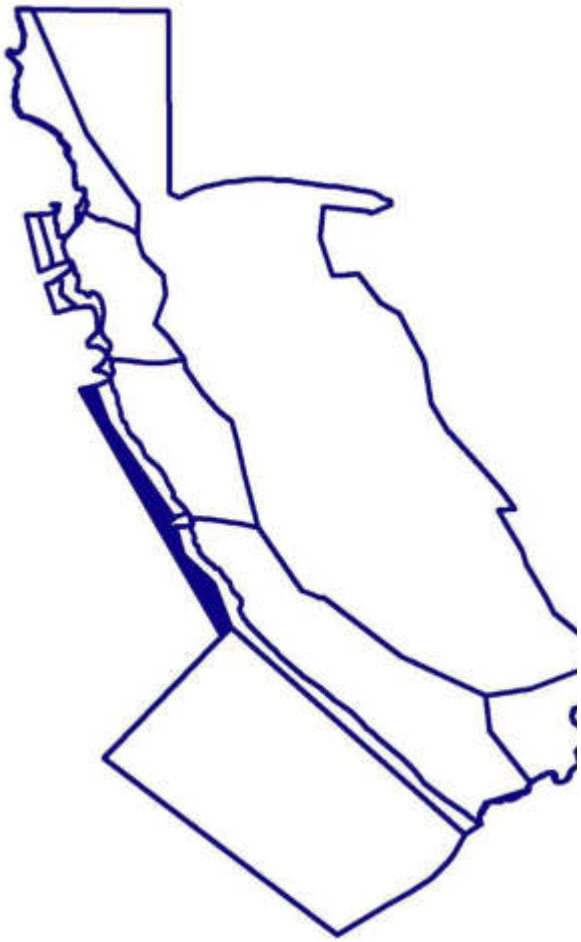

Environmental Management Programme Report Update for Namdeb's Mining Licence 128C

January 2022

ENVIRO DYNAMICS
Environmental Management Consultants

NAMDEB
A NAMIBIA DE BEERS PARTNER

Environmental Management Programme Report for Namdeb's Mining Licence 128C Update 2022

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Acknowledgements

This report update is based on the 2018 EMPR and on information sourced and provided by Namdeb's Environmental Section.

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Abbreviations and glossary

AA	Anglo American
DEA	Directorate of Environmental Affairs
DMS	Dense Medium Separation
EMP	Environmental Management Plan
EMPR	Environmental Management Programme Report
EMS	Environmental Management System
FAO	Food and Agricultural Organisation
FeSi	Ferrosilicon
GDP	Gross Domestic Product
MDP	Marine Dredging Project
MET	Ministry of Environment and Tourism
MFMR	Ministry of Fisheries and Marine Resources
ML	Mining Licence
MME	Ministry of Mines and Energy
MUN	Mine Workers Union of Namibia
Nemcom	Namdeb Executive Management Committee
NIMPA	Namibian Islands Marine Protected Area
SBP	Strategic Business Plan
SHE	Safety, Health and Environment
SME	Small and Medium Enterprises
SSSI	Site of Special Scientific Interest
TAC	Total Allowable Catch

Figures and tables

Chapter 1 Summary

1.1 Introduction

A series of four Environmental Management Programme Reports linked to Namdeb's licence areas forms the backbone of Namdeb's Environmental Management System (EMS). This report is an update of the EMPR for ML128 C (the Mid-water licence area) prepared in 2008 and updated in 2018. The report is prepared for the renewal of the Environmental Clearance Certificate, due in 2022. Information focusses on a report of the past period: 2018-2021 and planned activities for the period:2022-2025.

1.2 Description of activities

For the midwater section (area deeper than 50amsl) and to the licence boundary, multibeam bathymetry, seismic surveys and drill sampling were undertaken up to 2015. Trial mining last occurred in the licence area from February to April 2018. More trial mining is planned using a sampling vessel.

The Shallow Marine area (area shallower than 50amsl) is being and will continue to be mined by the Shallow Marine (SM) Diver Contractors and SM Remote Tool Contractors.

1.3 The natural environment in ML128C

Biogeographically, the southern Namibian coastline falls into the cold temperate Namaqua Province. The marine ecology of the southern Namibian coastline is shaped by coastal, wind-induced upwelling with communities in the offshore areas being particular only to substrate type or depth zone.

Geophysical surveys and sampling in ML128C and the offshore portions of ML43 and ML44 have revealed various mineralised geological zones in the mid-water area. Most of the licence area consists of Cretaceous aged clays and sandstones.

The structure of benthic communities of soft-bottom substrates is determined primarily by water depth and sediment grain size. Communities are characterised equally by polychaetes, crustaceans and molluscs. On hard substrates to 60m depth communities are dominated by encrusting sponges, starfish, anemones, soft corals, colonial ascidians and

rock lobsters. Deepwater reef communities at 100-120m depth include gorgonians, octocorals and reef-building sponges.

1.4 The socio-economic environment

Namdeb's overall contribution to the Namibian economy is substantial, with additional major positive spin-offs on secondary industries such as suppliers, service providers and contractors, a large part of it in the //Kharas Region.

Depending on the activity, the staff complement can range from 5 to 115. The resources are drawn from within Namdeb as well as Debmarine Namibia and De Beers Marine South Africa. This number also includes contractor-vessel employees.

1.5 Environmental management to date

Namdeb's Environmental Section is responsible for environmental protection. Currently ten full-time staff are responsible for planning, performance reporting, assurance, impact monitoring and stakeholder engagement. Although there is no environmental officer directly responsible for ML128C, the licence area currently falls under 'Exploration and Strategic Projects', for which two environmental employees have been made responsible. All Namdeb's operations are ISO14001:2015 certified and follow De Beer's and Anglo American's corporate standards.

1.6 Environmental assessment

The environmental impact assessment followed a process prescribed by Anglo American, using a risk assessment matrix. All activities resulting in "high" and "significant" impacts need to be managed. These are compiled in an impact register.

Exploration and test mining in ML128C focus on unconsolidated seabed sediments with concomitant activities of on-site tailings disposal resulting in impacts on marine habitats and biota. The extent of these impacts has not yet been established with certainty.

1.7 Environmental management plan

The Environmental Management Plan outlines overall environmental tasks, provides management actions for all high and significant impacts and describes monitoring activities. It is recommended that survey work continue to better determine the significance of impacts on the marine ecology.

Annex

The annex summarises the authors' credentials, presents all applicable legislation, and provides an impact register, and reviewed literature.

Chapter 2 Introduction

A series of four Environmental Management Programme Reports linked to Namdeb's licence areas forms the backbone of Namdeb's Environmental Management System (EMS). This report, specifically for ML128C, is an update of the 2018 EMPR for ML128 C.

2.1 Background

The backbone of Namdeb's environmental management is a series of four comprehensive Environmental Management Programme Reports (EMPRs) linked to each of Namdeb's mining licence areas.

Namdeb obtained the Mining Licence for the ML128A, B, and C areas in May 2003, and an EMPR was compiled for these licence areas in 2008 as part of the requirements for the Environmental Contract with the Namibian Ministries of Mines and Energy (MME) and the then Environment and Tourism (MET).

Implementation, additions, amendments and closing of management actions happen continuously since then to keep the EMS up-to-date. In 2018 a thorough revision was done of the 2008 report.

This report uses the 2018 EMPR as its basis of the ecological baseline, while reporting on any new findings since then. No specific specialist studies have however been undertaken for this report. The socio-economic information has been updated. Environmental management of the previous period:2018-2021 is reported on and proposed activities for the ensuing period:2022-2025 are described. The impact assessment uses the standard methodology of Namdeb as used for the 2018 EMPR.

Environmental management at Namdeb is centred on the ISO14001 certified Environmental Management System. This EMPR update will lead to any changes being incorporated into Namdeb's EMS and will be submitted to the authorities for the renewal of the environmental clearance certificate (ECC) for the period:2022 - 2025.

The consultants who compiled this report have undertaken environmental baselines, assessments and monitoring for Namdeb for two decades and have a combined experience of over 40 years in this area. They are therefore well familiar with all aspects relevant to this assignment (Annex 1).

2.2 Locality, company, legal and statutory requirements

Namdeb Diamond Corporation (Pty) Ltd mines alluvial diamonds in the south-western part of Namibia, in the Tsau //Khaeb National Park. Mining is also undertaken in the marine portions of mining licence areas ML43 and ML44 which extend ~5.5km offshore as a narrow strip adjacent to the coast between Oranjemund and Lüderitz. ML128C, is situated immediately offshore of the marine portions of ML43 and ML44 between Pomona Island and Chameis Bay, in water depths ranging from 50-120m. The spatial extent of the ML128C licence area is 414.6km^2.

The company is equally owned by the Government of the Republic of Namibia and De Beers Centenary forming Namdeb Holdings. Namdeb Holdings owns Namdeb and De Beers Marine Namibia. Namdeb is lead by the Chief Executive Officer (CEO), and operations are governed by the OPSCO team (mine managers, strategic projects and mineral resources), headed by the Chief Operating Officer (COO). OPSCO and departmental heads form the Namdeb Executive Management Committee (Nemcom), which reports directly to the Namdeb Holdings Board. The Environmental Manager reports to the department head Mineral Resources and Environment.

Namdeb holds four mining licences, of which ML128C is the only totally sea-based licence (Figure 1).

This EMPR is a requirement of the Minerals Act (1992, Clause 14), Minerals Agreement of 1994 and the Environmental Management Act (Act 7 of 2007). These and all other legislation relevant to this report have been reviewed and the relevant ones listed in the EMP.

ML128C falls into the Namibian Islands Marine Protected Area (NIMPA).

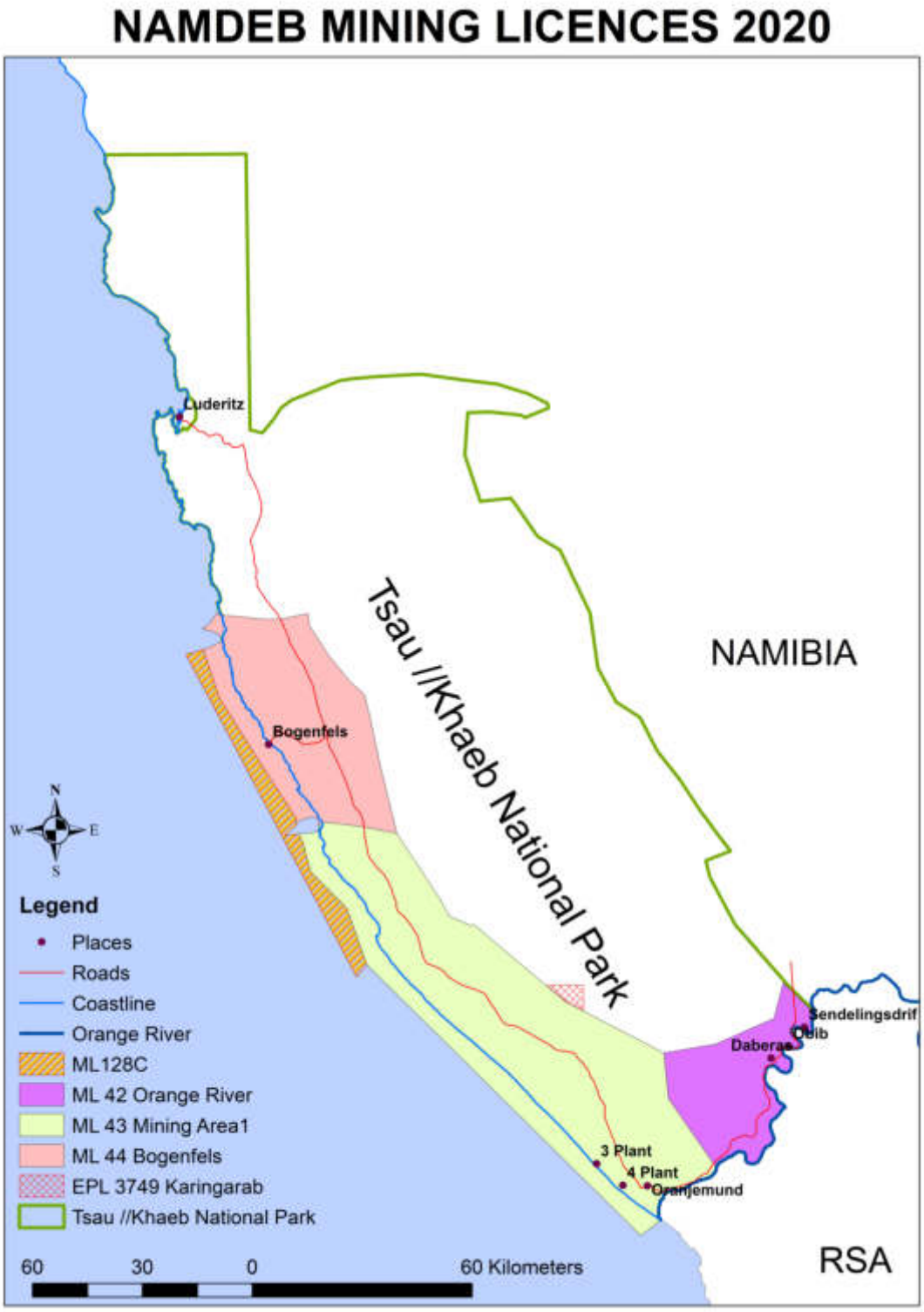


Figure 1: The position of Mining Licence Area 128C in Namibia and the Tsau//Khaeb (Sperrgebiet) National Park.

