus*	LC	LC
Sabine's Gull	*Larus sabini*	LC	LC
Lesser Crested Tern	*Thalasseus bengalensis*	LC	LC
Sandwich Tern	*Thalasseus sandvicensis*	LC	LC
Little Tern	*Sternula albifrons*	LC	LC
Common Tern	*Sterna hirundo*	LC	LC
Arctic Tern	*Sterna paradisaea*	LC	LC
Antarctic Tern	*Sterna vittata*	EN	LC

LC	Least Concern	VU	Vulnerable	NT	Near Threatened
EN	Endangered	CR	Critically Endangered	DD	Data Deficient

Fifteen species of seabirds breed in southern Africa; Cape Gannet (see Figure 4-26 (left)), African Penguin (see Figure 4-26 (right)), African Black Oystercatcher, four species of Cormorant, White Pelican, three Gull and four Tern species (see Table 4-6). The breeding areas are distributed around the coast with islands being especially important. Breeding islands located in proximity to the project area are McDougall's Bay and Boegoeberg (about 15 km south of the Orange River Mouth), Bird Island at Lambert's Bay, ~225 km west of the eastern boundary of Sea Area 5C, and Sinclair Island over 300 km to the north in Namibia (see Figure 4-27). There are also onshore breeding sites in the Northern Cape. 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 within 200 km offshore (Dundee (2006); Ludynia (2007); Grémillet *et al.* (2008)) and African penguins have also been recorded as far as 60 km offshore. Sea Areas 4C and 5C lie well to the north of the nearest South African gannet foraging areas (see Figure 4-27) but overlaps with the aggregate core home ranges of African Penguin (Figure 4-25) (BirdLife South Africa 2022). Aggregate core home ranges and foraging areas for Cape Cormorant and Bank Cormorant similarly lie well inshore of the Sea Areas (see Harris *et al.* 2022). However, there is overlap of the foraging areas of Wandering Albatross and Atlantic Yellow-nosed Albatross with the Sea Areas (Figure 4-25) (BirdLife South Africa 2022; Harris *et al.* 2022).

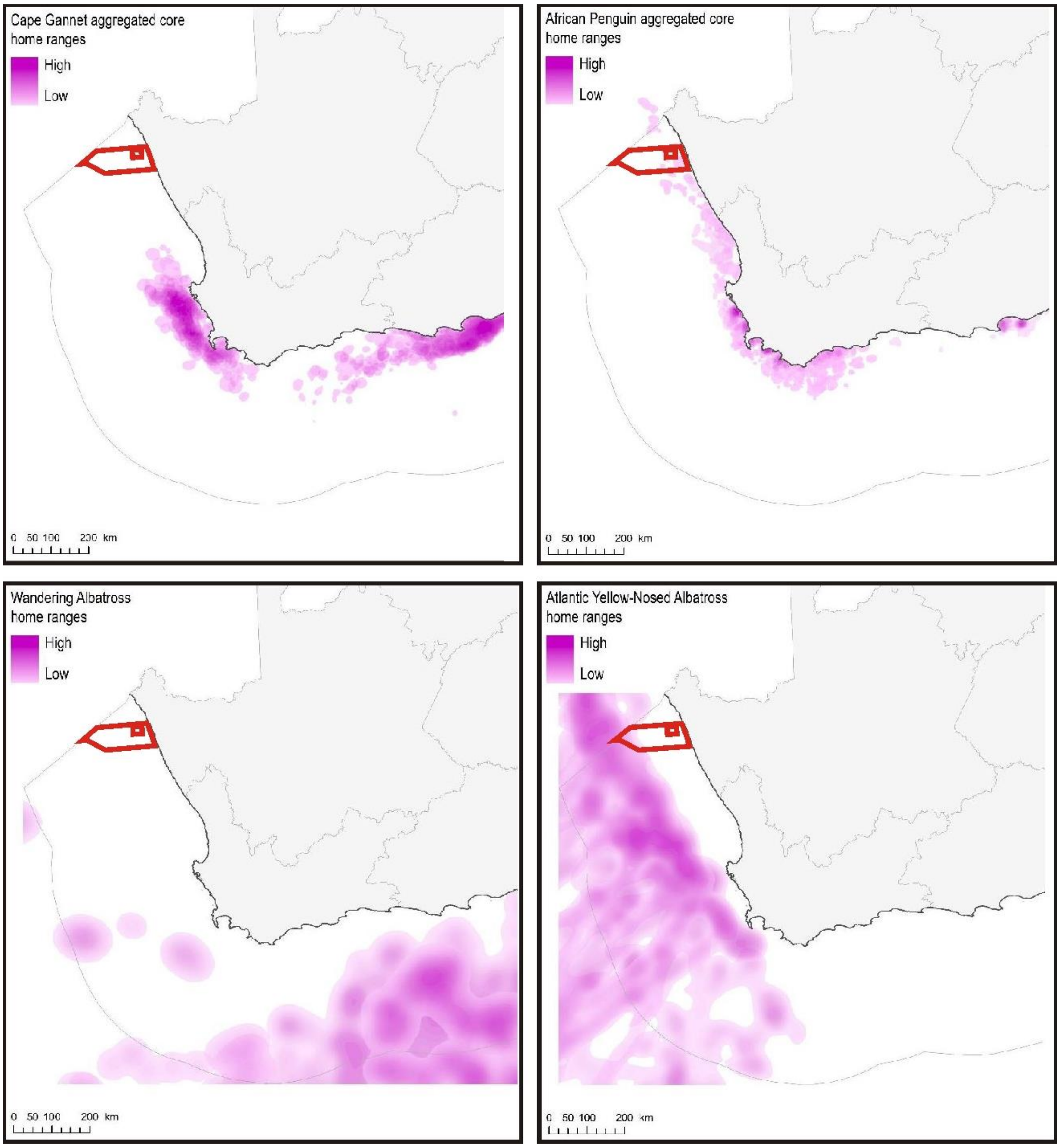

Figure 4-25: Sea Areas 4C and 5C (red polygon) in relation to aggregate core home ranges of Cape Gannet (top left), African Penguin (top right) for different colonies and life-history stages, and foraging areas of Wandering Albatross (bottom left) and Atlantic Yellow-nosed Albatross (bottom right). For foraging areas, darker shades are areas of higher use and where foraging areas from different colonies overlap (adapted from Harris *et al.* 2022).


Figure 4-26: Cape gannets *Morus capensis* (left) and African penguins *Spheniscus demersus* (right) breed primarily on the offshore islands (sources: NACOMA and Klaus Jost).

Cape cormorants and Bank cormorants showed a substantial decline from the late 1970s/early 1980s to the late 2000s/early 2010s, with numbers of Cape cormorants dropping from 106 500 to 65 800 breeding pairs, and Bank cormorants from 1 500 to only 800 breeding pairs over that period (Crawford et al. 2015).

Demersal and pelagic longlining are key contributors to the mortality of albatrosses (Browed albatross 7%, Indian and Atlantic Yellow-Nosed Albatross 3%), petrels (white-chinned petrel 66%), shearwaters and Cape Gannets (2%) through accidental capture (bycatch and/or entanglement in fishing gear), with an estimated annual mortality of 450 individuals of 14 species for the period 2006 to 2013 (Rollinson et al. 2017). Other threats include predation by mice on petrel and albatross chicks on sub-Antarctic islands, predation of chicks of Cape, Crowned and Bank Cormorants by Great White Pelicans, and predation of eggs and chicks of African Penguins, Bank, Cape and Crowned Cormorants by Kelp gulls. Disease (avian flu), climate change (heat stress and environmental variability) and oil spills are also considered major contributors to seabird declines (Sink et al. 2019).

Table 4-6: Breeding Resident Seabirds Present Along the West Coast (CCA & CMS (2011)). IUCN Red List and National Assessment status are provided (Sink *et al.* 2019). * denotes endemicity.

Common name	Species name	National Assessment	Global IUCN Status
African Penguin*	*Spheniscus demersus*	EN	EN
African Black Oystercatcher*	*Haematopus moquini*	LC	LC
White-breasted Cormorant	*Phalacrocorax carbo*	LC	LC
Cape Cormorant*	*Phalacrocorax capensis*	EN	EN
Bank Cormorant*	*Phalacrocorax neglectus*	EN	EN
Crowned Cormorant*	*Phalacrocorax coronatus*	NT	LC
White Pelican	*Pelecanus onocrotalus*	VU	LC
Cape Gannet*	*Morus capensis*	EN	EN
Kelp Gull	*Larus dominicanus*	LC	LC
Greyheaded Gull	*Larus cirrocephalus*	LC	LC

Common name	Species name	National Assessment	Global IUCN Status
Hartlaub's Gull*	*Larus hartlaubii*	LC	LC
Caspian Tern	*Hydroprogne caspia*	VU	LC
Swift Tern	*Sterna bergii*	LC	LC
Roseate Tern	*Sterna dougallii*	EN	LC
Damara Tern*	*Sterna balaenarum*	VU	VU

LC	Least Concern	VU	Vulnerable	NT	Near Threatened
EN	Endangered	CR	Critically Endangered	DD	Data Deficient

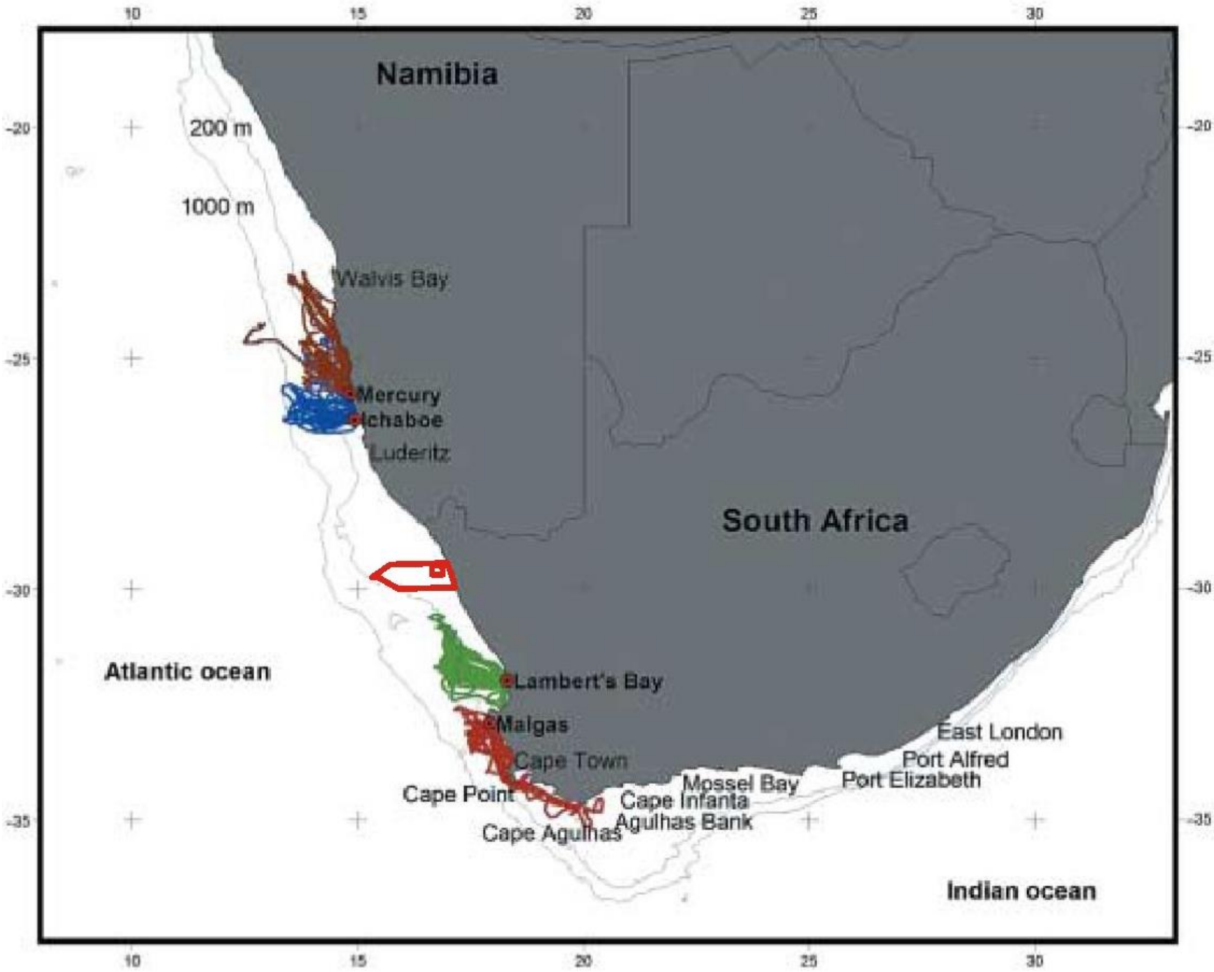

Figure 4-27: Sea Areas 4C and 5C in relation to GPS tracks recorded for 93 Cape gannets foraging off four breeding colonies in South Africa and Namibia (adapted from Grémillet *et al.* (2008)).

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-three 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 (see Table 4-7). The known seasonality of their occurrence within waters of the West Coast is provided in Table 4-8. Of the species listed, the blue whale is considered 'Critically endangered', fin and sei whales are 'Endangered' and one is considered vulnerable (IUCN Red Data list Categories). Altogether 17 species are listed as "data deficient" underlining how little is known about cetaceans, their distribution and population trends. 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. In the past ten years, passive acoustic monitoring and satellite telemetry have begun to shed light on current patterns of seasonality and movement for some large whale species (Best et al. 2009; Elwen et al. 2011; Rosenbaum et al. 2014; Shabangu et al. 2019; Thomisch et al. 2019) but information on smaller cetaceans in deeper waters remains poor. Records from marine mammal observers on seismic survey vessels have provided valuable data into cetacean presence although these are predominantly during summer months (Purdon et al. 2020). Information on general distribution and seasonality is improving but data population sizes and trends for most cetacean species occurring on the west coast of southern Africa is lacking.

Records from stranded specimens show that the area between St Helena Bay (~32° S) 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 ~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.

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. 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, Risso's dolphin, common dolphin, sperm whale (winter distribution) and humpback whale (Harris *et al.* 2022).

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 Sea Search, are provided in Table 4-7. 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). The large whale species for which there are current data available are the humpback and southern right whale, although almost all data is limited to that collected on the continental shelf close to shore. The seasonality of baleen whales in the broader project area is provided in Table 4-8. A review of the distribution and seasonality of the key cetacean species likely to be found within the project area is provided overleaf.

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.

- **Bryde's whales:** Two genetically and morphologically distinct populations of Bryde's whales (see Figure 4-28 (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. Several strandings of adult offshore Bryde's whales in central Namibia confirm that the species passes through the project area. The inshore population has recently been recognised as its own (yet to be named) sub species (*Balaenoptera brydei edeni*, Penry *et al.* 2018) with a total population for this subspecies of likely fewer than 600 individuals. The published range of the population is the continental shelf and Agulhas Bank of South Africa ranging from Durban in the east to at least St Helena Bay off the West Coast with possible movements further north up the West Coast and into Namibia during the winter months (Best 2007).

Table 4-7: Cetaceans occurrence off the West Coast of South Africa their seasonality, likely encounter frequency with proposed prospecting activities and South African (Child *et al.* (2016)) and global IUCN Red List conservation status.

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Delphinids							
Dusky dolphin	*Lagenorhynchus obscurus*	HF	Yes (0- 800 m)	No	Year round	Least Concern	Least Concern
Heaviside's dolphin	*Cephalorhynchus heavisidii*	VHF	Yes (0-200 m)	No	Year round	Least Concern	Near Threatened
Common bottlenose dolphin	*Tursiops truncatus*	HF	Yes	Yes	Year round	Least Concern	Least Concern
Common dolphin	*Delphinus delphis*	HF	Yes	Yes	Year round	Least Concern	Least Concern
Southern right whale dolphin	*Lissodelphis peronii*	HF	Yes	Yes	Year round	Least Concern	Least Concern
Striped dolphin	*Stenella coeruleoalba*	HF	No	Yes	Year round	Least Concern	Least Concern
Pantropical spotted dolphin	*Stenella attenuata*	HF	Edge	Yes	Year round	Least Concern	Least Concern
Long-finned pilot whale	*Globicephala melas*	HF	Edge	Yes	Year round	Least Concern	Least Concern
Short-finned pilot whale	*Globicephala macrorhynchus*	HF	Edge	Yes	Year round	Least Concern	Least Concern
Rough-toothed dolphin	*Steno bredanensis*	HF	No	Yes	Year round	Not Assessed	Least Concern
Killer whale	*Orcinus orca*	HF	Occasional	Yes	Year round	Least Concern	Data deficient
False killer whale	*Pseudorca crassidens*	HF	Occasional	Yes	Year round	Least Concern	Near Threatened
Pygmy killer whale	*Feresa attenuata*	HF	No	Yes	Year round	Least Concern	Least Concern
Risso's dolphin	*Grampus griseus*	HF	Yes (edge)	Yes	Year round	Data Deficient	Least Concern
Sperm whales							
Pygmy sperm whale	*Kogia breviceps*	VHF	Edge	Yes	Year round	Data Deficient	Least Concern
Dwarf sperm whale	*Kogia sima*	VHF	Edge	Yes	Year round	Data Deficient	Least Concern
Sperm whale	*Physeter macrocephalus*	HF	Edge	Yes	Year round	Vulnerable	Vulnerable
Beaked whales							
Cuvier's	*Ziphius cavirostris*	HF	No	Yes	Year round	Data Deficient	Least Concern
Arnoux's	*Berardius arnuxii*	HF	No	Yes	Year round	Data Deficient	Least Concern

Common Name	Species	Hearing Frequency	Shelf (<200 m)	Offshore (>200 m)	Seasonality	RSA Regional Assessment	IUCN Global Assessment
Southern bottlenose	*Hyperoodon planifrons*	HF	No	Yes	Year round	Least Concern	Least Concern
Layard's	*Mesoplodon layardii*	HF	No	Yes	Year round	Data Deficient	Least Concern
True's	*Mesoplodon mirus*	HF	No	Yes	Year round	Data Deficient	Least Concern
Gray's	*Mesoplodon grayi*	HF	No	Yes	Year round	Data Deficient	Least Concern
Blainville's	*Mesoplodon densirostris*	HF	No	Yes	Year round	Data Deficient	Least Concern
Baleen whales							
Antarctic Minke	*Balaenoptera bonaerensis*	LF	Yes	Yes	>Winter	Least Concern	Near Threatened
Dwarf minke	*B. acutorostrata*	LF	Yes	Yes	Year round	Least Concern	Least Concern
Fin whale	*B. physalus*	LF	Yes	Yes	MJJ & ON	Endangered	Vulnerable
Blue whale (Antarctic)	*B. musculus intermedia*	LF	No	Yes	Winter peak	Critically Endangered	Critically Endangered
Sei whale	*B. borealis*	LF	Yes	Yes	MJ & ASO	Endangered	Endangered
Bryde's (inshore)	*B. edeni (subspp)*	LF	Yes	Edge	Year round	Vulnerable	Least Concern
Bryde's (offshore)	*B. edeni*	LF	Edge	Yes	Summer (JFM)	Data Deficient	Least Concern
Pygmy right	*Caperea marginata*	LF	Yes	?	Year round	Least Concern	Least Concern
Humpback sp.	*Megaptera novaeangliae*	LF	Yes	Yes	Year round, SONDJF	Least Concern	Least Concern
Humpback B2 population	*Megaptera novaeangliae*	LF	Yes	Yes	Spring/Summer peak ONDJF	Vulnerable	Not Assessed
Southern Right	*Eubalaena australis*	LF	Yes	No	Year round, ONDJFMA	Least Concern	Least Concern

Table 4-8: Seasonality of baleen whales in the broader project area based on data from multiple sources, predominantly commercial catches (Best (2007) and other sources) and data from stranding events (NDP unpublished data).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bryde's Inshore	L	L	L	L	L	L	L	L	L	L	L	L
Bryde's Offshore	**H**	**H**	**H**	L	L	L	L	L	L	L	L	L
Sei	L	L	L	L	**H**	**H**	L	**H**	**H**	**H**	L	L
Fin	M	M	M	**H**	**H**	**H**	M	**H**	**H**	**H**	M	M
Blue	L	L	L	L	L	**H**	**H**	**H**	L	M	L	L
Minke	M	M	M	**H**	**H**	**H**	M	**H**	**H**	**H**	M	M
Humpback	M	M	L	L	L	**H**	**H**	M	M	L	M	**H**
Southern Right	**H**	M	L	**L**	L	**H**	**H**	**H**	**M**	**M**	**H**	**H**
Pygmy right	**H**	**H**	**H**	M	L	L	L	L	L	L	M	M

Note: Values of high (H), Medium (M) and Low (L) are relative <u>within</u> each row (species) and not comparable between species. For abundance / likely encounter rate within the broader project area, refer to Table 4-7.

The offshore stock was subjected to heavy whaling in the mid-20th century (Best 2001) and there are no current data on population size or stock recovery therefrom and is currently listed as 'Data deficient' on the South African Red List. The inshore stock is regarded as extremely 'Vulnerable' and listed as such on the South African red list as it regularly suffers losses from entanglement in trap fisheries and has been subject to significant changes in its prey base due to losses and shifts in the sardine and small pelagic stocks around South Africa.

- **Sei whales:** Sei whales spend time at high altitudes (40-50˚S) during summer months and migrate north through South African waters (where they were historically hunted in relatively high numbers) to unknown breeding grounds further north (Best (2007)). 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 caught 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:** 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. However, the location of the breeding ground (if any) and how far north it is remains a mystery (Best (2007)). 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.
- **Blue whales:** Antarctic blue whales were historically caught in high numbers off the South African West Coast, with a single peak in catch rates during July in Namibia and Angola suggesting that these latitudes are close to the northern migration limit for the species in the eastern South Atlantic (Best (2007)). Although there had been only two confirmed sightings of the species in the area since 1973 (Branch *et al.* (2007)), evidence of blue whale presence off Namibia is increasing. Recent acoustic detections of blue whales in the Antarctic peak between December and January (Tomisch *et al.* (2016)) off western South Africa (Shanbangu et al. 2019) and in northern Namibia between May and July (Thomisch 2017) supporting observed timing from whaling records. Several recent (2014-2015) sightings of blue whales during seismic surveys off the southern part of Namibia in water >1 000 m deep confirm their existence in the area and occurrence in Autumn months. The chance of encountering the species in the proposed survey area is considered low.
- **Minke whales**: Two forms of minke whale (see Figure 4-28 (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. Recent data available from passive acoustic monitoring over a two-year period off the Walvis Ridge shows acoustic presence in June - August and November - December (Thomisch *et al.* (2016)), supporting a bimodal distribution in the area. 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 and have been seen <2 km from shore on several occasions around South

Africa. Both species are generally solitary, and densities are likely to be low in the project area, although sightings have been reported (SLR data).

- The **pygmy right whale** is the smallest of the baleen whales reaching only 6 m total length as an adult (Best (2007)). The species is typically associated with cool temperate waters between 30°S and 55°S with records from southern and central Namibia being the northern most for the species (Leeney *et al.* (2013)). Its distribution off the West Coast of South Africa is thus likely to be limited to the cooler shelf waters of the main Benguela upwelling areas.

Figure 4-28: The Bryde's whale *Balaenoptera brydei* (left) and the Minke whale *Balaenoptera bonarensis* (right) (sources: www.dailymail.co.uk and www.marinebio.org).

The most abundant baleen whales in the Benguela are humpback whales (see Figure 4-26 (left)) and southern right whales (see Figure 4-29 (right)). 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 (Barense *et al.* (2011); Mate *et al.* (2011)). Increasing numbers of summer records of both species from the southern half of Namibia suggest that animals may also be feeding in the Lüderitz upwelling cell (NDP unpublished. data).

- **Humpback whales:** 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)). Until recently it was believed that that these breeding grounds were functionally separate from those off east (Mozambique-Kenya-Madagascar), with only rare movements between them (Pomilla & Rosenbaum 2005) and movements to other continental breeding grounds being even more rare. Recent satellite tagging of animals between Plettenberg Bay and Port Alfred during the northward migration, showed them to turn around and end up feeding in the Southern Benguela (Seakamela *et al.* 2015) before heading offshore and southwards using the same route as whales tracked off Gabon and the West Coast of South Africa. Unexpected results such as this highlight the complexities of understanding whale movements and distribution patterns and the fact that descriptions of broad season peaks in no way captures the wide array of behaviours exhibited by these animals. Furthermore, three separate matches have been made between individuals off South Africa and Brazil by citizen scientist photo-identification (www.happywhale.com). This included whales from the Cape Town and Algoa Bay-Transkei areas. Analysis of humpback whale breeding song on Sub-Antarctic feeding grounds also suggests exchange of singing male whales from western and eastern South Atlantic populations (Darling & Sousa-Lima 2005; Schall *et al.* 2021; but see also Darling *et al.* 2019; Tyarks *et al.* 2021). In coastal waters, the northward migration stream is larger than the southward peak (Best & Allison (2010); Elwen *et al.* (2014)), suggesting that animals migrating north strike the coast at varying places north of St Helena Bay. This results in increasing whale density in 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. 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.* (2014); Rosenbaum *et al.* (2014)). Although migrating through the Benguela, there is no existing evidence of a clear 'corridor' and humpback whales appear to be spread out widely across the shelf and into deeper pelagic waters, especially during the southward migration (Barendse *et al.* 2010; Best & Allison 2010; Elwen *et al.* 2014). The only available abundance estimate put the number of animals in the West African breeding population (Gabon) to be in excess of 9 000 individuals in 2005 (IWC 2012) and it is likely to have increased substantially since this time at about 5% per annum (IWC 2012; see also Wilkinson 2021). The number of humpback whales feeding in the southern Benguela has increased substantially since estimates made in the early 2000s (Barendse *et al.* 2011). Since ~2011, 'supergroups' of up to 200 individual whales have been observed feeding within 10 km from shore (Findlay *et al.* 2017) with many hundred more passing through and whales are now seen in all months of the year around Cape Town. It has been suggested that the formation of these super-groups may be in response to anomalous oceanographic conditions in the Southern Benguela, which result in favourable food availability, thereby leading to these unique humpback whale feeding aggregations (Dey *et al.* 2021; see also Avila *et al.* 2019; Meynecke *et al.* 2020; Cade *et al.* 2021). 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 during the northward migration in June – February and a smaller peak with the southern breeding migration around September – October but with regular encounters until February associated with subsequent feeding in the Benguela ecosystem.

Figure 4-29: The Humpback whale *Megaptera novaeangliae* (left) and the Southern Right whale *Eubalaena australis* (right) are the most abundant large cetaceans occurring along the West Coast.

(sources: www.divephotoguide.com and www.aad.gov.au)

- **Southern right whales**: 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 ~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 in 1920, 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.* (2019)) 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.* (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). Some southern right whales move from the South Coast breeding ground directly to the West Coast feeding ground (Mate *et al.* 2011). When departing from feeding ground all satellite tagged animals in that study took a direct south-westward track. Mark-recapture data from 2003-2007 estimated roughly one third of the South African right whale population at that time were using St Helena Bay for feeding (Peters *et al.* 2011). While annual surveys have revealed a steady population increase since the protection of the species from commercial whaling, the South African right whale population has undergone substantial changes in breeding cycles and feeding areas (Van Den Berg *et al.* 2020), and numbers of animal using our coast since those studies were done – notably a significant decrease in the numbers of cow-calf-pairs following the all-time record in 2018, a marked decline of unaccompanied adults since 2010 and variable presence of mother-calf pairs since 2015 (Roux *et al.* 2015; Vermeulen *et al.* 2020). The change in demographics are indications of a population undergoing nutritional stress and has been attributed to likely spatial and/or temporal displacement of prey due to climate variability (Vermeulen *et al.* 2020; see also Derville *et al.* 2019, 2020; Kershaw *et al.* 2021; van Weelden *et al.* 2021). Recent sightings (2018-2021) confirm that there is still a clear peak in numbers on the West Coast (Table Bay to St Helena Bay) between February and April. Given this high proportion of the population known to feed in the southern Benguela, and the historical records, it is highly likely that several hundreds of right whales can be expected to pass directly through Sea Areas 4C and 5C between May and June and then again November to January.

<u>Odontocetes (toothed) whales</u>

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 (see Figure 4-31). Those in the region can range in size from 1.6 m long (Heaviside's dolphin) to 17 m (bull sperm whale).

- **Sperm whales:** All information about sperm whales in the southern African sub-region results from data collected during commercial whaling activities prior to 1985 (Best (2007)). Analysis of recent passive acoustic monitoring data from the edge of the continental shelf (800 - 1 000 m water depth, roughly 80 km WSW of Cape Point) confirms year-round presence. 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)) (see

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- Figure 4-30 (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 makes 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. Beaked whales seem to be particularly susceptible to man-made sounds and several strandings and deaths at sea, often *en masse,* have been recorded in association with naval mid-frequency sonar (Cox *et al.* (2006); MacLeod & D'Amico (2006)) and a seismic survey for hydrocarbons also running a multi-beam echo-sounder and sub bottom profiler (Cox *et al.* (2006)). Although the exact reason that beaked whales seem particularly vulnerable to man-made noise is not yet fully understood, the existing evidence clearly shows that animals change their dive behaviour in response to acoustic disturbance (Tyack *et al.* (2011)), and all possible precautions should be taken to avoid causing any harm. Sightings of beaked whales in the project area are expected to be very low.

- **Pygmy and Dwarf Sperm Whales**: 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. Due to their small body size, cryptic behaviour, low densities and small school sizes, these whales are difficult to observe at sea, and morphological similarities make field identification to species level problematic. Although their narrow-band high frequency echolocation clicks make them detectable and identifiable (at least to the genus) using passive acoustic monitoring equipment. The majority of what is known about Kogiid 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)). *Kogia* species are most frequently occur in pelagic and shelf edge waters, are thus likely to occur in the survey area at low levels; seasonality is unknown. Dwarf sperm whales are associated with warmer tropical and warm-temperate waters, being recorded from both the Benguela and Agulhas ecosystem (Best (2007)) in waters deeper than ~1 000 m. Abundance in Sea Areas 4C and 5C is likely to be very low.
- **Killer whales:** Killer whales (see
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- Figure 4-30 (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 in South African waters were referred to a single morphotype, Type A, although recently a second 'flat-toothed' morphotype that seems to specialise in an elasmobranch diet has been identified (Best *et al.* (201)4). 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.
- **False killer whale:** Although the false killer whale is globally recognized as one species, clear differences in morphological and genetic characteristics between different study sites show that there is substantial difference between populations and a revision of the species taxonomy may be needed (Best (2007)). False killer whales are more likely to be confused with melon-headed or pygmy killer whales than with killer whales. The species has a tropical to temperate distribution and most sightings off southern Africa have occurred in water deeper than 1 000 m, but with a few 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)).

Figure 4-30: Sperm whales *Physeter macrocephalus* (left) and killer whales *Orcinus orca* (right) are toothed whales likely to be encountered in offshore waters (sources: www.onpoint.wbur.org and www.wikipedia.org)

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

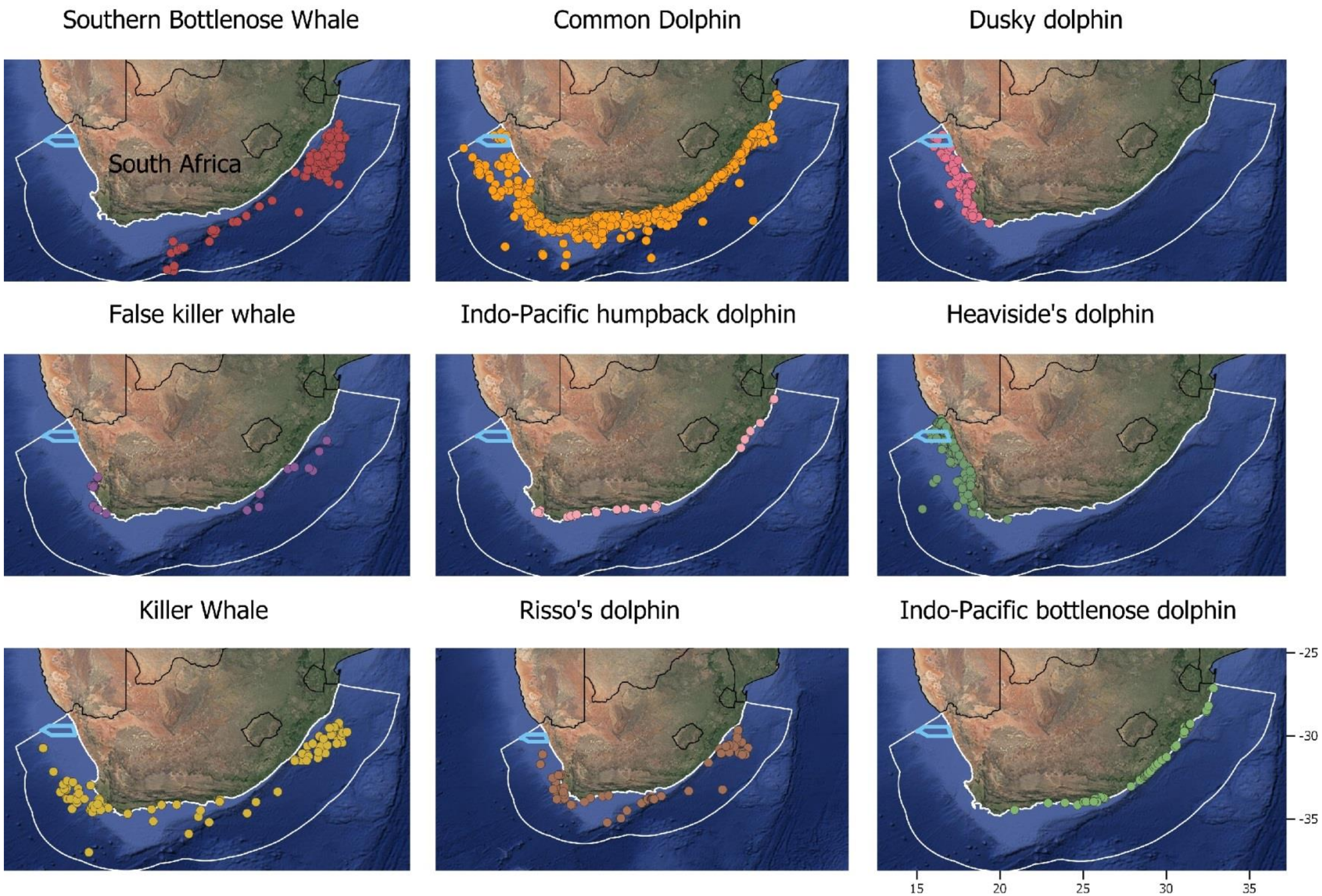

Figure 4-31: Sea Areas 4C and 5C in relation to projections of predicted distributions for nine odentocete species off the West Coast (adapted from Purdon *et al.* (2020))

- **Common dolphin**: Two forms of common dolphins occur around southern Africa, a long-beaked and short-beaked form (Findlay *et al.* 1992; Best 2007), although they are currently considered part of a single global species (Cunha *et al.* 2015). The long-beaked common dolphin lives on the continental shelf of south Africa rarely being observed north of St Helena Bay on the west coast or in waters more 500 m deep (Best 2007), although more recent sightings, including those from MMOs, suggest sightings regularly out to 1 000 m or more (SLR data, Sea Search data). Group sizes of common dolphins can be large, averaging 267 (± *SD* 287) for the South Africa region (Findlay *et al.* 1992). Far less is known about the short-beaked form, which is challenging to differentiate at sea from the long-beaked form. Group sizes are also typically large. It is likely that common dolphins encountered in the Northern Cape or deeper than 2 000 m are of the short-beaked form.*et al. et al.*
- **Heaviside's dolphins**: Heaviside's dolphins (see Figure 4-32 (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, (Elven *et al.* (2006); Best (2007)), and may show a diurnal onshore-offshore movement pattern (Elwen *et al.* (2010a, 2010b)), but this varies throughout the species range. Heaviside's dolphins are resident year-round.
- **Dusky dolphin:** In water <500 m deep, dusky dolphins (see Figure 4-32 (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.* (2010); NDP unpublished. 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.

