BASIC ASSESSMENT PROCESS FOR THE PROPOSED PROSPECTING IN SEA CONCESSION AREA 14A BY TRANS ATLANTIC DIAMONDS (PTY) LTD

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Appendix 3:

Marine Specialist Study

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MARINE SPECIALIST IMPACT ASSESSMENT FOR EXPLORATION AND PROSPECTING ACTIVITIES IN SOUTH AFRICAN SEA AREA 14A

NOVEMBER 2021

ANCHOR environmental

Anchor Environmental Consultants Report No. 1987/1

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Report prepared for:

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EXECUTIVE SUMMARY

Anchor Environmental Consultants were requested to undertake a marine specialist study for Trans Atlantic Diamonds (Pty) Ltd who are applying for a diamond prospecting right for Concession Area 14A, inshore along the Western Cape Coast. Proposed activities include geophysical exploration and sampling/prospecting to detect the presence of palaeo-beach deposits at different submerged sea levels that occur in Concession 14A, which are known from other concessions to contain diamondiferous gravels. Seismic surveying will be conducted using a dedicated survey vessel with a hull-mounted Multi-Beam Echo Sounder (MBES, high frequency range) and Topas sub-bottom profiler (SBP) system (mid-frequency range) collecting high-resolution acoustic data along lines 50 m to 200 m apart throughout the concession area. Areas within the concession that are shallower than 15m are expected to be surveyed by use of a small craft vessel equipped with a simplified array of seismic survey equipment. Sampling will be undertaken in targeted areas identified through the analysis of the acoustic survey data. Four potential methods of collecting geophysical samples from the seabed are being considered. A Van Veen grab with a sampling capacity of approximately 50 kg will be used to collect baseline environmental data on sediment and benthic macrofauna at 20-50 sites. Geotechnical samples to assist in understanding the sea floor geology and resource evaluation will be collected at 100-200 sites using either vibracoring, gravity coring or sonic coring. In addition to the above prospective targets will be analysed by a uniquely designed drill tool that can dredge gravel from the seabed. Pending the final tool design, the drill bit footprint will be between 3 and 5 m^2 with an expected average hole depth of 3 m. Sample volumes are anticipated to be in the range of 9 to 15 m^3 per sample. These samples will be spaced at roughly 300 m apart from north to south. Material from drill sampling will be processed onboard and tailings will be discarded overboard.

A description of the affected environment is provided. Habitat and biota of conservation importance were identified and mapped in relation to the proposed survey area. The likelihood of occurrence of affected marine fauna within the proposed survey area was ascertained from available literature. Important user groups such as fisheries are described and mapped in relation to the proposed survey area. Potential impacts from the proposed exploration and prospecting activities were identified. Impacts were assessed and, where possible, mitigation measures have been identified to avoid/minimise/reduce any impacts.

Assessment of potential impacts associated with the proposed activities range from medium to insignificant, but with effective mitigation these are all reduced to very low, low or insignificant (see Summary Table below).

The potential impact of most concern that was assessed as MEDIUM negative significance prior to mitigation was seismic disturbance to marine mammals. It is known that migrating humpback and southern right whales are frequently encountered on the west coast of southern Africa and encounters with odontocetes such as dusky dolphins and Heaviside's dolphin (listed as near threatened on the IUCN red data list) are likely throughout the year. Furthermore, humpback calves are vulnerable during the southern migration which takes place during the months of September and October. Of the proposed seismic survey activities, the Topas sub-bottom profiler system which uses shallow (35-45 kHz) and medium penetration (1-10 kHz) "Chirp" seismic pulses to map the sediment horizon could present a risk to dusky and Heaviside's dolphins. These species are regarded as mid-frequency

cetaceans that could be at risk during the proposed seismic survey. Effective implementation of mitigation measures should ensure that potential impacts on marine mammals arising from the proposed seismic survey activities in concession 14A would be reduced to LOW significance.

With respect to impacts on fisheries, Concession 14A is located within 12 km of Doringbaai, a small coastal village where marine resource use, particularly small-scale commercial (including interim relief rights holders) and subsistence line fishing, are critical livelihood activities that play an important role in ensuring food security for the community. The distance from Doringbaai harbour is well with the daily travel range of the small, outboard motor-powered boats used by small scale fishers, and the depth range of the concession area (16-30 m) overlaps with the depth range where the main target species in the area (west coast rock lobster and hottentot seabream) are found. There may well be fishing grounds that are important to the local community within the 14A concession area and it is recommended that these be identified in consultation with local stakeholders, such that effective and mutually acceptable mitigation measures can be implemented during the survey (e.g. avoidance of these areas during times of the year when fish are running).

Table i **Summary table of potential marine ecological and fisheries impacts associated with inshore diamond exploration activities (seismic survey and sampling/prospecting) in South African Sea Area concession 14A.**

Impact	Consequence	Probability	Significance	Status	Confidence
Seismic disturbance to invertebrates	Very low	Probable	VERY LOW	-ve	Medium
With mitigation	Very low	Improbable	INSIGNIFICANT	-ve	Medium
Seismic disturbance to fish	Very Low	Probable	VERY LOW	-ve	Medium
No mitigation	Very Low	Improbable	INSIGNIFICANT	-ve	Medium
Seismic disturbance to marine mammals	Medium	Probable	MEDIUM	-ve	High
With mitigation	Medium	Improbable	LOW	-ve	High
Seismic disturbance to seabirds	Low	Probable	LOW	-ve	High
With mitigation	Low	Improbable	VERY LOW	-ve	High
Seismic disturbance to turtles **No mitigation**	Very low	Improbable	INSIGNIFICANT	-ve	High
Marine megafauna collisions with survey vessels	Low	Possible	VERY LOW	-ve	High
With mitigation	Very low	Improbable	INSIGNIFICANT	-ve	High
Offshore based seabed sampling and tailings disposal **No mitigation**	Low	Definite	LOW	-ve	High
Fine sediment plumes **No mitigation**	Very low	Definite	VERY LOW	-ve	High
Waste discharges during vessel operations	Very low	Probable	VERY LOW	-ve	High
With mitigation	Very low	Improbable	INSIGNIFICANT	-ve	High
Impact on fisheries	Very Low	Probable	VERY LOW	-ve	High
No mitigation (see best practice recommendations)	Very Low	Improbable	INSIGNIFICANT	-ve	High

Mitigation measures recommended to avoid, reduce or remedy potential marine ecological impacts associated with the proposed prospecting in Concession 14A are summarised below.

Essential mitigation measures for impacts to marine megafauna

- A designated onboard Marine Mammal and Seabird Observer (MMSO) should be employed to ensure compliance with mitigation measures during geophysical surveying.
- MMSO to conduct pre-survey visual scans of at least 15 minutes for the presence of cetaceans, feeding seabirds and marine turtles around the survey vessel prior to the initiation of any acoustic impulses
- “Soft starts” should be carried out for equipment with source levels greater than 210 dB re 1 µPa at 1 m over a period of 20 minutes to give adequate time for marine mammals to leave the vicinity. Where this is not possible, the equipment should be turned on and off over a 20-minute period to act as a warning signal and allow cetaceans to move away from the sound source.
- Terminate the survey if any marine mammals, seabirds or turtles show affected behaviour within 500 m of the survey vessel or equipment until the mammal has vacated the area.
- Avoid planning geophysical surveys during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (beginning of June to end of November) and ensure that migration paths are not blocked by sonar operations.
- For the months of June and November ensure that Passive Acoustic Monitoring (PAM) is incorporated into any survey programme.
- Record incidences of encounters with marine life (mammals, seabirds, turtles, seals, fish) their behaviour and response to seismic survey activity. Ensure that MMSOs compile a survey close–out report incorporating all recorded data to the relevant DFFE authorities.
- Vessel transit speed to not exceed 12 knots (22 km/hr), except within 25 km of the coast where it should be kept to less than 10 knots (18 km/hr) as well as when sensitive marine fauna are present in the vicinity.

Best Practice Mitigation (Recommended) for impacts related to spills and waste generated by vessels

- Planning and management of potential discharges to ensure that tailings are not discarded onto potentially sensitive habitats.
- Inform & empower all staff about sensitive marine species & suitable disposal of waste;
- Ensure compliance with relevant MARPOL standards;
- Develop a waste management plan using waste hierarchy;
- A Shipboard Oil Pollution Emergency Plan (SOPEP) must be prepared for all vessels and should be in place at all times during operations;
- Deck drainage should be routed to a separate drainage system (oily water catchment system) for treatment to ensure compliance with MARPOL (15 ppm);
- All process areas should be bunded to ensure drainage water flows into the closed drainage system;

- Drip trays should be used to collect run-off from equipment that is not contained within bunded areas and the contents routed to the closed drainage system;
- Low-toxicity biodegradable detergents should be used in the cleaning of all deck spillages;
- All hydraulic systems should be adequately maintained and hydraulic hoses should be frequently inspected; and
- Spill management training and awareness should be provided to crew members of the need for thorough cleaning-up of any spillages immediately after they occur in order to minimise the volume of contaminants washing off decks.

Best Practice Mitigation (Recommended) measures for impacts on fisheries and other shipping
Prior to survey commencement, the following key stakeholders should be consulted and informed of the proposed survey activity (including navigational co-ordinates of the survey area, timing and duration of proposed activities) and the likely implications thereof:

- Fishing industry / associations:
  - SA Marine Linefish Management Association (SAMLMA);
  - South African Pelagic Fishing Industry Association (SAPFIA);
  - West Coast Rock Lobster Association; and
  - Local fishing communities in Doringbaai
- Other associations and organs of state
  - DFFE;
  - SAMSA;
  - South African Navy Hydrographic office; and
  - Overlapping and neighbouring right holders.

These stakeholders should again be notified at the completion of surveying when the survey vessel(s) is/are off location. The operator must request, in writing, that the South African Navy Hydrographic office release Radio Navigation Warnings and Notices to Mariners throughout the survey periods. The Notice to Mariners should give notice of (1) the co-ordinates of the proposed survey area, (2) an indication of the proposed timeframes of surveys and day-to-day location of the survey vessel(s), and (3) an indication of the required safety zone(s) and the proposed safe operational limits of the survey vessel. These Notices to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible.

Further mitigation measures associated with impacts to the fishing industry include:

- Undertake surveys when fishing effort is lower (preferably out of fishing seasons).
- Appoint a fisheries liaison officer (FLO) to facilitate communication with fishing community in Doringbaai. The FLO should report daily on vessel activity and respond and advise on action to be taken in the event of encountering fishing gear in the survey area.

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GLOSSARY

Amphipod/a	Crustaceans with no carapace and a laterally compressed body
Anthropogenic	Environmental pollution originating from human activity
Baseline	Information gathered at the beginning of a study which describes the environment prior to development of a project and against which predicted changes (impacts) are measured.
Benthic	Pertaining to the environment inhabited by organisms living on or in the ocean bottom
Benthic/benthos	The ecological region at the lowest level of a body of water such as an ocean, lake, or stream, including the sediment surface and some sub-surface layers
Biodiversity	The variability among living organisms from all terrestrial, marine, and other aquatic ecosystems, and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems.
Biomass	The mass of living biological organisms in a given area or ecosystem.
Biota	Living organisms within a habitat or region
Bryozoan	A sedentary aquatic invertebrate of the phylum Bryozoa, which comprises the moss animals.
Chlorophyll a	A green pigment, present in all green plants (including algae) and cyanobacteria, which is responsible for the absorption of light to provide energy for photosynthesis.
Community	In ecology, a community is a group or association of populations of two or more different species occupying the same geographical area and in a particular time.
Community composition	The number of species in that community and their relative numbers.
Crustacea/n	Generally differ from other arthropods in having two pairs of appendages (antennules and antennae) in front of the mouth and paired appendages near the mouth that function as jaws.
Cumulative impacts	Direct and indirect impacts that act together with current or future potential impacts of other activities or proposed activities in the area/region that affect the same resources and/or receptors.
Diatoms	A type of phytoplankton group that form a silica-based cell wall.
Dinoflagellate	A type of flagellate phytoplankton. Some produce toxins that can accumulate in shellfish, resulting in poisoning when eaten.
Ecological function	The potential of an ecosystem to deliver a service that is itself dependent on ecological processes and structures.
Ecology	The relations of organisms to one another and to their physical surroundings.
Environment	The external circumstances, conditions and objects that affect the existence of an individual, organism or group. These circumstances include biophysical, social, economic, historical and cultural aspects.
Faunal community	A naturally occurring group of native animals that interact in a unique habitat.
Filter feeding	(Off an aquatic animal) feeding by filtering out plankton or nutrients suspended in the water.
Geomorphology/ical	Relating to the physical features of the surface of the earth and their relation to its geological structures.
Impact	A change to the existing environment, either adverse or beneficial, that is directly or indirectly due to the development of the project and its associated activities.

Important Bird and Biodiversity Area	An area identified using an internationally agreed set of criteria as being globally important for the conservation of bird populations.
Invertebrate	An animal without a backbone (e.g. a starfish, crab, or worm)
Isopod/a	An order of freshwater, marine, or terrestrial crustaceans of the order or suborder Isopoda, with seven pairs of legs and a dorsoventrally flattened body.
Macrofauna	Animals larger than 0.5 mm.
Macrophyte	An aquatic plant large enough to be seen by the naked eye.
Mean Sea Level	An average level of the surface of the oceans from which heights such as elevation may be measured. MSL is a type of vertical datum (a standardised geodetic datum).
Megafauna	Large marine species such as sharks, rays, marine mammals and turtles. These animals are key components of marine ecosystems but, as they are long-lived and have low reproductive rates, their populations are usually the first to be reduced by human pressures.
Mitigation measures	Design or management measures that are intended to minimise or enhance an impact, depending on the desired effect. These measures are ideally incorporated into a design at an early stage.
Mollusc/a	Invertebrate with a soft unsegmented body and often a shell, secreted by the mantle.
Operational phase	The stage of the works following the Construction Phase, during which the development will function or be used as anticipated in the Environmental Authorisation.
Physico-chemical	Dependent on the joint action of both physical and chemical processes.
Phytoplankton	Ocean dwelling microalgae that contain chlorophyll and require sunlight in order to live and grow.
Plankton	Organisms drifting in oceans, seas, and bodies of fresh water. The word zooplankton is derived from the Greek zoon, meaning "animal", and planktos, meaning "wanderer" or "drifter". Typically comprised of phytoplankton and zooplankton, as well as the eggs, larvae and juveniles of larger animals.
Polychaete/a	Also known as the bristle worms. A paraphyletic class of annelid worms, generally marine. Each body segment has a pair of fleshy protrusions called parapodia that bear many bristles, called chaetae, which are made of chitin.
Specialist study	A study into a particular aspect of the environment, undertaken by an expert in that discipline.
Species	A category of biological classification ranking immediately below the genus, grouping related organisms. A species is identified by a two-part name; the name of the genus followed by a Latin or Latinised un-capitalised noun.
Species richness	The number of different species represented in an ecological community. It is simply a count of species and does not take into account the abundance of species.

LIST OF ABBREVIATIONS

Anchor/ AEC	Anchor Environmental Consultants (Pty) Ltd.
BCS	Benguela Current System
CBD	Convention on Biological Diversity
CPUE	Catch per unit effort
DFFE	Department of forestry, fisheries and the Environment (Formerly DEFF and DAFF)
DIN	Dissolved Inorganic Nitrogen
DMR	Department of mineral resources
DO	Dissolved Oxygen
EBSA	Ecologically or Biologically Significant Area
FLO	Fisheries Liaison Officer
IBA	Important Bird and Biodiversity Area
IEM	Integrated Environmental Management
IUCN	International Union for Conservation of Nature
LMP	Line fish Management Protocol
MARPOL	The International Convention for the Prevention of Pollution from Ships
MBES	Multi Beam Echo Sounder
MMI	Marine Mammal Institute
MMSO	Marine Mammal and Seabird Observer
MMO	Marine Mammal Observer
MPA	Marine Protected Area
MSL	Mean Sea Level
NBA	National Biodiversity Assessment
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act No. 107 of 1998, as amended
NH3-N	Ammonia
OMP	Operational Management Plan
PAM	Passive Acoustic Monitoring
PNE	Protected Natural Environment
PSU	Ocean salinity is generally defined as the salt concentration in sea water. It is measured in unit of PSU (Practical Salinity Unit), which is a unit based on the properties of sea water conductivity. It is equivalent to per thousand or (o/00) or to g/kg.
PTS	Permanent threshold shift
RQO	Resource Quality Objectives
ROV	Remotely Operated Vehicle
SADCO	Southern African Data Centre for Oceanography
SAMLMA	South African Mairne Linefish Management Association
SAMSA	South African Maritime Safety Authority
SANBI	South African National Biodiversity Institute
SAPFIA	South African Pelagic Fishing Industry Association
SBP	Sub-bottom profiler
SOPEP	Shipboard Oil Pollution Emergency Plan

TAC	Total allowable catch
TAD	Trans Atlantic Diamonds (Pty) Ltd
TAE	Total allowable effort
TSS	Total Suspended Solids
TTS	Temporary threshold shift
VHF	Very High Frequency

1 INTRODUCTION

Trans Atlantic Diamonds (Pty) Ltd (hereafter referred to as TAD) is applying for a prospecting right for Concession Area 14A, offshore of the Western Cape coast. Anchor Environmental Consultants (Pty) Ltd (AEC) were appointed as the Environmental Assessment Practitioner (EAP) to undertake the required Basic Assessment Process and support TAD with this application. AEC has inhouse marine specialist expertise and therefore also undertook the Marine Specialist Impact Assessment Study.

1.1 Terms of Reference

This Marine Specialist Study was required to identify and assess potential impacts that the proposed prospecting activities could have on the marine environment and other user groups. The Terms of Reference included requirements for the following:

- A project description adequate for the purposes of the marine impact assessment study;
- A description of the marine ecology within and surrounding the affected area;
- The identification and description of potentially sensitive habitats and species receptors of impacts (e.g. endangered, threatened and protected species, important feeding, breeding or migration routes, sensitive habitats, etc.);
- The identification of other user groups and potential user conflict based on area of overlap and regional importance of the concession area (including fisheries, commercial and recreational vessel traffic, other marine mining activities);
- The identification of potential direct, indirect and cumulative impacts resulting from the proposed prospecting activities;
- An assessment of identified impacts using an objective, and consistent methodology that meets the National South African legislative requirements (National Environmental Management Act No. 107 of 1998, as amended); and
- The identification of mitigation measures to avoid/minimise/reduce impacts and enhance benefits.

1.2 Diamond mining in South Africa

Diamond-mining concession areas in South Africa are grouped into three categories: Land, Surf-Zone and Marine (offshore) Concession Areas (Figure 1; Clark *et al.* 1999; Penney *et al.* 2007). The Land and Surf-Zone concessions areas are considered as "onshore mining" operations with mines located between the Orange River mouth and slightly south of the Olifants River in South Africa. Marine Concession Areas are those allocated offshore and extend southwards from the border of Namibia to an area just south of Saldanha Bay (Clark *et al.* 1999). These concession areas are further divided into four sub-areas (Figure 1 and Figure 2): the A concession extends 31.5 m west of the low-water mark to 1000 m west of the high water mark, the B concession extends from this boundary to 5000 m west of the high water mark offshore from the western boundary of A, the C concession extends westward of this point to the 200 m isobaths, and the D concession extends offshore to the 500 m isobath. Diamond mining concession areas in South Africa were mapped according to their licence (Figure 2). The exploration, prospecting and mining rights allocations (prior to 2018) are indicated in the inset map in Figure 2.