Chapter 3 Description of activities

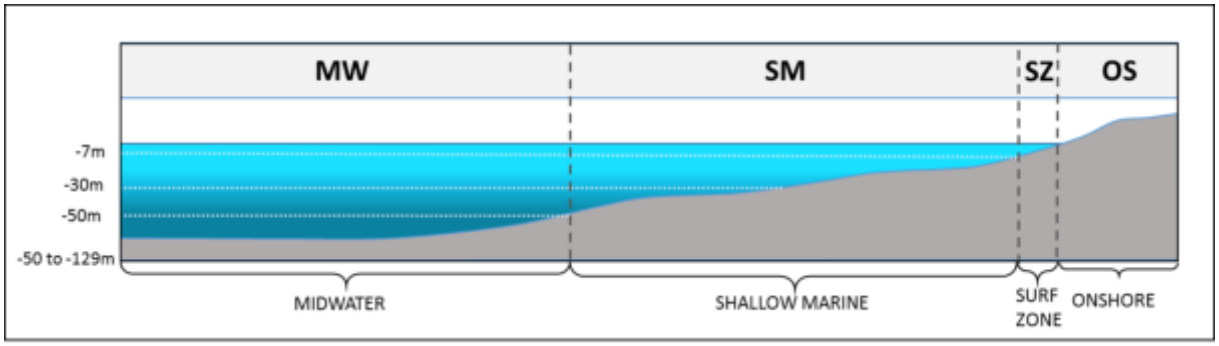
Exploration in the marine licence areas previously involved the collection of large-scale multibeam bathymetry and seismic data, followed by a regional geological drilling and sampling campaign, which opened up several new areas in the mid-water region. This was followed by sampling and test mining, the latter which will continue for the ensuing period:2022-2025.

The powerful natural tidal, current, wave and wind forces shaping the Benguela continental shelf were historically responsible for the deposition of diamond-bearing gravels along ancient beach terraces at various altered past sea levels, and for the subsequent inundation of these deposits with more recent sands and muds carried to sea by major river systems. The marine portions of ML43, ML44 - and ML128C, have as yet not been mined on a large scale.

Only the first two or three stages of the mine life cycle are relevant in Mining Licence 128C over the next three years. However, mining is a dynamic business and these different stages are in a continuous flux of change. The current EMPR provides a snap-shot of the status at this point in time, with a 3-year window until 2021.

To establish the extent of the future of offshore production mining in their mid-water areas, Namdeb has since 2007, been investigating the resource potential of ML128C. At present, the establishment of detailed mine plans for ML128C is still in progress, and the specific mining tools to be used have also not yet been decided on and developed.

Exploration activities also take place in the marine portions of ML43 and ML44. These overlap to some extent with those referred to in more detail here. For consistency, the following classification is used in the EMPRs:



Operation Depth (mbsl)	Operation Type
7m-25m	Diver Assisted
15m-35m	Shallow Water Remote Tool
35m-50m	Deeper Water Remote Tool

Figure 2: Marine water depth classification used in the EMPRs.

In 2018, Namdeb received exemption to extend the operations of the Shallow Marine from -30m to -50m. This is to facilitate the organic growth of the business from the Shallow Marine into the Midwater

3.1 Exploration and remote mining

3.1.1 History of operations

As mining in deeper water cannot proceed until economically viable accumulations of diamond-bearing gravel have been located with some certainty, Namdeb historically conducted a large-scale multibeam bathymetry survey over the entire mid-water area, followed by a seismic survey. Following processing and interpretation of the geophysical data, a regional geological drilling campaign was undertaken beyond -30m depth (known as the Midwater) in 2013. This opened up several new areas in the mid-water region where further sampling was targeted in 2015-2016. A test mining campaign was completed in 2018 to define the geotechnical parameters and resource performance of the area.

The tools used during the sampling operations include:
Megadrill: a drill sampling bit suitable for drilling a wide variety of materials;
Borer: a subsea sampling tool, the drill bit being capable of penetrating unconsolidated sediments, operated from a drill frame structure, which is launched through the moon pool with a 5m² footprint.
STR2: a drill bit with six slots of equal dimensions, which is fitted onto the tool in the drill frame structure of the sampling vessel. The tool has a footprint of 5m².

STR2.1: a reinforced version of the STR2, which was developed to sample areas with thin overburden and competent footwall. The bit with six slots, of which four have the same dimensions as the STR2 and two slots being slightly larger. The tool similarly has a footprint of 5m².

3.1.2 Sampling

Sampling in the Midwater areas was previously been undertaken by a contracted vessel the *MV The Explorer*. With an overall length of 114.4m and a gross tonnage of 4,677t, the vessel is equipped with sampling tools as described above, which are operated from a drill frame structure launched through the moon pool of the support vessel and positioned on the seabed.

Sampling in the Midwater will continue using a sampling vessel employing an airlift system deployed vertically to take single point samples. The information from the samples will be used to compile a resource evaluation report. This report will be used to draw up a test mining programme which would more than likely use a horizontal mining tool (i.e. crawler).

Figure 3: An example of a sampling vessel (The MV Explorer).

Figure 4: The 2.5m diameter drill bit within the drill frame structure.

3.1.3 Diamond-gravel processing

The sediments extracted by the sampling tool are fluidised with strong water jets and sucked up riser pipes to the support vessel using compressors to create pressure differentials. The material is discharged onto a series of screens, which separate the oversize (>16mm) and undersize fractions (<1.3mm). All oversized and undersized tailings, which comprise almost 90% of the material pumped to the surface, are immediately discharged back to the sea on site.

The gravel fraction of interest (1.3-16mm plant feed) is fed through a comminution circuit to fragment the shell, clay and conglomerate components, before being mixed with a high density ferrosilicon (FeSi) slurry and pumped into a Dense Medium Separation (DMS) plant. Low density materials (floats) are separated and discarded overboard. Most of the FeSi is magnetically recovered for re-use in the DMS plant.

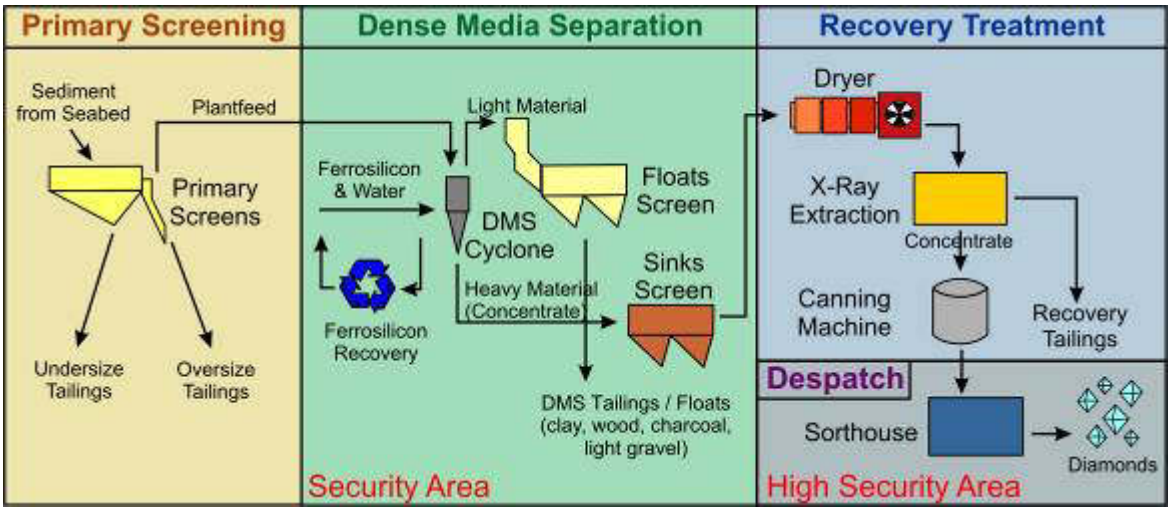


Figure 5: Simplified flowchart of the stages and processes during shipboard processing of marine diamond gravels.

The remaining high density fraction is dried and passed through an X-ray sorting machine to separate the diamonds, which fluoresce under X-ray illumination. Non-fluorescent material is discarded overboard and the fluorescent fraction is automatically sealed in cans for transport to shore and final hand sorting. In total, of the material pumped to the surface, over 99% is therefore returned directly to the sea.

3.1.4 Test mining

Following analysis of the drill samples and establishment of a potential resource, further sampling and/or test mining is conducted to confirm the economic viability of the resource. Test-mining is undertaken by a seabed crawler, deployed off a dedicated, contracted mining vessel. The vessel will likely have an overall length of 150m and a gross tonnage of over 9,000t, and be equipped with a track-mounted subsea crawler capable of working to depths up to 200m below sea level. The crawler, fitted with highly accurate acoustic seabed navigation and imaging systems, and equipped with an anterior suction system, would be lowered to the seabed and controlled remotely from the surface support vessel through power and signal umbilical cables. Water jets in the crawler's suction head would loosen seabed sediments, and sorting bars would filter out oversize boulders. The sampled sediments would be pumped to the surface for shipboard processing. The area of seabed sampled by crawler can only be determined following analysis of drill samples and development of a resource model.

As ongoing exploration and resource delineation are likely to yield potential test-mining targets in the inshore portions of ML128C, test mining is envisaged for ML128C over the next three years.

Figure 6: A typical mining vessel (above) and seabed crawler (below)

3.1.5 Production mining

Details on the vessels or tools that will ultimately be implemented for production mining operations in ML128C, cannot at present be provided as these have not yet been finalised. Research and development of appropriate sampling and mining tools will form part of the conceptual studies and prefeasibility and feasibility phases of the project following development of the inferred resource. Production mining will have its own submission for Environmental Clearance.

3.2 Infrastructure and services

3.2.1 Water and energy supply

The contracted exploration vessel is fully self-sufficient when at sea. The vessel uses marine gas oil, which is taken on board under controlled conditions in a harbour (Port of Cape Town or Lüderitz). Power is supplied by onboard diesel generators. Although the vessel will take on potable water when in port, it can make its own fresh water at a rate of 22m^3/day *via* an evaporation system on the main engines and reverse osmoses purifiers.

3.2.2 Vessel and equipment maintenance

Vessel and equipment maintenance is undertaken while in the Port of Lüderitz, or when in drydock in Cape Town.

3.2.3 Waste management

The contracted exploration vessel has strict waste management practices in place in compliance with a vessel-specific EMP. Soft waste is burned in an on-board incinerator, metal and glass is compacted and regularly transported to shore for disposal or recycling. All oil waste is stored in on-board dirty oil and sludge tanks and regularly transported to shore for recycling.

Sewage is discharged following onboard treatment and food waste is macerated such that it will pass through a 25mm screen. The vessel is thus fully MARPOL compliant regarding disposal of sewage and galley wastes.