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)).

Figure 4-32: The endemic Heaviside's Dolphin *Cephalorhynchus heavisidii* (left) and Dusky dolphin *Lagenorhynchus obscurus* (right) (Sources: De Beers Marine Namibia and scottelowitzphotography.com).

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.

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.

Cape Fur Seals

The Cape fur seal (*Arctocephalus pusillus pusillus*) (see

Figure 4-33) 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. 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)).

Figure 4-33: Colony of Cape fur seals *Arctocephalus pusillus pusillus* (source: Dirk Heinrich).

There are a number of Cape fur seal colonies within and around the study area: at Kleinsee (incorporating Robeiland), at Bucchu Twins near Alexander Bay, at Cliff Point (17 km north of Port Nolloth), at Kleinsee (incorporating Robeiland) and Strandfontein Point (south of Hondeklipbaai). The colony at Kleinsee 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. Meÿer, SFRI, pers. comm.). Non-breeding colonies occur, amongst others, 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. Their diet varies with season and availability and includes pelagic species such as horse mackerel, pilchard, and hake, as well as squid and cuttlefish. Although Cape fur seals are primarily epipelagic foragers, some degree of geographic and temporal variation in resource and habitat use have been demonstrated (Botha *et al.* 2023). Benthic feeding to depths of up to 454 m has been recorded in females from the Kleinsee colony on the West Coast, with individual modal dive durations of 0.2 – 5.6 minutes (Kirkman *et al.* 2015; Kirkman *et al.* 2019). Botha *et al.* (2020) reported diel foraging patterns in females from the Kleinsee and False Bay colonies, with dive depth and benthic foraging increasing during daylight hours likely reflecting the vertical movements of prey species. 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, with 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)).

Historically the Cape fur seal was heavily exploited for its luxurious pelt. Sealing restrictions were first introduced to Southern Africa in 1893, and harvesting was controlled until 1990 when it was finally prohibited. The protection of the species has resulted in the recovery of the populations, and numbers continue to increase. Consequently, their conservation status is not regarded as threatened. The Cape Fur Seal population in South

Africa is regularly monitored by DFFE (e.g. Kirkman *et al.* (2013)). The overall population is considered healthy and stable in size, although there has been a westward and northward shift in the distribution of the breeding population (Kirkman *et al.* (2013)).

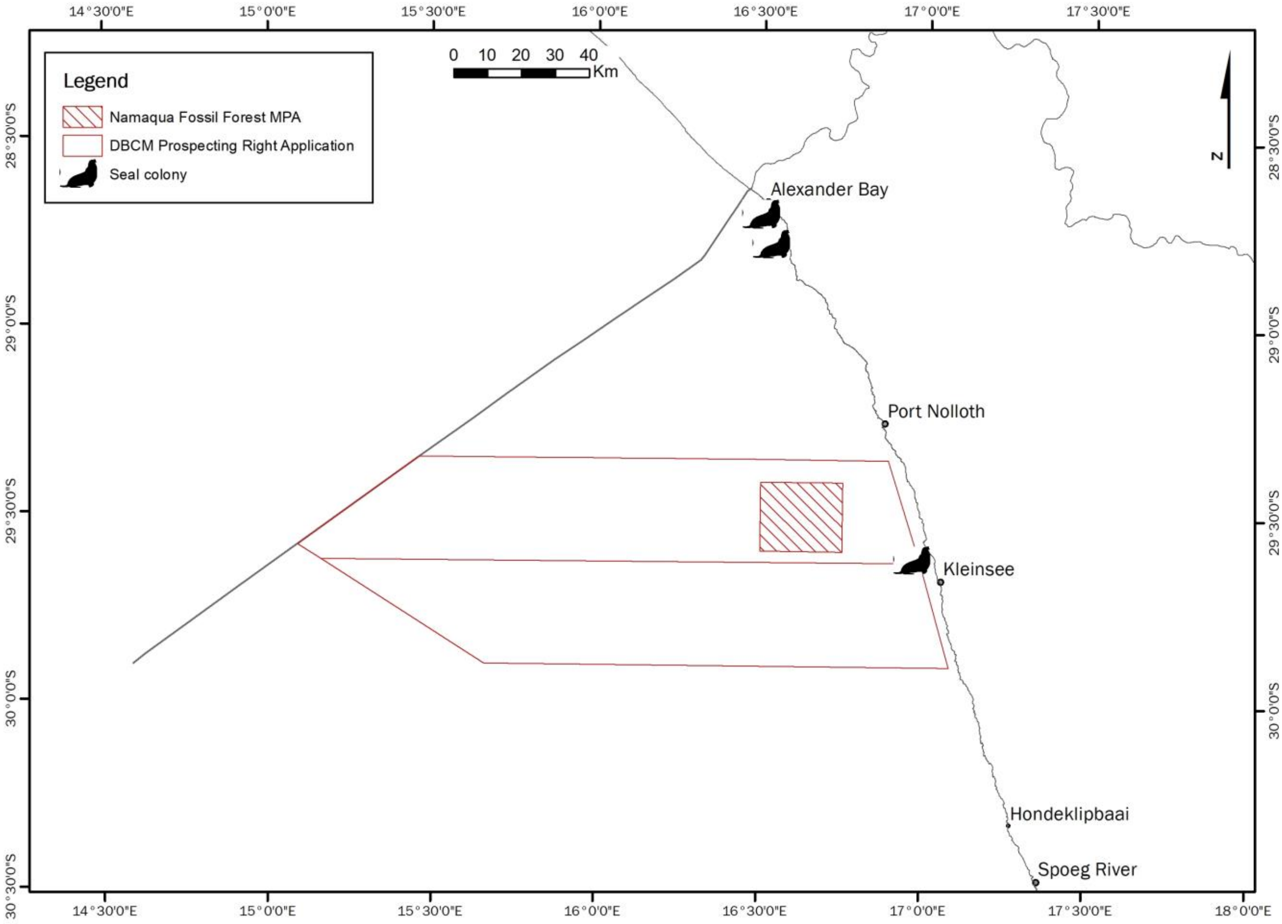

Figure 4-34: Sea Areas 4C and 5C in relation seal colonies (onland) along the West Coast.

4.2 CONSERVATION AND MARINE PROTECTED AREAS

4.2.1 Conservation Areas

Numerous conservation areas exist along the West Coast of South Africa. McDougall's Bay rock lobster sanctuary near Port Nolloth is located closest to the project area (approximately 12 km from the northern boundary of the application area), which is closed to commercial exploitation of rock lobsters.

The Orange River Mouth wetland located ~75 km to the north of the project area 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.

Various marine IBAs have also been proposed in South African and Namibian territorial waters, with a candidate trans-boundary marine IBA suggested off the Orange River mouth (see Figure 4-35). Sea Areas 4C and 5C lie south of these marine IBAs.

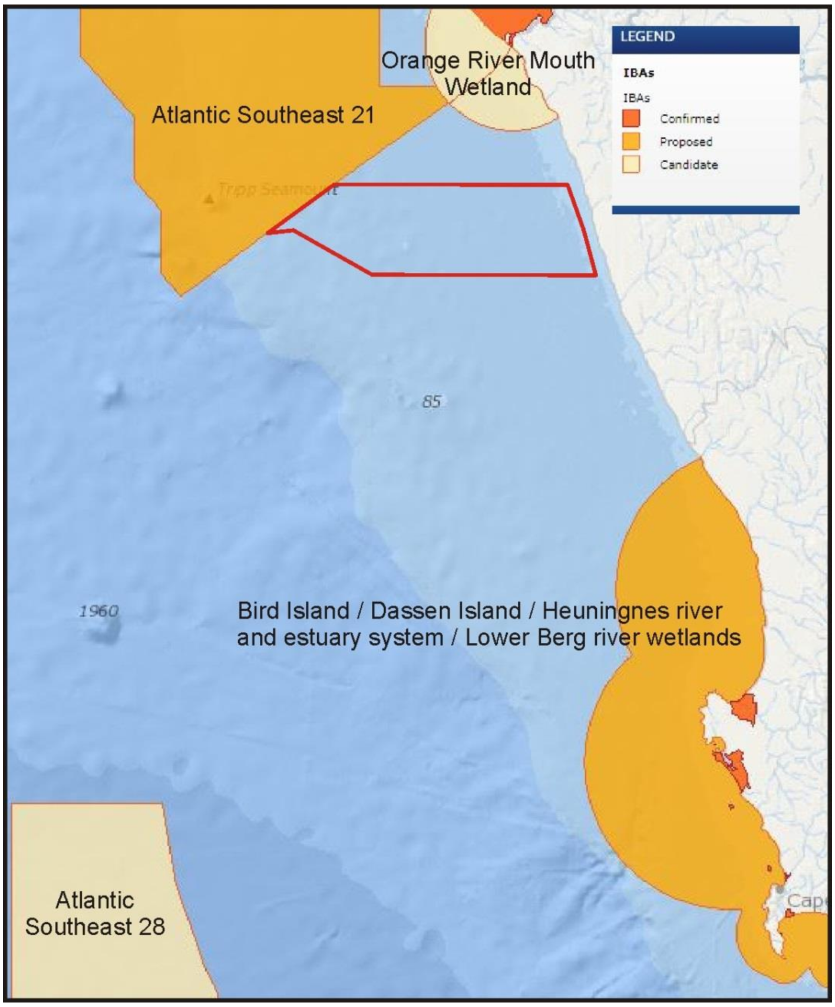

Figure 4-35: Sea Areas 4C and 5C in relation to coastal and marine IBAs in Namibia (source: www. maps.birdlife.org/marineIBAs).

4.2.2 Marine Protected Areas

'No-take' MPAs offering protection of the Namaqua biozones (sub-photic, deep-photic, shallow-photic, intertidal and supratidal zones) were absent northwards from Cape Columbine (Emanuel *et al.* (1992), Lombard *et al.* (2004)). This resulted in substantial portions of the coastal and shelf-edge marine biodiversity in the area being assigned a threat status of 'Critically endangered', 'Endangered' or 'Vulnerable' in the 2011 NBA (Lombard *et al.* (2004); Sink *et al.* (2012)). Using biodiversity data mapped for the 2004 and 2011 NBAs, a systematic biodiversity plan was developed for the West Coast (Majiedt *et al.* (2013)) with the objective of identifying both coastal and offshore priority areas for MPA expansion. Potentially 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. To this end, nine focus areas were identified 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 offshore MPAs. A network of 20 MPAs was gazetted on 23 May 2019, thereby increasing the ocean protection within the South African EEZ to 5%.

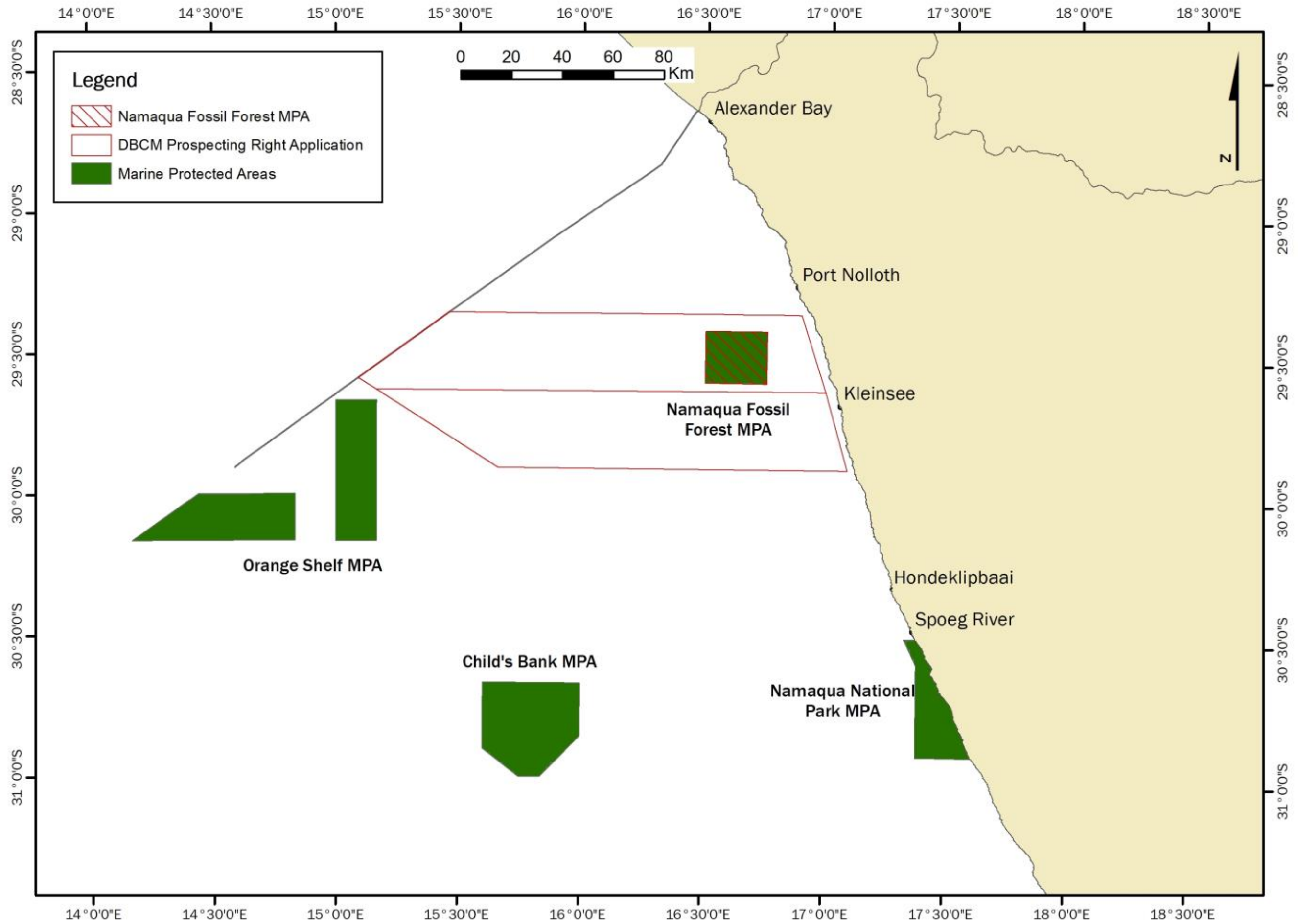

Figure 4-36: Sea Areas 4C and 5C in relation to Marine Protected Areas, showing exclusion of the Namaqua Fossil Forest Marine Protected Area.

The approved MPAs within the broad project area are shown in Figure 4-36 above. Sea Area 4C overlaps with the Namaqua Fossil Forest MPA, although the area has been excluded from the prospecting right application and no geophysical surveying and sampling activities will occur there. The Namaqua Fossil Forest Marine Protected Area in the Northern Cape is an offshore Marine Protected Area in the 120 m to 150 m depth range lying approximately 15 nautical miles offshore of the coastal area between Port Nolloth and Kleinsee. The area includes the sea bed, water column and subsoil within these boundaries. The purpose for declaring this Marine Protected Area is:

- to contribute to a national and global representative system of marine protected areas by providing protection to the benthic ecosystems of the inner shelf in this region;
- to conserve and protect an in-situ fossilised forest and its associated cold water corals; and
- to conserve and protect the biodiversity and ecological processes associated with these features.

The Namaqua Fossil Forest feature is a small unique seabed outcrop composed of fossilized yellowwood at 136-140 m depth which have been colonized by habitat-forming scleractinian corals. This small unique feature was observed within a 2 km^2 area and received full protection through the declaration in May 2019 of the much larger (~500 km^2) encompassing Namaqua Fossil Forest MPA.

Other MPAs located off the west coast of South Africa are described briefly below:

- The **Orange Shelf Edge MPA**, located to the west of Sea Areas 4C and 5C, covers depths of between 250 m and 1 500 m and comprises three separate areas and includes the sea bed, water column and subsoil. The key purpose of this MPA is to protect remnants of threatened seabed ecosystems particularly untrawled shelf edge areas which is an area of importance for migratory species. The MPA is designed to facilitate species management by protecting components of aggregating areas for sharks and other species.
- The 1 335 km^2 **Child's Bank MPA**, located to the south of Sea Areas 4C and 5C, supports seabed habitats inhabited by a diversity of starfish, brittle stars and basket stars, many of which feed in the currents passing the bank's steep walls. The MPA provides critical protection of the Childs Bank feature and associated ecosystems including cold water coral colonies.
- The 500 km^2 **Namaqua National Park MPA** (located to the south of Sea Areas 4C and 5C) was established for the purpose of conserving and protecting threated ecosystems in the Namaqua bioregion including several 'critically endangered' coastal ecosystem types. The area is a nursery area for Cape hakes, and the coastal areas support kelp forests and deep mussel beds, which serve as important habitats for the West Coast rock lobster. This MPA aims to protect and regulate access which contributes to eco-tourism and to provide an important baseline from which to understand ecological changes (e.g. introduction of invasive alien marine species, climate change) and human impacts (harvesting, mining) along the West Coast. Protecting this stretch of coastline is part of South Africa's climate adaptation strategy.

4.2.3 Sensitive Areas

Despite the development of the offshore MPA network a number of 'Endangered' and 'Vulnerable' ecosystem types (i.e. Orange Cone Inner Shelf Mud Reef Mosaic, Orange Cone Muddy mid Shelf, Namaqua Muddy Sands, Southern Benguela Outer Shelf Mosaic, Southern Benguela Shelf Edge Mosaic and Southeast Atlantic Lower Slope) are currently 'not well protected' and further effort is needed to improve protection of these threatened ecosystem types (Sink *et al.* (2019)) (see Figure 4-37). Ideally, all highly threatened ('Critically Endangered' and 'Endangered') ecosystem types should be well-protected. Currently, however, most of the Southern Benguela Sandy Shelf Edge (which overlaps with Sea Areas 4C and 5C) and Southeast Atlantic Upper- and Mid-Slope are poorly protected receiving only 0.2-10% protection, whereas the Southeast Atlantic Lower Slope receives no protection at all (Sink *et al.* (2019)). Expanding the size of the Orange Shelf Edge MPA to form a single MPA along the South African Border could improve protection of these threatened habitats. Most of the ecosystem types in Sea Areas 4C and 5C are deemed to be either poorly protected or not protected outside of the Namaqua Fossil Forest MPA.

4.2.4 Ecologically and Biologically Significant Areas

As part of a regional Marine Spatial Management and Governance Programme (MARISMA) the Benguela Current Commission (BCC) and its member states have identified a number of Ecologically and Biologically Significant

Areas (EBSAs) both spanning the border between Namibia and South Africa and along the South African West, South and East Coasts, with the intention of implementing improved conservation and protection measures within these sites. South Africa currently has 11 EBSAs solely within its national jurisdiction with a further four having recently been proposed. It also shares five trans-boundary EBSAs with Namibia (3) and Mozambique (2). The principal objective of these EBSAs is identification of features of higher ecological value that may require enhanced conservation and management measures. They currently carry no legal status.

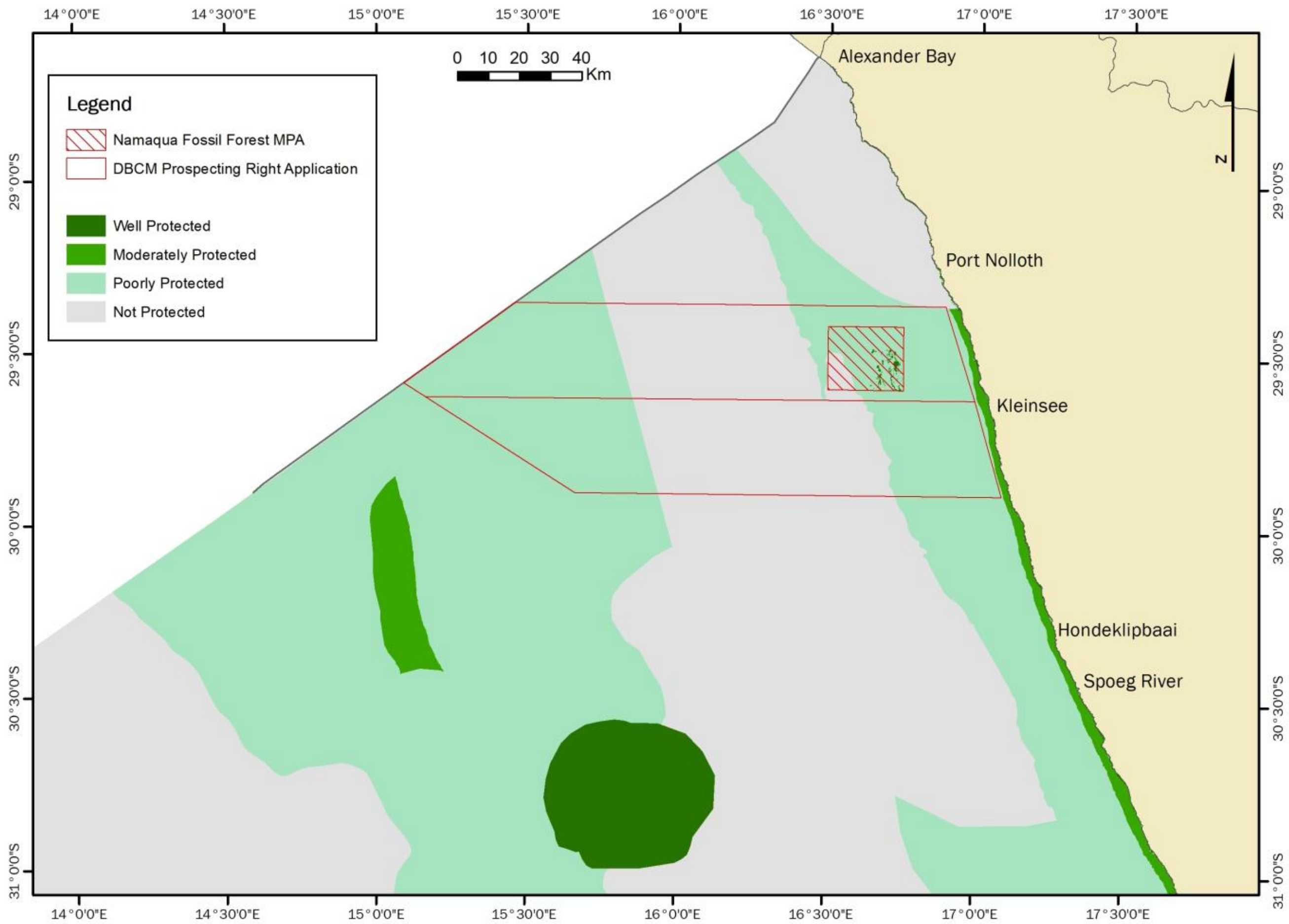

Figure 4-37: Sea Areas 4C and 5C in relation to protection levels of 150 marine ecosystem types as assessed by Sink *et al.* (2019)).

The impact management and conservation zones within the EBSAs are under review and currently constitute a subset of the biodiversity priority areas map (see next section); EBSA conservation zones equate to Critical Biodiversity Areas (CBAs), whereas impact management zones equate to Ecological Support Area (ESAs). The relevant sea-use guidelines accompanying the CBA areas would apply.

Sea Areas 4C and 5C overlap with the following EBSAs (see Figure 4-38):

- The **Namaqua Fossil Forest** is a small unique seabed outcrop composed of fossilized yellowwood at 136-140 m depth, which have been colonised by habitat-forming scleractinian corals and a habitat-forming sponge species. This feature was observed within a 2 km^2 area and received full protection through the declaration in May 2019 of the much larger (~500 km^2) encompassing Namaqua Fossil Forest MPA. The larger Namaqua Fossil Forest EBSA (total of ~830 km^2) encompasses this MPA and extends spatially beyond the MPA boundaries. Sea Areas 4C and 5C overlap with a portion of the Namaqua Fossil Forest EBSA that is not included within the boundaries of the Namaqua Fossil MPA, but which falls outside of the area where the unique fossilised feature was observed.

- The **Orange Seamount and Canyon Complex**, located to the west of Sea Areas 4C and 5C, occurs at the western continental margin of southern Africa, spanning the border between South Africa and Namibia. On the Namibian side, it includes the Tripp Seamount and a shelf-indenting canyon. The EBSA comprises shelf and 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 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.
- The **Benguela Upwelling System** is a transboundary EBSA (not show in Figure 4-38) which is globally unique as the only cold-water upwelling system to be bounded in the north and south by warm-water current systems and is characterized by very high primary production (>1 000 mg $C.m^{-2}.day^{-1}$). It includes important spawning and nursery areas for fish as well as foraging areas for threatened vertebrates, such as sea- and shorebirds, turtles, sharks, and marine mammals. Another key characteristic feature is the diatomaceous mud-belt in the Northern Benguela, which supports regionally unique low-oxygen benthic communities that depend on sulphide oxidising bacteria.

4.2.5 Biodiversity Priority Areas

The National Coastal and Marine Spatial Biodiversity Plan[2] comprises a map of proposed Critical Biodiversity Areas (CBAs), Ecological Support Area (ESAs) and accompanying sea-use guidelines. The CBA Map presents a spatial plan for the marine environment, designed to inform planning and decision-making in support of sustainable development. The sea-use guidelines enhance the use of the CBA Map in a range of planning and decision-making processes by indicating the compatibility of various activities with the different biodiversity priority areas so that the broad management objective of each can be maintained. The intention is that the CBA Map (CBAs and ESAs) and sea-use guidelines inform the MSP Conservation Zones and management regulations, respectively.

Sea Areas 4C and 5C overlap with areas mapped as Critical Biodiversity Area 1 (CBA 1): Natural and Critical Biodiversity Area 2: (CBA 2) Natural. Approximately 20% and 12% of the project area is covered by CBA 1 and

[2] The latest version of National Coastal and Marine Spatial Biodiversity Plan (v1.2 was released in April 2022) (Harris *et al.* 2022). The Plan is intended to be used by managers and decision-makers in those national government departments whose activities occur in the coastal and marine space, e.g., environment, fishing, transport (shipping), petroleum, mining, and others. It is relevant for the Marine Spatial Planning Working Group where many of these departments are participating in developing South Africa's emerging marine spatial plans. It is also intended for use by relevant managers and decision-makers in the coastal provinces and coastal municipalities, EIA practitioners, organisations working in the coast and ocean, civil society, and the private sector.

CBA 2: Natural, respectively (see Figure 4-39). ESA comprise 8% of Sea Areas 4C and 5C. CBA 1 indicates irreplaceable or near-irreplaceable sites that are required to meet biodiversity targets with limited, if any, option to meet targets elsewhere, whereas CBA 2 are "best design sites" and there often alternative areas where feature targets can be met; however, these will be of higher cost to other sectors and / or will be larger areas.

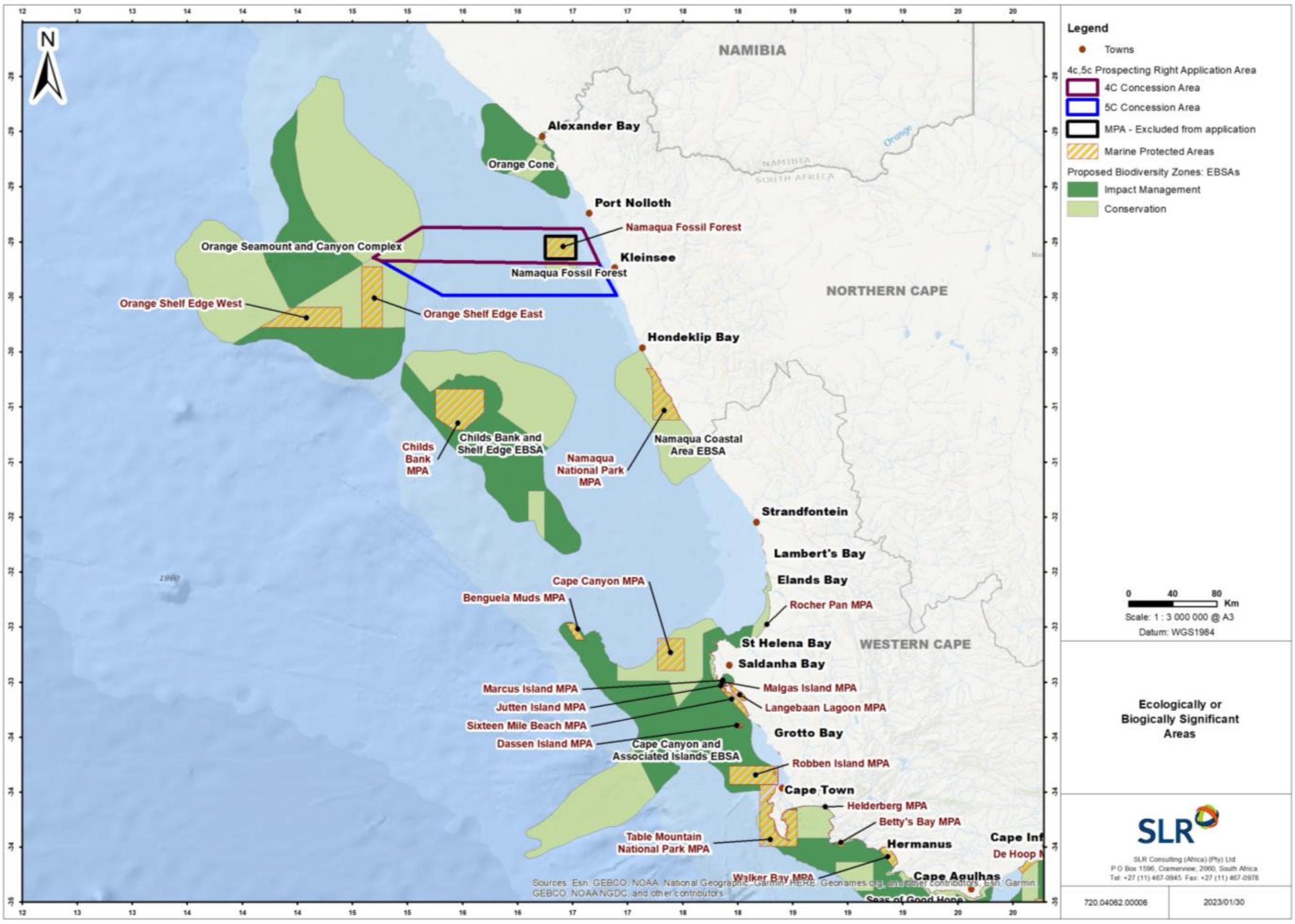

Figure 4-38: Sea Areas 4C and 5C in relation to the defined Ecologically and Biologically Significant Areas.

Regardless of how CBAs are split, CBAs are generally areas of low use and with low levels of human impact on the marine environment, but can also include some moderately to heavily used areas with higher levels of human impact. Given that some CBAs are not in natural or near-natural ecological condition, but still have very high biodiversity importance and are needed to meet biodiversity feature targets, CBA 1 and CBA 2 were split into two types based on their ecological condition. CBA Natural sites have natural / near-natural ecological condition, with the management objective of maintaining the sites in that natural / near natural state; and CBA Restore sites have moderately modified or poorer ecological condition, with the management objective to improve ecological condition and, in the long-term, restore these sites to a natural/near-natural state, or as close to that state as possible. ESAs include all portions of EBSAs that are not already within MPAs or CBAs, and a 5-km buffer area around all MPAs (where these areas are not already CBAs or ESAs), with the exception of the eastern edge of Robben Island MPA in Table Bay where a 1.5-km buffer area was applied (Harris *et al.* 2022).