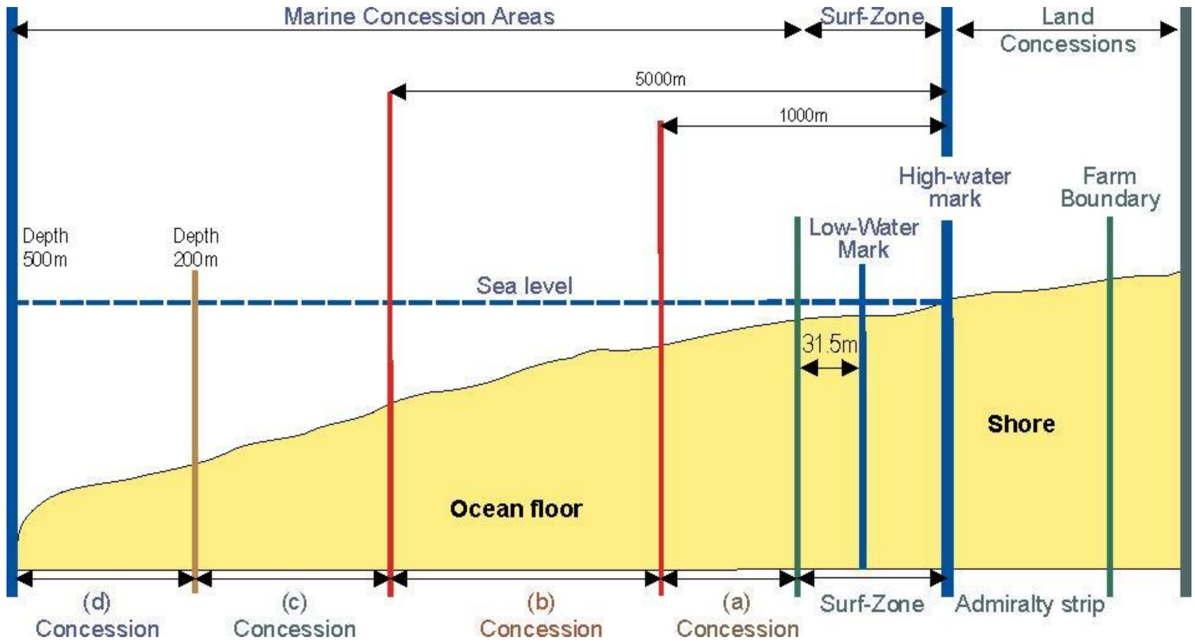

Figure 1 **Diagram of the onshore and offshore boundaries of the South African marine diamond mining concession areas (from Penney *et al*. 2007)**

A range of different techniques are used to access diamond resources in the marine environment. Typical onshore operators in the coastal environment use cofferdam and seawall mining techniques. Other methods for accessing resource in shallow subtidal gullies and small bays include, depending on the depth of the resource and access to the shoreline, shore and boat-based diving operations. Lastly, diamond mining operations also occur in the offshore environment where tools such as crawlers and drilling rigs are deployed from vessels to extract diamond-rich gravel from the seafloor.

1.3 Description of the proposed activity

1.3.1 Concession 14A

TAD is applying for a Prospecting Right to undertake geophysical surveying and sampling to target potentially diamondiferous and gemstone deposits in addition to other heavy minerals, Industrial minerals, Precious metals and Ferrous and Base metals that may exist within Sea Area 14A, in terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002, as amended) (MPRDA). Years of erosion and natural forces (wind, rain, water currents) wash gemstones and other valuable minerals from their primary deposits in kimberlite pipes to beaches where they are typically deposited. TAD intends to undertake geophysical exploration (seismic survey) and sampling to detect the presence of Paleo-beach deposits, which are known from other concessions to contain diamondiferous gravels, at different submerged sea levels.

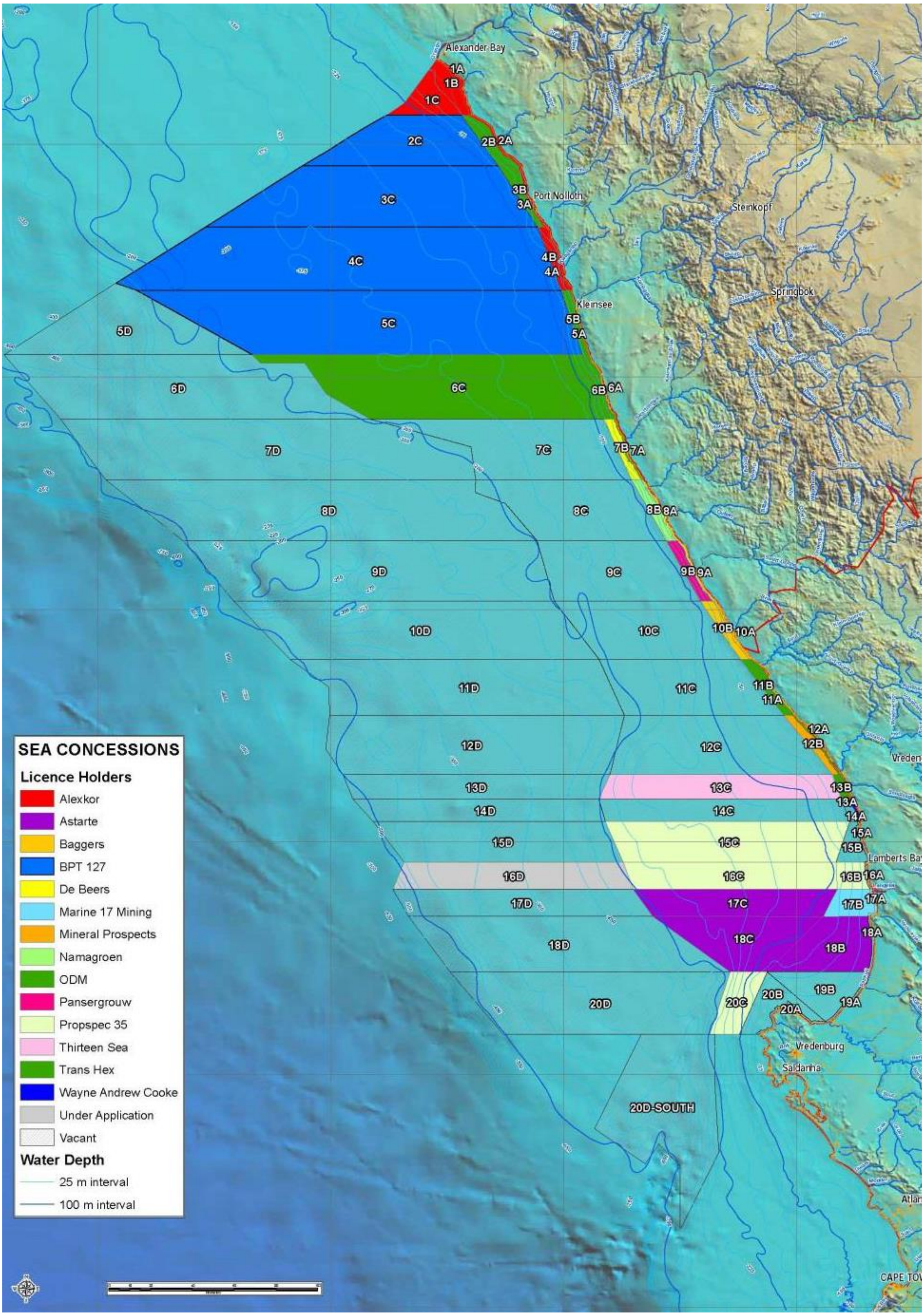

Figure 2 **The offshore diamond mining lease areas in South African waters. The coastal shelf waters have been divided into 20 contiguous, parallel strips which have been further subdivided into the onshore and offshore concession areas (A, B, C, D).**

The application area is the Sea Area 14A (i.e. Concession 14A) and is an area of sea covering 1 240 ha just offshore of the Western Cape coast of South Africa from Doringbaai (approximately 6.88 km south of Strandfontein) to just south of Groothoekbaai (Figure 3 and Figure 4). The proposed prospecting programme will be completed within five (5) years and includes a combination of non-invasive and invasive activities. The non-invasive activities are mostly related to geophysical exploration, data acquisition and analysis. The invasive activities are those related to sampling (collection of core and grab samples).

1.3.2 Geophysical Exploration

Geophysical surveying will be conducted using a dedicated survey vessel with a hull-mounted multibeam echo sounder (MBES) and Topas sub-bottom profiler system designed to collect high-resolution acoustic data along lines 50 m to 200 m apart, throughout the concession area. The use of this geophysical survey equipment allows the operator to produce a digital terrain model of the seafloor. The MBES provides depth sounding information on either side of the vessel's track across a swath width of approximately two times the water depth, while the Topas sub-bottom profiler generates profiles up to 60 m beneath the seafloor, thereby giving a cross section view of the sediment layers. The source sound level of the MBES is variable but will be a maximum of 221dB re 1µPa @ 1m, with a frequency range of between 200 and 400kHz. The Topas sub-bottom profiler uses shallow (35 to 45 kHz) and medium penetration (1 to 10 kHz) "Chirp" seismic pulses. 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 use of a magnetometer to detect magnetic signatures will also be required.

Low frequency seismic sources travel the greatest distance in the marine environment. Conversely, high frequency sources have greater attenuation over distance. Due to the higher frequency emissions of the MBES equipment, noise levels tend to dissipate over a relatively short distance, whereas the mid-frequency Topas chirp system will generate noise that will travel a greater distance. The acoustic footprint of the intended survey equipment is much lower than that of airgun arrays. It should be noted that a decibel is a logarithmic scale for noise where each unit of increase represents a tenfold increase in the quantity being measured.

TAD will be using the IMD SA survey vessel DP Star to conduct the geophysical acoustic surveys. This vessel is regularly used for similar survey work along the west coast of southern Africa. This type of survey typically does not require the vessel to tow any cables, however, it will be "restricted in its ability to manoeuvre" during the survey due to the operational nature of this work. Concession 14A will be surveyed from the western boundary (1 km from the highwater mark) to not shallower than 15m water depth for the sake of vessel safety (Figure 4). Survey lines for 14A amount to a total distance of approximately 120 km. The survey speed of the DP Star is typically 100 km/day, which would equate to just over a day's work. It has been proposed that survey work will be conducted over a one-week window period during suitable calm sea and weather conditions (probably late summer-autumn 2022). The area shallower than 15m is expected to be surveyed by use of a small craft vessel equipped with a simplified array of seismic survey equipment. The bathymetry of 14A will be modelled using processed seismic survey data before sampling can take place – it is estimated that this would take approximately one month.

1.3.3 Sampling activities

Sampling will be undertaken in targeted areas identified through the analysis of the acoustic survey data. Four potential methods of collecting geophysical samples from the seabed are being considered. A Van Veen grab with a sampling capacity of approximately 50 kg will be used to collect baseline environmental data on sediment and benthic macrofauna at 20-50 sites. Geotechnical samples to assist in understanding the sea floor geology and resource evaluation will be collected at 100-200 sites using either vibracoring, gravity coring or sonic coring. The latter is an advanced form of drilling that employs high-frequency, resonant energy generated inside the Sonic head to advance a core barrel or casing into subsurface formations, i.e. can penetrate some subsurface rock, whilst gravity and vibracoring can only sample unconsolidated material. The diameter of core samples will be approximately 10 cm, the corers will penetrate to depths of 3–8 m and the material brought to the surface for analysis. The volume per core is calculated at 0.24 m3. Core samples do not require onboard processing (i.e. no sediment spill in the ocean) as all material collected will remain intact within core tubes which are to be analysed on land. These core samples will be collected from a purpose-built survey vessel with equipment sourced from IMD SA and Underwater Mining Solutions. It is estimated that an initial 100 core samples would be required at a sampling rate of approximately ten cores per day which would amount to a total of ten days work. Sampling work will be restricted between the western boundary of the concession and not shallower than 20 m water depth.

In addition to the above prospective targets will be analysed by a uniquely designed drill tool that can dredge gravel from the seabed. Material will be processed onboard by a processing plant and tailings will be discarded overboard, thereby causing sediment plumes, in this instance as a near-shore deposit. The discard material is reported to consist mostly of sand that has a minimal suspension time. Pending the final tool design, the drill bit footprint will be between 3 and 5 m2 with an expected average hole depth of 3m. Sample volumes are anticipated to be in the range of 9 to 15 m3 per sample and will be spaced at roughly 300 m apart from north to south will be required during Phase 2 (reconnaissance sampling). It is expected that phase 3 (resource development phase) may require a greater density of samples (arranged in a 25 m to 50 m sampling grid).

The geophysical survey will allow the identification and mapping of rock formations within the concession area. Based on this data, an appropriate drilling method will be identified. This review will allow the applicant to identify target prospecting sites within the concession area. It can also enable the applicant to identify potential challenges and means to address these challenges to minimize environmental impacts and costs. This would facilitate an efficient and effective prospecting programme. Should the prospecting right be approved, it will allow TAD to determine if diamond mining within concession area 14A is economically viable. It is understood that the Prospecting Right will not provide the required environmental authorisation for mining activities to be undertaken. As such, any future intention to undertake mining within the application area would require a further application, investigation and public consultation process.

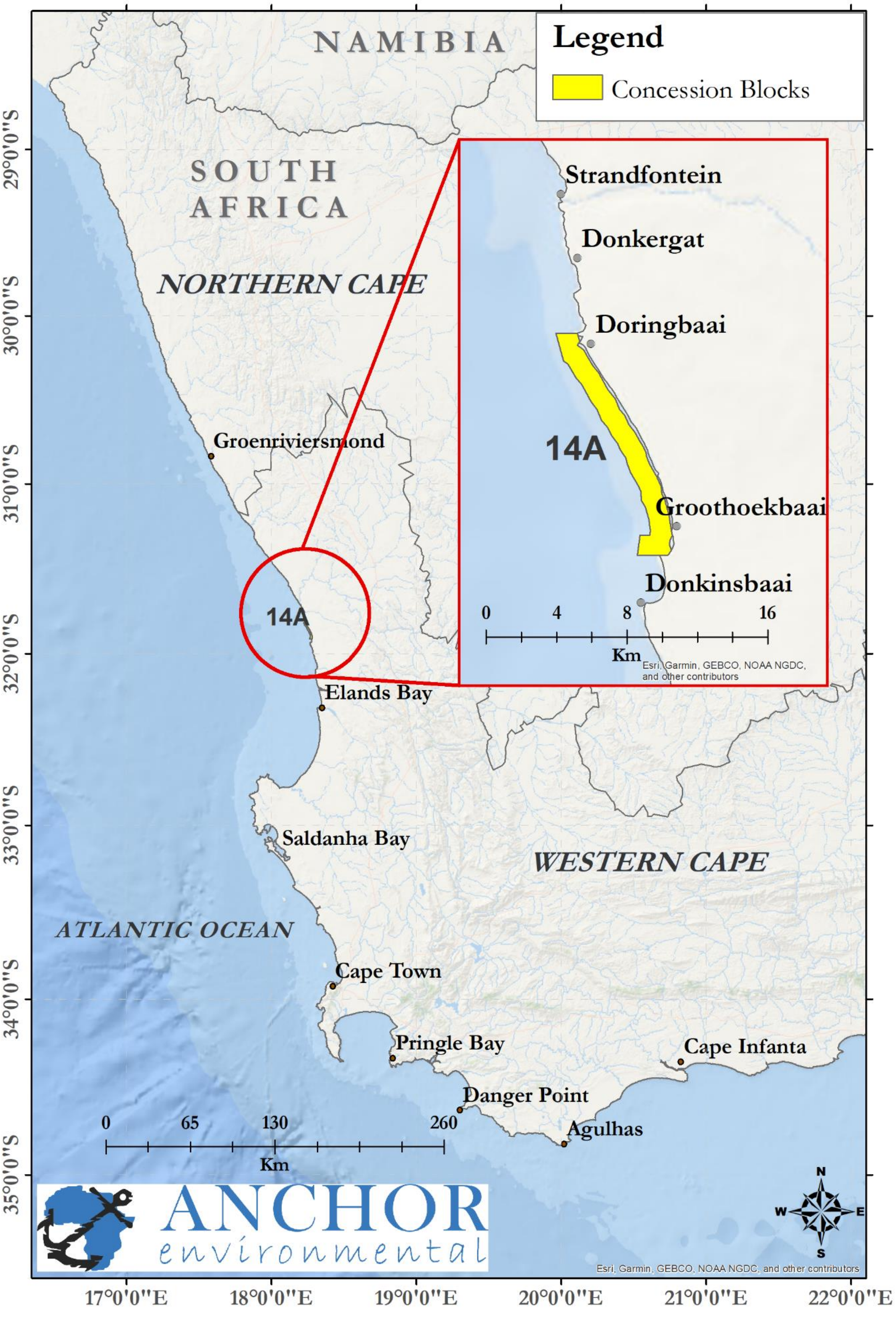

Figure 3 **Location of the concession area 14A off the Western Cape Coast. The concession starts 31.5 m west of the low water mark to 1000 m west of the high-water mark.**

Figure 4 Sea concession 14A off the Western Cape Coast with bathymetry (at 2 m intervals). The red hatched area indicates that portion of 14A that is shallower than 16 m and will not be surveyed by the geophysical survey vessel. A small craft vessel equipped with a simpler array of seismic survey equipment is expected to survey these shallow areas.

2 DESCRIPTION OF THE AFFECTED ENVIRONMENT

2.1 Regional oceanography

The Benguela system is influenced predominantly by the wind-driven upwelling of deep nutrient rich water close to the coast. Wind is the primary driver of life in the system, strongly influencing both water temperature and inorganic nutrient levels, and in turn, primary production. The prevailing south-easterly winds displace surface water offshore during the summer, and cause cold, nutrient rich water to rise from deeper water masses to replace this surface water. These upwelling events are the trigger for minimum temperatures and maximum nutrient levels (Branch and Griffiths 1988). The oceanic primary producers, phytoplankton, bloom when upwelled inorganic nutrients become available for photosynthesis in the presence of sunlight. These are consumed by zooplankton, which are in turn consumed by small pelagic fish species such as anchovy and sardine. The Benguela is one of the world's most productive systems, supporting rich fishing grounds and attracting large colonies of sea birds and seals (Branch 1981).

The West Coast is subject to semi-diurnal tides, with each successive high (and low) tide separated by 12 hours. Spring tides occur once a fortnight during full and new moons. Tidal activity greatly influences the biological cycles (feeding, breeding and movement) of intertidal marine organisms, and has an influence on when people visit the coastline to partake in various activities such as bathing and the harvesting of marine resources. The tidal variation on the West Coast usually ranges between 0.28 m (relative to the chart datum) at mean low water springs and 1.91 m at mean high water springs, with the highest and lowest astronomical tide being 2.25 m and 0.056 m, respectively.

The west coast of South Africa typically experiences high wave energy and is dominated by south-westerly swells with a long fetch and a period of 10 to 15 seconds (Branch and Griffiths 1988). Southerly and south-westerly waves frequently exceed 2 m (Figure 5). The predominant SW swell direction in this area results in a northward-flowing littoral current that runs parallel to the coast (MacDonald and Rozendaal 1995). Currents measured inshore at 10 m depth during late summer are mostly shore parallel (north westerly or south easterly) and 90% of the measured current velocities are low (< 10 cm/second, Figure 6, Laird and Clark 2018). The average water temperature during the summer months is cool due to upwelling (approximately 11°C) and slightly warmer during downwelling events, which are caused by westerly winds or occasional Benguela Ninos when unseasonal westerly winds result in a breakdown of the upwelling front with movement of warm oceanic water towards the coast (Laird and Clark 2018). Average background Total Suspended Solid (TSS) concentration in seawater along the west coast is highly variable and dependent on prevailing weather and seas conditions. TSS was measured off Tormin Mine to the north of concession 14 A as 73.73 mg/L on 14 March 2017, while average turbidity from 10 February to 14 March 2017 was calculated at 5.24 NTU (Laird and Clark 2018). Turbidity peaks within Concession Area 14A are expected during large wave events where fine material is resuspended, intense upwelling when phytoplankton blooms and floods from the Olifants estuary when there is considerable input of fine terrestrial sediments.

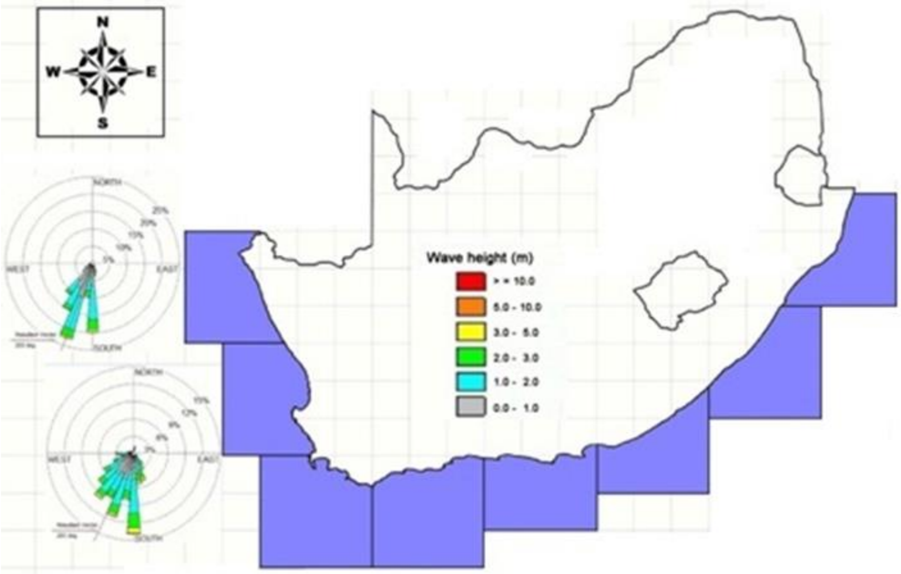

Figure 5 **Wave roses showing the frequency of significant wave heights and direction on the West Coast (Source: SADCO Voluntary Observing Ships data).**

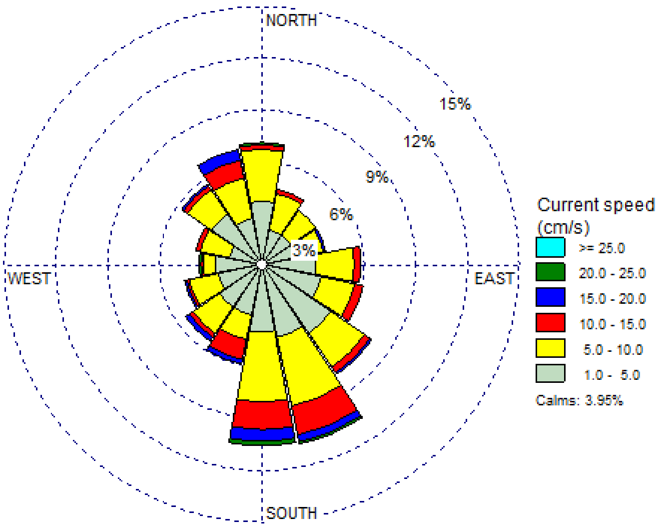

Figure 6 **Current rose showing current direction and strength data at -12 m water depth off Tormin mine (approximately 20km north of concession area 14A). (Source: Laird and Clark 2018).**

2.2 Biogeography

Concession Area 14A is positioned in the southern section of the Benguela Current System (BCS), which extends along the west coast of southern Africa between Cape Agulhas and Angola. The area falls within the Namaqua inner shelf ecozone, which is nested within the Southern Benguela Ecoregion as defined by Sink *et al*. (2012) (Figure 7).