Refuelling of the vessel occurs only under controlled conditions in a harbour; no re-fuelling takes place at sea.

Losses of FeSi used in the onboard DMS Plant are highly variable, depending on the substrate being mined. To reduce FeSi loss, the DMS

plant has been fitted with ball-mills to fragment shell- and clay-material during sediment processing.

3.2.4 Security

Security cameras are positioned in the onboard mineral recovery plant and at certain critical points of the subsea launch equipment. The cameras record onto a special hard drive system for review and analyses. Security rules on board the exploration and mining vessels are in accordance with the Contract Security Procedures.

3.3 Rehabilitation

As active rehabilitation of the marine environment below the low water mark is neither feasible, nor necessary, no seabed rehabilitation and biodiversity restoration programmes are in place. Recovery within the marine environment occurs naturally with the rate depending on the area impacted, the depth at which the impact occurred and the frequency of natural disturbances (e.g. low oxygen events) (Pulfrich & Penney 2001; Pulfrich et al. 2003; Pulfrich & Branch 2014a, 2014b). Of note also is that the cumulative disturbed footprint has occurred over a long period. Relative minimal disturbance occurs with every trial mining episode compared to the licence area extent (also see Section .

Monitoring the recovery of marine ecosystems of the impacted areas will continue beyond mine closure.

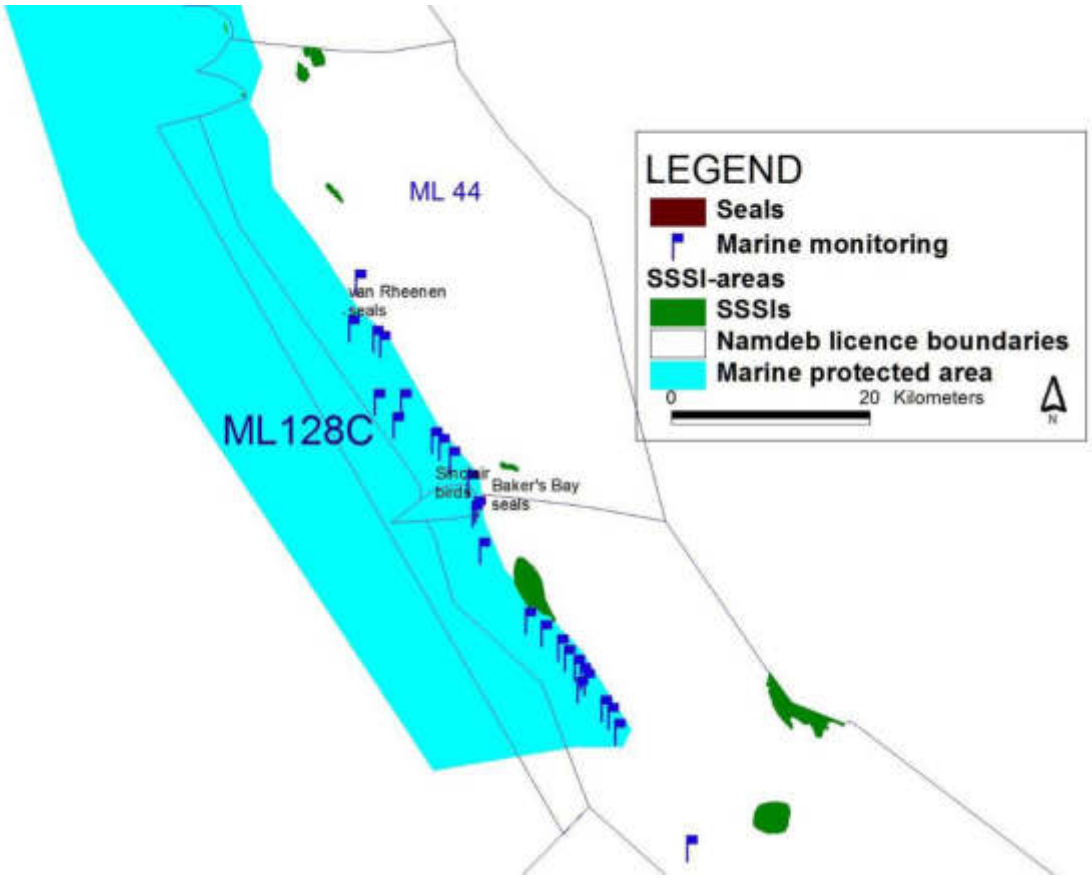


Figure 7: ML128C in relation to the Namibian Islands Marine Protected Area, Namdeb's marine monitoring programme and Sites of Special Scientific Interest (SSSI's) such as islands, seal and bird breeding sites.

Chapter 4 The natural environment in ML128C

Biogeographically, the southern Namibian coastline falls into the cold temperate Namaqua Province. The marine ecology of the region is shaped by coastal, wind-induced upwelling with communities in the offshore areas being particular only to substrate type or depth zone.

Geophysical surveys and sampling in ML128C and the offshore portions of ML43 and ML44 have revealed various geological mineralogical zones in the Midwater area. Most of the licences are dominated by exposed bedrock areas, with areas of resource potential being limited to isolated pockets of unconsolidated sediments.

The structure of benthic communities of soft-bottom substrates is determined primarily by water depth and sediment grain size. Communities are characterised equally by polychaetes, crustaceans and molluscs. On hard substrates to 60m depth communities are dominated by encrusting sponges, starfish, anemones, soft corals, colonial ascidians and rock lobsters. Deepwater reef communities at 100-120m depth include gorgonians, octocorals and reef-building sponges.

The cold temperate Namaqua Province extends from Cape Point to Lüderitz (Emanuel et al. 1992). The marine ecology of the southern Namibian coastline is shaped by coastal, wind-induced upwelling and is characterised by cold surface waters, high biological productivity, and highly variable physical, chemical and biological conditions (Barnard 1998). Communities within marine habitats are largely ubiquitous throughout the southern African West Coast region, being particular only to substrate type or depth zone. These biological communities consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales).

The 2018 EMPR contains a thorough summary of the baseline biophysical environment of the study area and a summary of it is provided below. This summary draws of the combined 40 years' experience of the authors in the area, combined with various literature sources and monitoring done there over the years.

4.1 Biophysical environment summary

Table 1 below provides a summary of the salient biophysical features of ML128.

Table 1: Summary of the biophysical environment in ML128C (Source: 2018 EMPR)

Climate	• Arid with low unpredictable winter rains, strong southerly winds, frequent fog. • Winds at sea surface seasonally modulated, significantly influence oceanography of the Benguela Region. • Occasionally easterly hot berg winds blow during winter months.
Bathymetry	• Continental shelf varies in width. The shelf is wide (230km) off the Orange River. Narrows to the North, and is 90km at its narrowest point (off Chameis Bay), and widens again towards Lüderitz (130km).
Geology and Geomorphology	• Inner shelf underlain by Precambrian rock with an irregular erosion surface with relief of up to 15m. • Overlain with a thin cover of unconsolidated Quaternary sediments of Orange River origin. • Middle and outer shelf - Cretaceous and Tertiary sediments. • Between Chameis Bay and Lüderitz - dominated by meta-sediments and metamorphosed igneous rock of the Precambrian Gariep Group, covered by Quaternary, aeolian sands. • Exploration has revealed various mineralised geological zones in the Midwater area from south of Chameis to Lüderitz. Resource potential is limited to isolated pockets of unconsolidated sediments. • ML128C boasts the offshore extension of the multilayered orebody that forms the Bogenfels feature in ML44.
Biota in unconsolidated sediments	• Invertebrates divided into macrofauna (animals >1mm) and meiofauna (<1mm). Their structure and composition in the study area is mainly a function of water depth and sediment grain size. • Other factors such as current velocity, organic content, food abundance also play a role. • There is a distinct difference in benthic invertebrate composition between the inner-shelf (<30m) and mid-shelf (30-150m) areas. • Species diversity, abundance and biomass typically increase from the shore to 80m depth, with communities being characterised equally by polychaetes, crustaceans and molluscs. • Recorded mean abundances off Bogenfels 250/ m^2, biomass of 20g/m^2, at Chameis, abundances and biomass were higher (1,305/m^2 and 33g/m^2, respectively). • At 120m depth, the mid-shelf mudbelt is particularly rich in benthic habitat – biomass of up to 60g/ m^2. This is a food source to carnivores. Out of this rich zone biomass declines again. • The inner-shelf community, which is affected by wave action, is characterised by various mobile predators, sedentary polychaetes and isopods. Typical species occurring at depths of up to 60m off Bogenfels included the snail, several members of the spionid genera *Prionospio*, and two species of amphipods. Two species bivalves are also common in certain areas. Species at Chameis included the bivalve *Macoma crawfordi*, and polychaetes of the families Lumbrineridae and Cirratulidae. All these species are typical of the southern African West Coast. • The distribution of species within these macrofaunal communities is inherently patchy reflecting the high natural spatial and temporal variability associated with macro-fauna of unconsolidated sediments with evidence of mass mortalities and substantial recruitments recorded on

	the South African West Coast. Complex interactions between physical and biological factors at the sediment-water interface as well as granulometric properties of the sediments probably play a role in distribution. • In areas of frequent oxygen deficiency, benthic communities are characterised either by species able to survive chronic low oxygen conditions, or colonising and fast-growing species able to rapidly recruit into areas that have suffered oxygen depletion. • Also associated with soft-bottom substrates are demersal communities that comprise epifauna and bottom-dwelling vertebrate species, many of which are dependent on the invertebrate benthic macrofauna as a food source for commercially valuable fish species and other higher order consumers. • The invertebrate macrofauna (Figure 8) are important in the marine benthic environment as they influence major ecological processes (e.g. remineralisation and flux of organic matter deposited on the sea floor, pollutant metabolism, sediment stability).
Marine mammals and birds	• Several species of whales and dolphins and one seal species, the Cape fur seal (*Arctocephalus pusillus pusillus*) – one of which occurs onshore of the northern portions of ML128C, occur off the Namibian coast. • Resident dolphin species are expected, and the area is on the migration routes of the southern right whales (*Eubalaena australis*) and humpback whales (*Megaptera novaeangliae*) that migrate between Antarctic feeding grounds and warmer breeding ground waters. They show a seasonal occurrence in the mining area, with abundance peaking between June and September. Whales are likely to be encountered in ML128C. • The Namibian coastline sustains large populations of breeding and foraging seabird and shorebird species, which require suitable foraging and breeding habitats for their survival. Most of the seabird species breeding in Namibia feed relatively close inshore (10-30km). Cape Gannets (*Morus capensis*),are known to forage up to 140km offshore), and African Penguins have been recorded as far as 60km offshore.
Exposed bedrocks and rocky outcrops	• Invertebrate communities inhabiting reefs and rocky outcrops in ML128C is limited, because of the difficulty sampling these deep water habitats. • Communities to 60m depth are dominated by a diversity of encrusting sponges, starfish, anemones, soft corals, colonial ascidians and the West Coast rock lobster (*Jasus lalandii*) • Hard-substrate habitats in 100-120m depth off southern Namibia suggest that deepwater reef communities include gorgonians, octocorals and reef-building sponges. • These rocky areas are zones of high biodiversity. The conservative life histories of these species have placed them in a category of potentially Vulnerable Marine Ecosystems (VMEs). They are particularly sensitive to anthropogenic disturbance (primarily deep-water trawl fisheries and mining), and once damaged are very slow to recover, or may never recover.

Figure 8: Benthic macrofaunal genera commonly found in sediments on the inner- and mid-shelf include: (top: left to right) Ampelisca, Prionospio, Nassarius; (middle: left to right) Callianassa, Orbinia, Tellina; (bottom: left to right) Nephtys, hermit crab, Bathyporeia (2018 EMPR)

Figure 9: Benthic communities recorded at depths of ~60m off southern Namibia (Photos: Namdeb) include colonial ascidians, sponges, soft corals, anemones and rock lobsters.

Figure 10: Gorgonians and bryozoans communities recorded on deep-water reefs (100-120m) off the southern African West Coast (Photos: De Beers Marine).

4.2 Existing disturbances

Previous sampling and prospecting campaigns in ML128C have involved disturbance of a cumulative area of about 11,033m^2 or 0.011km^2, or 0.002% of the ML128C mining licence area (414.6km^2).