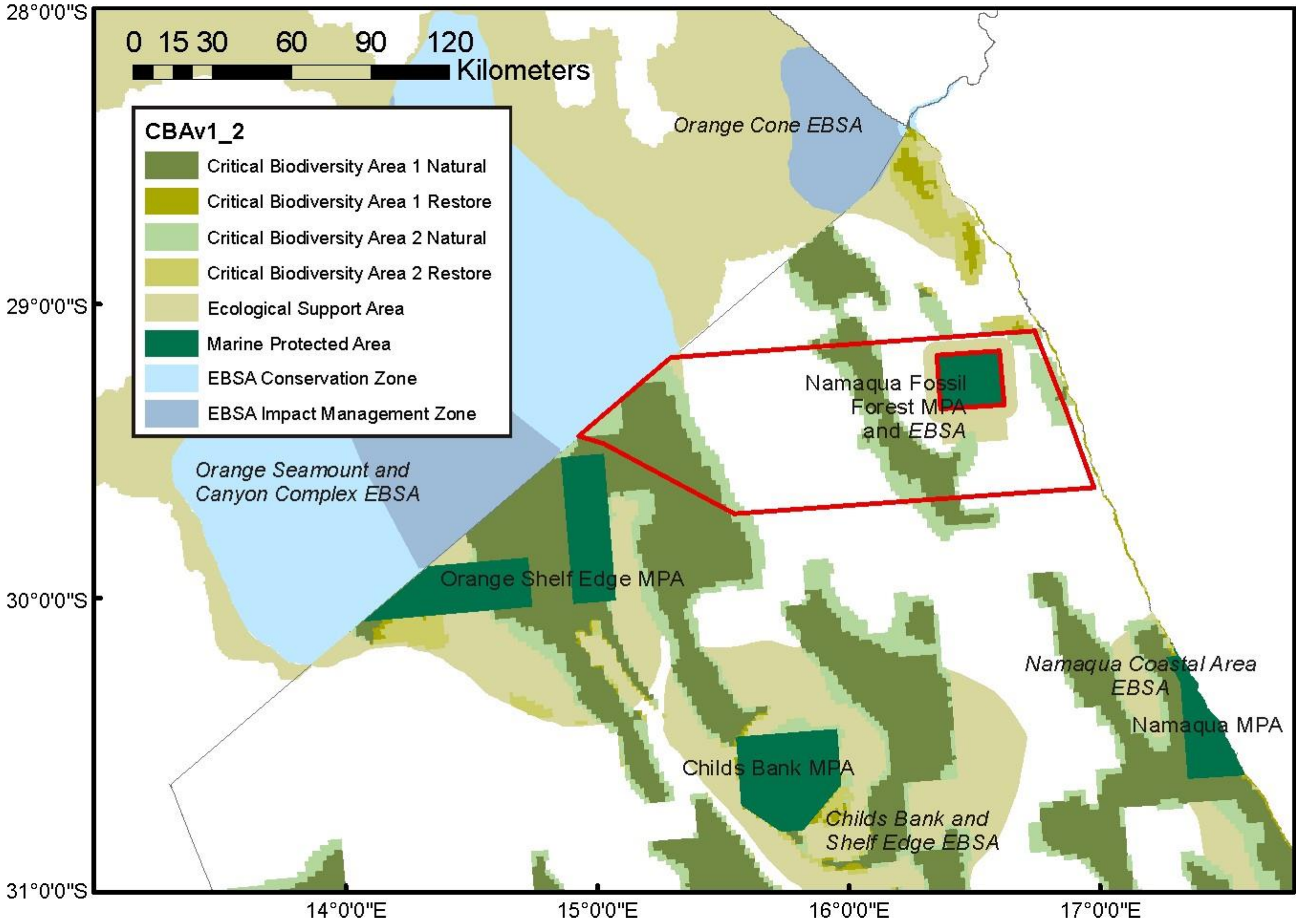

Figure 4-39: Sea Areas 4C and 5C in relation to the National Costal and Marine CBAs (version 1.0 (Beta 2)) (adapted from Harris *et al.* 2020).

Activities within these management zones are classified into those that are "compatible", those that are "not compatible", and those that have "restricted compatibility". Non-destructive prospecting (e.g. geophysical surveys) are classified as having "restricted compatibility" within CBA1 and CBA2 natural areas, whereas destructive prospecting (e.g. bulk sampling) is considered "not compatible" in CBA1 and CBA2 natural areas. Both activities are considered having "restricted compatibility" within ESAs. Activities with restricted compatibility require a detailed assessment to determine whether the recommendation is that they should be permitted (general), permitted subject to additional regulations (consent), or prohibited, depending on a variety of factors. Mining construction and operations[3] are, however, classified as "not compatible" in CBAs, but may be compatible, subject to certain conditions, in ESAs (Harris *et.al*. 2022).

[3] The activity should not be permitted to occur in CBAs because it is not compatible with the respective management objective. However, if significant mineral resources are identified during prospecting, then the selection of the site as a CBA could be re-evaluated as part of compromises negotiations in current or future MSP processes. This would require alternative CBAs and/or biodiversity offsets to be identified. However, if it is not possible to identify alternative CBAs to meet targets for the same biodiversity features that are found at the site, it is recommended that the activity remains prohibited.

Important Marine Mammal Areas (IMMAs)

Important Marine Mammal Areas (IMMAs) were introduced in 2016 by the IUCN Marine Mammal Protected Areas Task Force to support marine mammal and marine biodiversity conservation. Complementing other marine spatial assessment tools, including the EBSAs and Key Biodiversity Areas (KBAs), IMMAs are identified on the basis of four main scientific criteria, namely species or population vulnerability, distribution and abundance, key life cycle activities and special attributes. Designed to capture critical aspects of marine mammal biology, ecology and population structure, they are devised through a biocentric expert process that is independent of any political and socio-economic pressure or concern. IMMAs are not prescriptive but comprise an advisory, expert-based classification of areas that merit monitoring and place-based protection for marine mammals and broader biodiversity.

Modelled on the BirdLife International process for determining IBAs, IMMAs are assessed against a number of criteria and sub-criteria, which are designed to capture critical aspects of marine mammal biology, ecology and population structure. These criteria are:

- **Criterion A** – Species or Population Vulnerability
  Areas containing habitat important for the survival and recovery of threatened and declining species.
- **Criterion B** – Distribution and Abundance
  - *Sub-criterion B1* – Small and Resident Populations: Areas supporting at least one resident population, containing an important proportion of that species or population that are occupied consistently.
  - *Sub-criterion B2* – Aggregations: Areas with underlying qualities that support important concentrations of a species or population.
- **Criterion C** – Key Life Cycle Activities
  - *Sub-criterion C1* – Reproductive Areas: Areas that are important for a species or population to mate, give birth, and/or care for young until weaning.
  - *Sub-criterion C2* – Feeding Areas: Areas and conditions that provide an important nutritional base on which a species or population depends.
  - *Sub-criterion C3* – Migration Routes: Areas used for important migration or other movements, often connecting distinct life-cycle areas or the different parts of the year-round range of a non-migratory population.
- **Criterion D** – Special Attributes
  - *Sub-criterion D1* – Distinctiveness: Areas which sustain populations with important genetic, behavioural or ecologically distinctive characteristics.
  - *Sub-criterion D2* – Diversity: Areas containing habitat that supports an important diversity of marine mammal species

Although much of the West Coast of South Africa has not yet been assessed with respect to its relevance as an IMMA, the coastline from the Olifants River mouth on the West Coast to the Mozambiquan border overlaps with three declared IMMAs (Figure 4-40), namely:

- Southern Coastal and Shelf Waters of South Africa IMMA (166 700 km^2),
- Cape Coastal Waters IMMA (6 359 km^2), and
- South East African Coastal Migration Corridor IMMA (47 060 km^2).

These are described briefly below based on information provided in IUCN-Marine Mammal Protected Areas Task Force (2021) (www.marinemammalhabitat.org).

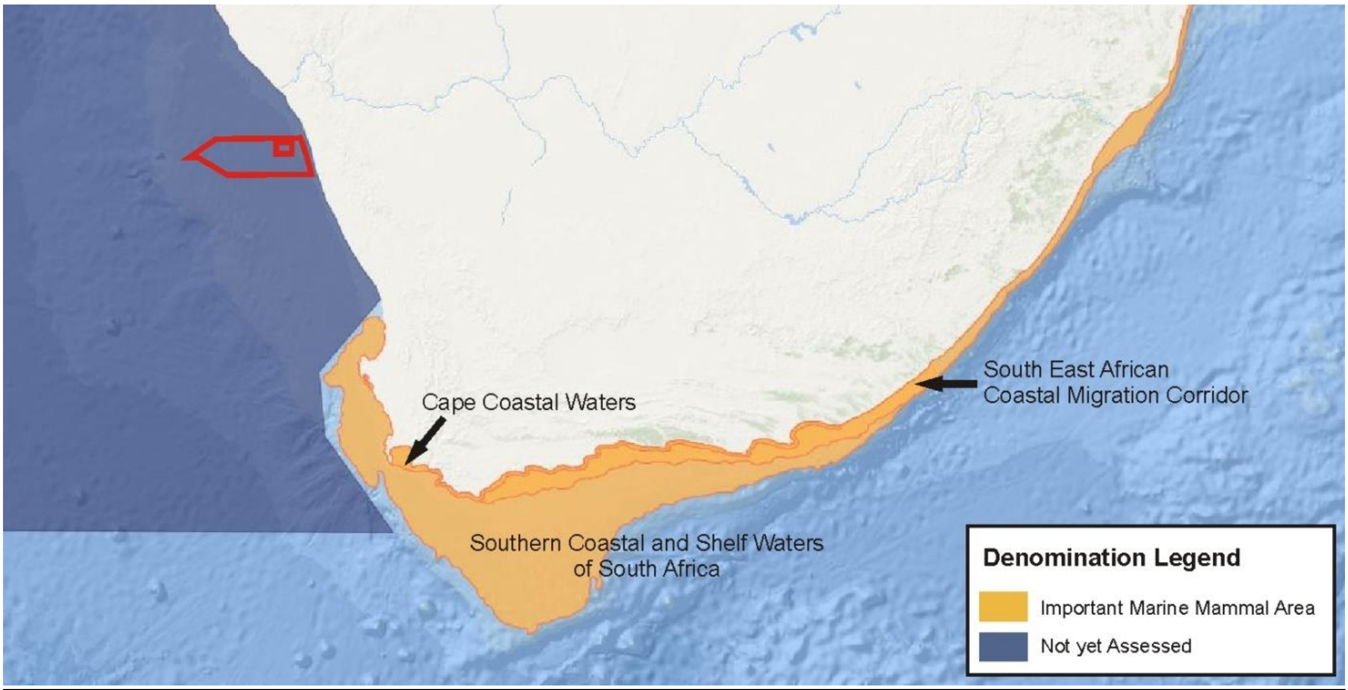

Figure 4-40: Sea Areas 4C and 5C (red polygon) in relation to coastal and marine IMMAs (Source: www.marinemammalhabitat. org/imma-eatlas/).

The 166 700 km^2 Southern Coastal and Shelf Waters of South Africa IMMA extends from the Olifants River mouth to the mouth of the Cintsa River on the Wild Coast. Qualifying species are the Indian Ocean Humpback dolphin (Criterion A, B1), Bryde's whale (Criterion C2), Indo-Pacific bottlenose dolphin (Criterion B1, C3, D1), Common dolphin (Criterion C2) and Cape fur seal (Criterion C2). The IMMA covers the area supporting the important 'sardine run' and the marine predators that follow and feed on the migrating schools (Criterion C2) as well as containing habitat that supports an important diversity of marine mammal species (Criterion D2) including the Indian Ocean humpback dolphin, the inshore form of Bryde's whale, Indo-Pacific bottlenose dolphin, common dolphin, Cape fur seal, humpback whales, killer whales and southern right whales.

The Cape Coastal Waters IMMA extends from Cape Point to Woody Cape at Algoa Bay and extends over some 6 359 km2. It serves as one of the world's three most important calving and nursery grounds for southern right whales, which occur in the extreme nearshore waters (within 3 km of the coast) from Cape Agulhas to St. Sebastian Bay between June and November (Criterion B2, C1). Highest densities of cow-calf pairs occur between Cape Agulhas and the Duivenhoks River mouth (Struisbaai, De Hoop, St Sebastian Bay), while unaccompanied adult densities peak in Walker Bay and False Bay. The IMMA also contains habitat that supports an important diversity of marine mammal species including the Indian Ocean humpback dolphin and Indo-Pacific bottlenose dolphin.

The South East African Coastal Migration Corridor IMMA extends some 47 060 km2 from Cape Agulhas to the Mozambiquan border and serves as the primary migration route for C1 substock of Southern Hemisphere humpback whales (Criterion C3). On their northward migration between June and August, they are driven closer to shore due to the orientation of the coast with the Agulhas Current, whereas during the southward migration from September to November, they remain further offshore (but generally within 15 km of the coast) utilising the southward flowing Agulhas Current as far west as Knysna. The IMMA also contains habitat that supports an important diversity of marine mammal species including the Indian Ocean humpback dolphin, Common dolphin, Indo-Pacific bottlenose dolphin, Spinner dolphin, Southern Right whale, and killer whale.

There is no overlap of Sea Areas 4C and 5C with these IMMAs as it falls within the area along the West Coast of South Africa that has not yet been assessed.

4.3 HUMAN UTILISATION

4.3.1 Fishing and Other Harvesting

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

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, the pole-and-line 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.

There are more than 230 small-scale fishing communities on the South African coastline (DFFE, 2020). Small-scale fisheries commonly use boats but occur mainly close to the shore. In addition to commercial and small-scale sectors, recreational fishing occurs along the coastline comprising. Recreational fisheries comprise shore-based, estuarine and boat-based line fisheries as well as spearfishing and net fisheries, including cast, drag and hoop net techniques.

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 the canning of sardine. Smaller fishing harbours on the West / South-West Coast include Port Nolloth, Hondeklip, Laaiplek, Hout

Bay and Gansbaai harbours. The main commercial sectors operating in the vicinity of the study area are discussed below:

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, and round herring using purse-seine fishing techniques. The wholesale value of catch landed by the sector during 2017 was R2.164 Billion, or 22% of the total value of all fisheries combined. The total combined catch of anchovy, sardine and round herring landed by the pelagic fishery has decreased by 38% from 395 000 t in 2016 to just 243 000 t in 2021. This is below both long-term (338 000 t) and short-term (294 000 t) averages. In 2019 and 2020, both the sardine and anchovy management procedures required "exceptional circumstances" due the low abundance levels.

Once a shoal has been located the vessel steams around it and encircles it with a large net. The depth of the net is usually between 60 m and 90 m as the fish are surface shoaling. 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 4-41). 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.

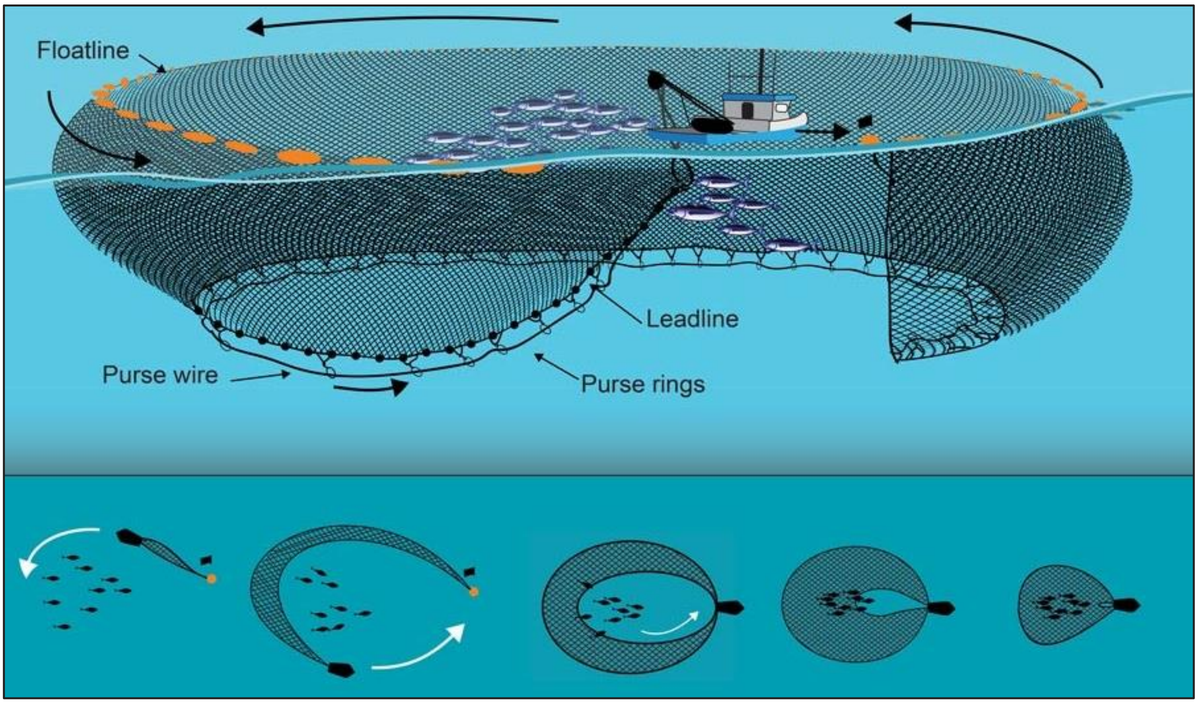

Figure 4-41: Schematic of typical purse-seine gear deployed in the "small" pelagic fishery (source: www.afma.gov.au).

The South African fishery, consisting of approximately 64 vessels, is active all year round with a short break from mid-December to mid-January (to reduce impact on juvenile sardine), with seasonal trends in the specific species targeted. The geographical distribution and intensity of the fishery is largely dependent on the seasonal fluctuation and geographical distribution of the targeted species. Fishing grounds occur primarily along the Western Cape and Eastern Cape coast up to a distance of 100 km offshore, but usually closer inshore. The sardine-directed fishery tends to concentrate effort in a broad area extending from Lambert's Bay, southwards past Cape Town towards Cape Point and then eastwards along the coast to Mossel Bay and Port Elizabeth. The anchovy-directed fishery takes place predominantly on the South-West Coast from Lambert's Bay to Kleinbaai (19.5°E) 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 Lambert's Bay. The spatial extent of the fishing grounds in relation to the Sea Areas 4C and 5C are shown in Figure 4-42. The main fishing areas are situated at least 150 km south of the prospecting application area and there is no spatial overlap of Sea Areas 4C and 5C with the expected fishing activity of the small pelagic purse-seine sector.

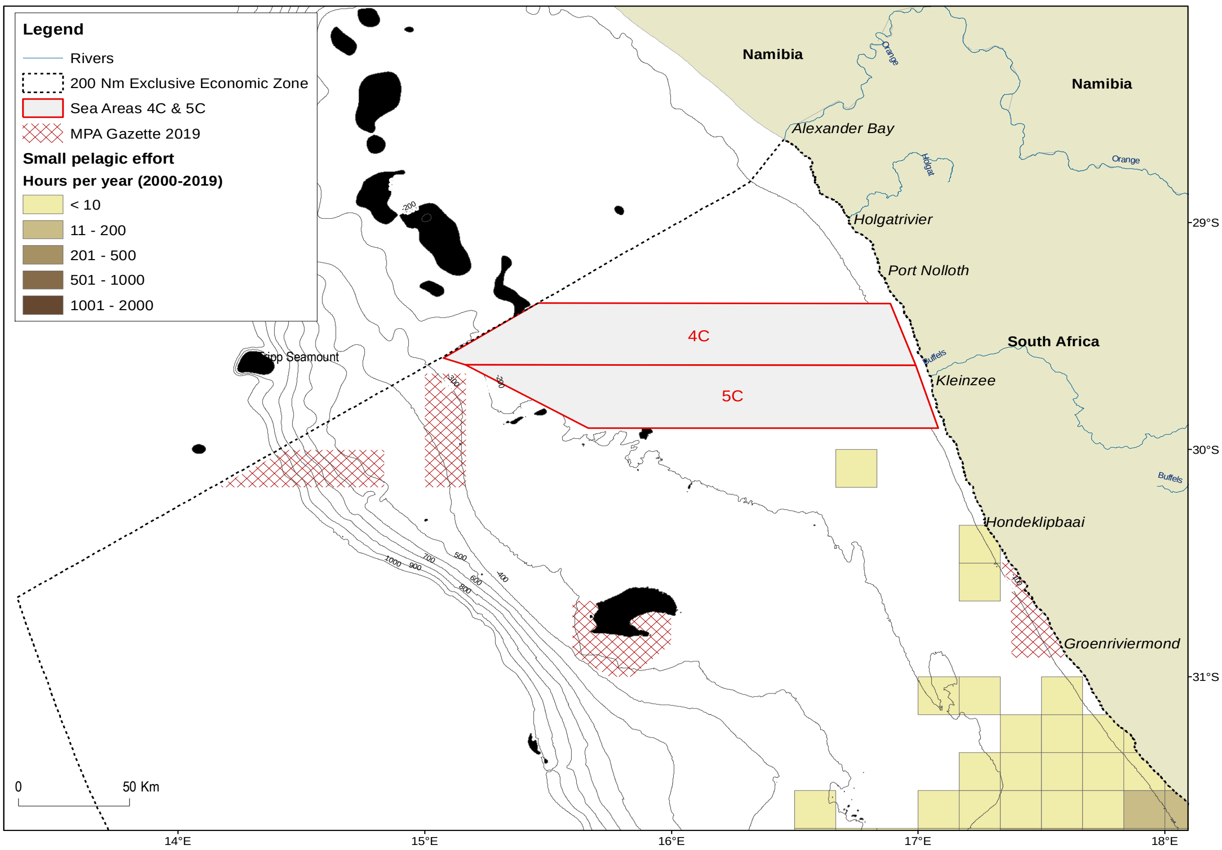

Figure 4-42: Sea Areas 4C and 5C in relation to the spatial distribution of effort reported by the South African Small Pelagic Purse-Seine Fishery (2000 – 2019).

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 200 m and 1 000 m bathymetric contours, although most effort is in the 300 m to 600 m depth range. 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 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 90 m in length. The gear configurations are similar for both freezer and wetfish 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 4-43). 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.

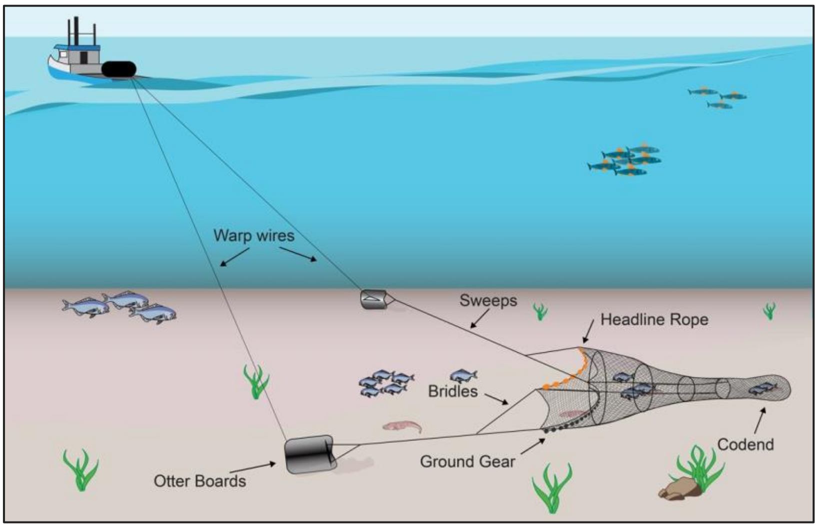

Figure 4-43: Typical gear configuration used by demersal trawlers (offshore) targeting hake (source: www.afma.gov.au).

The activity of the fishery is restricted by permit condition to operating within the confines of a historical "footprint" – an area of approximately 57 300 km^2 and 17 000 km^2 for the offshore and inshore fleets, respectively. Figure 4-44 shows the demersal trawl effort and catch in relation to the areas 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 Sea Areas 4C and 5C, 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 Areas 4C and 5C, which is situated at least 30 km from the designated footprint of trawling ground.

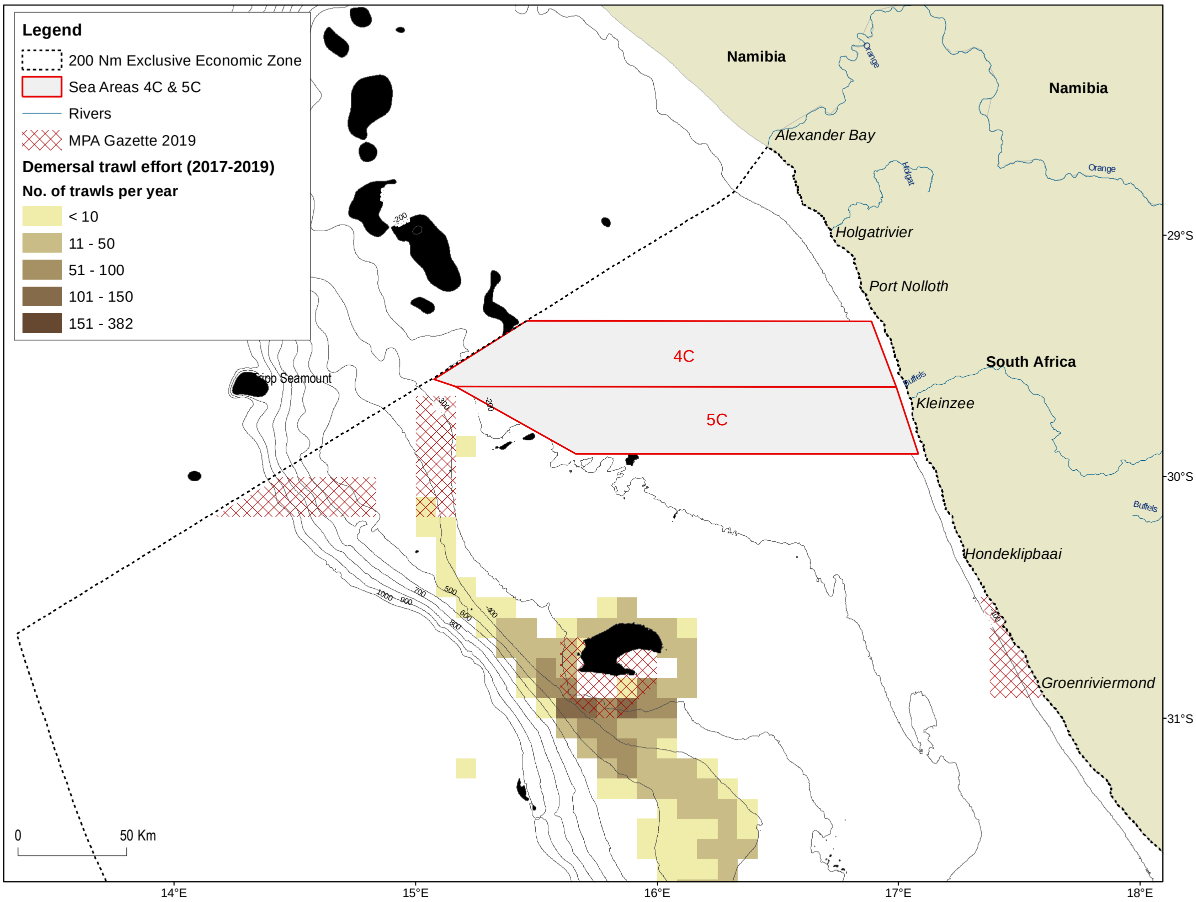

Figure 4-44: Sea Areas 4C and 5C in relation to the spatial distribution of trawling effort expended by the demersal trawl sector (2017 - 2019).

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 4-45). 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.

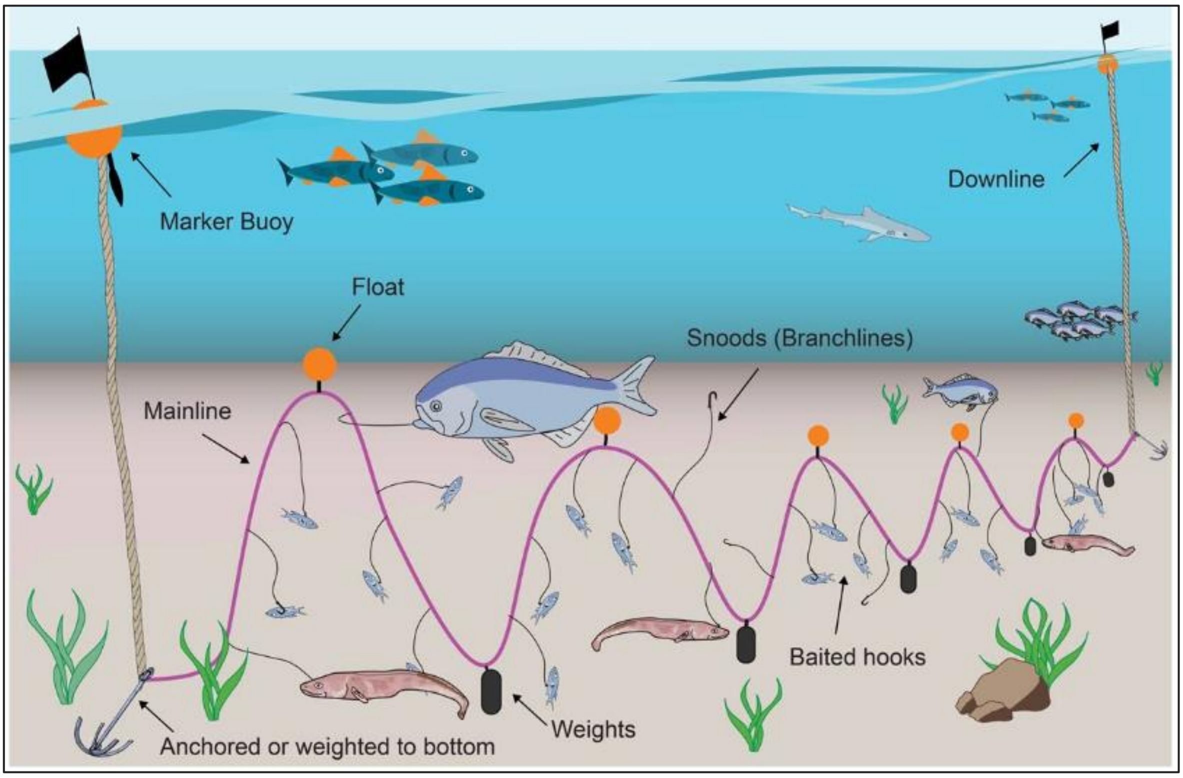

Figure 4-45: Typical configuration of demersal (bottom-set) hake long-line gear used in South African waters (source: www.afma.gov.au).

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 (29°S, 15°E) to the Agulhas Bank (37°S, 21°E). 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. A Namibian-registered fleet of demersal longline vessels operate on the Namibian side of the maritime border at a depth range of 200 m to about 500 m.

The spatial distribution of demersal longline fishing areas in Namibian and South African waters in the vicinity of Sea Areas 4C and 5C is shown in Figure 4-46. Over the period 2018 to 2020, an average of 128 000 hooks per year were set within the deeper water portion of Sea Areas 4C and 5C (beyond the current area of interest) yielding 2.19 tonnes of hake. This is equivalent to 0.47% of the overall effort and 0.47% of the overall catch reported nationally by the sector.

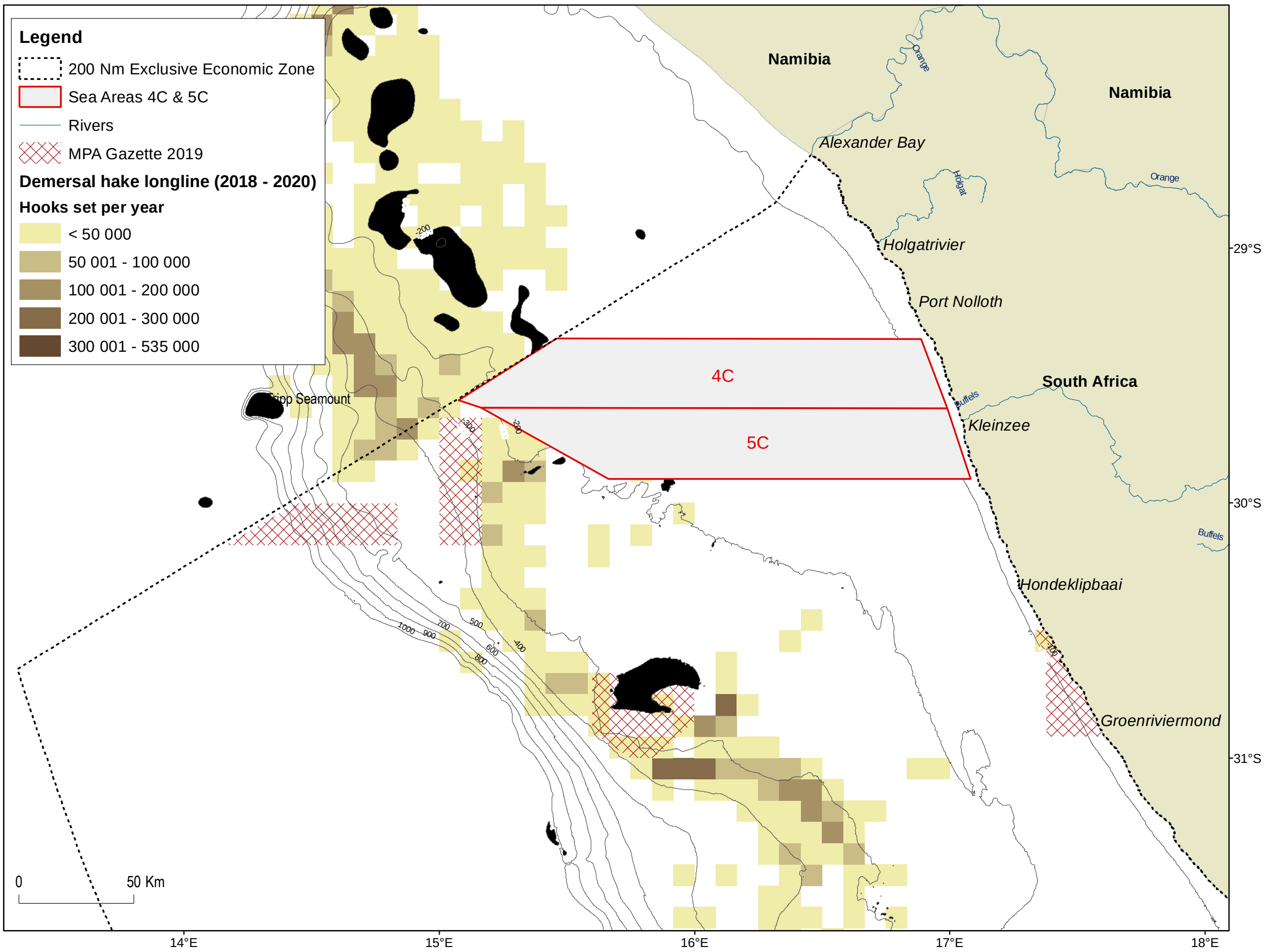

Figure 4-46: Sea Areas 4C and 5C in relation to the spatial distribution of effort expended by demersal long-line fishery (2018 - 2020).