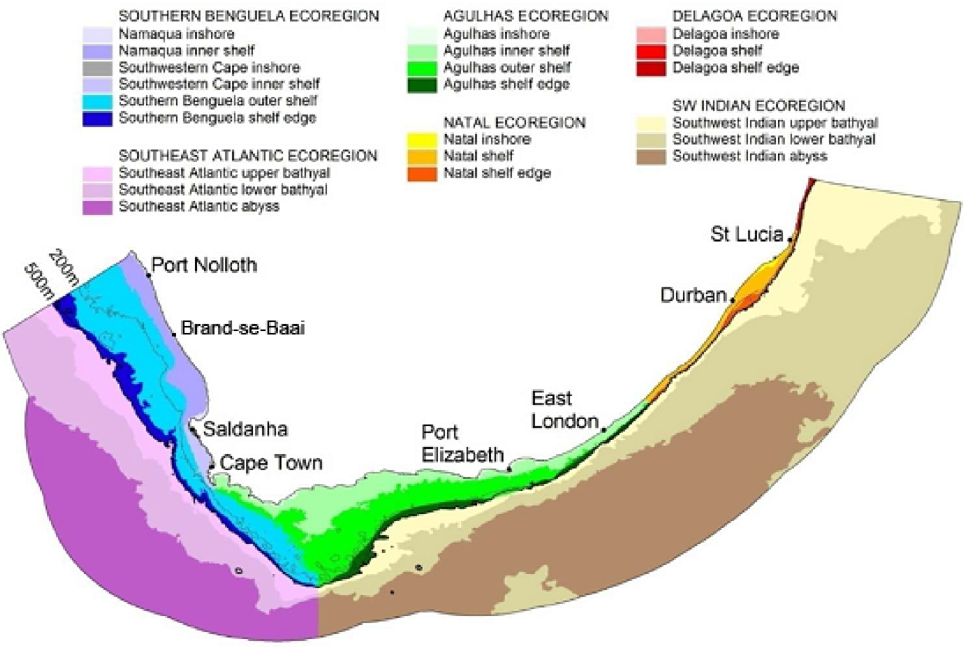

Figure 7 **Six marine ecoregions with 22 ecozones incorporating biogeographic and depth divisions in the South African marine environment as defined by Sink *et al*. (2012).**

2.3 Ecology

As discussed above, wind-driven coastal upwelling is the predominant physical driver that shapes the high levels of biological productivity in the southern Benguela, providing nutrients for primary producers, and food for diverse fauna, such as pelagic (pilchards, anchovy) and demersal (hakes, kingklip) fish stocks, near shore fisheries (linefish, rock lobster), mammals (seals and whales) and seabirds (penguins, gannets, cormorants etc.). There are five broad marine habitats within or adjacent to the 14A Concession Area. These include sandy beaches, sandy benthic habitat, rocky reefs, rocky shores and the water column or pelagic habitat.

2.3.1 Sandy beaches

Two types of beaches are found along the coast inshore of Concession Area 14A: long stretches of wide, flat dissipative beach with fine sands rich in sandy macrofaunal invertebrate species, and steep, short, reflective, pocket beaches with coarse-grained sand, an accumulation of empty bivalve shells and few sandy macrofaunal species. Reflective beaches typically have high wave energy, a narrow surf zone and high natural variability in macrofaunal community composition over a short/medium time scale due to storm events, tidal cycles, seasons or inter-annual weather changes (McLachlan 1980; Souza and Gianuca 1994; Calliari *et al.* 1996; Pulfrich 2011b). Dissipative beaches with a high input of kelp wrack have a rich and diverse drift-line fauna, which is sparse or absent on beaches lacking a drift-line (Branch and Griffiths 1988; Field and Griffiths 1991).

In the southern Benguela, a rich outer turbulent zone (10-33 m from the shore) supports cnidarians (anemones), tube-building polychaetes and amphipods; while the less diverse inshore turbulent zone (3-5 m from the shore) is typified by deep burrowing polychaetes and crustaceans. Poor species diversity and abundance, as well as the presence of cumaceans, characterise the inner turbulent part of the surf zone (0-1 m from the shore) (Figure 8). Fish such as galjoen (*Dichistius capensis*) and white and west coast steenbras (*Lithognathus lithognathus* and *Lithognathus aureti*) and southern mullet *Chelon richardsonii* frequent turbulent surf zone waters off the west coast where they swim over submerged beaches at high tide and feed on small crustaceans (Branch 1981) (Figure 8). Surf zone habitats, particularly medium to low energy beaches, are widely recognised as important nursery areas for fish (Lenanton *et al.* 1982; Clark *et al.* 1996). The intertidal zone of a west coast sandy beach is typified by mysids, scavenging gastropods (*Bullia* spp.), amphipods, isopods and polychaetes. The upper drift line is typified by air-breathing amphipods (*Talorchestia* spp.) and giant isopods (*Tylos granulatus*), as well as insects. Birds such as African black oystercatchers (*Haematopus moquini*), white fronted plovers (*Charadrius marginatus*) and sanderlings (*Calidris alba*) feed on sandy beach organisms along the west coast.

Figure 8 **A cumacean (left) and a white Steenbras (right), both found in the surf zone (Photo: Hans Hillewaert).**

Of particular importance is the presence of the isopod *Tylos granulatus* found predominantly on the upper portion of sandy beaches undisturbed by anthropogenic impacts (Figure 9). Populations of these invertebrates are easily disturbed and due to declining numbers, Brown (2000) made the recommendation to list these invertebrates as 'vulnerable' on the IUCN Red Data List.

Figure 9 **Holes in sandy sediment (left) indicating the presence of *Tylos granulatus* (right).**

2.3.2 Subtidal sandy benthic habitat

Fauna and flora that inhabit the surfaces of subtidal sand are called benthic epifauna, while those that burrow or dig into the soft sediments are called benthic infauna (Castro and Huber 1997). The distribution of infauna and the depth at which organisms can live in the substrate is largely dependent on sediment particle size. More porous, larger grained substrates allow for greater water circulation through the sediment, thereby replenishing the oxygen that is used up during the decomposition processes.

Much of the benthic infauna on the west coast of South Africa are deposit feeders (e.g. worms), which either ingest sediments and extract organic matter trapped between the grains, or actively collect organic matter and detritus (Castro and Huber 1997). Suspension feeders eat drifting detritus and plankton from the water column (e.g. seapens and some species of crabs), while filter feeders actively pump and filter water to extract suspended particles (e.g. bivalves and some species of amphipods and polychaetes). Predators in soft bottom habitats either burrow through sediments or catch their prey on the surface (Castro and Huber 1997). Most bottom-dwelling fish in soft bottom habitats are predators that scoop up prey (e.g. rays and skates), while flat fish (e.g. monk fish and sole) lie camouflaged on the bottom. Predators such as crabs, hermit crabs, lobsters and octopuses, which inhabit rocky areas, may move to sandy benthos to feed (Castro and Huber 1997). Similarly, reef-associated fish also rely on sandy substrate for food. The soft sediment subtidal biota of St Helena and Saldanha Bays is well studied where a diverse benthic macrofauna community (over 150 species) with a high biomass (St. Helena Bay = 846.53 g/m^2, Saldanha = 970.78 g/m^2) is found (Biccard *et al*. 2020a; Clark *et al*. 2020). This same is not necessarily true for the 0.5-26 m depth zone off the exposed west coast (such as Concession 14A), where the macrofauna is poorly known. Anchor Environmental did collect Van Veen grab samples in Concession 1B (slightly greater depth range and within the biogeographical zone as 14A) and recorded 45 species at a much lower average biomass (90.52 g/m^2) than found in the shallower, sheltered and retentive bays along the west coast (Mostert *et al.* 2016).

2.3.3 Rocky reefs

Temperate rocky reefs are found below the low water mark. Sources of disturbance include wave action and occasional sedimentation of shallow reefs surrounded by sand. Many large predators such as fish and sharks are attracted to rocky reefs and as such represent an important component of these ecosystems (Barros *et al.* 2001). Rocky reefs provide substratum to which kelp (*Ecklonia maxima* and *Laminaria pallida*) can attach and grow into large kelp forests that provide food and shelter for many organisms. *E. maxima* grows down to approximately 12 m depth, whilst *L. pallida* grows to depths of approximately 30 m (Branch *et al.* 2010). Encrusting coralline is the dominant algae below the kelp canopy, while epiphytic algae grows on kelp, along with numerous under-storey algae species (Meyer and Clark 1999). Filter feeders such as mussels, red bait and sea cucumbers comprise a large part of the faunal community on subtidal rocky reefs (Branch *et al.* 2010). Grazers include the dominant sea urchin *Parechinus angulosus*, limpets, isopods (i.e. *Paridotea reticulate*) and amphipods (i.e. *Ampithoe humeralis*) (Branch 1981). Predators include the West coast rock lobster (*Jasus lalandii*), octopus *Octopus vulgaris*, the starfish *Henricia ornata*, various feather and brittle stars (Crinoidea and Ophiuroidea), and the whelks *Nucella* and *Burnupena* spp. Fish species associated with rocky reefs include hottentot (*Pachymetopon blochii*), galjoen (*Dichistius capensis*), milk fish (*Parascorpis typus*), rock suckers (*Chorisochismus dentex*) and the catshark *Haploblepharus pictus* (Branch *et al.* 2010).

Deeper reefs, such as those possibly found in the 14A Concession, tend to have an absence of kelp and much lower algal biomass (due to light attenuation), but still have significant invertebrate communities dominated by filter feeders, detritivores and predators. These deep reefs could constitute important habitat for commercially important species such as rock lobster and hottentot sea bream.

Figure 10 ***Ecklonia maxima*** **kelp forest with Laminaria pallida sub-canopy and Hottentot Pachymetopon blochii (left). Blankets of sandy anemones Bunodactis reynaudi (right) are common both inter- and subtidally.**

2.3.4 Rocky shores

Rocky shore is a common habitat along this stretch of coast (Coastal Sensitivity Atlas of South Africa, 1984). This habitat can be divided into distinct bands according to the amount of time each section is exposed to the air. These zones (moving in a landward direction) are named the infratidal zone, the Cochlear zone, the lower balanoid zone, the upper balanoid zone and the littorina zone.

The infratidal zone is inhabited by species that cannot withstand long periods of exposure. Species that occur in this zone include algae (e.g. *Gigartina* spp. and *Champia lumbricalis*), articulated corallines, sea urchins (*Parechinus angulosus*) and the invasive black mussel, *Mytilis galloprovincialis*. The limpets *Scutellastra argenvillei* and *Cymbula granatina* form dense stands that extend up into the cochlear zone. *Octopus vulgaris*, and various species of fish, known as “klipvis”, are found in subtidal rock pools where they prey upon bivalves and other invertebrates.

Above the cochlear zone is the lower balanoid, where the limpet *Scutellastra granularis*, winkles (*Oxystele tigrina* and *O. variegata*) and whelks (*Burnupena* spp.) are found. The black mussel also extends into this zone and often competes for space with *Gunnarea gaimardi*, the Cape reef worm. Seaweed is sparse in the lower balanoid zone, however, some sea lettuce (*Ulva* spp.) is usually present and there are often scattered patches of the encrusting brown alga, *Ralfsia verrucosa*. The upper balanoid zone is dominated by animals, limpets and barnacles in particular. The harshest of all the zones is the littorina zone, which is dominated by the snail *Afrolittorina knysnaensis* and the flat-bladed alga *Porphyra capensis* (Branch 1981).

Figure 11 Typical rocky shore found on the coast inshore of concession area 14A.

Baseline information on rocky shore species found along the coast inshore of Concession 14A was compiled from existing literature and previous studies. Existing qualitative baseline data is available for the following sites:

- Brand-se-Baai (Biccard and Clark 2014a and Laird *et al*. 2014);
- The coastal stretch directly shoreward of 14A comprising the Tormin mineral sands mining concession (Laird and Clark 2018);
- Groenrivier (Biccard and Clark 2014b). This site is 40 km north of Brand-se-Baai but within the same Namaqua inshore ecozone.

The rocky shore survey of the Tormin concession identified 49 different invertebrate species including filter-feeders, grazers, predators and algae (Table 1). None of these species are rare or vulnerable locally or regionally, and rocky shore is a common habitat along this stretch of coast. The intertidal rocks provide habitat for a variety of sessile marine species including at least six species of invertebrates and 13 species of algae. The mid and low intertidal are covered by carpets of mussels (*Mytilus galloprovincialis*), which provide shelter for a wide variety of invertebrates such as whelks, amphipods and limpets.

Table 1 Comparison between species found in previous surveys and those found during this study.

Species	Brand-se-Baai (Laird *et al*. 2014)	Brand-se-Baai (Biccard and Clark 2014a)	Groenrivier (Biccard and Clark 2014b)	Tormin (Laird and Clark 2018)
FILTER-FEEDERS				
Aulacomya atra	X	X	X	
Encrusting bryozoan			X	
Choromytilus meridionalis			X	
Chthamalus dentatus	X			X
Crepidula porcellana	X			
Dendropoma corallinaceum	X			X
Gunnarea gaimardi	X	X	X	X
Hymeniacidon perlevis	X	X	X	X

Species	**Brand-se-Baai (Laird *et al*. 2014)**	**Brand-se-Baai (Biccard and Clark 2014a)**	**Groenrivier (Biccard and Clark 2014b)**	**Tormin (Laird and Clark 2018)**
Mytilus galloprovincialis	X	X	X	X
Octomeris angulosa	X		X	X
Sand worm	X			X
Tetraclita serrata	X		X	X
GRAZERS				
Affrolittorina knysnaensis	X	X	X	X
Cymbula compressa	X			
Cymbula granatina	X	X	X	X
Cymbula oculus	X			
Fissurella mutabilis	X			X
Helcion dunkeri			X	
Helcion pectunculus	X		X	X
Oxystele sinensis	X			
Oxystele tigrina	X		X	X
Oxystele variegata	X	X	X	X
Parechinus angulosus	X		X	X
Parvulastra exigua	X		X	X
Scutellastra argenvillei	X		X	X
Scutellastra barbara	X			
Scutellastra cochlear	X	X	X	X
Scutellastra granularis	X	X	X	X
Siphonaria capensis	X		X	X
Tricolia capensis	X			
PREDATORS				
Anthopleura michaelseni	X			
Anthothoe chilensis	X		X	X
Bunodactis reynaudi	X	X	X	X
Bunodosoma capense	X			X
Burnupena papyracea			X	
Burnupena spp.	X	X	X	X
Guinusia chabrus	X			
Marthasterias glacialis	X			
Nucella dubia	X			X
ALGAE				
Brown foliose algae			X	X
Caulacanthus ustulatus	X			X
Ceramium spp.	X			X
Chaetomorpha robusta	X			
Champia lumbricalis	X	X	X	X
Chordariopsis capensis	X		X	X
Cladophora flagelliformis	X	X	X	X
Codium fragile fragile	X			
Diatoms	X			X
Ekclonia maxima	X	X	X	X
Encrusting coralline	X	X	X	X
Gelidium pristoides	X	X	X	X
Gelidium vittatum	X			

Species	Brand-se-Baai (Laird *et al*. 2014)	Brand-se-Baai (Biccard and Clark 2014a)	Groenrivier (Biccard and Clark 2014b)	Tormin (Laird and Clark 2018)
Gigartina polycarpa	X			X
Hildenbrandia lecannellieri	X		X	X
Hypnea ecklonii	X			X
Laminaria pallida	X	X	X	X
Leathesia marina	X			
Mazzaella capensis	X	X	X	X
Nothogenia erinacea	X			X
Pachymenia carnosa			X	
Pachymenia orbitosa	X	X	X	X
Porphyra capensis	X	X	X	X
Ralfsia verrucosa	X	X	X	X
Red foliose algae		X	X	X
Red turf		X	X	X
Rhodymenia capensis	X			
Sarcothalia scutellata	X			
Splachnidium rugosum	X		X	X
Ulva spp.	X	X	X	X
Upright coralline			X	X
Total number of species	**64**	**24**	**43**	**49**

2.3.5 Pelagic habitat

This habitat type constitutes the largest of all habitats and is loosely defined as the water column of the open ocean, which can be further divided into regions by depth. Pelagic communities are largely defined by the physical properties of the water column. Main physical drivers include temperature, turbidity, dissolved oxygen, nutrient levels and light. These parameters vary with depth and play a large role in shaping the structure of pelagic communities. The major oceanic currents on the east and west coast of South Africa differ in terms of these parameters, and as such, harbour different pelagic communities. Where the Agulhas and Benguela current meet, off the southern coast of South Africa, these different communities merge and interact over several hundred kilometres resulting in rich pelagic biodiversity. In contrast to demersal and benthic biota that are associated with the seabed, pelagic species live and feed in the open water column. Pelagic communities are divided into plankton and fish, and their main predators, seabirds, marine mammals (seals, dolphins and whales) and turtles.

2.3.5.1 Planktonic communities

The ecology of the open water pelagic habitat within Concession 14A is typical of the Benguela upwelling region and the Namaqua inshore ecozone. Pulsed inputs of nutrients (nitrates, phosphates and silicates) due to wind driven upwelling result in high primary productivity with phytoplankton communities dominated by dinoflagellates and diatoms. Phytoplankton are consumed by a variety of zooplankton that typically consist of crustacean copepods, euphausiids, mysids and a myriad of eggs and larvae from almost all marine phyla. For example, ichthyoplankton in the southern Benguela are composed mainly of small pelagic anchovy and sardine fish eggs and larvae, with some hakes and mackerel (Shannon and Pillar 1986). Zooplankton are in turn the food source for large numbers of small pelagic fish, particularly sardine *Sardinops sagax*, anchovy *Engraulis encrasicolus,* red eye round herring *Etrumeus whiteheadi* and maasbanker, *Trachurus capensis*. These small pelagic fish exert a controlling influence on the abundance of both their zooplankton prey and their predators that include commercially important fish species such as snoek *Thyristes atun*, yellowtail *Seriola lalandi* and hake *Merluccius* sp. (Cury *et al.* 2000; Shannon *et al.* 2020).

2.3.5.2 Seabirds

Fourteen species of seabirds breed in southern Africa; Cape Gannet, African Penguin, four species of Cormorant, White Pelican, three Gull and four Tern species (Table 2). Species listed as endangered on the IUCN red data list include the African penguin, Cape cormorant and the bank cormorant. Breeding areas are distributed around the coast with islands being particularly important. The number of successfully breeding birds at each breeding site varies with the abundance of food. Most of the breeding seabird species forage for small pelagic fish at sea with most birds being found relatively close inshore (within 30 km of the coast). Of the diving birds that occur along the coast, only *Morus capensis*, the Cape gannet, regularly feeds from the inshore environment as far as 100 km offshore and African penguins have also been recorded as far as 60 km offshore. Most of the species listed here are likely to be encountered in concession 14A.

Table 2 Breeding seabirds present on the west coast of South Africa (adapted from Pulfrich 2021).