Chapter

5 The socio-economic environment

Namdeb's overall contribution to the Namibian economy is substantial, with additional major positive spin-offs on secondary industries such as suppliers, service providers and contractors, a large part of them in the //Kharas Region.

Depending on the activity, the staff complement can range from 5 to 115. This includes support from various other sections within Namdeb as well as from De Beers Marine and De Beers Marine Namibia.

5.1 Economic contribution

Initial growth projections for the mining industry in 2020 stood at 11.1%. However, the preliminary National Accounts, released by the Namibia Statistics Agency, show that the industry recorded a negative growth rate of 14.5%. This was a further contraction from the negative growth rate of 9.5% posted in 2019.

The demand for diamonds plummeted as a result of the pandemic. Reduced salaries and wages meant that consumers changed their spending patterns away from luxury goods to essential items. Sight holder sales were concluded with excess supply, creating an overflow in the diamond value chain. Rough diamond sales were also negatively impacted by frequent closures of major diamond cutting and polishing factories in India, and the major trading centre in Belgium. This resulted in bottlenecks along the entire value chain, causing diamond mining operations to curtail production.

In the second half of 2020, a slowing rate of COVID-19 infections, rapid vaccine developments and improved health infrastructure and capacity, led to a gradual lifting of restrictions and easing of lockdown measures. Global trading thus resumed, along with normal commercial activity, and this propelled the recovery of some economies, particularly in China. In the IMF's latest April World Economic Outlook, it revised global growth upwards to - 3.3 %, resulting from a quicker recovery, a surge in oil and base metals prices towards the end of 2020, as well as supportive financial conditions and fiscal policies, and improving financial markets.

Table 2 provides key socio-economic events for Namdeb from 2018-2020.

Table 2: Socio-economic highlights and events from the 2018-2020 Namdeb Annual Reviews (in Chamber of Mines Namibia, 2018-2020)

	2018	2019	2020
Highlights	Wins "Gender is my agenda" award, and inter-safety competition Five new mining faces at Southern Coastal operations Orange River Mines exceed production targets	Commencement of Sale of Elizabeth Bay Commencement of property sale in Oranjemund, previously owned by Namdeb Good production year	Covid-19 Pandemic response Sale of the Elizabeth Bay mine handed over to Sperrgebiet Diamond Diamond Mining (SDM). Closure envisaged in business plan from closure in 2020 to 2038
Output	571,847carats	407,986 carats	322,376 carats
Employees	Permanent 1533 Temporary 42 Contractors 726 Expatriate 15 Expenditure training and skills development N$ 7.91 million	Permanent 1339 Temporary 37 Contractors 964 Expatriate 10 Expenditure training and skills development N$ 8.8 million	Permanent 1394 Temporary 45 Contractors 963 Expatriate 10 Expenditure training and skills development N$ 9.55 million
Financial	Total procurement spent N$ 2.71 billion Total local procurement spent N$ 2.27 billion	Total procurement spent N$ 2.132 billion Total local procurement spent N$ 1.68 billion	Total procurement spent N$ 1.84 billion Total local procurement spent N$ 1.50 billion

5.2 Human resources

5.2.1 Employment and benefits

Depending on the activity, the staff complement of the offshore resources development team can range from 5 to 115. The resources are drawn from the Survey, Resource Evaluation, Environmental and Strategic Projects sections within Namdeb as well as Debmarine Namibia and De Beers Marine South Africa. This number also includes contractor-vessel employees and various consultants.

Since 2017 Namdeb employees can choose between free housing and a housing and utility allowance. Over 74% of Namdeb's employees are members of the Mine Workers Union of Namibia (MUN).

To address employees' and community expectations Namdeb has set up an incidents and grievance mechanism and has formulated an overarching stakeholder engagement plan.

5.2.2 Work hours and shifts

Shifts for personnel associated with the mid-water exploration project and operations in ML128C are determined by the contractor operating the exploration and mining vessels.

5.2.3 Skill development and training

Employees qualify for all Namdeb training programmes offering technical and non-technical training.

Namdeb provides bursaries to promising, young Namibians for studies in technical disciplines and it has a graduate trainee programme, which offers graduates job experience and on-the-job training.

5.2.4 Health, safety, medical care and emergency response

All staff can utilise the hospital and other medical facilities in Oranjemund. The hospital is a primary medical care facility and offers emergency, out-patient, dental care and a surgical theatre. Namdeb has an HIV/AIDS awareness and training programme. Occupational health amongst staff is monitored regularly for noise and dust exposure.

Namdeb has a disaster plan and staff trained and allocated to implement an appropriate response in an emergency (e.g. fire, floods, accidents and environmental incidents).

5.2.5 Education

Namdeb supports private pre-primary, primary and a state secondary school in Oranjemund and maintains an Educational Assistance Scheme to subsidize school fees.

5.2.6 Social transition and sustainability

In support of the proclamation of Oranjemund as a Town and ensuring its longevity, Namdeb embarked on developing a strategy to leave behind a sustainable town, in 2014. During the formulation of the strategy, extensive consultation was facilitated with different interest groups. The Oranjemund Town Transform Implementation Strategy (TT Strategy) was developed as a result, and is in an advanced stage of implementation.

The TT Strategy is Namdeb's key approach to social transition. It includes Oranjemund's opening as a town in and appointment of the Oranjemund Town Council (OTC). The town was officially opened in 2017.

In 2019 Namdeb commissioned a Social Impact Assessment (SIA) to determine the potential social and economic impacts on the direct and indirect communities of Namdeb operations during its closure. These impacts are not directly related to ML 128C, where no social closure activities are envisaged over the next three years, although these matters do play a role in overall mine planning.

5.3 Neighbouring licence holders

The mining licences ML43 and ML44, bordering the ML128C licence on its eastern (inshore) boundary, are also held by Namdeb. The marine areas bordering the western edge of ML128C, are the Marine Protected Area, which is not allocated for mining and prospecting. Beyond this area to the west are several exclusive prospecting licences (EPLs). The 'island concessions' to the north and in the centre of ML128C are held by Sakawe Mining Corporation (Samicor).

Chapter 6 Environmental management to date

Namdeb's Environmental Section is responsible for environmental protection. Currently ten full-time staff are responsible for planning, performance reporting, assurance, impact monitoring and stakeholder engagement. Although there is no environmental officer directly responsible for ML128C, the licence area currently falls under 'Exploration and Strategic Projects', for which two environmental employees have been made responsible. All Namdeb's operations are ISO14001:2015 certified and follow De Beer's and Anglo American's corporate standards.

Namdeb's environmental management encompasses planning, stakeholder engagement, performance reporting, impact monitoring and assurance. These aspects that are applicable to ML128 C are described below.

6.1 Planning

Environmental impact assessments undertaken by external environmental practitioners, internal risk assessments undertaken by Namdeb environmental staff and specialist baseline studies are the tools used to inform projects at Namdeb.

6.2 Performance reporting

Corporate environmental management at Namdeb requires reporting at a multitude of levels internally to De Beers and Anglo American peers, the Namdeb Executive Management Committee (Nemcom scorecard), the OPSCO team and the Head Mineral Resources and Environment and externally to the authorities.

ENABLON is Anglo American's computerised environmental platform which facilitates regular updates on-line and thus provides a real-time status of all Anglo-American / De Beers operations.

6.3 Assurance

Environmental performance at Namdeb is certified by auditors, externally and internally and backed by compliance visits from the authorities (e.g. Department of Water Affairs and Forestry) and corporate head office.

All Namdeb's operations are ISO14001:2015 certified. ML128C has not yet been certified but by De Beers Standards would be certified within a year following commencement of operations.

6.4 Impact monitoring

Monitoring of resource use and environmental impacts go hand-in-hand. These are some of the critical functions of Namdeb's environmental section.

6.4.1 Resource use and pollution monitoring

At this stage of the Mid-water Project, resource use and pollution monitoring would apply to the contracted exploration vessel only, and would be the responsibility of the contractor.

6.4.2 Impacts on biodiversity

The first soft-bottom benthic macrofaunal survey in the mid-water region was undertaken in 2001 by De Beers Marine Namibia, on contract to Namdeb. The surveys focussed on the Halifax, Elizabeth Bay, Bogenfels, Chameis and Kerbehuk areas and were repeated annually until 2004, with the objective of assessing mining impacts in areas where mining had taken place, and/or commenced after 2001.

However, owing to poor data availability on historical mining activities, the results of the surveys were only effective in describing the macrofaunal communities present, and no link could be made to anthropogenic impacts. From 2005 onwards, the survey design was adapted and the survey separated into i) the Marine Dredging Project (MDP) survey, and ii) the benthic monitoring survey. The 2005 survey focussed on shallow-water target sites off Pomona in the offshore portion of ML44, but it was expanded in 2006 to include two additional sites off Chameis (ML43).

As Namdeb places an emphasis on monitoring the potential impacts of its operations on biodiversity, a marine monitoring programme of benthic macrofaunal communities in unconsolidated sediments was initiated in 2008 as part of the mid-water operations. A further baseline survey, prior to test

mining of the Bogenfels and Channel features in the offshore portions of ML44 and ML45, was undertaken in December 2015.

With the continuous sampling campaign for development of the midwater resource, a phased approach to the marine monitoring programme for the offshore areas was proposed as follows in 2019:

Phase 1: Data review and mapping of biozones, and development of detailed benthic sampling programmes and developing the scope for a Fishery-Independent Monitoring Surveys (FIMS) for rock lobsters in collaboration with the Ministry of Fisheries and Marine Resources who is the custodian of such a scientific study.
Phase 2: Implementation of baseline surveys for benthic macro fauna.
Phase 3: Implementation of impact and recovery monitoring for benthic macro fauna and rock lobster (during and after mining).

The implementation of Phase 1 and Phase 2 is completed. The development of the detailed benthic sampling programmes was completed and implemented successfully. The biozones mapping is currently under review.

The monitoring as part of Phase 3 was not conducted due to financial constraints, but the decision has been taken in 2021 to resume same and the physical sampling was completed in December 2021. Data interpretation is currently underway.

Should exploration continue, a follow-up survey will be conducted prior to the activities.

The marine life sightings programme at the Ministry of Fisheries and Marine Resources is supported by Namdeb.

6.5 Stakeholder engagement

Engaging stakeholders and creating awareness is an important function of Namdeb's environmental staff. In addition to *ad hoc* public consultations related to impact assessments for specific projects, Namdeb has two regular, external fora for information exchange – the Marine Scientific Advisory Committee and the Namdeb Stakeholder Forum.

As part of the 2021 EMPR update, stakeholders were invited publicly to register. Those who registered in response to the public invitation, were added to Namdeb's overall stakeholder list. All on this contact list were sent the draft document for review over a two-week period. No comments were received, save for one enquiry about possible assistance with archaeological

work. Namdeb has, however, already identified the heritage sites on the Mining Licence and these sites form part of their EMS.

Awareness for environmental matters is created through environmental inductions, which form an integral part of the compulsory Safety, Health and Environment (SHE) inductions for all staff and contractors accessing Namdeb's operations. Contributions are also made to regular newsletters, Oranjemund radio, "mine-wides" and presentations. Namdeb is represented on many working groups dealing with environmental matters affecting Namdeb's licence areas. Namdeb has committed to maintaining on-going communication with key stakeholders on the progress of exploration (including marine exploration) and mining operations in ML128C.

Chapter 7 Environmental Assessment

The environmental impact assessment followed a process prescribed by Anglo American, using a risk assessment matrix. All activities resulting in "high" and "significant" impacts need to be managed. These are compiled in an impact register. The impacts identified during 2018 were reviewed, according to proposed activities for the following three-year period.

Exploration and test mining in ML128C focuses on unconsolidated seabed sediments with concomitant activities of on-site tailings disposal resulting in impacts on marine habitats and biota. The extent of these impacts have not yet been established with certainty.

7.1 Approach

Environmental risks at Namdeb are continuously reviewed and updated. To ensure that all environmental risks were covered during this EMPR review, all relevant reports since the previous EMPRs were reviewed, discussed and re-assessed, where necessary, at a risk assessment workshop with Namdeb's Environmental Section in Oranjemund 22-23 September 2015. Activities were reviewed in 2018 and the risk matrix updated accordingly. These risks were again re-evaluated during the 2021 update and amended accordingly where appropriate.