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. In 2017, 60 fishing rights were allocated for a period of 15 years. The total number of active long-line vessels within South African waters is 22, 18 of which fished in the Atlantic (West of 20°E) during 2017.

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 4-47). Hooks are attached to the mainline via 20 m long trace lines, which are clipped to the mainline at intervals of approximately 50 m. There can be up to 3 500 hooks per line. A single main line consists of twisted rope (6 to 8 mm diameter) or a thick nylon monofilament (5 to 7.5 mm diameter). Various types of buoys are used in combinations to keep the mainline near the surface and locate it should the line be cut or break for any reason. Each end of the line is marked by a Dahn Buoy and Radar reflector, which marks its position for later retrieval by the fishing vessel. A line may be left drifting for up to 18 hours before retrieval by means of a powered hauler at a speed of approximately 1 knot. During hauling a vessel's manoeuvrability is severely restricted and, in the event of an emergency, the line may be dropped to be hauled in at a later stage.

The fishery operates year-round with a relative increase in effort during winter and spring. Catch per unit effort (CPUE) variations are driven both by the spatial and temporal distribution of the target species and by fishing gear specifications. Variability in environmental factors such as oceanic thermal structure and dissolved oxygen can lead to behavioural changes in the target species, which may in turn influence CPUE (Punsly and Nakano (1992)).

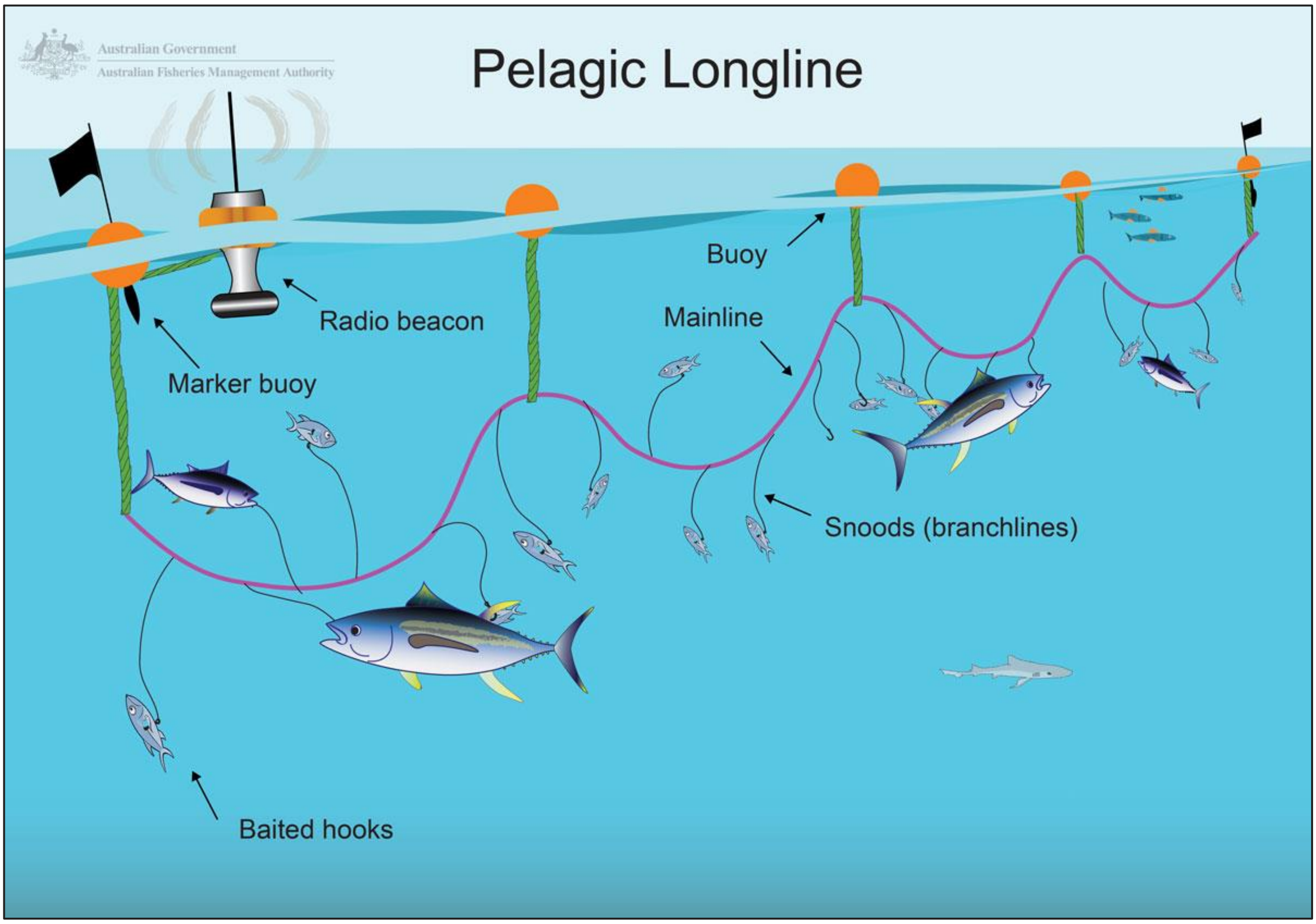

Figure 4-47: Typical pelagic long-line configuration targeting tuna, swordfish and shark species (source: www.afma.gov.za).

Vessels operate predominantly from the shelf break and into deeper waters. Over the period 2000 to 2019, no fishing activity was reported within the Sea Areas 4C and 5C and targeted areas were situated at least 50 km from the concession areas offshore of the 500 m bathymetric contour. The Namibian fleet of large pelagic longline vessels are permitted to target pelagic shark species in addition to tuna and therefore also operate inshore of the shelf break. The Namibian fleet would be expected to operate offshore of the 200 m depth contour adjacent to the South African maritime border and Sea Area 4C.

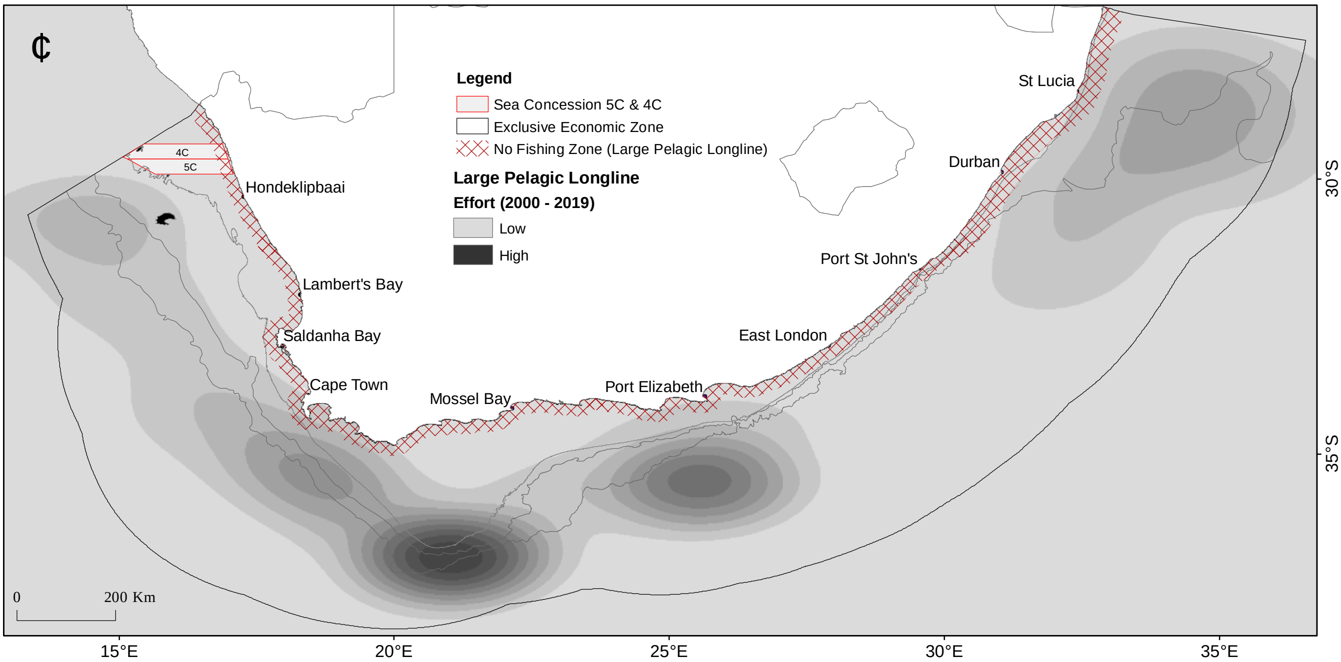

Figure 4-48: Sea Areas 4C and 5C in relation to spatial distribution of fishing positions recorded between 2000 and 2019 by the South African large pelagic long-line sector.

Pole-and-Line (Tuna Pole)

The pole-and-line 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 active South African fleet consists of approximately 92 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 November and May and peak catches recorded from November to January. Vessels normally operate within a 100 nm radius of these locations with effort concentrated in the Cape Valley area (South-West of Cape Point), and up the West Coast to the Namibian border with South Africa.

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 4-49). Vessels are relatively small (less than 25 m in length) and store catch on ice, thus staying at sea for short periods (approximately five days).

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

Fishing activity for tuna 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. Snoek-directed fishing activity is coastal and seasonal in nature – taking place inshore of the 100 m depth contour during the period March to July. Fishing records received from DFFE over the reporting period 2007 to 2019 indicate that tuna-directed fishing does not take place within either of Sea Areas 4C and 5C; however, a significant amount of snoek-directed activity occurs inshore of the 100 m depth contour (see Figure 4-50). Over the period 2017 to 2019, an average of 14 fishing events were reported having taken place within the Sea Areas 4C and 5C yielding 48 tonnes of snoek. This is equivalent to 0.53% of the overall effort expended by the pole-and-line sector (inclusive of offshore fishing activity targeting albacore tuna) and 6.97% of the snoek catch landed by the sector. Fishing activity within the area is seasonal with all fishing reported within the period March to July inclusive.

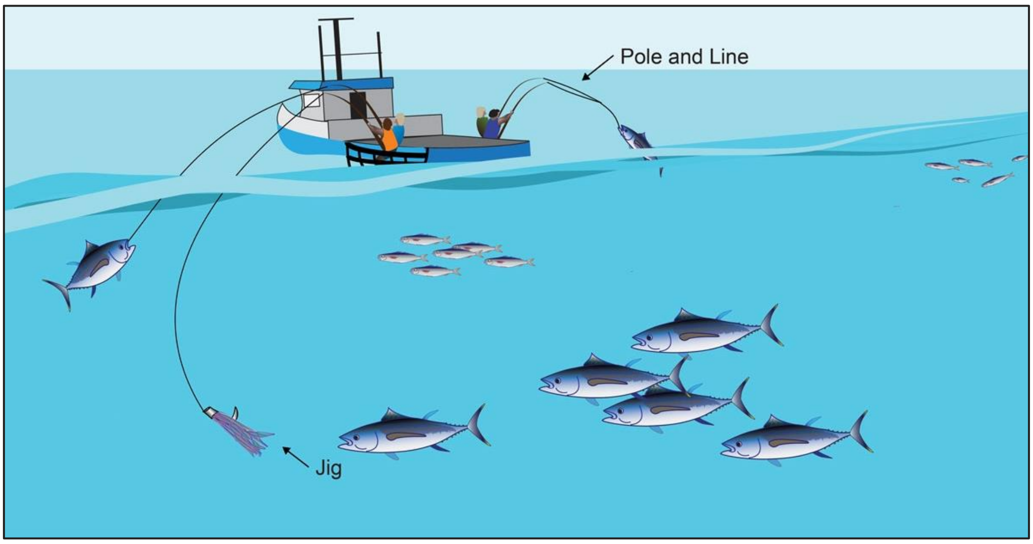

Figure 4-49: Schematic diagram of pole and line operation (source: www.afma.gov.au).

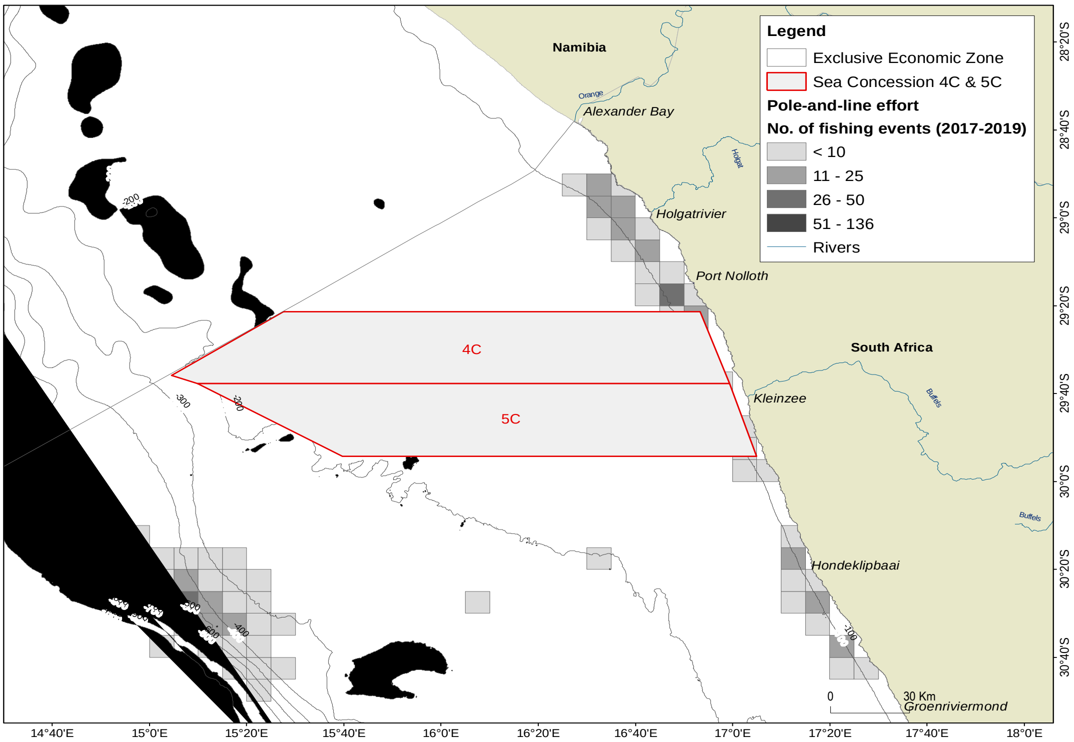

Figure 4-50: Sea Areas 4C and 5C in relation to the spatial distribution of pole-and-line catch (2017 - 2019).

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 Areas 4C and 5C coincide 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 455 vessels operating in the fishery, making it the largest fishing fleet in South Africa. The number of rights holders is 425. For the 2021/2022 fishing season, 325 vessels were apportioned to commercial fishing, whilst 122 vessels apportioned to small-scale fishing (see section below). 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)).

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).

Fishing activity is reported by landing point. In the vicinity of Sea Areas 4C and 5C, vessels operate from Port Nolloth, Doring Bay and Hondeklipbaai and fishing activity is directed in waters shallower than 100 m and in proximity to these launch sites. Records over the period 2017 to 2019 show that fishing activity within this area is seasonal – March to September – and that catches are exclusively snoek. Due to the largely informal nature of the snoek fishery, a Total Allowable Effort (TAE) approach has been used to manage the sector, which places constraints on the maximum level of fishing effort that can be applied to a fish stock during a specific period through limitations on the total number of vessels permitted in the sector, size of the vessel (maximum length 10 m), number of crew members per vessel, and geographic zone(s) which can be fished. In 2019, 340 rights were allocated for the area Port Nolloth to Cape Infanta with 218 rights activated. Besides the economic importance of direct landings to fishing communities, snoek provides indirect benefits through a combined formal and informal value chain, where snoek is processed and sold in different forms. Snoek reaches consumers through retail outlets supplied by large hawkers and processors or directly through small hawkers.

Fishing effort has not been reported within Sea Areas 4C and 5C (see Figure 4-51); however approximately 57.8 tonnes per year were reported in the vicinity of Doring Bay and Port Nolloth combined and 0.7 tonnes per year off Hondeklipbaai.

The reporting of fishing positions is not specific, but generally reported according to reference positions for different areas. Although there is no evidence from the DFFE dataset of fishing having taken place within Sea Areas 4CC, vessels could be expected to range to a distance of 15 km from the launch sites of Doring Bay, Port

Nolloth and Hondeklipbaai and fishing activity within the inshore portions of Sea Areas 4C and 5C should not be discounted.

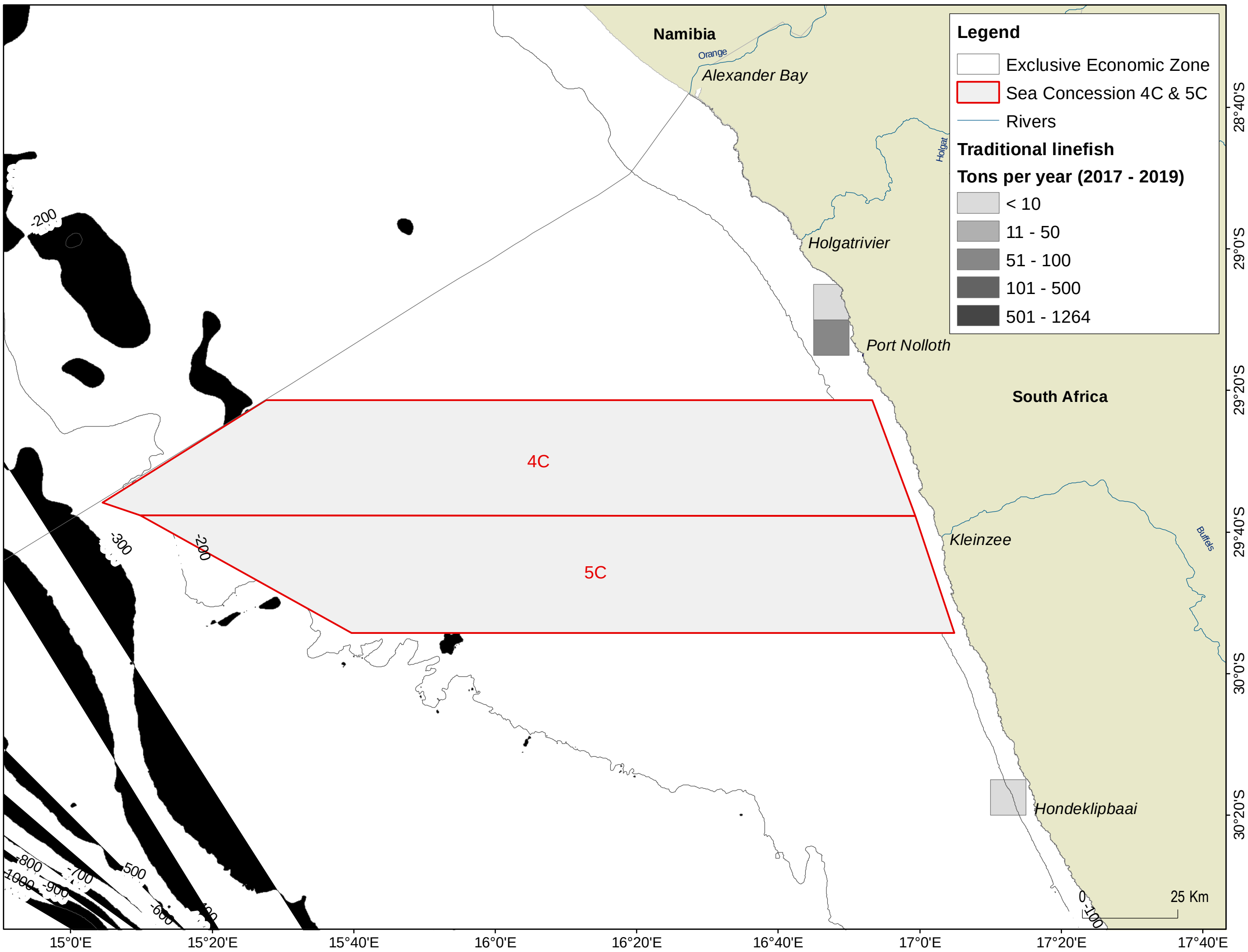

Figure 4-51: Sea Areas 4C and 5C in relation to the spatial distribution of catch landed by the South African traditional line-fish sector (2000 – 2016).

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.

The fishery is comprised of four sub-sectors – commercial offshore, commercial nearshore, small-scale and recreational, all of which have to share from the same national Total Allowable Catch (TAC). 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. The resource is managed geographically, with TACs set annually for different management areas. The TAC for the 2021/2022 fishing season was reduced by 28% from the previous fishing season (2020/2021). The updated stock assessment for the resource has indicated that it is further depleted than was thought to be the case two years ago, and poaching is one of the major contributors to the recently exacerbated depleted status of the resource. The resource has over recent decades been at about 2.5% of the pristine level, but that over the last few years this had dropped to about 1.5%. The commercial and small-scale fishing sectors are authorised to undertake fishing for four months in each management zone therefore closed seasons are applicable to different management zones.

Approximately 138 vessels participate in the offshore sector. Sea Areas 4C and 5C coincide with lobster management zones 1 and 2. As there is currently no commercial offshore fishing permitted within these areas, the proposed project activities would not coincide with areas targeted by the offshore commercial sub-sector.

The nearshore sector makes use of hoop nets which are deployed from small dinghies at a maximum seabed depth of about 30 m. Approximately 653 boats participate in the sector, operating from the shore and coastal harbours. Figure 4-52 shows the spatial distribution of fishing effort expended by the nearshore commercial sub-sector in the vicinity of Sea Areas 4C and 5C over the period 2006 to 2016. The Sea Areas 4C and 5C are situated offshore of rock lobster management zone 1 (Port Nolloth) and management zone 2 (Hondeklipbaai).

Over the period 2005 to 2016, the nearshore sector reported an annual average of 742 nets set and 2.7 tonnes of lobster caught within the management areas adjacent to Sea Areas 4C and 5C. The amount of catch and effort reported within the area amounted to 0.7% and 1.4%, respectively, of the total national landings and overall effort expended by the nearshore sub-sector. A fleet of small dinghies/bakkies target lobster at discrete suitable reef areas along the shore at a water depth of up to 15 m. Fishing activity could be expected within 1.5 km of the nearshore boundary of Sea Areas 4C and 5C. Management zones 1 and 2 have a seasonal operational window from 15 October to 15 February.

Abalone Ranching

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)). In the wild, abalone may take 30 years to reach full size of 200 mm, but farmed abalone attain 100 mm in only five years, which is the maximum harvest size (Sales & Britz (2001)).

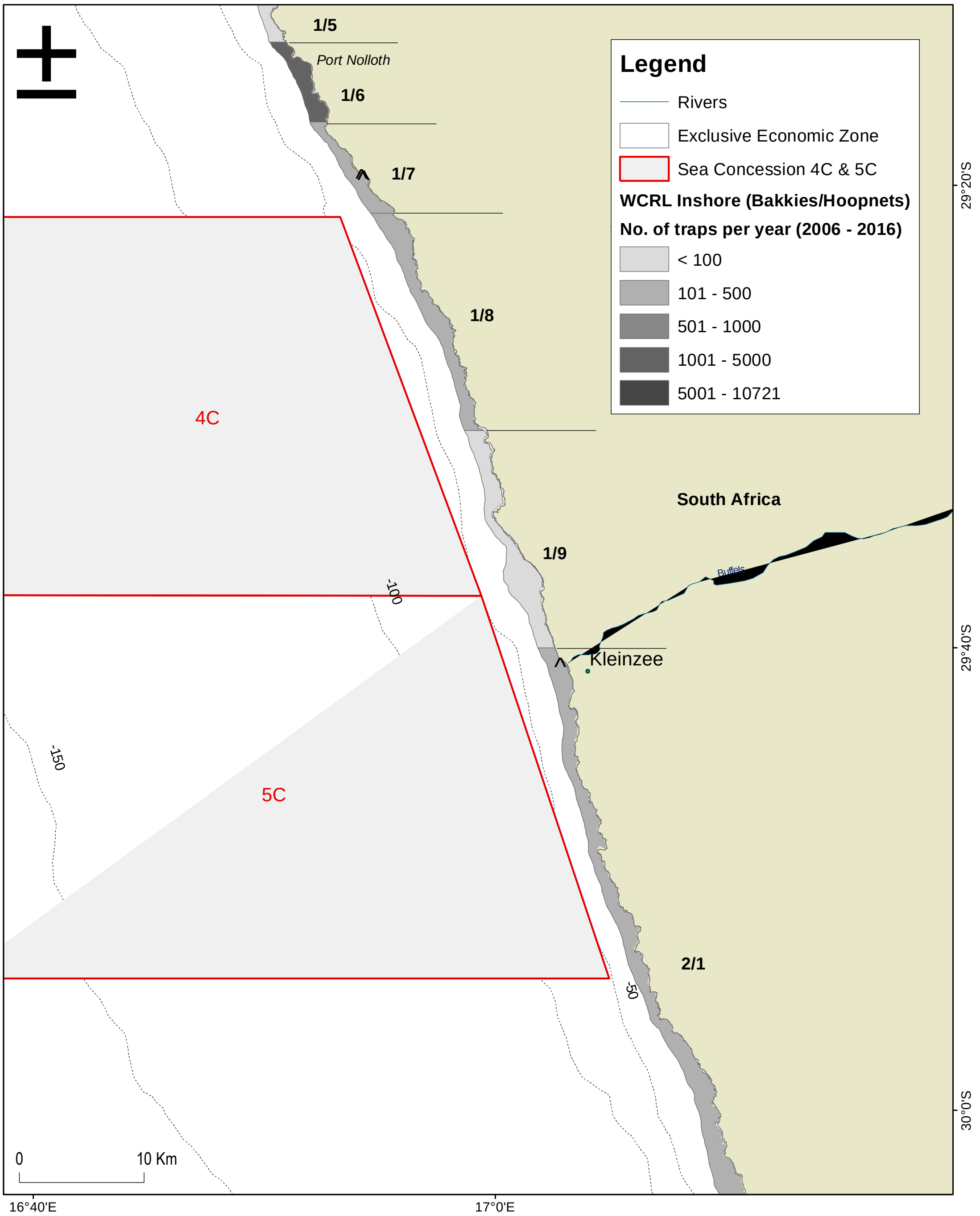

Figure 4-52: Sea Areas 4C and 5C in relation to the spatial distribution of fishing effort expended by the west coast rock lobster inshore (bakkies/hoopnets) sector (2006 – 2016).

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) (now the DFFE) issued rights for each of four Concession Area Zones. Two hatcheries exist in Port Nolloth producing up to 250 000 spat. Sea Area 4C coincides with Zone 2 and Sea Area 5C coincides with Zone 3. As the maximum depth of seeding is considered to be approximately 10 m, the proposed area of operations within the sea areas would not coincide with abalone seeding areas (see Figure 4-53).

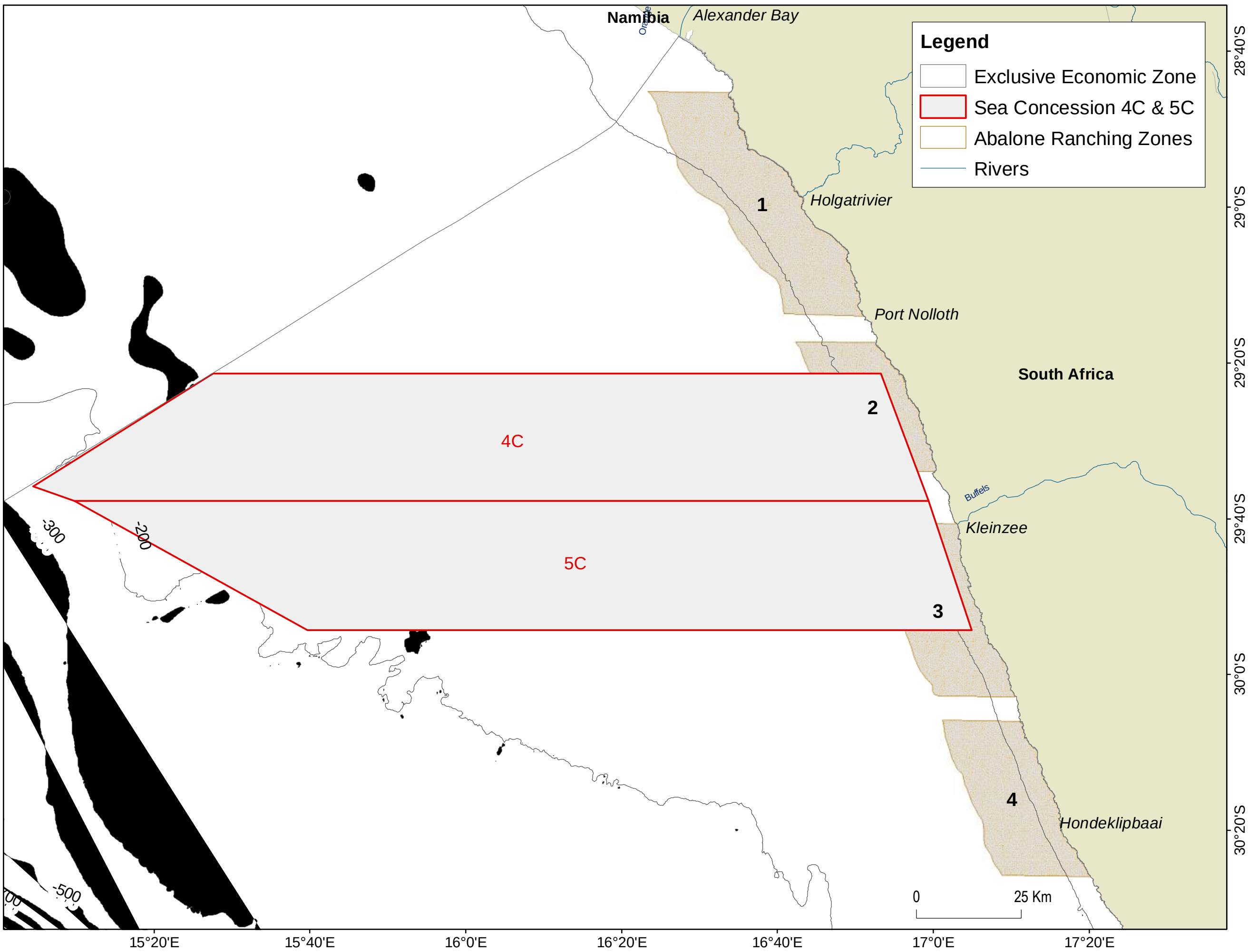

Figure 4-53: Sea Areas 4C and 5C in relation to the abalone ranching zones.

Small-Scale Fisheries

In South Africa, there is a long history of coastal communities utilizing marine resources for various purposes. Many of these communities have been marginalized through apartheid practices and previous fisheries management systems. In 2007 government was compelled through an equality court order to redress the inequalities suffered by these traditional fishers. The development of a Small-Scale Fisheries (SSF) sector aims in part to compensate previously disadvantaged fishing communities that have been displaced either politically, economically or by the development of large-scale commercial fisheries. This led to the development of the Small-Scale Fisheries Policy (SSFP), the aim of which is to redress and provide recognition of the rights of small-scale fishers (DAFF, 2015).

The SSF overlaps other historical fisheries in South Africa, leading to legal challenges where the SSF rights allocations are in conflict with other established commercial fishing sectors. SSF is defined as a fishery although specific operations and dynamics are not yet fully defined as they are subject to an ongoing process by DFFE. However, the SSF Regulations (DAFF, 2016) do define the fishing area for SSF as “"near-shore", meaning “the region of sea (including seabed) within close proximity to the shoreline”. Schedule 5 of the Regulations specifies “*Small-scale fishing areas and zones”* and states:

"5(1) *In order to facilitate the establishment of areas where small-scale fishers may fish, the Department must set up a procedure to engage and consult with the small-scale fishing community in proposing demarcated areas that may be established as areas where small-scale fishers may fish";*

and which under section 5(2)b notes that the demarcation must:

"5 (2)b *"take into account the mobility of each species in the allocated basket of species with sessile species requiring smaller fishing areas while nomadic and migratory species requiring larger area".*

Small-scale fishers fish to meet food and basic livelihood needs, but may also directly be involved in fishing for commercial purposes[4]. These fishers traditionally operate on nearshore fishing grounds to harvest marine living resources on a full-time, part-time or seasonal basis. Fishing trips are usually of short-duration and fishing/harvesting techniques are labour intensive[5].