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

Pelagic seabirds such as albatross, petrels and shearwaters are more prevalent in offshore but may also be encountered in 14A. A large number of these seabirds are supported by the small pelagic fish stocks of the Benguela system. The area between Cape Point and the Orange River is said to support 38% and 33% of the overall population of pelagic seabirds in winter and summer, respectively (Baker and Arnott 2021). Pelagic seabirds classified as being common in the southern Benguela are listed in Table 3. Species listed as endangered include the black-browed albatross and yellow-nosed albatross.

Most of the species in the region reach highest densities offshore of the shelf break (200 – 500 m depth) (Baker and Arnott 2021), well offshore of concession 14A.

Table 3 Pelagic seabirds common to the southern Benguela region (Crawford *et al.*, 1991).

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

2.3.5.3 Marine mammals

The marine mammal fauna occurring off the southern African coast includes several species of baleen whales, toothed whales, beaked whales, dolphins and one resident seal species. Based on the available literature we have identified thirty-six marine mammals that may occur in the proposed survey area (Table 4); each of these have been placed into marine mammal hearing groups as per Southall *et al*. (2019). Various research papers and reports were used to ascertain the relative likelihood of occurrence within the proposed survey area – Table 4 (Lane and Carter 1999; Penney *et al.* 2007; Child et al. 2016; Biccard *et al*. 2018; Baker and Arnott 2021; Pulfrich 2021). Conservation status from the IUCN (2021) red data list is provided.

Of the species listed, the blue whale is considered 'Critically endangered', fin and sei whales are 'Endangered' and two (humpback and sperm whale) are considered vulnerable (IUCN Red Data list Categories). Altogether 10 species are listed as "data deficient" underlining how little is known about cetaceans, their distribution and population trends. Current information on the distribution, population sizes and trends of most cetacean species occurring on the west coast of southern Africa is lacking (Pulfrich 2021). Our knowledge on the smaller cetaceans that occupy deeper waters is particularly poor and it is recommended that caution be applied when considering possible encounters with cetaceans in the area of interest (Pulfrich 2021).

The most abundant baleen whales in the Benguela are humpback whales and southern right whales (Figure 12). During the last decade, the prevalence of both species on the West Coast of South Africa outside of the usual June-November whale season has increased with feeding behaviour observed in upwelling zones off Kommetjie, 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) and will therefore occur in or pass through the area of interest (Pulfrich 2021).

Table 4 **Marine mammals thought to occur within the proposed survey area according to Merkel *et al*. 2012. Each species listed has been placed into a marine mammal hearing group as defined by Southall *et al*. 2019. The relative abundance and likelihood of occurrence within the proposed survey area during the survey period in late summer is indicated for each species. Conservation status from the IUCN (2021) red data list is indicated for each species.**

Marine Mammal hearing group (Southall *et al.* 2019)	Species	Shelf/Offshore	Likely encounter frequency in 14A and seasonality in parentheses	IUCN Conservation status
Low frequency cetaceans (Baleen whales) Generalised hearing range: 7 Hz to 35 kHz	*Balaenoptera bonaerensis* (Antarctic minke whale)	Shelf and offshore	Occasional (winter)	Least concern
	B. acutorostrata (Dwarf minke whale)	Shelf and offshore	Occasional (year-round)	Least concern
	B. physalus (Fin whale)	Shelf and offshore	Occasional (rarely in summer)	Endangered
	B. musculus (Blue whale)	offshore	Highly unlikely (seasonality unknown)	Critically Endangered
	B. borealis (Sei whale)	Shelf and offshore	Occasional (winter)	Endangered
	B. brydei (offshore Bryde's whale)	Shelf and offshore	Occasional (summer)	Not assessed
	B. brydei (subspp) (inshore Bryde's whale)	Shelf and offshore	Occasional (year-round)	Vulnerable
	Eubalaena australis (Southern right whale)	Shelf	Daily (year-round, higher in early spring and	Least concern
	Megaptera novaeangliae (Humpback whale)	Shelf and offshore	Daily (year-round, higher in summer)	Vulnerable
High frequency cetaceans (Dolphins, toothed whales, beaked whales) Generalised hearing range: 150 Hz to 160 kHz	*Lagenorhynchus obscurus* (Dusky dolphin)	Shelf (0-800 m)	Daily (year-round)	Data deficient
	Cephalorhynchus heavisidii (Heaviside's dolphin)	Shelf (0-200 m)	Daily (year-round)	Near threatened
	Tursiops truncates (Common bottlenose dolphin)	Shelf and offshore	Occasional (year-round)	Least concern
	Delphinus delphis (Common short beaked dolphin)	Shelf and offshore	Monthly (year-round)	Least concern
	Lissodelphis peronii (Southern right whale dolphin)	Shelf and offshore	Unlikely (year-round)	Least concern

Marine Mammal hearing group (Southall *et al.* 2019)	Species	Shelf/Offshore	Likely encounter frequency in 14A and seasonality in parentheses	IUCN Conservation status
	Stenella coeruleoalba (striped dolphin)	Offshore	Highly unlikely (unknown)	Least concern
	S. attenuate (Pantropical spotted dolphin)	Shelf edge and offshore	Highly unlikely (year-round)	Least concern
	Globicephala melas (Long-finned pilot whale)	Shelf edge and offshore	Unlikely (year-round)	Least concern
	G. macrorhynchus (Short-finned pilot whale)	Unknown	Unlikely (unknown)	Least concern
	Steno bredanensis (Rough-toothed dolphin)	Unknown	Unlikely (unknown)	Least concern
	Orcinus orca (Killer whale)	Shelf and offshore	Occasional (year-round)	Data deficient
	Pseudorca crassidens (False killer whale)	Shelf and offshore	Unlikely (year-round)	Least concern
	Feresa attenuate (Pygmy killer whale)	Offshore	Highly unlikely (unknown)	Least concern
	Grampus griseus (Risso's dolphin)	Shelf edge and offshore	Unlikely (unknown)	Least concern
	Kogia breviceps (Pygmy sperm whale)	Shelf edge and offshore	Unlikely (year-round)	Data deficient
	K. sima (Dwarf sperm whale)	Shelf edge	Unlikely (unknown)	Data deficient
	Physeter macrocephalus (Sperm whale)	Shelf edge and offshore	Unlikely (year-round)	Vulnerable
	Ziphius cavirostris (Cuvier's beaked whale)	Offshore	Highly unlikely (year-round)	Data deficient
	Beradius arnouxii (Arnoux's beaked whale)	Offshore	Highly unlikely (year-round)	Data deficient
	Hyperoodon planifrons (Southern bottlenose beaked whale)	Offshore	Highly unlikely (year-round)	Least concern
	Mesoplodon layardii (Layard's beaked whale)	Offshore	Highly unlikely (year-round)	Data deficient
	M. mirus (True's beaked whale)	Offshore	Highly unlikely (year-round)	Data deficient
	M. grayi (Gray's beaked whale)	Offshore	Highly unlikely (year-round)	Data deficient
	M. densirostris (Blainville's beaked whale)	Offshore	Highly unlikely (year-round)	Data deficient
Phocid carnivores in water (PCW)	*Mirounga leonine* (Southern elephant seal)	Shelf and offshore	Occasional (unknown)	Least concern
	Hydrurga leptonyx (Leopard seal)	Shelf and offshore	Occasional (unknown)	Least concern
Other marine carnivores in water (OCW)	*Arctocephalus pusillus* (Cape fur seal)	Shelf	Daily (year-round)	Least concern

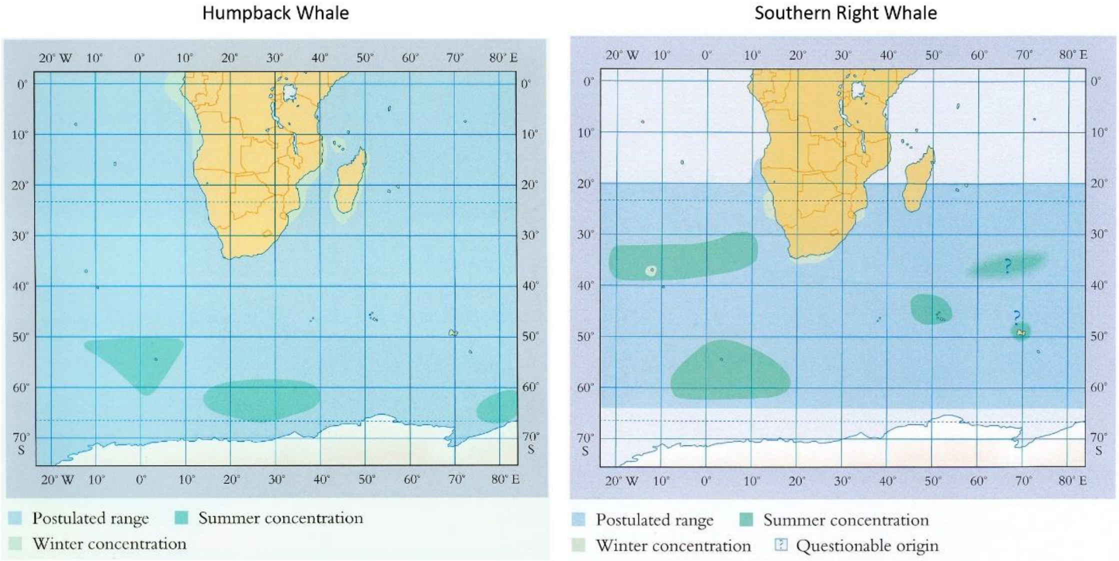

Figure 12 Migration routes are inferred from the seasonal distribution of humpback (left) and southern right (right) whales off the coast of southern Africa. Source: Best (2007).

2.4 Sensitivity and significance

2.4.1 Ecosystem threat status

The sensitivity of the different habitat types found within and adjacent to concession area 14A is related to the biodiversity (richness, uniqueness, spatial extent of the habitat type) and exposure levels to natural disturbance or environmental perturbations.

The 2018 National Biodiversity Assessment (NBA) for marine benthic and coastal habitat threat status for concession area 14A is shown in Figure 13 (SANBI 2018). This Ecosystem Threat Status developed by SANBI (2018) is an indicator of how threatened ecosystems are, specifically the degree to which ecosystems are still intact or alternatively losing vital aspects of their structure, function or composition (Harris *et al.* 2018). Ecosystem types are categorised as “Critically Endangered”, “Endangered”, “Vulnerable”, “Near Threatened” or “Least Concern”, based on the proportion of the original extent of each ecosystem type that remains in good ecological condition relative to a series of biodiversity thresholds (Harris *et al.* 2018). Critically Endangered, Endangered and Vulnerable ecosystems are collectively referred to as threatened ecosystems (SANBI 2016). An ecosystem type refers to, an ecosystem unit, or set of ecosystem units, that has been identified and delineated as part of a hierarchical classification system, based on biotic and/ or abiotic factors. Ecosystems of the same type are likely to share broadly similar ecological characteristics and functioning. South Africa’s work to assess ecosystem threat status feeds into a global initiative by the IUCN (currently underway) to develop a “global redlist” of ecosystems (Bland *et al.* 2017).

The ecosystem threat status of a feature is determined by evaluating the area of each feature in a condition against thresholds or targets. This method is designed to give comparable answers and categories for the marine environment to those used in the terrestrial, freshwater and estuarine assessments, and to ensure that the assessment remains within a systematic framework. The similar framework, methodology and categories across all realms allows for quick conceptual links to be made to IUCN Red List categories for species which are immediately understood by a broad range of biologists and conservationists.

Biodiversity threshold (Targets): The basic biodiversity thresholds were set at 20% of the area of each ecosystem type. The 20% target is a default value commonly used in South Africa when targets derived from the underlying characteristics (e.g. species area curves) of biodiversity features are not available. A review of targets for marine systems is being undertaken by SANBI, which will inform target setting for marine ecosystems in the future (Driver *et al.* 2005).

In terms of the SANBI Ecosystem Threat Status layer, the inside margin of concession 14A is listed as "near threatened" with the northern and southern inshore areas designated as "vulnerable" (Figure 13).

The sensitivity of the different habitat types found within and adjacent to Concession Area 14A is related to the biodiversity (richness, uniqueness, spatial extent of the habitat type) and exposure levels to natural disturbance or environmental perturbations. Sheltered, relatively undisturbed beach communities are more sensitive to anthropogenic change than beaches that are exposed to frequent natural disturbances (Brown and McLachlan 2002). As sandy beaches are highly dynamic, these habitats are less sensitive to disturbance than rocky shore environments. Sandy beaches are also quicker to recover from disturbance than rocky habitats, with recovery from intensive mining operations (including the discharge of tailings onto the beach as a sediment slurry) being found to occur within two to three years in Namibia without mitigation (Pulfrich and Branch 2014). Relatively few species occur on sandy beaches in comparison to rocky shores due to the unstable and harsh nature of beaches. Those species that do occur on sandy beaches are hardy and well adapted to life in these environments (Branch 1981). Although beaches are less sensitive than rocky shores, beach surf zones are classified as ecologically sensitive areas that take time to return to their natural state following disturbance.

Forty-nine invertebrate species were identified on rocky shores inshore of Concession Area 14A, including filter-feeders, grazers, predators and algae, none of which are rare or vulnerable locally or regionally. Although rocky shores are more sensitive to disturbance than sandy beaches, the reefs in the shallow inshore areas experience sand inundation and scouring due to sediment movement. This results in them being more tolerant to disturbance than typical rocky shores that are impacted only by wave action and tidal movement. Subtidally, sandy benthic habitats are generally not as diverse as offshore rocky reefs; however, they do host an assemblage of species not found in rocky areas. The majority of offshore habitat within the study site consists of sandy benthic communities scattered with patches of reef (Figure 4). These rocky patches are generally more diverse than areas consisting solely of sand (Barros *et al*. 2001). Rocky reefs within Concession Area 14A are known to support important fishery species such as Cape Bream *Pachymetopon blochii* and west coast Rock Lobster *Jasus lalandi*.

During phase 2 baseline biological sampling, in areas where grab samples cannot be collected and rocky reef is encountered; reef habitat should be visually assessed (by means of diver photographic survey, drop camera deployments or remotely operated underwater vehicle) with regular repeat surveys following prospecting and mining operations in the area. Reefs may not be directly impacted (mined) but are at risk of being indirectly impacted by tailings disposal. Offshore reef habitat does not recover easily from such disturbance (Biccard *et al*. 2020) and if left unchecked, future operations could have lasting deleterious impacts on this habitat and those who depend on its ecological functioning (e.g. fishermen).

In terms of conservation status and protected area status, the 14A concession block is not identified as part of a National Marine Protected Area (MPA) or a proposed Ecological and Biologically Significant

Area (EBSA) (Figure 14). EBSAs are defined by the Convention on Biological Diversity (CBD) as "geographically or oceanographically discrete areas that provide important services to one or more species/populations of an ecosystem or to the ecosystem as a whole, compared to other surrounding areas or areas of similar ecological characteristics, or otherwise meet the [EBSA] criteria".

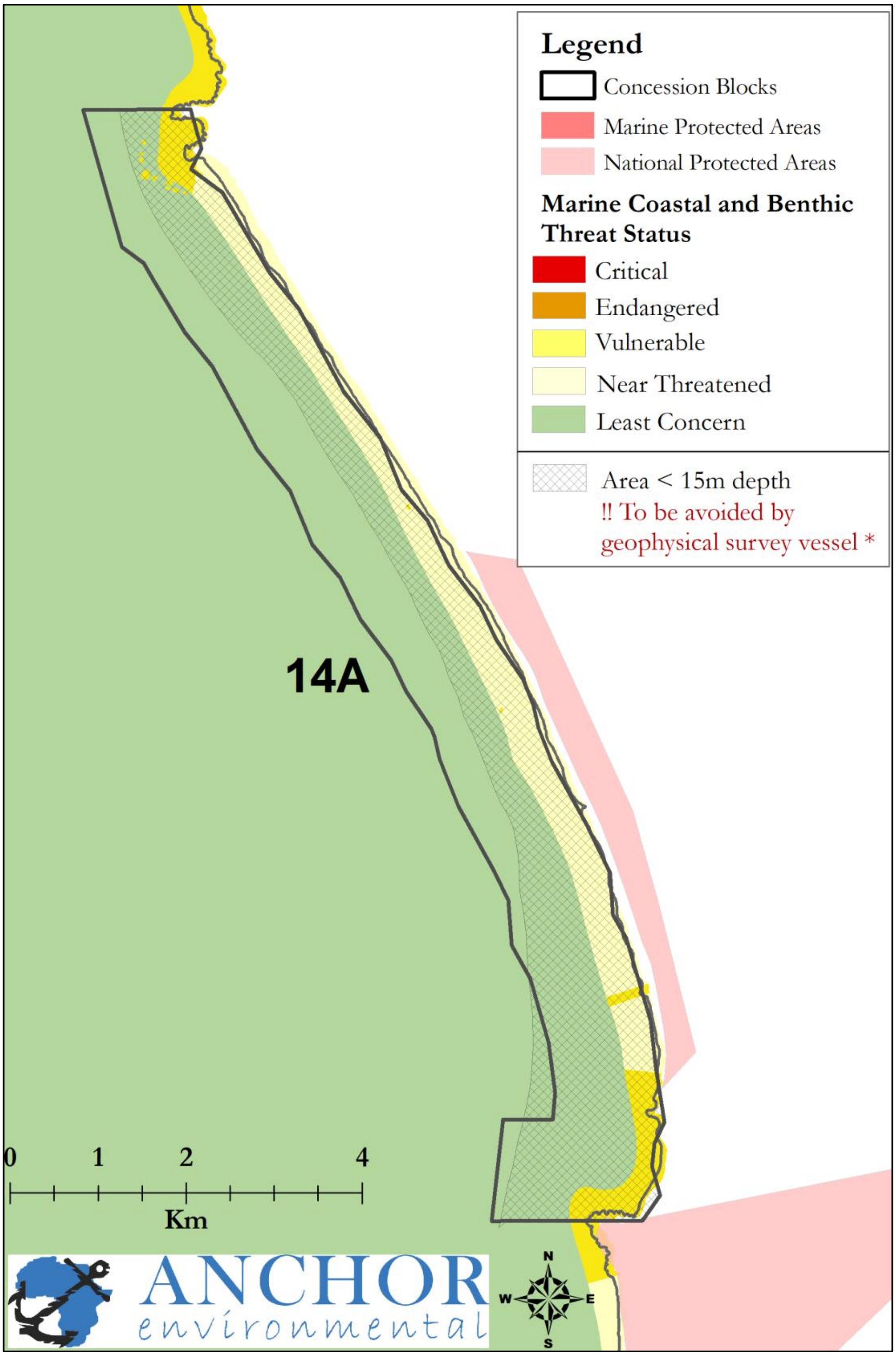

Figure 13 SANBI Ecosystem Threat Status and location of concession area 14A. Source: https://bgis.sanbi.org/

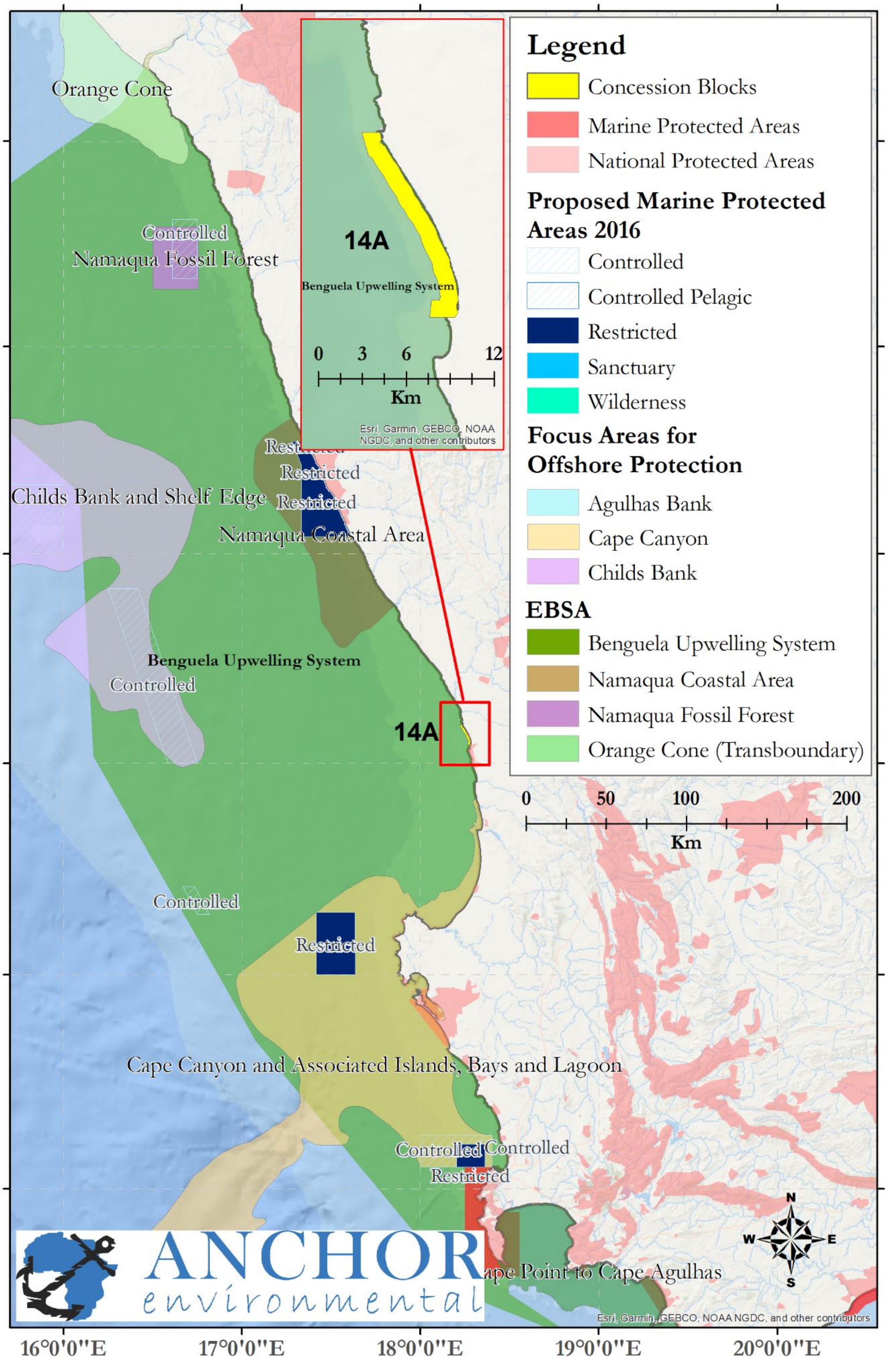

Figure 14 **Marine protected Areas and Ecological, Biologically Significant Areas and location of concession area 14A. Source: https://bgis.sanbi.org/**

2.5 User groups

The main users of the sea space in Concession 14A are the commercial shipping and fishing industries, and low levels of recreational boating activity. The wave exposed and linear nature of the coast and lack of nearby ports suitable for large vessels means that most merchant shipping would travel offshore of the concession area. Inshore of Concession 14A, diamond mining is undertaken by divers operating suction hoses from small vessels or from the shore. The potential spatial overlap of commercial fisheries with the Concession Area 14A was investigated based on published reports (specifically Norman *et al*. 2018) and an analysis of spatially referenced commercial catch return data obtained from the Department of Forestry, Fisheries and the Environment (DFFE). The demersal trawl, demersal hake longline, large pelagic longline, and tuna pole commercial fishing sectors that are active along the west coast all operate well offshore of the 14A Concession Area (Norman *et al*. 2018). Some spatial overlap with the small pelagic, traditional linefish, inshore net fishery and west coast rock lobster fisheries as well as the abalone farming and ranching aquaculture sector was identified. These four fisheries and the abalone sector are considered in more detail below.