Following an agreed level of assessment and assessment methodology, environmental risks are summarised in an impact matrix for each licence area for the natural and socio-economic environment (Table 3 and Table 4).

7.2 Assessment methodology

Namdeb is obliged to follow Anglo American's corporate procedures, one of which is a pre-scribed risk assessment, referred to as the 5x5 matrix. This 5x5 matrix also underlies the assessment process for environmental aspects in the computerised EMS. The Anglo 5x5 matrix includes the standard criteria "extent", "duration" and "likelihood", which form part of all environmental impact assessment procedures. "Magnitude/severity" is described as

"receiving environment/ ecosystem context". An overall significance rating is calculated from the ratings of these individual criteria by averaging the score of extent, duration and receiving environment and multiplying this with the score for likelihood. Descriptive criteria were added for the assessment of visual and social impacts and for resource use, as these were inadequately catered for the 5x5 matrix.

Table 3: Environmental assessment criteria from Anglo 5x5 matrix.

Score	Extent	Duration	Likelihood
1	Affecting small area (metres)	Days or less	Rare (7.5%)
2	Limited area (hundreds of metres)	Weeks	Unlikely (15%)
3	Extended area (kilometres)	Months	Possible (30%)
4	Sub-basin scale (marine: regional)	Years	Likely (60%)
5	Whole basin (marine: international)	Permanent	Almost certain (99%)
	Receiving environment		
1	Highly altered with no sensitive habitats and no biodiversity value/ no ecosystem services value		
2	Altered with little natural habitat and low diversity value/low ecosystem services value		
3	Largely natural habitat/moderate biodiversity value/moderate ecosystem services value		
4	Sensitive natural habitat with high biodiversity value/high ecosystem services value		
5	Sensitive natural habitat with very high biodiversity value/very high ecosystem services value		

Table 4: Significance levels based on the Anglo American risk assessment matrix.

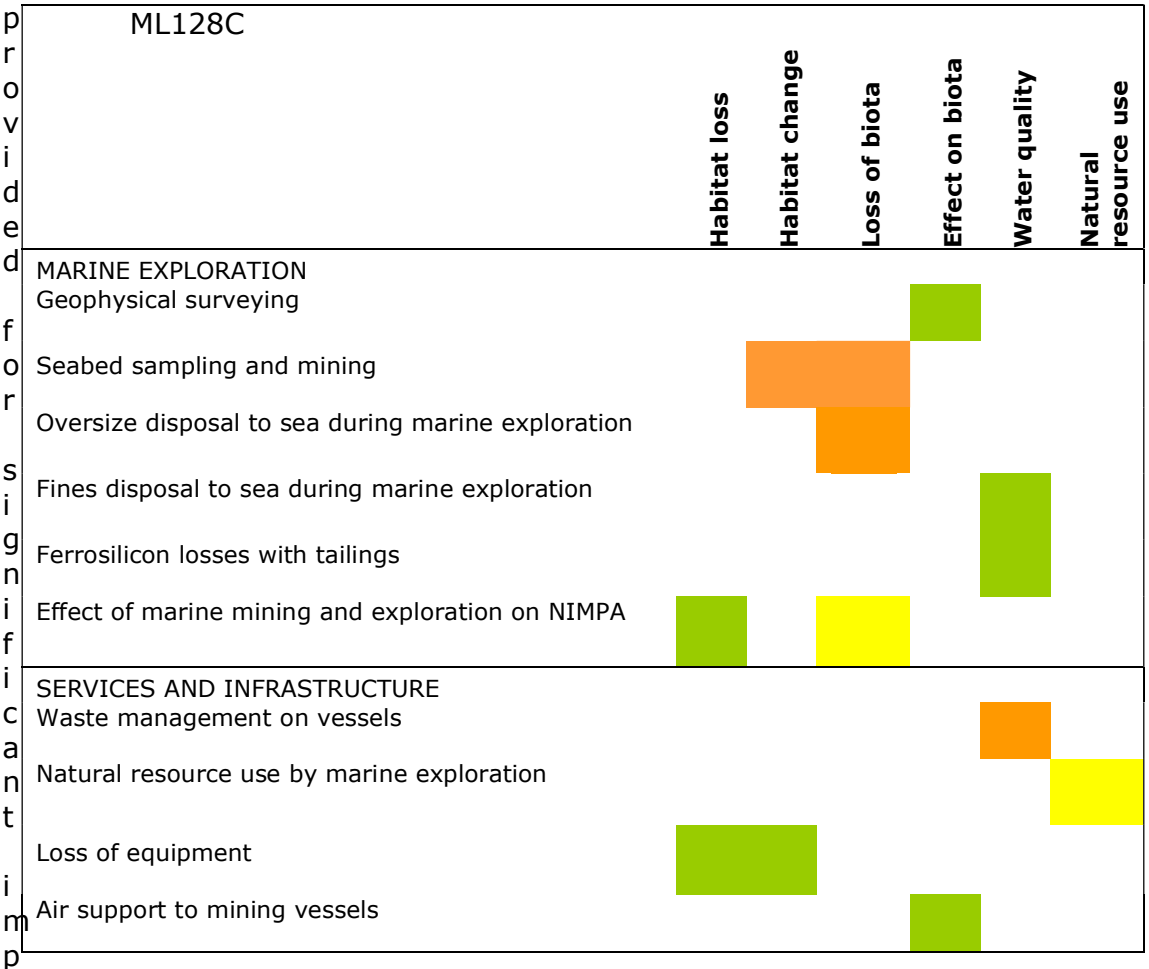
Score	Significance
1-5	Low
6-12	Medium
13-20	Significant
21-25	High

This assessment process does not cater for assessing the reversibility of the potential impact. This has been added as an additional criterion in the impact register (Annex 3).

7.3 7.3 Environmental risks and their significance

Description of all high and significant impacts is provided in Annex 3. Mitigation measures are included in the Environmental Management Programme (EMP) for all high and significant impacts and some medium and low impacts where mitigation is effective and presently applied.

Table 5 shows the main negative impacts on the natural environment associated with exploration and test-mining activities in ML128C. This is a summary of the detailed impact assessment undertaken using the Anglo 5x5 risk matrix. In this overview activities with identical risk ratings were combined, where feasible, and impacts have been divided into to six major impact categories. More detailed descriptions of individuals impacts are provided for significant impacts in the impact register (Annex 3). No "high" impacts were identified, but a fair number of impacts were rated "significant".



Mining in ML128C would focus on exploitation of discrete localised targets with concomitant activities of tailings disposal back into the sea on site, potentially resulting in significant impacts on marine habitats and biota. The extent of these impacts has not yet been established with certainty.

Table 5: Overall rating of negative environmental impacts associated with exploration and mining in Mining Licence 128C affecting the natural environment (S = significant,orange, M = medium,yellow, L = low, green).

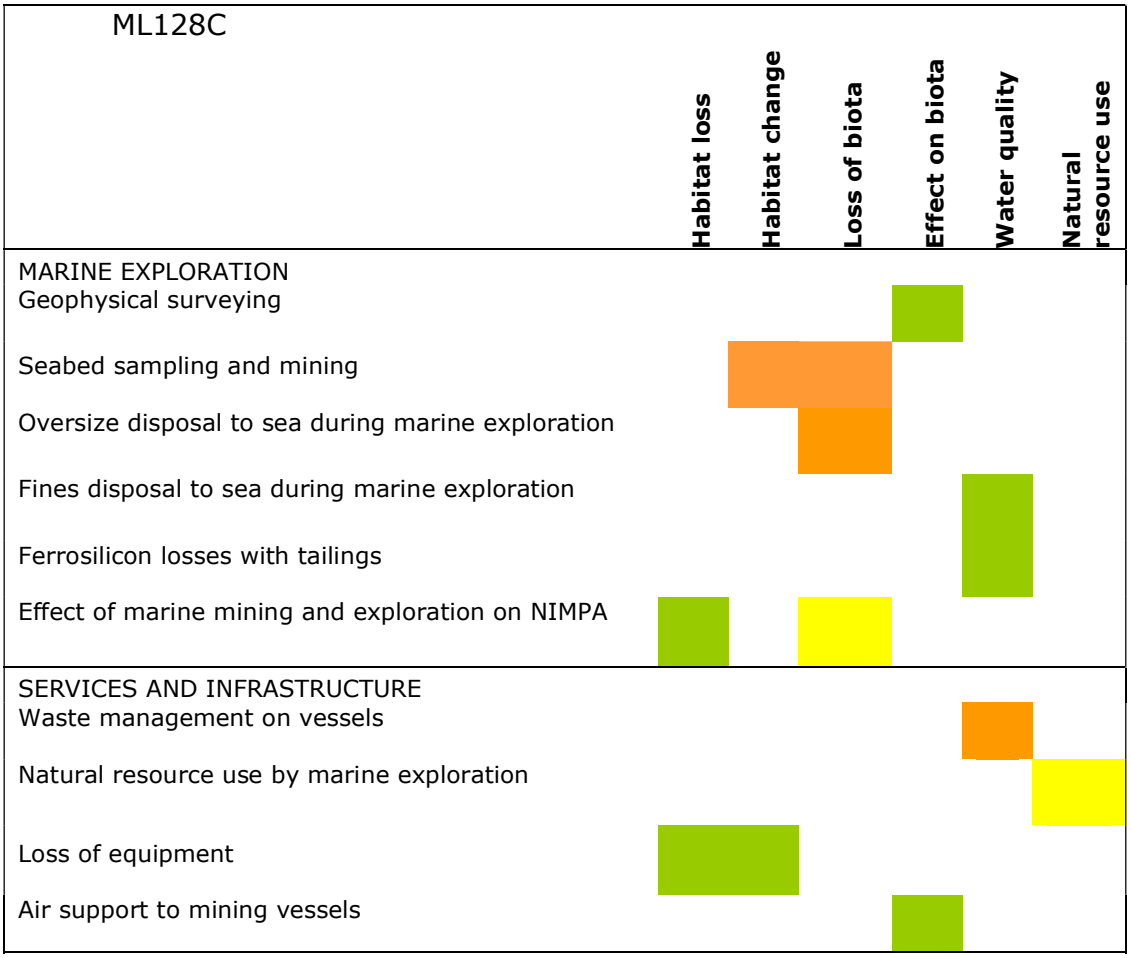


Table 6: Positive and negative socio-economic impacts of mining operation in Namdeb's ML128C (S = significant).

SOCIO-ECONOMIC	Positive
Positive	
Contribution to Namibian economy	S
Increased skills and employment	S
Development of technology	S
Improved scientific knowledge (geology, biodiversity and heritage)	S
Community support and awareness	S
Sustained employment	S
Sustained social services	S

Socio-economic impacts of mining activities in ML128C are largely positive. These also include aspects related to the natural environment such as increased knowledge through long-term ecological monitoring.

7.4 Cumulative effects

7.4.1 External factors

7.4.1.1 Commercial fishing

Commercial fishing undoubtedly has an effect on fish populations. Of particular relevance to the inshore portions of ML128C and particularly ML43 is the rock lobster industry. This makes it difficult to separate the impacts of mining on fish populations from those of commercial fishing.

The commercial rock-lobster fishery in Namibia is centred around Lüderitz, with the most important southern fishing grounds located off Kerbehuk in ML43. Between 40-60% of the annual Total Allowable Catch (TAC) is fished on these southern grounds. Although areas around Plumpudding Island and Chameis are also occasionally fished, little effort is directed at the ML44 area. Fishing is conducted with rectangular traps set in 10-40m depth from wooden deck boats. The fishery therefore primarily concentrates its efforts inshore of ML128C. The fishery is managed by means of a commercial fishing season from November to April, a size limit of 65mm carapace length, and an annually determined TAC.

While demersal fish species targeted elsewhere by the commercial trawl-fishery do occur in the ML128C licence area, trawling and longlining is prohibited in Namibia in waters shallower than 200m. There are further conditions applicable to hake trawling vessels fishing south of 25° latitude, where the fishing exclusion has been extended to a depth of 300m. Freezer trawlers fishing in this area are confined to fishing in depths of 350m or more (Currie *et al.* 2007). As ML128C lies well inshore of the 200m isobath, no interaction with commercial fisheries is therefore expected.