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 areas (Sunde & Pedersen C., 2007; Sunde, 2016.).

Many communities living along the coast have, over time, developed local systems of rules to guide their use of coastal lands, forests and waters. These local rules are part of their systems of customary law. Rights to access, use, and own different natural resources arise from local customary systems of law. These systems of law are not written down as in Western law, but are passed down from generation to generation through practice (https://www.masifundise.org/wp-content/uploads/2011/06/vissernet-eng-news-3-final.pdf). South Africa's Constitution recognises customary law together with common law and state law. In line with this, the SSFP also recognises rights arising in terms of customary law. Customary fishers are normally associated with discrete groups (tribes or communities with unique identities and associations with the sea) who may be defined by traditions and beliefs. These traditions are increasingly being challenged as stocks and marine resources have been depleted. This would include, for example, intertidal harvesting of seaweed, mussels, oysters, cephalopods and virtually any species available to these communities. These fishers are generally localised and do not range far beyond the areas in which they live[6].

SSF 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 SSF is to be implemented along the coast in series of community co-operatives. Only a co-operative is

4 There is no formal designation of artisanal (or traditional/subsistence) fishing in South Africa, which is generally considered as fishing or resource extraction for own use. As fisheries have evolved and the commercial benefit realised, subsistence fishers have increasingly moved to commercialisation aimed at supporting their livelihoods. This group can now, therefore, also include shore and boat-based anglers and spear-fishers who target a wide range of line fish species, some of which are also targeted by commercial operations, skin divers who collect rock lobsters and other subtidal invertebrates, bait collectors (mussels, limpets, red bait) and non-subsistence collectors of intertidal organisms. The high value of many intertidal and subtidal resources (e.g. rock lobster, abalone and mussels) has resulted in an increase in their production through aquaculture and small-scale harvesting in recent years (Clark, et al., 2010).

5 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.

6 It can include foot-fishers, but also boat fishers who may have difficult or restricted options for launching sites. Note that in some areas fishers are increasingly using more sophisticated technology such as fish finders and larger motorised boats. This ability means their activities may be increasingly commercialised and may overlap with more established commercial fishery sectors.

deemed to be a suitable legal entity for the allocation of small-scale fishing rights[7]. These community co-operatives will be given 15-year SSF Rights. The criteria to be applied in determining whether a person is a small-scale fisher are that the person must (a) be a South African citizen who associates with or resides in the relevant small-scale fishing community; (b) be at least 18 years of age; (c) historically have been involved in traditional fishing operations, which include catching, processing or marketing of fish for a cumulative period of at least 10 years; and (d) derive the major part of his or her livelihood from traditional fishing operations and be able to show historical dependence on fish, either directly or in a household context, to meet food and basic livelihoods needs.

More than 270 communities have registered an Expressions of Interest (EOI) with the DFFE and approximately 10 000 small-scale fishers have been identified around the coast. DFFE has split SFF by communities into district municipalities and local municipalities. These fishers are generally localised and do not range far beyond the areas in which they live. The location of these coastal communities and the number of fishers per community relative to Sea Areas 4C and 5C are shown in Figure 4-54 with Port Nolloth and Hondeklipbaai being the closest co-operatives.

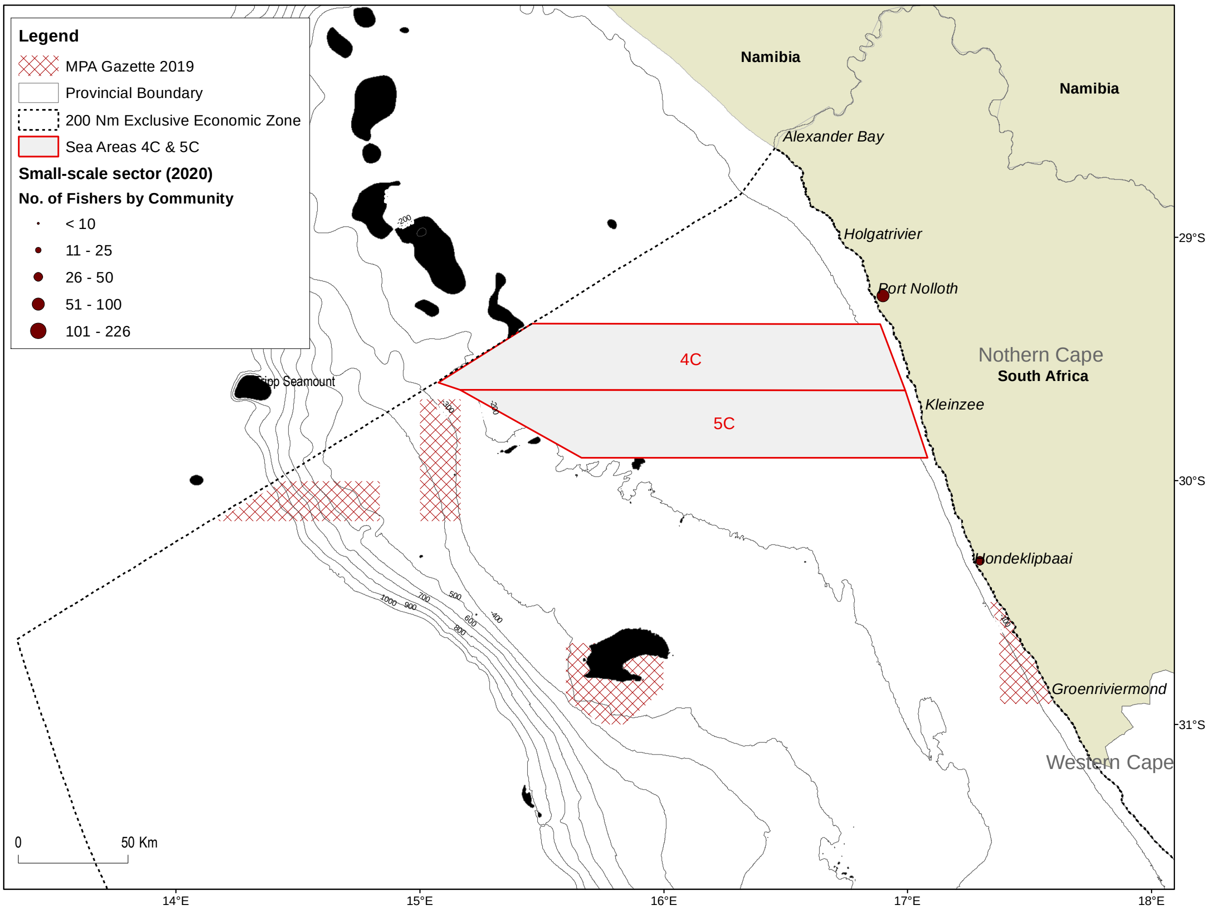

Figure 4-54: Sea Areas 4C and 5C in relation to the spatial distribution of small-scale fishing communities and number of participants per community along the west coast of South Africa.

[7] A co-operative is jointly owned and democratically controlled by small-scale fishers.

In the Northern Cape, there are 103 fishers registered in the Namakwa district, comprising the Richtersveld and Kamiesberg local municipalities. The SSFP requires a multi-species approach to allocating rights, which entails the allocation of rights for a basket of species that may be harvested or caught within particular designated areas[8]. Co-operatives can only request access to species found in their local vicinity. DFFE 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.

The mix of species to be utilised by small-scale fishers includes species that are exploited by existing commercial sectors viz; traditional linefish, west coast rock lobster, squid, hake handline[9], abalone, KZN beach seine, netfish (gillnet and beach-seine), seaweed and white mussel. An apportionment of TAE/TACs for these species will be transferred from existing commercial rights to SSF[10], whereas white mussels will become the exclusive domain of SSF. Species nominated for commercial use will be subject to TAE and/or TAC allocation. Species nominated for own use will be available to all members of a particular co-operative, but subject to output controls.

The small-scale fishery rights cover the nearshore area (defined in section 19 of the MLRA as being within close proximity of shoreline) and in reality these are unlikely to extend beyond 3 nm from the coast (i.e. generally inshore of the Sea Area boundary).

Small-scale fishermen along the Northern Cape and Western Cape coastlines are typically involved in the traditional line, west coast rock lobster and abalone fisheries. The small-scale communities on the West Coast, with long family histories of subsistence fishing, prioritise the harvest of nearshore resources (using boats) over the intertidal and subtidal resources.

Snoek (*Thyrsites atun*), Cape bream / hottentot (*Pachymetopon blochii*) and yellowtail (*Seriola lalandi*) are important linefish species that are targeted by SSF operating nearshore along the West Coast (refer to traditional linefish sector discussed above). Snoek are targeted by small-scale fishers during the snoek seasonal migration between April and June, during which time they shoal nearshore and are therefore available to handline fishermen[11]. Snoek availability coincides with peaks in the availability of other small pelagic species, notably anchovy and sardine (Nepgen, 1979). As shown by Crawford *et al.* (1987) snoek stay inshore on their southward

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8 Under the SSF regulations the species that may be included in the "basket" are provided in Annexures 2, 3 & 4 that includes fish species that are listed on the non-saleable list, and those that 2 shall only be caught for own consumption within the corresponding limits.

9 Hake handline is a small subsector of the hake fishery and requires a fishing right apportionment. The fishery has in recent years not been active because of resource availability. It is perceived as having potential for allocation as part of the SSF and as part of their "basket".

10 DFFE proposes that 50% of the overall TAE and TAC for the traditional linefish and abalone sectors, respectively, will be apportioned to small-scale fishing whereas 25% of the overall TAE for squid will be apportioned to small-scale fishing (DFFE 2020).

11 Snoek are known to undertake migrations in a southward direction from the waters of the northern Benguela into the southern Benguela towards the cape west and southern coasts. These migrations have certainly been long taken advantage of by fishers, including traditional linefishers and communities along the West Coast. Commercial fishers as well as the SSF sector capitalise on the inshore availability, but this opportunity is lost once the snoek move offshore in mid-winter and start their northward migration. Snoek are primarily a "winter" fish, moving systematically southwards in autumn and commercial linefish, recreational and community-based boats exploit this shoaling species mostly in the nearshore. Snoek are also caught by the hake trawl fleets in significant numbers at times as snoek may undertake diurnal migrations feeding or spawning in deeper waters (and are not accessible to surface line fishers at these times). There is however no definitive description of snoek migrations with regard to their exact spatial and temporal movements.

migration (i.e. April through to June) and then move offshore into deeper waters to spawn[12] in July and August (and are not available to linefishers during these times as the fish are beyond the depth range of surface linefishers).

Small-scale fishers also target west coast rock lobster (*Jasus lalandii*) using hoopnets set by small "bakkies" at a water depth of less than 30 m. Fishing activity may range up to 100 m water depth by the larger vessels that participate in the offshore commercial rock lobster trap sector (refer to West Coast Rock Lobster section described above).

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, four operate within Area A (Port Nolloth) and two operate within Area B (Hondeklipbaai).

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12 Snoek spawning occurs offshore during winter-spring, along the shelf break (150-400 m) of the western Agulhas Bank and the South African west coast. Prevailing currents transport eggs and larvae to a primary nursery ground north of Cape Columbine and to a secondary nursery area to the east of Danger Point; both shallower than 150 m. Juveniles remain on the nursery grounds until maturity, growing to between 33 and 44 cm in the first year (3.25 cm/month). Onshore-offshore distribution (between 5- and 150-m isobaths) of juveniles is determined largely by prey availability and includes a seasonal inshore migration in autumn in response to clupeoid recruitment. Adults are found throughout the distribution range of the species, and although they move offshore to spawn - there is some southward dispersion as the spawning season progresses - longshore movement is apparently random and without a seasonal basis (Griffiths, 2002).

Sea Areas 4C and 5C are situated offshore of Management Area A and Management Area B (see Figure 4-55) and the range of gillnets (50 m) and that of beach-seine activity (20 m) is not likely to directly overlap with Sea Areas 4C and 5C where surveying and sampling would take place in waters deeper than 70 m.

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 DFFE in order to set the annual TAC 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 4-56). The location of these trawls within the Sea Areas ranged between the 75 m and 196 m bathymetric contours. Up to 10 trawls could be expected within the concession areas during the annual research survey, timed to take place between January and possibly extending into March.

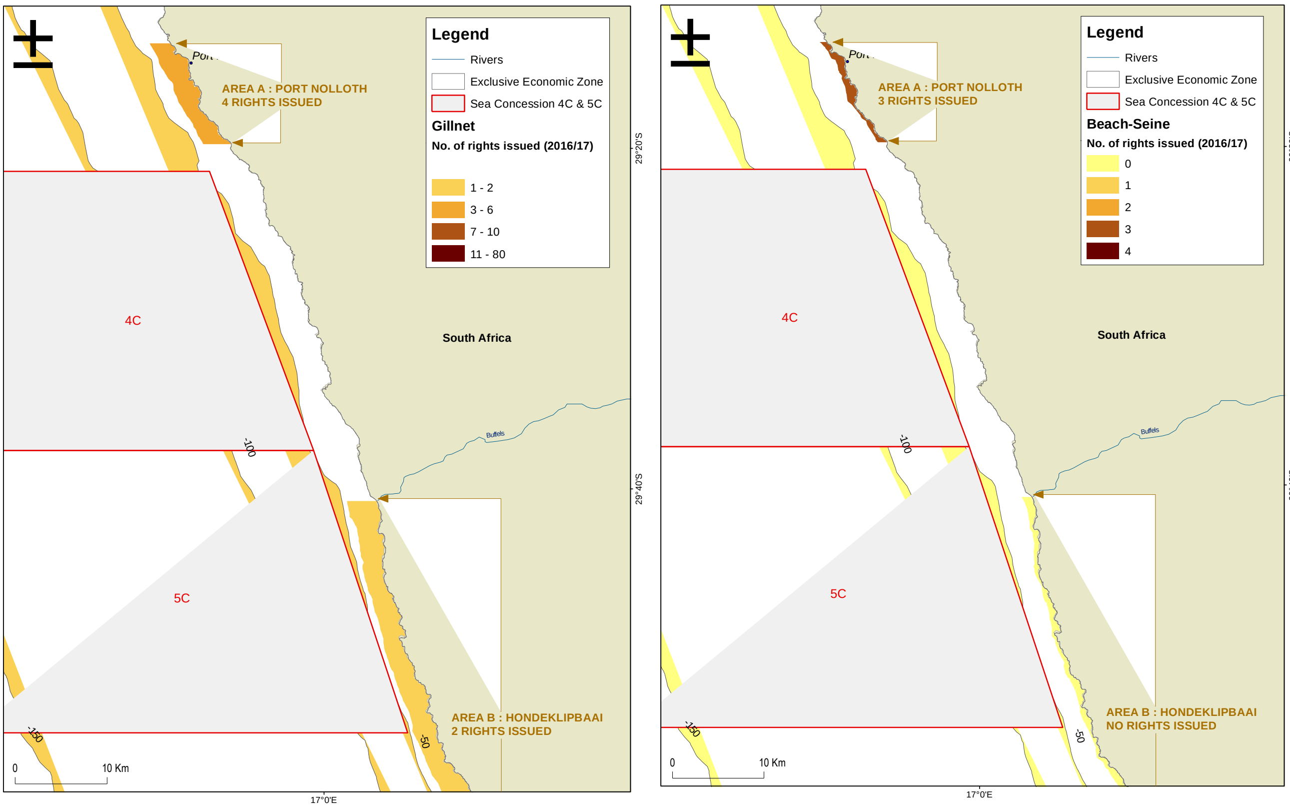

Figure 4-55: Sea Areas 4C and 5C in relation to the number of rights issued for gillnet (left) and beach-seine fishing areas A and B.

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 4-57). 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 DFFE 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. Up to five research survey transects are undertaken by DFFE within Sea Areas 4C and 5C.

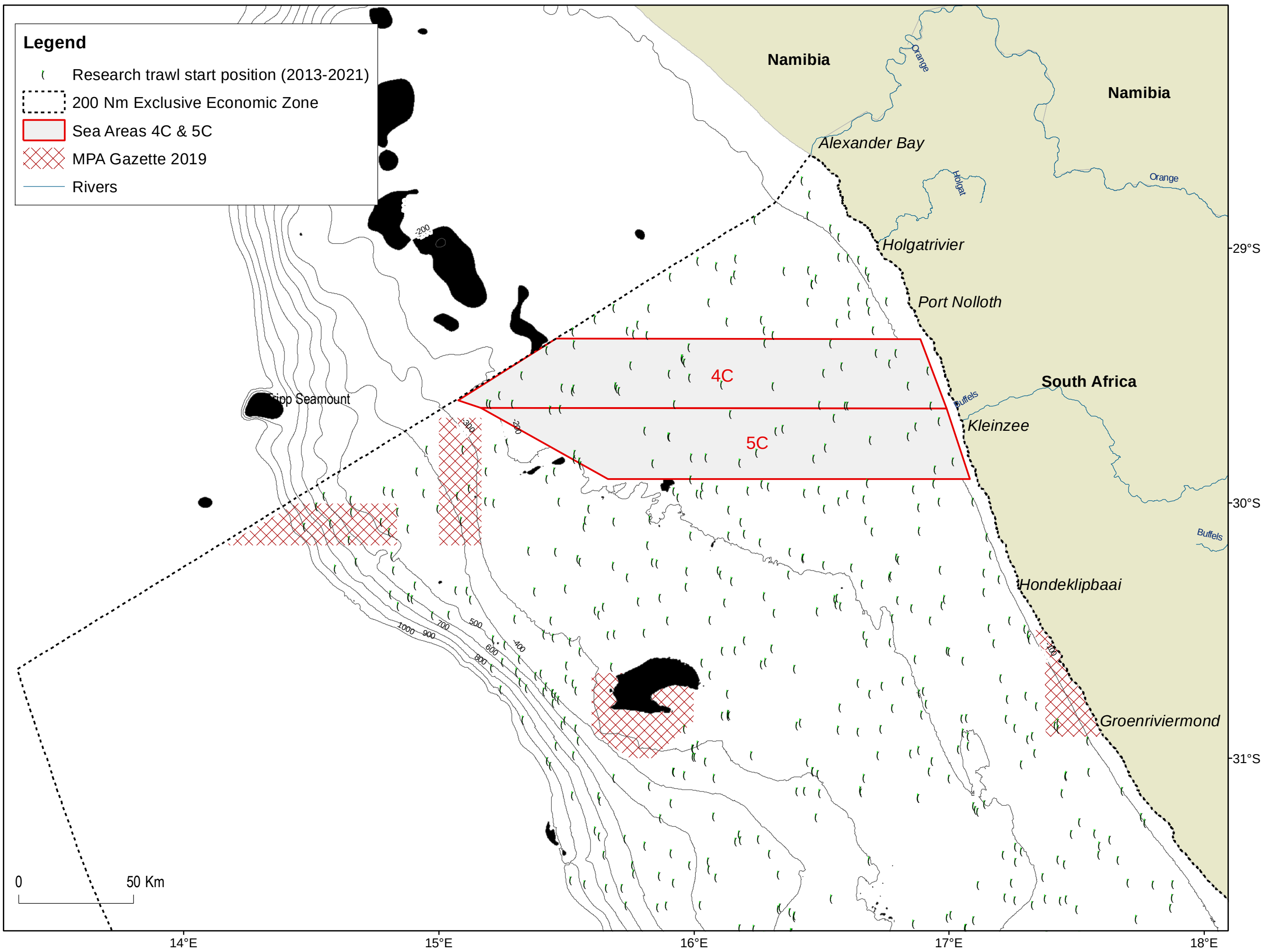

Figure 4-56: Sea Areas 4C and 5C in relation to the spatial distribution of trawling effort expended during research surveys undertaken by DFFE between 2013 and 2021.

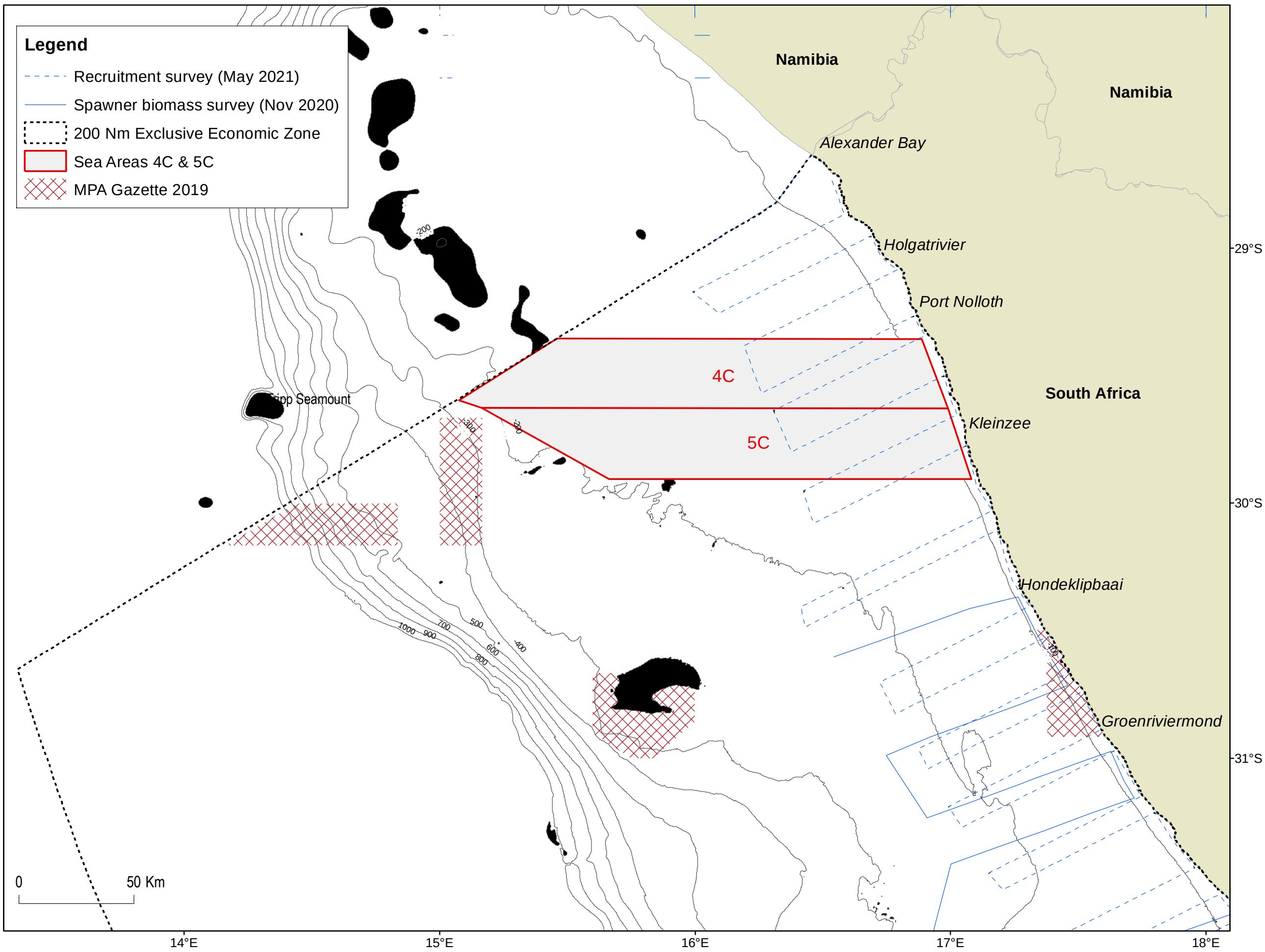

Figure 4-57: Sea Areas 4C and 5C in relation to the spatial distribution of research survey transects of recruitment and spawner biomass of small pelagic species undertaken by DFFE during November 2020 and May 2021, respectively.

4.3.2 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 (see Figure 4-58). The main shipping lanes overlap with the western portion of Sea Areas 4C and 5C.

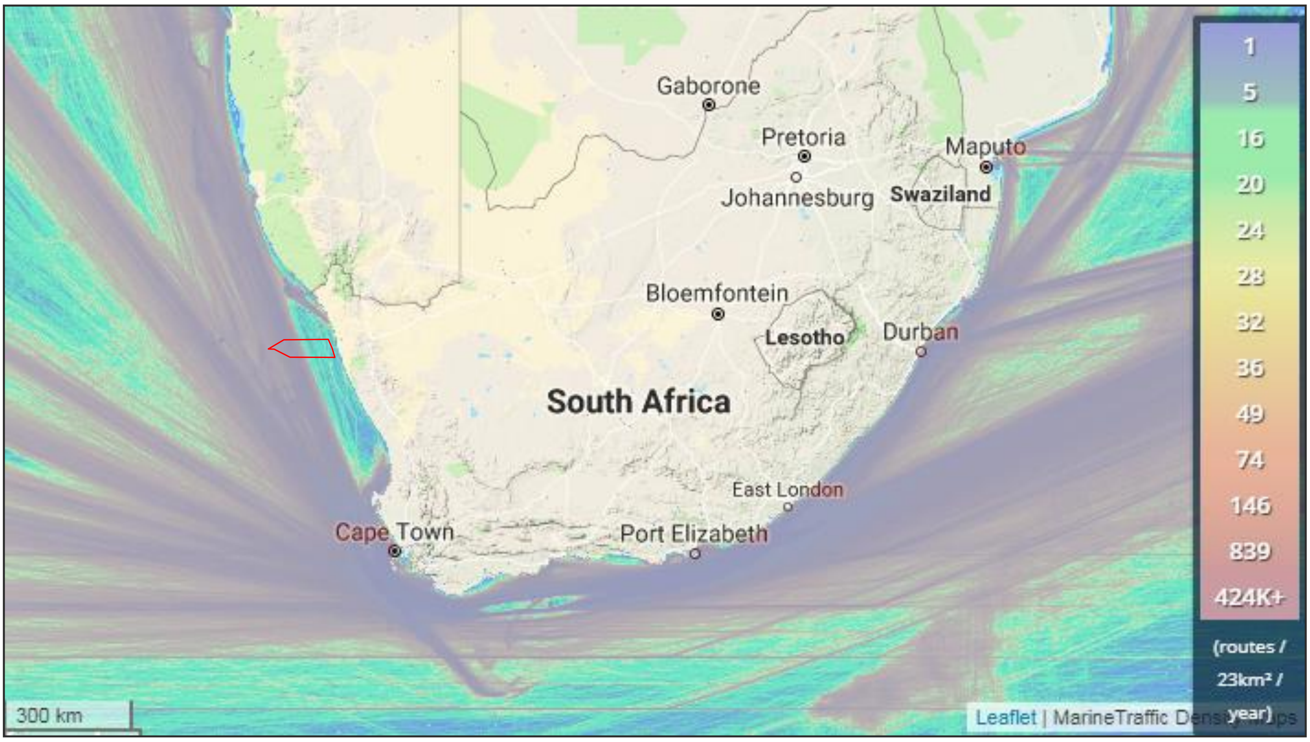

Figure 4-58: Major shipping routes along the west coast of South Africa. Approximate location of Sea Areas 4C and 5C is also shown.

4.3.3 Diamond Prospecting and Mining

The marine diamond concession areas are split into four or five zones (Surf zone and (a) to (c) or (d)-Sea Areas), which together extend from the high-water mark out to approximately 500 m depth. Off Namaqualand, marine diamond mining activity is primarily restricted to the surf-zone and (a)-concessions. Nearshore shallow-water mining is 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.

Diamond prospecting and mining rights in the ‘C’ areas of the Northern Cape Province are currently limited to (see Figure 4-59):

- Mining Right held by Belton Park Trading 127 (Pty) Ltd in 2C and 3C
- Mining Right held by Alexkor in 1C
- Prospecting Right held by DBCM in 6C.

In Namibia, diamond mining at similar water depths of between 90 m -150 m is undertaken by Debmarine Namibia (Pty) Ltd in the Atlantic 1 Mining Licence Area.

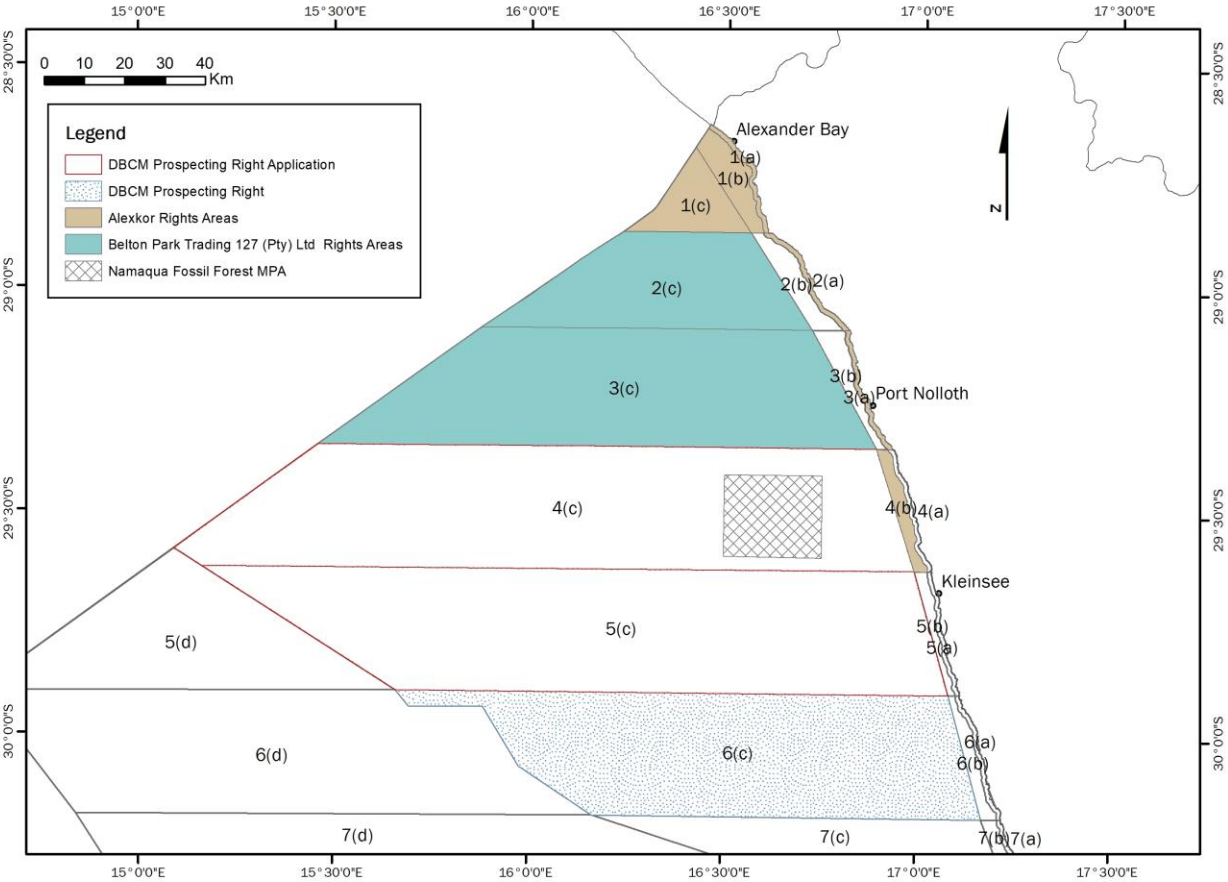

Figure 4-59: Sea Areas 4C and 5C in relation to known marine diamond mining and prospecting rights.

4.3.4 Hydrocarbons

The South African continental shelf and 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 approximately 40 wells having been drilled in the Namaqua Bioregion since 1976 (see Figure 4-60). 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.

Eco Atlantic recently completed the drilling of the Gazania-1 well in Block 2B, offshore South Africa, which was spudded on 10 October 2022 (the well was found to be dry). Further exploratory drilling is proposed within 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.

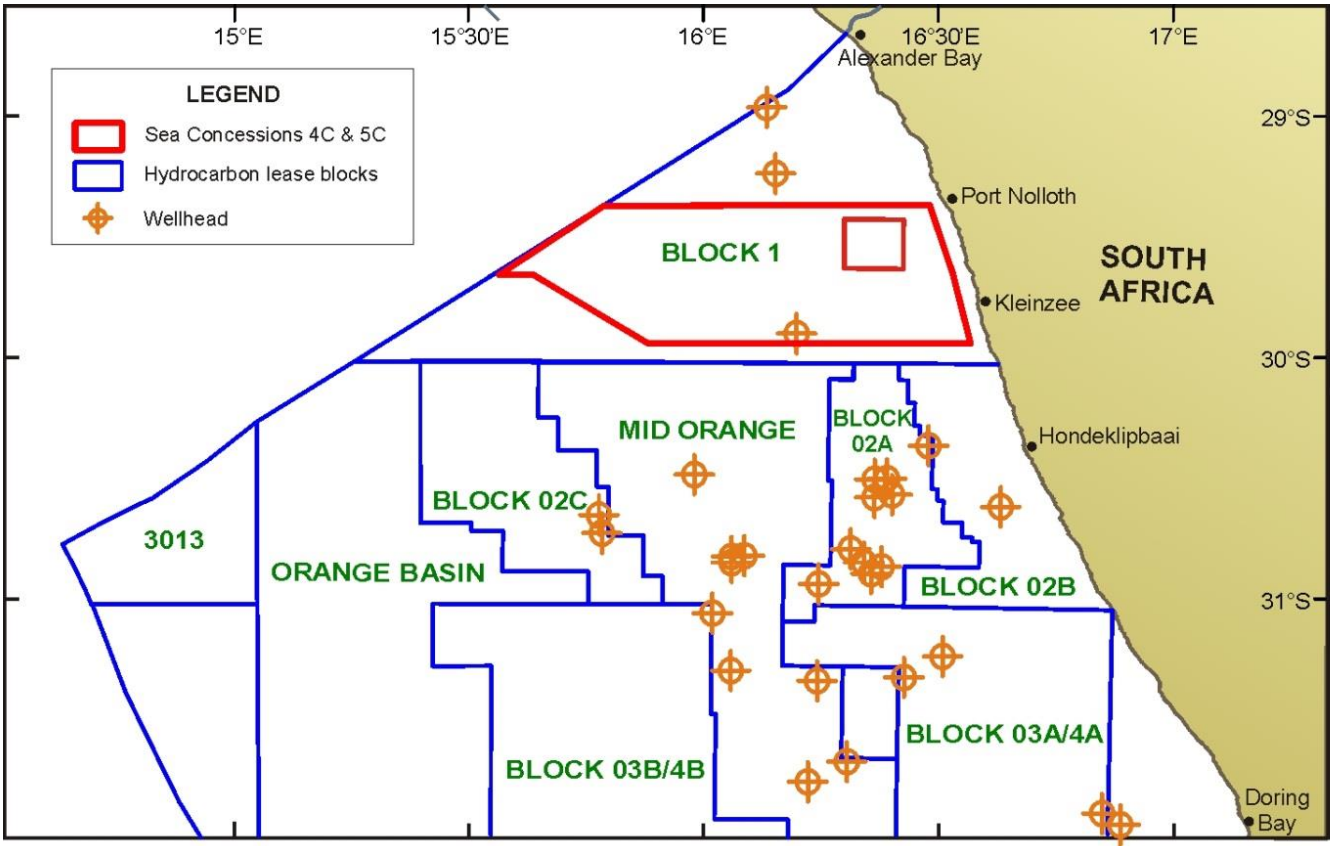

Figure 4-60: Sea Areas 4C and 5C in relation to hydrocarbon lease blocks, existing well heads, proposed areas for exploration wells and the routing of the proposed iBubesi gas export pipeline.