2.5.1 Small Pelagic Purse Seine

The South African small pelagic fishery developed in the 1940s with sardines *Sardinops sagax* primarily targeted along the west coast. Catches peaked in the early 1960s at around 400 000 tons but collapsed thereafter, thought to be a direct result of overfishing. The industry switched to smaller nets and began targeting anchovy *Engraulis encrasicolus*, which dominated the catches from about 1964 to the mid-1990s when recovery of the sardine stock was achieved under a stock rebuilding management strategy. Catches of both species have been at similar levels (around 250 000 tons) since then, as biomass increased from the mid-1990s until recently when a boom (1997-2004 with an associated eastward movement of the sardine stock) and bust scenario took place (crash in sardine biomass from ~2005 onwards). The fishery also targets red eye *Eutremeus whiteheadi* to a lesser degree, which along with anchovy, is processed into fish meal. The sardine catch is mostly canned with some marketed as fresh fillets or frozen for bait or human consumption. The fishery utilizes wooden, fibreglass or steel hulled purse-seine vessels and most of the large processing factories are located on the west and southwest coast (between St Helena Bay and Gansbaai) where purse seine fishing was historically concentrated.

The small pelagic fishery has the largest catch volume for any of the South African fishery sectors and has the second largest annual catch value, estimated at around R2.164 billion in 2017, which is approximately one fifth of the combined value of South African Fisheries (Japp & Wilkinson 2021). At this time, the industry supported around 4 500 full time staff, 2 500 seasonal staff and more than 700 fishers. The support industries contribute an estimated further 2 400 jobs. The small pelagic fishery is managed using an Operational Management Plan (OMP) that involves a trade-off between maximizing overall sardine and anchovy catches, whilst minimizing the risk of resource collapse. This trade-off is required as juvenile anchovy (which form the bulk of the anchovy catch) and juvenile sardine shoal together for much of the year. Allowance is therefore made for a sardine total allowable by-catch (TAB) of juvenile sardine in both the early and late anchovy allocations as well as a fixed TAB for adult sardine in the round herring directed fishery. The OMP is tuned to minimize risk of resource collapse which is defined as the probability of adult biomass falling below defined historical levels at least once during the simulation model projection period of 20 years. Stock status of anchovy and round herring are currently considered optimal, whilst sardine stocks are considered depleted (DEFF 2020).

The small pelagic purse-seine fishery operates between the Orange River and East London mostly in nearshore waters (within 10 km of the coast). The 14A Concession Area does overlap with identified priority fishing areas for anchovy and with part of the sardine directed fishing ground (Figure 15) (Norman *et al*. 2018).

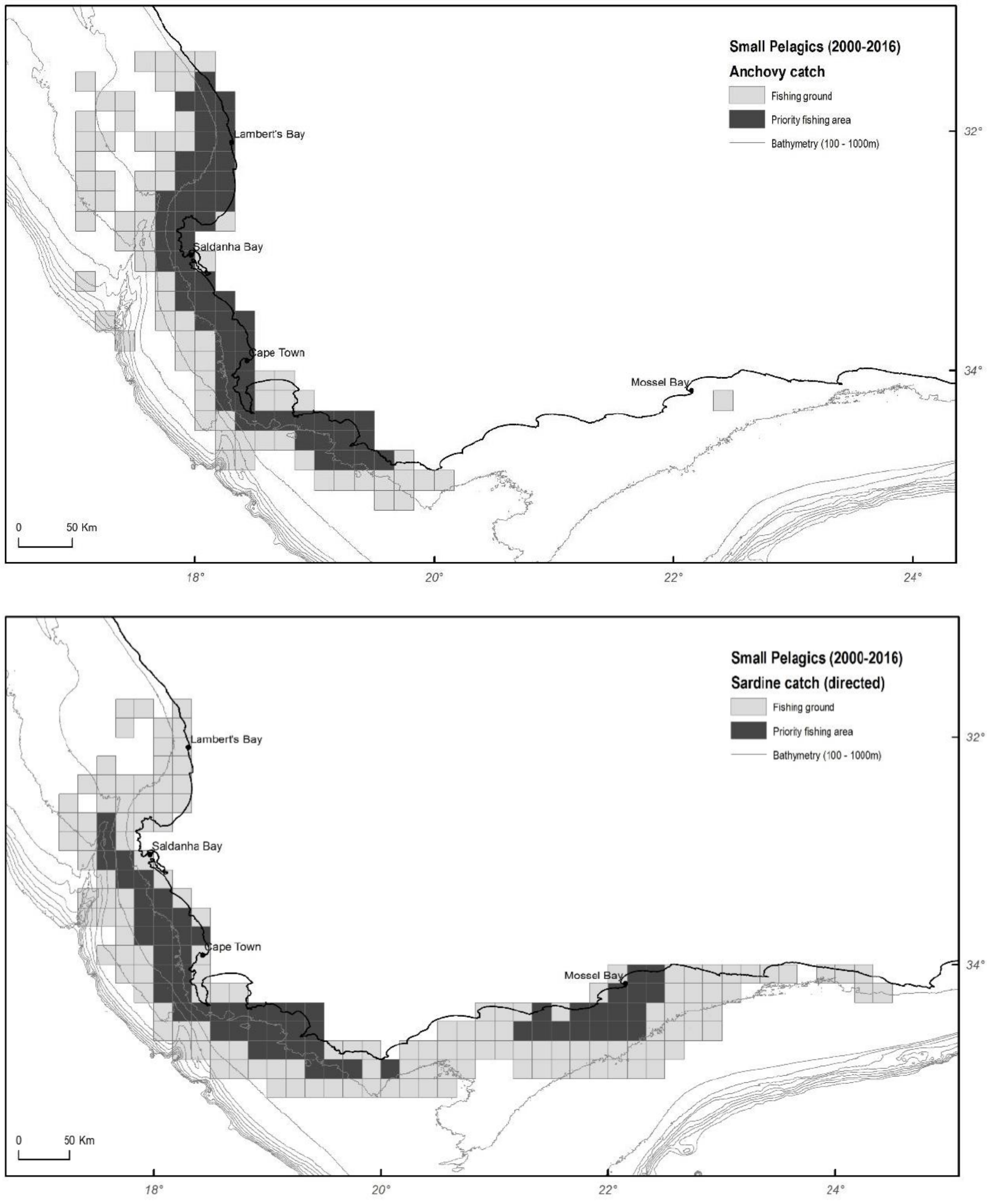

Figure 15 **Spatial distribution of anchovy (top) and sardine (bottom) purse seine catch (2000-2016) with identified priority fishing areas (Source: Norman *et al*. 2018).**

A quantitative spatial analysis using commercial catch return data (all small pelagic species combined) for the period 2006-2011, however, suggests that Concession Area 14A itself, does not constitute an area where a substantial proportion of the average annual purse seine catch is made. Despite the importance of partially overlapping reporting grid blocks to the small pelagic fishery that account for an average annual catch in the region of 3 300 tonnes, a relatively small proportion of the average annual catch over this period (~300 tonnes, which is <0.05% of the national total), was made within Concession Area 14A itself. This is assuming a uniform distribution of catches within a survey block and area-based allocation of catch to the concession area 14A, which is a conservative approach given the shallow water depths of <10m throughout much of the concession area that would preclude the deployment of the large purse seine nets in use by most vessels operating on the west coast (Figure 16). Furthermore, the target species are pelagic and their distribution is variable, so the fishery is unlikely to be significantly negatively affected by small temporary closures/exclusion zones around survey vessels and geotechnical survey sites.

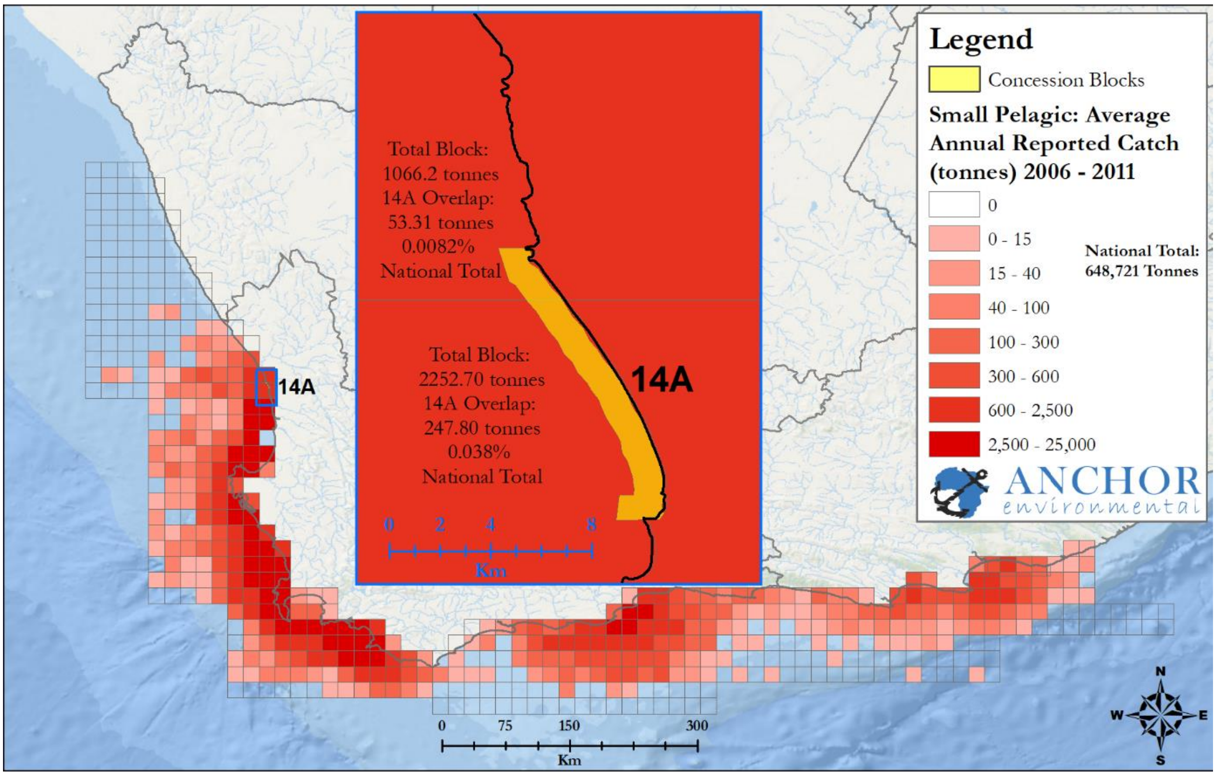

Figure 16 **Average annual reported small pelagic catch 2006-2011 (tonnes) and the calculated proportion of the average national total catch made within Concession Area 14A (Data source: DFFE).**

2.5.2 Line fish

Catching fish with hook and line is amongst the oldest form of fishing in South Africa and can be traced back to the fishing activities of indigenous Khoi and European seafarers in the 1500s. Both linefishing effort and catches increased substantially after the Second World War as a result of the introduction of technological advances such as reliable combustion engines, nylon line, chart plotters and echo sounders, as well as the construction of small boat harbours along the coast. In spite of technological advances over this period, declines in catch rates (in the region of 75-99%) were observed for many important line fish species during the 20th century, and are indicative of severe overexploitation.

Commercial, recreational and subsistence line fishers target up to 200 different fish species, both from boats and the shore. Due to this multispecies nature of the line fisheries, there is considerable overlap in catches between the three types of line fishers, and some overlap with other sectors such as inshore net fish and demersal trawling, and this complicates management. Commercial line fishing effort peaked in the 1990s with about 3 000 registered boats (only about 700 were active commercially), whilst recreational boat fishing (currently estimated at about 4 000 vessels), shore angling (~1 million participants) and subsistence fishing (largely shore based with an estimated 25-30 000 participants), continues to grow.

A management framework that included a comprehensive suite of line fish regulations was introduced in 1985, including revised minimum size limits equal to sizes at maturity (when known), daily bag limits, closed seasons, commercial fishing bans for certain species and the capping of the commercial effort at the 1984 level. CPUE data and stock assessments conducted since the mid-1980s have revealed that, with the exception of fast-growing species such as snoek and yellowtail, most commercially exploited traditional line fishes have been depleted to dangerously low levels. Apart from reduced productivity associated with stock depletion, other setbacks, such as ecosystem alteration, loss of genetic diversity and short-term commercial extinction, were also anticipated. This suggested that the line fish management framework in place at the time was failing to provide adequate protection for line fish stocks. This led to the development of a new Line fish Management Protocol (LMP) in 1999, that uses biological reference points for species for which quantitative stock assessment data exist, or trends in catch composition and catch rate for species were stock assessment data are lacking, to determine management actions.

In an effort to rebuild depleted line fish stocks an environmental emergency in the traditional line fishery was declared in December 2000. In terms of the emergency, the Minister determined that a Total Allowable Effort (TAE) of no more than 450 vessels and 3 450 persons may fish commercially for line fish. Revised bag and size limits for commercial and recreational line fishers were implemented in 2005. The commercial line fishery was split into three regional management zones, restricting the movement of vessels from one region to the next with the long-term rights allocation. Marine protected areas are a key component of line fish management, providing research opportunities in the absence of fishing effects, whilst numerous studies have demonstrated protection of spawner biomass in these areas and potential enhancement of adjacent fisheries through export of adults and juveniles. These measures have been met with some success and improved standardized CPUE trends are apparent for some species (DEFF 2020). However, the reduction in effort and resource recovery has been somewhat undermined by effort creep (via crew exemptions and interim relief measures), illegal fishing activity and unregulated subsistence fishing in important nursery habitats such as estuaries.

Line fishers operate in shallow water (generally <100 m depth) and would potentially be negatively impacted by coastal and nearshore seismic exploration, prospecting and mining operations (particularly recreational, small scale and subsistence shore fishing). A map of the reported commercial linefish catch data does show activity in one reporting block that overlaps with Concession Area 14A, although only a small proportion of the annual average reported national catch is made in this area (Figure 17). However, concession Area 14A starts just north and extends approximately 10 km south of Doringbaai, a small coastal village where marine resource use, particularly small-scale commercial (including interim relief rights holders) and subsistence line fishing, are critical livelihood activities that play an important role in ensuring food security for the community. The distance from is well with the daily travel range of the small, outboard motor-powered boats used by small scale line fishers operating from Doringbaai (and Lamberts Bay) harbours and the depth range of the concession area (0-30 m) includes the most frequently fished depths for one of the main target species in the area (hottentot seabream). There may well be fishing grounds that are important to the local community within the 14A concession Area and these must be identified in consultation with local stakeholders so that effective and mutually acceptable mitigation measures can be implemented during seismic survey, prospecting and mining phase activities.

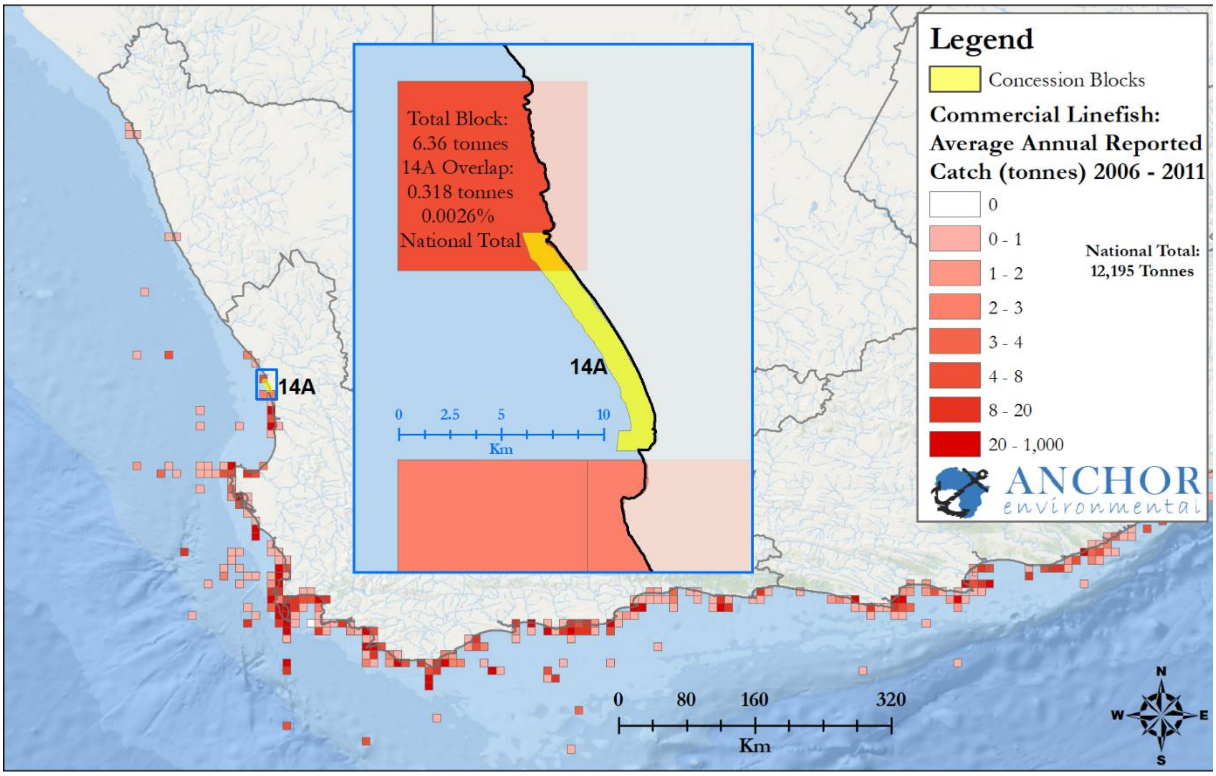

Figure 17 **Reported annual commercial line fishing catch and the calculated proportion of the average national total catch made within Concession Area 14A (Data source: DFFE).**

2.5.3 West coast rock lobster

Commercial west coast rock lobster, *Jasus lalandi*, fishing was historically concentrated along the South African West coast from the Namibian border to just east of Cape Point. Catch records prior to 1914 are sparse, but catches appear to have peaked in the period 1950 to 1965, when between 13 000 and 18 000 tons of lobster were landed annually. Different management measures have been introduced since 1933 including size limits, closed seasons, prohibition of landing berried females or soft-shell animals, and a TAC. Early management measures appeared to control catches until the mid-1960s, but in the late 1960s, catch rates began to decline, probably due to overfishing and quotas could not be filled. Decreases in the TAC to between 4 000 and 6 000 tons and the universal implementation of an 89 mm carapace length minimum size limit restored some balance in the period 1970/71 to 1989/90.