7.4.1.2 Climatic variations

The marine environment is most severely affected by changes in climate, which could result in sea level rise, shifts in large currents, changes to the physical conditions of seawater and effects on local climate. Which way these climatic changes will manifest themselves is currently still poorly understood, but there is a potential that these either intensify or alleviate the impacts of changes to the coastline resulting from mining. While a sea level rise would facilitate natural rehabilitation of the mined areas along the coast, a possible change in local weather patterns, e.g. changes in storm patterns and wind regimes may have the opposite effect. Due to the offshore location and depths of the ML128C licence, this area will not be affected by sea level rise.

7.4.1.3 Other marine mining

The ML128C licence lies directly offshore and adjoining Namdeb's mining licences ML 43 and ML44 and also those licence areas held by Samicor. Activities in these adjoining licences affect many of the same marine habitats such as subtidal reefs and areas of unconsolidated sediments.

7.4.2 Namdeb internal factors

Sampling and test-mining in ML128C would target discrete seabed areas, but as most of the seabed in the licence areas is characterised by emergent bedrock, there is a risk of the sediment disposal from exploration and mining vessels impacting reef areas adjacent to the mining targets. Due to the challenges of quantitatively sampling rocky areas, information on the biodiversity and sensitivity of hard substratum communities is lacking at this stage, making it difficult to confidently predict potential indirect mining effects on these habitats and their associated communities.

Monitoring studies of mining impacts on macrofaunal communities in soft sediments, and their subsequent recovery, have been undertaken by both Namdeb and De Beers Marine Namibia. As these have been only partially successful in shedding light on community recovery following mining, it is important for Namdeb to develop a sound benthic macrofaunal monitoring programme as part of their operations in ML128 C and the mid-water areas.

7.5 Shortcomings

7.5.1 Assumptions

The impact assessment presented here is based on the information provided by the Section Geologist – Contractor Operations. In the mid-water areas in particular, the exploration/mining environment changes continuously and this assessment is thus a snap-shot in time.

7.5.2 7.5.2 Uncertainties

The impact assessment of 2018 identified a few gaps in knowledge, such as:

- ◊ Lack of baseline information on marine biodiversity for the mid-water areas, particularly for reef habitats,
- ◊ Effects of mobilised mining-related sediments on the offshore reefs, and
- ◊ Namdeb's contribution to the health of the marine ecosystem.

To better understand these dynamics is a Digital Shoreline Analysis, currently being commissioned, to better understand sediment movement, mapping of biozones and the relationship between mining sediment deposition and rock lobster sanctuaries.

Poorly understood in this area are presently also

- ◊ Natural recovery potential of unconsolidated sediments and rocky outcrops,
- ◊ Natural recovery rates of different marine ecosystems,
- ◊ Contribution of other environmental impacts such as climate change and overfishing, and
- ◊ Ecosystem function and services.

Closing these knowledge gaps is not necessarily Namdeb's responsibility and should take practicalities into account, such as available expertise, identification and curating services in the case of biodiversity baseline information, as results may not be available in the time frame required to manage the anticipated impacts.

Chapter 8 Environmental Management Plan

The Environmental Management Plan outlines overall environmental tasks, provides management actions for all high and significant impacts and describes monitoring activities.

Environmental management tasks are organised according to overall tasks that are necessary for the implementation of the EMP, then by significance and within these according to aspects. These management actions need to be seen in the context of an existing environmental management system, which has been in place for over 20 years and where all measures applicable to common environmental aspects such as waste management, pollution control and protection of habitat, fauna and flora are well entrenched and routine. This EMPR update does not have specific new impacts since the 2018 EMPR. Environmental management priorities should continually be reviewed for current and expected contractors, even if the tasks seem entrenched and routine,

Objectives applicable to all management tasks in this EMP are described below and are not repeated for each task. Impact descriptions are provided in the impact register in Annex 3.

The Namdeb 2021 Environmental Objectives and Key performance indicators are provided in Table 7 below.

Table 7: Namdeb current Environmental Objectives and Key Performance indicators

NAMDEB
A Namibia De Beers Partnership

MINEWIDE ENVIRONMENTAL OBJECTIVES AND KEY PERFORMAN

KEY RISK AREA	OBJECTIVES & PERFORMANCE INDICATORS	OPERAT
System	Teams integrate responsible environmental practices across the operation by maintaining ISO14001:2015 certification.	All policies and procedures for the ISO 140 50% of competency training completed for Zero overdue actions on Isometrix. Zero major findings for external audits. Environmental Performance score of 4 (80 Isometrics Operational Risk Management (
Permitting/ Legal/ License to operate	Fulfil national statutory legal requirements and increasing maturity of permitting systems, tools and processes.	100% compliance to all permit conditions. Obtain Environmental Clearance Certificate
Environmental Incidents	To have ≤ 2 reportable environmental incidents. Level 4-5 potential (HPH) and actual (HPI) environmental incidents. Zero (0) repeats of Level 3 incidents.	Effectively implement ALL investigation acti Report all High Potential Incidents and Haz Evaluate effectiveness of existing controls a
Rehabilitation/ mine closure/ water	Plan and Implement biophysical rehabilitation.	100% compliance to the Sendelingsdrif and biodiversity restoration). Backfilling - Sendelingsdrif: 1,991,437 Landscaping - Sendelinsdrif: 0.6 Ha; Orex:1
Circular economy/ waste/ water	Reduce river/fresh water abstraction and reuse and recycle process water at operations. Avoid accumulation of non-mineral waste and minimize general waste going to the landfill.	**Water recycling targets:** Daberas: 61%; Sendelingsdrif: 86%; RAC Develop a waste road-map and milestones tins etc.)

The following legislation is directly applicable to the management actions (detail in Annex 2) and their link to particular management actions is indicated by the corresponding number (column "legal"):

1. Mineral Act 1992
2. Minerals Amendment Act 8 of 2008
3. Namdeb's minerals agreement
4. Environmental Management and Assessment Act 7 of 2007 and regulations
5. Namibian Constitution Section 95(l)
6. Labour Act 6 of 1992, Act 11 of 2007, and amendment of 2012
7. National Heritage Act 27 of 2004
8. Marine Resources Act 27 of 2000 and regulations
9. Prevention and combating of pollution of the sea by oil Act 6 of 1981
10. Convention on Biological Diversity 2002
11. Ramsar Convention on Wetlands of International Importance especially as Waterfowl habitat, 1971
12. United Nations Framework Convention on Climate Change 1992

The responsibility for implementation of all mitigation measures lies with the Environmental Manager. All tasks are on-going activities.

OVERALL ENVIRONMENTAL TASKS

Aspect	Mitigation and control measures	Legal
Implementation of EMP	• Check all high and significant management actions in IsoMetrix EMS database • Identify new management tasks, discuss and explain to all environmental staff with particular attention to natural recovery of marine ecosystems • Make financial provision for new management actions as appropriate including continuous monitoring of impact on benthic communities. Ensure that this monitoring programme resumed is continued as recommended by the specialists.	
Awareness	• Check environmental inductions to include environmental aspects and management actions • Broadcast environmental measures in all available forms of regular communications (briefs, monthly topic, etc.)	
Reporting	• Follow ISO14001, MEFT, Group (Anglo American and De Beers) and Namdeb internal reporting standards	
I&APs	• Present relevant key features of EMPR at Namdeb regular stakeholder fora	
Improved management of closure	• Allocate operational costs to monitor and demonstrate natural recovery of the seabed through pre- and post-mining benthic faunal and seabed surveys • Provide sufficient funds for a post-closure environmental survey (seabed and/or benthic faunal survey) in the event that on closure or premature closure, the benthic monitoring programme has not been completed or has not been able to demonstrate sufficiently that natural recovery processes are occurring	

SIGNIFICANT ENVIRONMENTAL RISKS

Aspect	Mitigation and control measures	Legal
Exploration		
Disturbance of the seabed and associated macrofaunal communities during sampling	• Keep easily retrievable spatial record of sampling activities	4,8
Oversize disposal to sea during marine exploration	• Keep easily retrievable, spatial record of activity • Avoid disposal of tailings on reefs where possible	4,8
Test-Mining		
Disturbance of the seabed and associated macrofaunal communities during test mining	• Keep easily retrievable spatial record of test mining activities to calculate annual and cumulative sampled and test-mined areas • As far as possible avoid mining in any rock-lobster sanctuaries • Develop a carefully designed Before-After/Control-Impact benthic macrofaunal monitoring programme and implement this programme before test mining commences • Determine areas that could be considered as "conservation corridors" in consultation with the Namibian government (current action: continue participation in EBSA[1] process and Marine Spatial Plan).	4,8
Disturbance and loss of habitat, sediment structures and geological record	• Keep easily retrievable spatial record of test mining activities to calculate annual and cumulative sampled and test-mined areas • Conduct high resolution geophysical surveys prior to test mining, and of mined areas ~2-3 years post-mining to determine the depth, wall steepness and infilling rates of excavations	4,8
Oversize disposal to sea during test mining	• Keep easily retrievable, spatial record of activity • Avoid disposal of tailings on reefs where possible • Conduct high resolution geophysical surveys post-mining to assess the extent of the effects of the discharged tailings on seabed life • If feasible, obtain video footage of potentially affected reef communities, before and after mining to assess the effects of discarded tailings on seabed life.	4,8

[1] Ecologically or Biologically Significant Areas (https://cmr.mandela.ac.za/Research-Projects/EBSA-Portal)

Services and infrastructure		
Hydrocarbon spills in the event of a vessel disaster	• Have oil spill contingency plan in place • Clean-up of spill as soon as possible following Namdeb policy PO-EV-07 and procedure PR-EV-07	4,8,9
Waste Management and pollution control on sampling/mining vessels	• All vessel operations, as well as waste management and pollution control is undertaken in accordance with the procedures and protocols of the prospecting/mining services provider • Adopt standard waste management practices	4,8,9

MEDIUM ENVIRONMENTAL RISKS		
Aspect	Mitigation and control measures	Legal
Mining		
Effect of marine mining on NIMPA	• No actions	
Oversize disposal to sea	• Avoid disposal of tailings onto unmined seabed • Avoid disposal of tailings on reefs • Keep easily retrievable, spatial record of activity	4,8
Interaction with the Rock Lobster Fishery	• Maintain transparency of operations • Regular interaction at stakeholder fora	4
Natural resource use by marine exploration	• Re-use and recycle as far as practicable	4

LOW ENVIRONMENTAL RISKS

Aspect	• Mitigation and control measures	Legal
• Exploration and Test Mining		
Marine geophysical surveys	• Develop a procedure to minimise impacts to marine mammals during geophysical surveys. This would include: ○ Onboard Marine Mammal Observers (MMOs) should conduct visual scans for the presence of cetaceans around the survey vessel prior to the initiation of any acoustic impulses ○ Pre-survey scans should be limited to 15 minutes prior to the start of survey equipment ○ "Soft starts" should be carried out for any equipment of source levels greater than 210 dB re 1 µPa at 1 m over a period of 20 minutes to give adequate time for marine mammals to leave the vicinity ○ Terminate the survey if any marine mammals show affected behaviour within 500m of the survey vessel or equipment until the mammal has vacated the area ○ The geophysical surveying should largely be undertaken between December and May, thereby avoiding the main migration period of baleen whales from their southern feeding grounds into low latitude waters. However, during the transition periods in June and November, surveying would be possible with stricter mitigation measures. As no seasonal patterns of abundance are known for odontocetes occupying the proposed exploration area, a precautionary approach to avoiding impacts throughout the year is recommended ○ Ensure that PAM (passive acoustic monitoring), which detects marine mammals through their vocalisations, is incorporated into any surveying taking place between June and November ○ A MMO should be appointed to ensure compliance with mitigation measures during seismic geophysical surveying. This will also reduce the chances of the vessel colliding with a marine mammal	8
Ferrosilicon losses with tailings	• Monitor Ferrosilicon use on an ongoing basis • Maximise Ferrosilicon recycling	4,8
Damage to or destruction of shipwrecks	• If shipwreck material is encountered in the course of test mining • Immediately inform the Marine Superintendent or Environment Manager who will inform the National Monuments Council • Retain artefacts recovered and, where possible, maintain a photographic record. Note the date, time, location and types of artefacts found in the logbook • Contract a marine archaeologist to survey the site • Avoid mining or prospecting within 500m from the centre of the site until the area has been surveyed	7