4.3.5 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 facilitated the development of the fishing and mariculture sectors by means of a holistic sector planning.

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). The current status of abalone ranching is described in Section 4.3.1 above.

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. Other industrial uses of the marine environment include the intake of feed water for mariculture, or diamond-gravel treatment. None of these activities should in any way be affected by offshore exploration activities.

4.3.6 Maritime and Underwater Cultural Heritage

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.

Palaeontological sites

Stevenson & Bamford (2003) describe an abundance of fossilised yellowwood in an approximate 2 km^2 area of seabed outcrop in 136-140 m depth located within Sea Area 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)). Fossil wood occurrences are abundant in southern African terrestrial sedimentary sequences. Reworked Early Cretaceous fossil wood clasts have been recovered from raised beaches on West coast (Bamford and Corbett, 1995) and the adjacent offshore continental shelf (Bamford and Corbett, 1994). These offshore samples include specimens recovered from 3C, 4C and 5C.

Following the application of the Conservation on Biological Diversity's Ecologically and Biologically Significant Area (EBSA) criteria, the area (referred to as the Namaqua Fossil Forest) was identified as unique, and presented at the Conservation on Biological Diversity Southeast Atlantic Ocean regional workshop for consideration as an EBSA warranting formal conservation (see Section 4.2.4).

Shipwrecks

Over 2 800 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 are protected under the National Heritage Resources Act, 1999 by the South African Heritage Resources Agency as archaeological resources.

Possible wrecks most likely to be encountered during the proposed prospecting activities 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 Sea Areas 4C and 5C (see Table 4-9) as well as a further 28 vessels that may be somewhere in the area.

Table 4-9: 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 Sea Area 5C. 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 Sea 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 (32 km) south of Port Nolloth. This vessel may be in the vicinity of Sea Area 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

Cultural Heritage and Spiritual Beliefs

Heritage conservation and management are complex because there are competing claims to culture and its preservation, as well as political pressure to inscribe dominant narratives of history. In addition, cultural groups are not socially pristine, meaning that, cultural boundaries are porous and result in cross-cultural exchange and reformulation of heritage practices and values. Furthermore, immigration is deepening cultural complexity, as new cultural groups arriving with their values and practices, engage with resident groups, further diversifying existing heritage.

South Africans have a very long relationship with the sea. Archaeological evidence in the form of shell middens which point to the exploitation by humans of marine resources around the South African coast, dates back into the Middle Stone Age, at least 30 000 years before the present and continues through the Later Stone Age and Iron Age (on the east coast) right up until, and beyond the arrival of Europeans on South African shores after the late 15th century. The available evidence suggests that the pre-colonial exploitation of marine resources and people's interaction with the sea was limited to the littoral and the intertidal zone. There is currently no archaeological evidence for the movement of pre-colonial people in South Africa in the marine environment, or the construction or use, prior to the arrival of Europeans, of watercraft in that environment (Tim Hart and John Gribble *pers. com.* 2022).

Since the beginning of the colonial presence in South Africa, there has been a tradition of boat-based fishing and marine resource exploitation and many of the small coastal communities have histories linked to this practice which date back many years. There has been a fishery based in Saldanha Bay since the early years of the Dutch settlement at the Cape, for example, and the small-scale fishers' village of Kassiesbaai at Arniston dates back to at least the early 19th century. There is thus a long tradition of boat-based colonial era fisheries with their attendant communities, particularly on the West Coast with its rich marine resources fed by the Benguela

Current and within these communities there will have developed clear and strong traditions and beliefs related to their way of life (Tim Hart and John Gribble *pers. com.*).

Intangible Cultural Heritage with respect to offshore activities consists of the folklore, ritual practice, beliefs, symbolism, social attachment, as well as associated human sensory engagement with the coast and sea. Intangible Cultural Heritage is also related to the tangible heritage, for example it can be associated with maritime artefacts that remain on the seafloor (e.g., shipwreck and associated loss of life) and shell middens (seashell sites) and caves with ancient rock art (produced by the First Peoples) in the Northern Cape and along the West and South Coasts of South Africa. Inshore archaeologically significant sites are also connected to coastal cultural heritages, since some rock art in these sites express the coastal activity of aquatic hunter gatherers, showing that historically, Khoisan peoples moved between inland sites and coastal sites.

There is need to consider terraqueous (territorial and watery) territories which refer to and includes inshore archaeological sites and sites of spiritual significance. These waterways are described as 'living' waters and are believed to play a critical role in spiritual and health management in indigenous groups specifically (First Peoples and Nguni), but also the descendant groups of Europeans in the country and immigrant (specifically southern African and Central African) beliefs and ritual practices at the coast.

The specific beliefs concerning these 'living' waters can be summarized as follows:

- That the waters contain the ancestral spirits of the cultural communities noted.
- That the waters offer a spiritual domain to which people in the present realm can travel to (intentionally or otherwise) and from which they can return if the correct ritual activities are performed to ensure safe return.
- That while the lesser waterways such as streams, rivers and pools may contain a community's specific ancestral spirits, the ocean itself contains the ancestral spirits of the African continent and arguably the ancestral spirits of all humanity.
- That the ancestral spirits in the ocean reside on the seabed or seafloor.
- That indigenous peoples should always approach the sea and coast, as well as lesser waterways with reverence and sometimes, fear.
- That belief in the ancestral world and the place of ancestors in waterways and other ecologically sacred places does not require a relinquishing of belief in an omnipresent God. The ancestors form part of a complex genealogy of which God is the head.
- That regular, consistent and frequent interaction take place with the coast and sea in order to secure the guidance and benevolence of ancestors, as well as spirits that reside in such living waters.

4.3.7 Undersea Cables

There are a number of submarine telecommunications cable systems across the Atlantic and the Indian Ocean (see Figure 4-61). None of these falls within Sea Areas 4C and 5C sea areas. A brief summary of the submarine telecommunications cables are provided as follows:

- 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.
- Western Africa 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).

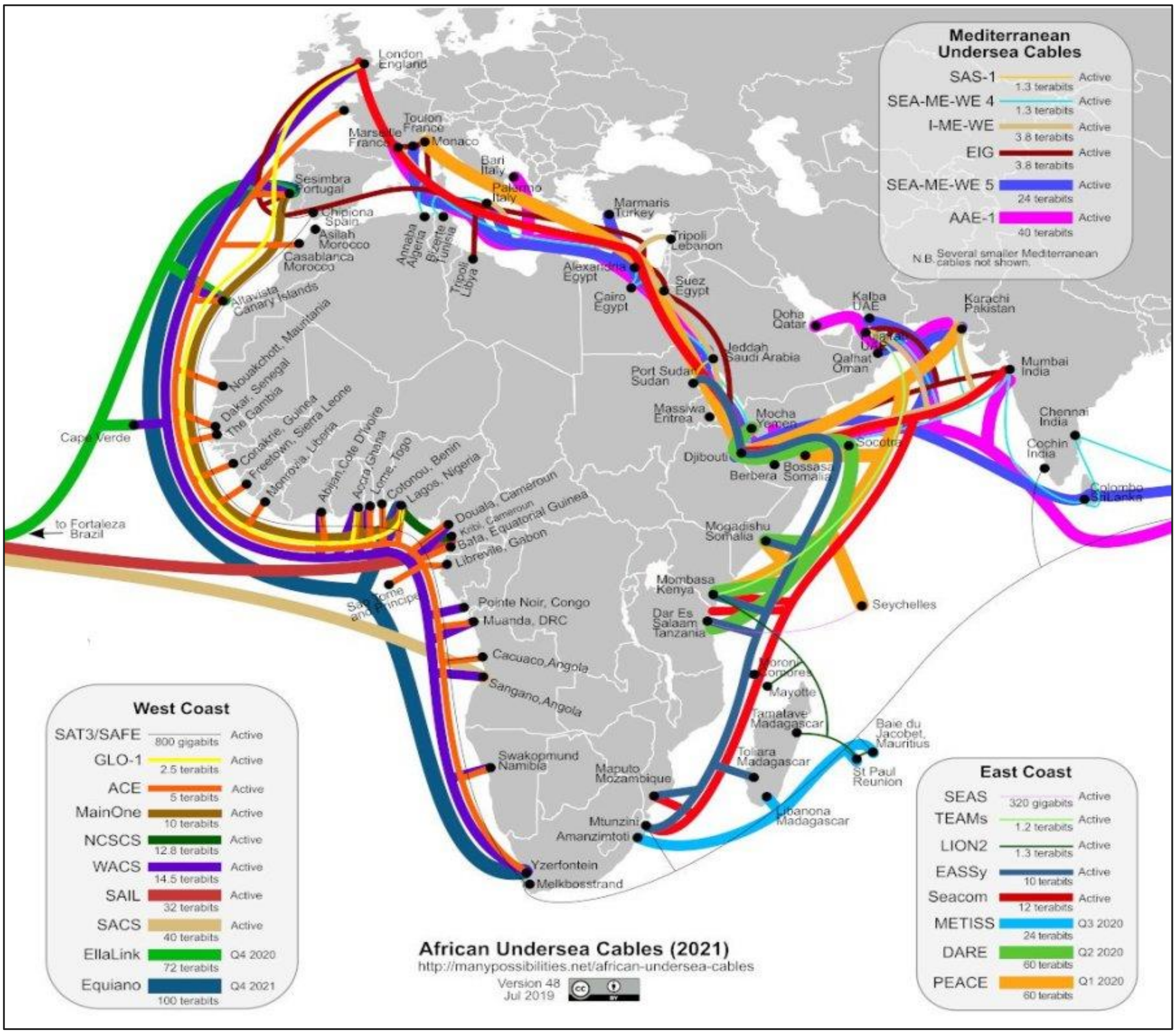

Figure 4-61: Configuration of the current African Undersea Cable Systems, July 2019 (source: www.manypossibilities.net).

5. IMPACT DESCRIPTION AND ASSESSMENT

This chapter describes and assesses the significance of potential impacts related to the proposed offshore prospecting activities in Sea Areas 4C and 5C. All impacts are systematically assessed and presented according to predefined rating scales (see Appendix E). 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 fauna (Appendix D1), fisheries (Appendix D2) and underwater cultural heritage resources (Appendix D3). In addition, this assessment was used as a basis for 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.

Sections 5.1 to 5.3 assess impacts related to the proposed project and associated alternatives on the benthic environment, marine fauna and other users of the sea. The identified potential socio-economic impacts of the project are described in Section 5.3.1. The implications of not going ahead with the proposed project (i.e. the No-Go Alternative) are assessed in Section 5.5 and cumulative impacts of the proposed projects are assessed in Section 5.6.

5.1 IMPACT OF THE VESSEL DISCHARGES / DISPOSAL TO SEA

During prospecting activities, normal discharges / disposal to sea from vessels can potentially lead to reduced water quality in the receiving environment. The impact of these discharges / disposals to sea are assessed individually in Sections 5.1.1– 5.1.5 below.

5.1.1 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:

- Ensure that hydrocarbons are stored in such a way as to prevent release of pollutants overboard;
- Ensure all crew are trained in spill management; and
- Low-toxicity biodegradable detergents and suitable absorbents (where possible reusable absorbent cloths), should be used in cleaning of all deck spillage.

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	None	
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	

5.1.2 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	None	
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	

5.1.3 Sewage

Description of impact

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

Assessment

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

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

Mitigation

The 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	

5.1.4 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 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 prospecting 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	

5.1.5 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	**Insignificant**	**INSIGNIFICANT**
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 Acoustic Impacts of Geophysical Surveys and Sampling Activities

Description of impact

This section assesses potential impacts that could be associated with the geophysical surveys on marine fauna (mainly cetaceans), which 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.

The taxa most vulnerable to disturbance by high-frequency underwater sonar noise are marine mammals, particularly the very-high frequency (e.g. Heaviside's dolphin, pygmy sperm and dwarf sperm whales) and high-frequency species (e.g. odontocetes: dolphins, toothed whales (e.g. sperm), beaked whales, bottle-nose whales). Some of the species potentially occurring in the project area, are considered regionally or globally 'Endangered' (e.g. fin and sei whales), 'vulnerable' (e.g. sperm whale). Although species listed as 'Endangered' or 'Vulnerable may potentially occur in the project area, due to their extensive distributions their numbers are expected to be low.

As the offshore portion of Sea Areas 4C and 5C is located within the main offshore shipping routes that pass around southern Africa (see Figure 4-58), the shipping noise component of the ambient noise environment is expected to be significant within and around Sea Areas 4C and 5C (OceanMind Limited 2020). Given the significant local shipping traffic and relatively strong metocean conditions specific to the area, ambient noise levels are expected to be 90–130 dB re 1 µPa for the frequency range 10 Hz – 10 kHz (SLR Consulting Australia 2020, 2021).

Assessment

The various geophysical survey and sampling techniques considered for prospecting are outlined in Section 3.2.1. The noise generated by the acoustic equipment utilized during geophysical surveys falls within the hearing range of most fish, turtles and marine mammals (see Appendix D1), and at sound levels of between 140 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). High frequency active sonar sources, in particular, have energy profiles that clearly overlap with cetacean's hearing sensitivity frequency range, particularly for cetaceans of High Frequency (e.g. odontocetes: dolphins, toothed whales (e.g. sperm), beaked whales, bottle-nose whales) and Very High Frequency (e.g. Heavisides dolphins, pygmy sperm and dwarf sperm whales) hearing groups. 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. The noise emissions are highly directional, spreading as a fan from the sound source, predominantly in a cross-track direction, and only directly below or adjacent to the systems (within 10 m of the source) would sound levels be in the 230 dB range where exposure would result in permanent threshold shifts (PTS). In the case of very-high- frequency cetaceans the maximum zones of PTS effect were predicted to occur within 70 m from the source along the cross-track direction. Temporary threshold shifts (TTS) for marine mammals of all hearing groups except very-high-frequency cetaceans were predicted to be within approximately 25 m from the sonar source, extending to within 140 m from the source along the cross-track direction for very-high frequency cetaceans (Li & Lewis 2020). Therefore, only directly below or within the sonar beam would receive sound levels be in the range where exposure results in trauma or physiological injury. As most pelagic species likely to be encountered within the Sea Areas are highly mobile, they would be expected to flee and move away from the sound source before trauma could occur. Furthermore, the statistical probability of crossing a cetacean or pinniped with the narrow multi-beam fan several times, or even once, is very small.

The underwater noise from the survey systems may, however, induce localised behavioural changes (e.g. avoidance of the source) in some marine mammal, but there is no evidence of significant behavioural changes that may impact on the wider ecosystem (Perry 2005) and no evidence of physical damage (i.e. PTS and TTS) (Childerhouse & Douglas 2016). The maximum impact distance for behavioural disturbance caused by the immediate exposure to individual sonar pulses was predicted to be within 1.8 km from the source for marine mammals of all hearing groups, at cross-track directions (Li & Lewis 2020).

Similarly, the sound level generated by sampling 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. 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 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).

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 (see Table 5-6).

The impact of underwater noise generated during sampling operations is considered to be of low intensity in the sampling 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 (see Table 5-7).

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. Recommendations for mitigation include:

- A MMO should be appointed to ensure compliance with mitigation measures during geophysical surveying.
- Onboard 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. Equipment of source levels greater than 210 dB re 1 µPa at 1 m not capable of “soft starts” would be run concurrently with equipment that can be soft started and only switched on once the soft-start has been completed.
- 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 possible, 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 passive acoustic monitoring (PAM) is incorporated into any surveying taking place between June and November.

Table 5-6: Impact of noise from Geophysical Surveys on Marine Fauna

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Medium	Low
Duration	Short-term: For the duration of the 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	As seismic survey and geophysical activities have recently been conducted along the West Coast, 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	Low	

Table 5-7: Impact of noise from Sampling Operations on Marine Fauna

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	No mitigation is proposed No mitigation proposed nor considered necessary for this impact.
Duration	Short-term: For the duration of sampling operations	
Extent	Local: Limited to target area	
Consequence	Very Low	
Probability	Definite	
Significance	**Very Low**	
Confidence	High	
Nature of cumulative impact	In the event where sampling activities have been conducted in the area (on the West Coast), 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 would be temporary	
Degree to which impact may cause irreplaceable loss of resources	N/A.	

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Degree to which impact can be mitigated	No possible mitigation identified.	

5.2.2 Electromagnetic Impacts of Geophysical Surveys

Description of impact

Various electrical, magnetic and/or electro-magnetic methods may be used during the proposed geophysical surveys. In the case of electromagnetic (EM) surveys, an example is provided below based on information from the hydrocarbon industry. During electromagnetic surveys, a horizontal electric dipole source containing electrodes is towed above the sea floor. An alternating current is set up to flow between the electrodes thereby injecting a current of up to 1 250 amperes (A) into the sea water and generating both an electric and magnetic field. The repetitive electromagnetic signal is transmitted at a frequency of 0.05 - 10 Hz, upwards into the overlying water column and downwards into the underlying sediments and recorded by an array of receivers placed on the seabed or behind the towed dipole-source.

No specific information is available at this stage on the electromagnetic fields strengths anticipated from the equipment proposed for the current project. However, it can safely be assumed that the field strengths will be considerably lower than those used by the hydrocarbon industry, which is described below. Controlled Source Electromagnetism is typically classified as *ultra low frequency* (0.05 - 10 Hz), with low electric field strengths (<30 mV/m) and low magnetic field strengths (<7 400 nT) (Buchanan *et al.* (2011)). Depending on the species, electromagnetic fields (EMFs) above corresponding thresholds can affect marine fauna by:

- Inducing micro-currents in marine organisms possibly disrupting their normal electrical functions resulting in potential physiological or behavioural impacts;
- Disruption of migratory behaviour in animals that use geomagnetism to assist navigation; and
- Disruption of feeding behaviour in animals that use electro-reception to assist in finding food.

Assessment

Magnetic orientation has been reported from a wide diversity of marine animals and are sensitive to EMFs. Some of these species potential occur in Sea Areas 4C and 5C and are considered regionally or globally 'Critically Endangered' (e.g. oceanic whitetip shark, leatherback turtle), 'Endangered' (e.g. shortfin and longfin mako sharks, dusky shark, southern bluefin tuna, leatherback turtles, fin and sei whales), 'vulnerable' (e.g. bigeye tuna, blue marlin, sailfish, loggerhead turtles, great white shark, sperm whale, Bryde's and humpback whales) or 'near threatened' (e.g. blue shark, swordfish, longfin tuna/albacore and yellowfin tuna).

There are naturally occurring electric and magnetic fields within the marine environment, such as the Earth's geomagnetic field (with typical magnetic flux densities from 30 000 nT at the equator, through 40 000 - 50 000 nT at mid-latitudes to 60 000 nT at the magnetic poles). Geomagnetic storms ranging from minor storms (70-120 nT occurring 9.7 to 19.3 times per year), moderate storms (120-200 nT occurring 3.4 to 6.8 times), strong storms (200-330 nT occurring 1.1 to 2.3); and severe storms (330-500 nT occurring every one to two years). Seawater flowing through the Earth's geomagnetic field, may thus also create electric fields. Voltage gradients from currents in the Atlantic typically are reported to range from 50-500 nV/cm, but can reach up to 750 nV/cm in the Schelde Estuary in the Netherlands. A mean of 386 nV/cm has been defined as a threshold reference (Buchanan *et al.* 2011). Furthermore, all marine animals are electrical conductors as they continually generate internal voltage gradients and electrical currents as part of normal functions, sensory and motor mechanisms, reproductive processes, and membrane integrity.

Based on available information, 200 nT and 386 nV/cm are considered generic thresholds of effects for magnetic and electric fields generated by electromagnetic surveys (Buchanan *et al.* (2011)). At the present stage of knowledge, the use of electromagnetic seabed logging techniques does not appear to involve substantial deleterious effects on marine life. Using data from the application of Controlled Source EM surveys undertaken by the hydrocarbon industry, electromagnetic fields strengths were calculated for variable source frequencies ranging for 0.25 to 10 Hz assuming a towed source antenna 30-50 m above the seafloor in a total water depth of 4 000 m. In all cases, field strengths attenuated to less than 200 nT within 400 vertical metres above the source.

The magnetic field generated during EM applications decreases rapidly with distance from the source, and animals with the capacity to detect and use constant geomagnetic fields are thus likely to only detect the signal within close proximity to the source without being negatively affected. Similarly, electric field strengths for variable source frequencies ranging from 0.25 to 10 Hz were calculated from industry data. Electric field strengths were maximal at 100 m radial distance from the source, attenuating to less than 386 nV/cm within 400 - 800 m vertical distance and 1 000 – 1 900 m radial distance from the source. However, in contrast to the deep-towed source, a shallow-towed source radiates electrical energy over a wider area and the radial area increases with frequency while the vertical area decreases with frequency. This may be due to the characteristics of the wave form (Buchanan *et al.* 2011).

Most cetaceans, sea turtles, pinnipeds, and seabirds that spend the majority of their time in the upper 200 m of the water column, are highly unlikely to be affected by an EM source towed at depth. Only the deep diving species (e.g. sperm whales, beaked whales) may detect the electromagnetic field generated by the source should they pass into the “zone of influence” (i.e. <400 m) of a typical source during a deep dive. Since most species are likely to have rapid escape mechanisms and will thus be able to avoid any field from the moving EM source, exposure times will be short and any pathological injury is highly unlikely. Animals would need to come in very close contact (within a few 100 m) of the electrodes in order to show behavioural response. It is only benthic and demersal species living in, or associated with the seabed, that may show behavioural response when they are exposed to the “zone of influence” (i.e. <400 m) of a typical source passing overhead. Any effects will be localised at any one time, affect relatively few members of a population, and will be of relatively short duration. EM surveys are therefore not expected to produce significant effects on the marine environment.

No specific information is available at this stage on the electromagnetic fields strengths anticipated from the equipment proposed for the current project. However, it can safely be assumed that the field strengths will be considerably lower than those used by the hydrocarbon industry referred to above. Recognising the different sensitivities of the various faunal groups and applying the precautionary principle, the impact of the EMF generated during an EM survey would potentially be of medium intensity, be highly localised at any one time (i.e. within metres from source within the survey area) and persisting only over the short term. Although it is possible that the towed EM source may affect some fauna at close range, the potential impact of EM surveys causing physiological injury to, or behavioural avoidance by benthic invertebrates, boney and cartilaginous fish, turtles, seabirds and marine mammals is deemed to be **INSIGNIFICANT** without and with mitigation (see Table 5-8).

Mitigation

The following mitigation measures are proposed for the electrical, magnetic and/or electro-magnetic surveys:

- Use standard operational procedure to warm up the electromagnetic source transmitter (i.e. equivalent to ramp-up of current in electric source). It is recommended that the electromagnetic source should be ramped up over a minimum period of 20 minutes.
- Turn off electromagnetic source when not collecting data.
- Use lowest field strengths required to successfully complete the electrical, magnetic and/or electro-magnetic survey.

Table 5-8: Impact of electromagnetic surveys on Marine Fauna

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Medium	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Possible	Improbable
Significance	**Insignificant**	**INSIGNIFICANT**
Status	Negative	Negative
Confidence	Medium	Medium
Nature of Cumulative impact	Cumulative impacts are not 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 would be temporary.	
Degree to which impact may cause irreplaceable loss of resources	Negligible	
Degree to which impact can be mitigated	Low	

5.2.3 Disturbance and Loss of Benthic Fauna During Sampling (including Coring)

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 corer or sampling tool. Benthic fauna typically inhabits 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. 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.

Assessment

It can be assumed that up to a maximum of 22 500 samples may be obtained within the potential deposit areas during the five years of prospecting, with the cumulative area of disturbance amounting to a maximum total of approximately 0.225 km^2 across Sea Areas 4C and 5C. Samples will be discrete, i.e. not contiguous and as a result recolonisation from adjacent undisturbed areas is possible. 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. at the sampling locations where discrete samples of typically 5-10 m^2 are acquired). The area disturbed constitutes ~ 0.0024% of the overall area of 4C and 5C. 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) within the discrete sampling footprints. 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 within the discrete sampling footprints. This impact is assessed to be of **Very Low to Low** significance without mitigation reducing to **VERY LOW** with mitigation (see Table 5-9). For coring, which typically has a footprint of approximately 10 cm, the impact would be insignificant.

Mitigation

No direct mitigation measures are possible, or considered necessary for the indirect loss of benthic macrofauna due to sampling activities. However, remote sensing data should be used to conduct a pre-sampling analysis of the seabed to identify high-profile, rocky-outcrop areas without a sediment veneer, which may have sensitive fauna. Exploration sampling targets gravel bodies in unconsolidated sediments and does not target these high-profile rocky-outcrops without a sediment veneer.

Table 5-9: 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: Individual sampling footprint	Local
Consequence	Very Low to Low	Very Low to Low
Probability	Definite	Definite
Significance	**Very Low to Low**	**VERY 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 Areas 4C and 5C during sampling activities would not result in a cumulative impact.	
Degree to which impact can be reversed	Fully reversible. The recovery of excavations through sediment influx and recolonisation will occur over the medium term.	

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
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	Medium.	

5.2.4 Crushing of Benthic Fauna During Sampling (including Coring)

Description of impact

Some disturbance or loss of benthic biota adjacent to the sample footprint may also be expected as a result of the placement on the seabed of either the corer frame or the sampling tool structure during coring / sampling activities. Epifauna and infauna beneath the footprint of the sampling tool structure could 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 with and without mitigation (see Table 5-10).

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 5-10: 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	Full reversible. The recovery would occur over the short term through recruitment and immigration from adjacent areas.	

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
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	Medium	

5.2.5 Generation of Sediment Plumes

Description of impact

As part of the sampling operations, the seabed sediments are pumped to the surface and discharged onto sorting screens on the sampling vessel for screening. This does not apply to coring activities. The unwanted material is returned overboard from where the coarse material settles on the seafloor in and around the excavated areas. The remaining sediment forms a sediment plume in the water column which dissipates with time. The fine sediments result in increased water turbidity and reduced light penetration resulting in both direct and indirect effects on primary producers (phytoplankton) in surface waters, and on pelagic fish and invertebrate communities in the water column. The finer sediments discharged at the surface generate a plume in the upper water column, which is dispersed away from the vessel by prevailing currents, diluting rapidly to background levels at increasing distances from the vessel. Sampling is not contiguous and therefore there will be a delay in time and spatially while the seabed tool is transferred to the new sampling site before additional sediment is released overboard with the next sample.

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. 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 within the plume. Poor visibility may also inhibit pelagic visual predators within the plume. Egg and/or larval development may be impaired through high sediment loading within the plume. 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. In circumstances where heavy metals or contaminants are associated with the fine sediments, these could possibly be remobilised and negative impacts could occur.

In general, 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. From previous operations undertaken by DBM, suspended sediments in plumes settle fairly rapidly (within hours) and water sampling has confirmed that contaminant levels in the plumes are well below water quality guideline levels

(Carter 2008). It follows that the impacts from suspended sediment plumes could be deemed as having a **VERY LOW** significance **with mitigation** (see Table 5-11).

Mitigation

No mitigation measures are considered necessary for the discharge of sampled material from the sampling vessel.

Table 5-11: Impact of the generation of suspended sediment plumes

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	No mitigation proposed nor considered necessary for this impact.
Duration	Short-term	
Extent	Local	
Consequence	Very Low	
Probability	Definite	
Significance	**Very Low**	
Status	Negative	
Confidence	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	None	

5.2.6 Smothering of Benthos in Redepositing Sediments

Description of impact

As mentioned above, the sampled seabed sediments are pumped to the surface and discharged onto sorting screens. The oversized material is discarded overboard and settles back onto the seabed largely beneath the vessel within the previously excavated area. This may result in localised smothering of benthic communities adjacent to sampled areas. Smothering involves physical crushing, a reduction in nutrients and oxygen, clogging of feeding apparatus, as well as affecting settlement site and post-settlement survival. This impact is not of relevance to coring activities.

Assessment

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 cold-water coral communities. Such communities would be expected in the Namaqua Fossil Forest habitat, which has been excluded from the prospecting right area. Rocky seabed outcrops are known to host habitat-forming scleractinian corals. Deep-water corals tend to occur in areas with low sedimentation rates (Mortensen et al. 2001). Those species occurring in the shallower portions of Sea Areas 4C and 5C are, however, likely to be adapted to elevated suspended sediment concentrations as the nearshore waters in the area are frequently characterised by elevated turbidity levels. Nonetheless, these benthic suspension-feeders and their associated faunal communities could potentially show 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). 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 without mitigation (see Table 5-12).

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. If the rocky-outcrop areas without a sediment veneer are avoided during sampling, there would be no direct impact, however the sediment plume may still result in possible smothering impacts in the event the turbidity due to the plume materially exceeds natural turbidity levels where such communities be located in close proximity to sampling areas. This is deemed to be of LOW significance without mitigation and **VERY LOW** significance with mitigation (see Table 5-13).

Mitigation

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

Table 5-12: Impact of the redeposition of discarded sediments on soft-sediment macrofauna

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	No mitigation proposed nor considered necessary for this impact.
Duration	Short-term	
Extent	Local	
Consequence	Very Low	
Probability	Probable	
Significance	**Very Low**	
Status	Negative	
Confidence	High	
Nature of cumulative impact	None	
Degree to which impact can be reversed	Fully Reversible	

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	Very Low	

Table 5-13: Impact of redeposition of discarded sediments on rocky outcrop communities

CRITERIA	WITHOUT MITIGATION	ASSUMING MITIGATION
Intensity	Medium	Low
Duration	Medium-term	Short-term
Extent	Local	Local
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	

5.2.7 Impact of Survey Vessel Lighting on Pelagic Fauna

Description of impact

The survey activities would be undertaken in the nearshore marine environment, about 2 km from the shore, some distance from sensitive coastal receptors (e.g. bird or seal colonies), but could still directly affect migratory pelagic species (pelagic seabirds, turtles, marine mammals and fish) transiting through Sea Areas 4C and 5C. The strong operational lighting used to illuminate the survey vessel at night may disturb and disorientate pelagic seabirds feeding in the area. Operational lights may also result in physiological and behavioural effects of fish and cephalopods as these may be drawn to the lights at night where they may be more easily preyed upon by other fish and seabirds.

The taxa most vulnerable to ambient lighting are pelagic seabirds, although turtles (particularly hatchlings and neonates), large migratory pelagic fish, and both migratory and resident cetaceans transiting through the survey area may also be attracted by the lights. Some of the species potentially occurring in the survey area, are considered regionally or globally 'Critically Endangered' (e.g. oceanic whitetip shark, leatherback turtle), 'Endangered' (e.g. shortfin and Longfin mako sharks, dusky shark, southern bluefin tuna, leatherback turtles, fin and sei whales), 'Vulnerable' (e.g. bigeye tuna, blue marlin, sailfish, loggerhead turtles, great white shark, and sperm whale, Bryde's and humpback whales) or 'Near Threatened' (e.g. blue shark, swordfish, longfin tuna/albacore and yellowfin tuna). Although species listed as 'Critically Endangered' or 'Endangered' may potentially occur in the survey area, due to their extensive distributions their numbers are expected to be low.

Assessment

Seabird collisions with vessels (or reports of collisions or death of seabirds on vessels) are rare. Should they occur, the impact would primarily occur in the survey area and along the route taken by the survey vessel. Most of the seabird species breeding along the West Coast feed relatively close inshore (10 - 30 km), with African Penguins and Cape Gannets up to 60 km and 140 km offshore, respectively. Pelagic species occurring further offshore would be unfamiliar with artificial lighting and may be attracted to the survey vessel. Fish and squid may also be attracted to the light sources potentially resulting in increased predation on these species by higher order consumers. However, as the offshore portion of the survey area is located within the main traffic routes that pass around southern Africa, which experience high vessel traffic, animals in the area should be accustomed to vessel traffic and it is expected fauna in the area would become accustomed to the presence of the survey vessel within a few days.

Due to their extensive distributions, the numbers of pelagic species (large pelagic fish, turtles and cetaceans) encountered during the proposed geophysical survey and sampling is expected to be low. Due to anticipated numbers and the proximity of project area to the main traffic routes, the increase in ambient lighting in the near- and offshore environment would be of low intensity and local in extent (limited to the area in the immediate vicinity of the vessel) over the short-term. The potential impact of vessel lighting on marine fauna would thus be of VERY LOW significance with and without mitigation. (seeTable 5-14).