Commercial rock lobster fishing is now split into two sectors: a nearshore component that uses hoop nets deployed from small vessels and an offshore component that uses traps deployed from larger deck boats with greater than 1.5 tonne allocations. The offshore sector is not restricted to a particular fishing zone or area but is allowed to fish according to an agreed inter-area schedule. In the nearshore sector, right-holders may only use hoop nets and may not move between areas. Recreational permit holders may harvest four rock lobsters per day during season using hoop nets and poles, or by diving without the use of scuba.

Area or zonal allocations were introduced in the early 1980s. The 1990/91 season again saw catch rates dropping sharply as a result of a dramatic reduction in lobster somatic growth rates, which resulted in decreased recruitment to the lobster population above the minimum size limit. To maintain fishery stability and address concerns regarding increased discard mortality due to increased handling of undersized lobsters, the minimum size limit was reduced from 89 mm to 75 mm carapace length (CL) between the 1991/1992 and 1993/1994 fishing seasons and has remained unchanged since then. An OMP was implemented in 1997 with the aim of rebuilding stocks to 20% above the 1996 level by 2006. The commercial TAC was gradually reduced to 2000-3000 tonnes until 2012/13, and dramatically thereafter to around 1 000 tonnes in recent years (837 tonnes for the 2020/21 season). Despite this, there has been little evidence of recovery. The OMP of 2011 aimed for a recovery of 35% over 2006 levels by 2021, which was less than the recovery target initially set for 2006. Results from an updated assessments in 2016 and 2018 indicate that the situation remained dire, and that further substantial cuts in TAC were necessary (DEFF 2020). To date, recovery targets have not been achieved due to a combination of environmental factors leading to poor recruitment, and increased fishing pressure due to the allocation of more inshore rights and illegal fishing. The resource is currently assessed as heavily depleted with the biomass of male rock lobster above the minimum size limit estimated at only 1.8% of pristine biomass (DEFF 2020).

West Coast Rock Lobster is a nearshore, west coast species and any mining or prospecting activities that negatively impact the kelp bed and reef habitat required by this crustacean will further impact this depleted stock. Similar to line fishing, west coast rock lobster fishing constitutes an important economic activity for residents of Doringbaai, where few other livelihood options exist. A map of allocated TAC by right holder residential address shows that approximately 1% (3 tonnes) of the national near shore allocation (~300 tonnes) is held by right holders who reside in Doringbaai (Figure 18). It is frequently the same fishers who target line fish and west coast rock lobster and as recommended above, important rock lobster fishing grounds within the 14A Concession Area must be identified in consultation with local stakeholders so that effective and mutually acceptable mitigation measures can be implemented when seismic exploration and prospecting is undertaken.

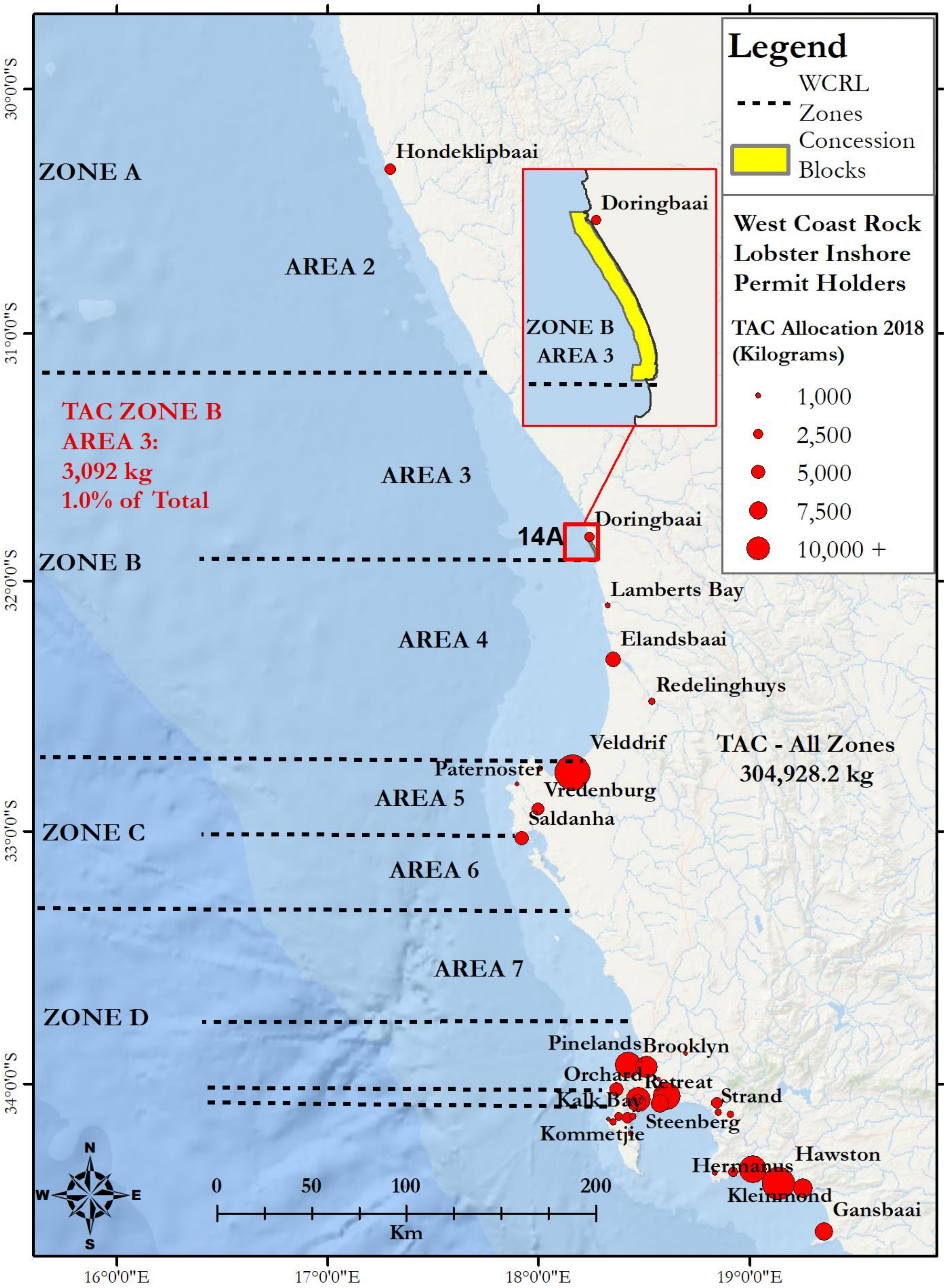

Figure 18 Map showing the proportion of the spatial distribution of quota in the west coast rock lobster nearshore sector by right holders given residential address (Source: DFFE, Fishing Right Register for all Commercial Fishing Sectors 2017).

2.5.4 Inshore net fishing

Beach seine net fishing takes place in the Western Cape, whilst gill net fishing is only permitted along parts of the west coast. Beach seine and gill net fisheries have a long history in the Western Cape, having been introduced by early European settlers. All near shore fish species were originally targeted, but since the mid-1980s gill net and beach seine permits in the Western Cape have been issued solely for the capture of harders *Chelon richardsonii*, St Joseph sharks *Callorhynchus capensis* and species on the bait list. This restriction does not apply to False Bay where a variety of line fish species such as yellowtail were historically targeted. A seasonal beach seine fishery for sardines takes place annually off the KZN coast, and a small (single permit holder) mixed species beach seine fishery is found off Durban.

A comprehensive investigation of the Western Cape inshore net fisheries around the turn of the century, incorporating fishery dependent monitoring, a socio-economic survey and fishery independent sampling revealed an oversubscribed fishery with a majority of part-time participants, evidence of overexploited harder stocks in areas with excess effort, and on average low economic returns. By-catch of juvenile line fish species, particularly in the estuarine gill net and illegal net fisheries were also identified as management concerns. In light of this, the medium- and long-term rights allocation largely removed part-time fishers not reliant on the fishery and resulted in a considerable effort reduction. The number of legal beach-seine nets was reduced from 200 to 28 and gill net permits from 450 to 162.

Recognizing the importance of estuarine nursery areas, a decision was also taken to phase out estuarine gill net fishing, although gill net fishing rights in the Olifants estuary are still recognised by the DFFE and an active fishery of 90 exemption permit holders target harders in this large estuary that enters the sea approximately 8 km north of Concession 14A. Beach seine netting is restricted to west of Cape Agulhas and gill net fishing to the north of Yzerfontein on the West Coast. A Total Allowable Effort (TAE) of 10 inshore net permits are allocated for the netfish management zone C that overlaps with concession area 14A. Four rights were issued to this zone, two are active from Lamberts Bay, whilst two right holders operate in the Doring Baai area using gill nets to target harders. Catches in this region are typically less than those made further south in St Helena Bay but would still constitute an important income and food source to the rights holders, their crew (approximately 4-6 fishers in total) and their dependents. Prospecting activities in concession 14A are, however, not expected to have a significant negative impact on this fishery that typically operates in shallow waters (<20 m depth), beyond the operational range of the proposed seismic survey and sampling vessel.

2.5.5 Abalone farming

Doring Bay Abalone (Pty) Ltd. (DBA) has been undertaking on-shore mariculture of abalone *Haliotis midae* at Doring Baai since 2014. The company has received support from TRONOX mining and the Matzikama municipality but is now totally reliant on its own income from sale of its farmed Abalone to cover all its running expenses. The sustainability of this project is critical to the survival of the community of Doring Baai and surrounding areas. DBA employs over 50 staff from the local community of Doring Baai. DBA also considers abalone ranching as an important diversified activity which would complement the land-based facility; and in so doing could assist in meeting social upliftment objectives via the creation of lasting direct and indirect job opportunities and improve marketing prospects and economic returns due to the preference for larger abalone that can only be economically produced via ranching. The Spatial Development Framework for the Matzikama Municipality, 2014 read together with the Amendment thereof in 2019 supports this proposal as follows: "Further development of the aquaculture sector e.g. abalone farms as well as associated facilities and development possibilities."

DBA has been successful in Phase 1 of the abalone ranching application process (Government Gazette 21 April 2011, No. 352 & 353) and in 2019, submitted an application for Phase 2 of the application process to establish an abalone ranching pilot project in the vicinity of Doring Baai extending from a point just south of Doring Baai to a point near Strandfontein 7 km to the north (pending DFFE approval). This area would overlap partially with the 14 A concession area. Diamond prospecting and mining activities can be in direct conflict with abalone ranching as not only is potential ranching habitat lost within the mining footprint, but a far larger spatial scale impact due to the creation of sediment plumes in the nearshore is likely.

Currently, limited acoustic surveying and no sampling is planned for the areas of mining concession 14A shallower than 15m and potential negative impacts on abalone farming (& planned ranching habitat) are considered unlikely. The proposed drill sampling, onboard processing and disposal of spoil overboard could, however, cause elevated turbidity in inshore areas under certain oceanographic conditions (onshore winds and currents), and suitable mitigation measures should be developed and implemented to not cause significant negative impacts on abalone farming activities.

3 IMPACT ASSESSMENT

Potential impacts were identified for exploration and prospecting in marine diamond mining Concession 14A. Potential impacts were assessed in terms of their nature, extent, duration, intensity, probability of occurrence, potential for mitigation and overall significance (see APPENDIX :1 IMPACT RATING METHODOLOGY).

3.1 Identification of impacts

Potential impacts to the marine environment as a result of exploration and prospecting are identified based on available literature, previous EIA and monitoring reports (Lane and Carter 1999; Penney et al. 2007; Pulfrich 2016, 2017, 2021; Biccard et al. 2018; Baker and Arnott 2021) and the specialist's own knowledge. It is assumed that a vessel with dynamic positioning will be used for all survey and sampling activities and potential impacts of anchoring on the seabed are therefore not assessed. Should this not be the case the potential impacts of anchoring must be assessed, and appropriate mitigation included in a revised EMPr. Identified potential impacts include:

- Seismic disturbance to marine fauna
- Marine megafauna collisions with survey vessels.
- Direct impact of seabed excavation and tailings disposal during drill sampling on benthic habitats e.g. soft sediments and/or reefs and associated infaunal and epifaunal communities;
- Impact on surrounding benthos and water column via fine sediment plume;
- Waste discharges during vessel operations
- Impacts on fisheries (and livelihoods of those who depend on these fisheries) due to exclusion zones around survey vessels and direct potential impacts on target species and supporting ecosystems, and

3.1.1 Seismic disturbance to marine fauna

There is growing concern that anthropogenic sounds in the marine environment potentially have a substantial impact on marine organisms (Branch and Branch 2018). Sounds generated by vessels in addition to the noise from seismic surveys have been related to negative impacts on marine animals (Koper and Plön 2012). These negative impacts include direct effects, such as physical injury (i.e. auditory and non-auditory), stress, perceptual interference, behavioural changes, and chronic responses, and indirect effects on predator species as a consequence of a change in prey distribution or abundance due to direct effects of sound on the prey (NRC 2003; Koper and Plön 2012). The impacts associated with seismic surveys are not yet fully understood and further research is currently underway.

During prospecting, sounds and vibrations emanating from sampling tools only last a few days but can be intense. Exposure to intense sounds for even short periods of time can lead to permanent hearing damage. Concerns over these disturbing effects have been raised in international literature (Richardson *et al*. 1986; 1990; 1995; Richardson and Malme 1993; Finley *et al*. 1990; Gordon *et al*. 1992; Bauer *et al*. 1993; Maybaum 1993; Bain and Dahlheim 1994; McCauley 1994; Vincent 1996;

Richardson and Würsig 1997; Gisiner 1998; Würsig *et al*. 1998; Lesage *et al*. 1999; Terhune and Verboom 1999; Au and Green 2000; McCauley *et al*. 2000; Miller *et al*. 2000; Nowacek *et al*. 2001; 2004; Nowacek and Wells 2001; Erbe 2002; Leung-Ng and Leung 2003). However, the potential effects of diamond prospecting and mining in southern Namibia on marine mammals have been reported to be minimal Findlay (1996).

It should be noted that natural sound sources are also emitted frequently from the ocean to a point where "sea noise" and biological sound sources (baleen whale calls, dolphin echolocation, shrimp snapping etc.) may even overshadow anthropogenic noise (Penney *et al*. 2007; Pulfrich 2017; Au 1993; Richardson *et al*. 1995).

Adverse impacts of underwater sound can be broadly summarised into three categories:

- Physical traumatic injury and fatality;
- Auditory injury (either permanent threshold shift (PTS) or temporary threshold shift (TTS) and;
- Disturbance.

Invertebrates

Invertebrates mostly do not possess hearing organs, but many do have tactile organs or hairs that are sensitive to underwater sound pressure (Mason 2017). Some invertebrates have highly sophisticated statocysts, which resemble the ears of fishes. While there is very little published information available about the effects of seismic noise on marine invertebrates, it has been postulated that benthic invertebrates can only hear seismic survey sounds at very close range. This implies that only surveys conducted in very shallow water will have any detrimental effects on benthic invertebrates. The 14A concession is very shallow (< 30 m) and harbours at least one commercially important invertebrate (west coast Rock lobster *Jasus lalandi*). The impacts of underwater noise on rock lobster are not completely understood, but research has demonstrated that exposure to seismic airgun signals has resulted in disruption of physiology in spiny lobsters (Fitzgibbon *et al*. 2017), whilst *J. edwardsii* incurred persistent damage to the statocyst and righting reflex following exposure to seismic air gun signals (Day *et al*. 2020). Exposure to high levels of low frequency anthropogenic noise caused similar damage to the statocyst but not the righting reflex, suggesting an ability to cope with or adapt to the mechanosensory damage (Day *et al*. 2020). The potential for negative impacts due to the proposed seismic exploration in concession 14A on rock lobster feeding, reproduction and survival do, therefore exist. These impacts would, however, be at the local scale for a short duration and the overall impact is assessed to be INSIGNIFICANT with mitigation that includes avoiding important fishing grounds and seasons (Table 5).

Table 5 **Seismic disturbance to invertebrates.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Medium 2	Short-term 1	Very low 4	Probable	**VERY LOW**	-ve	Medium

Essential mitigation measures: • Avoid important rock lobster fishing grounds • Conduct surveys outside of rock lobster fishing season								
With mitigation	Local 1	Medium 2	Short term 1	Very low 4	Improbable	**INSIGNIFICANT**	-ve	Medium

Fish

Although the impacts of underwater noise on spawning behaviour of fish have not been quantified to date, it is predicted that if fish are exposed to powerful external forces on their migration paths or spawning grounds, they may be disturbed or even cease spawning altogether, possibly affecting recruitment to fish stocks. The Multibeam Echo Sounder (MBES) to be used in this study is a high-frequency system (frequencies in excess of 10 kHz) and it is known that fish are unable to perceive the high frequencies that characterise these sources (Popper *et al*. 2014; Barham and Mason 2021). The Topas chirp SBP falls within the mid-frequency range from Popper *et al*. (2014) (1 kHz to 10 kHz) which is also mostly inaudible to fish (Mason 2017). Some species, particularly those that possess swim bladders, can suffer serious injury, but the majority of fish are highly mobile and are able to avoid seismic noise at levels that can cause injury (Mason 2017). Possible injury or mortality could occur on initiation of a sound source at full power in the immediate vicinity of fish, or where reproductive or feeding behaviour may override a flight response to seismic survey sounds. As noted above, Concession area 14A is in shallow water and reef areas within the concession are habitat for the important fishery species Cape Bream *Pachymetopon blochii*. Cape Bream are largely resident on reef systems and may not move away from the seismic source during surveying. The limited extent and short duration of the planned surveys, however, mean that the overall impact of the use of the seismic survey equipment on fish is assessed to be VERY LOW. Mitigation includes avoiding important fishing grounds which reduces the assessed impact to INSIGNIFICANT (Table 6).

Table 6 **Seismic disturbance to fish.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Medium 2	Short-term 1	Very Low 4	Probable	**VERY LOW**	-ve	Medium
Essential mitigation measures: • Avoid important rock lobster fishing grounds								
With mitigation	Local 1	Medium 2	Short-term 1	Very Low 4	Improbable	**INSIGNIFICANT**	-ve	Medium

Marine mammals

All marine mammals, through adaptation to the marine environment, have developed broader hearing ranges than are common to land mammals. These broader hearing ranges make them susceptible to acoustic trauma from geophysical survey activity. Such injuries are either temporary (temporary threshold shift – TTS) or permanent (permanent threshold shift – PTS). Injuries are likely to result in a reduction in foraging efficiency, reproductive potential, social cohesion and ability to detect predators (Weilgart 2007). The prevalence of geophysical survey data acquisition has increased across the globe in recent years and this has prompted scientists to establish noise exposure criteria to predict the onset of auditory effects in marine mammals in order to avoid or mitigate for such impacts (Southall *et al*. 2019).

To date, extensive seismic surveys have been conducted on the continental shelf on the west and south coasts of South Africa (Branch and Branch 2018). The scientific community have voiced their concern over the potential impacts associated with these seismic surveys on various groups of marine fauna. It is known that migrating whales are frequently encountered on the west coast of southern Africa during the summer months (due to feeding activity) and encounters with odontocetes such as dusky dolphins and Heaviside's dolphins are possible throughout the year. Furthermore, humpback calves are vulnerable during the southern migration which takes place during the months of September and October. The timing of seismic survey activity in concession 14A should be confined to seasons when cetaceans are scarce to ensure minimal disturbance (Gründlingh *et al*. 2006).

There is little information available on the levels of noise that would potentially result in physiological injury to cetaceans, and no permanent threshold shifts (PTS) have been recorded (Mason 2017). Available information suggests that the animal would need to be in close proximity to operating seismic equipment to suffer severe physiological injury (Koper and Plön 2012). As whales are highly mobile, it is assumed that they would avoid sound sources before such injury occurs. Observations show that responses to seismic activity varies between species with smaller odontocetes displaying the strongest avoidance response, while the responses of medium and large odontocetes (killer whales and pilot whales) were less marked (Mason 2017). Baleen whales showed fewer responses to seismic survey activity than small odontocetes, but all baleen whales showed changes in behavioural responses. McCauley *et al*. (2000b) found no obvious evidence that Humpback whales were displaced by seismic surveys and no apparent gross changes in the whale's migratory path could be linked to seismic survey activities, although localised avoidance of survey vessel has been noted. Such avoidance is generally considered of minimal impact in relation to the distances of migrations of the majority of whale species.