• Services and infrastructure		
Loss of equipment from marine vessel	• All lost equipment must be accurately recorded in a hazards database, and reported to maritime authorities. • Every effort should be made to recover or remove lost equipment.	8,9
Air support to mining vessel	• Flight paths must be pre-planned to ensure that no flying occurs over the Ichaboe, Halifax and Possession Islands or over the Atlas Bay, Wolf Bay and Long Islands seal colonies. [coastal islands or seal colonies] • Extensive low-altitude coastal flights should be avoided. • The flight path between the onshore logistics base in Lüderitz and mining vessel should be perpendicular to the coast • It is recommended that a flight altitude >300m be maintained at all times, except for when the aircraft lands on or takes off from the mining vessel and logistics base • The contractor should comply fully with aviation and authority guidelines and rules • All pilots must be briefed on ecological risks associated with flying at a low level along the coast or above marine mammals	8

ENVIRONMENTAL MONITORING DURING OPERATION

Aspect	Parameter	Frequency	Comments
Biodiversity			
Marine ecosystems	Benthic macrofauna in unconsolidated sediments and sediment textural analyses	Once every 2 years	
	Benthic fauna on hard substrata	Once every 2 years or when opportunities permit	Collect video footage using ROVs or submersible in rocky areas adjacent to mining targets prior to and after sampling/mining

ENVIRONMENTAL MONITORING AT CLOSURE

Aspect	Parameter	Frequency	Comments
Marine monitoring			
Physical parameters	Natural infill rates	Every two years	
Biological parameters	Benthic macrofauna in unconsolidated sediments, and Benthic fauna on hard substrata	Every two years	Monitoring until completion criteria are reached

Chapter 9 Annex

The annex summarises the authors' credentials, presents all applicable legislation and provides an impact register, and a list of reviewed literature.

9.1 *Annex 1*. The environmental practitioners

Stephanie van Zyl: 2021 EMPR Update

Academic Qualifications:
Bachelaureus (Town and Regional Planning) University of Pretoria 1992
Masters (Environmental Management) University of the Orange Free State 1999

Stephanie has twenty-five years' experience in Environmental Management and Public Participation and Facilitation (Environmental and Social Assessment, Environmental Management Plans, Environmental Education, Environmental Management Systems, Environmental Monitoring and Evaluation), Urban and Regional Development Planning, Socio-Economic Research, Land Use Planning, and Project Co-ordination.
She has been involved in or acted as the principal consultant for a number of large-scale environmental and social assessments in the following sectors:

- Land use and development plans for urban centres, regions, and nation-wide;
- Various other strategic initiatives;
- infrastructure including roads, railway lines, power lines, and water supply networks;
- tourism including tourism development plans and lodges;
- mining;
- processing and manufacturing projects;
- agriculture; and
- power generation projects.

Andrea Pulfrich

Academic qualifications

1995: **Dr rer nat** (Ph D), Major: **Fisheries Biology**, Minors: Oceanography, Aquaculture; Department of Fisheries Biology of the Institute for Marine Science at the Christian-Albrechts University, Kiel, Germany.
1987: MSc (Zoology), University of Cape Town, South Africa.
1983: BSc (Hons) (Zoology), University of Cape Town.
1982: BSc (Zoology and Botany), University of Natal, Pietermaritzburg.

Dr Pulfrich is the director of Pisces Environmental Services and has 29 years of professional experience in marine and coastal environmental sciences. Since its founding in 1998, Pisces Environmental Services has successfully completed a broad variety of assignments, ranging from technical field surveys and baseline data collection and environmental assessments, to sophisticated statistical analyses, reporting and public presentation of results. The Company has acquired a reputation among its clients for reliable, efficient, and result-orientated work. A great number of studies have been published in the internationally reviewed scientific literature. Through its links with research and government institutions, universities and industry, the

Company keeps pace with advancements in marine sciences and technology, thereby applying up-to-date information and methodologies to its products.

Antje Burke

Academic qualifications

1993: **Dr rer nat** (Ph D), Major: **Landscape Ecology**, Minors: Botany, Geography; Westfälische Wilhelms-Universität, Münster, Germany
1987: **Diplom** (M Sc equivalent), Major: **Geography**, Minors: Botany, Geology
1984: First degree (B Sc equivalent): Geography, Botany, Geology

Dr Burke has 30 years of professional experience in environmental research and management in Namibia, Germany, Israel, South Africa and Botswana. She has coordinated coordinated and participated in over 50 Environmental Impact Assessments, Management Plans, Audits, Sectoral Reviews and Natural Resource Assessments in Namibia – the majority in the mining and infrastructure sector. She is author of over 70 scientific publications, 50 of these in peer-reviewed, international journals and books, and over 100 popular and educational publications and is a scientific reviewer for eleven international journals. Dr Burke is a scientist widely recognised in her field of expertise. Her strong research background in environmental sciences, combined with in-depth practical experience, has enabled her to always maintain an exceptionally high standard, but unique and realistic approach in all her assignments.

9.2 Annex 2. Legislation and statutory requirements

Legislation	Applicability
MINING LEGISLATION	
Mineral Act, 1992	Rehabilitation requirements, environmental status prior to mining/prospecting, pollution control measures, liability for pollution
Minerals (Prospecting and Mining) Amendment Act, 8 of 2008	Requirement of EMPR
Diamond Act 13 of 1999 and regulations, GN 84 of 31 March 2000	Permits for handling diamonds
Environmental clause of Namdeb's Minerals Agreement	Requirement of EMPR
ENVIRONMENTAL LEGISLATION	
Environmental Management and Assessment Act 7 of 2007; List of activities that may not be undertaken without Environmental Clearance Certificate, GN 29 of 2012; Environmental Impact Assessment Regulations, GN 30 of 2012	Requirements for and process of environmental assessments
Draft Regulations for Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA), 2008 and Draft procedures and guidelines for Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP), 2008	Contents of strategic environmental assessments, Environmental Impact Assessments and Environmental Management Plans
Namibian Constitution Section 95(l)	Use of natural resources, protection of environment, biodiversity and ecosystems
Hazardous Substances Ordinance, 14 of 1974	Declaration and handling of hazardous substances
Labour Act 6 of 1992, Regulations relating to the health and safety of employees at work, GN 156, GG 1617 of 1 August 1997	Protection of employees from hazardous substances, incl. asbestos
Atmospheric Pollution Prevention Ordinance, 11 of 1976, prohibition of the import of ozone depleting substances, GN 281, 31 December 2010	Permitting of fuel burning appliances, prohibition of ozone-depleting substances
Atomic Energy and Radiation Protection Act, 5 of 2005; 1A.1 Radiation Protection and Waste Disposal Regulations, GN 221 of 18 November 2011	Handling, transport and disposal of radioactive substances
Road Traffic and Transport Act, 22 of 1999 and regulations GN53 of 2001	Transportation of dangerous goods
Water Act, 54 of 1956	Permitting for industrial effluents
Water Resources Management Act, 11 of 2013 (not in force yet)	Protection, development and management of water resources; licencing water abstraction, protection of groundwater, water pollution control, obstruction of watercourses, control and use of wetlands
Soil Conservation Act, 76 of 1969	Prevention of soil erosion, no regulations, not

	enforced
Forest Act, 12 of 2001	Protected trees, permit for mining in forested areas and cutting of trees and shrubs within 100m from river, stream or watercourse
Nature Conservation Ordinance, 4 of 1975	Protected species
National Heritage Act, 27 of 2004	Heritage site protection
MARINE LEGISLATION	
Marine Resources Act, 27 of 2000; 18.1 Regulations relating to the exploitation of marine resources, GN 241 of 7 December 2001; 18.2 Regulations relating to Namibian Islands' Marine Protected Area, GN 316 of 31 December 2012	Protection of marine habitats and animals
Marine Traffic Act 2	No abandoning of ships
Prevention and Combating of Pollution of the Sea by Oil Act, 6 of 1981	Liability, combating and prevention of oil pollution
Wreck and Salvage Act, 5 of 2004	Procedures related to salvage of ships, aircraft and life, preventing damage to marine life
Namibian Ports Authority Act 2 of 1994	Establishment of Namibian Ports Authority and management of ports and lighthouses, protection of the environment in its jurisdiction
Territorial Sea and Exclusive Economic Zone of Namibia Act 3 of 1990	Definition territorial sea and exclusive economic zone
POLICIES AND OTHER	
National Policy on Coastal Management 2012	Protect, maintain and restore health and biological diversity of ocean and coastal ecosystems
Explosives Act, 26 of 1956	Import, storage and transport of explosives
Fire Brigade Services Act, 5 of 2006 and regulations 2010	Maintenance of fire brigade services
Petroleum Products and Energy Act, 13 of 1990; 5H.1 Petroleum Products Regulations, 2000 and Notice of Application of Specifications and Standards, GN 54 of 2016	Distribution and price control
Red data lists	Plant and animals species classified as vulnerable, threatened or endangered
Oranjemund town business registration regulations, 2013	
Oranjemund town noise control regulations, 2013	Noise control in Oranjemund town
Electricity Act 4 of 2007	Environmental Impact Assessment for electricity installations
Electricity Regulations: Administrative, GN 13 of 16 February 2011	
Electricity Control Board: Namibian electricity safety code, GN 200 of 12 October 2011, Electricity Control Board: Namibian Electricity Safety Code, Amendment, GN 234 of 2012, technical rules, GN 47 of 2016, economic rules, GN 46 of 2016	Electricity generation licences

INTERNATIONAL CONVENTIONS AND PROTOCOLS	
Convention on Biological Diversity, 1992	Protection of biodiversity
United Nations Framework Convention on Climate Change, 1992 13.1 Kyoto Protocol, 1997	No legislation promulgated yet to meet proposed guidelines
Montreal Protocol on substances that deplete the ozone layer, 1987; Amendments 1990 and 1992, Vienna Convention for the protection of the ozone layer 1985	Prohibition of ozone depleting substances
Ramsar Convention on Wetlands of International Importance especially as Waterfowl Habitat, 1971	Protection of declared wetlands
Law of the Sea Convention, 1982 (United Nations)	Territorial sea limits up to 12 nautical miles, innocent passage through territorial sea, exclusive economic zone, conservation and management of living resources, protection of marine environment
Protocol on Shared Watercourse Systems in the SADC Region	Coordinated and environmentally sound development of shared water resources, basin management committees
International Convention for the Prevention of Pollution from Ships (MARPOL 73/78)	Regulations for prevention of pollution by oil, noxious liquid substances, harmful substances, sewage and garbage
Convention on International Trade with Endangered Species (CITES)	Internationally accepted list of plant and animals species under trade restrictions

9.3 Annex 3. Impact register

The impact register provides a description of significant and high impacts. All impacts rated "significant" (S) and "high" (H) require management actions. A description of these impacts is included below, management actions are described in the Environmental Management Plan. Many activities result in various impacts. In this case, if at least one impact is rated significant, the activity will require management. Other, not significant impacts associated with this activity are then also included in the description. Because this is an update of a previous EMPRs, the descriptions are deliberately concise and activities receiving the same impact ratings have been combined, where feasible.

A 4-scale rating has been included here for reversibility (none, low, medium, high) assuming that the management actions for this activity are implemented and thus reflecting an impact assessment with mitigation.

The activities are organized according to overarching categories exploration, mining, infrastructure and services, marine contractors and socio-economic.