Mitigation

The use of lighting on the survey and sampling vessels cannot be eliminated due to safety, navigational and operational requirements. Recommendations for mitigation include:

- Reduce lighting on the survey and sampling vessels to a minimum compatible with safe operations whenever and wherever possible. Light sources should, if possible and consistent with safe working practices, be positioned in places where emissions to the surrounding environment can be minimised.
- Keep disorientated, but otherwise unharmed, seabirds in dark containers for subsequent release during daylight hours. Ringed/banded birds should be reported to the appropriate ringing/banding scheme (details are provided on the ring).
- Where feasible and where such is not required for vessel safety reasons, vessels should:
    - adjust the orientation of lights (e.g. not pointing directly out to sea).
    - avoid operating extremely bright lights during foggy conditions (as this exacerbates the impact on seabirds).
    - ensure that personnel are adequately trained to care for any downed seabirds.

Table 5-14: Impact of vessel lighting on Pelagic Fauna

CRITERIA	WITHOUT MITIGATION	ASSUMING MITIGATION
Intensity	Low	Very Low
Duration	Short-term	Short-term

CRITERIA	WITHOUT MITIGATION	ASSUMING MITIGATION
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Possible	Possible
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	None	
Degree to which impact can be reversed	No cumulative impacts are anticipated	
Degree to which impact may cause irreplaceable loss of resources	Fully Reversible	
Degree to which impact can be mitigated	Low	

5.2.8 Collisions with Project Vessels and Equipment

Description of impact

The movement of vessels can result in animal-vessel collisions and faunal strikes at various stages during the proposed prospecting operations. These include ship strikes during transit of vessel to and from the survey area and while undertaking the planned prospecting activities. In addition, marine fauna may become entangled in towed equipment lines. The potential effects of ship strikes or entanglement on marine fauna (especially turtles and cetaceans) include physiological injury or mortality.

Assessment

The physical presence of the survey or sampling vessel and increased vessel traffic could increase the likelihood of animal-vessel collisions (“ship strikes”). Ship strikes have been documented from many regions and for numerous species of whales, with large baleen whales being particularly susceptible to collision. Any increase in vessel traffic through areas used as calving grounds or through which these species migrate will increase the risk of collision between a whale and a vessel. However, collisions between turtles or cetaceans and vessels are not limited to survey and sampling vessels.

The geophysical survey equipment that may be towed astern of the survey vessel also increases the potential for collision with or entrapped in equipment and towed equipment when these are being lowered from the vessel into the water. Entanglement of cetaceans in gear is possible in situations where tension is lost on the towed array. In South Africa, the major cause of large whale entanglements (mainly southern right and humpback whales) are static fishing gear, anchor, mooring and buoy lines and the large-mesh shark nets set off KwaZulu-Natal (Meÿer *et al.* 2011). Basking turtles are particularly slow to react to approaching objects and may not be able to move rapidly away from approaching equipment. Entanglement may as a result of 'startle diving' in front of towed equipment.

Given the slow speed (about 2 - 3 kts) of the vessel while towing the sonar sources, as well as the nature of the equipment to be used, ship strikes and entanglement whilst surveying are unlikely, but ship strikes may occur during the transit of the survey/sampling vessel to or from the area of interest.

The potential for collision between adult turtles / cetaceans and the geophysical survey vessel, or entanglement in the towed equipment is highly dependent on the abundance and behaviour of turtles and cetaceans in the survey area at the time and vessel speed.

Due to their extensive distributions and feeding ranges, and the extended distance (over 1 000 km) from their nesting sites, the number of turtles encountered during the proposed geophysical survey is expected to be low. The number of cetaceans expected to be encountered during the proposed geophysical survey operations is also expected to be low due to their extensive distributions and feeding ranges. Should collisions or entanglements occur, the impacts would be of high intensity for individuals but low for the population as a whole. Furthermore, the duration of the impact would be limited to the short-term (3 months) and be restricted to the survey area. Thus, the potential for collision and entanglement in equipment is considered to be of **VERY LOW** significance with and without mitigation (see Table 5-15).

Mitigation

- Vessel operators should keep a watch for marine mammals and turtles in the path of the vessel.
- Ensure vessel transit speed of 10 knots (18 km/hr) when sensitive marine fauna are present in the vicinity.A non-dedicated marine mammal observer (MMO) must keep watch for marine mammals behind the vessel when tension is lost on the towed equipment. Either retrieve or regain tension on towed gear as rapidly as possible.
- Should a cetacean become entangled in towed gear, contact the South African Whale Disentanglement Network (SAWDN) formed under the auspices of DFFE to provide specialist assistance in releasing entangled animals.
- Report any collisions with large whales to the International Whaling Commission (IWC) database to assist in the identification of species most affected, vessels involved in collisions, and correlations between vessel speed and collision risk.

Table 5-15: Impact of ship strikes, collision and entanglement with towed or moored equipment on turtles and cetaceans.

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	Very Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Possible	Unlikely
Significance	**Very Low**	**Very Low**
Status	Negative	Negative
Confidence	High	High

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Nature of cumulative impact	Considering any vessels could traverse the area, some cumulative impacts can 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	Partially Reversible	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	High	

5.2.9 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. The potential effects of loss of equipment on marine fauna include disturbance and damage to seabed habitats and associated fauna within the equipment footprint and potential physiological injury or mortality to pelagic and neritic marine fauna due to collision or entanglement in equipment drifting on the surface or in the water column.

Assessment

The benthic fauna inhabiting unconsolidated sediments at the depths of the proposed sampling are expected to be relatively ubiquitous, varying only with sediment grain size, organic carbon content of the sediments and/or near-bottom oxygen concentrations. These benthic communities usually comprise fast-growing species able to rapidly recruit into areas that have suffered natural environmental disturbance. Epifauna living on the sediment typically comprise urchins, burrowing anemones, molluscs, seapens and sponges, many of which are longer lived and therefore more sensitive to disturbance. No rare or endangered species have been reported or are known from the unconsolidated sediments in Sea Areas 4C and 5C. However, the benthos of hard substrata, are typically vulnerable to disturbance due to their long generation times. High proportions of hard ground have been identified between 180 m and 480 m depth (the deepest depth in Sea Areas 4C and 5C is ~200 m). Thus, these areas are more sensitive to disturbances.

The low-intensity negative impact of lost equipment would be extremely localised but if not retrieved would endure permanently. Although the lost equipment would eventually be colonised by benthic organisms typical of hard seabeds, every effort should be made to remove such foreign objects. The significance of this potential is deemed to be **VERY LOW** with and without mitigation (see Table 5-16).

Mitigation

- Accurately record the positions of all lost equipment in a hazards database, and reported to maritime authorities. Every effort should be made to recover lost equipment.

Table 5-16: Impact of equipment lost to the seabed on marine fauna.

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	Very Low
Duration	Short-term	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.	
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	

5.2.10 Noise from Helicopters

Description of impact

Possible crew transfers by helicopter to the survey/sampling vessels will generate noise in the atmosphere that may disturb coastal species such as seabirds and seals resulting in behavioural changes or displacement from important feeding or breeding areas (direct negative impact). The taxa most vulnerable to disturbance by helicopter noise are pelagic seabirds (except where the flight path crosses the coastal zone), turtles, and large migratory pelagic fish and marine mammals. In addition, seabirds and seals in breeding colonies and roosts along coast could be impacted where the flight path crosses the coastal zone. Some of the seabirds roosting and nesting along the coast are listed by the IUCN as 'Endangered' (e.g. African Penguin, Bank Cormorant, Cape Cormorant and Cape Gannet), 'Near threatened' (e.g. African Black Oystercatcher and Crowned Cormorant) or 'Vulnerable' (e.g. Damara Tern). The overall sensitivity is considered to be high.

Assessment

Helicopter operations to and from the vessel would occur sporadically only, if at all. Nonetheless, indiscriminate low altitude flights over whales, seals, seabird colonies and turtles by helicopters could thus have an impact on behaviour and breeding success. The intensity of disturbance would depend on the distance and altitude of the aircraft from the animals (particularly the angle of incidence to the water surface) and the prevailing sea conditions and could range from low to high intensity for individuals but of LOW intensity for the populations as a whole. As such impacts would be REGIONAL (although temporary in nature a few minutes in every week while the helicopter passes overhead) and SHORT TERM, impacts would be of **VERY LOW** significance.

The potential impact of aircraft noise causing physiological injury to, or behavioural avoidance by, pelagic and coastal sensitive species, is deemed to be of LOW significance considering their high sensitivity and very low consequence. Aircraft noise would, however, likely contribute to the growing suite of cumulative acoustic impacts to marine fauna in the area, but assessing the population level consequences of multiple smaller and more localised stressors (see for example Booth et al. 2020; Derous et al. 2020) is difficult to determine.

Mitigation

Recommendations for mitigation include:

- Ensure all flight paths avoid coastal seal and penguin colonies.
- Avoid extensive low-altitude coastal flights (<762 m or <2 500 ft and within 1 nautical mile of the shore) by ensuring that the flight path is perpendicular to the coast, as far as possible.
- Maintain a flight altitude >1 000 m to be maintained at all times, except when taking off and landing or in a medical emergency.
- Maintain an altitude of at least 762 m or 2 500 ft above the highest point of a National Park or World Heritage Site.
- Brief all pilots on the ecological risks associated with flying at a low level along the coast or above marine mammals.

Table 5-17: Impact of helicopter noise on marine fauna

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	Low
Duration	Short-term	Short-term
Extent	Regional: Along flight path	Regional
Consequence	Very Low	Very Low
Probability	Possible	Possible
Significance	**Very Low**	**VERY LOW**
Status	Negative	Negative
Confidence	High	High
Nature of Cumulative impact	Possible	
Degree to which impact can be reversed	Fully Reversible - any disturbance of behaviour that may occur would be temporary.	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	Low	

5.3 IMPACT ON OTHER USERS OF THE SEA

5.3.1 Potential Impact on Fishing Industry

Description of impact

While the survey and sampling vessels are operational at a given location, a temporary 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 sampling operations would either operate with dynamic positioning or typically operate on a 3 or 4 anchor spread with unlit anchor mooring buoys. For the duration of operations, a coastal navigational warning would be issued by the South African Navy Hydrographic Office (SANHO) requesting a minimum exclusion safety zone of ~500 m around the prospecting vessels which will vary depending on the particular activities of the vessels. The safety zones aim to ensure the safety both of navigation and of the prospecting vessel, avoiding or reducing the probability of accidents caused by the interaction of fishing boats and gears and the vessel. The exclusion of vessels from entering the safety zone around the prospecting vessel would pose a direct impact to fishing operations in the form of loss of access to fishing grounds if overlap were to occur.

Assessment

The exclusion of vessels from entering the safety zone around a vessel engaged either in survey or sampling could pose a direct impact to fishing operations in the form of loss of access to fishing grounds if there was overlap with the fishing ground. The extent of fishing operations in and around Sea Areas 4C and 5C is described in detail in Section 4.1.4. The anticipated fishing sectors that could be affected by the proposed prospecting operations include the pelagic long-line, demersal longline, tuan pole, traditional line-fish fisheries, small-scale fishers, as well as fishery research. The anticipated impact for each of these is described below.

The sensitivity of these fishing sectors (i.e. the ability of the fishing industry to operate as expected considering a project-induced change to their normal fishing operations) to the impact of the safety / exclusion zone would differ according to the degree of disruption to that fishing operation. This relates to the type of gear used, the mobility of fishing operations and the probability that the fishing operation can be relocated away from the safety / exclusion zone into alternative fishing areas. Due to their mobile nature, the sensitivity of the pole-and-line, linefish and small-scale sectors is considered to be low, however, the sensitivity of fisheries research surveys is considered to be medium and high for the demersal longline sector.

In the vicinity of Sea Areas 4C and 5C, the South African pelagic longline fleet targets fishing areas is offshore of the 500 m bathymetric contour and the closest activity would be expected 50 km outside of the offshore boundary of Sea Areas 4C and 5C. However, the Namibian fleet operate in shallower waters inshore of the shelf break where they target pelagic shark species. Thus, the Namibian fleet would be expected to operate adjacent to Sea Area 4C offshore of the 200 m depth contour along the South African maritime border. This is however beyond the focus area for prospecting operations which typically range up to 160 m water depth within the prospecting right area.

Namibian-registered demersal longline vessels operate on the Namibian side of the maritime border at a depth range of 200 - 500 m. As such, fishing activity can be expected along the boundary of Sea Area 4C. While, the South African fleet of demersal longline vessels also operate at a similar depth range, there is minimal overlap of fishing ground with the offshore portions of the Sea Areas 4C and 5C. Over the period 2018 to 2020, an average of 128 000 hooks per year were set within the Sea Areas 4C and 5C yielding 21.9 tonnes of hake. This is equivalent to 0.47% of the overall effort and 0.47% of the overall catch reported nationally by the sector. These activities are beyond the focus area of operations and therefore overlap with these fisheries is considered improbable and no impact is expected.

Vessels registered under the pole-and-line sector target either albacore in favoured areas off the shelf break, or they target snoek and yellowtail in coastal waters. Tuna-directed fishing is not expected to coincide with the Sea Areas 4C and 5C, however, a significant amount of snoek-directed fishing activity occurs inshore of the 100 m depth contour over the period March to July. Over the period 2017 to 2019, an average of 14 fishing events were reported having taken place within Sea Areas 4C and 5C yielding 48 tonnes of snoek. This is equivalent to 0.53% of the overall effort expended by the pole-and-line sector (inclusive of offshore fishing activity targeting albacore tuna) and 6.97% of the snoek catch landed by the sector. Due to the limited fishing effort recorded in the Sea Areas 4C and 5C, as well as the focus of fishing activity being inshore of the prospecting target area, overlap with this fishery is expected to be improbable.

Boat-based fishing for linefish takes place in close proximity to launch sites at Port Nolloth and Doringbaai. Over the period March to September, snoek is targeted in nearshore waters. Although unlikely to extend into Sea Areas 4C and 5C, the possibility of fishing activity extending into the shallow water areas of Sea Areas 4C and 5C cannot be excluded. However, as prospecting is expected to be typically focused in waters deeper than 70 m, overlap with this fishing activity is improbable.

The small-scale fishery rights cover the nearshore area (defined in section 19 of the MLRA as being within close proximity of shoreline). Since the grounds fished by the nearshore rock lobster sector are situated inshore of Sea Areas 4C and 5C, this fishing activity is not expected to be affected by the proposed survey and sampling activities. However, as for the linefish commercial sector above, the possibility of small-scale fishing activities for linefish species extending into the shallow water areas of Sea Areas 4C and 5C also cannot be excluded. As prospecting is expected to be typically focused in waters deeper than 70 m, overlap with this fishing activity is improbable.

Research trawls are undertaken by DFFE on a national scale to establish the stock status of key commercial species. The demersal trawl survey would be expected to take place within Sea Areas 4C and 5C over the period January/February whereas the acoustic survey for small pelagic species would be expected to operate within the area during November and again during May/June (a pre-recruitment biomass survey for small pelagic species).

Based on the location of the demersal longline, pole-and-line, traditional linefish, west coast rock lobster, beach-seine and gillnet fisheries in relation to Sea Areas 4C and 5C, the spread of sound into these fishing grounds may also affect catch rates. However, the generation of noise by the proposed geophysical survey methods would be highly reversible and any disturbance of behaviour of target fish species that may occur as a result of survey noise would be temporary and fully reversible.

Given that impacts on the above-mentioned fisheries are improbable and would be limited to a small area within Sea Areas 4C and 5C, the potential impact of the proposed prospecting activities on these fisheries would be of local extent (survey area), short term (only during the survey campaign) and of medium intensity. The significance of impact is considered to be **Very Low** without mitigation for fisheries research. By liaising with the DFFE to ensure that the proposed prospecting activities avoid the planned research surveys there would be **NO IMPACT**. The significance of impact is considered to be **INSIGNIFICANT** for Pole-and-line, linefish, small-scale fisheries (see Table 5-18) with and without mitigation.

The proposed prospecting activities would have **NO IMPACT** on demersal trawl, mid-water trawl, small pelagic purse-seine, large pelagic purse-seine, west coast rock lobster, abalone ranching, and beach-seine and gillnet fisheries sectors, as Sea Areas 4C and 5C do 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 fishing / research operations.

- A demersal research survey is undertaken each year within Sea Areas 4C and 5C over the period January/February. Acoustic surveys for small pelagic species are carried out twice a year and may be expected within Sea Areas 4C and 5C any time from mid-May to mid-June and from mid-October to mid-December. The most effective means of mitigation would be to ensure that the proposed prospecting activities do not coincide with the research surveys. It is recommended that prior to the commencement of the proposed activities, De Beers consult with the managers of the DFFE 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 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 representatives of small-scale local fishing co-operatives, South African Tuna Association, South African Tuna Longline Association, South African Deepsea Trawling Industry Association (SADSTIA), South African Hake Longline Association (SAHLLA), West Coast Rock Lobster Association if any activities are activated within the 100 m contour line), South African Linefish Associations (various) and SA Marine Linefish Management Association (SAMLMA)); and
  - Other: Representatives of small-scale local fishing co-operatives, DFFE Vessel Monitoring, Control and Surveillance (VMS) Unit, South African Maritime Safety Authority (SAMSA), and Transnet National Ports Authority (ports of Cape Town and Saldanha Bay).
- Prior to commencement of activities notify the SAN Hydrographic Office, requesting a Notice to Mariners be issued with the co-ordinates of the geophysical or sampling areas with the required safety zones around the survey or sampling vessel for the duration of the operations; and
- Notify the SAN Hydrographic office when the programme is complete so that the Navigational Warning can be cancelled.

Table 5-18: Assessment of the potential impacts on the demersal longline, pole-and-line, linefish, small-scale fisheries and fisheries research.

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Medium	Low
Duration	Short-term	Short-term
Extent	Local	Local
Consequence	Very Low	Very Low
Probability	Possible	Possible

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Confidence	Medium	Medium
Significance	**Very Low** (Fisheries research)	**NO IMPACT** (Fisheries research)
	Insignificant (Pole-and-line, linefish, small-scale fisheries)	**INSIGNIFICANT** (Pole-and-line, linefish, small-scale fisheries)
Status	Negative	Negative
Nature of cumulative impact	Considering the potential for other geophysical and seismic surveys to be conducted in the area, some cumulative impacts can be 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	None	

5.3.2 Potential Impact of Survey Noise on Catch Rates

Description of impact

The presence and operation of the survey vessel will introduce a range of underwater noises into the surrounding water column that may potentially contribute to and/or exceed ambient noise levels in the area. As noted in Section 5.2.1, such noise could result in physiological injury and behavioural avoidance of the survey area, including fish in the area. The resultant impacts on fish could have a knock-on impact on catch rates of fisheries operating within the Sea Areas.

Assessment

The noise generated by the acoustic equipment proposed for the geophysical survey would fall within the hearing range of most fish, and at sound levels of between 190 to 232 dB re 1 µPa at 1 m. Similarly, the sound level generated by sampling operations fall within the 120-190 dB re 1 µPa range at the sampling unit, with main frequencies between 3 – 10 Hz.

The noise emissions from the geophysical sources are highly directional, spreading as a fan from the sound source, predominantly in a cross-track direction. Due to the rapid attenuation of high-frequency sound in the ocean, the spatial extent of the impact of noise on catch rates is expected to be localised. Based on the location of fishing grounds of the various fisheries sectors in respect to the prospecting application area, the effects of acoustic disturbance on catch rates would be considered to be of negligible significance for most sectors. However, in the case of the pole-and-line, traditional linefish, west coast rock lobster, beach-seine and gillnet fisheries, small-scale fisheries and fisheries research, the spread of sound into fishing grounds may have a potential effect on catch rates. However, the generation of noise by the proposed geophysical survey methods would be highly reversible and any disturbance of behaviour of target fish species that may occur as a result of survey noise would be temporary and fully reversible.

The impact on these sectors is assessed to be of medium intensity, local extent (survey area) and would be of short-term (only during survey campaign) duration. The significance of this potential is deemed to be **VERY LOW without mitigation** (see Table 5-19).

Mitigation

No mitigation measures are possible, or considered necessary for the generation of noise by the geophysical survey methods proposed in the current project. The impact is considered to be highly reversible – any disturbance of behaviour that may occur as a result of survey noise would be temporary and would cease once the noise source is turned off.

Table 5-19: Assessment of the potential impact of survey noise on catch rates.

<table>
<tr><th>CRITERIA</th><th>WITHOUT MITIGATION</th><th>WITH MITIGATION</th></tr>
<tr><td>Intensity</td><td>Medium</td><td rowspan="8">No mitigation proposed nor considered necessary for this impact.</td></tr>
<tr><td>Duration</td><td>Short-Term</td></tr>
<tr><td>Extent</td><td>Local</td></tr>
<tr><td>Consequence</td><td>Very Low</td></tr>
<tr><td>Probability</td><td>Probable</td></tr>
<tr><td>Significance</td><td>Very Low</td></tr>
<tr><td>Status</td><td>Negative</td></tr>
<tr><td>Confidence</td><td>Medium</td></tr>
<tr><td>Nature of cumulative impact</td><td colspan="2">Considering the potential for other geophysical and seismic surveys to be 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.</td></tr>
<tr><td>Degree to which impact can be reversed</td><td colspan="2">FULLY REVERSIBLE</td></tr>
<tr><td>Degree to which impact may cause irreplaceable loss of resources</td><td colspan="2">NEGLIGIBLE</td></tr>
<tr><td>Degree to which impact can be mitigated</td><td colspan="2">Low</td></tr>
</table>

5.3.3 Potential Impact of Sediment Plume on Fish Stock Recruitment

Description of impact

Sediment plumes generated during sampling could have an impact on fish stock recruitment due to potential impairment of egg and/or larval development through high sediment loading.

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 Areas 4C and 5C. 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.

In terms of seaweeds, sediment plumes could significantly reduce the photosynthetic ability, spore settlement, and spore survival of *E. maxima* and *L. pallida*. The sediment plume would need to persist for an extended time for kelp populations within the Sea Areas to be negatively affected. However, the sediment plume may enhance cumulative impacts of turbidity, as high amounts of turbidity characterise the West Coast. The high turbidity in the area is a result of the combination of the presence of sand on the seafloor, the hydrodynamic environment, muds transported to the ocean from the Orange River, local fluvial input (runoff), aeolian input and the cumulative effects of anthropogenic activity along the West Coast.

Relative to the location of the above-mentioned nursery areas, sediment plumes generated during 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 low intensity over the short-term. The impact is thus considered to be **VERY LOW to INSIGNIFICANT** without mitigation (see Table 5-20).

Mitigation

No mitigation measures are considered necessary for this impact.

Table 5-20: Assessment of the potential impact on fish stock recruitment due to sediment plumes.

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	Low	No mitigation is proposed for this impact.
Duration	Short-term	
Extent	Local	
Consequence	Very Low	
Probability	Definite	
Significance	**VERY LOW to INSIGNIFICANT**	
Status	Negative	
Confidence	Medium	
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	None	

5.3.4 Potential Impact on Other Marine Prospecting / Mining Operations

Description of impact

The presence of the survey and/or sampling vessels could interfere with other marine mining or prospecting operations in the neighbouring rights areas.

Assessment

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

As the 4C and 5c Sea Areas do not overlap with any other marine mineral prospecting or 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 (see Table 5-21).

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 5-21: 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	

5.3.5 Potential Impact on Petroleum Exploration and Production

Description of impact

The proposed prospecting activities could affect petroleum exploration and future production activities, that overlap with Sea Areas 4C and 5C, and vice versa.

Assessment

The proposed prospecting area overlaps with Block 1 held by Tosaco Energy (Pty) Ltd (refer to Figure 4-60 in Section 4). The proposed geophysical survey or sampling activities could affect and disrupt exploration activities in these blocks if the activities occur coincidentally in the same area at the same time. However, the likelihood of this happening is very 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 5-22).

Mitigation

- Notify Tosaco Energy, 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 5-22: 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	Local	Local
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	

5.3.6 Potential Impact on Marine Transport Routes

Description of impact

The presence of the prospecting 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 Sea Areas 4C and 5C. The inshore traffic of the continental shelf along the West Coast is largely comprised of fishing and mining vessels, especially between Kleinsee and Oranjemund (refer to Figure 4-58).

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 5-23).

Mitigation

- Prior to the commencement of activities, the operator must notify relevant bodies including: DMRE, DFFE, SAMSA, and relevant Port Captains, providing the navigational coordinates of the prospecting areas;
- Prior to commencement of activities notify the SAN Hydrographic Office, requesting a Notice to Mariners be issued with the co-ordinates of the geophysical or sampling areas. Notify the SAN Hydrographic Office on completion of the operations so that the Notice to Mariners can be withdrawn.
- The survey/sampling vessel(s) must be certified for seaworthiness through an appropriate internationally recognised marine certification programme (e.g. Lloyds Register, Det Norske Veritas).

Table 5-23: 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	

5.4 SOCIO-ECONOMIC IMPACT

5.4.1 Impact on Cultural Heritage Material

Description of impact

Sampling activities could disturb cultural heritage material on the seabed, such as palaeontological and historical shipwrecks.

Assessment

As noted in Section 4.3, an abundance of fossilised yellowwood occurs within an approximate 2 km^2 area located within Sea Area 4C. However, as mentioned in Section 4.2.2, the fossilised yellowwoods have been incorporated into the Namaqua Fossil Forest MPA and this area has been excluded from the prospecting right application and no geophysical surveying and sampling activities will occur there.

In addition, 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 Sea Areas 4C and 5C (refer to Table 4-9), 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 **Medium**, 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 5-24).

Mitigation

- Areas where shipwreck sites are identified during the previous geophysical surveys must be excluded prior to undertaking sampling activities.
- Objects of cultural significance, including fossils, recovered during sample processing will be recorded and addressed in accordance with the requirements of the National Heritage Resources Act, 1999.
- The onboard DBCM/DBM 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 vessel operator must be notified that archaeological sites could be exposed during sampling activities, as well as the procedure to follow should archaeological material be encountered.
- If shipwreck material is encountered during the course of sampling in Sea Areas 4C and 5C, 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 DBM 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 with on the site, unless under permit from SAHRA.

Table 5-24: Impact on palaeontological material and shipwrecks

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Intensity	High	Low
Duration	Short-term	Short-term
Extent	National	National
Consequence	Medium	Low
Probability	Improbable	Improbable
Significance	**Medium**	**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	

5.4.2 Impact related to Job Creation and Business Opportunities

Description of impact

The proposed project could create a small number of local employment and business opportunities. Direct revenues could be generated as a result of the proposed prospecting activities. Revenue generating activities are related to the actual prospecting operations and include refuelling, vessel / gear repair, port dues, hire of support vessel(s).

Assessment

Offshore prospecting is highly technical and requires specialised vessels and crews. Thus, job opportunities during the activities would be limited. There may, however, be opportunities for local companies to provide support services during the course of operations, e.g. vessel supplies, support vessels, etc.

The overall positive impact of job creation and the generation of direct revenues are considered to be local in extent and of low intensity over the short-term. It follows that the potential impact of job creation is considered to be ***VERY LOW (positive)*** with and without mitigation (see Table 5-25). Should the prospecting operations be successful, future job creation and business opportunities would arise where the operations advance to mining (which would require a separate application for environmental authorisation).

Mitigation

The use of local companies for support services should be promoted as far as possible, with consideration of youth & women owned companies.

Table 5-25: Impact of job creation and the generation of direct revenues.

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 (positive)***	***VERY LOW (POSITIVE)***
Status	Positive	Positive
Confidence	Medium	Medium
Nature of cumulative impact	Other activities that may contribute to the cumulative impact of job creation and the generation of direct revenues include other exploration and mining activities off the coast of South Africa. As there are few of these other activities currently being undertaken off the West Coast, the cumulative impact is considered to be of LOW (positive) significance.	
Degree to which impact can be reversed	Fully reversible	
Degree to which impact may cause irreplaceable loss of resources	N/A	
Degree to which impact can be mitigated	None	

5.5 NO-GO ALTERNATIVES

Description of impact

The implications of not going ahead with the proposed prospecting operations 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 socio - 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 5-26). 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 5-26: Assessment of impact related to No-Go alternative.

CRITERIA	WITHOUT MITIGATION
Intensity	Low
Duration	Permanent
Extent	Regional
Consequence	Medium
Probability	Improbable

CRITERIA	WITHOUT MITIGATION
Significance	**LOW**
Status	Neutral
Confidence	Low
Nature of cumulative impact	Potential loss of opportunity to expand South Africa's own 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

5.6 CUMULATIVE IMPACTS

Description of impact

Cumulative impacts are commonly understood as the potential impacts which combine from different actions and which result in significant change, which is larger than the sum of all the impacts. The consideration of the 'cumulative impact' should include "past, present and reasonably foreseeable future developments or impacts". This requires a holistic view, interpretation and analysis of the biophysical, social and economic systems. Cumulative impact assessment is limited and constrained by the method used for identifying and analysing cumulative effects. It is not practical to analyse the cumulative effects of an action on every environmental receptor, the list of environmental effects should focus on those that are truly meaningful. For cumulative effects analysis to help the decision-maker and inform interested parties, it must be limited to effects that can be evaluated meaningfully (DEAT 2004).

The primary impacts associated with the geophysical prospecting 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 sediment plumes to the benthic environment, and associated vessel presence.

With respect to activities that may contribute to cumulative impacts, there are many other rights holders in the South African offshore environment (see Figure 5-1 showing the demarcated Sea Areas for prospecting and mining and Figure 5-2 showing the Petroleum Licence Blocks). Historic and currently ongoing, activities within these areas would contribute to cumulative impacts in the offshore marine environment.

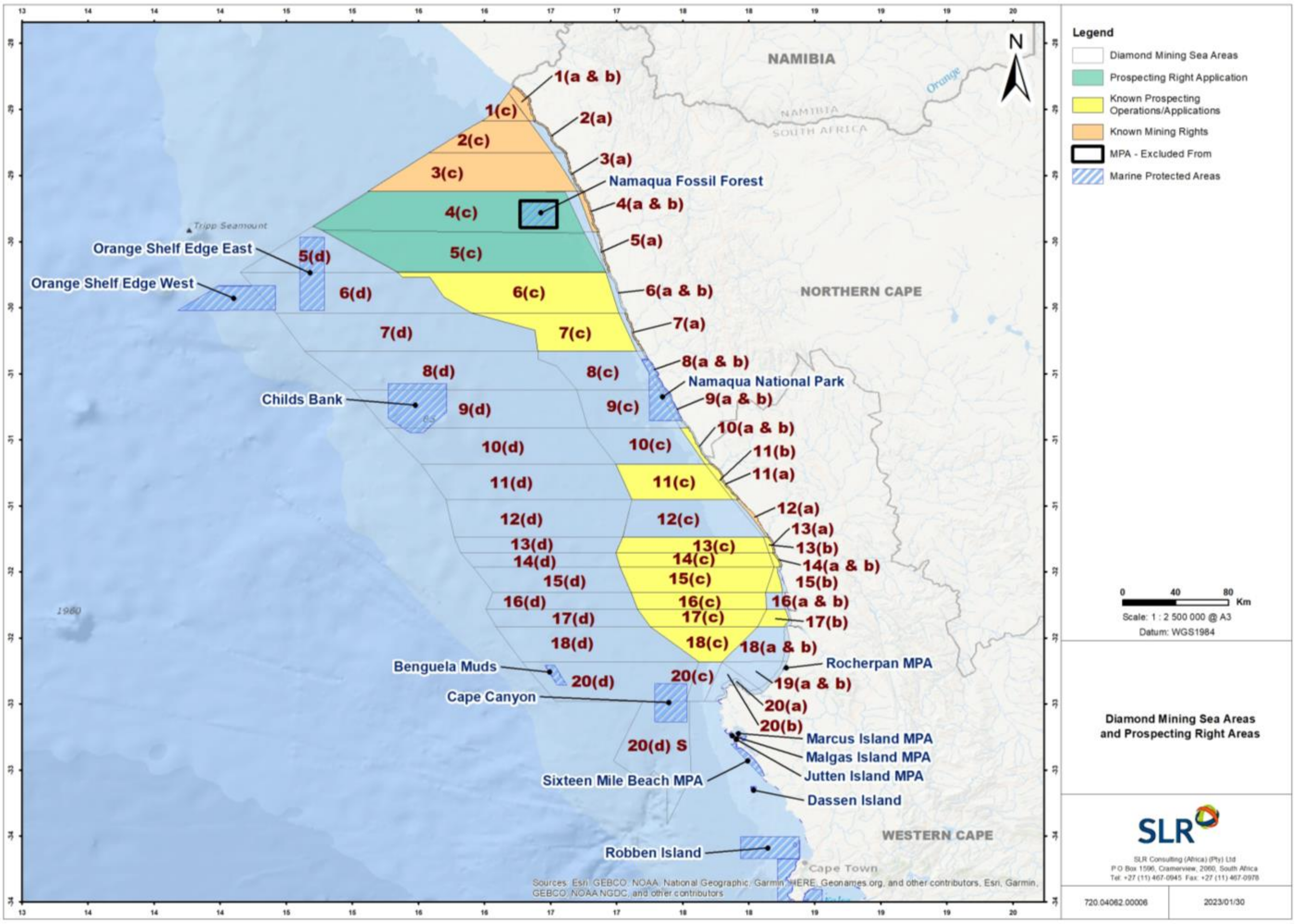

Figure 5-1: Sea Areas 4C and 5C (green) in relation to the demarcated Sea Areas off the West Coast (Google Earth, 2023). Only some of these Sea Areas have applications in them. Note De Beers' prospecting right application in Sea Areas 4C and 5C does not include the Namaqua Fossil Forest Marine Protected Area (MPA). The other MPA's on the West Coast are also shown.