Of the proposed seismic survey activities, the Topas sub-bottom profiler system which uses shallow (35-45 kHz) and medium penetration (1-10 kHz) "Chirp" seismic pulses to map the sediment horizon could present a risk to dolphins that are known to occur in the area (mainly dusky and Heaviside's dolphins). Heaviside's dolphins are listed as near threatened on the IUCN red data list, are known to occur in the area, and fall into the category of mid-frequency cetaceans that could be at risk during the proposed seismic survey. Dusky dolphins (listed as "least concern" on the IUCN red data list) are also known to occur in the area and could also be at risk.

A noise modelling study (using marine mammal noise exposure criteria from Southall et al. (2019)) that was undertaken in Greenland in 50-250 m water depth for a similar MBES and Chirp sub-bottom profiler geophysical survey system predicted worst case scenario impact ranges for HF and LF cetacean hearing groups of less than 100 m for both PTS and TTS (Barham and Mason 2021). That said, it is recommended that an MMSO be on duty during the proposed seismic survey activities and as a precaution, the listed mitigation measures are followed. A passive acoustic monitoring (PAM) system should also be used during survey activity to detect cetaceans that could be at risk. Implementation of these mitigation measures should ensure that PTS and TTS impacts arising from the proposed seismic survey activities in concession 14A would be unlikely.

A breeding colony of Cape fur seals (*Arctocephalus pusillis pusillis*) exists on Elephant Rock, inshore of concession 14A, approximately 10 km north of the Olifants River Mouth. Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 m (approximately 220 km) offshore. It is highly likely that seals will be encountered during seismic exploration and sampling/prospecting activities in Concession 14A. In general, seals display considerable tolerance to underwater noise (Richardson *et al*. 1995). This has been confirmed by a study in Arctic Canada in which ringed seals showed only limited avoidance of seismic operations (Lee *et al*. 2005). In another study, ringed seals were shown to habituate to industrial noise (Blackwell *et al*. 2004). It is likely that seals would only suffer significant injury if they were diving directly below the vessel in close proximity to the seismic source. The likelihood of this occurring is considered low.

Based on the above, impacts to marine mammals was assessed to be of MEDIUM risk and with the implementation of mitigation (see below) this is reduced to LOW risk (Table 7).

Table 7 Seismic disturbance to marine mammals.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional 2	High 3	Short-term 1	Medium 6	Probable	**MEDIUM**	-ve	High
Essential mitigation measures: • A designated onboard Marine Mammal and Seabird Observer (MMSO) to ensure compliance with mitigation measures during geophysical surveying. • MMSO to conduct pre-survey visual scans of at least 15 minutes for the presence of cetaceans around the survey vessel prior to the initiation of any acoustic impulses • “Soft starts” should be carried out for equipment with source levels greater than 210 dB re 1 µPa at 1 m over a period of 20 minutes to give adequate time for marine mammals to leave the vicinity. Where this is not possible, the equipment should be turned on and off over a 20 minute period to act as a warning signal and allow cetaceans to move away from the sound source. • Terminate the survey if any marine mammals show affected behaviour within 500 m of the survey vessel or equipment until the mammal has vacated the area. • Avoid planning geophysical surveys during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (beginning of June to end of November) and ensure that migration paths are not blocked by sonar operations. • For the months of June and November ensure that Passive Acoustic Monitoring (PAM) is incorporated into any survey programme.								
With mitigation	Regional 2	High 3	Short term 1	Medium 6	Improbable	**LOW**	-ve	High

Seabirds

As with other vertebrates, the assessment of indirect effects of seismic surveys on diving seabirds is limited by the complexity of trophic pathways in the marine environment (Mason 2017). Impacts of seismic pulses to marine birds (diving or resting on water surface) include physiological injury, behavioural avoidance of seismic survey areas and indirect impacts due to effects on prey. The African penguin (*Spheniscus demersus*), which is flightless and occurs along the West Coast, is particularly susceptible to impacts from underwater noise. Due to the continuous nature of the intermittent seismic survey pulses, African penguins and other diving birds would be expected to hear the sound sources at distances where levels would not induce mortality or injury and likely avoid the approaching sound source (Mason 2017). This is supported by the findings of Pichegru *et al*. (2016) who have shown that feeding areas within 50 km of seismic surveys are completely avoided by African penguins.

Most of the impacts identified depend on the diet of the bird species concerned and the effect of seismic surveys on the diet species. For example, plunge-diving birds forage on small shoaling fish prey species relatively close to the shore (Mason 2017). Of the diving birds that occur along the coast, only *Morus capensis*, the Cape gannet, regularly feeds from the inshore environment as far as 100 km offshore. Other seabirds found close inshore that may be impacted include the cape cormorant and various terns and gull species. Pelagic seabirds such as albatross, petrels and shearwaters are most likely to be encountered in offshore waters, however, there is a possibility that vagrants may occur within 14A. The overall impact is assessed to be of LOW risk and with the implementation of mitigation (see below) is reduced to VERY LOW (Table 8).

Table 8 **Seismic disturbance to seabirds.**

<table>
<tr><th></th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td>Without mitigation</td><td>Local
1</td><td>High
3</td><td>Short-term
1</td><td>Low
5</td><td>Probable</td><td>LOW</td><td>-ve</td><td>High</td></tr>
<tr><td colspan="9"><u>Essential mitigation measures:</u>
• A designated onboard Marine Mammal and Seabird Observer (MMSO) to ensure compliance with mitigation measures during geophysical surveying
• MMSO to conduct pre-survey visual scans of at least 15 minutes for the presence of feeding seabirds in the survey area
• If spotted wait until all marine life (seabirds, seals, cetaceans and turtles) have cleared an area of 500 m radius of the centre of the seismic source before resuming with seismic survey (initiate soft start procedure when resuming seismic survey).
• Terminate the survey, if any seabirds show affected behaviour within 500 m of the survey vessel or equipment, until they have vacated the area.
• Record incidences of encounters with marine life (seabirds, turtles, seals, fish) their behaviour and response to seismic survey activity.
• Suspend operations if any obvious mortalities or injuries to marine life are observed.</td></tr>
<tr><td>With mitigation</td><td>Local
1</td><td>High
3</td><td>Short term
1</td><td>Low
5</td><td>Improbable</td><td>VERY LOW</td><td>-ve</td><td>High</td></tr>
</table>

Turtles

The overlap of turtle hearing sensitivity with the higher frequencies produced by seismic survey equipment suggests that turtles may be considerably affected by seismic noise. Recent evidence suggests that turtles only detect seismic survey equipment at close range (< 10 m, possibly linked to visual rather than auditory cues) or are not sufficiently mobile to move away from approaching survey vessels (particularly if basking). Initiation of a sound source at full power in the immediate vicinity of a swimming or basking turtle could therefore result in physiological injury. Injured turtles are less mobile than other large marine fauna and are vulnerable to both boat strikes and entanglement with seismic towed equipment. Most importantly, turtles are restricted to offshore pelagic waters off the west coast of South Africa and are unlikely to be encountered in Concession 14A, however, the possibility does exist that vagrant individuals might be encountered. Further to this, most incidents involve foraging turtles or turtles diving in an escape response becoming trapped by towed survey equipment which is not in the scope of works for the proposed seismic survey in Concession 14A. The overall impact is therefore assessed to be INSIGNIFICANT with no mitigation required (Table 9).

Table 9 Seismic disturbance to turtles

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Short-term 1	Very Low 3	Improbable	**INSIGNIFICANT**	-ve	High

Mitigation Measures

Current mitigation measures for impacts to marine fauna include spatial and temporal restrictions (i.e. activity restricted to specific areas or a time of year), source based mitigation (i.e. sound containment and improvement of current equipment used), and operational mitigation where a certain protocol is followed to avoid mortalities and/or injuries to marine animals when they are encountered during survey operations. These existing mitigation measures are highly valuable for a country such as South Africa, which has a rich coastal biodiversity and is an important habitat for threatened marine species, while experiencing a rapid increase in coastal industrial developments (Koper and Plön 2012).

The following mitigation measures identified by Mason (2017) and Koper and Plon (2012) are recommended where applicable to reduce the severity of the aforementioned impacts:

- Implement airgun "soft-starts" of at least 20 minutes duration.
- Employ on board independent observer(s) / MMSO(s) with experience in seabird, turtle and marine mammal identification and observation techniques to carry out daylight observations.
- If surveys are to be undertaken at night, it is recommended that the vessel is fitted with Passive Acoustic Monitoring (PAM) technology. Utilise PAM technology when surveying at night or during adverse weather conditions and thick fog (commonly encountered on the west coast of South Africa).
- Record marine mammal incidences and responses to seismic survey activity, including data on position, distance from the vessel, swimming speed and direction and obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) along with seismic noise levels.

- Terminate acoustic survey if mass mortalities of fish are observed.
- If spotted wait until all marine life (seabirds, seals, cetaceans and turtles) have cleared an area of 500 m radius of the centre of the seismic source before resuming with seismic survey (initiate soft start procedure when resuming seismic survey).
- Record incidences of encounters with marine life (seabirds, turtles, seals, fish) their behaviour and response to seismic survey activity.
- Suspend operations if any obvious mortalities or injuries to marine life are observed.
- Wait until all small cetaceans (<3 m in overall length) have cleared an area of 500 m radius of the seismic survey vessel before resuming with seismic survey. If, after a period of 30 minutes, small cetaceans are still within 500 m of the airguns, the normal "soft start" procedure should be allowed to commence for at least 20-minutes duration. Small cetacean behaviour during "soft starts" shall be monitored.
- Record seabird incidences and behaviour, including any attraction of predatory seabirds and incidents of feeding behaviour around the survey vessel.
- Ensure that MMOs compile a survey close–out report incorporating all recorded data to the relevant DFFE authorities.
- Make marine mammal incidence data and seismic source output data from surveys available on request to the Marine Mammal Institute (MMI), DAFF and DMR.

3.1.2 Marine megafauna collisions with survey vessels

There is a low risk of survey vessel collisions with marine megafauna such as whales and turtles that are susceptible to "ship strikes". Any increase in vessel traffic through habitat used by these animals can increase the risk of collision whilst the deployment of towed survey gear carries a risk of entanglement - towed survey equipment is not in the scope of works for the proposed seismic survey in Concession 14A. The main causes of cetacean (mainly southern right and humpback whales) entanglement in South Africa involve static fishing gears particularly west coast and south coast rock lobster traps and long lines (Meyer *et al*. 2011). The potential for collision between cetaceans and other megafauna and the survey vessel, or entanglement in the deployed sampling equipment is directly proportional to the vessel speed and the abundance and behaviour and cetaceans in the area during the surveys. The 14A concession area is part of the natural range of several species of marine mammals including large whales such as humpback and southern right whales, but it is not considered an important aggregation site or migration route (see Section 2.3.5). The number of marine fauna expected to be encountered during the limited time that the survey vessel is active is therefore expected to be very low and the intensity of the impact is considered high for the individual affected animal and medium for the population as a whole.

The potential impact of marine megafauna collision with the survey vessel or entanglement in sampling equipment is therefore assessed to be of VERY LOW significance and with the implementation of mitigation measures is reduced to INSIGNIFICANT (Table 10).

Table 10 Marine megafauna collisions with survey vessels.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional 2	Medium 2	Short-term 1	Low 5	Possible	**VERY LOW**	-ve	High
Essential mitigation measures: • A designated onboard Marine Mammal Observer (MMO) and vessel operator to keep watch for marine megafauna in the path of the vessel during geophysical surveying. • 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. • Vessel transit speed to not exceed 12 knots (22 km/hr), except within 25 km of the coast where it should be kept to less than 10 knots (18 km/hr) as well as when sensitive marine fauna are present in the vicinity.								
With mitigation	Regional 2	Low 1	Short term 1	Very Low 4	Improbable	**INSIGNIFICANT**	-ve	High

3.1.3 Seabed sampling and tailings disposal

Approximately 100-200 sites will be sampled in Concession 14A using either vibracoring, gravity coring or sonic coring techniques. The diameter of core samples will be approximately 10 cm, the corers will penetrate to depths of 3–8 m and the material brought to the surface for analysis. The volume per core is calculated at 0.24 m^3. The total volume for the 200 cores is calculated at 4.71 m^3. The 200 cores will cover a total surface area of 1.57 m^2, although the core might impact a surface area slightly larger than this. In addition to this, prospective targets will be analysed by a uniquely designed drill tool that can dredge gravel from the seabed. Material will be processed onboard by a processing plant and tailings will be discarded overboard, thereby causing sediment plumes, in this instance as a near-shore deposit. Pending the final tool design, the drill bit footprint will be between 3 and 5 m^2 with an expected average hole depth of 3 m. Sample volumes are anticipated to be in the range of 9 to 15 m^3 per sample. Drill samples will be spaced at roughly 300 m apart from north to south during Phase 2 (reconnaissance sampling).

Impacts from sampling are likely to result in localised removal of benthic organisms and their habitat within the footprint of the sampling tool, which due to the relatively small size of the various coring tools, is expected to be virtually negligible. However, the impacts from drill sampling are expected to be more extensive. These impacts include direct habitat loss and smothering of the benthos adjacent to sampling sites associated with localised tailings discard. The samples are discrete (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. sampling locations). Full recovery is expected to take place within the short to medium term (i.e. 5 – 10 years). Furthermore, biomass often remains reduced for several years as long-lived species like molluscs, larger burrowing crustaceans and echinoderms need longer to re-establish the natural age and size structure of the population. It is generally accepted that inshore disturbed require a shorter period of time to recover than those in deeper water further offshore (Figure 19). Important drivers of inshore habitat recovery are related to the exposure to dynamic physical processes such as wave action and sediment refill from river mouths (Biccard *et al*. 2020b). Hence, recovery times greatly increase with depth and distance from sources of sedimentation.

No direct mitigation is considered necessary for seabed sampling and localised smothering of the benthos (tailings disposal). However, it is possible to implement careful planning and management of potential discharges to ensure that tailings are not discarded onto sensitive reef habitat (Penney *et al*. 2007; Pulfrich 2017). The overall consequence of this impact is considered to be low and is of LOW significance (Table 11). No mitigation measures are required.

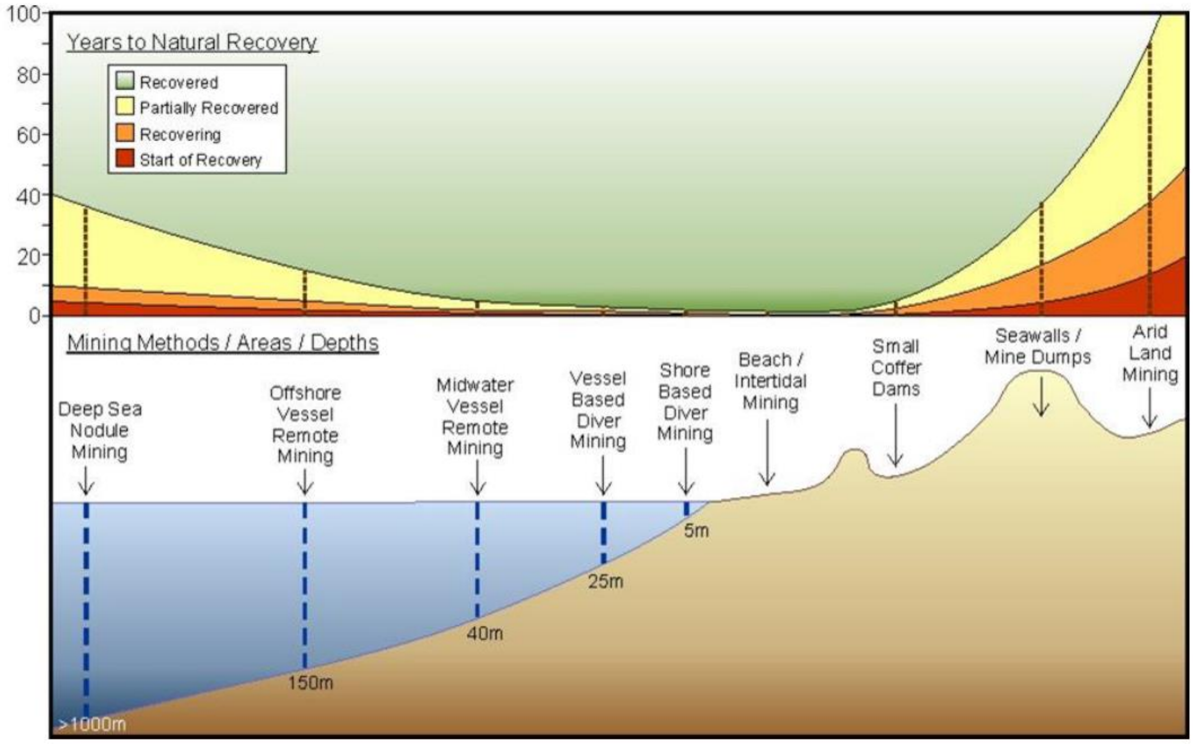

Figure 19 **Maximum times to various stages of natural recovery (still impacted, recovering, partially recovered and recovered) reported in the literature for various local studies of marine mining, and relevant international studies on other seabed disturbances (Penney et al. 2007).**

Table 11 **Benthic Impact of Seabed sampling and tailings disposal.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Medium 2	Medium-term 2	Low 5	Definite	**LOW**	-ve	High

Best Practice:

- Planning and management of potential discharges to ensure that tailings are not discarded onto potentially sensitive habitats
- No essential or potential mitigation measures identified

3.1.4 Fine sediment plumes

During the sampling process, sedimentary material that has been brought to the surface will be processed onboard and unwanted material (tailings) will be discarded overboard, thereby causing sediment plumes. These plumes can affect light penetration through the water column and can adversely affect phytoplankton productivity in the water column (Johnson 1981; Poopetch 1982; Kirk 1985; Parsons *et al*. 1986a; 1986b; Monteiro 1988; O'Toole 1997; Pulfrich 2017). Suspended sediment plumes can also develop either near the seabed, or in mid-water due to the dynamic collapse and diffusion of the sediment jet following the discharge. Suspended sediment concentrations generated at the point of discharge, the extent and area over which plumes disperse, and their duration, depend largely on the proportions of silts, muds and clays in the mined sediments, as well as the sea-surface conditions during disposal. 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 activities in 14A will not be contiguous. This will result in a delay in time while the seabed tool is transferred to the new sampling site before additional sediment is released overboard with the next sample.

In addition to reduced phytoplankton productivity, suspended sediments may also affect the biological responses of consumers (hatching success, larval survival and foraging behaviour) provided they contain inorganic particles (Clarke and Wilber 2000). Although, these plumes differ in intensity and timing from natural background conditions, marine communities in the Benguela region are well adapted to such events as they are frequently exposed to naturally elevated suspended-sediment levels (Penney *et al* 2007). This is particularly true for shallow inshore waters, like 14A, where sediment is suspended as a result of wave action. Further to this, studies conducted on dredge-mining operations have recorded that water-column turbidity return to natural background levels within a few hours after dredging has ceased (Evans 1994; Whiteside *et al*. 1995).

The volumes of sediment that are expected to be collected and processed in this project are relatively small, and hence impacts on the environment are expected to be insignificant and without any measurable cumulative impact (Table 12). No direct mitigation is feasible as tailings disposal is an integral part of this mining method.

Table 12 Potential Impact of tailings discharge and fine sediment plumes on the pelagic habitat.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Short-term 1	Very low 3	Definite	**VERY LOW**	-ve	High
Best Practice: • No essential or potential mitigation measures identified								

3.1.5 Waste discharges during vessel operations

Water quality in the vicinity of exploration, sampling and associated support vessels may be impaired by various forms of waste discharged into the marine environment. During operation, normal discharges to the sea can come from a variety of sources but these are all regulated generally by onboard waste management plans which must be MARPOL compliant. The impacts on marine life depend on the properties of the waste discharged. The various kinds of waste produced at sea, their associated impacts and management protocols are outlined below.

Discharge of wastes and hydrocarbons

Vessel operators may experience accidental spills from operational machinery, which could include hydrocarbons such as hydraulic fluids, diesel, oils and/or hazardous substances. Spills of this nature are highly toxic and unless carefully managed, may pollute nearshore and coastal environments as well as damage and potentially destroy, marine organisms (wreckage of a vessel). The duration of the impact would depend on the bio-degradation of the type of waste. Solid wastes (e.g. plastics, scrap metals) may take decades or centuries to degrade. Cumulative impacts are unlikely due to the low likelihood of major accidents such as collision or wreckage. Strict waste management plans should be enforced for all operators; all deck drainage from workspaces and ballast water to be discharged must meet the MARPOL compliance level of 15 ppm oil in water. This is achieved through use of an oily-water separation system. The oily substances must be skimmed off the top of the discharge water and added to the waste (oil) lubricants and disposed of on land.