9.3.1 Exploration and Test-Mining

Impact category	Description	Significance	Reversibility
	Seabed sampling and test-mining		
Loss of marine biota	Disturbance and loss of biota in sampled/mined sediments	Significant	Medium
	Oversize disposal to sea during marine exploration		
Loss of marine biota	Smothering of reef biota by tailings, change in community composition	Significant	Low-Medium

9.3.2 Services and infrastructure

Impact category	Description	Significance	Reversibility
	Waste management on vessels		
Loss of marine biota Water quality	Loss of marine biota through toxic effects of hydrocarbon spills Pollution of coastal waters through spilled hydrocarbons and litter	Significant	High

9.4 Annex 4. Literature

For 2021 Update

Botha P, Coetzer W, Faul A, van der Merwe J. April 2021; Review and Update of Namdeb's Waste Management Strategy and Plan.
Burke A and Pulfrich A (2018). EMPR for ML128C. For Namdeb.
Burke A. (2021) Namdeb's Biodiversity Action Plan.
Burke A, Schneider, G. (2021). Namdeb's Cultural Heritage Management Plan.
Namdeb (2021). Namdeb Integrated Closure Plan.
Namdeb (2019-2021). Environmental Performance Management Reports. Internal Reports.

For previous EMPRs

Barnard P. (ed.) (1998) Biological diversity in Namibia - a country study. Namibian National Biodiversity Task Force, Windhoek, 325 pp.

Birch G.F., Rogers J., Bremner J.M., Moir, G.J. (1976) Sedimentation controls on the continental margin of Southern Africa. First Interdisciplinary Conf. Mar. Freshwater Res. S. Afr., Fiche 20A: C1-D12.

Breeze H., Davis D.S., Butler M., Kostylev V. (1997) Distribution and status of deep sea corals off Nova Scotia. Marine Issues Special Committee Special Publication No. 1. Halifax, NS: Ecology Action Centre. 58 pp.

Chamber of Mines (2017) Annual review of the Chamber of Mines of Namibia. Windhoek.

Christie N.D. (1974) Distribution patterns of the benthic fauna along a transect across the continental shelf off Lamberts Bay, South Africa. Ph.D. Thesis, University of Cape Town, 110 pp & Appendices.

Christie N.D. (1976) A numerical analysis of the distribution of a shallow sublittoral sand macrofauna along a transect at Lambert's Bay, South Africa. Trans. Roy. Soc. S. Afr., 42: 149-172.

Cowling R.M., Egoh B., Knight A.T., O'Farrell J., Reyers B., Rouget M., Roux D.J., Weiz A. & Wilhelm-Rechman A. (2008) An operational model for mainstreaming ecosystem services for implementation. Proceedings of the National Academy of Sciences 105: 9483-9488.

Currie H., Grobler K., Kemper J. (eds) (2009) Namibian Islands' Marine Protected Area. Ministry of Fisheries and Marine Resources, Namibia. http://www.nacoma.org.na/ key_Activities/Marine Protected Areas.htm.

Dingle R.V. (1973) The Geology of the Continental Shelf between Lüderitz (South West Africa) and Cape Town with special reference to Tertiary Strata. J. Geol. Soc. Lond., 129: 337-263.

Dundee B.L. (2006) The diet and foraging ecology of chick-rearing gannets on the Namibian islands in relation to environmental features: a study using telemetry. MSc thesis, University of Cape Town, South Africa.

Ellingsen K.E. (2002) Soft-sediment benthic biodiversity on the continental

shelf in relation to environmental variability. Mar. Ecol. Prog. Ser., 232:15-27.

Emanuel B.P., Bustamante R.H., Branch G.M., Eekhout S. & Odendaal, F.J. (1992) A zoogeographic and functional approach to the selection of marine reserves on the west coast of South Africa. South African Journal of Marine Science 12: 341-354.

EnviroDynamics (2010) Socio-economic impact assessment Orange River Mines Life o Mine Extension Project. Report for CSIR-EIA, 66 pp.

FAO (2008) International Guidelines for the Management of Deep-Sea Fisheries in the High Seas. SPRFMO-VI-SWG-INF01

Flach E., Thomsen L. (1998) Do physical and chemical factors structure the macrobenthic community at a continental slope in the NE Atlantic? Hydrobiologia 375/376:265-285

Goosen A.J.J., Gibbons M.J., McMillan I.K., Dale D.C. & Wickens, P.A. (2000) Benthic biological study of the Marshall Fork and Elephant Basin areas off Lüderitz. Prepared by De Beers Marine (Pty) Ltd. for Diamond Fields Namibia, January 2000. 62 pp.

Hanson C., Ranganathan J., Iceland C. & Finisdore J. (2008) The corporate ecosystem services review. World Business Council for Sustainable Development. http://www.wbcsd.org

Kendall M.A., Widdicombe S. (1999) Small scale patterns in the structure of macrofaunal assemblages of shallow soft sediments. Journal of Experimental Marine Biology and Ecology, 237:127-140.

Kenny A.J., Rees H.L., Greening J., Campbell S. (1998) The effects of marine gravel extraction on the macrobenthos at an experimental dredge site off north Norfolk, U.K. (Results 3 years post-dredging). ICES CM 1998/V:14, pp. 1-8.

Lane S.B., Carter R.A. (1999) Generic Environmental Management Programme for Marine Diamond Mining off the West Coast of South Africa. Marine Diamond Mines Association, Cape Town, South Africa. 6 Volumes.

Lange L. (2012) Use of demersal bycatch data to determine the distribution of soft-bottom assemblages off the West and South Coasts of South Africa. PhD thesis, University of Cape Town

Ludynia, K. (2007) Identification and characterisation of foraging areas of seabirds in upwelling systems: biological and hydrographic implications for foraging at sea. PhD thesis, University of Kiel, Germany.

MacIssac K., Bourbonnais C., Kenchington E.D., Gordon Jr., Gass S. (2001) Observations on the occurrence and habitat preference of corals in Atlantic Canada. In: (eds.) Willison J.H.M., Hall J., Gass S.E., Kenchington E.L.R., Butler M., Doherty P. Proceedings of the First International Symposium on Deep-Sea Corals. Ecology Action Centre and Nova Scotia Museum, Halifax, Nova Scotia.

Monteiro P.M.S., Van Der Plas A.K. (2006) Low Oxygen Water (LOW) variability in the Benguela System: Key processes and forcing scales relevant to forecasting. In: Shannon V., Hempel G., Malanotte-Rizzoli P., Moloney C.,

Woods J. (Eds) Large Marine Ecosystems, Vol. 15, pp 91-109.

Namdeb (2011) Namdeb annual review. www.namdeb.com, accessed August 2015

Parkins C.A. & Field J.G. (1998) The effects of deep sea diamond mining on the benthic community structure of the Atlantic 1 Mining Licence Area. Annual Monitoring Report – 1997. Unpublished Report to De Beers Marine, April 1998, 44 pp.

Parry D.M., Kendall M.A., Pilgrim D.A., Jones M.B. (2003) Identification of patch structure within marine benthic landscapes using a remotely operated vehicle. J. Exp. Mar. Biol. Ecol., 285– 286: 497–511.

Pulfrich A. & Branch G. (2014a) Using diamond-mined sediment discharges to test the paradigms of sandy-beach ecology. Estuarine, Coastal and Shelf Science 150: 165-178. DOI: 10.1016/j.ecss2013.08.002

Pulfrich A. & Branch G.M. (2014b) Effects of sediment discharge from Namibian diamond mines on intertidal and subtidal rocky-reef communities and the rock lobster Jasus lalandii. Estuarine, Coastal and Shelf Science 150: 179–191.

Pulfrich A., Parkins C.A. & Branch G.M. (2003) The effects of shore-based diamond diving on intertidal and subtidal biological communities and rock lobster in southern Namibia. Aquatic Conservation: Marine and Freshwater Ecosystems (Aquatic Conserv: Mar. Freshw. Ecosyst. 13: 233-255.

Pulfrich, A., Parkins, C.A., Branch, G.M., Bustamante, R.H. & Velásquez, C.R. (2003) The effects of sediment deposits from Namibian diamond mines on intertidal and subtidal reefs and rock lobster populations. Aquatic Conservation: Marine and Freshwater Ecosystems 13: 257-278.

Pulfrich A., Penney A.J. (1999) The effects of deep-sea diamond mining on the benthic community structure of the Atlantic 1 Mining Licence Area. Annual Monitoring Report – 1998. Prepared for De Beers Marine (Pty) Ltd by Marine Biology Research Institute, Zoology Department, University of Cape Town and Pisces Research and Management Consultants CC. pp 49.

Pulfrich A., Penney A.J. (2001) Assessment of the impact of diver-operated nearshore diamond mining on marine benthic communities near Lüderitz, Namibia. Phase III. Report to NAMDEB Diamond Corporation (Pty) Ltd, 50pp.

Pulfrich A., Penney A.J., Brandão A., Butterworth D.S., Noffke M. (2006) Marine Dredging Project: FIMS Final Report. Monitoring of Rock Lobster Abundance, Recruitment and Migration on the Southern Namibian Coast. Prepared for De Beers Marine Namibia, July 2006. 149pp.

Rogers J. (1977) Sedimentation on the continental margin off the Orange River and the Namib Desert. Unpubl. Ph.D. Thesis, Geol. Dept., Univ. Cape Town. 212 pp.

Rogers J., Bremner, J.M. (1991) The Benguela Ecosystem. Part VII. Marine-geological aspects. Oceanogr. Mar. Biol. Ann. Rev., 29: 1-85.

Seiderer L.J., Newell R.C. (1999) Analysis of the relationship between sediment composition and benthic community structure in coastal deposits: Implications for marine aggregate dredging. ICES J.Mar.Sci., 56: 757–765.

Shaughnessy P.D. (1979) Cape (South African) fur seal. In: Mammals in the Seas. F.A.O. Fish. Ser., 5, 2: 37-40.

Snelgrove P.V.R., Butman C.A. (1994) Animal–sediment relationships revisited: cause versus effect. Oceanogr. Mar .Biol. Ann. Rev., 32: 111–177.

Steffani C.N. & Pulfrich A. (2004a) Environmental Baseline Survey of the Macrofaunal Benthic Communities in the De Beers ML3/2003 Mining Licence Area. Prepared for De Beers Marine South Africa, April 2004., 34pp.

Steffani C.N. & Pulfrich A. (2004b) The potential impacts of marine dredging operations on benthic communities in unconsolidated sediments. Specialist Study 2. Specialist Study for the Environmental Impact Report for the Pre-feasibility Phase of the Marine Dredging Project in Namdeb's Atlantic 1 Mining Licence Area and in the nearshore areas off Chameis. Prepared for PISCES Environmental Services (Pty) Ltd, September 2004.

Steffani C.N. & Pulfrich A. (2007) Biological Survey of the Macrofaunal Communities in the Atlantic 1 Mining Licence Area and the Inshore Area between Kerbehuk and Lüderitz 2001 – 2004 Surveys. Prepared for De Beers Marine Namibia, March 2007, 288 pp.

Steffani N. (2007a) Biological Baseline Survey of the Benthic Macrofaunal Communities in the Atlantic 1 Mining Licence Area and the Inshore Area off Pomona for the Marine Dredging Project. Prepared for De Beers Marine Namibia (Pty) Ltd. pp. 42 + App.

Steffani N. (2007b) Biological Monitoring Survey of the Macrofaunal Communities in the Atlantic 1 Mining Licence Area and the Inshore Area between Kerbehuk and Bogenfels. 2005 Survey. Prepared for De Beers Marine Namibia (Pty) Ltd. pp. 51.

Steffani N. (2009) Baseline Study on Benthic Macrofaunal Communities in the Inner Shelf Region and Assessment of Mining Impacts off Chameis. November 2009. Prepared for Namdeb. pp. 45 + Appendices.

Urban Econ & Urban Dynamics (2008) Oranjemund tourism feasibility plan and associated business plan. Report for OTMCo, Oranjemund.

Van Dalfsen J.A., Essink K., Toxvig Madsen H., Birklund J., Romero J., Manzanera M. (2000) Differential response of macrozoobenthos to marine sand extraction in the North Sea and the Western Mediterranean. ICES J. Mar. Sci., 57: 1439–1445.

Zajac R.N., Lewis R.S., Poppe L.J., Twichell D.C., Vozarik J., Digiacomo-Cohen M.L. (2000) Relationships among sea-floor structure and benthic communities in Long Island Sound at regional and benthoscape scales. J. Coast. Res., 16: 627– 640.