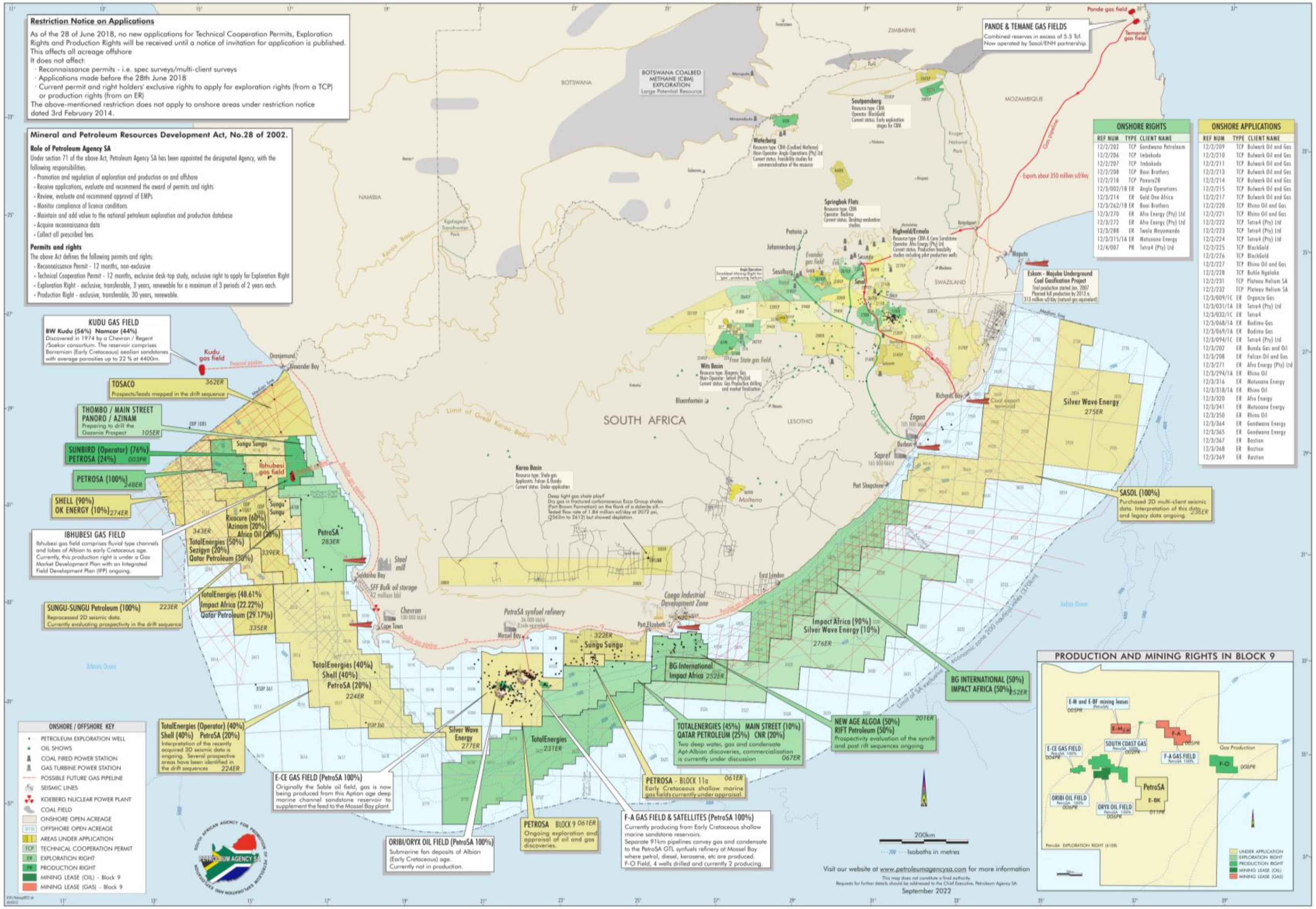

Figure 5-2: Petroleum Licence Blocks off the coast of South Africa (PASA, 2022).

It is noted that a number of applications / environmental assessment processes for prospecting and petroleum exploration off the West Coast have recently been undertaken. However, a small percentage of the applications submitted (and potentially approved) have advanced to implementation/completion. Furthermore, the proposed activities in each of these applications are generally restricted to a significantly smaller footprint within the overall prospecting/exploration right area. Thus, the number of available licences and application processes being undertaken off the West Coast is not an indication of the actual cumulative impacts which have taken place or that could take place in the future.

With respect to possible future activities, there is also currently insufficient information available to make reasonable assertions as to the nature of future mining activities. This is primarily due to the current lack of relevant geological information, which the proposed prospecting process aims to address. Thus, the possible range of the future prospecting, mining, exploration and production activities that could arise will vary significantly in scope, location, extent, and duration depending on whether a resource(s) is discovered, its size, properties and location, etc. As these cannot at this stage be reasonably defined, it is not possible to undertake a reliable assessment of the potential cumulative environmental impacts. It is also possible that the proposed, or future, prospecting fails to identify an economic mineral resource, in which case the potential impacts associated with the mining phase would not be realised.

The assessment methodology used in the Basic Assessment by its nature already considers past and current activities and impacts. In particular, the status of the receiving environment (benthic ecosystem threat status, protection level, protected areas, etc.) or threat status of individual species is taken into consideration, which is based to some degree on past and current actions and impacts (e.g. the IUCN conservation rating is determined based on criteria such as population size and rate of decline, area of geographic range / distribution, and degree of population and distribution fragmentation).

The current best available information regarding cumulative pressures is provided by Sink *et al.* (2019) and Harris *et al.* (2022). The map was generated as part of the NBA 2018 by doing a cumulative pressure assessment in which the impact of both current and historical ocean-based activities on marine biodiversity was determined by spatially evaluating the intensity of each activity and the functional impact to, and recovery time of, the underlying ecosystem types (Figure 5-3, left). Based on the severity of modification across the marine realm, a map of ecological condition was generated (Figure 5-3, right) which shows that Sea Areas 4C and 5C are located in an area experiencing very low cumulative impacts and that the ecological condition is therefore still natural or near-natural.

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 sea-mount environments such as Child's Bank and Tripp Seamount are located over 70 km offshore of Sea Areas 4C and 5C. While the Namaqua Fossil Forest MPA is located within Sea Area 4C, no prospecting activites will be undertaken in this area; the Namaqua Fossil Forest MPA was specifically excluded by DBCM from this Prospecting Right application.

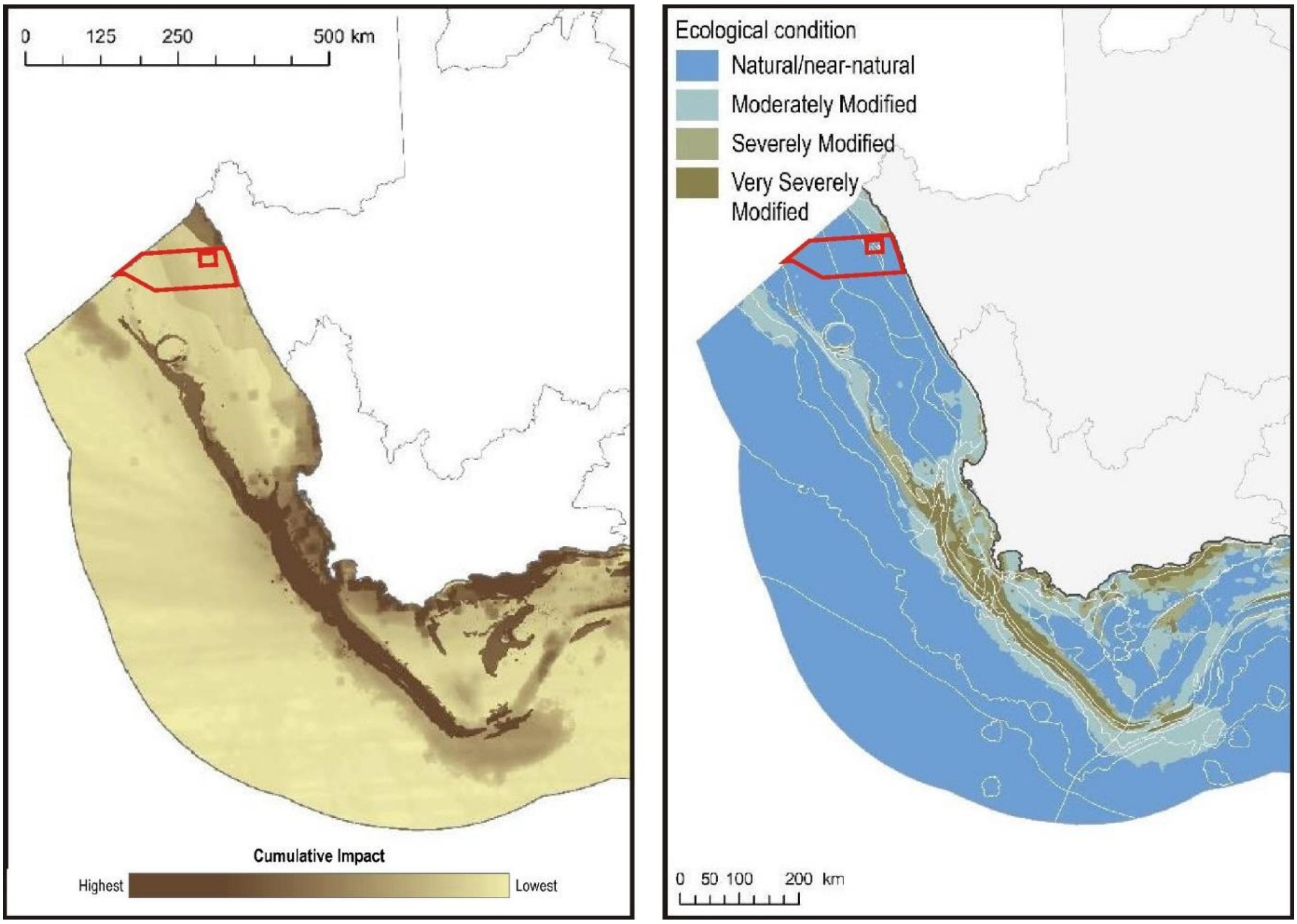

Figure 5-3: Sea Areas 4C and 5C (red polygon) in relation to cumulative impact on marine biodiversity, based the intensity of all cumulative pressures and the sensitivity of the underlying ecosystem types to each of those pressures (left) and the ecological condition of the marine realm based on the severity of modification as a result of the cumulative impacts (adapted from Sink *et al.* 2019 and Harris *et al.* 2022).

With respect to physical disturbance impacts, the existing cumulative impacts to the benthic environment include the development of hydrocarbon wells (see Section 4.3.4). Since 1976 approximately 40 wells have been drilled in the Southern Benguela Ecoregion. The majority of these occur in the iBhubesi Gas field in Block 2A to the south of Sea Areas 4C and 5C (Eco Atlantic recently completed the drilling of the Gazania-1 well in Block 2B which was spudded on 10 October 2022). Prior to 1983, technology was not available to remove wellheads from the seafloor, thus 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. Cumulative impacts from other hydrocarbon ventures in the area are likely to increase in future. 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 Sea Areas 4C and 5C.

The proposed sampling operations within Sea Areas 4C and 5C are likely to impact a maximum cumulative area of <0.3 km^2 in the Namaqua Bioregion (which has a total extent of 222 240 km^2), which is an insignificant percentage (0.002%) of the prospecting right area, excluding the Namaqua Fossil Forest MPA, and an even more insignificant percentage (0.00013%) of the bioregion as a whole and which will not significantly affect the near-natural ecological condition of the area. The cumulative impact as a result of the proposed sampling activities on the benthic environment is, thus considered to be **INSIGNIFICANT**.

The assessments of impacts of anthropogenic sounds provided in the scientific literature usually consider short-term responses at the level of individual animals only, as our understanding of how such short-term effects relate to adverse residual effects at the population level are limited. Data on behavioural reactions to anthropogenic noise acquired over the short-term could, however, easily be misinterpreted as being less significant than the cumulative effects over the long-term and with multiple exposures, i.e. what is initially interpreted as an impact not having a detrimental effect and thus being of low significance, may turn out to result in a long-term decline in the population, particularly when combined with other acoustic and non-acoustic stressors (e.g. temperature, competition for food, climate change, shipping noise) (Przeslawski *et al.* 2015; Erbe *et al.* 2018, 2019; Booth *et al.* 2020; Derous *et al.* 2020). Physiological stress, for example, may not be easily detectable in marine fauna, but can affect reproduction, immune systems, growth, health, and other important life functions (Rolland *et al.* 2012; Lemos *et al.* 2021). Confounding effects are, however, difficult to separate from those due to geophysical surveys. Similarly, potential cumulative impacts on individuals and populations as a result of other geophysical and seismic surveys (which are of much lower frequency and higher intensity) undertaken previously, concurrently or subsequently are difficult to assess.

A significant adverse residual environmental effect is considered one that affects marine biota by causing a decline in abundance or change in distribution of a population(s) over more than one generation within an area. Natural recruitment may not re-establish the population(s) to its original level within several generations or avoidance of the area becomes permanent. Historic seismic survey data acquired by the Petroleum industry off the West Coast is illustrated in Figure 5-4, which shows the 2D survey lines shot between 2001 and 2018, and indicates 3D survey areas on the West Coast. Despite the density of the Petroleum industry's seismic survey coverage over the past 17 years, the southern right whale population is reported to be increasing by 6.5% per year (Brandaõ *et al.* 2017), and the humpback whale by at least 5% per annum (IWC 2012) over a time when seismic surveying frequency has increased, suggesting that, for these population at least, there is no evidence of long-term negative change to population size as a direct result of seismic survey activities. It is important to note that the systems used for the proposed geophysical surveys for this prospecting right application use higher frequency acoustic sources at typically lower energy.

Reactions to sound by marine fauna depend on a multitude of factors including species, state of maturity, experience, current activity, reproductive state, time of day (Wartzok *et al.* 2004; Southall *et al.* 2007). If a marine animal does react briefly to an underwater sound by changing its behaviour or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the population as a whole (NRC 2005). However, if a sound source displaces a species from an important feeding or breeding area for a prolonged period, impacts at the population level could be significant. The increasing numbers of southern right and humpback whales around the Southern African coast, and their lingering on West Coast feeding grounds long into the summer, suggest that those seismic surveys (amongst other anthropogenic noise sources) conducted over the past 17 years have not negatively influenced the distribution patterns of these two migratory species at least. Information on the population trends of resident species of baleen and toothed whales is unfortunately lacking.

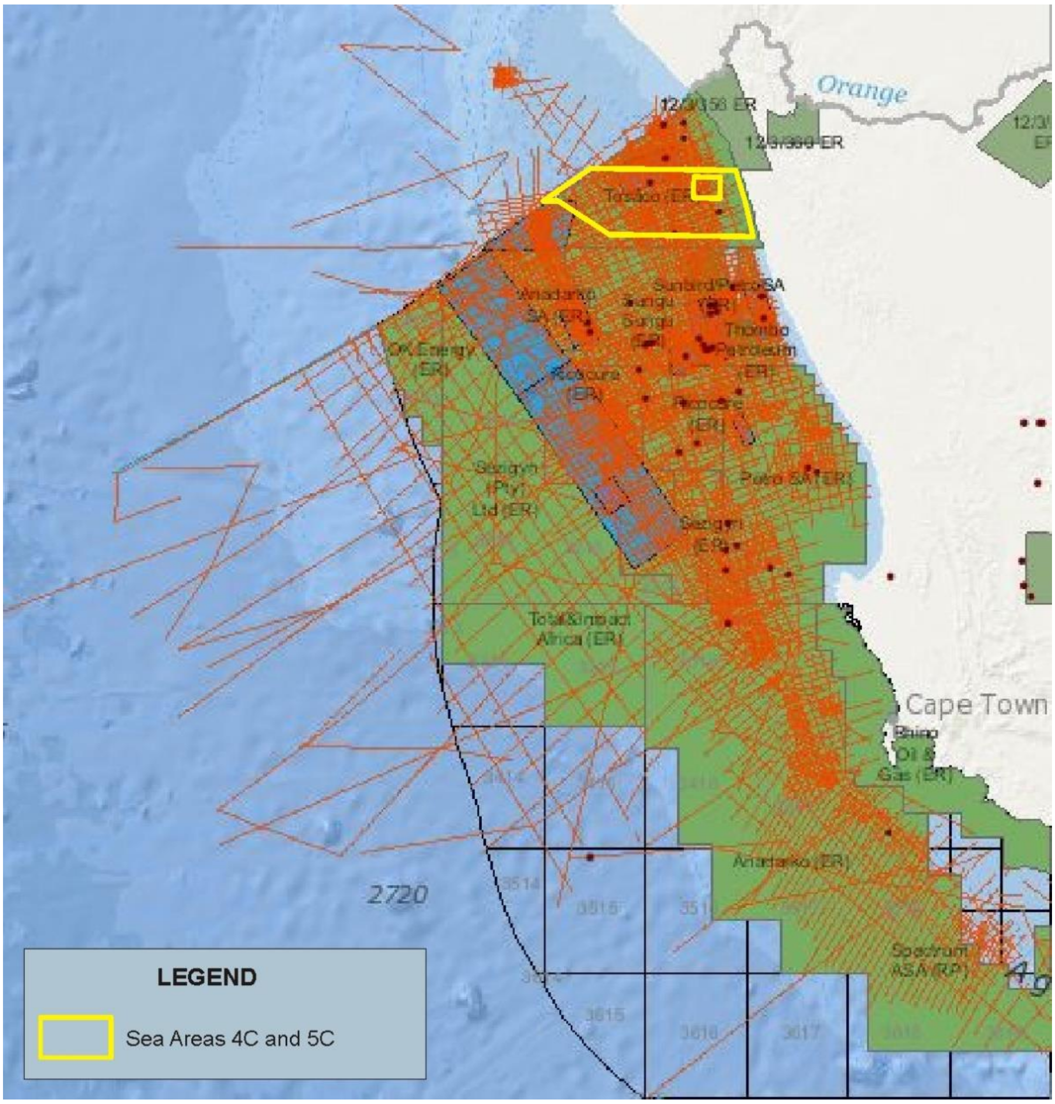

Figure 5-4: Sea Areas 4C and 5C in relation to historical Petroleum industry 2D (orange lines) and 3D (blue and purple polygons) surveys conducted on the West Coast between 2001 and 2018. Black dots are historically drilled exploration wells (Source: PASA).

Consequently, suitable mitigation measures must be implemented during geophysical data acquisition to ensure the least possible disturbance of marine fauna in an environment where the cumulative impact of increased background anthropogenic noise levels has been recognised as an ongoing and widespread issue of concern (Koper & Plön 2012; Simmonds *et al.* 2014; Williams *et al.* 2015; Chahouri *et al.* 2021). Should other concurrent geophysical or seismic exploration activities be undertaken in the project area, cumulative impacts can be expected. However, as the proposed geophysical survey activities will likely not occur concurrently to other seismic/geophysical surveys, concurrent cumulative acoustic impacts are thus deemed to be unlikely. However, should there be concurrent surveys, the cumulative impact could be of **LOW** significance depending on the frequency, duration, extent of the additional survey and the proximity of each survey to one another.

With respect to the potential cumulative impacts on the socio-economic environment, should additional exploration activities overlap in the same area within a relatively short period of time (e.g. within one year), the chance of an increase in disturbance and disruption to fisheries active in the area (namely demersal long-line, traditional line-fish, pole-and-line and fisheries research surveys), including small-scale fishery activities, is possible. However, the nature of the proposed geophysical surveys and sampling activities are such that the fishing vessels would still be able to fish in the vast majority of Sea Areas 4C and 5C sea areas and would only be temporarily excluded from undertaking fishing activity within a minimum exclusion safety zone of ~500 m around the prospecting vessels which will vary depending on the particular activities of the vessels. In light of the very short duration of the planned prospecting activities, the likelihood of any overlap with other seismic surveys or exploration activities in the area is unlikely and thus the potential cumulative impact on fishing activity is expected to be **VERY LOW.**

As noted previously, offshore prospecting and exploration is highly technical and requires specialised equipment. Thus, job opportunities during such activities would typically be limited, with some opportunities for local companies to provide support services during the course of operations. The overall cumulative positive impact of job creation and the generation of direct revenues could be of ***VERY LOW (POSITIVE)*** to ***LOW (POSITIVE)*** significance should there be concurrent prospecting/exploration activities in the region.

6. CONCLUSIONS AND RECOMMENDATIONS

DBCM is proposing to undertake offshore diamond prospecting activities in Sea Areas 4C and 5C, off the West Coast of South Africa. SLR was appointed to act as the independent EAP to undertake the necessary BA process and associated public consultation process for the proposed project. The BA 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, fisheries and underwater cultural heritage 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

6.1.1 General 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 or survey areas. As a result, the majority of the impacts associated with the geophysical survey or sampling vessels are considered to be of **INSIGNIFICANT** to **VERY LOW** significance after mitigation.

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

The proposed prospecting operations could potentially impact upon the demersal longline, pole-and-line, traditional linefish and small-scale fishery sectors, as well as fishery research surveys through the implementation of the required safety exclusion zones around the survey/sampling vessel. This impact would be of short-term duration and limited to the small portions of the overall extent of Sea Areas 4C and 5C. As demersal longline fishing activity is located beyond the focus area of proposed prospecting operations, any overlap with these fisheries is considered improbable and is expected to be **INSIGNIFICANT**. By liaising with the DFFE to ensure that the proposed prospecting activities avoid the planned research surveys there would be **NO IMPACT**.

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 operations, the impact would be at the national level, and of high intensity. Without mitigation this is of **Medium** significance. However, with the implementation of mitigation, cultural heritage sites can largely be avoided and if sampling is temporarily terminated in the unlikely event of encountering a shipwreck, archaeological investigations can be held and the impact regarded as **INSIGNIFICANT**.

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

Table 6-1: Summary of the Significance of the Potential Impacts Associated with the Proposed Prospecting Activities and No-Go Alternative

Potential impact	Significance	
	Without mitigation	With mitigation
Impact of the Vessel Discharges / Disposal to Sea		
Deck Drainage	VL	**VL**
Machinery Space Drainage	VL	**VL**
Sewage	VL	**VL**
Galley Waste	VL	**VL**
Solid Waste	INSIG	**INSIG**
Impact on Marine Fauna:		
Acoustic Impacts:		
Geophysical Surveys	VL	**VL**
Sampling Operations	VL	**N/A**
Electromagnetic Impacts of Geophysical Surveys	INSIG	**INSIG**
Disturbance and Loss of Benthic Fauna	VL to L	**VL**
Crushing of Benthic Fauna During Sampling Operations	VL	**VL**
Generation of Sediment Plumes	VL	**N/A**
Smothering of Benthos in Redepositing Sediments:		
Redeposition of discarded sediments on soft-sediment macrofauna	VL	**N/A**
Redeposition of discarded sediments on rocky outcrop communities	L	**VL**
Vessel lighting on pelagic fauna	VL	**VL**
Collisions with Project Vessels and Equipment	VL	**VL**
Potential loss of Equipment	VL	**VL**
Noise from Helicopters	VL	**VL**
Impact on Other Users of the Sea:		

Potential impact		Significance	
		Without mitigation	With mitigation
Fishing industry	Exclusion of the traditional line-fish, pole-and-line, small-scale fishers	INSIG	**INSIG**
	Exclusion of the fisheries research	VL	**NO IMPACT**
	Potential Impact of Survey Noise on Catch Rates	VL	**N/A**
	Sediment plume impact on fish stock recruitment	VL - INSIG	**N/A**
Marine mining and prospecting		INSIG	**INSIG**
Petroleum exploration		VL-L	**VL**
Marine transport routes		INSIG	**INSIG**
Socio-Economic Impact			
Impact on Cultural Heritage Material		M	**INSIG**
Impact related to job creation and business opportunities		*VL+*	***VL+***
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	**N/A**
Cumulative Impact:			
Benthic environment		**INSIG**	
Acoustic Impacts		**L**	
Fishing activity		**VL**	
Impact related to job creation and business opportunities		***VL+ - L+***	

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

6.1.2 Comparative Assessment of Project Alternatives

Site Alternatives

The intention of the proposed prospecting operations is to determine the presence of economically viable diamond deposits that occur within Sea Areas 4C and 5C. The proposed prospecting operations are fixed by the location of the economic resources within Sea Areas 4C and 5C and it follows that no location alternatives can be considered in the BA process.

This BAR has assessed the potential impacts associated with proposed prospecting activities within Sea Areas 4C and 5C. The potential impact on the marine benthic environment and significance thereof would be dependent on whether any vulnerable or sensitive benthic communities occur within the vicinity of the planned sampling footprints. As sampling targets gravel bodies, they would avoid known sensitive habitats and high-profile, rocky-outcrop areas without a sediment veneer.

Similarly, the potential impact on cultural heritage material is dependent on whether any wrecks or palaeontological material is located near or would be affected by the proposed prospecting activities. In order to minimise the significance of these potential impacts, it is recommended that the final sampling areas would be adjusted, as needed, to avoid any known significant vulnerable habitats / species or wrecks.

Geophysical Surveying and Sampling technological alternatives

Section 3.2.1 sets out the possible survey and sampling methodologies that could be employed for the proposed operations. It is anticipated that there are unlikely to be any additional impacts and very little difference in impact significance relating to the described survey technologies and proposed sampling methods. Due to the offshore location of Sea Areas 4C and 5C and associated water depths, no other alternative sampling methods (e.g. diver-assisted sampling) are considered feasible for assessment in the BA.

No-go Alternative

The no-go alternative is the option of not undertaking the proposed prospecting operations. This would result in a decrease in commercial interest in South Africa's offshore diamond mining sector, and the loss of potential economic benefits including government revenues, taxes and employment.

Logically if the planned prospecting operations do not proceed, the residual impacts (i.e. impacts after implementation of mitigation measures) of the proposed activities would not occur.

The implications of not going ahead with the proposed prospecting operations in Sea Areas 4C and 5C relate to the lost opportunity to maximise the use of South Africa's own mineral resources. This potential impact of the No-Go Alternative is considered to be of **LOW** significance.

6.1.3 Recommendation / Opinion of the EAP

The key principles of sustainability, including ecological integrity, economic efficiency, and equity and social justice, are integrated below as part of the supporting rationale for recommending an opinion on whether the proposed project should or should not be approved.

- **Ecological integrity** - The disturbance of benthic fauna and associated biodiversity is considered to be of medium intensity as the benthic biota within the sampling footprints would be lost or disturbed. However, the maximum potential total area of disturbance (0.225 km^2) is considered to be relatively small in comparison to the total available area of similar habitat, and full recovery of benthic biodiversity within the disturbed footprints would take place within the medium term due to natural sedimentation processes and recolonization by benthic communities.
  In summary, the proposed project could result in the loss of some ecological integrity in small areas within the study area, but it is considered to be a highly localised and short- to medium-term under normal operating conditions.
- **Economic efficiency -** As noted in Section 3.5.2, marine and coastal resources in the Northern Cape provide the greatest value to the mining and fishing sectors for the province. It is acknowledged in the Northern Cape PSDF that the province *"has an abundance of diamond deposits both onshore and in marine deposits"* and that *"this has led to the development of a large diamond mining sector, which has become the dominant activity of the coastal zone".*

If there was any overlap, the proposed prospecting activities could result in impacts on fishing as a result of the minimum exclusion safety zone of ~500 m around the prospecting vessels which will vary depending on the particular activities of the vessels (i.e. loss of access to fishing grounds). The demersal longline, pole-and-line, traditional linefish and small-scale fisheries are the sectors that could potentially be affected by the proposed project and given the short-term duration of prospecting and that fishing activity is expected to generally occurs outside of the target areas for the prospecting operations within Sea Areas 4C and 5C, the impact of the proposed project on fisheries is considered to be insignificant.

Although offshore prospecting is highly technical and requires specialised vessels and crews, there be a few opportunities for local companies to provide support services during the proposed prospecting operations, e.g. vessel supplies, support vessels, etc. As opportunities would be limited, the economic benefits (job creation and generation of direct revenues) associated with the project are considered to be only of ***VERY LOW (positive)*** significance.

On the basis of the above, the proposed project is considered to be economically efficient, as it provides a potential opportunity to increase the use of South Africa's own natural resources off the West Coast of South Africa while at the same time only having a negligible impact on fishing sectors.

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

With the implementation of the proposed mitigation measures, the nature and extent of the proposed prospecting activities are anticipated to have generally **INSIGNIFICANT to VERY LOW** significant impacts. While the impact of disturbance and loss, crushing, sediment removal and generation of suspended sediment plumes on benthic macrofauna is assessed to be of **VERY LOW to LOW** significance, it is noted above that full recovery within the sampling footprints is expected to take place within the medium term due to natural sedimentation process and recolonisation by benthic communities. Given this, as well as the sustainability criteria described above, and 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.

6.2 RECOMMENDATIONS FOR MITIGATION

6.2.1 General Mitigation Recommendations for the Proposed Prospecting Operations

Compliance with Environmental Management Programme and MARPOL 73/78 standards

- All phases of the proposed project must comply with the Environmental Management Programme attached as Appendix F; and
- The sampling and support vessels must ensure compliance with MARPOL 73/78 standards.

Notification and communication with key stakeholders

- Prior to the commencement of the proposed activities, DBCM or appointed operator should consult with the managers of the DFFE 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 activities, notify overlapping and neighbouring petroleum rights holders, as well as any neighbouring mineral prospecting or mining rights holders, to ensure that there is no overlapping of activities in the same area over the same time period;
- Notify relevant government departments and other key stakeholders of the commencement of sampling 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;
    - South African Deepsea Trawling Industry Association (SADSTIA);
    - South African Linefish Associations;
    - SA Marine Linefish Management Association (SAMLMA);
    - Hake Longline Association;
    - National Small, Medium and Micro-Enterprise (SMME) Fishing Forum; and
    - West Coast Rock Lobster Sea Management Association (if any activities are activated within the 100 m contour line).
  - Representatives of small-scale local fishing co-operatives;
  - DFFE Vessel Monitoring, Control and Surveillance (VMS) Unit;
  - South African Maritime Safety Authority (SAMSA);
  - DFFE, including the fisheries research managers;
  - Transnet National Ports Authority (ports of Cape Town or Saldanha Bay, as may be applicable); and
- Prior to commencement of activities notify the SAN Hydrographic Office, requesting a Notice to Mariners be issued with the co-ordinates of the geophysical or sampling areas with the required safety zones around the survey or sampling vessel for the duration of the operations.
- Notify the SAN Hydrographic office when the programme is complete so that the Navigational Warning can be cancelled.

Discharges

- Ensure that hydrocarbons are stored in such a way as to prevent release of pollutants overboard;
- Ensure all crew are trained in spill management;
- Low-toxicity biodegradable detergents and suitable absorbents (where possible reusable absorbent cloths) should be used in cleaning of all deck spillage; and
- Minimise the discharge of galley waste material should obvious attraction of marine fauna be observed.

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).

Vessel Transit

- All vessel operators should keep a watch for marine mammals and turtles in the path of the vessel.
- Ensure vessel transit speed 10 knots (18 km/hr) when sensitive marine fauna are present in the vicinity.

- Reduce lighting on the survey and sampling vessels to a minimum compatible with safe operations whenever and wherever possible. Light sources should, if possible and consistent with safe working practices, be positioned in places where emissions to the surrounding environment can be minimised.
- Keep disorientated, but otherwise unharmed, seabirds in dark containers for subsequent release during daylight hours. Ringed/banded birds should be reported to the appropriate ringing/banding scheme (details are provided on the ring).

Geophysical Surveys

- A MMO should be appointed to ensure compliance with mitigation measures during geophysical surveying.
- Onboard 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. Equipment of source levels greater than 210 dB re 1 µPa at 1 m not capable of "soft starts" would be run concurrently with equipment that can be soft started and only switched on once the soft-start has been completed.
- 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 possible, 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 prospecting area, a precautionary approach to avoiding impacts throughout the year is recommended.
- Ensure that passive acoustic monitoring (PAM) is incorporated into any surveying taking place between June and November.
- Use standard operational procedure to warm up the electromagnetic source transmitter (i.e. equivalent to ramp-up of current in electric source). It is recommended that the electromagnetic source should be ramped up over a minimum period of 20 minutes.
- Turn off electromagnetic source when not collecting data.
- Use lowest field strengths required to successfully complete the electrical, magnetic and/or electro-magnetic survey.
- A non-dedicated marine mammal observer (MMO) must keep watch for marine mammals behind the vessel when tension is lost on the towed equipment. Either retrieve or regain tension on towed gear as rapidly as possible.
- Should a cetacean become entangled in towed gear, contact the South African Whale Disentanglement Network (SAWDN) formed under the auspices of DFFE to provide specialist assistance in releasing entangled animals.
- Report any collisions with large whales to the International Whaling Commission (IWC) database to assist in the identification of species most affected, vessels involved in collisions, and correlations between vessel speed and collision risk.

Sampling Activities

- Remote sensing data should be used to conduct a pre-sampling analysis of the seabed to identify high-profile, rocky-outcrop areas without a sediment veneer. Exploration sampling targets gravel bodies in unconsolidated sediments and does not target these high-profile rocky-outcrops without a sediment veneer.

Cultural Heritage Material

- Areas where shipwreck sites are identified during the geophysical surveys must be excluded prior to undertaking sampling activities;
- Objects of cultural significance, including fossils, recovered during sample processing will be recorded and addressed in accordance with the requirements of the National Heritage Resources Act, 1999.
- The onboard DBCM/DBM 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 vessel operator 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; and
- If shipwreck material is encountered during the course of sampling in Sea Areas 4C and 5C, 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 DBM 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.

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