Sewage

In accordance with MARPOL, sewage effluent must not produce visible floating solids in, nor cause discolouration of the surrounding water. The treatment system must provide primary settling, chlorination and dechlorination before the treated effluent can be discharged into the sea. The discharge depth is variable, depending upon the draught of survey vessel at the time, but should not be less than 5 m below the surface.

Litter

Large numbers of marine organisms, including fish and marine mammals, are killed or injured by becoming entangled in debris (Wallace 1985), while others, including seabirds, are at risk through the ingestion of small plastic particles (Shomura and Yoshida 1985). The problem of litter entering the marine environment has escalated dramatically in recent decades, with an ever-increasing proportion of litter consisting of non-biodegradable plastic materials. Objects that are particularly harmful to marine fauna include plastic bags and bottles, pieces of rope and small plastic particles (Wehle and Coleman 1983). Large numbers of marine organisms, including fish, birds and marine mammals, are killed or injured by becoming entangled in debris (Wallace 1985) while others, including seabirds, are at risk through the ingestion of small plastic particles (Shomura and Yoshida 1985). All reasonable measures must be implemented to ensure that no littering takes place during installation, operation and closure of oil and gas production facilities.

Food (galley) waste

Food waste may be discharged after it has been passed through a grinder in cases where the drilling unit or production facility is located more than 3 nautical miles offshore. Discharge of whole food waste is permitted beyond 12 nautical miles offshore. The ground wastes must be capable of passing through a screen with openings <25 mm. The daily volume of discharge from a standard drilling unit is expected to be <0.5 m^3 (Pulfrich 2015). Concession14A is located well inshore of these limits and thus all food waste should be retained until the survey vessel has moved beyond the prescribed limits for food waste disposal at sea.

Detergents

Detergents used for washing exposed marine deck spaces are discharged overboard. The toxicity of detergents varies greatly depending on their composition, but low-toxicity, biodegradable detergents should preferably be used. Those used on work deck spaces would be collected with the deck drainage and treated as described above.

Cooling Water

Electricity on exploration, sampling and associated support vessels is typically provided by diesel-powered engines and generators, which are cooled by pumping water through a set of heat exchangers. The cooling water is then discharged overboard. Other equipment is cooled through a closed loop system, which may use chlorine as a disinfectant. Such water would be tested prior to discharge and would comply with relevant Water Quality Guidelines.
Based on the relatively small volumes of waste that can be expected, the potential impact of operational discharges from exploration and sampling/prospecting on the marine environment are of very low consequence, and the extent is likely to be limited to the immediate area around the vessel(s).

Overall, the potential impact of operational discharges on the marine environment is considered to be of VERY LOW significance. With the implementation of the stipulated mitigation measures this is reduced to INSIGNIFICANT (Table 13).

Table 13 Waste discharge during vessel operation.

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Low 1	Medium-term 2	Very low 4	Probable	**VERY LOW**	-ve	High

Best practise:

- & empower all staff about sensitive marine species & suitable disposal of waste;
- Ensure compliance with relevant MARPOL standards;
- Develop a waste management plan using waste hierarchy;
- A Shipboard Oil Pollution Emergency Plan (SOPEP) must be prepared for all vessels and should be in place at all times during operations;
- Deck drainage should be routed to a separate drainage system (oily water catchment system) for treatment to ensure compliance with MARPOL (15 ppm);
- All process areas should be bunded to ensure drainage water flows into the closed drainage system;
- Drip trays should be used to collect run-off from equipment that is not contained within bunded areas and the contents routed to the closed drainage system;
- Low-toxicity biodegradable detergents should be used in the cleaning of all deck spillages;
- All hydraulic systems should be adequately maintained and hydraulic hoses should be frequently inspected; and

• Spill management training and awareness should be provided to crew members of the need for thorough cleaning-up of any spillages immediately after they occur in order to minimise the volume of contaminants washing off decks.								
With mitigation	Local 1	Low 1	Short term 1	Very low 3	Improbable	**INSIGNIFICANT**	-ve	High

Mitigation Measures

The following mitigation measures are recommended (Pulfrich 2015):

- Inform & empower all staff about sensitive marine species & suitable disposal of waste;
- Ensure compliance with relevant MARPOL standards;
- Develop a waste management plan using waste hierarchy;
- A Shipboard Oil Pollution Emergency Plan (SOPEP) must be prepared for all vessels and should be in place at all times during operations;
- Deck drainage should be routed to a separate drainage system (oily water catchment system) for treatment to ensure compliance with MARPOL (15 ppm);
- All process areas should be bunded to ensure drainage water flows into the closed drainage system;
- Drip trays should be used to collect run-off from equipment that is not contained within bunded areas and the contents routed to the closed drainage system;
- Low-toxicity biodegradable detergents should be used in the cleaning of all deck spillages;
- All hydraulic systems should be adequately maintained and hydraulic hoses should be frequently inspected; and
- Spill management training and awareness should be provided to crew members of the need for thorough cleaning-up of any spillages immediately after they occur in order to minimise the volume of contaminants washing off decks.

3.1.6 Impacts on fisheries

According to the International Regulations for Preventing Collisions at Sea (Colregs 1972), vessels engaged in seismic surveys are recognised as vessels limited in their ability to manoeuvre and as such, vessel engaged in other activities (such as fishing) are obliged to give way. Furthermore, the implementation of a safety (exclusion) zone around the seismic vessel will exclude any other users of the sea from these areas. In practice, this exclusion zone takes form of a moving footprint extending around the survey vessel (Mason 2017). In this case, the size of the footprint can be expected to be around 500 m in extent.

Exclusion of fishing vessels from fishing areas, possible altered behaviour of fish due to seismic activities and interference with shipping could have (indirect) socio-economic implications for the affected industries. Fisheries might be affected by target species avoiding seismic survey areas for several days after the survey has terminated or the vessel has moved on (Mason 2017). Survey vessels may also encounter and possibly dislocate fishing gear (e.g. lobster traps) deployed within the survey area.

Fisheries sectors operating within Concession 14A that could be impacted include those listed in section 2.5 (traditional line, small pelagic purse seine and the west coast rock lobster fisheries). Overlap with each of these sectors is shown in Figure 16, Figure 17 and Figure 18– the catches from these sectors made within the concession area 14A are all of limited significance as a proportion of the national total catch, however, for local small scale fisherman impacts such as the temporary exclusion of fishing vessels from the concession area during seismic survey and sampling/prospecting activities could be more significant. Concession Area 14A starts adjacent to Doringbaai, a small coastal village where marine resource use, particularly small-scale commercial (including interim relief rights holders) rock lobster and line fishing are critical livelihood activities that play an important role in ensuring food security for the community. The entire concession area is well with the daily travel range of the small, outboard motor-powered boats used by small scale fishers operating from Doring Baai and the depth range of the concession area (5-30 m) includes the most frequently fished depths for the main target species in the area (west coast rock lobster and Cape seabream). There will be fishing grounds that are important to the local community within the 14A Concession Area and these must be identified in consultation with local stakeholders so that effective and mutually acceptable mitigation measures can be implemented during seismic survey, prospecting and mining phase activities. Overall, the impact is assessed to be of VERY LOW significance and with the implementation of mitigation could be reduced to INSIGNIFICANT (Table 14).

Table 14 **Impact on fisheries.**

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Medium 2	Short-term 1	Very Low 4	Probable	**VERY LOW**	-ve	High
<u>Essential mitigation measures:</u> • Implement "soft starts" of at least 20 minutes. • Undertake surveys when fishing effort is lower (preferably out of fishing seasons). • Appoint a fisheries liaison officer (FLO) to facilitate communication with fishing community in Doringbaai. The FLO should report daily on vessel activity and respond and advise on action to be taken in the event of encountering fishing gear in the survey area. **Best Practice:** • Prior to survey commencement, key stakeholders (see below) should be consulted and informed of the proposed survey activity and the likely implications thereof								
With mitigation	Local 1	Low 1	Short term 1	Very Low 3	Improbable	**INSIGNIFICANT**	-ve	High

Mitigation Measures and recommendations

Prior to survey commencement, the following key stakeholders should be consulted and informed of the proposed survey activity (including navigational co-ordinates of the survey area, timing and duration of proposed activities) and the likely implications thereof:

- Fishing industry / associations:
    - SA Marine Linefish Management Association (SAMLMA);
    - South African Pelagic Fishing Industry Association (SAPFIA)

  - West Coast Rock Lobster Association; and
  - Local fishing communities in Doringbaai
- Other associations and organs of state
  - DFFE;
  - SAMSA;
  - South African Navy Hydrographic office; and
  - Overlapping and neighbouring right holders.

These stakeholders should again be notified at the completion of surveying when the survey vessel(s) is/are off location. The operator must request, in writing, that the South African Navy Hydrographic office release Radio Navigation Warnings and Notices to Mariners throughout the survey periods. The Notice to Mariners should give notice of (1) the co-ordinates of the proposed survey area, (2) an indication of the proposed timeframes of surveys and day-to-day location of the survey vessel(s), and (3) an indication of the required safety zone(s) and the proposed safe operational limits of the survey vessel. These Notices to Mariners should be distributed timeously to fishing companies and directly onto vessels where possible.

4 CONCLUSIONS AND RECOMMENDATIONS

Anchor Environmental Consultants were requested to undertake a marine specialist study for Trans Atlantic Diamonds (Pty) Ltd who are applying for a diamond prospecting right for Concession Area 14A, offshore of the Western Cape Coast. Proposed activities include geophysical exploration (seismic survey using MBES and SBP) and sampling/prospecting to detect the presence of palaeo-beach deposits at different submerged sea levels that occur in Concession 14A, which are known from other concessions to contain diamondiferous gravels. Seismic surveying will be conducted using a dedicated survey vessel with a hull-mounted MBES (high frequency range) and Topas sub-bottom profiler (SBP) system (mid-frequency range) collecting high-resolution acoustic data along lines 50 m to 200 m apart throughout the concession area.

A description of the affected environment is provided. Habitat and biota of conservation importance were identified and mapped in relation to the proposed survey area. The likelihood of occurrence of affected marine fauna within the proposed survey area was ascertained from available literature. Important user groups such as fisheries are described and mapped in relation to the proposed survey area. Potential direct, indirect and cumulative impacts from the proposed exploration and prospecting activities were identified. Impacts were assessed and, where possible, mitigation measures have been identified to avoid/minimise/reduce any impacts.

Risks and impacts associated with the proposed activities range from medium to insignificant but with effective mitigation these are all reduced to very low or insignificant. Potential impacts of most concern include seismic disturbance to marine mammals and impacts on fisheries within Concession 14A. Heaviside's dolphins (listed as near threatened on the IUCN red data list – Elwen *et al*. 2010) are known to occur in the area and fall into the category of high frequency cetaceans that could be at risk during the proposed seismic survey. Of the proposed seismic survey activities, the Topas sub-bottom profiler system which uses shallow (35-45 kHz) and medium penetration (1-10 kHz) "Chirp" seismic pulses to map the sediment horizon could present a risk to dusky and Heaviside's dolphins. These species are regarded as mid-frequency cetaceans (Simon Elwen *pers. comm.*) that could be at risk during the proposed seismic survey. A noise modelling study (using marine mammal noise exposure criteria from Southall *et al*. (2019)) that was undertaken in Greenland in 50-250 m water depth for a similar MBES and Chirp sub-bottom profiler geophysical survey system predicted worst case scenario impact ranges for HF and LF cetacean hearing groups of less than 100 m for both PTS and TTS (Barham and Mason 2021). To mitigate for potential impacts to these dolphins it is recommended that an MMSO be on duty during seismic survey activities and that the listed mitigation measures (halting the survey when cetaceans if cetacean approach within close proximity to the survey vessel and using soft start procedures, etc.) are followed. Should seismic surveys continue into the night or during periods of low visibility (mist is frequently encountered at sea along the west coast), it is recommended that a passive acoustic monitoring (PAM) system also be used to detect cetaceans that could be at risk. For larger migratory cetaceans, seismic surveying should be confined to seasons when they are scarce to ensure minimal disturbance (Gründlingh *et al*. 2006).

Temporary exclusion of fishing vessels from the concession area during seismic survey and sampling/prospecting activities is also of potential concern. Concession 14A starts just south of Doringbaai, a small coastal village where marine resource use, particularly small-scale commercial (including interim relief rights holders) and subsistence line fishing are critical livelihood activities that play an important role in ensuring food security for the community. The distance from Doringbaai harbour is well with the daily travel range of the small, outboard motor-powered boats used by small scale linefishers and the depth range of the concession area (0-30 m) includes the most frequently fished depths for the main target species in the area (west coast rock lobster, snoek and hottentot seabream). There may well be fishing grounds that are important to the local community within the 14A Concession Area and it is recommended that be identified in consultation with local stakeholders so that effective and mutually acceptable mitigation measures can be implemented during seismic survey, prospecting and future mining phase activities.

Offshore reef habitat is expected to be encountered in concession 14A (Figure 4). These reefs are considered sensitive habitat and it is recommended that they be visually assessed (by means of drop camera deployments or diver surveys) during the baseline environmental survey with regular repeat surveys in the event of future mining operations in the area – offshore reefs may not be directly impacted (mined) but are at risk of being indirectly impacted by smothering from tailings disposal. These offshore rocky reefs are colonised by a range of epifauna including bryozoans, encrusting and upright sponges, solitary and colonial ascidians, sea anemones and cold-water coral colonies – the latter being slow-growing and taking many years to become established (Biccard *et al*., 2020b). Studies undertaking assessments of prospecting and mining-related impacts on these habitats in this region are relatively new and the time taken for disturbed epifaunal communities inhabiting offshore rocky reefs to recover has not yet been determined (Biccard *et al*., 2020b).

Table 15 **Summary table of potential marine ecological and fisheries impacts associated with inshore diamond exploration activities (seismic survey and sampling/prospecting) in South African Sea Area concession 14A.**

Impact	Consequence	Probability	Significance	Status	Confidence
Seismic disturbance to invertebrates	Very low	Probable	VERY LOW	-ve	Medium
With mitigation	Very low	Improbable	INSIGNIFICANT	-ve	Medium
Seismic disturbance to fish	Very Low	Probable	VERY LOW	-ve	Medium
No mitigation	Very Low	Improbable	INSIGNIFICANT	-ve	Medium
Seismic disturbance to marine mammals	Medium	Probable	MEDIUM	-ve	High
With mitigation	Medium	Improbable	LOW	-ve	High
Seismic disturbance to seabirds	Low	Probable	LOW	-ve	High
With mitigation	Low	Improbable	VERY LOW	-ve	High
Seismic disturbance to turtles **No mitigation**	Very low	Improbable	INSIGNIFICANT	-ve	High
Marine megafauna collisions with survey vessels	Low	Possible	VERY LOW	-ve	High
With mitigation	Very low	Improbable	INSIGNIFICANT	-ve	High
Offshore based seabed sampling and tailings disposal **No mitigation**	Low	Definite	LOW	-ve	High
Fine sediment plumes **No mitigation**	Very low	Definite	VERY LOW	-ve	High
Waste discharges during vessel operations	Very low	Probable	VERY LOW	-ve	High
With mitigation	Very low	Improbable	INSIGNIFICANT	-ve	High
Impact on fisheries **No mitigation (see best practice recommendations)**	Very Low	Probable	VERY LOW	-ve	High
	Very Low	Improbable	INSIGNIFICANT	-ve	High

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6 APPENDIX :1 IMPACT RATING METHODOLOGY

The significance of all potential impacts that would result from the proposed project is determined in order to assist decision-makers. The **significance** of an impact is defined as a combination of the **consequence** of the impact occurring and the **probability** that the impact will occur. The significance of each identified impact was thus rated according to the methodology set out below:

Step 1 – Determine the **consequence** rating for the impact by determining the score for each of the three criteria (A-C) listed below and then **adding** them. The rationale for assigning a specific rating, and comments on the degree to which the impact may cause irreplaceable loss of resources and be irreversible, must be included in the narrative accompanying the impact rating:

Rating	Definition of Rating	Score
A. ***Extent – the area over which the impact will be experienced***		
Local	Confined to project or study area or part thereof (e.g. limits of the concession area)	1
Regional	The region (e.g. the whole of Namaqualand coast)	2
(Inter) national	Significantly beyond Saldanha Bay and adjacent land areas	3
B. ***Intensity – the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources***		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. ***Duration – the time frame for which the impact will be experienced and its reversibility***		
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2
Long-term	More than 15 years (state whether impact is irreversible)	3

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

Combined Score (A+B+C)	**3 – 4**	**5**	**6**	**7**	**8 – 9**
Consequence Rating	Very low	Low	Medium	High	Very high

Example 1:

Extent	Intensity	Duration	Consequence
Regional 2	Medium 2	Long-term 3	High 7

Step 2 – Assess the **probability** of the impact occurring according to the following definitions:

Probability– the likelihood of the impact occurring	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

Example 2:

Extent	**Intensity**	**Duration**	**Consequence**	**Probability**
Regional 2	Medium 2	Long-term 3	High 7	Probable

Step 3 – Determine the overall **significance** of the impact as a combination of the **consequence** and **probability** ratings, as set out below:

		Probability			
		Improbable	Possible	Probable	Definite
Consequence	Very Low	**INSIGNIFICANT**	**INSIGNIFICANT**	**VERY LOW**	**VERY LOW**
	Low	**VERY LOW**	**VERY LOW**	**LOW**	**LOW**
	Medium	**LOW**	**LOW**	**MEDIUM**	**MEDIUM**
	High	**MEDIUM**	**MEDIUM**	**HIGH**	**HIGH**
	Very High	**HIGH**	**HIGH**	**VERY HIGH**	**VERY HIGH**

Example 3:

Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**
Regional 2	Medium 2	Long-term 3	High 7	Probable	HIGH

Step 4 – Note the **status** of the impact (i.e. will the effect of the impact be negative or positive?)

Example 4:

Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Status**
Regional 2	Medium 2	Long-term 3	High 7	Probable	HIGH	– ve

Step 5 – State the level of **confidence** in the assessment of the impact (high, medium or low).

Impacts are also considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The prescribed system for considering impacts status and confidence (in assessment) is laid out in the table below. Depending on the data available, a higher level of confidence may be attached to the assessment of some impacts than others. For example, if the assessment is based on extrapolated data, this may reduce the confidence level to low, noting that further ground-truthing is required to improve this.

Confidence rating	
Status of impact	+ ve (beneficial) or – ve (cost)
Confidence of assessment	Low, Medium or High

Example 5:

Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**Status**	**Confidence**
Regional 2	Medium 2	Long-term 3	High 7	Probable	HIGH	– ve	High

The significance rating of impacts is considered by decision-makers, as shown below. Note, this method does not apply to minor impacts which can be logically grouped into a single assessment.

- **INSIGNIFICANT**: the potential impact is negligible and **will not** have an influence on the decision regarding the proposed activity.
- **VERY LOW**: the potential impact is very small and **should not** have any meaningful influence on the decision regarding the proposed activity.
- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity.
- **MEDIUM**: the potential impact **should** influence the decision regarding the proposed activity.
- **HIGH**: the potential impact **will** affect a decision regarding the proposed activity.
- **VERY HIGH**: The proposed activity should only be approved under special circumstances.

Step 6 – Identify and describe practical **mitigation** and **optimisation** measures that can be implemented effectively to reduce or enhance the significance of the impact. Mitigation and optimisation measures must be described as either:

- **Essential**: must be implemented and are non-negotiable; and
- **Best Practice**: must be shown to have been considered and sound reasons provided by the proponent if not implemented.

Essential mitigation and optimisation measures must be inserted into the completed impact assessment table. The impact should be re-assessed with mitigation, by following Steps 1-5 again to demonstrate how the extent, intensity, duration and/or probability change after implementation of the proposed mitigation measures.

Example 6: A completed impact assessment table

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Regional **2**	Medium **2**	Long-term **3**	**High 7**	Probable	**HIGH**	**– ve**	High
Essential mitigation measures: xxxxx xxxxx								
With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Improbable	**VERY LOW**	**– ve**	High

Step 7 – Prepare a summary table of all impact significance ratings as follows:

Impact	***Consequence***	***Probability***	**Significance**	***Status***	***Confidence***
Impact 1: XXXX	Medium	Improbable	LOW	–ve	High
With Mitigation	Low	Improbable	VERY LOW		High
Impact 2: XXXX	Very Low	Definite	VERY LOW	–ve	Medium
With Mitigation:	*Not applicable*				

Indicate whether the proposed development alternatives are environmentally suitable or unsuitable in terms of the respective impacts assessed by the relevant specialist and the environmentally preferred alternative.

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